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International Recommendations for the Index of Industrial Production 2010

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Preface

Comparison of economic performance over time is a key factor in economic analysis and a fundamental requirement for policymaking. 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. The Index of Industrial Production measures volume changes in the production of an economy and is therefore free of the influences of price changes, making it an indicator of choice for many applications. Not only is the Index of Industrial Production an important indicator in its own right, but it also plays an important role in the System of National Accounts, since it reflects temporal changes in value added for individual industries, besides having a strong relationship with the performance of the economy as a whole.

The present publication is a revision of the original manual entitled *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, which include *System of National Accounts 2008*, *International Standard Industrial Classification of All Economic Activities (ISIC) Rev.4*, the *Central Product Classification Version 2 (CPC Ver.2)*, *International Recommendations for Industrial Statistics 2008*, the *Producer Price Index Manual: Theory and Practice* and the *Consumer Price Index Manual: Theory and Practice*.

The updated methodology described in this publication, used together with that of the *Compilation Manual for an Index of Services Production*, published by the Organization for Economic Cooperation and Development, currently 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 on the actual steps to be taken in index number calculation and presents recommended methods for each industry within its scope with a view to assisting countries in producing high-quality short-term economic indicators that are also internationally comparable.

Acknowledgements

The present publication draws from or makes direct use of text material from a number of sources, in particular the Organization for Economic Cooperation and Development (OECD) *Compilation Manual for an Index of Services Production*; various Eurostat manuals; the International Monetary Fund *Producer Price Index Manual*; and the International Labour Office *Consumer Price Index Manual*. The United Nations Statistics Division acknowledges the contributions made by those organizations through allowing the above-mentioned volumes to be used in the preparation of this publication.

The standards presented here are closely aligned with those of the OECD *Compilation Manual*, which details concepts and methodology related to the compilation of index numbers for the services sector of the economy. Wherever possible, the structure, concepts and terminology of the two publications have been harmonized.

The United Nations Statistics Division 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 the publication was reviewed in detail at the Group's 2008 meeting. Expert Group members who attended the 2008 meeting were: Mr. Cristiano Santos (Brazil), Ms. Teofana Genova (Bulgaria), Mr. Michel Girard (Canada), Mr. Peter Lys (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 of America), Mr. Robert Yuskavage (United States of America), Mr. Eun-Pyo Hong (OECD) and Mr. Shyam Upadhyaya (United Nations Industrial Development Organization).

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

Within the United Nations Statistics Division, the initial version was drafted by Mr. Marcel van Kints, with guidance and review provided by Mr. Ralf Becker and Mr. Ivo Havinga. Additional drafting and editing were carried out by Mr. Becker and Mr. Thierno Aliou Balde.

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Acronyms and abbreviations used

CPC	Central Product Classification
CPI	consumer price index
EPI	export price index
GDP	gross domestic product
IIP	Index of Industrial Production
ILO	International Labour Organization
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 I
Introduction

1.1 Index of industrial production (IIP)

1.1. The Index of Industrial Production (IIP) reflects 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 that accurately measures value added, gross output measures such as value of production or turnover data are more commonly used.[1] Being a volume index, the IIP is not influenced by price fluctuations.

1.2. The IIP is an important short-term economic indicator in official statistics. Besides being an important indicator in its own right, it is used in comparison or in conjunction with other short-term indicators to assess the performance of an economy. In some countries, the IIP is also 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 of fluctuations in the level of industrial activity 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 facilitate 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 with other indicators is its combination of high frequency, fast availability (relative to gross domestic product (GDP), for example) and its detailed activity breakdown.

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

1.5. While providing important information in its own right, the IIP is also commonly used in comparison or in conjunction with a number of other economic statistics in order to assess the current state of a national or regional economy, or the global economy. Some of these complementary indicators include capacity utilization, new orders and inventories. Further, the IIP is a data source that can also be used in the compilation of quarterly GDP (see sect. 2.5 for a detailed discussion).

[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 issue is also discussed in sects. 4.1.1 and 5.4.2. In addition, since, typically, for a particular industry, volumes of value added move at similar rates to those of 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 as primary products, intermediate products or finished products.

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

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 1920s.

1.8. The United Nations has a long history of collecting and publishing industrial statistics and related information. Among those types of statistics, the Index of Industrial Production is one of the most well known. The collection of these index numbers started in the 1950s following the recommendations of the Statistical Commission, which, at its fifth session, held at Lake Success, New York, from 8 to 17 May 1950, outlined the methods to be used in compiling index numbers of industrial production.[4]

1.9. *Index Numbers of Industrial Production*,[5] the first and only United Nations publication detailing the production index methodology, was published in 1950. While the United Nations has issued publications on related topics, such as *Guidelines on Principles of a System of Price and Quantity Statistics*,[6] in 1977, and the *Manual on Producer's Price Indices for Industrial Goods*,[7] in 1979, no revision of the methodology contained in the 1950 manual has been released.

1.10. Since the publication of that methodology in 1950, many changes have taken place which call for an updated version of *Index Numbers of Industrial Production*. Country experiences, for example, in compiling index numbers over the past decades have led to more economical and reliable methods of compilation which better respond to the need for rapidly generated descriptive indicators of economic growth. Moreover, a number of underlying and related statistical standards and recommendations have been updated, particularly in recent years. These factors make it necessary for the concepts and methodology applied in *Index Numbers of Industrial Production* to be updated as well. The updated standards and recommendations are contained in:

- *System of National Accounts 2008*,[8] whose compilation of quarterly national accounts is linked to the IIP calculation (see sect. 2.5 below)
- *International Recommendations for Industrial Statistics 2008*,[9] which describes the standards for industrial statistics, including their scope, and includes the IIP as one of the recommended indicators
- The International Monetary Fund (IMF) *Producer Price Index Manual: Theory and Practice*,[10] which describes the calculation of producer price indices

[4] See *Official Records of the Economic and Social Council, 1950, Supplement No. 4* (E/1696/Rev.1), paras. 60-61.
[5] Studies in Methods, 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).
[8] 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).

(PPIs) which are used in the calculation of the IIP when the deflation method is applied (see sect. 4.2 below)

- *International Standard Industrial Classification of All Economic Activities (ISIC), Rev.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
- Central Product Classification Version 2 (CPC Ver.2)[12] whose categories are used to define products and product groups used in the IIP calculation.

1.11. The above-mentioned standards and guidelines have led to changes in some features of the IIP compilation as presented in the 1950 index manual. Those changes, which are reflected in the present publication, encompass:

- *The scope of the IIP.* The current scope is defined in terms of ISIC, Rev.4, that is, the scope of the industrial sector has been defined to cover section B (Mining and quarrying), section C (Manufacturing), section D (Electricity, gas, steam and air conditioning supply) and section E (Water supply; sewerage, waste management and remediation activities). This reflects a divergence from the original scope in 1950 which included mining and quarrying, manufacturing, and electricity, gas, water and sanitary services.
- *Calculation methods, index weighting practices, linking and rebasing 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; and there has been a greater preference for the chain-linked approach, with annually updated weights, in recent years. The chain-linked approach is in fact the method recommended by this publication.

1.12. This revision of *Index Numbers of Industrial Production* has been carried out at the request of the United Nations Statistical Commission.[13] Draft text of the publication and related issues had been discussed at United Nations Expert Group meetings in 2005, 2007 and 2008 and those issues and the draft version of this publication were the subject of a worldwide consultation held in early 2009.

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[10] Washington, D.C., 2004.

[11] Statistical Papers, Series M, No. 4, Rev.4 (United Nations publication, Sales No. E08.XVII.25).

[12] Detailed structure and explanatory notes are available from http://unstats.un.org/unsd/cr/registry/cpc-2.asp.

[13] In para. 14 of the report on industrial statistics of the Director-General for Policy Planning (Statistical Standards) of the Ministry of Internal Affairs and Communications of Japan (see E/CN.3/2006/3), submitted to the Statistical Commission at its thirty-seventh session in 2005, it was noted that since 2004, the revision of *Index Numbers of Industrial Production* had become part of the United Nations Statistics Division economic statistics programme. Work on the IIP had commenced in 2005; and in 2006, the Commission endorsed the work undertaken by the Statistics Division (see *Official Records of the Economic and Social Council, 2006, Supplement No. 4* (E/2006/24), decision 37/101, para. (c)).

1.3 Purpose and scope of this publication

1.13. *International Recommendations for the Index of Industrial Production 2010*, which reflects a wide range of experiences and expertise derived from consultations with a large number of potential users, outlines practical and suitable measurement methods, including issues and benefits, derived from recent theoretical and practical work in this area.

1.14. Intended for compilers and users of indices of industrial production, this publication is designed to assist compilers in producing comparable index numbers which can then serve to enable reliable international comparisons of economic performance and behavior utilizing the best international practices. The publication also aims to assist countries that plan to set up a more comprehensive system of volume measures not only by providing the methodological foundations for the index number compilation, but also by giving practical guidance on individual steps in and elements of the compilation process.

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

1.16. The publication will also serve the needs of users by making them aware of the methods employed by national statistical offices to compile the indices. In addition, it discusses potential IIP calculation errors and biases and incompatibilities between different approaches that may be employed, so that users can properly interpret the results. They are therefore encouraged to consult metadata information on index number calculation methods used in different countries to exercise better judgement with regard to the comparability of the indices. The United Nations Statistics Division has issued a working paper entitled "Country practices for the collection and calculation of the index of industrial production"[14] which can be used for this purpose.

1.17. *International Recommendations for the Index of Industrial Production 2010* considers 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, namely, mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; and water supply; sewerage, waste management and remediation activities.

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

1.19. Readers familiar with the 1950 publication will note that the 2010 International Recommendations have been developed based on a slightly different approach. While it does outline key aspects of IIP theory and key concepts, as did its predecessor, the present publication goes a step further by providing guidance through the use of data-based examples to demonstrate actual statistical practice. Guidance on methods and approaches at a detailed industry level is provided in chapter VII.

[14] ESA/STAT/2008/8.

1.20. The 2010 International Recommendations can be used in conjunction with the Organization for Economic Cooperation and Development (OECD) *Compilation Manual for an Index of Services Production.*[15] The two publications, when used side by side, will provide compilation guidance on how to produce indices for the majority of goods- and service-producing industries.

1.4 Organization of this publication

1.21. International Recommendations for the Index of Industrial Production 2010 comprises two parts.

1.22. Part one encompasses 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. Countries are encouraged to fully comply with these recommendations.

1.23. Part two includes international guidance designed to assist countries in implementing the international recommendations set out in part one. It presents a set of methods (categorized as “preferred”, “alternative” and “other”) and variables for each ISIC, Rev.4 class within the scope of this publication, to be applied in the compilation of an IIP. The information is based on current country practices which have been surveyed for this purpose and is intended to provide guidance to countries in setting up or revising their IIP calculation.

1.24. The content of parts one and two may be described as follows:

In part one, entitled “International recommendations”:

- Chapter II details the fundamental concepts underlying the compilation of an index of industrial production, including definitions of industrial production, volume measures and index numbers and a discussion of the uses of the IIP
- Chapter III 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 on classifying units in the context of “outsourcing”. The chapter concludes with a discussion of business registers
- Chapter IV outlines the various methods of IIP compilation and the types of data items utilized. The sources of data used to compile the IIP are also examined
- Chapter V presents key IIP compilation concepts and provides a step-by-step guide to the compilation process
- Chapter VI outlines key principles of presentation and dissemination

In part two, entitled “Guidance on implementation”:

- Chapter VII presents a framework and associated criteria for assessing the quality of the variables to be used for an IIP. It also utilizes country practices

[15] Paris, 2007.

as a basis for recommending approaches to the production of an index of industrial production and variables for each in-scope ISIC class.

1.5 Summary list of recommendations in this publication

1.25. The present section lists all the recommendations presented in this publication to facilitate quick reference. The recommendations are categorized by topic, with a reference to the paragraph in which they appear.

1.5.1 Statistical units, classifications and the business register

(i) Statistical unit for compiling the IIP

The recommended statistical unit for data collection in compiling the IIP is the establishment (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 (para. 3.12)

The Central Product Classification Version 2 (CPC Ver.2) is to be used to assign products to product groups (para. 3.13)

(iii) Business register and statistical surveys

It is recommended (para. 3.33) 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 that it remains as representative as possible and contains current information on its constituents
- A sample of reporting units be used as a means of minimizing response burden and lowering operational cost
- The sample selection be updated each year to coincide with the update of index weights

(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 (paras. 4.61-4.65)

1.5.2 Scope and frequency

(v) Scope of industrial production indices

The Index of Industrial Production should be compiled for activities in ISIC, Rev.4, sections B through E, namely, mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; and water supply; sewerage, waste management and remediation activities (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 (para. 2.23)

1.5.3 Sources and methods

(vii) *Method for compiling volume measures for the IIP*

In general, the deflation process with the use of an appropriate price index is recommended (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 enable compilation of volume measures of output for the IIP (para. 4.44)

(ix) *Level at which to apply the deflator*

It is recommended that the deflator be applied to the value data at the lowest level possible, but not higher than at 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 accord as closely as possible (in terms of scope, valuation and timing) with the product groups for which it is being used as a deflator (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 to be preferred over input measures (labour and materials consumed) (para. 4.54)

1.5.4 Index compilation

(xi) *Type of index formula to be used*

The Laspeyres-type index formula is recommended for compiling the IIP (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 (paras. 5.37-5.40)

(xiii) *Data adjustments: quality change*

Quality changes should be incorporated into the calculation of the IIP either through using the price index when deflation methods are employed, or by adjusting input data when volume extrapolation methods are used (para. 5.48)

(xiv) *Weighting variable: product and product group level of the index*

Value of output is recommended as the weight variable for compiling the IIP at the product and product group levels of the index (paras. 5.56-5.62)

(xv) *Weighting variable: industry level of the index*

Gross value added at basic prices data is recommended as the weight variable for compiling the IIP for the different levels of the ISIC structure (para. 5.58)

(xvi) *Frequency of weight update: product group level of the index*

Product group weights should be updated at least every five years (para. 5.67)

(xvii) *Frequency of weight update: industry level of the index*

Industry-level weights of the IIP should be updated annually (para. 5.66)

(xviii) *Use of chain-linking*

The chain-linking method should be used when weights are updated, that is, the new series should be linked to the old series so as to produce a continuous series (para. 5.89)

(xix) *Aggregation of the IIP*

Aggregation from basic data items (products or product groups) should be carried out directly for industries, without an intermediate step of calculating indices for establishments. Aggregations to higher-level industries should be achieved in steps: in the case of ISIC, through each level of ISIC, using the existing ISIC structure, that is, 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 to the section (letter) level (paras. 5.24 and 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 for which the IIP is calculated (para. 5.208)

(xxi) *Benchmarking of IIP data*

Benchmarking of the IIP should be considered for reconciling high-frequency with low-frequency series, as well as for other sources, like the annual national accounts (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 (para. 7.7)

1.5.5 Presentation and dissemination

(xxiii) *Presentation of the IIP: data*

The following key principles for presentation of an index of industrial production should be adhered to (para. 6.19):

- 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 by convention, this period is set to an index number of 100. Index numbers for all subsequent periods are percentages of the value of the reference period
- The main contributors to change — i.e., those product groups or industries that are primarily responsible for the monthly movement in the IIP — should be presented to users

(xxiv) *Presentation of the IIP: metadata*

The following metadata should be provided (para. 6.20):

- Precise definitions of the underlying economic concepts that the indices intend to measure
- Specific mention of any limitations to 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 rebasing and procedures for linking indices
- Treatment of changes in the composition of commodities in the market, as well as changes in quality
- Comparison of the methodologies applied with underlying IIP concepts and a description of the impact of departures

(xxv) *Dissemination of the IIP*

The dissemination of IIP data should follow standard dissemination criteria, specifying, inter alia, that (paras. 6.2-6.15):

- Data should be released as soon as possible (noting the trade-off between timeliness and quality)
- Data should be released according to a pre-announced release calendar
- Confidentiality of individual survey respondents must 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 explanation and advice with respect to methodology
- Data should be accompanied by commentary to assist users in making their own judgements about the economic implications, that is to say, the commentary should make no assessment of current government policies
- Contact details for relevant statisticians who can answer the questions of users should be included with the release of data

(xxvi) *Data revisions*

It is recommended that the following revision practices be followed by countries (para. 6.35):

- A statement by the national statistical office about the reasons for and schedule of 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 user 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 include identification of data in the statistical publications that are preliminary (or provisional) and data that are revised, with explanations of the reasons for revisions, and explanations of breaks in series when consistent series cannot be constructed
- Users should be reminded of the size of the forthcoming revisions based on past history

(xxvii) *International data reporting*

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

Part one
International recommendations

Chapter II
Fundamental concepts and uses of the IIP

2.1. The present 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, and 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 2008 System of National Accounts (SNA) defines 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" (para. 6.2) and indicates that "[t]he 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" (para. 6.10).

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,[16] that is, before or after deducting consumption of fixed capital. Specifically:

- Gross value added is the value of output less the value of intermediate consumption, such as of 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 explained in paragraph 6.9 of the 2008 SNA:

> 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 SNA to be measured either gross or net of the consumption of fixed capital.

2.5. The above definition of production covers all sectors of the economy. However, it is commonly accepted that *industrial production* refers to production having 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. For the purpose of this publication, the

[16] "Census value added" is another concept of value added that was used in the 1950 publication on index numbers of industrial production. However, the concept of value added as defined in the 2008 System of National Accounts (see para. 6.8), should be used in the context of the IIP.

International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4, is the classification used to define industrial production.

2.6. *International Recommendations for Industrial Statistics (IRIS) 2008* defines the scope of industrial production as encompassing 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 established in IRIS 2008. The inclusion of sewerage, waste management and remediation activities within the traditional scope of industrial production activities, which has remained relatively constant since 1950, represents a significant change.

2.8. The scope of the index of industrial production under ISIC, Rev.3.1,[17] included its sections C (Mining and quarrying), D (Manufacturing) and E (Electricity, gas and water supply). Part of the revision to ISIC, that is, the development of ISIC, Rev.4, entailed ensuring that similar activities were grouped together, as attested by the suggestion that the activities within ISIC, Rev.3.1, section O, division 90 (Sewage and refuse disposal, sanitation and similar activities) be grouped with water supply activities in what became ISIC, Rev.4, section E (Water supply; sewerage, waste management and remediation activities). This was based on the observation that in many countries, water production and waste-water treatment activities were performed by the same business unit. This change, i.e., moving division 90 of ISIC, Rev.3.1, to what became section E of ISIC, Rev.4, was therefore implemented.

2.9. The 2008 International Recommendations for Industrial Statistics were also being developed around the same time as the revision to ISIC. IRIS 2008 set out the internationally agreed scope of industrial statistics. As part of the development of IRIS, it was agreed that the scope of industrial statistics should be established within the framework of ISIC, Rev.4, and defined at the section level of the ISIC hierarchy. The scope of industrial production in this publication therefore encompasses sections B through E of ISIC, Rev.4.

2.2 Measuring industrial production

2.10. With industrial production now defined, it is necessary to discuss how industrial production is measured and 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 as the amount by which the outputs produced (by the establishment, the industry, etc.) exceed the intermediate inputs consumed. It may be measured in current price or volume terms.

2.12. The current price value comprises current period quantities and current period prices. In contrast, the volume measure describes the economic situation of a

[17] Statistical Papers, Series M, No. 4, Rev.3.1 (United Nations publication, Sales No. E.03.XVII.4).

particular period in terms of the prices of another period. Estimates valued at current prices and measures in volume terms are therefore fundamentally different.

2.13. A volume estimate of value added is obtained from a current price value through a process of price deflation. The current price value is *deflated*[18] by the use of a price index in order to obtain the volume measure. The change over time of the volume measure is referred to as *volume change.*[19]

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, which is known as the *double deflation* approach. It entails:

- Obtaining current price values of output and intermediate consumption
- Deflating the current price values of output and intermediate consumption using appropriate price indices to obtain volume measures and then
- Subtracting 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 for calculating intermediate consumption, are generally not available at the required level of detail and/or frequency. Therefore the challenge for compilers of an IIP is to obtain the most readily available data that provide the best approximation of short-term movements in value added.

2.16. Given the measurement difficulties associated with the application of the ideal approach, various approaches to approximating short-term movements in value added for the industrial sector have been developed. The aim of these approximation approaches to the measurement of output or inputs of the production process is to obtain a proxy volume measure of industrial production. Specifically, output approaches include measuring physical output quantities and values of output, while input approaches include measuring labour input and materials consumed in the production process. Such approaches assume a fixed relationship between the variable being measured and value added.

2.17. A variety of approximate approaches are used to measure industrial production because, practically speaking, it is not possible to identify a single recommended approach for all industrial activities. The most accurate proxy measure of industrial production will depend on the specific industrial activity being measured.

2.18. Chapter IV of this publication, on sources and methods, provides a detailed discussion of the various approaches to approximating short-term measures of industrial production. Chapter VII utilizes a set of variables and approaches, by each ISIC activity, derived from country practices, as the basis for creating an Index of Industrial Production.

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[18] See sect. 4.2.1 for a simple illustration of the deflation process for a single good.

[19] The term “volume change” is preferred to “quantity change” because the change in quantities must be adjusted to reflect the changes in quality.

2.3 Presenting industrial production volume measures as index numbers

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

2.20. An index is a numerical scale that is derived from observed facts and used to describe relative changes over time, including how variables, for example: prices, costs and quantities, change over time. An index is typically expressed as the percentage of a base value, which by convention is 100.

2.21. The presentation of industrial production volume data in monetary terms does have some advantages; for example, it allows non-additivity[20] due to chain-linking and the relative size of the industrial aggregates to be explicitly shown.

2.22. This publication, however, recommends using index numbers for the presentation of industrial production volume measures in order 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 in this regard are monthly and quarterly compilation. This publication recommends that the IIP be compiled monthly.

2.5 Uses of the IIP

2.24. The IIP is a key indicator of economic performance in most countries. The present 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 are useful in evidence-based policy decision-making. In addition, index numbers facilitate international comparisons.

2.26. In microeconomic analysis, an index number of production shown with an industrial grouping enables comparisons of industry performance to be made, particularly when other data, for example, on employment, wages and earnings, are also used. A specific example is provided by the analysis of relative changes in productivity, measured as output per hour worked. In macroeconomic 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 to 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 the national microeconomic and national macroeconomic spheres. For the indices to be useful in an international

[20] See sect. 5.4.4 for a discussion of non-additivity.

context, it is also important that the index numbers be compiled on a comparable basis. The indices can then be compared with one 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. In some countries, the IIP has an important role also in the compilation of quarterly national accounts (QNA).

2.29. Quarterly national accounts constitute a system of integrated quarterly time series of macroeconomic aggregates, coordinated through an accounting framework. They conform to the same principles, definitions and structure as the annual national accounts. In principle, QNA cover the entire sequence of accounts and balance sheets as set out in the 2008 SNA; in practice, however, 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 that available from the annual national accounts
- A more comprehensive view of current economic conditions than that available from individual short-term indicators

2.31. While the integration of the three main approaches to measuring GDP (the production, expenditure and income approaches) in the supply and use tables constitutes recommended means of compiling 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, which can be used in the compilation of the QNA.

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

2.33. One alternative method utilizes short-term statistics to move forward the annual benchmarks so as to produce the quarterly estimates of production. One of the short-term indicators that can be used in compiling the QNA is the IIP.

2.34. The compilation of quarterly volume estimates for the industrial sector in some countries entails using the quarterly movement of the IIP to extrapolate forward volume measures of value added from the previous quarter. Gaps in IIP coverage, for example, of particular industries, goods that are not easily quantified or repair services, may require use of supplementary sources. 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 International Monetary Fund (IMF) *Quarterly National Accounts Manual: Concepts, Data Sources, and Compilation*,[21] 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.

[21] Adriaan M. Bloem, Robert J. Dippelsman and Nils Ø. Maehle, *Quarterly National Accounts Manual: Concepts, Data Sources, and Compilation* (Washington, D.C., IMF, 2001).

Chapter III
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. The present chapter presents the various *statistical units* and *classifications* in use internationally and recommends the most appropriate type of unit and classification for the compiling of an IIP. Classifying units in the context of outsourcing, and the key principles governing use of a business register within the context of the IIP, are also discussed.

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. Statistical units range 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. There are various types of statistical units, as detailed in IRIS 2008 (see chap. II.D):

- *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 centre, especially for the policy on production, sales and profits, or it may centralize certain aspects of financial management and taxation. It constitutes an economic entity that is empowered to make choices, particularly concerning the units under its control.
- *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.
- *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), that 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 that engages in only one kind of productive activity or in which the principal productive activity accounts for most of the value added. In the case of such a unit, as compared with an establishment, there is no restriction imposed on the geographical area in which the activity is carried out.

- *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. In this context, 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 of a contact address than a unit. Sometimes, the questionnaire is completed by a central administrative office or an accountancy firm which 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[22] is the recommended statistical unit for the purpose of compiling an IIP because it is the most detailed unit for which the range of data required are normally available. The data gathered need, in order to be analytically useful in an IIP context, to be grouped according to such characteristics as kind of activity, geographical area[23] and size, which is facilitated by the use of the establishment as a statistical unit.

3.2 Classifications

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

3.8. There are various activity and product classifications in use in States Members of the United Nations, which are often tailored to specific country needs. However, many of the national activity classifications are either derived from[24] or related to[25] the ISIC, the international reference classification for activities,[26] which is being

[22] The establishment is also recommended as the preferred statistical unit for the collection of the range of industrial statistics covered in IRIS 2008.

[23] In circumstances where no geographical dimension of the IIP is planned, the kind-of-activity unit may be suitable.

[24] The basis for derived classifications is either adoption of the reference classification structure and categories, with possible provision of additional detail, or rearrangement or aggregation of items from one or more reference classification. Derived classifications are often tailored to use at the national or multinational level. One example is the Statistical Classification of Economic Activities in the European Community (NACE).

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

[26] Reference classifications are those economic and social classifications that are a product of international agreements approved by the Statistical Commission or another competent

maintained by the United Nations. Similarly, many national product classifications are derived from or related to the Central Product Classification (CPC), the international reference classification for products which 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 chap. V for details). In this case, a product classification be used for which 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 1 (Ores and minerals; electricity, gas and water), 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 CPC Ver.2, while the relevant services are classified in divisions 69 (Electricity, gas and water distribution (on own account)), 86 (Support services to agriculture, hunting, forestry, fishing, mining and utilities), 87 (Maintenance, repair and installation (except construction) services), 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 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.

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 around the world as possible. The international reference classification for economic activities, ISIC, Rev.4, is the most suitable classification for this purpose. In addition, the IRIS 2008 defines the scope of industrial statistics in terms of ISIC, Rev. 4.

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

3.2.2 Classification of statistical units: a special case — Outsourcing/activities carried out 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. In the case of outsourcing, the process of classifying units is somewhat more complex. The present section provides guidance on the correct classification of these units and thereby determines whether they are in scope for the purposes of the IIP.

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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.

3.15. 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. The following terminology is applied:

- The *principal*[27] is a unit that enters in to a contractual relationship with another unit (here called the contractor) for the purpose requiring the contractor to carry out some part (or all) of the production process
- The *contractor*[28] 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"
- *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.[29]

Classification of the contractor

3.19. Contractors, that is, 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, that is, 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

[27] Sometimes referred to elsewhere as the "contractor" or the "converter".

[28] Sometimes referred to elsewhere as the "subcontractor".

[29] Elsewhere, the terms "insourcing" and "outsourcing" (referring to relationships between units involved) or "offshoring" (referring to transactions between economic territories) may be used; however those distinctions have no bearing on the guidelines set out in this section and are not employed.

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. The principal provides the contractor with the technical specifications of the manufacturing activity to be carried out on the input materials (raw materials or intermediate goods), which can either be provided (owned) by the principal or not.

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

3.25. A principal that 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 resell it. Such an activity is classified in ISIC, Rev. 4, section G (Wholesale and retail trade), according specifically to the type of sale and the type of good sold.[30]

3.3 The business register and the IIP

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

3.27. In an IIP context, the business register provides the basis for identification of a sampling frame, i.e., a list of all economic units in the industrial sector is selected from the business register to form the sampling frame, which 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
- 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 (referred to as the sample selection) and it is from these units that data required for the compilation of the IIP are requested. A sample survey normally provides an efficient method for obtaining statistical information from large populations — a method that is subject to the enormous costs and large human resource requirements of census-type enumerations.

3.29. In order for the coverage of the business register to be kept as representative as possible, it must contain current information on its constituents. This means that the register is maintained over time to take note of the changes in enterprise dynamics. For example, an enterprise may merge or split up, change its production activities,

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

or move its 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 lose 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 becoming one of the major sources from which economic statistics can be compiled in many countries. These data are derived from government operations that require respondents to furnish information owing to legislative provisions. As a result, the administrative data generally represent 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 as a complementary source with respect to completing existing statistics, confronting statistical output and providing a frame for sampling. The administrative data are likely to also be an important basis of survey-frame maintenance by reflecting timely changes in the business-unit population.

3.32. The use of administrative data sources should therefore be considered within the context of the IIP. However, some potential disadvantages do exist, including differences between the administrative source and statistical standards in terms of concepts, definitions and units. Section 4.4 offers a more detailed discussion of 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 for identification of a sampling frame
- The business register be maintained to ensure that it remains as representative as possible and contains current information on its constituents
- A sample survey be used as a means 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 means of reducing response burden.

Chapter IV
Sources and methods

4.1. The present chapter outlines the sources and methods for the compilation of an IIP. Section 4.1 discusses the variables used to approximate industrial production and section 4.2 examines the methods used to obtain volume measures. Section 4.3 focuses on the variables and methods recommended for obtaining industrial production volumes. The chapter concludes with a discussion of data sources.

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 on data availability. It is common therefore in the construction of a total IIP for a single country to utilize a range of variables and methods for different economic activities.

4.3. Chapter VII provides a full list of preferred variables and methods, by industry, for compiling an IIP. This list not only provides guidance to countries on compiling an IIP but also seeks to foster 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 data required, in particular for calculating intermediate consumption, are generally not available at the required detail, and/or frequency level. 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 centre on the output of production and, in some cases, the inputs used in the production process.

4.1.1 Measures of output for industrial production

4.5. Output, as defined in the 2008 SNA (para. 6.89), is 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. Whenever a production 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 (para. 6.90).

4.6. The measurement of output for the purpose of constructing an IIP is undertaken in a number of ways. Output can be measured in monetary terms (values) or in physical quantities. In addition, a simplified concept of output referred to as “value of output sold in the reference period” is sometimes also utilized to define industrial production for an IIP. These three means of 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[31] prevailing at that time.

4.8. The most accurate output information on products is obtained through the conduct of production surveys. For the purpose of compiling the IIP, it is likely that a representative monthly survey would be 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, capable of easily providing 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 that the output is produced. This is a little more difficult in the case of a 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 markup.

4.11. Bearing in mind that the purpose 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 to 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 distorted by events during the observation period that may affect value added and value of output in different ways, such as changing production patterns, including outsourcing.[32]

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 (discussed in detail in sect. 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 yields reasonable results only 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

[31] According to the 2008 SNA (para. 6.51 (a)), the 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.

[32] See also sect. 5.4.2 regarding the use of value added for establishing weights.

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 those for the same goods or services produced for export. A simple shift between these market destinations would create a change in the value of output, although the volume of goods produced would not have changed. Separate price deflators may be necessary to handle the two types of products (those for the domestic market versus those for the export market). If deflation takes place at the industry level, similar distinctions will have to be made between, for instance, a conventional manufacturer of goods and a provider of manufacturing services (contractor).

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 methods recommended in section 7.3 of this publication.

(b) Physical quantity of output

4.15. Physical quantity of output is a data variable also used to approximate industrial production. Data on physical quantity of output are, in general, also obtained through the use of production surveys. This approach measures product output in terms of the number of items — tons, litres, 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 compared with 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. The change of these characteristics over time is referred to as *quality change*. Quality changes to products should be included in the changes in volumes and therefore 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 through data adjustments.[33]

4.19. The physical quantity of output approach to measuring industrial production is most suited to those industries that produce homogeneous goods whose quality remains constant over time such as the coal industry, coal of a specific grade being a homogeneous good, easily measurable (in tons) and of a quality that remains constant over time.

4.20. One feature of this output approach is that it does not require a deflation process, exemplifying an approach that uses the volume extrapolation method instead (discussed in detail in sect. 4.2.2).

[33] See sect. 5.3.2 for a detailed discussion of quality adjustment issues.

(c) Value of output sold

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

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

4.23. There are some important methodological differences associated with using value of output sold (compared with value of output or physical quantity of output) to compile the IIP. These differences can adversely affect the quality of the IIP. For example:

- Value of output sold does not equal output of the production process in the reference period, owing to the fact that goods can be used in other ways (that is, for barter or own use) or entered into inventories for sale or other use or sold from inventories
- Work-in-progress is also excluded when the value of output sold is used to compile the IIP

4.24. It is possible to resolve some of the issues associated with using data on value of output sold to compile the IIP by adjusting the data, for example, by using changes in inventories, including changes in work-in-progress. However, timely and reliable data would be needed to effect these adjustments and such data are rarely available.[34]

4.25. While the use of data on value of output sold 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
- Data collection is less costly owing to the higher level of aggregation of data on value of output sold compared with product data

4.26. Finally, in order that volume data from value of output sold data may be obtained, a process for excluding price effects is needed. This process, referred to as deflation, is discussed in detail in section 4.2.1.

4.1.2 Measures of input for approximating industrial production

4.27. Use of measures of input to approximate industrial production is generally introduced in circumstances where reliable or accurate measures of output cannot be obtained.[35] In practice, the main input variables used to approximate industrial production are: (a) labour input; and (b) materials consumed.

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[34] 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, these data are rarely available on a monthly basis. For additional details, see Bloem, Dippelsman and Maehle, *Quarterly National Accounts Manual*, paras. 3.134-3.144.

[35] 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 based on an output measure when revised in a subsequent release.

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.

(a) Labour input

4.29. Labour 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. As an indicator of labour input, number of hours worked is preferable to number of employees. Output is affected by changes in standard weekly working hours, the proportions of part-time employees, and hours of overtime. Number of hours worked takes these effects into account, while number of employees does not.[36] It is preferable that actual hours worked be covered, rather than paid hours, which includes sick leave, vacations and public holidays but excludes unpaid work. The labour input measure should include working proprietors and the self-employed as well as employees.

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

4.32. If the production process becomes more efficient because of an increase in labour 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 labour force in response to short-term fluctuations in operating surplus, which means that labour input may be steady while value added is in fact changing.

4.33. Ideally, adjustments need to be made to the labour input data whenever the relationship between labour input and value added changes. Accurate adjustments are rather difficult to achieve in practice but they may be attempted by applying productivity factors.[37] However, productivity factors should be applied only 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 utilized to approximate industrial production for use in the IIP. Material consumption is useful only when there is a clear-cut relationship between material use and production. The process in this case entails either obtaining a *value* for the material that is consumed in the production process or measuring the *quantity* of material consumed, and monitoring the value or quantity of these materials over time. Where it is the value of material consumed

[36] Number of hours worked is still an imperfect measure of labour input, since ideally, labour input measures should take into account different types of labour (for example, by disaggregating by occupation or skill level), weighted by their different rates of remuneration or through 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.

[37] Labour productivity factors are usually calculated on the basis of data on annual production and hours worked. These annual data are then transformed into monthly data, under the constraint that the monthly average of the transformed data is to be the same as that of the annual data.

that 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 the case where material values are being used), while the quantities have to be combined using appropriate weights, such as unit price in the base period (in the case where material volumes are being used).

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

4.2 Methods for obtaining industrial production volumes

4.36. The 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 for isolating 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*. The present section examines these two methods.

4.2.1 Deflation

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

4.39. Box IV.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.[38]

[38] In this section, discussion will centre on the use of price indices to obtain volume measures of output or production. This publication is not a guide, however, to the construction of price indices (i.e., the producer price index (PPI) and the consumer price index (CPI)). For such guidance, the reader is referred to the IMF *Producer Price Index Manual* and the International Labour Organization (ILO) *Consumer Price Index Manual: Theory and Practice* (Geneva, International Labour Office, August 2004).

Box IV.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 deflation method is applied to the output variables "value of output" and "value of output sold" and the input variable "value of material consumed" in compiling the IIP.

4.41. A range of price indices is currently compiled by countries 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: 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 generate 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. It is recommended that countries use the PPI as the price index when current price values are deflated to derive volume measures of output for the IIP, since the PPI directly measures product prices from the producer (both input and output product prices of the production process) and usually takes quality changes into account. Also, the likelihood that price changes of items selected for the PPI for a product group are similar to price changes of items not selected, is greater than the corresponding likelihood for volume changes. However, IIP compilers should first examine the details of the PPIs available to ensure that: (a) they are representative of the value aggregate to be deflated (the price survey may differ from the survey used for the value aggregates); and (b) 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 to producer products
- 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 accord as closely as possible (in terms of scope, valuation and timing) with the product groups for which it is being used as a deflator and should be applied at the lowest level possible but not higher than at the ISIC class (4-digit) level. The quality and application of the PPI are 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 to directly calculate an IIP. The volume measure in the current period is compared with the volume measure in the base period and the resulting volume relative is used to calculate the IIP. Box IV.2 provides an example illustrating this process.

Box IV.2
Volume extrapolation process

	Period T_0		*Period T_1*	
	Volume (Tons of coal)	*IIP*	*Volume (Tons of coal)*	*IIP*
Coal	20 000	100.0	22 000	110.0

Data relating to volume/quantity (tons) 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 (tons of coal) is used to calculate a volume index. The IIP volume index in period T_1 is calculated as follows:

tons (T_1)/tons (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 volume extrapolation method is applied to the output variable "physical quantity of output" and the input variables "labour input" and "materials consumed" use to compile the IIP.

4.50. The volume extrapolation method is used, for example, in the mining and quarrying industries because the products being measured are generally homogeneous, the quality of the products tends to remain constant over time and it is often possible to obtain an almost complete observation of all production volumes. With regard to the manufacturing service industries, volume extrapolation of hours worked is the preferred method, owing 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 measurement of the value of work-in-progress can be difficult. It is recommended that whenever "hours worked" data are used, they should ideally be adjusted for changes in productivity so as to reflect the change in the relationship between hours worked and output of the production process over time.

4.3 Recommended variables and methods for obtaining industrial production volumes

4.52. Sections 4.1 and 4.2 above outlined various approaches to and methods for obtaining 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, it is not possible to recommend a single approach to obtaining 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 in terms of both methods and variables.

4.54. In general, measures of output are to be preferred over input measures. This is owing primarily to (a) the difficulty of identifying changes in the relationship between input variables and the value added of the production process; and (b) the need, consequently, to make adjustments to the data, so as to take account of these changes. As regards use of output measures, "value of output" or "physical quantity 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 in compiling the IIP which centre on the factor of timely availability of data. Further, value of output is preferred to 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 industrial production, especially in cases where industries produce homogeneous goods whose quality remains constant over time.[39]

4.55. In practice, deflation and volume extrapolation, the two alternative methods for achieving volume measures of industrial production, are *not* considered to be equivalent. In general, the deflation process, including the use of an appropriate price index, is recommended. It is acknowledged however, 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 described below:

- Deflation better accommodates a heterogeneous product mix owing 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, an advantage that volume measures cannot provide.
- The quality changes associated with changing, new and disappearing products can be more easily reflected when current values are deflated by price indices, since the price index used for deflation already takes quality changes into account. It is possible to adjust for quality changes also in the volume extrapolation method, using techniques similar to those used for quality adjustment in the price index, but this would entail a greater workload than in the deflation procedure.

4.57. While this chapter provides general recommendations for deflation and volume extrapolation, chapter VII presents the set of “preferred”, “alternative” and “other” methods and variables for each ISIC, Rev.4, industry class, to be used in the compilation of an IIP, as well as the framework used to make these assessments. The detailed table in chapter VII demonstrates that the preferred method is predominantly the deflation approach, specifically the deflation of value of output by an appropriate PPI.

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

[39] A good practice regarding 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 major part 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. The volume of output of the same item can then be requested and recorded each month. The manufacturer can be asked to indicate whether any quality dimensions (from a checklist of specs) have changed and, if so, to enumerate what features have changed and whether they are important in a price-determining sense. If they are not important, then the (changed) replacement can be classified as a comparable one and volume measurement can be 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 then be linked to the old. The quantities of the new replacement can be requested from the establishment for the previous overlap period or, if they are not available, some estimate can be made.

4.4 Sources of data

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

4.60. Basic data are collected 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 sources of collecting economic data: (a) surveys conducted by the statistical office and (b) 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 may be characterized as follows:

- *Surveys*. The information required to compile an IIP can be collected by the statistical office directly from the units concerned or obtained from secondary sources.[40] When data are collected directly from those units by the statistical office, data collection could be carried out by either enumerating all the units in the population (census) or eliciting responses only from representative units scientifically selected from the population (sample survey). Compared with the census approach, the sample survey technique is a less costly means of collecting data for the compilation of accurate industrial statistics at high frequency. It should be noted that various approaches to sample surveys are currently implemented by countries, including surveying only those businesses above a size threshold (in terms, for example, of employment or contribution to production); drawing a simple sample from the whole population; and the stratified sample. The stratified sample approach is recommended with complete enumeration above a threshold (that is, 100 per cent coverage of the biggest businesses) and samples of businesses below the threshold (that is, partial coverage of smaller businesses). The survey approach does, however, possess some significant disadvantages, since surveys, compared with the administrative data approach, are relatively resource-intensive (both financially and in terms of manpower), require additional respondent burden and may result in sampling errors and higher non-response rates.
- *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 the establishment of a register of the institutional units — enterprises, 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, that is, 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, compared with statistical surveys, are lower

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

response burden and higher cost-efficiency for the statistical agency. However, differences between administrative concepts and statistical concepts often arise.

4.62. The possibility of using administrative data sources for statistical purposes has received increased attention in recent years; and statistical agencies worldwide have been examining the opportunities and issues associated with these sources of data. There are a number of factors responsible for the increased focus on administrative data sources for statistical purposes. For example:

- Statistical producers are attempting to expand the range and depth of their statistics programmes as they come under increasing pressure to reduce their costs as well as the burden that statistical surveys place on the respondents.
- While smaller-sized businesses are large in number and generally have simple organizational structures, they are a relatively expensive source of data in a traditional survey setting. Their characteristics also suggest that they are well suited to the utilization of administrative data, particularly tax data (if such units are registered with tax authorities), in lieu of survey data.
- 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 raises some issues and problems, including differences in terms of coverage, timeliness, definitions and activity classifications, and data-quality issues. Nevertheless, concerted attempts are constantly being made to mitigate or accommodate these problems.[41]

4.64. The weaknesses inherent in administrative data, as regards concept and coverage of the statistical units and the target population, are overcome in adopting the sample survey as the means of data collection, because in that case the planning, execution of the sample 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 (specifically 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, available especially through use of administrative data sources, are examined and exploited, where appropriate.

[41] The OECD administrative data framework outlines good practice in the use of administrative data sources for compiling short-term statistics such as for the IIP. See http://www.oecd.org/document/18/0,3343,en_2649_34257_36239186_1_1_1_1,00.html.

Chapter V
Index compilation

5.1. The objective in constructing an Index of Industrial Production, 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, for collecting data on these 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 II through IV.

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

5.3. One practical component of this publication is a step-by-step guide to carrying out the recommended compilation process which 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 focuses on the aggregation of the IIP from the lowest level to higher aggregations; section 5.3 discusses management of input data; section 5.4 addresses the topic of weights used for the index calculation; section 5.5 provides step-by-step guidance on compiling the index; and section 5.6 examines several additional compilation topics. The chapter concludes with a set of annexes providing more theoretical background on the IIP calculation: annex 5.A discusses index number theory in an economic context and provides historical information on IIP calculation; annex 5.B sets out common criteria for index numbers and how they apply to the index types discussed in this publication; and annex 5.C provides a numerical example demonstrating the difference between chain-index and fixed base index calculation.

5.1 Index types for compiling 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. In this context, “volume” is a more correct and appropriate term than “quantity” for the purpose of emphasizing that quantities must be adjusted to reflect changes in quality.

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 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. The Fisher index is defined as the geometric mean of the Laspeyres and Paasche indices.[42]

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[43] by taking $b = 0$. Thus, it can be expressed as:

Formula V.1
Laspeyres index formula

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

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

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.[44] The Paasche-type volume index can be obtained directly from the Lowe formula, with $b = t$. Thus, it can be written as:

[42] See annex 5.B for a comparison of the index types.
[43] See annex 5.A for a definition and discussion of the Lowe index.
[44] Note that the weights in Laspeyres and Paasche formulae denote the true relative shares as opposed to the hybrid weights encountered in the general Lowe formula.

Formula V.2
Paasche index formula

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

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 ($i,j = 1, 2, \ldots, n$)

5.10. Before considering other possible formulae, it is useful to establish the behaviour 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 for/by goods and services that have become relatively more expensive. In such circumstances, the inequalities expressed above would be reversed.

5.12. The Laspeyres and Paasche volume indices are members of the Lowe family of index numbers. Their formulae differ in that the Laspeyres index holds the basket fixed in the reference period and the Paasche index holds it fixed 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, while neither formula can be judged superior to the other, 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 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 produces the so-called Walsh quantity index.[45] The second approach consists in an even-handed average of the primary "fixed-basket" indices, namely, the Laspeyres and Paasche indices. Taking the geometric mean as an average for these two indices produces the so-called Fisher ideal volume index, which is generally considered the best evenly weighted average of the Paasche and Laspeyres indices. In fact, it has been proved 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 and Paasche-type indices for the same period. It is expressed mathematically as follows:

Formula V.3
Fisher index formula

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

5.1.2 The recommended index type

5.15. Determining which index type should be used to compile the IIP is not necessarily simple; indeed, 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 annex 5.B. Each index type in fact possesses characteristics that makes it more or less desirable in certain circumstances. The Fisher index, for example, possesses several theoretically desirable characteristics (like factor reversal and time reversal) (see annex 5.B) but is considered difficult to produce in a timely and cost-effective manner owing to its use of the Paasche index

[45] 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.

(current information on price and quantity 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 regard to 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, with respect to the need to update the weights so as to produce a chained series of superlative indices. The ultimate aim would be to end up with an index that incorporates all the available historical (path-dependent) information in order to track the dynamic changes in industrial production.

5.17. In summary, the selection of the index type to be used in compiling the IIP should take into account:

- The purpose of the index (i.e., to provide a short-term indicator of production and, where required, to be used in the compilation of the quarterly national accounts)
- Theoretical considerations (i.e., inclusion of an up-to-date weighting structure, time and factor reversal, etc.)
- Practical considerations (i.e., what can be practically achieved in the context of resource constraints and data availability)

5.18. An overall assessment of both theoretical and practical issues has resulted in the wide use of the Laspeyres-type volume index by national statistical agencies. This publication also recommends a Laspeyres-type volume index for the compilation of the IIP.[46]

5.19. More specifically, the recommended index is the arithmetic version of the so-called Young index[47] 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 $b \leq 0$).[48] 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, when $b = 0$), the Young index is then equal to the Laspeyres index. The choice of holding constant the revenue shares has a particular importance in the context of weight updating[49] 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 will

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[46] The Laspeyres-type index is used in place of the Fisher “ideal” approach when timeliness is important. However, calculation, when possible, of retrospective Fisher IIPs is also advised, so that users can be informed of the extent of the substitution bias.

[47] A detailed description of the Young index and its properties can be found in the IMF *Producer Price Index Manual*.

[48] See paras. 5.260-5.263 below on the Lowe family of index numbers.

[49] 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.

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 obtain the weights.

5.20. The characteristics of the Young index usually differ slightly from those of a true Laspeyres index although they suffer from a 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 (if, for example, the proportionate decline in quantity is greater than the proportionate increase in prices), then the covariance will be positive and the Young index will 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.

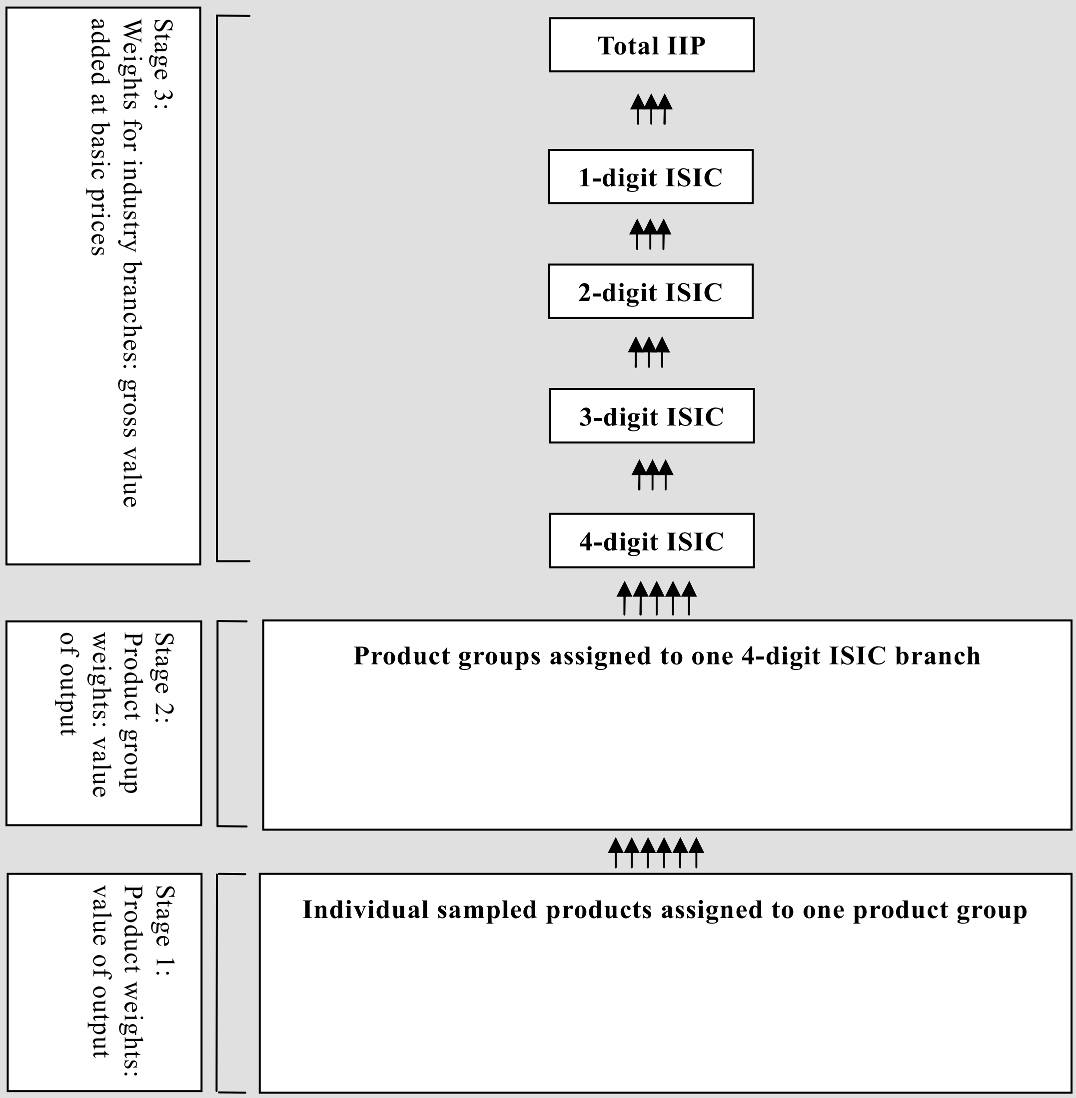
5.21. Finally, it should be noted that the geometric form of the Young index (as a weighted geometric average of the quantity relatives using the revenue shares of period b as weights) offers many attractive theoretical features.[50] However, these types of index cannot be expressed as the ratios of 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 in 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 (for example, an ISIC, Rev.4, class). At the third stage, upper-level indices are calculated in line with the industry classification structure. Figure V.1 demonstrates the three stages of construction of the IIP index structure.

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

Figure V.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 CPC Ver.2, which serves as an appropriate and internationally accepted standard. These product groups contain fairly homogeneous products, and through 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.[51] Aggregation from basic data items (products or product groups) should be carried out directly to industries, without the intermediate step of calculating indices for establishments. Upper levels of the industry classification are then produced by combining industry class data and using weights.

5.25. It should be noted that the product data (collected at stage 1, as illustrated in figure V.1) are used for compilation at the following stages of index construction and may be available in the form of *quantities* or *values*. Where values of production are collected, deflation[52] is needed to obtain industrial production volumes. It is recommended that deflation of the value data to produce volume measures should occur at the most detailed level of the index structure but not higher than at the 4-digit ISIC level, 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 that the deflation of the output values at the 4-digit ISIC level be undertaken first, followed by calculation of the deflated (volume) 4-digit output relatives,[53] as demonstrated in the sequence of steps set out 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 owing to the fact that 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 V.3.

Box V.1

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 ($i = 1, 2, \dots, n$)

[51] A detailed discussion of weights used to compile the IIP can be found in sect. 5.4 below.

[52] See sect. 4.2.1 above for a discussion of deflation.

[53] The rule "100" in the base year (as the average of the 12 months in the base year) can be applied only to the original, unadjusted series. Seasonally adjusted series are usually not equal to 100.0 in respect of 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, that 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 that would be achieved by using Paasche deflators, since in cases 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 piece of information, which makes the IIP at this level essentially a gross output index. The IIP, at least at the lower levels of aggregation, that is, 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, that is, aggregation 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, and has a distinct advantage over the use of output.

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

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 weights are then used to produce IIP data for all levels of the ISIC structure (see sect. 5.4 for a discussion of the weights to be used).

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

5.32. Section 5.5 provides a detailed discussion of the process of compiling an IIP, extending 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 with the quantities in the quantity reference period (that is, 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.

5.3 Managing input data

5.33. The present 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 (from respondents through surveys, 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, in other words, some of the data may be missing or may 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 for those 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's having failed to return the questionnaire (unit non-response).

5.36. There are two general strategies for dealing with *item non-response*:

(a) Ignoring all forms with missing values and confining analysis to the fully completed forms;

(b) Estimating missing data so that the data matrix is complete. This is called imputation.

5.37. Strategy (b), imputation, is recommended inasmuch as adopting the first strategy leads to a discarding of the valid data contained in the partially complete forms.[54] There are a variety of imputation methods, ranging from simple and intuitive procedures to rather complicated statistical ones. Some of the more common methods are: (a) *mean/modal value imputation*: imputing the mean value of a variable for missing data; (b) *post-stratification*: dividing the sample into strata and then imputing stratum mean, mode or median; (c) *carrying 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 (d) *regression imputation*: using 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, regression imputation calls for a significant amount of available data in the historical part of the series as well as in the independent variables used to explain the dependent variable at hand. The choice of method for imputation in an 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 means of managing non-response/missing data is to use administrative data as a replacement strategy. When available, administrative data can be modelled or substituted directly to fill data gaps.

[54] 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.

5.40. There are also non-statistical means of minimizing both forms of non-response. These include (a) impressing upon respondents the importance of providing the requested data; (b) sending reminders to non-respondents; and (c) 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 as well as quality changes are considered changes in volumes and should therefore be reflected in the IIP.

5.42. The term *quality*[55] refers to all those characteristics of goods and services that are sufficiently different to make them distinguishable from each other from an economic point of view. An accurate reflection of quality changes in the IIP calculation is important and can be achieved in the following ways: either through deflation, when using a price index that is constructed to hold constant quality, or through 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 nature and extent 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.[56]

5.44. In the second method, where an IIP is compiled using volume extrapolation, inclusion of quality changes in the IIP calculation is a more complex undertaking.

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 situations, however, where quantity data (specifically labour input data) are the only data available.

5.46. As noted in chapter IV, labour input is seldom preferred as a volume measure because the relationship of labour 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 labour 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 for which quality adjustments are required include output variables like physical quantity and input variables like materials consumed.

[55] See the 2008 SNA, chap. 15, sects. B.4 and B.5, for a detailed discussion of the topic of quality.

[56] 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 the 2008 SNA, chap. 15, sect. B.5, as well as in the *Producer Price Index Manual* and the *Consumer Price Index Manual*.

5.48. In summary, it is recommended that quality changes be incorporated into the calculation of the IIP. However, the method used to incorporate quality change into the IIP will 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 for the reasons outlined above.[57]

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 those weights to derive a weighted-average aggregate index.

5.51. Box V.2 provides a simple illustration of the important role that weights play when an index is being compiled. The weight attached to each product determines the impact that the volume change of that product will have on the overall index. For simplicity's sake, this example involves only two products, A and B. Product A is more important than product B, which is reflected by the weights in panel (i). The resulting index for panel (i) is *115.3*. Panel (ii) covers the situation where products A and B are used in the calculation without its reflecting their differences in importance. The resulting index for panel (ii) is *116.7*.

Box V.2
Using weights to compile indices

Panel (i)

	Base period			*Current period t*		
	Weight (percentage)	*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)**	

[57] 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.

Panel (ii)

	Base period			Current period t		
	Weight (percentage)	*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 owing to its reflection of the differences in importance of the products. More generally, this shows that accurate weights have significant 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 for constructing an IIP are required at three fundamental levels, encompassing (a) weights for products; (b) weights for product groups; and (c) weights for industry branches. Weights at these three levels are obtained from different sources and utilize different data variables. Figure V.1 illustrates the three levels of the index.

5.54. Formula V.4 presents the steps in 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; of a product group in an ISIC class; and of an ISIC class in an ISIC group, etc.

Formula V.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

Hence: $\sum_{i \in K} w_{i,0} = 1$

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

5.55. *(a) Product weights*. The aggregation of the index starts with a sample of specific products. Product data are combined to form product groups using weights that reflect their relative importance. 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*[58] should be used to establish the weight of each product selected in the product group. The information on these product weights is generally obtained through the conduct of product censuses or surveys. As indicated in paragraph 4.11, above, the use of value of output may be a concern, given that the intention of the index is to measure changes in value added. This applies in particular to the establishment 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 prevent distortions in the index compilation.[59]

5.57. *(b) Product group weights*. In the base period, these 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 through the conduct of product censuses or surveys. Each product group is assigned to just one ISIC 4-digit industry.

5.58. *(c) Weights for industry branches* (that is, weights at the 1-, 2-, 3- and 4-digit levels of ISIC). In the base period these are obtained by determining the share of gross *value added* (see the 2008 SNA, para. 6.8) *at basic prices* by industry of all industries in scope of industrial production. Such information is available through annual national accounts compilation. However for some countries, obtaining weights for lower levels of ISIC requires the use of other comprehensive data sources.

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. Using the value of output for weights is not suitable in this context, as it would give any industry using intermediate goods and services produced by other (or even the same) industries a greater weight and essentially introduce a distortion owing 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 would be limited by theoretical and practical factors. 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 as

[58] See sect. 4.1.1 for a detailed discussion of value of output.

[59] More detailed guidance on how to calculate the IIP in cases of outsourcing will be provided in a separate document, available from the industry statistics website (http://unstats.un.org/unsd/industry/guidelines.asp).

approximations on the basis of such a concept are often not available with 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., starting typically 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. First, gross value added is associated more with supply-side considerations with respect to meeting final demand, including gross capital formation, while net value added is more meaningful in an income approach to measuring welfare and living standards. Second, the measurement of consumption of fixed capital, as required for net value added, is quite difficult to achieve, as described in the 2008 SNA.

5.62. Also of interest is the concept of gross value added at factor cost, which is mentioned since 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 speaking, a measure of value added: it is essentially a measure of income and not output.[60]

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 so. 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 to be 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 (a) the need to accurately reflect the current relative importance of product groups and industries; (b) data availability; and (c) 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 well. 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.[61] 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

[60] Paras. 6.80-6.81 of the 2008 SNA provide a detailed description of this concept, including an explanation of why gross value added at factor cost is not a concept used explicitly in the SNA.

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

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 in the IIP compilation process. Delays in the availability of annual weighting data will necessitate 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 (for example, at least every five years), as this provides an opportunity to incorporate new products (see sect. 5.6.2) as well as reflects 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. Owing 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.

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. In section 5.1.2 above, it was recommended that the IIP be compiled using the Young index. The use of this Laspeyres-type index formula provides some flexibility with regard to the frequency of weight updates, as the weights are not derived from the current period. In contrast, the Paasche and Fisher indices 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 signify rather different entities. 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 ($q_{i,0}$ in formulas V.1 and V.2)
- The *weight reference period*, that is, the period, usually a year, whose values serve as weights for the index ($w_{i,0}$ in formula V.1)
- The *index reference period*, that is, the period for which the index is set equal to 100

5.71. While the three types of base periods may coincide, frequently they do not.

5.72. One consequence of implementing the recommended approach, that is, the one using the 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.[62]

5.73. Some countries, however, update their "weight reference period" less frequently, such as every five years, owing to a variety of factors, including resource and data availability constraints. In circumstances of less-frequent weight updates, it is important to carefully select the weight reference period so as to ensure that the resulting IIP is fit for purpose. The weight reference period should therefore be: (a) reasonably normal/stable (that is, typical of recent and likely future years); (b) not too distant from the reference period; and (c) clearly identifiable when analysing and comparing the index results.

5.74. In summary, it is recommended that industry-level weights be updated annually and product group weights frequently, i.e., at least every five years.

5.4.4 Fixed-weight versus chained index

5.75. The simplest case of an index time series is provided 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 Laspeyres, Paasche or Fisher indices. Not only is this case the simplest, but it also exemplifies the natural procedure that unfolds 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 occurs is that the 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 suggests 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 entirely of the data as cumulated to the current year. The main principle underlying the concept of chaining is to consider only short series of a traditional index (Laspeyres, Paasche, etc.) and to 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-year chain of Laspeyres or Paasche indices. Indeed, the process can be accelerated to yield annual or even more frequent chaining. In fact, the more frequently weights are updated, the more representative the resulting index series will be.

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[62] 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 (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 recalculated on the basis of 2004 weights when they become available).

5.78. Irving Fisher, who gave the chain system its name, noted that it is invariant to changes in the base period and 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.[63]

5.79. In the case of more elaborated and complex index numbers such as the IIP, the above issue translates into the more general one of updating or incorporating new 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. However, it is necessary to first explain the terms *fixed-weight indices* 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. The 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 explains why fixed-weight indices are also known as fixed-base indices). These weights are traditionally updated every five years, at which time the entire time series is recalculated based on the new set of weights.

- Using *chain-linked indices* entails updating the weights and linking two index series together to produce a time series. The chain approach, unlike the fixed-weight approach, does not entail recalculating the entire historical series whenever the weights are updated, but rather linking or splicing 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 the base year and index weights are changed, 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, since by definition they must relate to the starting point of the time series, which therefore becomes less and less relevant the greater the length of the time series. In practice, the weighting reference period is generally associated with some point within the time series assigned by a predetermined weight updating strategy. For example, weights might be updated for a fixed-weight index every five 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 François Divisia,[64] is based on the assumption that price and

[63] Irving Fisher, *The Purchasing Power of Money* (London, Macmillan, 1911), para. X.17.

[64] See François Divisia, "L'indice monétaire et la théorie de la monnaie", *Revue d'Economie Politique*, vol. LX, No. 1 (Paris, Société anonyme du Recueil Sirey, 1926), pp. 49-81.

quantity data are available as continuous functions of time. Mathematical differentiation is used then to decompose the rate of change of a continuous time value aggregate into two components which 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 his approach offers some insights, it does not offer much guidance to statistical agencies on choosing a definite 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 (for example, one-year or five-year) of the component indices be 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 compiled with the new weights only 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 the original weights for each past segment are kept fixed.

5.83. The weighting methodology for the segments will depend on whether the type of index used is the chained Laspeyres, the chained Paasche, the chained Fisher or some other.[65] For example, in the case of a five-year chained Laspeyres index with a time series starting in 1990, the portion of the index from 1990 to 1994 would be compiled using weights from 1990, linked to the portion of the index from 1995 to 1999 compiled using weights from 1995, then linked to the portion of the index from 2000 to 2004, and so on. In general, the more frequently weights are updated, the more representative the resulting volume or quantity index series. For an annual chain-linked Laspeyres volume index where the weights are updated each year, the links are combined by successive multiplications 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 $w_{i,\mathrm{t}}$ 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

65 Other chain-linked indices can be considered where the weights refer to some midpoint 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 to 2002 based on weights from 2000 and so on. Such an index, called a "midyear index", belongs to the class of Lowe indices (see the *Producer Price Index Manual*).

in the past as it is to use the weights from a long time in the past for the current period.

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 involves the lack of the *additivity characteristic*. Briefly, additivity is a property whereby a total aggregate is defined as the sum of its components. As a direct result of the chaining process, the aggregate is no longer the sum of the components and is said to be "non-additive".[66] In an IIP context, this means that the lower-level volume measures, say, of ISIC 4-digit classes, do not sum with respect 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 in 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 that additivity breaks down in periods significantly earlier or later than the reference period. It is for this reason that some statistical agencies update both the *weight reference period* and *index reference period*[67] on an annual basis.

5.88. Another drawback of the chain-linking approach stems 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 would a simple fixed-weight index. Szulc (1983) made the point that when prices or quantities oscillate ("bounce"), chaining can lead to considerable index drift, which means that, if after several periods of bouncing, prices and quantities return to their original levels, a chained index will not normally return to unity.[68] It should be noted, however, that on balance, situations favourable to the use of chain indices over time seem more likely than those that are unfavourable, 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.

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66 See Bloem, Dippelsman and Maehle, *Quarterly National Accounts Manual*, pp. 163-164, for a detailed discussion of the non-additivity issue.

67 See the subsection entitled "Frequency of weight updates" in sect. 5.4.3 above for definitions of these terms.

68 See Bohdan J. Szulc, "Linking price index numbers", in *Price Level Measurement*, Erwin Diewert and Claude Montmarquette, eds. (Ottawa, Statistics Canada, 1983).

5.89. As a general recommendation, the chain-linking approach, and more specifically the chained Laspeyres-type volume index, is recommended for the compilation of the IIP. With this approach, when re-weighting occurs, the index is compiled with weights for only 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 five years. It is important, however, that the issue of non-additivity as a result of chaining be carefully presented and explained 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 owing to seasonality and short-term irregularities, the advantages of chaining at these higher frequencies are fewer and chaining should definitely not be applied to seasonal data that are not adjusted for seasonal fluctuations.

5.5 Compilation procedures

5.90. The present section contains a practical guide to the compilation of an IIP from raw data in line with the recommended approach. The guide leads the reader through the compilation process step by step.

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

Introduction of the example

5.91. The present example lays out the process of compiling a monthly Laspeyres IIP using the deflation approach. It presents the calculation of the first two months of the IIP.

5.92. Each step in this example of the process of compiling an IIP includes a description of that step in the process and the provision of the relevant formulae as well as illustrations through the use of data. The steps follow the recommended approach described in section 5.2 above and depicted in figure V.1.

5.93. The compilation of the IIP commences with the collection of basic data (also known as microdata) relating to products. The basic data are combined (using weights) to produce indices for product groups, which are then combined (using weights) to reach 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 V.3, panel (i), presents the products, product groups and corresponding industries used in the example, illustrating the steps involved in the IIP compilation. Box V.3 panels (ii) and (iii) exhibit the basic data that are used throughout the example.

5.96. Of interest is the fact that in this example, the IIP is compiled from value data. 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 carried out 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.[69]

5.97. The calculation of the index in this example comprises 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- and 2-digit ISIC levels

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

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 preprocessing, 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.[70]

5.100. The "value of output" data presented below in box V.3 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, that is, through multiple observations, but this would not affect the calculation.

5.101. The product groups are representative of ISIC classes, in our example classes 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 V.3, panel (i), provides a possible interpretation of the products and product groups used in this example.

5.102. The categories have been recruited just for purposes of illustration of the aggregation of products to product groups, etc. It should be noted that for each product group, a representative (but, not necessarily exhaustive) number of products is chosen. Depending on local needs and the structure of individual industries, a narrower definition of product groups or products may need to be applied (one, for example, identifying brand names or models) so as to ensure that the data collected for these categories remain representative of volume changes.

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[69] Sect. 5.5.2 below demonstrates the process deployed to produce the IIP using the volume extrapolation method.

[70] 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 V.3.

Box V.3
Step-by-step guide to compiling the index

Box V.3
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	G_1 — Leather	P_1 — Chamois leather
	G_2 — Fur skins	P_2 — Dressed fur skins
1512 — Manufacture of luggage, handbags and the like, saddlery and harness	G_3 — Luggage	P_3 — Leather suitcases
1520 — Manufacture of footwear	G_4 — Leather footwear	P_4 — Men's shoes with leather uppers
		P_5 — Women's shoes with leather uppers
	G_5 — Textile footwear	P_6 — Shoes with textile uppers
	G_6 — Sports footwear	P_7 — Ski boots
		P_8 — Tennis shoes
		P_9 — Men's running shoes

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

- 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), which 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 have been recorded and for which the IIP will be compiled (for our purposes, it is assumed that T_1 and T_2 are months immediately following the year of the reference period)

Box V.3
Panel (ii)
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 goods but also relevant services figure in this calculation process.

5.105. After obtaining the raw data from a set of observations, that is, the 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 which will be used in the following steps.[71]

5.106. Box V.3, panel (iii), presents the data for each product whose values have been calculated in this step.

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

Box V.3
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 V.3, panel (iv), contains the individual product weights and product group weights. These weights are used to combine the product data so as 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 contained 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, owing 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), owing to the fact that panel (iii) includes only the weight of the selected observations for product P_i, while data in panel (iv) reflect 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 V.3
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 (iii). Formula V.5 presents the method of calculation for the value relatives for products.

Formula V.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 V.3
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	1.2642
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	0.9419
P_8	47	36	0.7660	33	0.7021
P_9	94	112	1.1915	111	1.1809

Note:
(a) Data for columns [1], [2] and [4] are sourced from panel (iii).
(b) 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 V.3, 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 by the weight for this product, and then adding 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 V.3
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	1.2326	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). 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 V.3, panel (vii), provides a summary of the product group data results obtained in panel (vi).

Box V.3
Panel (vii)
Aggregated product group value indices

		Product group value index		
Product group	*Assigned ISIC class*	${}^{pg}_{VAL}I_{j,0}$	${}^{pg}_{VAL}I_{j,1}$	${}^{pg}_{VAL}I_{j,2}$
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: Although the "value indices" have been multiplied by 100 solely to conform to the standard presentation of 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 must be established, and then the calculation and aggregation procedure is carried out.

5.116. Box V.3, panel (iv), above shows the product group weights used for this example, taking into consideration the remarks made in paragraph 5.109 above.

5.117. Box V.3, panel (viii), shows the calculation for this step, which is similar to the previous one of constructing the value indices at the product group level.

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

Box V.3
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			1.1318

Note: Data for columns [2] and [5] are sourced from panel (vii), data for column [1] from panel (iv). 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 V.3, panel (ix), provides a summary of the ISIC class data results obtained in panel (viii).

Box V.3
Panel (ix)
Aggregated ISIC class value indices

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

Note: While the “value indices” have been multiplied by 100 solely to conform to the standard presentation of 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 above recommends that the producer price index (PPI) at the corresponding level of aggregation be used as the deflator.

5.121. Box V.3, 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 V.3
Panel (x)
Producer price index data

	Producer price indices		
ISIC class	${}_{P}I_{j,0}$	${}_{P}I_{j,1}$	${}_{P}I_{j,2}$
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 V.3, panel (xi), presents the deflation calculation to obtain the volume indices (IIP) by ISIC class. The volume indices are calculated using formula V.6.

Formula V.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 V.3
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). 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 V.3, panel (xii), presents the volumes by ISIC class that were calculated in panel (xi). For ease of notation, we will use $I_{j,i} = {}_{VOL}^{c}I_{j,i}$ hereinafter. The index j will denote the ISIC class, group, division or section in those cases.

Box V.3
Panel (xii)
Summary table of the 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 6: Calculating volume indices at 3- and 2-digit ISIC levels

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 already been removed.

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 sect. 5.4.2), which can be obtained from national accounts data. Box V.3, panel (xiii), presents the weights that are being used in this example for the aggregation to higher-level indices.

Box V.3
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, for example, $w_{151,0}$=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 sect. 5.4.2 for a discussion of this issue).

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

5.129. Box V.3, panels (xiv) and (xv), show the calculation for the IIP at the next-higher ISIC levels, i.e., at group and division levels. 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 the sake of clarity.)

Box V.3
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 V.3
Panel (xv)
Aggregating to higher levels of ISIC: ISIC divisions (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 V.3, panel (xvi), presents a summary of the data results for this example.[72]

Box V.3
Panel (xvi)
Summary of data results

	Index of Industrial Production (IIP)		
ISIC	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. The present section illustrates how to calculate 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 particular note is the fact that the volume extrapolation method does not require that the process of deflation be used 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 to that for the deflation method, as shown in section 5.5.1. We will therefore keep the explanations to a minimum and focus on the differences in the two approaches.

72 Refer to chap. VI below for guiding principles and recommendations for the presentation and dissemination of these statistics.

5.133. The calculation is carried out in several steps similar to those in the deflation method:

- Preparation of product data (preprocessing)
- Calculation of volume relatives at product level
- Calculation of volume indices at product group level
- Calculation of volume indices (IIP) at industry (4-digit ISIC) level
- Calculation of volume indices (IIP) at 3- and 2-digit ISIC levels

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 preprocessing, requires the preparation of all data including variables and weights. The imputation of any missing data, while not explicitly presented in this example, also occurs at this stage.[73]

5.135. The “quantity of output” data presented in box V.4, panel (ii), represent monthly data for 15 products (P_1, …, P_{15}) representative of six product groups (G_1, …, G_6).

5.136. The categories are provided merely for purposes of illustration of the aggregation of products to product groups, etc. For each product group, a not necessarily exhaustive number of representative products are chosen, etc. Depending on local needs and the structure of individual industries, a narrower definition of product groups or products may need to be applied so as to ensure that the data collected for these categories remain representative of overall volume changes. In contrast with the example in section 5.5.1, it should be noted that in the case of volume extrapolation, a more detailed selection of products is often necessary so as 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, which in our example are classes 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 V.4, panel (i), provides a possible interpretation of the products and product groups used in this example.

[73] 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 V.4.

Box V.4
Step-by-step guide to compiling the index using volume extrapolation

Box V.4
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	G_1 — Leather	P_1 — Chamois leather
	G_2 — Fur skins	P_2 — Dressed fur skins
1512 — Manufacture of luggage, handbags and the like, saddlery and harness	G_3 — Luggage	P_3 — Leather suitcase, model A
		P_4 — Leather suitcase, model B
		P_5 — Handbags, model A
1520 — Manufacture of footwear	G_4 — Leather footwear	P_6 — Men's shoes, model A
		P_7 — Men's shoes, model B
		P_8 — Men's shoes, model C
		P_9 — Women's shoes, model A
		P_{10} — Women's shoes, model B
		P_{11} — Women's shoes, model C
	G_5 — Textile footwear	P_{12} —Textile shoes, model A
	G_6 — Sports footwear	P_{13} — Ski boots, model A
		P_{14} — Tennis shoes, model A
		P_{15} — Men's running shoes, model A

5.138. A first aggregation of individual observations to the product level must be carried out in a manner similar to that in the example in section 5.5.1. For this example, we show only the aggregated product data in panel (ii).

5.139. It should be noted that the quantity/volume data can be either observed directly as the quantity of output of the given product or 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 V.4
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	Square metres	240	303	340
P_2	G_2	1511	Square metres	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 V.4, panel (iii), contains the weight data used in this example. The relationships between the product and product group weights are similar to those in the example in section 5.5.1, as explained in para. 5.109. The weight data represent gross output figures for these products and product groups.

Box V.4
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		86	0.3691
P_4	G_3	115	0.4936
P_5		32	0.1373
P_6		100	0.2062
P_7		140	0.2887
P_8		33	0.0680
P_9	G_4	81	0.1670
P_{10}		72	0.1485
P_{11}		59	0.1216
P_{12}	G_5	40	1.0000
P_{13}		64	0.3832
P_{14}	G_6	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		550	0.6166
G_5	1520	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 that of formula V.5 in section 5.5.1, except for the fact that volumes (quantities) are used instead of values.

Box V.4
Panel (iv)
Product volume relatives by period

Product	Product volume for period T_0 ${}_{VOL}^{p}V_{j,0}$ [1]	Product volume for period T_1 ${}_{VOL}^{p}V_{j,1}$ [2]	Product volume relative for period T_1 ${}^{p}R_{j,1}$ [3]=[2]/[1]	Product volume for period T_2 ${}_{VOL}^{p}V_{j,2}$ [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 V.4, 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 displayed 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:

$${}_{VOL}^{pg}I_{k,t} = \sum_{j} {}^{p}w_{j,0} . {}^{p}R_{j,t} ,$$

where the summation runs over all products P_j in product group G_k.

Box V.4
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		0.9231	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		1.1071	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) and data for column [1] from panel (iii). By design, the volume 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 V.4, panel (vi), provides a summary of the product group data results obtained in panel (v).

Box V.4
Panel (vi)
Aggregated product group volume indices

		Product group volume index		
Product group	*Assigned ISIC class*	${}^{pg}_{VOL}I_{j,0}$	${}^{pg}_{VOL}I_{j,1}$	${}^{pg}_{VOL}I_{j,2}$
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: While the "value indices" have been multiplied by 100 solely to conform to the standard presentation of 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 are combined, using the appropriate product group weights, to produce a volume index at the industry level. The calculation is similar to that of 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 V.4 panel (vii), presents 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 V.4
Panel (vii)
Combining product 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])
	G_1	0.5017	1.2625	0.6334		1.4167	0.7108	
	G_2	0.4983	1.1319	0.5640		1.1597	0.5779	
1511					1.1974			1.2886
	G_3	1.0000	0.9064	0.9064		0.9650	0.9650	
1512					0.9064			0.9650
	G_4	0.6166	1.0870	0.6097		1.0408	0.6418	
	G_5	0.0448	1.1500	0.0272		1.2000	0.0538	
	G_6	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 V.4, panel (viii), provides a summary of the ISIC class data results obtained in panel (vii).

Box V.4
Panel (viii)
Summary of data results

	Index of Industrial Production (IIP)		
ISIC class	$_{VOL}^{c}I_{j,0}$	$_{VOL}^{c}I_{j,1}$	$_{VOL}^{c}I_{j,2}$
1511	100.0	119.7	128.9
1512	100.0	90.6	96.5
1520	100.0	111.6	108.8

Note: While the indices have been multiplied by 100 solely to conform to the standard presentation of index numbers, this is not necessary for the calculation itself.

5.148. Since the calculation of these indices was carried out using volume information only, no separation of a price component, i.e., no deflation step, was required. The volume indices therefore constitute the IIP sought 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 that shown in the example in section 5.5.1, since in both cases volume indices at the ISIC class level are now available. Panels (xiii) to (xvi) of box V.3 in section 5.5.1 lay out the exact calculation (using the same data). The detailed calculation is therefore not repeated here.

5.6 Additional compilation issues

5.150. The present 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). It then outlines 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).

5.152. It is desirable to maintain a continuous index series whenever new weights are incorporated into an index. This publication therefore 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 but with this method (in contrast to 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 compiled with the new weights only 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. Chapter IX of the IMF *Quarterly National Accounts Manual* provides a detailed discussion of three linking methods, the *one-quarter overlap* technique (whereby 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 (whereby 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 (whereby a link factor is determined based on the same period in the previous year).

5.154. According to the *Quarterly National Accounts Manual* (para. 9.39):

> While, in many cases, all three 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 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, however, in contrast to the annual overlap technique that may introduce a step between each link.

5.155. The linking method presented below solely for presentation purposes is the annual overlap approach.[74] 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, a process known as *re-referencing*.

5.157. Box V.5 illustrates the calculation for the linking process, including re-weighting and re-referencing.

Box V.5

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**	**3 920.00**	**3 920.00**	**100.00**					**100.00**
2006-q1	74.2	63.6	9.8	5.2	1 057.88	1 060.00	108.16					108.16
2006-q2	72.8	64.2	9.3	5.8	1 049.40	1 049.00	107.04					107.04
2006-q3	75.3	65.6	8.6	6.1	1 047.74	1 081.00	110.31					110.31
2006-q4	76.7	67.6	8.3	6.5	1 076.01	1 105.00	112.76					112.76
2006	**299**	**261**	**9.0**	**5.9**	**4 230.90**	**4 295.00**	**109.57**	**4 230.90**	**100.00**			**109.57**
2007-q1	77.1	65.5	8.1	6.7	1 063.36			1 080.35	102.14			111.91
2007-q2	76.3	66.2	7.8	6.9	1 051.92			1 077.28	101.85			111.59
2007-q3	77.8	68.2	7.6	7.3	1 089.14			1 102.58	104.24			114.21
2007-q4	78.8	69.1	7.3	7.5	1 093.49			1 116.89	105.59			115.70
2007	**310**	**269**	**7.7**	**7.1**	**4 296.90**			**4 377.10**	**103.46**	**4 296.90**	**100.00**	**113.35**
2008-q1	80.1	70.2	7.1	7.9	1 123.29					1 115.19	103.81	117.68
2008-q2	79.5	72.2	6.9	8.2	1 140.59					1 124.77	104.71	118.69
2008-q3	81.1	71.9	6.5	8.8	1 159.87					1 134.96	105.65	119.76
2008-q4	83.3	72.7	6.3	9.1	1 186.36					1 157.58	107.76	122.15
2008	**324**	**287**	**6.7**	**8.5**	**4 610.30**					**4 532.50**	**105.48**	**119.57**

74 An important issue here is the feasibility of compilation by IIP compilers, each year for each link, of annual overlaps for their monthly series using both the old and the new weights, while producing a real-time index. In many respects, the one-quarter overlap can be most useful in this regard. For example, the annual overlap method becomes more difficult in the case where the linking in of new products is being considered.

Independently chain-linked annual indices							
2005	3 920.00						100.00
2006	4 295.00	109.57	4 230.90				109.57
2007			4 377.10	103.46	4 296.90		113.35
2008					4 532.50	105.48	119.57

5.158. The indices in box V.5 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.

For example:

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.

For example:

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 (with 2005 as the reference period for the chain-linked index).

For example:

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.[75]

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.

For example:

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

…

5.159. Box V.5 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 must be calculated using both the old and the new set of weights.

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 in order to bring the index up to the level of the old series.[76] 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:

Link factor = $\frac{Index_{oldbase}}{Index_{newbase}}$, which is $\frac{109.57}{100.00}$ = 1.0957 in this example.

(B) Multiplying the indices calculated using 2006 prices by the linking factor, for example, 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 a 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:

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

[76] For a detailed description of linking using coefficients, please see the IMF *Producer Price Index Manual*, paras. 9.117-9.118.

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

5.6.2 Introducing new products

5.163. The emergence of new products and the disappearance of old products constitute 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 a product may become so significantly different that it can no longer be considered the same product, thereby rendering direct comparisons to the base period no longer possible. This results in fewer and fewer actual product comparisons from which to compile the IIP.

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 to note that appropriate weighting data need to be available for these products before they can be incorporated into the index.

5.166. Box V.6 illustrates the process of incorporating new products into an index at the time of re-weighting. Assume that there is an index that is compiled from three components (A, B and C). The weights are initially from 2003. Component A had a 50 per cent share, B had a 35 per cent share and C had a 15 per cent share. Assume that new weights for these components are available in 2004. As part of the process of collecting new weighting data, a new component (D) is found with a significant weight share (15 per cent). The new weights for 2004 are: A (45 per cent), B (30 per cent), C (10 per cent) and D (15 per cent).

5.167. The total index is derived from products A, B and C in periods preceding January 2005 and from products A, B, C and D in periods from January 2005 onward. Calculation of the chained and re-referenced indices is based on the content of box V.5 above.

Box V.6
Incorporating new products into an IIP

Index	Weight 2003	2003	December 2004	2004 Annual index	Weight 2004	2004	January 2005	February 2005	March 2005
		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**	**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 January 2005 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 does not 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 V.7) to cope with these situations. A data example using the formula is presented in box V.7 below.

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

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

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 : first period in which replacement product *i* is used

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

5.169. Box V.7 uses formula V.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, to simplify 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 C 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[77] for incorporating replacement products into an index. In this example, the overlap period is T_1.

5.172. Panel (i) of box V.7 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 A within the wider product group. However, a chain formulation in which weights are regularly updated would be a better mechanism for achieving this.

[77] A detailed account of all the methods for incorporating products into an index are available in chap. 8 of the *Consumer Price Index Manual* and chap. 8 of the *Producer Price Index Manual*.

Box V.7
Incorporating replacement products into an index between re-weights

Panel (i)
Observed data

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

Panel (ii)
Index compilation

We use formula V.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 V.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:

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

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 owing to the replacement, we essentially consider only two products in our formula, namely, A and B.

With this we obtain:

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

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 which mask relevant short- and long-term movements of these series and impede a clear understanding of the underlying economic phenomena. A proved and well-known solution is to identify and remove these effects, thereby enabling the reliance 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 exhibit "normal" and repeating events but rather 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 refer to those movements that recur with similar intensity in the same season each year and that, 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 working/trading-day effects which represent the "within-month" effects, and moving-holiday 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 during each Gregorian calendar year.

5.176. A trivial means of dealing with seasonal patterns is through same-month comparisons in the original series, that is, consideration of rates of change compared with those of 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:

(a) Unadjusted data are useful in their own right. While the non-seasonally adjusted data indicate 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 reveal the underlying movements that may have been hidden by the seasonal variations. Thus, compilation of seasonally adjusted data exclusively entails a loss of information;

(b) No unique solution exists on how to conduct seasonal adjustment;

(c) 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 smoother and more understandable series, thereby revealing the "news" contained in the time series of interest. Seasonal adjustment facilitates the comparison of long- and short-term movements among industries, sectors and countries; and 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 based on the software used or on the options chosen within a given software package.

- 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 also consider all the 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 an economic explanation of the seasonal/calendar effects. Making any seasonal and/or calendar adjustment of time series that do not show any evidence of seasonal and/or calendar effects represents inappropriate statistical treatment.

5.181. It must also be noted that some time series can be characterized only by calendar effects but not by seasonal ones; in this case, only the calendar adjustment will be appropriate. Moreover, other series can be characterized only by seasonal effects but not by 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 time intervals they form a time series. Data on production of new motor vehicles for each sub-period (week, month, quarter) of the year in a given country form a good example of a time series. In order for a time series to be useful (or even meaningful), the data must be comparable over time, that is, consistent over time in terms of concepts and measurement. The reporting periods have also to be discrete (i.e., every month, quarter, year, etc.), of the same type and non-overlapping. In contrast, data collected irregularly or only once do not constitute 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, the 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, which can be described as follows:

(a) *The trend component* (T_t) reflects long-term movements lasting many years. It is generally associated with structural factors, 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 a 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 revealed in the data.[78]

(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 the type 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 (for example, public holidays such as Christmas);

(d) *The irregular component* (I_t) represents unforeseeable movements related to events of all kinds. It encompasses the residual variations, due to developments or momentous occurrences such as wars or national catastrophes, that affect a number of series simultaneously. In general, the irregular component has a stable random appearance and captures effects that are unpredictable unless additional information is available as regards timing, impact and duration. The irregular component includes the following: (a) irregular effects narrowly defined; (b) outlier effects; and (c) 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, a low level of winter construction, high pre-Christmas retail sales, and seasonal variations in agriculture are well-known phenomena in this regard. Seasonality represents the composite effect of climate and institutional events that repeat more or less regularly every year. Major

[78] This approach is used in the discussion of composition models in sect. 5.6.3.2 below.

causes of seasonality include weather, composition of the calendar, timing decisions and expectations. These factors 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 factors can produce an evolving seasonality; for example, changes in technology alter the importance of climatic factors; and 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 and/or stochastic manner.

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 moving-holiday effects, working/trading-day effects, which represent 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 the Gregorian calendar, which is widely used as a world standard for statistical time series. Therefore, their exact timing shifts systematically in each Gregorian calendar year. The impact of these moving holidays can include the loss of working days and changes in economic and social behaviour. Such effects are usually country-specific, making it difficult to build them into standard routines. Examples of moving holidays include Easter, Chinese New Year, Korean Thanksgiving Day and Ramadan.

5.189. While Easter generally falls in April, it can also fall in late March and affect a wide range of economic time series, including those on 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 (as it usually does) in April. Chinese New Year affects industrial production activities in a similar way 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-effects.

5.190. *Working/trading day.* The 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 not only differ from period to period, but 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. The 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 conveys 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 economic activity. The working/trading-day effect needs to be accounted for because it may attest to apparent changes in level of activity when the underlying level has in fact remained 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 within 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, then 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 carried out 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 are 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: (a) errors in the data; and (b) "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 have 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 that the seasonal component may be removed 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 each 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 behaviour, i.e., if the seasonal effects are the same from year to year. The additive decomposition model takes the following form:

$$X_t = TC_t + S_t + I_t$$

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 the 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. The relevant equation is:

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

5.200. The equation for the multiplicative model can also be expressed in logarithmic (log-additive) form. 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, a trend only in the mean is present, the multiplicative decomposition is generally used. Clearly, neither, the multiplicative nor the log-additive model can be used when the original series contain zero values. In this case, a pseudo-additive decomposition model can be used (see para. 5.201 below). The relevant equation for the log-additive model is:

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

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 on 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, since the additive relationship between the seasonal and irregular components allows either one of them to absorb the zero values without disturbing the trend-cycle behaviour 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. The equation in this case is:

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

5.202. *Quality of seasonal adjustment*. The most fundamental requirement of seasonal adjustment quality is that there be no estimable seasonal effect still present in the seasonally adjusted series. The presence of estimable seasonal effects either in the seasonally adjusted series or in the de-trended seasonally adjusted series (i.e., the irregular component) is referred to generally 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 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 V.8 shows an example of the decomposition of an IIP data series into its three components and the resulting adjusted IIP time series.

Box V.8
Example of seasonal adjustment

Data series: Germany, IIP total industry, January 1995-March 2011, base year = 2005

Software: X-12-ARIMA

Model: Multiplicative model

Figure 1

Decomposition: trend cycle, seasonal factors and irregular components

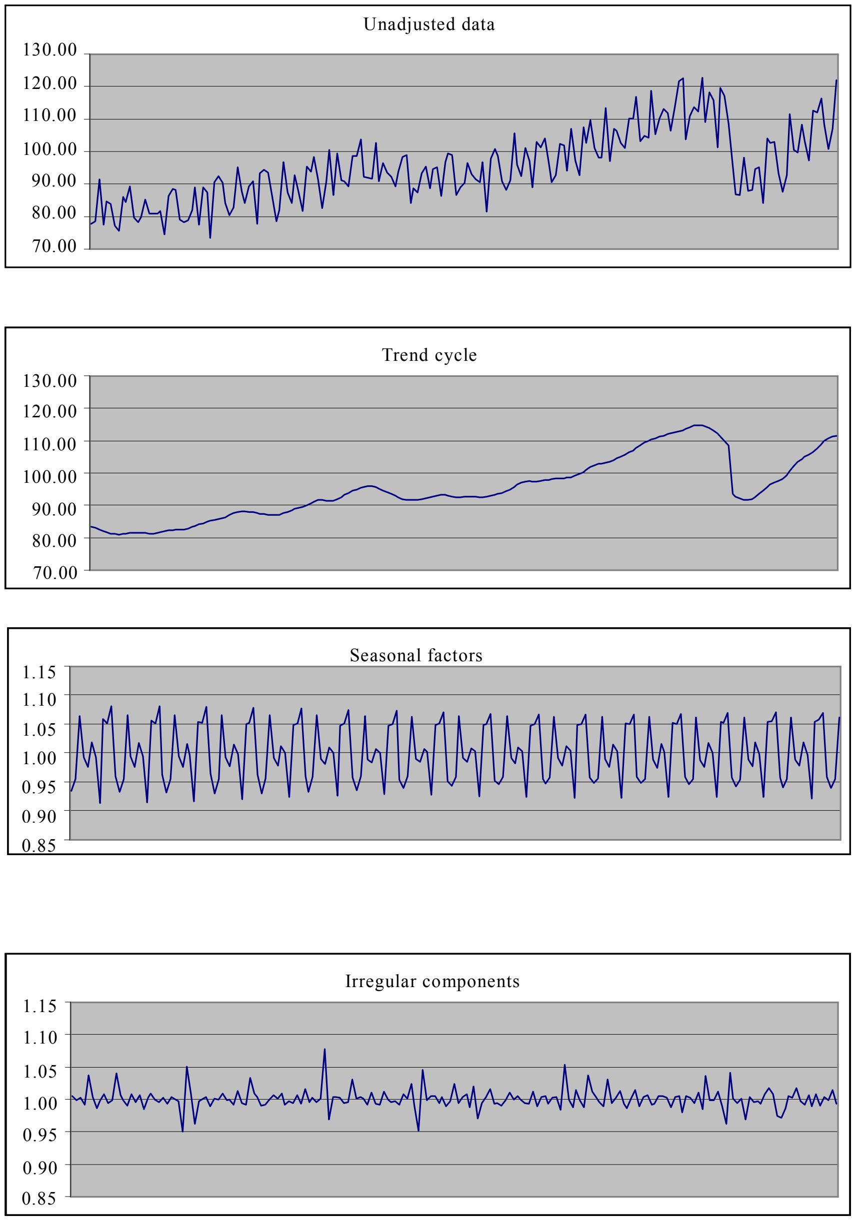
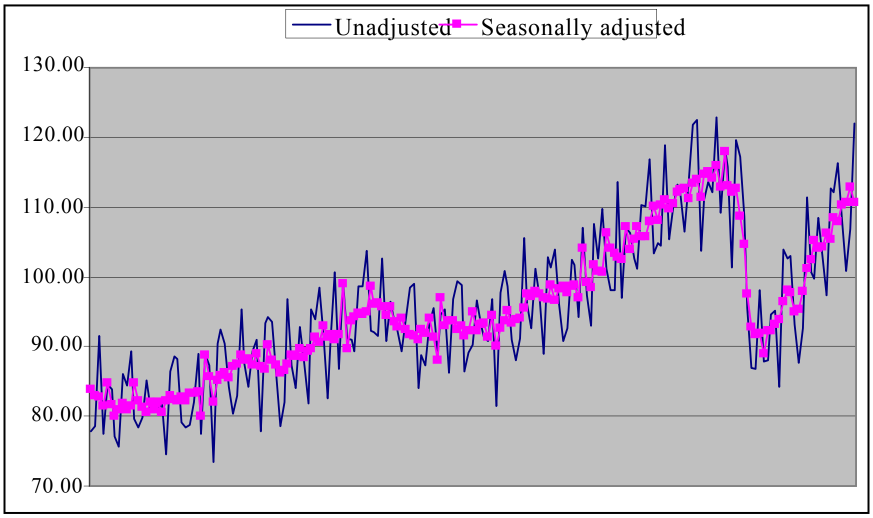


Figure 2
Unadjusted and seasonally adjusted series



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 of methods: those based on moving average techniques; and those 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 adjustment methods used by statistical offices belong to the class of methods based on moving averages. The methods employed 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 modelled separately. This approach assumes that 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 modelled directly. In other cases, the original series is modelled 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 seasonal adjustment is to be applied 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 the 3- or 4-digit ISIC level but it will vary by country. It is generally recommended that seasonal and working-day adjustments be performed at the lowest level, provided that the data have sufficient accuracy to enable reliable adjustments to be performed. If this is not possible owing 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 the minimum length for obtaining 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 effects are difficult, as about seven years of data are needed to secure enough examples of the different types of months (there are seven types of 31-day month, seven types of 30-day month, seven types of 29-day month, and one type of 28-day month). Working/trading-day effects are usually not analysed 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- 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 a 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 option of consistency 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 sect. 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 carried out in such a way as to ensure 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 (for example, sum or average) can have several disadvantages, including:

- The presence of bias in the seasonally adjusted data, especially in cases where the relevance of calendar and other non-linear effects is significant
- 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 from seasonally adjusting the series itself (direct adjustment) or from 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 depend to a great extent on the set of series in question. Because neither theoretical nor empirical evidence uniformly favours one approach over the other, countries are advised to deal with this issue on a case-by-case basis, 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 practical guidance on how to deal with direct/indirect seasonal adjustment in some particular cases is provided directly below:

(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 distortion of the trend path. As the trend path is intended to measure the long-term growth of time series, response to a one-off irregular movement is not desirable. 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, knowledge of subject matter must be used along with a thorough descriptive analysis of the time series under review.

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

5.216. Generally, when data revisions are based solely 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 which may later be reversed, that is, to achieve 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 must be given to the needs of users and the resources available to implement the policy. A sound revision policy should address the following issues at least: (a) the frequency and relative size of revisions due to seasonal adjustment; (b) the precision of the seasonally adjusted data; (c) the time period over which the raw data have been revised; and (d) 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 be as coherent and transparent as possible and that it not lead to the publication of suboptimal seasonally adjusted data, which could mislead users when 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 the seasonal adjustment procedure every month/quarter (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 for the production of up-to-date seasonally adjusted data through recalculation of the values every time that 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. Seasonally adjusted data have to be validated using a wide range of quality measures to ensure that they are of good quality. There has to be a careful assessment to establish, inter alia, the absence of residual seasonal and/or calendar effects, as well as the stability of the seasonally adjusted pattern. The validation of seasonally adjusted data can be carried out 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 available in 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 philosophies underlying the two approaches; nevertheless, they include a number of common measures.

5.220. The full model-based structure of TRAMO-SEATS attests that diagnostics to determine 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, the size of the innovation in the seasonal component, the seasonally adjusted series estimation error, the standard error of the revision and of the growth rates, the 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 pretreatment component and a fully non-parametric seasonal adjustment component. 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 subannual index numbers with 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. Examination of the data obtained from the various sources to determine whether they present to users with a consistent message about the economy seems, therefore, to be a sensible undertaking.

5.223. The process of comparing data that have 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 there be an attempt to compare the subannual IIP with other data sources, essentially in order 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 with, for example, the annual surveys that measure value added is suggested when 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 subannual frequencies are likely to produce some discrepancy in the results owing to conceptual and practical factors. However, further examination of the data results (both subannual and annual) are required in cases where the discrepancies cannot be explained by such factors.

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 applied 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 (for example, on industrial production and wholesale and retail trade) has been implemented 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 imposed by the low-frequency data. The more frequently (monthly or quarterly) observed series are usually less reliable than the less frequently (quarterly or annual) observed ones. For this reason, the latter are generally considered 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 entails a particular form of benchmarking known as reconciliation. The issue of benchmarking arises also with annual data, when a survey is conducted only every few years, and with monthly data, when they should be benchmarked to the quarterly estimates.

5.230. Broadly speaking, benchmarking consists in the creation of a new high frequency series (the benchmarked series) through adoption of 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 become 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 have 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 (see paras. 5.210-5.211). In this case, the seasonally adjusted subannual 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 the benchmarking of time series: a purely numerical approach and a statistical modelling approach. The numerical approach differs from the statistical modelling approach by virtue of not specifying a statistical time-series model that the series is assumed to follow. The numerical approach encompasses the prorating method and the (Denton) family of least-squares minimization methods. The statistical modelling approach encompasses ARIMA model-based methods and a set of various regression models. The most commonly used numerical approaches are described briefly below.

5.233. *The prorating method*. This is the simplest benchmarking method which entails multiplying the subannual values by the corresponding *annual proportional discrepancies*, obtained as the ratio of the annual benchmarks to the corresponding sum of original subannual (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 requires: (a) that the month-to-month (or quarter-to-quarter) growth in the indicator series and the growth in the benchmarked series be as similar as possible and (b) that the adjustments to neighbouring months/quarters be as similar as possible. The month-to-month (or quarter-to-quarter) growth in the two series can be specified as absolute growth or rate of growth. The goal is to minimize the absolute or relative difference between the two series in terms of month-to-month (or quarter-to-quarter) growth.

5.235. While still imposing the benchmarks upon the subannual original series, the Denton family solves the problem of the large inter-annual discontinuities observed in the prorating method. Among the Denton family of benchmarking methods, the *proportional Denton method*[79] is usually the one most preferred. The key feature of this particular technique is its implementation of the least-squares method to minimize the month-to-month (or quarter-to-quarter) movements in the ratio between the benchmarked series and the indicator (the BI ratio). It is relatively easy to implement and provides a simple framework for extrapolation which takes fully into account the existence of any systematic bias or lack thereof in the year-to-year rate of change in the original subannual series. However, the practical implementation of the proportional Denton technique requires application of special software.

5.236. *Benchmarking software packages*. Significant developments have occurred in the field of benchmarking both in theory and in 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, based mostly on the Denton family of benchmarking methods.[80]

5.237. *Benchmarking and revisions.* To prevent the introduction of 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

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[79] See IMF *Quarterly National Accounts Manual*, chap. VI, for a more detailed description.

[80] Statistics Canada has recently developed a benchmarking program in which three generalized least squares (GLS) models have been implemented. Eurostat has also recently developed a Windows-based 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.

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. One practical recommendation suggests countries that 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 data gaps and overcoming potential shortcomings. They can also play an important role in optimizing the use of the data when many sources of data are available and reconciliation of those data is therefore required.

5.239. Countries need to consider the pros of benchmarking (for example, ensured consistency between two data series) and the cons (for example, need for frequent revisions of the subannual series) according to their own circumstances in order to determine whether 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 the present section is to provide guidance on the implementation of the recommended approach — an annually chained IIP of the Laspeyres type.[81] Particular emphasis is placed on procedures for transitioning 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 five years and at that 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 needed to produce an IIP in line with the new recommendations of this publication are (a) annual updating of weights; and (b) chaining of indices. This means increasing the frequency with which the re-weight process occurs and then chaining the indices together instead of recalculating the entire historical series whenever the weights are updated. It should be noted that in countries currently compiling a chained index quinquennially, a significant change would need to be instituted: a more frequent, i.e., annual, updating of weight. Section 5.6.1 serves as an important reference in this context.

5.242. The transition from a fixed-weight index to a Laspeyres-type IIP with annual chaining can be broken down 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. At this stage, it is important to develop a sound project management framework which ensures that the project is carried out efficiently, meets the desired objectives, assigns responsibilities and reporting arrangements, identifies risks and lays out the set of tasks to be undertaken. There are various project management

[81] Relevant material can also be found in annex 5.C to this chapter.

frameworks available which can assist statistical agencies in undertaking this work. Also, it is suggested that planning for the change in methodology begin one to two years prior to the implementation of 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 the detailed methodologies required to calculate the annually chained Laspeyres IIP. The topics should centre on methodologies for rebasing and linking the indices every year, including the source of annual weighting data, as well as for producing seasonally adjusted estimates.

Stage 3: Specify and develop the necessary computer systems

5.245. The computer systems used to produce the monthly IIP would need to be changed so as 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 controlled environment to ensure that the production of estimates is 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 towards utilization of a new index methodology. Communication of these changes to key users should encompass:

- Release of a special information paper, including the presentation of the new methodology to those users and reasons for the changes, as well as results of research
- Conduct of seminars and workshops for key users, as they would provide an opportunity for users to gain an understanding of the new methodology, ask questions and provide feedback
- Release of experimental estimates as providing an opportunity for users to become accustomed to the changes before the changes are implemented through 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 in the context of the new methodology should be set following (a) extensive consultation with users including a detailed presentation of the new methodology, (b) verification that the computer systems are producing estimates in accordance with the required methodology and (c) a sufficiently long period of production of experimental estimates.

Annex 5A
Basic elements of index number theory

1. The word "index" is derived from Latin and signifies a pointer, sign, indicator, list or register. Nowadays, the reach of the concept of index numbers is wide and has extended to various fields and disciplines where scientific measurement is needed, including economics, anthropology, physics, mathematics and astronomy. An index number is essentially a practical construct, and its computation is as much a problem of economic theory as of statistical technique.

2. 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, for example, in the context of identifying the different phases of the business cycle. A number of index types can be distinguished for that purpose. A volume index, for example, 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.

3. Francis Ysidro Edgeworth provided the concise classic definition of an index number. He proposed "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".[a]

4. Another definition using a more developed form of the same concept, was formulated by Bowley (1926):[b]

> 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. In its simplest form, an index number is typically expressed as a percentage of a base value, which is given as 100 for the variable at hand and 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 with this base-period figure. The calculation is based on this formula: (*[new observation]/[old observation]) * 100*. For example, if the price of a one kilogram 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.

6. While some applications of index numbers are not strict within the field of economics but occur in more or less distantly related domains ranging from demography to medicine and technology, the main uses of index numbers are in

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[a] F. Y. Edgeworth, "The plurality of index-numbers", *Economic Journal*, vol. 35, No. 139 (September 1925), p. 379. Available from http://www.jstor.org/stable/2223216.

[b] Arthur Lyon Bowley, *Elements of Statistics*, 5th ed. (London, Staple Press, 1926), p. 196.

economics, hence index number theory is best developed in an economic context. Throughout the present annexes, index number theory will be presented in such a context and will thus refer to quantity and/or price indices.

Index number theory in economic context

7. Economic theory is in part concerned with modelling the demand and supply in respect of *individual* goods and services (products)[c] and *individual* economic agents (producers and consumers).[d] However, owing 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 are often aggregated over agents. The main question here is how to accomplish this aggregation.

8. In the same vein, the basic index number problem in the context of microeconomic theory can be framed as 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 is how to summarize or aggregate 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 and the quantity level equals the sum of the products of the individual prices and the quantities of the commodities to be aggregated.

9. The aggregation problem also encompasses two others: (a) aggregation over time and (b) 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, the same physical good could be considered different products based on different terms of sale.

10. 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 smaller the amount of actual production or consumption available for observation; and comparisons between these tiny units will become meaningless. Thus, for normal economic data, the time period under consideration is usually: (a) a shift (part of a working day), (b) a day, (c) a week, (d) a month, (e) a quarter or (f) a year. A normal "spatial" unit is usually: (a) an enterprise or a household at a specific address or (b) an aggregate of enterprises or households over a region, which could be a county or municipality, a metropolitan region, a State or province, a country or a group of countries. Here in after, the aggregation problem is to be understood to concern the aggregation over goods and services through time.

11. 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

[c] 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 CPC Ver.2 for a discussion of this issue.

[d] See W. Erwin Diewert and Alice O. Nakamura, eds., *Essays in Index Number Theory*, vol. I (Amsterdam, Elsevier Science Publishers, 1993).

quantities $Q^1, Q^2, \ldots, Q^T$, such that the aggregate value in period t, P^tQ^t, equals the total microeconomic value (over all products) for each time period t, that is:

$$\sum_{i=1}^{n} p_{i,t}q_{i,t} = P^tQ^t \text{ for } t = 1, 2, \ldots, T.$$

12. The aggregate period t price P^t is supposed to represent all of the period t microeconomic prices, $p_{1,t}, p_{2,t}, \ldots, p_{n,t}$, in some sense and, similarly, the aggregate period t quantity Q^t is supposed to represent all of the period t microeconomic quantities, $q_{1,t}, q_{2,t}, \ldots, q_{n,t}$, in some sense. Thus, the index number problem can be framed in terms of how exactly these aggregates, P^t and Q^t, are to be constructed. As can be seen from the formulation of the problem, index numbers in economic theory come in pairs: one for price and a matching one for quantity. Sometimes, they may be used alone; still, there is almost always a mate in the background.

13. The earliest approach to index number theory was the *fixed-basket approach* pioneered by Joseph Lowe (1822)[e] in the context of the calculation of bilateral price indices. This approach specifies an approximate representative product basket which is a representative of purchases made during the two periods under consideration (periods 0 and t), the level of prices in period t relative to period 0 is then 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 which is *not* required to be restricted to the basket actually produced in either of the two periods compared. There are two natural choices for the reference basket: (a) the period 0 product vector $q^0 = (q_{1,0}, q_{2,0}, \ldots, q_{n,0})$ which leads to the well-known Laspeyres price index; and (b) the period t product vector $q^t = (q_{1,t}, q_{2,t}, \ldots, q_{n,t})$ which leads to the Paasche price index.[f] The corresponding quantity indices are easily obtained by interchanging the roles of prices and quantities.

14. For practical reasons, the basket of prices/quantities has usually to be based on surveys conducted in a period earlier than either of the two periods whose prices/quantities are compared (that is, a period b with $b \leq 0 \leq t$). Because the operation of collecting and processing survey data (i.e., revenue data) is a lengthy one, there is usually a considerable 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 conducted 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.

15. The positioning of period b is crucial. While it 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 periods 0 and t, the quantities are likely to be equi-representative of both periods, assuming that there is a fairly smooth transition from the relative

[e] Joseph Lowe, *The Present State of England in Regard to Agriculture, Trade and Finance*, 2nd ed. (London, Longman, Hurst, Rees, Orme and Brown, 1822).

[f] Explicit formulations of the Laspeyres, Paasche and Fisher volume indices are presented in sect. 5.1.1.

prices/quantities of period 0 to those of period t. In these circumstances, the Lowe index is likely to be close to other indices, known as "superlative" indices.[g]

16. 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 formulated, 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 5A.1
Lowe index formula

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

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)

17. As researchers attempted to be more precise about the "fixed basket", the fixed-basket approach led eventually to the utilization of the so-called Fisher and Walsh types of indices which 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).

18. 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 predetermined desirable properties of an index number. The other two main approaches 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 the behaviour of the economic agents, namely, consumers and producers.

[g] See paras. 35-39 below on the method of exact numbers.

The axiomatic approach

19. The origins of the axiomatic or test approach can be traced back to the more or less casual observations of the early workers in the index number field regarding their favourite index number formulae or those of their competitors. In this approach, various desirable properties of an index are proposed, depending on the situation at hand; it is then determined whether there is any index formula, 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.

20. In an ideal situation, there would have to be an agreed set of "standard tests" and an index would be found that met 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.

21. A broad range of criteria or tests for assessing the overall quality of an index have been proposed in the literature. Among them are five axiomatic tests, which 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 principle underlying each is given below:

- According to the commensurability test or test of invariance to changes in the units of measurement, the index should not change if the units of measurement for each commodity or price has changed
- According to the constant quantities test, if quantities are identical in two periods, then the quantity index should be the same regardless of what the prices are in both periods
- According to the constant basket test, 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 the values between the two periods
- According to the proportionality test, 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
- According to the time reversal test, the index going from period 0 to period *t* is required 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 which period is chosen as the base period: the new index number should simply be the reciprocal of the original index.

22. Another problem associated with the axiomatic approach stems from the fact that it is not sufficient to know which tests an index has failed: it is also necessary to

know how badly that index has failed. If an index fails badly a major test like the commensurability test, this might be considered sufficient to rule it out. Border line failure of several minor tests, however, may not be deemed sufficient cause for disqualification. 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 to satisfy more than 20 such tests or criteria, hence the name "Fisher ideal index".

The stochastic approach

23. 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 such issues as the appropriate form of average to be employed and the most efficient means of estimating it from a sample of price relatives or quantity relatives, once the universe has been defined. However, the approach does not provide help in deciding 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.

24. The stochastic approach to index number theory dates back to the work of Jevons (1863)[h] and Edgeworth (1888)[i] centring on the so-called unweighted approach. Within 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 $i = 1, 2, \ldots, n$, can be regarded as an estimate of a common inflation rate between periods 0 and t; that is, $\frac{p_{i,t}}{p_{i,0}} = \alpha + \varepsilon$, $i = 1, 2, \ldots, n$ where α is the common inflation rate and the ε's are random variables with mean 0 and standard deviation σ. The ordinary least squares (OLS) or maximum likelihood (ML) estimator for α yields the so-called Carli index. Using a log-linear model when the random component is multiplicative (instead of additive, as in the above model), yields the so-called Jevons index as the OLS and ML estimator of the inflation rate α.

25. 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 in the work of Walsh (1901)[j] and later developed by Theil (1967)[k] and other index number theorists. Walsh pointed out that in the context of a sensible stochastic approach to measuring price change, individual, price relatives should be weighted according to

[h] W.S. Jevons, "A serious fall in the value of gold ascertained and its social effects set forth", reprinted in *Investigations in Currency and Finance* (London, Macmillan, 1884), pp. 13-118. Originally published in 1863.

[i] F. Y. Edgeworth, "Some new methods of measuring variation in general prices", *Journal of the Royal Statistical Society*, vol. 51, No. 2 (1888), pp. 346-368.

[j] C. M. Walsh, *The Measurement of General Exchange Value* (New York, Macmillan, 1901).

[k] H. Theil, *Economics and Information Theory* (Amsterdam, North-Holland, 1967).

their economic importance or their transactions' value in the two periods under consideration.

26. 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 has 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.

27. 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 this approach can be very useful, especially in the estimation of elementary prices from which most aggregate price indices are constructed. As these elementary prices usually have to be based on samples of prices, the stochastic approach may provide useful guidance on how best to estimate them.

The economic approach

28. The economic approach to index number theory relies on the assumption of optimizing behaviour on the part of economic agents: utility-maximizing or expenditure-minimizing behaviour on the part of consumers and profit-maximizing or cost-minimizing behaviour on the part of producers. In this approach, the microeconomic price vectors p^t are regarded as *independent* variables, while 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.

29. Suppose that an economic agent facing price vectors p^t has consumer preferences (or a production function) over differing amounts of n goods which 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 $t = 1, 2, ..., T$.

30. 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 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 $t = 1, 2, ..., T$.

31. The main difficulties associated with the economic approach concern how to practically implement results derived from the underlying microeconomic theory — results that are themselves somewhat theoretical in nature. There are, however, at least three different means of "operationalizing" the theoretical indices defined by this approach: (a) econometric estimation; (b) use of non-parametric bounds; and (c) application of the theory of exact index numbers.

32. *Econometric estimation*. Given time-series or cross-sectional 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 are chosen for *C* or *F* that are flexible, 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 stems from 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.

33. *Method of non-parametric bounds*. Owing to the fact that, practically speaking, it is 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 framework within which the optimization problem is defined: cost minimization or revenue maximization for producers, and utility maximization for consumers. Downward-biased Laspeyres and upward-biased Paasche indices 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 indices will always include the value of a theoretical economic index.[1] This suggests that taking some sort of average or symmetrical mean of the Paasche and Laspeyres price indices should yield an empirically observable price index that is "close" to the unobservable theoretical price index.

34. This method gives highly satisfactory results in the time-series context, as Paasche and Laspeyres price indices for consecutive time periods will usually differ by a relatively small margin. However, in the cross-sectional 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.

35. *The method of exact index numbers.* This method uses the rationale of microeconomic theory of producers and consumers in seeking out explicit solutions to the index number problem based on particular functional forms of the aggregator

[1] See Diewert and Nakamura, eds., *Essays in Index Number Theory*.

function *F*. Diewert (1976)[m] introduced the notion of "flexible aggregators" which are functional forms that provide a second-order approximation to an arbitrary twice-differentiable linear homogeneous function. Flexible aggregators can be interpreted as functional forms that cover a wide range of utility, production, distance, cost or revenue functions.

36. 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 which 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.

37. 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 "trans-logarithmic"[n] specification, which has been a widely tested and widely used tool in econometric analysis, then, under standard assumptions about producer behaviour, the so called Törnqvist index 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), the Fisher ideal index number provides an exact formulation for the underlying theoretical index.

38. In conclusion, it is worth mentioning that although the economic approach to index number theory is perhaps the most compelling, the axiomatic and stochastic approaches still offer some advantages. In particular, these two approaches do not suffer from certain limitations of the economic approach. Stemming from the fact that it: (a) is based on optimizing behaviour, an assumption that may not be warranted in general; (b) 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 (c) is usually based on ex ante expectations about future prices, expectations that cannot be observed, whereas the test and stochastic approaches are based on ex post accounting data, which can be observed.

39. Annex 5B illustrates some characteristics of the Laspeyres, Paasche and Fischer volume indices, which are the types of index numbers used most internationally to aggregate economic quantities over time.

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[m] W. E. Diewert, "Exact and superlative index numbers", *Journal of Econometrics*, vol. 4, No. 2 (May 1976), pp. 115-145.

[n] An homogeneous trans-logarithmic aggregator *f* has the following form:

$$\ln f(x_1,\dots,x_n) \equiv \alpha_0 + \sum_i \alpha_i \ln x_i + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln x_i \ln x_j \quad \text{where} \quad \sum_i \alpha_i = 1; \alpha_{ij} = \alpha_{ji}; \sum_{ij} \alpha_{ij} = 0$$

Annex 5B
Comparison of index types

1. The present annex provides more detailed information on the criteria employed to assess different types of indices that can be used to compile a monthly (or quarterly) IIP. Such criteria are relevant, for instance, in the axiomatic approach (see annex 5A). The criteria and their definitions are presented first, followed by an assessment of the Laspeyres, Paasche and Fisher indices against these common criteria for index numbers.

2. The following notations are used in this annex:

- $q^t = \left(q_1^t, ..., q_n^t\right)$: quantity vector at period t
- $p^t = \left(p_1^t, ..., p_n^t\right)$: 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 indices (as a function of the quantity and price values in period 1 and base period 0)
- V^t: value in period t $\left(V^t = \sum_{i=1}^{n} p_i^t q_i^t\right)$

Period 0 serves as the base period in this notation.

3. Note that for two quantity (or price) vectors q^a and q^b, we say that $q^a < q^b$ if $q_i^a \le q_i^b$ for all $i \in \{1, ..., n\}$ and that $q_k^a < q_k^b$ 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	$Q\left(p^0, p^1, q^0, q^1\right) = \frac{\sum_{i=1}^{n} p_i^* q_i^1}{\sum_{i=1}^{n} p_i^* q_i^0}$ Where p^* is the common reference price vector, $p^* \equiv \left(p_1^*, ..., p_n^*\right)$	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.

	Criteria	Definition	Explanation
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	$Q\left(p,\ p,\ q^0,\ q^1\right)=\frac{\sum_{i=1}^{n} p_i q_i^1}{\sum_{i=1}^{n} p_i q_i^0}=\frac{V^1}{V^0}$	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	$Q\left(p^0,\ p^1,\ q^0,\ \lambda q^1\right)=\lambda \cdot Q\left(p^0,\ p^1,\ q^0,\ q^1\right)$ 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	$Q\left(p^0,\ p^1,\ \lambda q^0,\ q^1\right)=\lambda^{-1} \cdot Q\left(p^0,\ p^1,\ q^0,\ q^1\right)$ 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.
8	Invariance to proportional changes in current prices	$Q\left(p^0,\ \lambda p^1,\ q^0,\ q^1\right)=Q\left(p^0,\ p^1,\ q^0,\ q^1\right)$ 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	$Q\left(\lambda p^0,\ p^1,\ q^0,\ q^1\right)=Q\left(p^0,\ p^1,\ q^0,\ q^1\right)$ for $\lambda > 0$	When base-period prices are all multiplied by the number λ, the quantity index remains unchanged.
10	Commodity reversal test	$Q\left(p^0{*},\ p^1{*},\ q^0{*},\ q^1{*}\right)=Q\left(p^0,\ p^1,\ q^0,\ q^1\right)$, 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	$Q\begin{pmatrix}\alpha_1^{-1} p_1^0, ..., \alpha_n^{-1} p_n^0; \alpha_1^{-1} p_1^1, ..., \alpha_n^{-1} p_n^1; \\ \alpha_1 q_1^0, ..., \alpha_n q_n^0; \alpha_1 q_1^1, ..., \alpha_n q_n^1\end{pmatrix} = Q\left(p_1^0, ..., p_n^0; p_1^1, ..., p_n^1; q_1^0, ..., q_n^0; q_1^1, ..., q_n^1\right)$ For all $\alpha_1>0, ..., \alpha_n>0$	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.

	Criteria	Definition	Explanation
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	$\dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0}\right)}{Q\left(p^0, p^1, q^0, q^1\right)} = \dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^1 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^1}\right)}{Q\left(p^0, p^1, q^1, q^0\right)}$ i.e., $P\left(p^0, p^1, q^0, q^1\right) = P\left(p^0, p^1, q^1, q^0\right)$	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.
15	Factor reversal test	$P(p^0, p^1, q^0, q^1) = Q(q^0, q^1, p^0, p^1)$ and therefore $Q(p^0, p^1, q^0, q^1) \cdot P(p^0, p^1, q^0, q^1)$ $= Q(p^0, p^1, q^0, q^1) \cdot Q(q^0, q^1, p^0, p^1)$ $= \dfrac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0} = \dfrac{V^1}{V^0}$	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 by a price index of the same type is equal to the proportionate change in the current values.
16	Mean value test for quantities	$\min_i \left(\dfrac{q_i^1}{q_i^0}\right) \le Q\left(p^0, p^1, q^0, q^1\right) \le \max_i \left(\dfrac{q_i^1}{q_i^0}\right)$	The quantity index lies between the minimum and maximum rates of growth of the individual quantities.
17	Mean value test for prices	$\min_i \left(\dfrac{p_i^1}{p_i^0}\right) \le \dfrac{\left(V^1 / V^0\right)}{Q\left(p^0, p^1, q^0, q^1\right)} \le \max_i \left(\dfrac{p_i^1}{p_i^0}\right)$	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.

	Criteria	Definition	Explanation
20	Monotonicity in current prices	$\dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0}\right)}{Q\left(p^0, p^1, q^0, q^1\right)} < \dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^2 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0}\right)}{Q\left(p^0, p^2, q^0, q^1\right)}$, i.e., $P(p^0, p^1, q^0, q^1) < P(p^0, p^2, q^0, q^1)$ 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	$\dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^0 q_i^0}\right)}{Q\left(p^0, p^1, q^0, q^1\right)} > \dfrac{\left(\dfrac{\sum_{i=1}^{n} p_i^1 q_i^1}{\sum_{i=1}^{n} p_i^2 q_i^0}\right)}{Q\left(p^2, p^1, q^0, q^1\right)}$, 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: A checkmate ("✓") indicates that the index meets the criterion.

Annex 5C
Fixed-weight versus chain approach (example)

1. The present annex aims to demonstrate that fixed-weight and chain approaches produce different results.[a] In the example provided 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.

2. 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.

Panel (i): item data

	Period T_0			*Period T_1*			*Period T_2*		
Product	*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

3. Panel (ii) displays value data (unit price multiplied by quantity) when prices are held constant. This constitutes a process for obtaining 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 value(p_0q_0)*	*Period T_1 value(p_0q_1)*	*Period T_2 value(p_0q_2)*	*Period T_1 value(p_1q_1)*	*Period T_2 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**

[a] Sect. 5.4.4 discusses the fixed-weight and chain-linked indices and provides a rationale for why the chain-linked approach is to be preferred.

4. 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" ($I_{fixed,0,1}$) in panel (iii) is equal to:

$$I_{fixed,0,1} = \frac{\sum_i p_{0,i} q_{1,i}}{\sum_i p_{0,i} q_{0,i}} \cdot 100 = \frac{575}{530} \cdot 100 = 108.5$$

5. A similar process is carried out to obtain the fixed weight index for "period T_0 to T_2", i.e.:

$$I_{fixed,0,2} = \frac{\sum_i p_{0,i} q_{2,i}}{\sum_i p_{0,i} q_{0,i}} \cdot 100 = \frac{648}{530} \cdot 100 = 122.3$$

6. The process for calculating the chain index is somewhat different (as is made apparent in the example for the period T_2 chain index). The chain index result in period T_1 is calculated in the same way as the fixed-weight index. For period T_2, the chain index ($I_{Chain,0,2}$) is equal to:

$$I_{chain,0,2} = \frac{\sum_i p_{0,i} q_{1,i}}{\sum_i p_{0,i} q_{0,i}} \cdot \frac{\sum_i p_{1,i} q_{2,i}}{\sum_i p_{1,i} q_{1,i}} \cdot 100 = \frac{575}{530} \cdot \frac{735}{654} \cdot 100 = 121.9$$

7. Note that period T_1 and T_2 quantities for the chain index are revalued in terms of period T_1 prices (not period T_0 prices, as in the case of 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

8. As stated above, the purpose of this example is to show that the index results are different when fixed-weight, and chain index approaches are employed to calculate the IIP (122.3 versus 121.9, respectively).

Chapter VI
Data dissemination

6.1 Introduction

6.1. The present chapter outlines the issues and topics associated with data dissemination, both generally and in the context of the IIP. It presents data dissemination principles (sect. 6.2), outlines publication activities (sect 6.3), discusses data revisions with a focus on the IIP (sect. 6.4) and sets out international reporting recommendations (sect. 6.5). The final section provides additional dissemination-related reference material.

6.2. Data dissemination, which consists in the distribution or transmission of statistical data to policymakers, members of the business community and other data users, 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 being 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 media. The presentation of data and the method of dissemination should be influenced, to a large degree, 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 which 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 *International Recommendations for Industrial Statistics 2008*.

6.5. Three almost universal principles have been implemented by statistical organizations: *statistical confidentiality*; *equality of access*; and *objectivity*. These principles are discussed below.[82]

6.2.1 Statistical confidentiality

6.6. The United Nations Fundamental Principles of Official Statistics (para. 6) 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".[82] 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 subsisting among the national statistical office, other data producers, respondents and users. As a result of such a breach, individual data providers may not cooperate with data-collection entities in the future and data users may question the objectivity and reliability of data from the national statistical office.

[82] See *Official Records of the Economic and Social Council, 1994, Supplement No. 9* (E/1994/29), chap. V, para. 59.

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 methods designed to protect against the disclosure of confidential data include:

- *Aggregation*, 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 their presentation and dissemination at the group (3-digit) level of ISIC.

- *Suppression*, where records from a database or a table that contains confidential data are removed.

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. It serves a dual purpose: it makes the data officially public; and 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, the national statistical office/data producers should develop and announce an advance data release calendar, which should be publicized (for example, posted on websites) at least three months in advance of scheduled release dates. In addition, contact details for relevant statisticians who can answer questions posed 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 those circumstances are 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, so as to allow them time to undertake analysis and to develop a briefing, for example, for provision to relevant ministers after the lifting of the embargo. Key ministers would then be able to respond in an informed manner to requests from the media upon release of the statistics, thereby preventing any inadvertent misinterpretation.

6.13. The timely release of the IIP is paramount, given its usefulness to policymakers, analysts and the wider public. It is to be noted that there is a trade-off between timeliness and quality. It is therefore recommended that the monthly IIP be released within six weeks after the end of the reference month.

6.2.3 Objectivity

6.14. The released data should not be accompanied by subjective interpretations, judgements or recommendations, as they are likely to compromise the independent and objective position of the national statistical office. The focus of accompanying commentary should be to assist users in making their own judgements about economic implications. The released data should also include methodological explanations and advice.

6.15. National statistical offices/data producers are entitled, however, to comment on erroneous interpretation and misuse of statistics (see the Fundamental Principles of Official Statistics, principle 4, on prevention of misuse).

6.3 Publication activities

6.16. Publication is the action of making statistical information public in printed form or on the Internet, and also includes CD-ROMs, magnetic tapes, audio-cassettes, radio and TV broadcasts, as well as any other media that can meet the same objectives. Publication encompasses a series of steps including: selecting and presenting content for publication; selecting publication types and formats; producing IIP publications; reviewing publications before their release; 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 (for example, percentages and rates of change), tables and graphs.

6.18. It is customary to highlight key figures in publications. Common examples are monthly and annual percentage changes of total industrial production. Tables are a useful means of presenting both summary and detailed data.

6.19. Agencies involved in the production of IIP publications need to ensure that these publications are drafted so that content is presented in meaningful ways. Adherence to the following key presentation principles is 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 from month to month and change from the same month one year earlier should be presented
- A reference period needs to be determined and, by convention, this period is set to a value of 100 (100.0)

- The main contributors to change — i.e., those product groups or industries that are primarily responsible for the monthly movement in the IIP — should be presented to users

6.20. In addition, the provision of an adequate description of characteristics and methodologies specific to indices is as important to users as quality assessments of the data. Consideration should also be given to providing 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 to 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 rebasing and procedures for linking indices
- Treatment of changes in the composition of commodities in the market, as well as changes in quality
- Comparison of the methodologies applied, assessed 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 the need to ensure that information is timely, accessible and understandable. These considerations need to be weighed against cost, i.e., the 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, which include press releases, fact sheets and profiles; and thematic publications, which contain detailed data “by industry” and “by region”.

6.23. Concise publications are short and may include key indicators, summary tables, graphs and compressed supporting text. They generally have a larger audience than that for detailed thematic publications and reports.

6.24. Thematic reports are more detailed publications, which include tables (for example, standard tables), along with other information encompassing, inter alia, 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, their analytical use of the data makes them very important.

6.25. Publications can be produced in hard-copy or electronic format. The upfront cost of publishing statistical products in hard copy (traditional formats like bulletins, digests, abstracts and yearbooks are still widely used) is greater than that for electronic information (in spreadsheets and text files, as well as PDF, CSV, DOC, XLS, XML formats). However, there are specific costs associated with electronic formats, including budgets required to pay for administrative and technical support.

6.26. The time lag that occurs between data collection and data dissemination through traditional print media is greatly reduced when traditional publications are disseminated by the Internet. In practice, Internet dissemination is usually possible around the time the print version has been finalized 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 publication.

6.3.3 Review of publications prior to their issuance

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 available data 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, ensure that the publications are reviewed internally prior to release, check for errors in the publication (such as inconsistencies between 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. Promotion should be targeted to include policy developers, decision makers in government, the media, the business community, researchers known to use IIP data, and the general public. Promotional activities 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, which can help improve future publications.

6.29. It is impossible to measure the success of dissemination efforts without monitoring the use of IIP statistics. The Internet has provided statistical agencies with various means of tracking the popularity of its publications. Still, in many instances it is difficult to determine for what purpose data are used, or who uses those data. At a minimum, the unit within the national statistical office responsible for disseminating hard-copy publications should record requests for, or sales of, those publications. Such information 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 with respect to compilation of industrial statistics. Revision of the estimates is vital statistical activity in all countries, both developed and developing. It is an inherent component of the process through which estimates are compiled and released by the national statistical offices — a process running the gamut from "preliminary data" (based mainly on trends in indicators and statistical techniques) and "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 the need for reliability, accuracy and comprehensiveness. To meet user needs, national statistical offices compile timely preliminary estimates which are later revised 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 dispense with them by producing accurate but rather outdated data will result in a failure to satisfy user needs, particularly in the case of the IIP, whose advantage is its combination of high frequency and rapid availability.

Reasons for revisions of data

6.32. In general, there are two types of revisions: (a) revisions representing a part of "normal" statistical procedures (reflecting, for instance, the availability of new information, a change in methodology, a change in data source, or a change of the base year); and (b) revisions carried out to correct errors that may have occurred in source data or in processing.

6.33. It is recommended that corrections of errors (statistical or data-processing errors) be carried out in a transparent manner as soon as they are detected. The revisions should be explained to the users in such a way as to provide assurance that corrections were not politically motivated.

6.34. Countries should develop a revision policy for normal statistical data revisions.[83] The development of a revision policy should aim to provide users with the information necessary to deal with revisions in a more systematic manner. The essential features of a well-established revision policy are its predetermined schedule, reasonable stability from year to year, openness, provision of advance notice of reasons for and effects of revision, and provision of 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 occur 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 this 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 for and schedule of revisions should be made public and be readily accessible to users

[83] The OECD-Eurostat Task Force on Revisions Analysis has prepared guidelines on revisions policy and analysis, available from www.oecd.org/document/21/0,3343,en_2649_34257_40016853_1_1_1_1,00.html.

- The revision cycle should be relatively stable from year to year, (users place great importance on the regularization of the revision schedule)
- Major conceptual and methodological revisions should be introduced as required, balancing the need for change and user 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 include identification of data in the statistical publications that are preliminary (or provisional) and of data that are revised, with explanations of the reasons for revisions, and explanations of breaks in series when consistent series cannot be constructed
- 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 United States of America, when the IIP data for the most recent month are published, revised estimates for the previous five months are published as well. 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 economies are having a significant impact on national economies. International statistics therefore provide an important information source from which policymakers and analysts can draw to 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.[84] 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 (at least) a quarterly basis, with a lag of no more than six weeks after the reference quarter at the 2-digit level of ISIC, Rev. 4, and on a monthly basis at the 1-digit level of ISIC, Rev.4, with a lag of no more than six 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

[84] The collection of these index numbers by the United Nations started in the 1950s following the recommendations of the Statistical Commission at its fifth session in 1950. The United Nations Statistics Division currently compiles and disseminates IIP data at the world, regional and country levels on monthly, quarterly and annual bases.

the presentation and dissemination of all official statistics (i.e., they are not limited just to the IIP):

- United Nations Fundamental Principles of Official Statistics (1994)
- IMF, *Producer Price Index Manual: Theory and Practice* (2004), chap. 13
- OECD, *Data and Metadata Reporting and Presentation Handbook* (2007)
- Statistics Canada, “Policy on informing users of data quality and methodology” (2000), sect. E.3
- *International Recommendations for Industrial Statistics* (2008)

Part two
Guidance on implementation

Chapter VII
Quality assessment and guidance on compiling an IIP

7.1. The present chapter presents a quality assessment framework for an IIP as well as practical guidance on compiling the index. Section 7.1 presents the framework that can be used to assess the entire 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 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 levels attempt to systematically evaluate the quality of their own statistical output using various tools and processes. A quality framework[85] 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 displays a multidimensional framework for assessing quality rather than, say, accuracy, which traditionally has 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, cannot be easily accessed or appear to conflict with other data. Alternatively, a variable for producing the IIP that is regarded as preferable from a conceptual perspective may not be sufficiently timely or sufficiently accurate. In this case, it would be desirable to use another variable — one that scores higher in the overall evaluation of suitability for use in compiling a monthly IIP.

7.4. The quality of a statistical product is assessed on the basis of the following seven characteristics:

- *Relevance*. Statistics are compiled to meet the strong demands of analysts and policymakers. Relevance depends upon both the coverage of the required topics and the use of appropriate concepts.
- *Accuracy*: Accuracy refers to the closeness between the values provided and the (unknown) true values. Accuracy has many dimensions: in practical terms, there is no single aggregate or overall measure of it.
- *Credibility*. The credibility of data products is based on the confidence that users place in those products based simply on their perception of the data producer, i.e., the brand image.

[85] The present section offers a summary of the contents of sect. 5.5.3 of the OECD *Compilation Manual for an Index of Services Production*. Topics are covered in brief in the present publication, while a detailed description can be obtained from the OECD *Manual* itself. Further, detailed information on the OECD quality framework is available from www.oecd.org/statistics/qualityframework.

- *Timeliness*. Data should be made available quickly following the reference period.
- *Accessibility*. The accessibility of data products encompasses 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, as well as the affordability of the data.
- *Interpretability*. The interpretability of data is closely related to the users' understanding of the data in the context of their own use. Thus, the degree of interpretability depends on all the information aspects of the data, such as adequacy of the definitions of concepts, target populations, variables and terminology, limitations, etc.
- *Coherence*. The coherence of data products reflects the degree to which they are logically connected and mutually consistent. Four important subdimensions of coherence can be distinguished:
    - Coherence within a data set
    - Coherence across data sets
    - Coherence over time
    - Coherence across countries.

7.5. The cost of producing necessary statistics constitutes an additional criterion for 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 borne by the provider, but it is a cost nevertheless.

7.6. A difficult challenge associated with 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. The effective operation of many of these frameworks requires a specialist's knowledge of the data in question.

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. The present section utilizes the relevant dimensions of the quality framework presented in section 7.1 to establish a classification of variables as "preferred" (representing best practice), "alternative" or "other", to be used in the production of an IIP by industry.

7.9. The *preferred approach* presents the variables and methods that are considered to be most appropriate for the compilation of short-term indicators within 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, however, that other variables could produce acceptable results, depending on the country and activity context.

7.10. The five 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 that industry knowledge be possessed by the statistician or "industry expert".

7.11. The five suitability issues are:

- *Relevance*. The purpose is to measure short-term change in value added. An indicator should be designed for that purpose, rather than, for instance, for measuring 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.

- *Accuracy*. 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.

- *Timeliness.* As the purpose is to estimate short-term change in value added, a short-term indicator needs to be made available quickly, i.e., shortly after the end of the period to which it relates. Timeliness also includes the concept of periodicity/frequency, that is, in order to reflect monthly (or quarterly) value added, an indicator should ideally consist of independent monthly (or quarterly) observations (entailing, for example, release of IIP data approximately six weeks after the end of the reference period, for monthly indices).

- *Interpretability*. 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.

- *Coherence*. The same indicator should be used throughout the entire time series. If there are definitional changes, adjustments should be applied so as to ensure consistency and to enable comparison over time and between countries, etc.

7.12. Section 7.3 presents, in tabular form, the results of the quality assessment of industrial production data variables and methods, encompassing 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 for compiling the IIP is a survey conducted monthly, specifically for that purpose; therefore, the survey of industrial production will provide most of the required data. This is not the case, however, in all countries; and in some cases, various data sources are utilized to compile the index. In the table below, it is assumed that the primary data source is the survey of industrial production and attention is therefore focused on the variables and methods needed to compile the index.

7.14 The explanatory notes presented in the table constitute a summary or subset of the complete set of explanatory notes that can be found in *International Standard Industrial Classification of All Economic Activities* (ISIC), *Rev.4*.[86]

7.15. The column entitled "Products or product groups" 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 Index of Industrial Production. Countries should review the list to determine whether the products on the list are significant ones in the context of their individual domestic economies.

[86] The United Nations Statistics Division website (http://unstats.un.org/unsd/class) also contains the complete updated reference relating to ISIC, Rev.4.

Recommended variables and methods for calculating an IIP for each class of ISIC, Revision 4

ISIC Section: B — Mining and quarrying

Division: 05 — Mining of coal and lignite

This division includes the extraction of solid mineral fuels including through underground or open-cast mining, and also 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).

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 – Briguettes 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).

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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*	*Alternative 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
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*	*Alternative 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 aluminium 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
0893	**Extraction of salt**	This class includes: – extraction of salt from underground including by dissolving and pumping – salt production by evaporation of seawater 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**
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 geologic observations as well as drilling, test-drilling or redrilling for oil wells, and 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*	*Alternative 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 (sect. 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 to 3821.

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 purée 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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, groundnut, 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 by 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 – Yogurt 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 therefor 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**
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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
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**
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	– Prepared meals 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
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 non-alcoholic 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*	*Alternative 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 per cent 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 plants 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 or 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*	*Alternative 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*	*Alternative 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	– Bleaching of 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 – Non-wovens – 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*	*Alternative 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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*	*Alternative 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; metallized leather – Tanned or dressed fur skins	**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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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, planning, 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*	*Alternative 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 millimetres; 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**
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	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			– Particle board and similar board of wood or other ligneous materials – Fibreboard of wood or other ligneous materials				
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**
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	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			– Articles of natural cork				
			– Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork				

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 fibres from other impurities in wood or used paper. The manufacture of paper involves matting these fibres 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*	*Alternative 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 non-dissolving) 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 or 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*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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) (3520).

The manufacture of petrochemicals from refined petroleum is classified in division 20.

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
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 (gasoline) – 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*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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, and 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**
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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
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**
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,	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			not carded or combed				
			– Artificial filament yarn (except sewing thread and multiple or cabled yarn), not put up for retail sale				

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*	*Alternative 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*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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**
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*	*Alternative 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 other 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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*	*Alternative 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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**
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	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			– Heavy weapons (artillery, mobile guns, rocket launchers, torpedo tubes, heavy machine guns)				
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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 tableware – 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**

* This industry produces a variety of metal products (ranging from bridges to steel plates). Therefore, the volume indicator to be used will depend on the product being measured, which is why a variety of preferred volume methods are presented for this industry.

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*	*Alternative 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, liquid crystal display) – 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	– 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	**Volume indicator (input-based)** Number of hours worked adjusted for changes in productivity	**2630**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
		wires or through the air, such as radio and television broadcast and wireless communications equipment			adjustments, by product		
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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
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 – Computerized tomography (CT) and positron emission tomography (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**
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*	*Alternative 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 fibre-optic cable for data transmission or live transmission of images	– Fibre-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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
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**
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, push-button, 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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*	*Alternative 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, carburettors 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 hose and fittings)	– 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 – Permanent 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**
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	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			– Pneumatic nailers – Buffers – Routers – Grinders				
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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 angle dozers – 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 for making 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**
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	**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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
			– Semiconductor manufacturing machinery – Aircraft launching gear, aircraft carrier catapults and related equipment				

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*	*Alternative 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, trolleybuses 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 shipbuilding 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*	*Alternative 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, cofferdams, 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 motorboats	– Inflatable boats and rafts – Canoes, kayaks, rowing boats, skiffs – Motorboats – 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 armoured amphibious military vehicles – manufacture of other military fighting vehicles	Tanks – Armoured amphibious military vehicles – Military fighting vehicles	**Volume indicator** Quantity (count) of products produced, by product or **Deflated indicator** Number of hours worked adjusted	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
				for changes in productivity			
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 occur 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 moulding process for plastics furniture is similar to the moulding 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*	*Alternative 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*	*Alternative 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 gem 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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 – 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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 of restoring machinery, equipment and other products to working order. The provision of general or routine maintenance (i.e., servicing) on such products to ensure that 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 goods. 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 are 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*	*Alternative 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 of 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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 measuring, testing, navigating and control equipment – Repair and maintenance of irradiation, electromedical and electrotherapeutic 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
			– Repair and maintenance of optical instruments and equipment				
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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
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	**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 class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
			– irradiation and electromedical equipment, etc. – bowling alley equipment				

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*	*Alternative 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 centres and distribution to end users	– Electricity generated – 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	– Gas supplied – 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	**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**

ISIC class	Description	Explanatory notes	Products or product groups	Preferred method	Alternative method	Other methods	ISIC class
			through a system of mains				
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*	*Alternative 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*	*Alternative method*	*Other methods*	*ISIC class*
3700	**Sewerage**	This class includes the operation of sewer systems or sewage treatment facilities	– Sewage removal services usually provided using equipment such as waste pipes, sewers or drains – Sewage treatment services using dilution, screening and filtering, sedimentation, chemical precipitation	**Volume indicator (output-based)** Quantity of sewage 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 sewage 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*	*Alternative 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, biohazardous 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**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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	**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	**3822**

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative method*	*Other methods*	*ISIC class*
			and storage of radioactive nuclear waste				
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, 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 clean–up of contaminated buildings and sites, soil, surface or ground water.

ISIC class	*Description*	*Explanatory notes*	*Products or product groups*	*Preferred method*	*Alternative 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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