INSTITUTO NACIONAL DE ESTADISTICA

Industrial Production Indices (IPI) Base 2010

Methodology

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.

It complies with European Union Council Regulation no. 1165/98, of 19 May 1998, regarding short-term statistics; as well as the remaining Regulations amending it. The purpose of these Regulations is to create a common framework for the production of community statistics regarding the short-term evolution of supply, demand, production factors and prices.

In order to achieve the objective set out by the Regulation 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 [1].

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

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

Where:

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

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

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

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

Reordering terms

[1] European Commission Regulations 588/2001 and 1503/2006 regarding definitions of Regulation 1165/98 on short-term statistics and Regulation 1158/2005 amending the former

It is possible to express the primer, multiplying in the base period in terms of Gross Added Value (GAV), given that it is all valued at prices for 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.

The production index is a theoretical measurement that must be approached using practical measurements [2]. 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

[2] International Recommendations for the 2010 Industrial Production Index
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 are the set of industrial activities, including the extractive and manufacturing industries and the supply of electrical energy, gas, steam and air conditioning; sections B, C and D from the National Classification of Economic Activities (CNAE-2009). Moreover, new base 2010 also includes division 36 from CNAE-2009: 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.

Nonetheless, the CBD is used indirectly as the population framework of the IPI in the case of sections C and D, given that, in practice, the selection of the informant units of the IPI for these sections is carried out with the establishments in the Annual Industrial Products Survey (which does take the CBD directly as the population framework).

The Annual Industrial Products Survey (AIPS) is an annual, structural survey targeting all establishments dedicated to Sections C (manufacturing industry) and D (Supply of electrical energy, gas, steam and air conditioning) of CNAE-2009. The sample targets more than 60,000 establishments that it requests information from, in physical amounts and by value, on the production of a series of industrial products (approximately 4,000) that cover a significant pat of the Spanish industrial sector.

4.2. INFORMANT UNIT AND INFORMATION UNIT

Council Regulation No. 1165/98, regulating the production of this indicator, considers the statistical unit to be the economic activity unit, understanding this to be that which carries out a single activity , to a four-digit level of 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. INFORMATION COLLECTION

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.

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
Receipt of questionnaires at Central Services	Near day 25 of month t+1
Filtering and calculation of indices	As of day 26 of month t+1
Publication of results	According to the short-term statistics availability calendar of the INE, approximately 37 days after the reference month

6. BASE YEAR

Council Regulation (EC) No. 1165/98, of 19 May 1998, regarding short-term statistics, modified, among others, by European Parliament and Council Regulation (EC) no. 1158/2005, of 6 July 2005, requires that the indices change base every five years, with the base years ending in zero and in five. All indices must be adapted to the new base year within three years from the end of said new base year.

7. FORMULATION OF THE INDICES

The Industrial Production Index, base 2010, 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 the IPI, the basic aggregates are the most suitable products to approach the evolution of the activity of each of the classes (to four digits) of sections B, C, D and division 36 of CNAE-2009.

For each of the branches of industrial activity, established at a level of CNAE-2009 class, we obtain the production value of each of the products that are included in that class according to the PRODCOM, from the Annual Industrial Products Survey corresponding to the base year of the IPI. Once these products are ordered by their production value, the most important are selected, until a significant percentage of the total production value in that class is covered. It is important that this analysis is carried out in each base change, in order to ensure the representativeness of the products that will comprise the IPI basket during the time that base is in force.

The new base 2010 has included new products, such as prefabricated wooden buildings, electrical and/or hybrid vehicles and some services related to industry, such as those referring to the furniture industry (varnishing, apholstering, lacquering, etc.).

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:

-)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.

- 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.

- 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:

${}_0\boldsymbol{I}_{\boldsymbol{i}}^{\boldsymbol{t}}$	is basic index i, in period t, with regard to base period 0, in Autonomous Community or national (A)
${}_0\boldsymbol{I}_{\boldsymbol{i}}^{\boldsymbol{t-1}}$	is basic index i, in period t-1, with regard to base period 0, in Autonomous Community or national (A)
$\boldsymbol{q}_{\boldsymbol{i,h}}^{\boldsymbol{t}}$	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).
$\boldsymbol{q}_{\boldsymbol{i,h}}^{\boldsymbol{t-1}}$	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:

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

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

Then:

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

7.1 AGGREGATED (GROUPED) 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.

The weightings based on the added value are taken from the Annual Industrial Companies Survey (AICS) corresponding to the base year, 2010.

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

8. INDICES ADJUSTED FOR SEASONAL AND CALENDAR EFFECTS

The national Industrial Production Indices are published adjusted for seasonal and calendar effects in base 2010.

These indices had already been published adjusted for calendar effects in base 2005, but it was in the new base 2010 where, for the first time, they were also published adjusted for seasonal effects.

The seasonal adjustment of these indicators has been carried out according to the INE Standard for the correction of seasonal effects and calendar effects of the short-terms series available in INEbase. This standard is the result of the INE Seasonal Adjustment Work Group, which was created by the Board of Management of the INE in May 2012, and follows the recommendations of the European Union provided for in ESS guidelines on seasonal adjustment.

8.1 INDICES ADJUSTED FOR CALENDAR EFFECTS

The European Regulation regarding short-term statistics, for the purpose of harmonising (standardising) 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 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 for the month refers to the variations in industrial production caused by the different number of holidays in the same month in subsequent years.

The method used to adjust for calendar effects is based on regARIMA models (regression models with stationary ARIMA errors), following the INE Standard and Eurostat recommendations. For each activity, four centred intervention variables have been prepared, covering the three following effects:

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, bearing in mind the working calendars as of the year 1992, and is created, following the same structure used in the TRAMO-SEATS programme for the creation of its Trading Day series. 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 activity.

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.
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).

The time series analysis methodology recommends a periodical revision of the models, in order to incorporate the most current information. This leads to the series adjusted for calendar and seasonal effects always being provisional.