



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

# Quarterly and monthly reports on World Manufacturing Production

Methodological Note

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# 1 Introduction

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## 1.1 Objectives

Policymakers, business associations and other international data users rely on information of the most recent production growth trends. To meet these data needs and to highlight UNIDO's position as the specialized UN agency in the field of industrial developments, UNIDO Statistics periodically presents the latest growth estimates for the manufacturing sector as a whole as well as for its major industries. These results are published as digital quarterly reports on World Manufacturing Production<sup>1</sup> since 2011. Beginning with the year 2020, UNIDO Statistics has also published monthly data on world manufacturing production in their original form as well as seasonally adjusted time series.

The main objective of the quarterly and monthly reports is to provide an overview of the current growth trends in world manufacturing production by country groups and by major sectors. They present the observed growth rates and growth estimates for the most recent periods. The figures presented in the reports are based on monthly or quarterly production data obtained from national data sources.

## 1.2 Data sources

The main data source of UNIDO's quarterly and monthly reports is monthly or quarterly index numbers of industrial production (IIP), compiled and disseminated by National Statistical Offices (NSOs) through publications or websites.<sup>2</sup>

UNIDO Statistics derives index data from official publications, so that NSOs do not bear any additional respondent burden to report data. This approach does not entail direct interaction with NSOs on the methods used for compiling IIPs. Country practices may deviate from internationally recommended methods, which could affect data comparability across countries. Therefore, UNIDO Statistics urges NSOs to comply with the International Recommendations for the Index of Industrial Production 2010<sup>3</sup> (IRIIP) endorsed by the

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<sup>1</sup><http://www.unido.org/resources/statistics/quarterly-report-on-manufacturing.html>

<sup>2</sup>For most European countries, IIP data are obtained from the Eurostat database, which contains data reported directly by NSOs.

<sup>3</sup><https://unstats.un.org/unsd/statcom/doc10/BG-IndustrialStats.pdf>



UN Statistical Commission. UNIDO Statistics uses national data to aggregate and derive estimates at the regional and global level.

### 1.3 Index of Industrial Production

The target variable compiled by UNIDO Statistics would normally be the value added of a reporting country's manufacturing sector. However, information on value added would require obtaining detailed information on outputs as well as inputs of each sector. Input data are difficult to estimate from regular surveys. NSOs therefore often use output data to measure the approximate developments of value added within a short period of time.

The IIP measures the growth of industrial production in real terms, free from price fluctuations. Users are advised to take note that while annual industrial growth rates, e.g. from national accounts, generally refer to changes in manufacturing value added (MVA)<sup>4</sup>, i.e. output net of intermediate consumption, the sub-annual indices reflect the growth of gross output. Given the temporal nature of estimates, output growth provides the best approximation of value added growth, assuming that the input-output relationship is relatively stable during the observation period.

The measurement of output volume can be conducted in several ways for constructing the IIP. According to the IRIIP, the preferred proxy measure of output volume is generally an output value deflated using the producer price index as the recommended deflator. Another accurate and commonly used proxy measure is the quantity of output. Value of sales is readily available and is used in practice as a proxy measure for volume of output after the deflation process has been carried out. In special cases, the most suitable approximation of changes in volume of output are input measures, such as labor input or materials consumed, though this approach is less accurate. Indices are usually computed using either a deflating or a volume extrapolation method. IRIIP offers guidance on selecting suitable variables and methods to calculate IIP for particular sectors of production.

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<sup>4</sup>For a description of MVA, see <https://stat.unido.org/content/learning-center/what-is-manufacturing-value-added%253f>.

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## 2 Methods

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Data compilation and presentation methods have regularly been updated since the first quarterly report was released in 2011. This document presents the methods currently implemented for compiling and disseminating the IIPs.

### 2.1 Requirements for national data

To obtain internationally comparable growth estimates from national data, certain methodological standards must be respected and implemented at the national level. These internationally accepted standards are introduced in the IRIIP for a sub-annual IIP. In some cases, UNIDO Statistics takes certain measures to normalize the data when these standards are not fully met, while preserving the underlying message of nationally published production statistics.

#### 2.1.1 Classification

Since 2016, the monthly and quarterly data have implemented Revision 4 of the International Standard for Industrial Classification of All Economic Activities (ISIC Rev.4).<sup>5</sup> For countries that publish index numbers based on ISIC Rev.4, national data from the sections Mining and Quarrying (B), Manufacturing (C) (including the 2-digit division levels), Electricity, gas, steam and air conditioning supply (D) as well as Water Supply; sewerage, waste management and remediation activities (E) are used in their original form. For countries that still produce index numbers based on ISIC Rev.3 or another classification system, growth figures are estimated at the 2-digit level of ISIC Rev.4 using correspondence tables.

#### 2.1.2 Seasonal adjustment

The purpose of seasonal adjustment is to filter out any seasonal fluctuations or calendar effects within the time series, which can mask short and long-term movements and impede a clear understanding of underlying phenomena. In this way, the seasonally adjusted results

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<sup>5</sup>[http://unstats.un.org/unsd/publication/seriesM/seriesm\\_4rev4e.pdf](http://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4e.pdf).

do not show "regular" and repeating events, but rather help to reveal the "news" contained in the time series (IRIIP, p. 102).

It is highly recommended to perform seasonal adjustment at the country level. Seasonal adjustment is only carried out by UNIDO Statistics in case original data with a clear presence of seasonality are available from national sources. UNIDO Statistics may occasionally conduct seasonal adjustments in other special cases, e.g. now-casting. Further information on the process of seasonal adjustment within UNIDO Statistics can be found in a methodological document.<sup>6</sup>

In general, a time series consists of different components, from which seasonally adjusted time series should only contain irregular and trend components.

- Seasonal and calendar effects: cyclical fluctuations related to the calendar (including moving holidays, working day effects, periodic fluctuations, such as Christmas);
- Cycles: cyclical fluctuations longer than a year (such as business cycles);
- Trend: long-term movements at the level of the series; and,
- Irregular: other random or unpredictable short-term fluctuations (such as strikes or unusual weather situations).

Since 2017, seasonal adjustment is achieved using the TRAMO/SEATS method<sup>7</sup> in the JDemetra+ software with a partial concurrent revision policy when a new observation becomes available. A full review of all seasonal adjustment parameters is carried out once a year, usually at the beginning of the production year. Besides the automatic procedures implemented in JDemetra+, model modification by the user is often necessary where in-time modeling of unpredictable and unstable events is done with a focus on a stable time series. Large economic uncertainties or other unusual events (e.g. the economic crisis of 2020 caused by COVID-19) need to be analyzed carefully and included in the models of the seasonally adjusted time series as outliers.

One common misconception of seasonal adjustment is that it hides outliers. Outliers are extreme observations that deviate from the trend. These abnormal values may occur for

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<sup>6</sup><https://stat.unido.org/content/publications/seasonal-adjustment-of-iip>

<sup>7</sup>TRAMO stands for Time series Regression with ARIMA noise, Missing values and Outliers, and SEATS for Signal Extraction in ARIMA Time Series. ARIMA is the abbreviation of Autoregressive Integrated Moving Average, a widely applied statistical method for time series analysis.

instance as a result of new policies or new types of taxes, extreme natural events or a closure of a significant manufacturer.

The most common outlier types are:

- Additive outlier (AO): This outlier type affects a single observation caused by a random or short-term effect, such as a strike. After this disruption, the series returns to its normal path as if nothing happened.
- Temporary (transitory) change (TC): This outlier is a spike that takes several periods to disappear exponentially. TC may occur due to deviations from average monthly weather conditions.
- Level shift (LS): It refers to a more permanent change, which may also occur because of changes in economic behavior or in legislation. Level shifts change the level of the time series, but do not modify seasonal behavior.

Regarding the selection of a direct or an indirect approach to seasonally adjust aggregated series, neither theoretical nor empirical evidence uniformly favors one approach over the other. UNIDO Statistics has adopted the indirect approach for country group aggregates to preserve the additive relationship between data. Aggregates published by NSOs, with a presence of seasonality, are mostly seasonally adjusted using the direct approach. For other aggregates on the country level created by UNIDO Statistics, a case-by-case study is used to determine the proper approach.

In seasonal adjustment methods, benchmarking entails a procedure in which the annual sums of seasonally adjusted data are rendered equal to the annual sums of the non-seasonally adjusted data. Even though this ensures consistency between seasonally adjusted and raw data over the year, UNIDO Statistics does not implement this procedure, as it may degrade the quality of the seasonal adjustment and thus produce non-optimal results. Hence, careful consideration is needed when using annual IIP derived from quarterly IIP with filtered seasonality.

Data revisions need to be carried out as soon as new data or information are accessible. In UNIDO Statistics, the new specification is defined when all sub-annual IIP data become available. The ARIMA models for seasonal adjustment are revised based on a partial concurrent revision for each reporting period when new data are included. Besides all the advantages of seasonally adjusted data for a better understanding of "news" in the time series, users should carefully consider the implications of seasonal adjustment for their analysis (e.g. for econometric modelling).



### 2.1.3 Missing data

UNIDO Statistics performs imputations or projections for missing data whenever appropriate. Imputation is conducted for the latest period based on index numbers of earlier periods obtained from national data sources. These projections are based on the ARIMA model of an available time series. Such imputations and projections have helped to maintain the national index series as the primary source for the estimation process.

The estimates are replaced as soon as the officially reported values become available in national statistical publications. Every quarterly report presents estimates for the current as well as revised estimates for the previous quarter.

### 2.1.4 Base year

The index reference period is the period against which other periods are compared and for which the index is set equal to 100. The weight reference period is the period whose values serve as weights for the index. When the weight reference period and the index reference period are the same (so-called base period), then the index is the Laspeyres index, which is the recommended type of volume index for the compilation of IIP according to IRIIP guidelines. Currently, the chosen base period is the year 2015.

In practice, there is inconsistency between the countries in the frequency of updating new weights and incorporating the fixed-weight approach vs. the chain-linked approach to compile the IIP time series. Due to the lack of methodological information and lower stage indices at the country level, UNIDO Statistics cannot control this aspect of the obtained time series in depth.

Consistent time series at least since 2015, but preferably since 2005, should be available because of the following reasons:

- to ensure that 2015 = 100;
- to carry out a detailed time series analysis and high-quality seasonal adjustment;
- to obtain meaningful comparisons among countries; and,
- to compile adequate and sufficiently long time series to generate country aggregates.



### 2.1.5 Requested features of national data

To summarize the compilation of internationally comparable IIP data, it is highly desirable for national data to exhibit the following features:

- Classification: ISIC Rev.4;
- Scope:
  - Mining and Quarrying (B);
  - Manufacturing (C);
  - Electricity, gas, steam and air conditioning supply (D);
  - Water Supply; sewerage, waste management and remediation activities (E).
- Level for Manufacturing (C): 2-digit;
- Base year: 2015;
- Time lag: no more than two quarters;
- Original as well as seasonally and calendar adjusted data;
- IIP time series consistent over time, preferably since 2005.

## 2.2 Aggregation

Country data are aggregated by stage of industrial development and geographical region. The averages for country groups as well as the world are calculated using the relative contribution (weight) of the given countries to their group's or the world's total manufacturing value added. These indices are computed according to the Laspeyres fixed-base method. The base weights refer to the value added figures for 2015. The country weight is further disaggregated to the industry weights at the 2-digit level of ISIC Rev.4. The distribution of weights is consistent across both countries as well as manufacturing industries. Overall manufacturing output growth can be computed by aggregating either all country indices or all industry indices. However, these two results may differ slightly due to the non-additivity caused by direct seasonal adjustment of national aggregates.

Let  $w_0$  and  $I_q$  denote the base weights and indices of industrial production for quarter  $q$ , which are available by manufacturing industry  $i$  and by country  $j$ . Subsequently, the overall index for country group  $J$  and industry  $i$  in quarter  $q$  is calculated as:

$$I_{q,i,J} = \sum_{j \in J} w_{0,i,j} I_{q,i,j}$$

where:

$I_{q,i,J}$  - overall aggregated index for the  $i$ -th industry and the  $J$ -th country group in the  $q$ -th quarter,

$w_{0,i,j}$  - base weight for the  $i$ -th industry of country  $j$ ,

$I_{q,i,j}$  - production index for the  $i$ -th industry of country  $j$  in the  $q$ -th quarter.

The compilation process involves aggregating the division level indices to the national level and further aggregating to the country group level as well as the world aggregate. The weights of the base year are updated annually, with the latest available weighting data drawn primarily from the UNIDO databases INDSTAT 4 (currently INDSTAT 4 2020, ISIC Revision 4) and MVA 2020, both available from the UNIDO Statistics Data Portal.<sup>8</sup> The main reason for this procedure is to include all data revisions for the chosen base year published by the countries to refer to the latest available data.

### 2.3 Country groups

UNIDO Statistics is using country groups in terms of economic territories rather than political boundaries, which are classified according to their stage of industrialization. This grouping is implemented in all UNIDO's statistical publications, including the quarterly and monthly reports.

Both reports present growth figures of the country groups by stage of industrial development and by geographic region. The report is compiled from a sample number of countries which are stratified into Industrialized Economies (IE), Developing and Emerging Industrial Economies (excl. China) (DEIEC) and China. As regards geographic regions, developing and emerging industrial economies are disaggregated into Africa, Asia & Pacific and Latin America, whereas industrialized countries include North America, Europe and East Asia as separate regions.

The full list of economies used in the country grouping is available in the latest edition of the International Yearbook of Industrial Statistics.<sup>9</sup> A disaggregation of the sample into these groups ensures better representativeness of data. The grouping is particularly useful for presenting aggregated growth estimates by country group at different levels of industrialization.

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<sup>8</sup><https://stat.unido.org/>

<sup>9</sup><https://www.unido.org/resources-publications-flagship-publications/international-yearbook-industrial-statistics>

### 3 Results

The resulting figures for the quarterly report are compiled from around 90 countries accounting for more than 95 per cent of world MVA. These results are presented in the quarterly report and published in UNIDO's Quarterly IIP database.<sup>10</sup> Additionally, monthly data of around 60 countries (with an MVA share of 90 per cent) on world manufacturing production with monthly updates are published in UNIDO's Monthly IIP database.<sup>11</sup>

The reports contain two sets of growth indicators for world manufacturing output:

- the reference period compared to the previous period; and
- the reference period compared to the same period of the previous year.

These growth figures refer to the change in MVA or more precisely, to the change in production (as measured by IIP). For the quarterly report, the growth figures are transcribed to the growth percentage of a quarter-on-quarter comparison:

$$G_q^{QoQ} = \left( \frac{I_q}{I_{q-1}} - 1 \right) \times 100$$

or a year-on-year comparison:

$$G_q^{YoY} = \left( \frac{I_q}{I_{q-4}} - 1 \right) \times 100.$$

For the monthly report, the growth figures are transcribed to the growth percentage of a month-on-month comparison:

$$G_m^{MoM} = \left( \frac{I_m}{I_{m-1}} - 1 \right) \times 100$$

or a year-on-year comparison:

$$G_m^{YoY} = \left( \frac{I_m}{I_{m-12}} - 1 \right) \times 100.$$

<sup>10</sup><https://stat.unido.org/database/Quarterly%20IIP>

<sup>11</sup><https://stat.unido.org/database/Monthly%20IIP>



While the first set of growth indices represents more recent growth trends and allow to study short-term developments, the second set provides more stable estimates when analyzing a country's manufacturing performance, as year-on-year comparisons help mitigate many undetected seasonal or calendar variations.

The reports use year-on-year comparisons instead of period-on-period comparisons, as national data are not always seasonally adjusted. Due to country specific national holidays or other particularities, certain hidden seasonal or calendar patterns might remain in the adjusted series when carrying out seasonal adjustment at the international level.

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## 4 Limitations

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Growth estimates published in quarterly reports are based on sound methodology, best practices and thoroughly checked data. Nevertheless, aggregated index figures have some limitations, which are described here to clarify the technical process of treatment of national indices. Users should consider these limitations when conducting economic analysis and interpreting results.

The main purpose of the reports is presenting the short-term growth trends of manufacturing production. The reports therefore present growth figures rather than the index of industrial production in levels. Index numbers are presented in UNIDO's quarterly as well as monthly IIP databases. Note that not all countries publish harmonized and long time series. The national data source may revise the index series in case new data are collected. The reports and databases are based on the latest data releases. As soon as new releases from national sources are available, UNIDO Statistics revises the figures in its databases, which may result in some alterations of the figures published in different reports.

Index figures for a significant number of countries in the sample are not seasonally adjusted, which has implications for comparability over time as well as for the imputation of missing values. Even though UNIDO Statistics carries out seasonal adjustment whenever necessary or appropriate, it is recommended that countries themselves perform seasonal adjustments for their data.

The national IIP data was converted from various classifications of industrial activities to the 2-digit level of ISIC Rev.4. Even though these classifications are mostly compatible with ISIC Rev.4, there is no one-to-one match for all industries. Occasionally, national sources publish data at a more aggregated level, which requires a disaggregation of the index numbers to the 2-digit level of ISIC. Since there is no effective way to properly disaggregate these data, UNIDO Statistics uses the aggregated time series either for all industries included therein or only selects one or some of them according to their MVA contribution to total manufacturing.

Despite these limitations, the figures presented in the quarterly report are highly reliable and adequately reflect the growth trends in global manufacturing.