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# **Methodological Recommendations for the Compilation of the Index Numbers of Industrial Production (IIP)**

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## **Importance of IIP**

- Empirical trend analysis of economic performance is a fundamental information source for the formulation of viable development/business policies and strategies.
- In this context, short-term indicators play an important role. Among these, IIP, which measures short-term trend/changes in the production of a given industrial activity, is a well-used indicator by business people, policy makers and media as such.
- By its nature, relative advantages of IIP relate to its high frequency and timeliness, comparing to, e.g., general industrial statistics (GIS) (survey statistics), commodity trade statistics (administrative statistics), NA and BoP statistics.

## Concept of IIP

IIP indicates real monthly (or quarterly) growth of production, say, value added of industrial activities at different levels of aggregation.

Thus, IIP is a typical short-term indicator indicating short-term trends in industrial production of individual industries/sectors.

The aggregation level of IIP dissemination depends on the availability of relevant input data and resources at the producing NSO. Nevertheless, the recommended IIP compilation starts with that at the 4-digit level of ISIC.

IIP compares the output level in real term in a reference period  $t$  with that in a selected base period  $t(0)$ .

## IIP Survey

IIP is a short-term performance indicator for industries.

→

Its compilation depends on the available current information on individual producing units' (e.g., industrial establishments) short-term (monthly or quarterly) production performance.

→

Regular establishment surveys are required monthly/quarterly to gather relevant micro data.

→

Thus, IIP is a survey-based statistical indicator.

*Sampling, types of micro data to be obtained and a proposed structure of a related short-term questionnaire that is to be filled in by reporting establishments will be explained later.*

# **Methodological Recommendations refers to:**

**Classifications**

**Scope of the IIP**

**Frequency of IIP compilation and publication**

**Primary data source**

**Sampling frame**

**Sample selection**

**Approximation of industrial production**

***Product Survey - Selection of main products of each ISIC industry***

***Methods to obtain industrial production volumes, volume relatives and IIPs for ISIC classes***

***Chain linking of the IIP on weight change***

***IIP-related monthly questionnaire to be filled by establishments***

***Office editing of input data***

***Seasonal adjustment***

# Recommended Classification Schemes and Scope

- Industrial activity classification = ISIC Rev.4
- The recommended IIP compilation takes so-called a *product approach* as seen below. Because of its clear-cut correspondence with ISIC Rev.4, CPC-Version 2.1 (CPC Ver.2.1) should be employed for the product classification.

*(For the details of ISIC-rev.4, CPC-ver.2.1 and the correspondence between the two classifications, see a UN Statistical Division website, <unstats.un.org/unsd/class>.)*

The scope of IIP in terms of ISIC-rev.4:

- ✓ Section B (mining and quarrying),
- ✓ Section C (manufacturing),
- ✓ Section D (electricity, gas, steam and air conditioning supply) and
- ✓ Section E (water collection, treatment and supply, sewerage, etc.).

## Progressive compilation of IIPs

Initially, select main products of each of the ISIC 4-digit industries and calculate the weights of the main products based on their annual output values (This may require periodical product survey).

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Aggregate the micro data on the production of selected products obtained via short-term establishment survey to calculate so-called volume relative (or IIP) for the individual products of a given ISIC4-dig industry.

→

Calculate a weighted average of the IIPs of the products, which is the IIP of the ISIC 4-dig industry in question.

→

Similarly, calculate a weighted average of the IIPs for the ISIC 4-dig industries to obtain IIP of the corresponding ISIC 3-dig class.

→

Compile IIPs for further aggregated ISIC classes in the same manner.  
(Laspeyres-type weighted-average method)

## **Measurement of Production Amount**

Although IIP refers to value added, due to general difficulties in compiling data on monthly (or quarterly) value added, turnover of output are often used as a proxy to measure period-to-period changes in value added at the product level.

## **Frequency and Aggregation Level**

Frequency, industrial aggregation levels and method of IIP depend on the potential availabilities of relevant input data and the NSO's resources as well as industrial establishments' capability/willingness to provide the NSO with monthly (or quarterly) micro data on required statistics.

Recommended frequency = monthly.

Desirable level of industry aggregation for publication = ISIC 3-dig. level and higher.

*The number of 2-digit industrial categories (Divisions) of ISIC-Rev.4 :  
B=5 Divisions, C=24 Divisions, D=1 Division. and E=4 Divisions. Thus,  
total for the whole broad industrial sector = 34 Divisions.*

## Selection of ‘main products’ of individual ISIC 4-dig industries

IIP compilation starts with the identification of the country-specific main products of each ISIC 4-digit industry. For this, an initial product survey may be needed:

- Proposed establishment coverage of the survey = All industrial establishments with 10 or more persons engaged and registered in the NSO’s business register for the annual GIS survey.
- Data to be collected = micro data on value of annual output of each establishment's major product(s).
- Code the major products of the establishments at the 5-digit level of CPC Ver.2.1. Then aggregate the micro data across the establishments by CPC code. Then, sort the product data by corresponding ISIC 4-digit industry.
- For each ISIC 4-digit industry, the “main products” can be defined as those which together account for, say, 75 per cent of the total output of the ISIC industry.

## **Sampling Frames and Sampling**

- For a product survey: All industrial establishments with ten or more persons engaged that are registered in the latest business register maintained by the NSO.

Samples = All those establishments.

- For the monthly/quarterly establishment survey for IIP production: Sampling frames, which are sub-frames of the sampling frame for the product survey, for individual main products.

Samples for a main product = Main producing establishments of the product in terms of value of output.

## Required data

- For the selected products of individual ISIC 4-digit industries:
  - Value of monthly/quarterly output sold (For manufactured products with a few exceptions),
  - Quantity of monthly/quarterly output sold (For non-manufactured products, in general),
  - Monthly/quarterly total hours worked (For a few manufactured and industrial-service products).
  - Values of annual total output sold/produced. These data are based on the product survey and to calculate these products' weights within the corresponding ISIC 4-dig. Industry.
- For 4-, 3- and 2-digit levels of ISIC, annual value added. These data are obtained from the latest version of the NSO's GIS database, and to calculate these ISIC industries' weights within the corresponding higher aggregated ISIC categories.
- For 4-, 3- or 2-digit level of ISIC, monthly/quarterly PPI.

## **Monthly/Quarterly Questionnaire**

*For a prototype design as a reference, please see the handout.*

*As indicated in it, it is desirable that, because of the practical reasons, the out-going questionnaire be electronic and pre-filled with the data previously reported to the NSO.*

## Methodological steps (Assuming monthly IIP)

- 1) Obtain cross-establishment time-series aggregates on value of monthly output sold (or desirably produced) of each selected product.
- 2) By dividing the monthly output values with the value for the base month, obtain “value relative” for each period. (Obviously, the value relative for the base month = 1.00).
- 3) Calculate Laspeyres-type weighted average of the value relatives for each period across the selected products of the given ISIC 4-dig.industry.
- 4) By applying an appropriate PPI for the ISIC industry in question to the value relative of the industry, obtain IIP of the ISIC industry.
- 5) Obtain IIPs of higher aggregated ISIC classes by using a similar calculation method by using respective value-added weights.

For a homogeneous product, IIP is, in principle, to be calculated based on its quantum output data. (In this case, deflation of output data is naturally not needed. )

## **IIP production**

### ***Calculation of Laspeyres-type IIP for ISIC classes:***

Laspeyres-type IIP ( $L$ ) for the ISIC-4digit industry for month  $t$  is a weighted average of the volume relatives of the selected products (1,.. 2, .... i, ....,k) of the ISIC industry:

$$L_t = \sum w_{i,0} (V_{i,t} / V_{i,0}) \quad \sum = \text{summation over } k \text{ products.}$$

$w_{i,0}$  = weight of product  $i$  in terms of output ( $O$ ):  $w_{i,0} = O_{i,0} / \sum O_{j,0}$ ,  $j = 1, 2, \dots, k$ .

Data on output value ( $O_i$ ) of the main product  $i$ ,  $i=1, 2, \dots, k$ , are the results of the product survey mentioned above,

Laspeyres –type IIP of the ISIC-3d class for period  $t$  is a weighted average of  $L_t$  :

$$IIP_t = \sum v_{j,0} L_t \quad \sum = \text{summation over } m \text{ ISIC-4d industries } 1, 2, \dots, m.$$

$v_{j,0}$  = weight of ISIC-4d industry  $j$  in the base month ( $t_0$ ) in terms of value added (VA):

$$v_{j,0} = VA_{j,0} / \sum VA_{r,0}, \quad r = 1, 2, \dots, m.$$

Note: The Young index, a type of the L-index, uses weights,  $w$  and  $v$ , calculated for month  $b$  (where  $b < 0$ ). If  $b=0$ , then the Young index = the Laspeyres index.

## *IIP production – numerical illustration (1)*

### **1. Deflation method (using the output data to calculate the volume relatives (IIP):**

- 1) Based on the micro data , obtain data on value of output at the product level (O: Cross-establishment aggregate on output of a product).
- 2) Obtain 'value-relatives' of main products (a) and (b) of ISIC-4.dig industry (A) for month 0, 1, 2 .

	<b>Base month (0)</b>	<b>Month (1)</b>	<b>Month(2)</b>
Output of product (a) (at current prices)	250	400	600
Value relative of Product (a)	100.0	160.0	240.0
	<b>Base month (0)</b>	<b>Month (1)</b>	<b>Month(2)</b>
Output of product(b) (at current prices)	140	180	80
Value relative of Product (b)	100.0	128.6	57.1

## **IIP production - Numerical illustration (2)**

- 3) Obtain output-weights of Product (a) and (b) (say,  $a=0.40$ ,  $b=0.60$ ) from the results of a product survey.
- 4) Combine the value relatives of the two products to produce value relative of the ISIC-4.dig industry (A) by using the Laspeyres-type formula.

	<b>Base month (0)</b>	<b>Month (1)</b>	<b>Month(2)</b>
Value relative of Product(a)	100.0	160.0	240.0
Value relative of Product(b)	100.0	128.6	57.1
Weight of Product(a)	0.4	0.4	0.4
Weight of Product(b)	0.6	0.6	0.6
Value relative of Industry(A)	100.0	141.2	130.3

## **IIP production - Numerical illustration (3)**

5) Deflation: Divide the value relative of ISIC-4.dig Industry(A) by PPI appropriate for Industry(A) (Suppose that the PPI is: base month=Month(-3)=100, Month(0)=132, Month(1)=146, Month(2)=152) to obtain the volume relative (IIP) of the Industry.

Note:  $IIP_t = (\text{volume relative in period } t) = (V_t / V_0) \times 100$ , where  $V_t = O_t / (p_t / p_0) = (Q_t \times p_t) / (p_t / p_0) = Q_t \times p_0$  = Value of  $O_t$  at constant base-year prices

	Base mon.(0)	Month (1)	Month(2)
Value relative of Industry(A)	100.0	141.2	130.3
PPI(base month=Month(-3))	132.0	146.0	152.0
Re-referenced PPI(base month=Month(0))	100.0	110.6	115.2
<b>Volume relative (IIP) of Industry(A)</b>	<b>100,0</b>	<b>127.7</b>	<b>113.1</b>

## **IIP production - Numerical illustration (4)**

- 6) Aggregate the IIPs of the ISIC-4.dig Industries (A), (B) and (C) all of which are the components of ISIC-3dig Class(I), to obtain IIP of the ISIC-3dig Class(I) by applying the Laspeyres-type formula. For this, obtain the value-added weights of the three ISIC-4.dig Industries based on the latest available annual data on value added for the three industries. Suppose the weights of the ISIC 4-dig Industries (A), (B) and (C) are respectively 0.5, 0.2 and 0.3.

	Base mon.(0)	Month (1)	Month(2)
IIP of Industry(A) [weight=0.5]	100,0	127.7	113.1
IIP of Industry(B) [weight=0.2]	100.0	120.0*	150.0*
IIP of Industry(C) [weight=0.3]	100.0	130.0*	170.0*
<b>IIP of ISIC-3.dig Class(i)</b>	<b>100.0</b>	<b>126.9</b>	<b>137.6</b>

\* = Created for the illustration.

- 7) Similarly , obtain ISIC-2.dig and 1.dig classes' IIPs.

## *IIP production - (cont'd).*

### ***2. Using the volume extrapolation method to calculate the IIPs of ISIC classes that produces homogeneous products:***

The procedures are basically the same as those of the deflation method but no deflation is implemented.

## ***Chain linking of the IIP on weight change***

Supposing that the value-added weights of ISIC classes are updated every January, the new series (which consists of twelve data points) of the latest year(Y) should be linked to the old series up to December of year t-1 to produce a continuous series without recalculating the whole historical time series each time when weights are updated. Instead only re-referencing of the IIP is required.

To link old series up to month (t-1) and new series for month (t) onward, an annual overlapping month (t), in which the index has to be calculated using both the old and new sets of weights, is needed.

$$\text{Link factor} = \text{Index}_{\text{old-base}} / \text{Index}_{\text{new-base}}$$

Re-referencing: Apply the following re-reference factor to the historical series:

$$\text{Re-reference factor} = \text{Index}_{\text{new-base}} / \text{Index}_{\text{old-base}}$$

## ***Chain linking of the IIP on weight change – Numerical illustration***

Suppose that the first reference month of the IIP compiled as the first time is October 2017 and that the value-added weights are updated in January 2018. For instance, the 2017's monthly IIP series and the 2018's monthly IIP series are the following, and by applying the reference factor for the 2017 series, =  $\text{Index}_{\text{new-base}} / \text{Index}_{\text{old-base}} = 100 / 130 = 0.7692$ , a final long IIP series with January 2018 being the base year can be made:

	10.2017	11.2017	12.2017	01.2018	02.2018	03.2018
2017 IIP (based on initial weights)	100	106	114	130		
2018 IIP (based on new weights)				100	124	130
Final IIP	77	82	88	100	124	130

# Seasonal Adjustment

After several years of observation for the patterns and extents of seasonal fluctuations, seasonal adjustment based on such observations could be made. In the case of IIP, seasonal adjustment should be applied to the IIP data at the lowest level of aggregation. However, the seasonally adjusted data are only to complement the original data.

While the seasonal adjustment process can remove some part of the seasonality, it cannot remove the working/trading day variations or the moving-holiday effect (e.g., Ramadan).

In practice, no unique method exists on how to make seasonal adjustment. Furthermore, seasonally adjusted data are subject to revisions as future data become available.

## **Software for automatic seasonal adjustment of IIP time series:**

For the seasonal adjustment of IIP, the United Nations Industrial Development Organization (UNIDO) applies the TRAMO/SEATS method by using Demetra+ software. Demetra+ 1.0.4 (17/12/2012) can be downloaded easily and with compatible with Microsoft Office 2010. The appropriate Microsoft Access Database Engine must be installed by the user to work with Excel workbooks.

See UNIDO statistical working paper 09/2014, Seasonal Adjustment of National Indices of Industrial Production at International Level", Shyam Upadhyaya, UNIDO, Vienna 2015.

## ***Numerical Exercise for calculating IIPs***

Calculate IIP of ISIC 106 based on the data shown in the below three tables. It is assumed that the main products of the ISIC106's two components industries namely ISIC 1061 and 1062 were selected through the latest product survey being based on their annual output produced in 2014, the reference year of the survey.

ISIC 3-dig. Class	ISIC 4-digit class	Main product in terms of 5-digit code of CPC	Value of annual output produced (\$)
106	1061(Manuf. of grain mill products)	23110(Wheat and meslin flour)	400
		23120(Other cereal flours)	650
		23161(Rice, semi- or wholly milled)	200
	1062(Manuf. Of starch and starch products)	23220(Starches, inulin, wheat gluten, etc.)	320

## ***Numerical Exercise for calculating IIPs (cont'd)***

Assume that data on annual value added of the two ISIC 4-digit industries for 2013 for which the latest data are available were extracted from the NSO's GIS database and are those shown in the following table:

ISIC 34-dig. class	ISIC 4-digit class	Annual value added (\$)
106	1061(Manuf. of grain mill products)	680
	1062(Manuf. Of starch and starch products)	220

## ***Numerical Exercise for calculating IIPs (cont'd)***

Assume

- that monthly time series data on output sold in current dollars of the four main products are those shown in the following table, and
- that the base month of the IIP to be compiled be January 2017.

Main product	Jan. 2017	Feb. 2017	Mar. 2017	Apr. 2017	May 2017
CPC 23110	20	28	26	36	50
CPC 23120	38	40	46	60	70
CPC 23161	16	20	28	35	40
CPC 23220	22	44	30	40	45

## ***Numerical Exercise for calculating IIPs (cont'd)***

Assume that monthly time series data on PPI (Base month = July 2016) for the two ISIC 4-digit industries are those shown in the following table:

	Jan. 2017	Feb. 2017	Mar. 2017	Apr. 2017	May 2017
ISIC 1061	120	130	135	144	150
ISIC 1062	110	115	120	130	140

## ***Numerical Exercise for calculating IIPs (cont'd)***

By step-by-step, calculate IIP of ISIC 106.

	Jan. 2017	Feb. 2017	Mar. 2017	Apr. 2017	May 2017
Value relative of CPC23110	100				
Value relative of CPC23120	100				
Value relative of CPC23161	100				
Value relative of CPC23220	100				
Value relative of ISIC1061	100				
Volume relative (IIP) of ISIC1061	100				
Value relative of ISIC1062	100				
Volume relative (IIP) of ISIC1062	100				
IIP of ISIC 106	100				

*Thank you for  
your attention and patience  
and for providing me with  
valuable information, suggestions and  
questions!!*

***All the Best!!***