World Manufacturing Production

Methodology of the Quarterly Report
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1 Introduction

1.1 Objectives

For many years, UNIDO statistical publications were released only annually. While fundamental economics research takes recourse to detailed business structure statistics, other international data users, especially policymakers and business associations, depend on more recent assessments of overall production growth trends. To meet users’ demands in current industrial statistics and to share UNIDO’s assessments of growth trends in production as a 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 have been regularly disseminated worldwide and published as Quarterly Reports on World Manufacturing Production since 2011.

The main objective of this report is to provide an overview of the current growth trends in world manufacturing production by country group and by major sector. It presents the observed growth rates and growth estimates for the current quarter. The figures presented in the report 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 report is monthly or quarterly index numbers of industrial production (IIP) compiled and disseminated by National Statistical Offices (NSOs) through publications or websites. For the majority of European countries, IIP data are obtained from the Eurostat database, which contains data reported directly by NSOs.

UNIDO derives index data from official publications, i.e. the NSOs do not bear any respondent’s burden to report data. This approach does not, however, entail direct interaction with NSOs on the methods used in a particular country in the process of compiling IIP. Country practices may deviate from internationally recommended methods. Such deviation affects

data comparability across countries. UNIDO thus urges NSOs to comply with the international recommendations for the Index of Industrial Production 2010\(^2\) (IRIIP) endorsed by the UN Statistical Commission.

National data and results are often compared with international data sources such as from the OECD and UNSD to confirm the consistency of estimates. These international sources are also occasionally used as an additional source when data in national publications are missing or questionable. Finally, UNIDO uses national data to aggregate and derive estimates at the regional and global level.

### 1.3 Index of Industrial Production

The lowest index level UNIDO draws from NSO publications is the relative growth of value added of the reporting country’s manufacturing sector. However, it is quite difficult to obtain input data from quarterly surveys, which are required to estimate value added. NSOs therefore often use output data to measure the approximate development of value added within a short period of time.

IIP measures the growth of the volume of industrial production in real terms, free from price fluctuations. Users are advised to take note that while annual industrial growth rates generally refer to changes in manufacturing value added (MVA), i.e. output net of intermediate consumption, the quarterly 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 the purpose of constructing the IIP. According to IRIIP, the preferred proxy measure of output volume is generally a deflated output value, using the Producer Price Index as the recommended deflator. Another fairly accurate and commonly used proxy measure is quantity of output. Value of sale is readily available and is therefore 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 labour input or materials consumed, though this approach is less accurate. Indices are usually computed using either a deflating or volume extrapolation method. IRIIP offers guidance on selecting suitable variables and methods to calculate IIP for particular sectors of production.

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2 Methods

Data compilation and presentation methods have regularly been updated since the first quarterly report was released, resulting in the methodology depicted in this document, which has been applied since the first quarter of 2017.

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 IRIIP for a sub-annual IIP indicator. In some cases, UNIDO takes certain measures to normalize the data when these standards are not followed, while preserving the underlying message of nationally published production index figures.

2.1.1 Classification

Since 2016, the quarterly reports have implemented Revision 4 of the International Standard for Industrial Classification of All Economic Activities (ISIC Rev 4) in the quarterly data. For countries that publish monthly or quarterly index numbers based on ISIC Rev 4, national data from the section Manufacturing (C) at division level (2-digit) 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 Rev 4 using the corresponding 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 shifts, which can mask short and long-term movements in a

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time series and impede a clear understanding of underlying phenomena. The earliest reports included index figures for some countries that were not seasonally adjusted or for which no information on seasonal adjustments was available. Since 2013, growth figures based almost exclusively on seasonally adjusted index numbers have been published.

It is highly recommended to perform seasonal adjustment at the country level. Seasonal adjustment is therefore carried out by UNIDO only in case original data with a clear presence of seasonality are available from national sources. UNIDO may occasionally conduct seasonal adjustments in other special cases as well.

Since 2017, seasonal adjustment is achieved using the TRAMO/SEATS method\(^4\) 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.

As regards the direct vs. the indirect approach to seasonally adjusted values of the aggregated series, neither theoretical nor empirical evidence uniformly favours one approach over the other. UNIDO has adopted the indirect approach for country group aggregates to preserve the additive relationship between data. All aggregates created at the national level with a presence of seasonality are seasonally adjusted at the international level using the direct approach. For aggregates at the country level created by UNIDO, 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 the 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 does not implement this procedure, as it may degrade the quality of the seasonal adjustment and thus produce non-optimal results. Hence, careful consideration should be taken when using annual IIP that us derived from quarterly IIP with filtered seasonality.

\(^4\) 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 analyses.
2.1.3 Missing data

UNIDO performs imputations or projections for missing data whenever appropriate. Imputation is conducted for the latest period based on the index numbers for earlier periods obtained from national data sources and estimated percentage changes for periods of interest computed from international data sources. A typical example of applying the international data source for estimation is given by:

\[ I_{q,i,j} = I_{q-1,i,j}^{NSO} \times \frac{I_{q,i,j}^{IS}}{I_{q-1,i,j}^{IS}} \]

where:
- \( I_{q,i,j} \) - estimated production index of country \( j \) for the \( i \)-th industry and quarter \( q \),
- \( I_{q-1,i,j}^{NSO} \) - production index of country \( j \) for the \( i \)-th industry in the preceding quarter \( q - 1 \) as reported by the NSO,
- \( I_{q,i,j}^{IS} \) and \( I_{q-1,i,j}^{IS} \) - production indices of country \( j \) for the \( i \)-th industry in quarter \( q \) and the preceding quarter reported by international data sources.

When neither national nor international sources contain information on production for a certain period or if the release of IIP data is delayed, projections based on the ARIMA model of an available time series is used. Such imputations and projections have helped maintain the national index series as the primary source for the estimation process.

These estimates are generally replaced as soon as the officially reported values become available in national statistical publications. Every report thus 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. In our case, the chosen base period is the year 2010.
In practice, there is inconsistency between 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 cannot control this aspect of the obtained time series in depth.

To ensure “2010=100”, but also 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; consistent time series at least since 2010, but preferably since 2005, should be available.

### 2.1.5 Requested features of national data

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

- Classification: ISIC Rev 4;
- Level: 2-digit;
- Scope: Manufacturing (C);
- Base year: 2010;
- Time lag: no more than two quarters;
- Seasonal and working days adjusted data;
- IIP time series consistent over time, preferably since 2005.

### 2.2 Aggregation

Country data are aggregated by development group and world average based on the relative contribution of the given country (weight) to its respective group’s (or to the world’s) total manufacturing value added. Indices are computed using the Laspeyers fixed-base method. The base weights refer to the value added figures for 2010. The country weight is further disaggregated to the industry weight at the 2-digit level of ISIC Rev 4. The distribution of weights is consistent both across countries as well as manufacturing industries. Thus, overall manufacturing output growth can either be computed by aggregating all country indices or
all industry indices; however, these two results may differ slightly due to the non-additivity caused by direct seasonal adjustment.

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 or country group level and aggregating the national level indices to the country group level. The weights are updated annually, with the latest available weighting data drawn primarily from the UNIDO database INDSTAT 4 and MVA, currently INDSTAT 4 2017, ISIC Revision 4 and MVA 2017, both available from the UNIDO Statistics Data Portal.

2.3 Country groups

In 2013, UNIDO Statistics introduced new country groups, with economic territories being classified based on their stage of industrialization. Country groups are based on economic territories rather than on political boundaries. This grouping is implemented in all of UNIDO’s statistical publications, including the quarterly report.

The quarterly report presents 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 (IC) and Developing and Emerging Industrial Economies (DEIE). As the developing countries are highly heterogeneous in terms of level of industrial development, the sample was selected from three development

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5 https://stat.unido.org/#
groups within the category DEIE, namely Emerging Industrial Economies (EIE), Other Developing Countries (ODC) and Least Developed Countries (LDC). However, the report does not present separate estimates for LDCs due to limited data availability. As regards geographic region, developing countries are disaggregated into Africa, Asia & Pacific and Latin America. No specific stratification has been planned for the group of industrialized countries (the sample includes North America, Europe and East Asia).

The full list of economies used in the country grouping is available in the International Yearbook of Industrial Statistics\(^6\). 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.

3 Results

The resulting figures for the quarterly report are compiled from around 70 countries that account for more than 90 per cent of world MVA. These results are presented in the quarterly report and published in UNIDO’s Quarterly IIP database.\(^7\)

The quarterly report contains two sets of growth indicators for world manufacturing output:

- the reference quarter compared to the previous quarter;
- the reference quarter compared to the same quarter of the previous year.

These growth figures refer to the change in MVA or more precisely, to change in production (as supposed to be measured by IIP). The results are presented with some interpretations. For this purpose, the growth figures are transcribed to the growth percentage of a quarter-by-quarter comparison:

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

or a year-by-year comparison:

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

While the first set of growth indices represents more recent growth trends, the second set provides more precise estimates when analysing a country’s manufacturing performance, as year-by-year comparisons help mitigate undetected seasonal or calendar variation, which are simply eliminated.

The quarterly report uses year-by-year comparisons over quarter-by-quarter comparisons, as national data are not always seasonally adjusted and there is thus a chance that certain hidden seasonal or calendar patterns caused by a country’s specific national holidays or other particularities might remain in the adjusted series when carrying out seasonal adjustment at the international level.

\(^7\) [http://stat.unido.org/](http://stat.unido.org/)
4 Limitations

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 take these limitations into account when conducting economic analyses and interpreting results.

The main purpose of the quarterly reports is to present the short-term growth trends of manufacturing production. The report therefore presents growth figures rather than the index of industrial production itself. Index numbers are presented in UNIDO’s Quarterly IIP database. Note that not all countries publish harmonized, long-time series indices of industrial production.

The national data source may revise the index series in case new data are collected. The quarterly report and database is based on the latest data releases. As soon as new releases from national sources are available, UNIDO revises the figures in its database, 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 some implications for comparability over time as well as for the imputation of missing values. Even though UNIDO carries out seasonal adjustment whenever necessary or appropriate, it is recommended to perform seasonal adjustments at the national level.

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 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.