IMPLICATIONS OF THE CHANGES IN THE BASE YEAR AND THE WEIGHTING SYSTEM IN THE INDUSTRIAL PRODUCTION INDEX CALCULATION MODEL

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Abstract

The industrial production index is part of the short-term statistical indicators, the main purpose of which is to reflect as accurately as possible the real variations in the evolution of the production volume in industry, both at national level and for each of its administrative-territorial units.

Changes in the base year and the weighting system are elements that have become increasingly necessary as they move away from the year initially set as the benchmark, given that the weights, which highlight the relative importance of the different industrial branches / divisions, undergo a constant change process, leading inevitably to a gradual deterioration in the quality of the industrial production index.

Our research tackles the main methodological coordinates and their implications from a practical point of view in order to outline a clear image of the steps to be taken when changing the reference year in the industrial production index calculation model. A first aspect concerns the assurance of the representativeness of the product group used in the calculation of the volume index of industrial production, at both general and detailed level of each NACE division, against the background of the determination of corresponding values of the average prices of the basic period for the industrial products included in the sample. At the same time, the real structural evolution of the industrial sector in the considered administrative-territorial unit must be reflected as accurately as possible in the shares held by each industrial branch / division in the new base year. The final part of the paper describes the issue of ensuring the continuity of the index series and, implicitly, the relative comparability of the two sets of data through the reweighting process (adjustment of the indices calculated using the old weights with the ratio coefficient determined between the two indices).

Key words: industrial production index, turnover, average monthly production, average delivery price, reference period, reweighting.
JEL Classification: L11, L16

1. Introduction an literature review

The industrial production index (IPI) is part of the short-term statistical indicators, the main purpose of which is to reflect as accurately as possible the real variations in the evolution of the production volume in industry, both at national level and for each of its administrative-territorial units. Our research is aimed at presenting in a logically structured manner the main theoretical and practical implications of the changes in the base year and the weighting system in the industrial production calculation model, the main goal of which is the creation of a methodological framework allowing a unitary approach of all the statistically involved factors at territorial level in the "real time" evolution of industrial production.

The issue of the calculation methodologies specific to the industrial production index (IPI) plays a particularly important role in analyzing the evolution of the results of industrial activities from one period to the next, with a series of studies focusing on a purely theoretical approach, designed to contribute to a superior understanding of the statistical notions involved in the analysis of this complex phenomenon (Harja and Turcu, 2001, Alexevici et al, 2010, Anghelache et al, 2012, Pârțachi and Cara, 2012, Țarcă, 2017).

In our country, the procedure for calculating the industrial production index aligned with the legislation and methodology of the European Union is based on the provisions stipulated in the Order no. 231 / 27.05.2002 issued by the Chairman of the National Statistics Institute. The document is based on Council Regulation (EC) No 1165/1998 on short-term statistics and the Eurostat Handbook *"Short-Term Statistics Methodology"*, 1998 edition, which describes the procedures used in the European Union Member States.

Given the fact that a Laspeyres formula (the volume of industrial production is weighted with the basic level of the qualitative factor - the average price of the products in the year set as the reporting standard) is used to calculate the industrial production index, literature recommends that in a stable economy the reference year should change every 5 years, usually the years ending in zero or five. As of 2018, after a 2-year period (2016 and 2017) in which industrial production indices were calculated using the base year 2010, the latter was changed by using average prices and weights for the relative importance of each industry in the year 2015.

Changes in the base year and the weighting system have become increasingly necessary as they move away from the year initially set as the benchmark, given that the weights, which highlight the relative importance of the different industrial branches / divisions, undergo a constant change process, leading inevitably to a gradual deterioration in the quality of the industrial production index. An important role in the deterioration of the

statistical information contained in this indicator over a particular period of time is also played by the fluctuations induced in the evolution of production volume by the manufacture of new products and by the disappearance in the years following the setup of the sample of products which in some cases had a significant share in the reference year. We also recall the influence of the average prices of industrial products in the base year, which, as a weighting element, gradually diminishes its relevance as time passes, by also distorting for this reason, although in a secondary manner, the statistical information contained in the indicator.

2. Procedural aspects of changing the base year and the weighting system at Iasi County level

2.1. Selection of a sample of representative industrial products both at general and structural levels

In order to select the products in the sample, the monthly data bases generated from the IND TS statistic application for the years 2015, 2016 and 2017 were cumulated for each calendar month, for each PRODROM basic product code and for each industrial production unit covered in the research program.

The comparability over time of the data on the evolution of the industrial production volume was achieved by aggregating the basic products specific to each PRODROM code in product families (CAEN Rev. 2 and PROD1).

Depending on the specific importance of the Iasi county industry, on the continuity in the production process and in order to provide an efficient and relatively stable basis of comparison in the process of elaboration of the industrial production index system, the control group (sample) selected from industrial products constantly manufactured throughout the three-year period (2015, 2016 and 2017) includes "138 families of products" identified by the specific NACE and PROD1 codes resulting from the aggregation of 841 potential basic industrial products for each PRODROM code used. Thus, the fluctuations induced in the evolution of the industrial production volume are significantly diminished by the manufacture of new products and by the disappearance in the years following sample setup of products with a sometimes significant weight in the base year.

Sample model selected from the common industrial product groups manufactured between 2015 and 2017 (IND TS monthly survey)

Table 1

Div.	CAEN	PROD1	UM	PRODROM	Product Name	Number of industrial manufacturing enterprises		
						2015	2016	2017
10	1013	3618	kg	101314601	Sausages and similar products of meat, offal or blood and food preparations based thereon …	3	3	3
10	1013	3618	kg	101314602	Other sausages …	3	3	3
					…			
13	1392	74148	pieces	139212530	Bed linen of cotton (excluding knitted or crocheted)	4	4	3
					…			
14	1413	3489	pieces	141334800	Women's or girls' skirts and divided skirts (excluding knitted or crocheted)	18	16	17
					…			
15	1520	3547	pieces	152013520	Women's town footwear with leather uppers …	3	4	5
					…			
17	1721	3294	kg	172113000	Cartons, boxes and cases, of corrugated paper or paperboard	5	5	5
					…			
20	2030	2685	kg	203011500	Paints and varnishes, based on acrylic or vinyl polymers dispersed or dissolved in an aqueous medium	3	3	3
					…			
23	2363	2895	mc	236310000	Ready-mixed concrete	3	4	4
					…			
25	2511	38841	kg	251123500	Other structures principally of sheet	5	4	5
					…			
26	2651	707	lei	265165001	Hydraulic or pneumatic automatic regulating or controlling instruments and apparatus	3	4	4
					…			
29	2932	2125	lei	293230901	Other parts and accessories, n.e.c., for vehicles of HS 8701 to 8705	3	3	4
					…			
31	3109	4441	pieces	310912301	Wooden bedroom furniture	6	5	5
					…			
32	3250	714	lei	325022590	Dental fittings (including dentures and part dentures, metal crowns, cast tin bars, stainless steel bars)	3	3	4
					…			
35	3530	16	Gcal	353011033	Thermal energy produced to be delivered in gaseous hydrocarbon thermal power plants	3	3	3
Number of industrial products selected in the sample						295	287	295
Total number of industrial products produced at county level (IND TS survey)						330	318	333
Share of the number of industrial products in the sample						89,4%	90,3%	88,6%

As shown by the data in Table 1, the number of products actually produced by the business entities included in the sample underlying the calculation of the industrial production indices in the county in the new base 2015 ranges between 287 and 295 throughout the whole reference period, while their total number related to the monthly statistical survey IND TS ranges

from 318 to 333 during the same time interval, but the percentage of selected products is fairly stable (around 89 %). At the same time, 841 potential basic industrial products (138 families of products) are taken into account, the result being a number of basic industrial goods "related" to those actually produced at the time of sampling, a number ranging between 546 and 554. These are included automatically in the calculation of the industrial production index to the extent that they will be included in the actual production process.

However, it is also worth highlighting the share held in terms of output expressed in value in current prices of industrial products not included in the sample, due to the fact that they were not manufactured constantly throughout the reference period, namely between 2015 and 2017 (Table 2).

Percentage of non-sampled industrial products in total county output (current prices)

Table 2

PRODROM	Product Name	2015	2016	2017
103917250	Concentrated tomato puree and paste	0,000%	0,021%	0,019%
	…			
141110000	Articles of apparel of leather or of composition leather (including coats and overcoats) (excluding clothing accessories, headgear…)	0,000%	0,000%	0,007%
	…			
161011380	Coniferous wood; sawn or chipped lengthwise, sliced or peeled, of a thickness > 6 mm, end-jointed, sanded or planed	0,013%	0,000%	0,000%
	…			
204215001	Beauty, make-up and skin care preparations including suntan	0,000%	0,000%	0,019%
	…			
222319903	Builders' ware for the manufacture of flooring, walls, partition walls, ceilings, roofing, etc., guttering and accessories, banisters…	0,006%	0,000%	0,000%
	…			
231213301	Multiple-walled insulating units of glass	0,001%	0,029%	0,000%
	…			
241051202	Flat-rolled products of iron or non-alloy steel, of a width >= 600 mm, electrolytically plated or coated with zinc	0,000%	0,000%	0,268%
243120300	Bars and rods of tool steel, only cold-formed or cold-finished …	0,000%	0,000%	0,130%
243330000	Structures, solely or principally of iron or steel sheet ….	0,000%	0,000%	0,144%
	…			
261130940	Other electronic integrated circuits n.e.c.	0,000%	0,018%	0,020%
	…			
274025000	Chandeliers and other electric ceiling or wall lighting fittings (excluding those used for lighting public open spaces …)	0,000%	0,468%	0,260%
	…			
284140300	Parts and accessories for metal cutting machine tools (excluding tool holders and self-opening dieheads, work holders …)	0,158%	0,008%	0,000%
	…			
293230902	Other parts and accessories, n.e.c., for vehicles of HS 8701 to 8705	0,356%	0,086%	0,000%
	…			
302040304	Parts of locomotives or rolling-stock	0,277%	0,241%	0,089%
	…			
331119002	Repair and maintenance of non-domestic central heating boilers	0,005%	0,044%	0,000%
	…			
35231000N	Gas distribution services via pipelines	0,000%	0,000%	0,078%
Percentage of non-sampled industrial products in total county output		**1,000%**	**1,138%**	**1,296%**

The data in Table 2 clearly show coverage of approximately 99% for the industrial products included in the control group, the value of the non-included products amounting to around 1%, with a very slight upward trend as compared to the base year 2015.

Analysis of the representativeness of the group of products used in the calculation of the industrial production volume index could not be considered complete in the absence of a breakdown at the level of each NACE Rev. 2 division, in order to make it possible to highlight any structural shortcomings that may exist behind an apparently well-chosen sample, from the viewpoint of the overall coverage. For this reason, in this paper, the specific industrial production was reported for each sample division at the corresponding value determined for all products under the survey of short-term industrial statistical indicators, in the current prices of each period (Table 3).

The percentage of industrial production at the sample level in the total production subject to IND TS survey

Table 3

Div.	Division Name	2015	2016	2017	ian.18
10	Manufacture of food products	100,0%	99,3%	99,3%	99,5%
11	Manufacture of beverages	100,0%	100,0%	100,0%	100,0%
13	Manufacture of textiles	99,7%	99,4%	100,0%	99,6%
	...				
17	Manufacture of paper and paper products	100,0%	100,0%	100,0%	99,6%
18	Printing and reproduction of recorded media	99,1%	100,0%	100,0%	100,0%
20	Manufacture of chemicals and chemical products	99,3%	100,0%	91,4%	94,8%
	...				
22	Manufacture of rubber and plastic products	99,4%	100,0%	100,0%	90,0%
23	Manufacture of other non-metallic mineral products	99,9%	98,6%	100,0%	100,0%
24	Manufacture of basic metals	100,0%	100,0%	94,1%	91,8%
	...				
32	Other manufacturing	99,4%	99,6%	99,1%	87,6%
33	Repair and installation of machinery and equipment	99,5%	97,7%	99,2%	89,9%
35	Electricity, gas, steam and air conditioning supply	100,0%	100,0%	98,0%	96,3%

As shown in Table 3 for each NACE Rev. 2 division, the sample is also structurally representative, the percentages relative to the total industrial production of the IND TS survey ranging in the 2015 – 2017 period from 91.4%, for the NACE code 20 "Manufacture of chemicals and chemical products" in 2017, to 100%, for a large number of other industrial divisions in the county.

The figures shown here also reveal a high degree of homogeneity at industry level during the three years, which is also preserved in January of the fourth year. Thus, the representativeness of the group of products selected and used in the practical determination of the industrial production indices is very good.

2.2. Updating industry-specific important coefficients and average product prices in the new base year

In practice, when calculating the industrial production volume index, the Laspeyres weighting system is used, the production volume of each industrial product included in the sample and expressed in units of physical measurement (kg, ton, m2, m3, pieces, thousand kWh, Gcal, etc.) being multiplied by the basic level of the qualitative factor, i.e. the corresponding average price of the year established as the reporting standard (U.N.S.D., 2010). The average prices of each family of industrial products in the base year only play a secondary part within the industrial production volume index system. They contribute to the achievement of a value aggregate in the reference year for the component expressed in units of physical measurement. For the most realistic determination of the average prices in the reference period for the industrial products included in the sample, the corroborated information resulting from the monthly IND TS (Short-Term Indicators in Industry) statistical survey is used, in order to reduce the occurrence of errors (especially random ones) , with the data from the PRODROM annual statistical survey (regarding the physical industrial production carried out in Romania), taking into account the modalities of presentation, sometimes different in terms of the unit of measurement, in which the statistical data specific to the same product are collected.
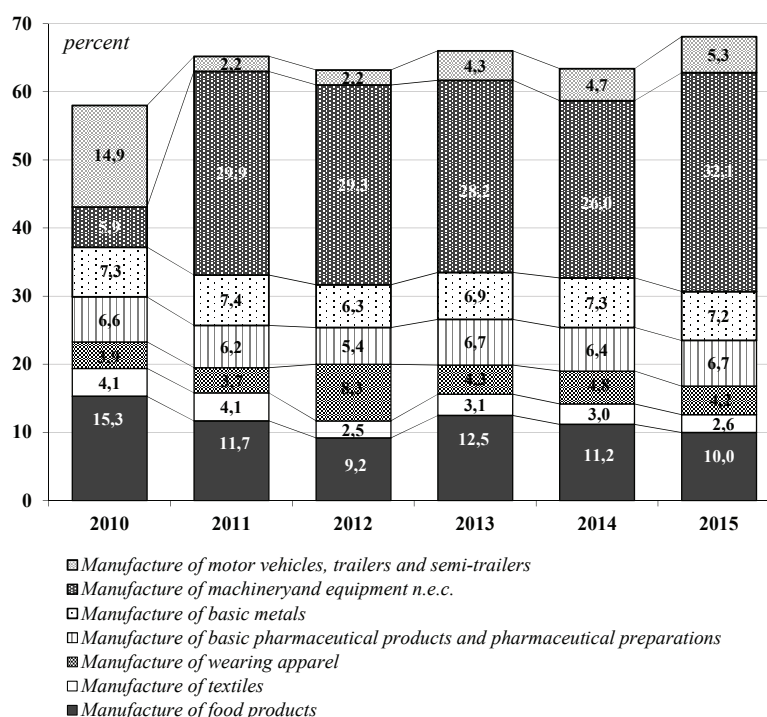
Industrial products expressed in units of currency (LEI) in the current month will be translated as values at the level of the base year by deflation with indices of industrial production prices calculated at NACE Rev. 2 class level. 2. These are shown in the Statistical Price Bulletin, a synthetic monthly publication of the National Statistics Institute.

The two industrial production components described above (value-based and physical) will be aggregated in monetary expression at the level of each NACE Rev. 2 division, the result being the industrial production value volume in the current period expressed in the average prices of each family of products (delimited by the pair of NACE and PROD1 codes) in the reference period.

The industrial production value volume calculated for the current month will be reported for the average monthly production of the base year separately for each NACE Rev. 2 division under survey, at the level of the products included in the sample. The result will be subsequently adjusted with the relative importance of each division in the total industry of the territorial unit, according to the turnover in the base year (or gross value added at factor cost).

The structural evolution of turnover by main industrial activities

Figure 1

Source: *Statistical Yearbook of Iaşi County 2017, p. 137*

As one may see in Figure 1, which shows the structural evolution of the turnover of all industrial business entities in Iasi County, the shares held by each industrial division experienced an extremely varied dynamics, i.e. a decrease of nearly 10% in division 29 "Manufacture of road transport vehicles, trailers and semi-trailers" and by over 5% in the food industry, due to the over five-fold increase in the relative importance of the businesses engaged in manufacturing of machinery, equipment and facilities. At the same time, the metallurgical, pharmaceutical and clothing industries have preserved a relatively constant coefficient of importance over the entire period of 2010-2015.

The penetration on the industrial market in the county of new players with high financial potential, the reorientation of the existing business entities towards the manufacture of different products, better adapted to the extremely dynamic requirements of a continuously expanding marketplace and, last but not least, the leaving of the economic area by companies in search of better

optimization of their activities, were mainly responsible for the important changes in the structural evolution of the turnover during the period 2010-2015.

Considering the structural changes occurred in Iasi County as concerns the shares held by the different industries within the analyzed territorial structure industry, the updating of the importance coefficients held by each NACE Rev. 2 division is imperative every five calendar years.

As stated in literature (Ţarcă, 2017), the use of industrial weight ratios (coefficients of importance) in calculations triggers absolutely no change in the industrial production indices determined at NACE Rev. 2 division level, the shares held by each industrial division having an important influence on the overall values of the industrial production indices, by sections or total industry, at higher aggregation levels.

2.3. Reweighting designed to ensure index series continuity

Gradually, as we move away from the year initially established as a basis of reporting, the shares that highlight the relative importance of different industries / industrial divisions suffer a constant change process, which inevitably leads to the progressive deterioration of the quality of the determined industrial production index. Also, an important role in the deterioration of the statistical information contained in this indicator over a period of time also lies in the fluctuations induced in the evolution of the production volume by the manufacture of new products, as well as by the disappearance of products in the years following the sample constitution, which, in some cases, held a significant share in the reference year.

Specifically, in line with international recommendations, the process of changing the weights held by each industry / division in accordance with the structural evolution of Gross Value Added (*VABCF*) to factor cost or, as the case may be, of the turnover (*CA*), occurs every 5 years.

In view of this consideration, at each 5-year period, in order to maintain the continuity of the index series calculated using the old weights (e.g. base year 2010) with those weighted with new weights (base year 2015), we link (chain) the indices.

Consequently, for the considered overlapping period, i.e. the average variation of the phenomenon analyzed in the year 2016 as compared to 2015, the two reporting bases (2010 and 2015) will be calculated in parallel with the industrial production indices for each division and for all the industries present in that administrative-territorial unit.

The industrial production volume indices calculated at year level (2016/2015) in both reporting bases will be obtained by applying the formula

for calculating the simple arithmetic mean of the 12 monthly average values of the I.P.I. determined for each NACE Rev. 2 division and for the total industry, following the processing of primary statistical data resulting from the monthly IND TS (Short-Term Indicators in Industry) research.

Determination of the ratio between I.P.I. annual averages 2016 / 2015 calculated on the old basis (2010) and the new basis (2015)

Table 4

Div.	Division Name	2016 / 2015 (Basis 2015)	2016 / 2015 (Basis 2010)	Coefficient A / B
		A	B	
10	Manufacture of food products	119,06	123,99	0,96023
11	Manufacture of beverages	61,14	52,39	1,16713
13	Manufacture of textiles	90,69	101,83	0,89067
14	Manufacture of wearing apparel	135,63	114,65	1,18301
...				
17	Manufacture of paper and paper products	100,56	100,55	1,00011
18	Printing and reproduction of recorded media	127,64	128,24	0,99531
20	Manufacture of chemicals and chemical products	109,57	106,26	1,03116
...				
23	Manufacture of other non-metallic mineral products	114,82	116,79	0,98313
24	Manufacture of basic metals	98,93	107,84	0,91744
25	Manufacture of fabricated metal products, except machinery and equipment	111,23	118,37	0,93969
26	Manufacture of computer, electronic and optical products	88,25	79,82	1,10557
27	Manufacture of electrical equipment	114,24	107,06	1,06707
...				
31	Manufacture of furniture	102,99	116,22	0,88623
32	Other manufacturing	117,49		
33	Repair and installation of machinery and equipment	96,14	141,84	0,67779
35	Electricity, gas, steam and air conditioning supply	87,18	107,58	0,81042
TOTAL		**105,67**	**105,64**	**0,99979**

By reporting the industrial production index with a new basis (2015) to the same indicator determined in the old basis (2010) we obtain the coefficient of ratio between the two indices, which will then be applied to the series of indices calculated on the old basis, thus achieving the reweighting process. The analysis of Table 4 reveals that, although there are sometimes important differences between the indices of each industrial division determined in the two bases, which is clearly highlighted by the general ratio coefficient, the values of the two indicators are almost identical for the whole industrial production, the differences being visible starting with the second decimal.

As a result of the reweighting process, the industrial production indices determined on the basis of 2010 will be reconfigured in the new basis, the main objective of this study being the creation of a picture of the current structure of the existing industrial sector in Iasi County.

At the same time, the continuity of the index series is also ensured in order to present from the viewpoint of the structure of the current parameters the real evolution of the industrial production in the administrative-territorial unit analyzed over a longer period of time (e.g. for the entire 10-year period where the indices were calculated in the two bases).

4. Conclusions

On the basis of the information presented in detail in this paper, the main methodological coordinates may be defined as well as their practical implications in order to outline a clear solution regarding the steps to be taken at the time of changing the reference year within the model for the calculation of the industrial production index.

The representativeness of the batch of products used in the calculation of the industrial production volume index should be checked both at the general and detailed levels at each NACE Rev. 2 division level, in order to emphasize any structural deficiencies that may exist behind an apparently well-chosen sample, and to ensure a high degree of homogeneity in the process of determining the index system, both at the general level and for each industry.

In order to obtain the pertinent average prices of the basic period for the industrial products included in the sample, both the results of the monthly IND TS (Short-Term Indicators in Industry) statistical survey and the data from the annual PRODROM statistical survey (on the physical industrial production in Romania) will be used, necessarily taking into account the modalities of presentation, sometimes different in terms of unit of measurement, in which statistical data for the same product are collected.

The influence of the weighting system that objectively and structurally reflects the relative importance of the industries is an essential requirement that can guide the evolution of the global volume of industrial production in a direction as close as possible to the real tendency of the analyzed phenomenon. The reweighting process, as the last step in obtaining industrial production volume indices showing the evolution of the phenomenon over a longer period of time, ensures compatibility between the series of indices calculated using different reference periods, reflecting the current structure of the industrial sector in the county.

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