INSTITUTO NACIONAL DE ESTADÍSTICA

Industrial Price Index. Base 2015

Methodology

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Index

1. Introduction

The Industrial Price Index (IPRI) is a statistic whose main objective is to measure the evolution of industrial prices. To this end, the design used is based on the structures of the different industrial activities and the products most commercialised in each of them, based on the turnover of the companies involved. These elements, along with others that make up the methodology of this indicator, need to be updated in more or less frequent periods of time in order to preserve the representativeness of the IPRI.

The operation of the base change of the IPRI consists, fundamentally, of reviewing and updating each of its components and determining the best options to achieve a representative and precise indicator that adapts to the trends of the industrial sector.

Furthermore, Council Regulation (EC) No 1165/98 concerning short-term statistics establishes a common framework for the production of community statistics for all the countries of the European Union and for a set of short-term indicators for industry, construction and services, in order to analyse the development of the economic cycle. One of the rules included in this regulation states that member states are obliged to change the base of their short-term indicators every five years.

Therefore, the IPRI base 2015, the main characteristics of which are detailed in this methodology, responds on the one hand to the need to adapt to the changes that have taken place in the industrial sector in recent years and, on the other, meets the requirements established by European regulations in this regard.

Until the entry into force of the base 2010, the IPRI based its calculation on what is called a fixed-base system, whose main characteristic is that both the composition of the market basket of products and its weightings are unaltered for the entire time that the base is used. Therefore, the only way to be able to collect the changes in the behaviour of producers and for the IPRI to adapt to these trends was to wait until the following base change. Obviously, in some cases this time frame was excessively long.

With the IPRI base 2010, a new way of conceiving this indicator was initiated, based on an annual review of the weightings for the main levels of functional aggregation, and the possibility of including any significant change that occurs in the industrial sector, whether it be the appearance of new products, changes in the productive activity or in the sample of establishments. In this way, the IPRI is better adapted to the economic reality and is much more dynamic than its predecessors.

As a result of this operating scheme, in January 2018, the Industrial Price Index came into force in base 2015, replacing the IPRI which, with base 2010, was in force until December 2017.

The IPRI base 2015, maintains the main characteristics of the IPRI base 2010, and, like the latter, will annually review the weightings for a certain level of functional disaggregation. To carry out this update, it will use the latest information available from the *Structural Business Statistics: industrial sector*.

In addition, the methodology of the new System was analysed by the High Council on Statistics and was the object of study by the Permanent Commission of said Council until it was approved in the Plenary of the High Council on Statistics.

The main characteristics of the Industrial Price Index, base 2015, are included in this methodology.

2. Definition of the indicator

The Industrial Price Index (IPRI), which is published monthly, aims to measure the evolution of the prices of industrial products, manufactured and sold on the domestic market, in the first stage of their commercialisation, that is, from the supply side (producer). The prices considered for the calculation are ex-factory sales prices, excluding transport and marketing costs and invoiced VAT.

The precision with which this short-term indicator measures the evolution of price level depends on two qualities that every index must have: **representativeness and comparability over time**.

The degree of representativeness of the IPRI is determined by the adaptation of this indicator to the current economic reality; thus, the variation rate calculated from the IPRI will more closely approximate the evolution of the set of prices of the industry, the more the elements selected for its measurement are adapted to the behaviour patterns of the producers. To achieve this, the selected products that comprise the market basket of the IPRI should be those with the highest production value within the corresponding branch, the establishments in the sample must have the highest production, and the relative importance of each product in the market basket must respond to the production trends of the industry. The better the selection of these elements, the more representative the indicator will be.

Furthermore, the IPRI is an indicator that only makes sense when comparisons are made over time; in fact, an index number barely has any meaning if a comparison is not established with indices from other periods, to obtain the corresponding variation rates (this could be one month, one year, or any other period of time). Therefore, the other quality that can be attributed to an IPRI is the **comparability over time**, that is, the need for the elements that define the IPRI to remain stable over time, except, logically, the prices collected every month. In this way, any variation in the IPRI will be due only to changes in the prices of the selected products and not to any change in the methodological content of this indicator.

The applications of the IPRI are numerous and of great importance in the economic and legal fields. Among them it is worth noting its use as a measure of price inflation in industrial production. It is also applied in the revision of certain contracts and as a deflator in the National Accounts and in the Industrial Production Index (IPI).

3. Indicator scope

3.1 Time scope

3.1.1 BASE PERIOD

The base period or reference period of the index is the one in which the index equals 100. This is normally an annual period. In the new system, the arithmetic mean of the twelve monthly indices of the year 2015 published in base 2010 is equal to 100. This means that the year 2015 is the period to which the successive indices that will be published in the new base refer, and that is why it is called IPRI base 2015.

3.1.2 REFERENCE PERIOD OF THE PRICES

This is the period with whose prices the current prices are compared, that is to say, the period chosen for the calculation of the elementary indices.

With the calculation formula used for the IPRI base 2015 (chained Laspeyres), the price reference period is the month of December of the year immediately preceding the year under consideration. Therefore, at the beginning of each year the reference period changes.

3.1.3 REFERENCE PERIOD OF THE WEIGHTINGS

The reference period of the weightings is the period to which the weightings that serve as the structure of the system refer.

For the year 2018, the calculation of the weightings has been carried out based on the data from the *Structural Business Statistics: industrial sector* (SBS) and the Industrial Products Survey, referring to the year 2015, which provide information on turnover by branch of activity and product, respectively.

In addition, in order to correct the mismatch between this reference period of the annual surveys and the price reference period (December 2017), the weightings have been updated using information on price developments from the IPRI.

Thus, the reference period of the weightings is December 2017, during the year 2018. And in subsequent years it will be the month of December preceding each year, as the weightings will be updated annually, using annual information from the SBS, the IPRI and other available sources.

This annual revision of weightings will be performed for certain geographical and functional breakdown levels, using the information available closest to the moment of the revision.

In addition, every five years, a base change will be carried out, in which the weightings will be updated for all functional and geographical breakdown levels.

3.2 Population scope

The population of the index or reference stratum is the population group whose income structure serves as the basis for the selection of representative products and the calculation of their weights.

In the IPRI, base 2015, the reference stratum of the index includes all establishments that manufacture and sell industrial products in the domestic market. Therefore, revenue from products sold on the foreign market is not included.

3.3 Geographical scope

The geographical scope of the research is the entire national territory, with the exception of Ceuta and Melilla.

3.4 Scope of application

It is all the industrial goods that the companies in the reference stratum manufacture for sale on the domestic market; therefore, goods manufactured for sale on the foreign market are not considered.

Each branch of activity of the CNAE is represented by one or more products in the IPRI, so that the evolution of the prices of these products represents that of all the elements comprising that branch of activity. This is called a *market basket of products*.

3.4.1 MARKET BASKET OF PRODUCTS

It is the set of products selected in the IPRI whose price evolution represents that of all those that comprise the branch of the CNAE to which they belong.

The selection of the products that make up the IPRI market basket has been made on the basis of the IPRI, base 2010, and data from the *SBS industrial sector* 2015 and the *Industrial Products Survey* 2015. The criterion for determining which activities should be considered as part of the indicator is to include all activities above a minimum turnover threshold for the branch. Once the activities represented in the index had been selected, the products making up the market basket for base 2010 were revised, increasing, decreasing or maintaining the products included in each activity, depending on its weighting, the number of products that comprise it and the variability in the prices of said products.

Thus, the total number of products comprising the market basket of the IPRI base 2015 is 1,443.

3.5 Functional breakdown of the indices

The IPRI base 2015 is completely adapted to the national classification of economic activities CNAE 2009. The products of the basket are added in classes (4 digits CNAE), these in groups (3 digits CNAE), then in divisions (2 digits CNAE), and finally, the divisions in sections (1 digit CNAE).

The functional structure of the new IPRI with respect to that of the IPRI base 2010 is the same at all levels (except for groups and classes, where one and two branches are no longer covered, respectively). Thus, in the IPRI, base 2015, this structure consists of 4 sections, 28 divisions, 94 groups and 217 classes as of January 2018.

In addition, indices are calculated distinguishing by economic destination of the goods.

3.6 Geographical breakdown of the indices

The IPRI base 2015 publishes the indices for the same levels of geographical disaggregation as those published in the IPRI base 2010.

The following table collects the breakdown for which data is published monthly.

INDEX	**National**	**Autonomous Community**
General	X	X
Major Industrial Sectors	X	X
Divisions	X	X
Sections	X	
Groups	X	
Classes	X	

4. Sample design

As in most countries of the European Union (EU), the sample design of the prices involved in the calculation of the IPRI is based on a cut-off sampling, consisting of ordering the items to be sampled in a decreasing order according to their values (in this case, turnover) and selecting for the sample those that exceed a minimum threshold established. It is, therefore, a non-probabilistic design, given the characteristics of the population under study.

In order to obtain significant indicators at all levels of functional and geographical disaggregation for which the IPRI is published, the sample selection process has been structured into three main sections, each of which aims to select the different components of the sample. These are as follows:

- Selection of activities.
- Selection of products.
- Selection of establishments.

4.1 Selection of activities

The criteria used to define which activities will form part of the calculation of the IPRI, base 2015, are as follows: for the national total, it includes the classes (4 digits CNAE-09) that exceed 0.1% of the total turnover of the industry, and for the Autonomous Communities, the divisions (2 digits CNAE-09) that exceed 1.0% of the total turnover of the industry for each Autonomous Community.

Following these criteria, the following branches have been removed from the list, which according to the latest available data, do not reach the minimum national coverage: *Manufacture of leather clothes*, *Manufacture of fibre cement* and *Manufacture of musical instruments*. On the other hand, a branch has been included whose turnover has increased in recent years: *Distribution of gaseous fuels through mains*.

In total the IPRI, base 2015, covers 4 sections, 28 divisions, 94 groups and 217 classes.

4.2 Selection of products

The products that constitute the IPRI market basket, base 2015, are included according to their production value within the class to which they belong, until they cover 60% of it, for those that weigh more than 0.1%, and 40% for the rest.

The information to make the selection of products is obtained from the Industrial Products Survey, referring to the year 2015.

With these selection criteria, in the IPRI base 2015, the market basket is made up of 1,443 products.

4.3 Selection of establishments

For each of the products in the market basket, the establishments are selected in such a way as to guarantee that the estimation of the variation rates is significant at the maximum level of geographical and functional breakdown that is published.

The number of establishments surveyed for each product is determined on the basis of its weight, trying to cover at least 60% of the production value.

The information to make the selection of establishments is obtained from the Industrial Products Survey.

4.4 Number of observations

The number of observations for each product is determined by the sub-variety reported by the establishments.

Each establishment is required to report information on the price of the sub-varieties (specific models of a product) they sell the most.

Thus, in the base 2015 there are approximately 28,000 prices of sub-varieties.

5. General calculation method

The formula used to calculate the IPRI indices, base 2015, is the chained Laspeyres formula, which has already been used for the IPRI, base 2010.

The general index corresponding to a moment in time *t* is mathematically expressed as follows:

$$ {}_0I^t_{LE} = \prod_{k=1}^{t} \frac{\sum_i p_i^k q_i^{k-1}}{\sum_i p_i^{k-1} q_i^{k-1}} $$

Where:

P_i^k and P_i^{k-1}	is the price of product i at the time k and k-1*,* respectively
q_i^k	is the quantity of the product *i* produced at the time *k-1.*

Similarly, it can be expressed as:

$$ {}_0I^t_{LE} = \prod_{k=1}^{t} \frac{\sum_i \frac{p_i^k}{p_i^{k-1}} p_i^{k-1} q_i^{k-1}}{\sum_i p_i^{k-1} q_i^{k-1}} = \prod_{k=1}^{t} \sum_i {}_{k-1}I_i^k W_i^{k-1} $$

where:

$$ {}_{k\text{-}1}I_i^k = \frac{p_i^k}{p_i^{k-1}} \quad \text{and} \quad W_i^{k-1} = \frac{p_i^{k-1} q_i^{k-1}}{\sum_i p_i^{k\text{-}1} q_i^{k\text{-}1}} $$

As can be seen, a chained index establishes the relationship between the current period (*t*) and the base period (*0*) on the basis of intermediate situations (*k*).

In the IPRI base 2015, the intermediate situations considered correspond to the months of December of each year. Thus, the index in base 2015 for the month *m* of the year *t*, is obtained as the product of indices in the following way:

$$ {}_{15}I_G^{mt} = {}_{15}I_G^{dic(t-1)} * \left(\frac{{}_{dic(t-1)}I_G^{mt}}{100} \right) = $$

$$ = {}_{15}I_G^{dic15} * \left(\frac{{}_{dic15}I_G^{dic16}}{100} \right) * \ldots * \left(\frac{{}_{dic(t-2)}I_G^{dic(t-1)}}{100} \right) * \left(\frac{{}_{dic(t-1)}I_G^{mt}}{100} \right) $$

where:

${}_{15}I_G^{mt}$	is the general index, in base 2015, for the month *m* of the year *t*.
${}_{dic(t-1)}I_G^{mt}$	is the general index, referring to December of the year *(t-1)*, of the month *m* of the year *t*.

The main inconvenience of chained indices is the lack of additivity. For this reason, it is not possible to obtain the index of any aggregate in base 2015 as a weighted average of the indices in base 2015 of the aggregates that compose it. Thus, for example, the general index cannot be calculated as a weighted average of the indices of the four sections.

5.1 Elementary indices

An elementary aggregate is the component with the lowest level of aggregation for which indices are obtained, and in whose calculation no weightings are involved; the price indices of these aggregates are called elementary indices. In the IPRI, an elementary index is calculated for each product in the market basket in each of the Autonomous Communities. Therefore, the elementary aggregate is the product-Autonomous Community.

The index of the elementary aggregate i is obtained as the quotient of the average price of that elementary aggregate in the current period and the average price in the reference period of the prices, that is, December of the previous year:

$$ {}_{dic(t-1)}I_i^{mt} = \frac{\overline{P}_i^{mt}}{\overline{P}_i^{dic(t-1)}} \times 100 $$

where:

${}_{dic(t-1)}I_i^{mt}$ is the index, referring to December of the year (*t-1*), of the elementary aggregate *i*, in the month *m* of the year *t*.

$\overline{P}_i^{mt}$ is the average price of the elementary aggregate *i*, in the month *m* of the year *t*.

$\overline{P}_i^{dic(t-1)}$ is the average price of the elementary aggregate *i*, in December of the year (*t-1*).

At the same time, the average price of the aggregate *i*, in the period (*m,t*), $\overline{P}_i^{mt}$, is the simple geometric mean of the prices collected in that period:

$$ \overline{P}_i^{mt} = \sqrt[n_i^{mt}]{\prod_{j=1}^{n_i^{mt}} P_{i,j}^{mt}} $$

where:

$P_{i,j}^{mt}$ is the price of the elementary aggregate *i* collected in the establishment *j*, in the period (*m,t*).

n_i^{mt} is the number of prices processed for the elementary aggregate *i*, in the period (*m,t*).

The geometric mean gives the same importance to the variations of all prices, regardless of their level.

5.2 Weightings

The weighting structure of the IPRI, base 2015, has two fundamental sources of information:

- The *Structural Business Statistics (SBS): industrial sector*, which provides data on the turnover of industrial companies, by main branch of activity.

- The *Industrial Products Survey*, which provides information on the production value of industrial products.

From the first, the weighting of each of the branches represented in the IPRI is obtained, as a quotient of the turnover of the companies whose main activity is this branch and the total turnover of the industry. Before calculating the weights, the turnover of the branches not represented is distributed among the branches of the upper aggregate.

Secondly, the data from the *Industrial Products Survey* are used to obtain the weighting of the products, distributing the weighting of the branch among the products that make up the IPRI market basket, in proportion to their production value.

The data used in the calculation of the weightings, used during the year 2018, are those corresponding to the year 2015.

In addition, in order to correct the mismatch between the weighting reference period and the price reference period (December 2017), the weightings are updated using information on price developments from the IPRI. In this way, the reference period of the weightings, used during the year 2018, is December 2017.

As mentioned above, the weight or importance of the aggregates that make up this indicator is updated annually, which allows the indicator to be adapted to changes occurring in industrial activities.

The weighting of each branch represents the ratio between the turnover of that branch and the total turnover:

$$W_i = \frac{cifra\ de\ negocios\ de\ la\ rama\ i}{cifra\ de\ negocios\ total}$$

The weight of each class is distributed among the products included in that activity according to the relation between the production value of that product and the production value of all the products included in the branch to which they belong:

$$W_{ij} = W_i * \frac{valor\ de\ la\ producción\ del\ producto\ j}{valor\ total\ de\ la\ producción\ en\ la\ rama\ i}$$

These weightings are different in each of the geographical aggregations (Autonomous Communities and the national total), and from them, the weightings of the different functional aggregations are obtained. Thus, the weighting of the functional aggregate *A* is obtained as the sum of the weightings of the products that make up said aggregate:

$$W_A = \sum_{i \in A} W_i$$

The annual updates of the weightings, to be conducted in the IPRI, base 2015, will be carried out with the latest available annual information from the *Structural Business Survey: industrial sector*.

5.3 Aggregate indices

As already mentioned above, the elementary indices refer to December of the immediately preceding year. In turn, the weightings used for the calculation of the aggregations also refer to December of the previous year, thereby maintaining coherence with the reference prices.

Aggregate indices are calculated using weighted sums of the elementary indices. Thus, different functional aggregations can be obtained for a given region, or an aggregation of different geographical groupings for a given functional aggregate, as detailed below.

Functional aggregations within an Autonomous Community

In order to calculate the index referenced to the month of December of the year prior to the current year of any functional aggregation A (class, group, division, MIG, section, etc.), in an Autonomous Community *p*, the elementary indices of the products belonging to said aggregation shall be aggregated using their weightings in the IPRI market basket in the following manner:

$$_{dic(t-1)}I^{mt}_{A,p} = \frac{\sum_{i\in A} {}_{dic(t-1)}I^{mt}_{ip} * {}_{dic(t-1)}W_{ip}}{\sum_{i\in A} {}_{dic(t-1)}W_{ip}}$$

where:

$_{dic(t-1)}W_{ip}$ is the weighting of the product i in the Autonomous Community p, referring to *December (t-1)*, which comes into force in January of year t.

$_{dic(t-1)}I^{mt}_{ip}$ is the index referenced to December *(t-1)* of the product in the Autonomous Community p in the month m of the year t.

Once the aggregate indices are calculated as detailed above, it is necessary to chain them. These indices are those which are finally disseminated and give continuity to the series published.

For any functional aggregation A, the index in base 2015 in the Autonomous Community p is calculated as follows:

$$_{15}I^{mt}_{A,p} = {}_{15}I^{dic(t-1)}_{A,p} * \left(\frac{_{dic(t-1)}I^{mt}_{A,p}}{100}\right) = \frac{_{15}I^{dic\ (t-1)}_{A,p}}{100} * {}_{dic(t-1)}I^{mt}_{A,p}$$
$$= C^{t}_{A,p} * {}_{dic(t-1)}I^{mt}_{A,p}$$

That is, each index calculated with reference to December *t-1* is multiplied by a coefficient, obtained as a quotient between the index in base 2015 of December *t-1* and 100. This coefficient is called the **chaining coefficient**.

Geographical aggregations of a functional aggregation

In the same way as in the previous case, the following calculation will be made to calculate the index for the national total of a given functional grouping A:

$$_{dic(t-1)}I^{mt}_{A} = \frac{\sum_{\forall p} {}_{dic(t-1)}I^{mt}_{Ap} * {}_{dic(t-1)}W_{Ap}}{\sum_{\forall p} {}_{dic(t-1)}W_{Ap}}$$

where:

$_{dic(t-1)}W_{Ap}$ is the weighting of the functional grouping *A* in the Autonomous Community *p*, referring to *December (t-1)*, which comes into force in January of year *t*.

$_{dic(t-1)}I^{mt}_{Ap}$ is the index of the functional aggregation A in the Autonomous Community p in the period *(m,t)*.

As with the functional aggregations, once the aggregate indices are calculated, it is necessary to chain them.

For any functional aggregation *A*, the chained index, in base 2015, in the month *m* of the year *t*, is:

$$
\begin{aligned}
{}_{15}I_A^{mt} &= {}_{15}I_A^{dic(t-1)} * \left(\frac{{}_{dic(t-1)}I_A^{mt}}{100}\right) = \frac{{}_{15}I_A^{dic(t-1)}}{100} * {}_{dic(t-1)}I_A^{mt} \\
&= C_A^t * {}_{dic(t-1)}I_A^{mt}
\end{aligned}
$$

5.4 Calculation of variation rates

5.4.1 MONTHLY VARIATION RATES

The monthly variation rate of an index in the period *(m, t)* is calculated as the quotient between the index of the current month *m* and the index of the previous month *(m-1)*, according to the following formula:

$$
\begin{aligned}
V^{mt/(m-1)t} &= \left(\frac{{}_{15}I^{mt}}{{}_{15}I^{(m-1)t}} - 1\right) * 100 = \left(\frac{{}_{dic(t-1)}I^{mt} * C^t}{{}_{dic(t-1)}I^{(m-1)t} * C^t} - 1\right) * 100 = \\
&= \left(\frac{{}_{dic(t-1)}I^{mt}}{{}_{dic(t-1)}I^{(m-1)t}} - 1\right) * 100
\end{aligned}
$$

where:

$V^{mt/(m-1)t}$ is the monthly variation rate, in the month *m* of the year *t*.

${}_{15}I^{mt}$ is the index, in base 2015, in the month *m* of the year *t*.

$_{dic(t-1)}I^{mt}$ is the index, referring to December of the previous year, in the month *m* of the year *t*

C^t is the chaining coefficient in year t.

In other words, the monthly variation rates can be calculated with the published indices, in base 2015, or with the unchained indices (referring to December of the previous year).

5.4.2 ACCUMULATED VARIATION RATES

The accumulated variation rate (year-to-date) is calculated as the quotient between the index from the current month and the index from December of the previous year:

$$V^{mt/dic(t-1)} = \left(\frac{_{15}I^{mt}}{_{15}I^{dic(t-1)}} - 1\right) * 100 = \left(\frac{_{dic(t-1)}I^{mt} * C^t}{_{dic(t-1)}I^{dic(t-1)} * C^t} - 1\right) * 100$$
$$== \left(\frac{_{dic(t-1)}I^{mt}}{_{dic(t-1)}I^{dic(t-1)}} - 1\right) * 100 = \left(\frac{_{dic(t-1)}I^{mt}}{100} - 1\right) * 100$$

where:

$V^{mt/dic(t-1)}$ is the accumulated variation rate, in the month *m* of year *t*.

$_{15}I^{mt}$ is the index, in base 2015, in the month *m* of the year *t*.

$_{dic(t-1)}I^{mt}$ is the index, referring to December of the previous year, in the month *m* of the year *t*

C^t is the chaining coefficient in year t.

That is to say, the accumulated variation rates can be calculated with the published indices, in base 2015, or with the unchained indices (referring to December of the previous year). In the latter case, the index of December *t-1* referring to December *t-1* equal to 100, by definition.

5.4.3 ANNUAL VARIATION RATES

The annual variation rate is calculated as the quotient between the indices published in the current month and from the same month of the previous year, both in base 2015:

$$V^{\frac{mt}{m(t-1)}} = \left(\frac{{}_{15}I^{mt}}{{}_{15}I^{m(t-1)}} - 1 \right) * 100$$

where:

$V^{mt/m(t-1)}$	is the annual variation rate, in the month *m* of the year *t*
${}_{15}I^{mt}$	is the index, in base 2015, in the month *m* of the year *t*.

In the case of annual variations, these cannot be calculated with the indices referring to December of the previous year, as occurs with the monthly and accumulated variations. The reason is that each of the two indices involved in the formula has been chained with different chaining coefficients (one referring to the year *t* and the other to *t-1*) so they are not reduced, as in the previous formulas:

$$V^{\frac{mt}{m(t-1)}} = \left(\frac{{}_{15}I^{mt}}{{}_{15}I^{m(t-1)}} - 1 \right) * 100 = \left(\frac{{}_{dic(t-1)}I^{mt} * C^{t}}{{}_{dic(t-2)}I^{m(t-1)} * C^{t-1}} - 1 \right) * 100$$

5.5 Calculation of contributions

5.5.1 MONTHLY CONTRIBUTIONS

The contribution of a monthly variation rate of a product or aggregate in the general index is defined as the part of the monthly variation of the general index that corresponds to said product or aggregate. Therefore, the sum of the monthly contributions of all the products in the IPRI market basket is equal to the monthly variation rate of the general index.

In other words, the contribution that the monthly price variation of a product or aggregate has in the monthly variation of the general index is the variation that this index would have experienced if all the prices of the other products had remained stable that month.

The mathematical expression of the monthly contribution of a given product (or aggregate) *i*, in the month *m* of year *t*, is as follows:

$$R_i^{mt/(m-1)t} = \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}} \times {}_{dic(t-1)}W_i \times 100$$

where:

$_{dic(t-1)}I_i^{mt}$ is the index, referring to December of the year *(t-1)*, of the product *i*, in the month *m* of the year *t*.

$_{dic(t-1)}I_G^{(m-1)t}$ is the general index, referring to December of the year *(t-1)*, in the month *(m-1)* of the year *t*.

$_{dic(t-1)}W_i$ is the weighting, referring to December of the year *(t-1)*, of the product *i*, as per unit.

Developing the previous formula, we obtain an alternative way of calculating the contributions through the variation rates:

$$R_i^{mt/(m-1)t} = \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}} \times {}_{dic(t-1)}W_i \times 100 =$$

$$= \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}} \times \frac{{}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_i^{(m-1)t}} \times {}_{dic(t-1)}W_i \times 100 =$$

$$= \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_i^{(m-1)t}} \times 100 \times {}_{dic(t-1)}W_i \times \frac{{}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}}$$

$$= V_i^{mt/(m-1)t} \times {}_{dic(t-1)}W_i \times \frac{{}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}}$$

Therefore, the monthly contribution of a given product *i*, is the multiplication of its monthly variation rate ($V_i^{m,t/(m-1)t}$) by its weight ($_{dic(t-1)}W_i$) and by the quotient between the product index and the general index of the previous month ($_{dic(t-1)}I_i^{(m-1)t} / {}_{dic(t-1)}I_G^{(m-1)t}$). Thus, a product in the sample will have a greater contribution to the variation rate of the general index the more its prices have changed, the higher its weight and the greater the value of its index in relation to the general index.

On the other hand, as previously mentioned, the sum of the monthly contributions of all the products comprising the IPRI market basket is equal to the monthly variation of the general index. This is demonstrated as follows:

$$\sum_i R_i^{mt/(m-1)t} = \sum_i \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}} \times {}_{dic(t-1)}W_i \times 100 =$$

$$= \frac{\left(\sum_i {}_{dic(t-1)}I_i^{mt} \times {}_{dic(t-1)}W_i - \sum_i {}_{dic(t-1)}I_i^{(m-1)t} \times {}_{dic(t-1)}W_i\right)}{{}_{dic(t-1)}I_G^{(m-1)t}} \times 100 =$$

$$= \frac{{}_{dic(t-1)}I_G^{mt} - {}_{dic(t-1)}I_G^{(m-1)t}}{{}_{dic(t-1)}I_G^{(m-1)t}} \times 100 = V_G^{mt/(m-1)t}$$

5.5.2 ACCUMULATED CONTRIBUTIONS

The contribution of the year-to-date variation (or accumulated variation) of a product or an aggregate to the general index represents the accumulated variation that the general index would have experienced if the rest of the products had not experienced any variation in prices so far this year. In other words, it is the part of the accumulated variation due to said product or aggregate.

The formula for the accumulated contribution of a given product (or aggregate) *i* in the month *m* of the year *t* is as follows:

$$R_i^{mt/dic(t-1)} = \frac{{}_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{dic(t-1)}}{{}_{dic(t-1)}I_G^{dic(t-1)}} \times {}_{dic(t-1)}W_i \times 100 =$$

$$= \frac{{}_{dic(t-1)}I_i^{mt} - 100}{100} \times {}_{dic(t-1)}W_i \times 100 = \left({}_{dic(t-1)}I_i^{mt} - 100\right) \times {}_{dic(t-1)}W_i$$

where:

$${}_{dic(t-1)}I_i^{mt}$$ is the index, referring to December of the year *(t-1)*, of the product *i*, in the month *m* of the year *t*.

$_{dic(t-1)}W_i$ is the weighting, referring to December of the year *(t-1)*, of the product *i*, as per unit.

Using the alternative formula for calculating contribution that were developed in the previous section, we obtain that the accumulated contribution is equal to the product of the accumulated variation by the weighting:

$$R_i^{mt/dic(t-1)} = \frac{_{dic(t-1)}I_i^{mt} - {}_{dic(t-1)}I_i^{dic(t-1)}}{_{dic(t-1)}I_G^{dic(t-1)}} \times {}_{dic(t-1)}W_i \times 100 =$$

$$= V_i^{mt/dic(t-1)} \times {}_{dic(t-1)}W_i \times \frac{_{dic(t-1)}I_i^{dic(t-1)}}{_{dic(t-1)}I_G^{dic(t-1)}} =$$

$$= V_i^{mt/dic(t-1)} \times {}_{dic(t-1)}W_i \times \frac{100}{100} = V_i^{mt/dic(t-1)} \times {}_{dic(t-1)}W_i$$

In the case of accumulated contributions, it is also verified that their sum is equal to the accumulated variation rate, developing the same steps as in the previous section.

6. Collection of prices

The prices of the products included in the IPRI market basket are collected from the different provincial delegations and the central services, through the completion of a monthly questionnaire by the establishment.

Since 2011, the INE has promoted the completion of questionnaires via the Internet, through the IRIA collection platform (Integration of Information Collection and Administration). The request of information is made, fundamentally, via the Internet and it is the respondents who choose the method of completion: either through the web or by using the traditional postal or e-mail channels.

For certain multi-located companies or companies that are part of corporations or groups, the INE manages the collection process from the central services. To this end, it has a special unit dedicated exclusively to the collection of questionnaires from this type of companies, which are informants in various surveys, including the IPRI.

For sectors in which, in addition to the quantitative information required, it is necessary to establish a more personalised contact with companies in order to require certain qualitative information on their activity, which complements the information in prices, the collection is carried out from the unit promoting the survey itself.

The products whose prices are collected directly by the promoting unit are those with one or more of the following characteristics:

- their prices are the same in a broad geographical area,
- their prices are subject to rates published in the BOE,
- there are few companies that market the product, and the product has an important weight in the index.

The collection of prices is done through a single questionnaire, the price reflected in the questionnaire, refers to the selling price by the establishment on the 15th of the month.

6.1 Organisation of fieldwork

Most of the information is collected by the staff assigned to the survey in the 10 INE provincial delegations responsible for industrial surveys. Each team consists of a group of interviewers, inspectors of interviewers, a survey inspector and, at the head of each delegation, a provincial delegate who has ultimate responsibility for collecting the information in his or her collection unit.

The technical responsibility corresponds to the survey inspector. He or she is responsible for organising and distributing the work, analysing the price series, planning the sending of questionnaires and data collection and, in general, solving problems that arise during the collection of prices. To this end, they are supported by the inspectors of the interviewers, who must check the suitability and representativeness of the products and establishments, advise them on the correct way to collect prices and monitor and inspect the work carried out by the interviewers in their charge.

Finally, the interviewer is responsible for sending and receiving the price questionnaires, monitoring the products to confirm that they are always the same and, if they are not, verifying that the sub-varieties proposed as substitutes are correct, as well as claiming this substitution if the company does not propose substitutes. He or she will also inform the inspector of the interviewers of any incidents that may arise.

7. Processing of information

7.1 Information reception

As mentioned above, the collection is carried out by means of a questionnaire in which the respondent of the establishment records the prices of the products requested and their corresponding incidences, if any. Once completed, the respondent sends the questionnaire to the INE delegations or their central services.

After an initial cleaning of the questionnaires received by the interviewer, the data are recorded.

After each recording stage of questionnaires, computer applications are used to detect possible errors.

The inspector of interviewers is responsible for checking the atypical prices before moving on to the next stage of the process. This system allows to detect any error in the collection of data and resolve the incident without much time from the time of collection of the information.

The last stage, prior to sending the information to the central services, is the analysis of the price series by the survey inspector.

Once the previous stages have been completed, the monthly information is sent to the central services on the planned dates, so that the index can be compiled as soon as possible so that the indicator can be published on the established date.

At the central services, the data sent by the delegations and the prices collected in these services are processed together.

The total number of prices processed monthly, which is approximately 28,000, is analysed in the central services, requiring, when necessary, confirmation by the delegations on atypical variations. Once the prices have been cleaned and analysed, the indices and their corresponding rates of variation are obtained and published on a provisional basis 25 days after the reference month of the data. Final data are published 3 months after the first publication.

7.2 Cleaning of prices

As mentioned in the previous section, all prices collected monthly are received, cleaned and analysed by the INE Central Services.

In general, all variations of more than 100% or less than -50% are reviewed for all products and for those within the range (-50%,100%) that have a significant impact on the index.

In addition to that, the processing of the lack of price is also carried out, that is, the price of those products that were not available at the time of completing the questionnaire is estimated.

The method for estimating the lack of prices consists of applying the average variation of the rest of the prices collected for the same product in the other establishments of the sample, within the activity to which it belongs.

7.3 Quality changes

The accuracy with which the IPRI estimates price changes depends, to a large extent, on the stability over time of the conditions initially established. This implies that the product selected for the sample should not change its technical and commercial characteristics.

However, this requirement for homogeneity is not always possible, as the market itself is characterised by product differentiation and segmentation, and by technological development. These problems are most pronounced in certain industrial sectors, such as clothing or printing, and in products that have a long manufacturing period. In such cases, adjustments are needed to correct changes in the sample of products and to estimate the price change without being disturbed by the change. These adjustments are known as adjustments due to a change in quality.

This problem can be solved, to some extent, by an appropriate selection of sub-varieties and, sometimes, by using average tariffs or prices, even if these do not correspond to real transactions. As a general rule, when a price variation occurs as a result of a change in specifications in a sub-variety, it is assumed that the variation is not due solely to a price variation, and if no additional information is available to calculate what part of the variation is due to the price variation and what part to the quality change, the price variation is estimated with the average variation of the rest of the prices of that product.

7.3.1 DEFINITION

As already indicated, an adjustment for quality change is necessary when one sub-variety, the price of which is part of the IPRI calculation, is substituted for another. When this happens, it is necessary to determine what part of the price difference between the new sub-variety chosen and the one that disappears is due to the fact that the quality is different between both.

Substitutions of sub-varieties may be due to several reasons:

- the establishment ceases to manufacture the sub-variety;
- the sub-variety is no longer representative in the establishment;
- the establishment where the price of the sub-variety is recorded is no longer representative, closes or changes its economic activity.

The sub-varieties that comprise the market basket remain fixed over time as they define the most widely traded variety, but must be replaced when they are no longer traded or are no longer the most frequently sold in the establishment.

When the sub-variety that disappears and the new one coexist in time, it is possible to establish a relationship between both, and the quality adjustment is almost automatic. However, there is not always an overlap period between the products, nor is there an identity between a model and the one that replaces it. It is therefore necessary to estimate which part of this price difference is due to technical improvements, changes in material, etc., and which part is a pure price change.

7.3.2 QUALITY ADJUSTMENT METHODS

The quality adjustment methods that are the most habitually used in the IPRI base 2015, are the following:

a) Total quality adjustment.

It starts from the assumption that the difference between the price of the substituted product and the substitute product is entirely due to the difference in quality between the two or that the products are so different that they cannot be compared. It is therefore considered that the difference in prices between the two products is due only to the different quality of the products, so that the index will not reflect price variations. With this adjustment it is assumed that if the substituted product had remained for sale, its price would not have changed.

b) Adjustment due to identical quality.

It is assumed that the substitute product is of the same quality as the substituted product, i.e. that the price difference between the two is due to a real price change. With this adjustment, it is assumed that had the substituted product been sold, its price would have been the same as that of the substitute product.

c) Other adjustments.

This section includes all those adjustments for which the value of the difference in quality between one product and its substitute is estimated. The most frequent practices are:

- Imputation prices.

It is imputed the variation of the average price of a larger aggregate to which the product belongs.

- Information provided by experts:

  Experts or specialists on the product are asked which amount of the difference between the prices of the products (substitute and substituted) is due to the difference in quality between both.

- Overlap prices:

  The value of the quality difference between the substituted and the substitute product is the price difference between them in the overlap period, i.e. in the period in which both products are for sale.

In most cases, the method used to make the quality adjustments in the IPRI is that of imputation prices.

8. Chained series

For the new IPRI, base 2015, as it is a chained index, it has not been necessary to calculate any chain coefficient, since the chaining calculation method allows changes to be made in weightings, sample and methodology each December and to chain the indices obtained with the new calculations, with the series that had been published calculated with the old sample, weightings and methodology.

Thus, in the IPRI, base 2015, only the reference period of the indices or base period has been changed, which went from being the year 2010 to the year 2015. For this purpose, a re-scale coefficient has been calculated, which has converted the indices published in base 2010, from January 1975 to December 2017, into indices in base 2015.

This coefficient is the one which makes that the simple arithmetic mean of published indices in 2015, in base 2010, is equal to 100:

$$\left(\frac{1}{12} * \sum_{m=enero}^{diciembre} {}_{10}I^{m15}\right) * C_{re-escala} = 100 \rightarrow$$

$$\rightarrow \ C_{re-escala} = \frac{100}{\left(\frac{1}{12} * \sum_{m=enero}^{diciembre} {}_{10}I^{m15}\right)}$$

By multiplying the series published in base 2010 by this re-scale coefficient, we obtain a series of indices in base 2015, which preserves the variation rates published, and with which the new indices in base 2015 have been chained, calculated as of January 2018.

In this way, the INE has given continuity to all the series that have been published until now.

Annexe I. Calculation of aggregated indices

With the calculation formula of the IPRI base 2015 (chained Laspeyres), the indices referring to *December of the year (t-1)* start from a value equal to 100 in December of that year. Since it is necessary to give continuity to the published IPRI series, the indices must be chained to obtain indices referring to December must be chained to obtain other indices that give continuity to those already published in previous periods.

Thus, the chained index (the one to be published) in the month *m* of the year *t*, in base 2015, is obtained by multiplying the index of *December (t-1)*, in base 2015, by the index of the month *m* of the year *t* referred to *December (t-1)*, divided by 100:

$$ {}_{15}I^{mt} = {}_{15}I^{dic(t-1)} * \left(\frac{{}_{dic(t-1)}I^{mt}}{100} \right) $$

Chained indices are not additives, that is, from published indices it is not possible to calculate the indices of functional or geographical aggregations. These aggregations are calculated using the indices referring to December of the previous year (the unchained ones), since are additives.

The following describes the steps to follow to obtain the index in base 2015 of an aggregate *A*, from the indices published, in base 2015, of its components *A1* and *A2*:

1. The indices referring to December of the previous year must be obtained for each component *A1* and *A2*. This is done by dividing the published index of the month *m* of the year *t*, by the published index of December of the previous year:

$$ {}_{dic(t-1)}I_i^{mt} = \left(\frac{{}_{15}I_i^{mt}}{{}_{15}I_i^{dic(t-1)}} \right) * 100 \quad i = A1\ y\ A2 $$

2. The indices obtained in the previous step are aggregated using the weights in force in the reference period of the index *(m,t)*. With this, the index of the aggregate *A*, is obtained, referred to December of *(t-1)*:

$$ {}_{dic(t-1)}I_A^{mt} = \frac{{}_{dic(t-1)}I_1^{mt} \times {}_{dic(t-1)}W_1 + {}_{dic(t-1)}I_2^{mt} \times {}_{dic(t-1)}W_2}{{}_{dic(t-1)}W_1 + {}_{dic(t-1)}W_2} $$

3. The index in base 2015 of aggregate *A* is calculated as the product of the index published in December of the previous year, by the quotient of the aggregate index obtained in step 2 and 100:

$$ {}_{15}I_A^{mt} = {}_{15}I_A^{dic(t-1)} * \left(\frac{{}_{dic(t-1)}I_A^{mt}}{100} \right) $$