INSTITUTO NACIONAL DE ESTADISTICA

Industrial Production Indices

Base 2021

Methodological Manual

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Subdirectorate General for Short-term Statistics

Index

1 Introduction

The Industrial Production Index (IPI) is a volume index whose objective is to measure the short-term evolution of added value in the industrial branches. The indicator has a monthly frequency.

This indicator is set out in REGULATION (EU) 2019/2152 OF the EUROPEAN PARLIAMENT and OF THE COUNCIL of 27 November 2019 on European business statistics, and developed in COMMISSION IMPLEMENTING REGULATION (EU) 2020/1197 of 30 July 2020 laying down technical specifications and modalities pursuant to Regulation (EU) 2019/2152 of the European Parliament and of the Council. The objective of these Regulations is to create a common and unified framework for the production and publication of statistical information on the economic activities of companies of the Member States with an integrated approach to the development, production and publication of business statistics.

In order to achieve the objective set out by the Regulations for obtaining this indicator, a basket of products or representative goods is selected from throughout industry, and a panel of industrial establishments that manufacture these goods and which will be those that provide the data regarding the monthly production carried out. With this data, it is possible to obtain the indicators for the different headings of CNAE-2009 (classes, groups, divisions and sections) and of the Large Industrial Sectors or Sectors by Economic Destination of the Goods, on both national and Autonomous Community levels.

2 Definitions

The objective of the Production Index is to measure the changes that occur in the volume, in terms of added value, in short and periodical periods. This index measures the evolution of the volume, over the course of a given reference period, in general monthly.

A Production Index measures the short-term evolution of the volume of the output produced by companies, in terms of added value. This is defined as the ratio between the output volume produced by companies in time period t, less the consumption required for this, and the output volume produced by the same industries in the base period, less the consumption required.

Given that it is a volume index, the amounts (both those produced and those consumed) must be assessed at the prices of the base period

$$ {}_0\boldsymbol{I}_{\boldsymbol{Q}}^{\boldsymbol{t}} = \frac{\sum_{i=1}^{N} \boldsymbol{p}_{i,0} \times \boldsymbol{q}_{i,t} - \sum_{j=1}^{M_t} \boldsymbol{a}_{j,0} \times \boldsymbol{\delta}_{j,t}}{\sum_{i=1}^{N} \boldsymbol{p}_{i,0} \times \boldsymbol{q}_{i,0} - \sum_{j=1}^{M_0} \boldsymbol{a}_{j,0} \times \boldsymbol{\delta}_{j,0}} $$

Where:

$ {}_0\boldsymbol{I}_{\boldsymbol{Q}}^{\boldsymbol{t}} $	is the production index in period *t* with regard to base period *0*
$ \boldsymbol{q}_{i,t} $	is the amount produced of product *i* in period *t*
$ \boldsymbol{q}_{i,0} $	is the amount produced of product *i* in period *0*
$ \boldsymbol{p}_{i,0} $	is the price of product *i* in period *0*
$ \boldsymbol{\delta}_{j,t} $	is the amount of input j necessary to produce product i in period *t*
$ \boldsymbol{\delta}_{j,0} $	is the amount of input j necessary to product product i in period *0*
$ \boldsymbol{a}_{j,0} $	is the price of input j in period *0*

Multiplying and dividing by the volume produced in the base period:

$$ {}_0 I_Q^t = \frac{\sum_{i=1}^{N} p_{i,0} \times q_{i,t} - \sum_{j=1}^{M_t} a_{j,0} \times \delta_{j,t}}{\sum_{i=1}^{N} p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} * \frac{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}}{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} $$

$$ {}_0 I_Q^t = \sum_{i=1}^{N} \frac{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}}{\sum_{i=1}^{N} p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} * \frac{p_{i,0} \times q_{i,t} - \sum_{j=1}^{M_t} a_{j,0} \times \delta_{j,t}}{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} $$

Reordering terms, the first factor of the multiplication can be expressed in terms of Gross Value Added (VAB) in the base period, since everything is valued at prices of this period.

$$ {}_0I_Q^t = \sum_{i=1}^{N} \frac{VAB_{i,0}}{\sum_{i=1}^{N} VAB_{i,0}} * \frac{p_{i,0} \times q_{i,t} - \sum_{j=1}^{M_t} a_{j,0} \times \delta_{j,t}}{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} $$

In this way, the index weightings are expressed in terms of the GAV for each sector in the base year.

$$ {}_0I_Q^t = \sum_{i=1}^{N} W_{i,0} * \frac{p_{i,0} \times q_{i,t} - \sum_{j=1}^{M_t} a_{j,0} \times \delta_{j,t}}{p_{i,0} \times q_{i,0} - \sum_{j=1}^{M_0} a_{j,0} \times \delta_{j,0}} $$

In practice, it is not possible to obtain the amounts of intermediate consumption each month and value them at the prices of the base period, so the production index defined in the previous paragraphs is a theoretical measurement that must be approached using practical measurements[1].

In practice, the following values are suitable as replacements for the construction of the indices:

1. The gross production values (deflated).
2. The volumes
3. The turnover (deflated)
4. The labour input
5. The raw material input
6. The energy input

[1] International Recommendations for the Index of Industrial Production 2010
http://unstats.un.org/unsd/statcom/doc10/BG-IndustrialStats.pdf

3 Scope of the survey

3.1 Population scope

The population scope of the Industrial Production Index to which the general index refers is the set of industrial activities, which includes the extractive and manufacturing industries and the supply of electrical energy, gas, steam and air conditioning, sections B, C and D, respectively, of the National Classification of Economic Activities (NACE-2009). In addition, as of base 2010, division 36 of NACE-2009 was also included: Collection, purification and distribution of water.

3.2 Time scope

The reference period is the month

3.3 Geographical scope

The indices provide data on a national level and by Autonomous Community, excluding Ceuta and Melilla.

4 Framework, information unit and sample

4.1 Survey framework

The Framework of the Survey is the Central Business Directory (Central Directory of Companies and Establishments). This is an organised register of information with data on the identification, location, territorial distribution and classification, by size and economic activity of the units: company and establishment. This directory is compiled using administrative sources, and it is updated with other information from the current statistical operations of the INE.

However, the DIRCE is used indirectly as an IPI population framework in the case of sections B, C and D, since, in practice, the selection of IPI reporting units for these sections is made from the establishments of the Annual Industrial Product Survey (EIAP - PRODCOM) (which does have the DIRCE as a direct population framework).

The Annual Industrial Product Survey (EIAP - PRODCOM) is an annual structural survey aimed at all establishments dedicated to Sections B (Extractive Industries), C (Manufacturing Industry) and D (Production of electricity, gas, steam and hot water) of the CNAE 2009.

Until the reference year 2020, the population subject to the survey consisted of all industrial establishments belonging to companies with twenty or more people employed, regardless of whether the main activity of the company to which it belonged was industrial or not. The aim is to cover a significant percentage of production in the different industrial sectors investigated by the survey.

In certain sectors in which the production of the establishments of companies with twenty or more people employed was not representative of the total, the establishments of companies with less than 20 people employed were also included. The ultimate goal was to achieve coverage that included establishments representing approximately 90% of the corresponding activity.

As of the 2021 reference year, the population subject to the survey consists of all industrial establishments belonging to legal units, regardless of whether the main activity of the legal unit to which they belong is industrial or not and without setting size limits. In this way, the production coverage has become 100%.

Until the reference year 2020, the sample design of the Annual Industrial Product Survey was based on a cut-off sampling, which covered approximately 90% of the production of each class of activity.

From the 2021 reference year, on the occasion of the entry into force of the new European Business Statistics (EBS) regulation, in which the requirement has become to estimate the production corresponding to each class with sufficient quality, without mentioning that 90% coverage, a change has been made in the sampling design, from sampling by cut-off point to a probabilistic sampling with 100% coverage of the production.

The sample is aimed at more than 38,000 establishments that are asked for information, in physical quantities and in value, on the production of a series of industrial products (around 5,000) that cover a very important part of the Spanish industrial sector.

4.2 Informant unit and information unit

Regulation (EU) 2019/2152 OF THE EUROPEAN PARLIAMENT and OF THE COUNCIL of November 27 2019, developed in COMMISSION IMPLEMENTING REGULATION (EU) 2020/1197 of July 30 2020 establishing the technical specifications, definitions and concepts, which regulate the production of this indicator contemplates as a statistical unit the unit of economic activity, understanding as such that which carries out a single activity, at the four-digit level of the CNAE-2009.

Facing the lack of administrative registers to break down this type of unit, we have selected the establishment (unit that carries out one or more activities in a single physical location) as the information unit.

The informant unit to which the questionnaires are sent may be the establishment itself or the company, so long as the company provides the information broken down for each establishment.

4.3 Sample

The sample of establishments that supply information comprises a panel of establishments that, according to the Annual Industrial Products Survey, produce a significant percentage of each good selected in the basket, as the most representative of each class in CNAE-2009.

The sample includes approximately 11,500 establishments.

5 Recogida de la información

The information collection is carried out through the Provincial Delegations and the Central Services of the INE. The collection system is through the completion of a monthly questionnaire by the establishment informant.

Informant may use different means of returning the completed questionnaires (Internet, through the IRIA system, electronic questionnaire via email, post or fax).

The following table presents the work performed in each phase prior to the publication of the results, and the periods during which these are carried out. assuming a generic month t.

Task to carry out	Date
Mailing of questionnaires to the informant units	Last week of the end of month t
Arrival of questionnaires at the delegation	As of day 5 of month t+1
Recording and microfiltering	As of day 6 of month t+1
Process for calculating and debugging indices in SSCC	From the 15th day of the month t+1 and until the publication of the indices
Publication of results	According to the short-term statistics availability calendar of the INE, approximately 37 days after the reference month t

6 Base year

Regulation (EU) 2019/2152 OF THE EUROPEAN PARLIAMENT and OF THE COUNCIL of 27 November 2019, developed in COMMISSION IMPLEMENTING REGULATION (EU) 2020/1197 of 30 July 2020 establishing the technical specifications, definitions and concepts that the indices change base every five years, the base years being those ending in zero or five.

Due to the exceptional nature of the year 2020 due to the COVID pandemic, the EU statistical office, Eurostat, has established that the change of base that should have been established in 2020 should be carried over to 2021.

All indices must be adapted to the new base year within three years from the end of said new base year.

For these indices the base year is 2021.

7 Formulation of the indices

The Industrial Production Index, base 2021, is a fixed-base Laspeyres index. This type of index has the advantages of enabling the comparability of the same structure over the course of the time that the system is in force, and the additivity of the indices in the aggregated levels; however, it has the disadvantage (in the case of price and volume indices) that the weighting structure loses force as time goes by.

Moreover, in the case of the IPI, the index basket of products and the sample of informant establishments can lose representativeness as well. It is for this reason that base changes are important, not only to update the weightings, but also to revise the basket of products and the establishment panel (though the delistings occurring to to establishments closing are replaced).

7.1 Basic indices

A basic aggregate is the lowest grouping component for which indices are obtained, and whose calculation entails no weightings. The indices for these aggregates are known as basic indices or simple indices.

In the case of IPI, the elementary aggregates are the products selected for the indicator basket as they are considered the most appropriate and representative to approximate the evolution of the activity of each of the classes (four digits) of sections B, C, D and division 36 of the CNAE 2009.

For each of the branches of industrial activity, determined at the class level of the CNAE 2009, the value of the production of each of the products that according to PRODCOM are included in that class is obtained from the Annual Industrial Product Survey (EIAP) corresponding to the base year of the IPI. Once these products have been sorted by their production value, the most important ones are selected, until they cover a significant percentage of the value of the total production in that class. It is important that this analysis is carried out at each base change to ensure the representativeness of the products that will make up the IPI basket during the term of that base.

In the new 2021 base, new products have been added such as hand sanitizing gels, diagnostic or laboratory composite reagents or masks with FFP filters according to EN149, and other masks

7.1.1 INFORMATION COLLECTION FOR THE BASIC AGGREGATES

In the definition section, we mentioned that the production index is a theoretical index that must be arrived at through practical approaches. According to international recommendations, in practice, the following values are suitable as replacements for the construction of the indices: the gross production values (deflated), volumes, turnover (deflated), labour input, input of raw materials and energy input.

In the case of the IPI, three of these methods are used:

a) The volumes

This method is used for those products that belong to activities with production that is homogeneous in physical amounts, where the informant are asked the amounts of the product selected during that month, expressed in Kilogrammes, Tonnes, Metres, Litres,

Hectolitres, units, pairs, etc., as pertinent. This method is used the most; the activities for which it is used represent 77% of GAV.

b) The gross production values (deflated).

This is used for those products of activities with heterogeneous or changing production. In this case, the establishment is asked the production value of that product in the reference month, and subsequently, this is deflated, using the price index that best adjusts to that product. The price indices for deflating are obtained from the Industrial Price Indices (IPRI) and the Export Price Indices for Industrial Products (IPRIX). This is used for branches of activity that represent 21% of GAV.

c) The labour input

This method is used for those activities with products with a long manufacturing process, unique processes, etc. (naval, railway and aeronautical industry). It is used in few branches that represent 2% of GAV.

7.1.2 FORMULATION OF THE SIMPLE OR BASIC INDICES

The expression of the calculation formula of the basic indices of the products comprising the basket is as follows::

$$ {}_0I_i^t = {}_0I_i^{t-1} \frac{\sum_{\{h \in A_t\}}^{N} q_{i,h}^t}{\sum_{\{h \in A_t\}}^{N} q_{i,h}^{t-1}} $$

Where:

$ {}_0\boldsymbol{I}_i^t $	is basic index i, in period t, with regard to base period 0, in Autonomous Community or national (A)
$ {}_0\boldsymbol{I}_i^{t-1} $	is basic index i, in period t-1, with regard to base period 0, in Autonomous Community or national (A)
$ \boldsymbol{q}_{i,h}^t $	is the production data (volume, production value or hours worked) for product i, in month t, provided by informant h, located in Autonomous Community or national (A).
$ \boldsymbol{q}_{i,h}^{t-1} $	is the production data (volume, production value or hours worked) for product i, in month t-1, provided by informant h, located in Autonomous Community or national (A).
$ h \in A_t $	Each establishment that provides information in month t and t-1, located in Autonomous Community or national (A).

It might occur that in some month, for holiday reasons, due to being seasonal or other products, the index in a given period reaches a value of zero, or the denominator of the previous expression is 0. In these cases, in order to calculate the indices for subsequent months and avoid an indeterminate situation in the formula, the following general expression is used:

Then:

$$Si\ I_i^{t-1}=0\ \ o\ \ \sum_{\{h\in A_t\}} q_{i,h}^{t-1}=0 \Rightarrow buscar\ k\in\{2,3,\ldots 12\}\ tal\ que$$

$$I_i^{t-k}>0\,,\ \ \{h\in A_t\cap A_{t-k}\}\neq\Phi\ y\ \sum_{\{h\in A_t\cap A_{t-k}\}} q_{i,h}^{t-k}>0$$

$$\boldsymbol{I_i^t = I_i^{t-k} * \frac{\sum_{\{h\in A_t\cap A_{t-k}\}} q_{i,h}^{t}}{\sum_{\{h\in A_t\cap A_{t-k}\}} q_{i,h}^{t-k}}}$$

7.2 Aggregated indices

The aggregated indices of the classes (to four digits of the CNAE) are obtained as the weighted sum of the basic indices of the products belonging to said class, weighted depending on the production value taken from that of the Annual Industrial Products Survey (AIPS). This survey does not have information on the added value generated during the production of each of the goods, but it does have the production value of each one.

$$_0I_t = \sum_{i\in clase} \frac{VP_{i,0}}{\sum_{j\in clase} VP_{j,0}} *\ _0I_i^t = \sum_{i\in clase} W_{i,0} *\ _0I_i^t$$

The indices of any functional aggregation at a more aggregated level, groups, divisions, sections of CNAE-2009, or economic sectors by economic destination of the goods (durable consumer goods, non-durable consumer goods, capital goods, intermediate goods and energy) are obtained as the aggregation of the indices for the lower aggregation level, and belonging to that which we wish to calculate, using, as weights or weightings, the added value generated in that activity or sector during the base year, in the corresponding territorial area (Autonomous Community or national territory), with regard to the added value generated by all of the activities or sectors included in that level.

Value-added weights are extracted from the Structural Business Statistics: Industrial Sector - Year 2021.

$$\boldsymbol{_0I_t = \sum_{i=1}^{N} \frac{VAB_{i,0}}{\sum_{i=1}^{N} VAB_{i,0}} *\ _0I_i^t = \sum_{i=1}^{N} W_{i,0} *\ _0I_i^t}$$

8 Indices adjusted for seasonal and calendar effects

The national Industrial Production Indices are published corrected for seasonal and calendar effects.

These indices are published from the 2005 base corrected for calendar effects and from the 2010 base they are also published corrected for seasonal effects. In the 2021 base, these indexes continue to be calculated both corrected for calendar effects and corrected for seasonal and calendar effects.

The seasonal adjustment of these indicators is carried out according to the INE Standard for the correction of seasonal effects and calendar effects of the cyclical[1] series that is available in INEbase. This standard follows the recommendations of the European Union contained in the ESS guidelines on seasonal adjustment.

The adjusted series of calendar effects and the adjusted series of seasonal and calendar effects are obtained with the JDemetra+ software [2], from the publication of data in base 2015. JDemetra+ has been officially recommended by Eurostat since February 2015, to make seasonal and calendar adjustment in the official statistics of the European Union[3].

The time series analysis methodology recommends a periodic review of the models in order to incorporate the most current information. This makes the corrected series of calendar effects and seasonal and calendar effects always provisional.

8.1 Indices adjusted for calendar effects

The European Regulation regarding short-term statistics, for the purpose of harmonising all of the indicators compiled by the different European Union countries and achieve the greatest possible comparability, requests that they provide the indices, eliminating the calendar effect.

The calendar effect is defined as the impact produced in the time series of a variable, due to the different structure that the months (or quarters) present in the different years (in both length and composition), even if the remaining factors influencing said variable remain constant.

The length and composition of the month is not completely absorbed by the seasonal component, since the number of days in February is not the same each year. This non-seasonal part of the component of the length of the month must be eliminated in the series adjusted for the calendar effect.

On the other hand, the composition of the month refers to the variations in industrial production caused by the different number of holidays, weekends and/or composition of the different days of the week for the same month in successive years.

The method used for the correction of calendar effects is based, following the INE standard and according to Eurostat recommendations, on regARIMA models (regression models with stationary ARIMA errors). For each activity, focused intervention variables have been constructed that collect the following three effects:

1

a) Effect of working days

The adjustment for the effect of working days has been carried out with the design of an intervention variable based on the characteristics of industry in Spain.

This variable is created taking into account the work calendars since 1991 and is built following the same structure that appears in the INE standard for the regressor of working days. For the purpose of including all holidays, both on a national level and by Autonomous Community, the latter are weighted by the weight that each Autonomous Community holds in the IPI of each activityd.

The possible significant differences between the different days of the week are also taken into account, if any, using regressors of days of the week. These days of the week regressors will be developed following a standard methodology such as that used by JDemetra+.

b) Effect of the Easter Holiday.

The intervention variables to cover the effect of the Easter Holiday represent the public holidays and working days, respectively, of the Easter Holiday.

This has considered that the different Autonomous Communities celebrate either Holy Thursday or Easter Monday, or both, weighting these days according to the weight that each Autonomous Community holds in the IPI of the activity.

c) Effect of the leap year.

Every four years, the month of February has 29 days and this can affect the economic series for two reasons: the composition of the month varies (in terms of working or non-working days with respect to the average) and the length of the month changes. The first effect is measured with the business day regressor (where day 29 should be considered as business or non-business as appropriate); while the second effect should be quantified with the leap year regressor.

This regressor must also be calculated in deviations from its mean and, therefore, its value will be 0.75 in the Februaries of the leap years, -0.25 every February of the non-leap years and 0 in the rest of the months

The intervention variable that covers the effect of the leap year distinguishes those months of February that have 29 from the remaining months of February.

8.2 Indices adjusted for seasonal and calendar effects

Once the calendar effects are adjusted, a further step is taken and the indices of seasonal effects are adjusted.

Seasonal fluctuations are movements that occur with a similar intensity each month, each quarter or each season of the year, and which are expected to continue occurring.

Seasonally adjusted series, that is, those that are adjusted for seasonal and calendar effects, provide an estimate of what is "new" in a series (change in the trend, the cycle and the irregular component).