# INFORMATION PAPER ON CHAIN LINKING OF MONTHLY INDEX OF INDUSTRIAL PRODUCTION (2019 = 100)

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# CHAIN LINKING OF THE INDEX OF INDUSTRIAL PRODUCTION (2019=100)

## A) Introduction

1. The index of industrial production (IIP) measures the real output of the manufacturing sector. It is an important indicator of the performance of the manufacturing sector in Singapore.

2. The EDB Research and Statistics Unit (RSU) has been computing the IIP using the fixed weight method, i.e. using a fixed basket of industries, commodities and a weight pattern in the base year. It has recently updated the IIP compilation method and now compiles the annual chain link IIP from reference year 2019 onwards. With the annual chain linking method, the weight-pattern used in computing the production indices is updated annually using information from the latest annual Census of Manufacturing Activities (CMA).

## B) Computation of Chain Link Index of Industrial Production

3. The IIP is compiled using the Laspeyres annual chain linking method, starting from year 2019. The IIP is first computed at the commodity level, and progressively built up to the industry (at SSIC[1] 5-digit level), industry division (at SSIC 2-digit level) and total manufacturing level using relevant weights. As the weight-pattern is updated annually, the industry, industry division and overall manufacturing indices will not be comparable over the years. Hence, the indices of the respective series are chained together to ensure comparability across time.

4. In mathematical terms, the construction of the production indices by Laspeyres annual chain linking method is as follows:

[1] SSIC refers to the Singapore Standard Industrial Classification

For month *m* of current year *t*

Let $q_{t-1}^{i}$ be the average quantity of the i[th] commodity produced in the year *t-1*

$q_{t,m}^{i}$ be the quantity of the i[th] commodity produced in the month *m* of current year *t*

Then $UI_{t,m}^{i} = \frac{q_{t,m}^{i}}{q_{t-1}^{i}}$ is the quantity of the i[th] commodity produced in the month *m* of current year *t* relative to the average quantity produced in the <u>previous year</u>

$$UI_{t,m}^{j} = \sum_{i}^{n_i} W^{i} UI_{t,m}^{i}$$

where $UI_{t,m}^{j}$ is the monthly unchained index of the j[th] industry (at SSIC 5-digit level)

and $W^{i}$ is the weight of the i[th] commodity within the j[th] industry, which has $n_i$ commodities, based on latest CMA

$$UI_{t,m}^{k} = \sum_{j}^{n_j} W^{j} UI_{t,m}^{j}$$

where $UI_{t,m}^{k}$ is the monthly unchained index of the k[th] industry division (at SSIC 2-digit level)

and $W^{j}$ is the weight of the j[th] industry within the k[th] industry division, which has $n_j$ industries, based on latest CMA

$$UI_{t,m}^{tot} = \sum_{k}^{n_k} W^{k} UI_{t,m}^{k}$$

where $UI_{t,m}^{tot}$ is the monthly unchained index at the total manufacturing level

and $W^{k}$ is the weight of the k[th] industry division within the manufacturing sector, which is divided into $n_k$ industry divisions, based on latest CMA

To derive the monthly chained index for each industry, industry division and total manufacturing

$$I_{t,m}^{j/k/tot} = UI_{t,m}^{j/k/tot} \times I_{t-1}^{j/k/tot}$$

where $I_{t,m}^{j/k/tot}$ is the monthly chained index of the j[th] industry, k[th] industry division or total manufacturing

and $I_{t-1}^{j/k/tot}$ is the annual chained index of the j[th] industry, k[th] industry division or total manufacturing in the previous year

## C) Differences in Fixed Weight and Chain Link Method

5. The fixed weight method of index compilation uses a fixed weight-pattern in the base year which is updated every four years. However, this method produces less accurate IIP growth rates overtime as the structure of the manufacturing sector changes from the base year, making the fixed weight-pattern outdated. By contrast, the chain link method uses a weight-pattern which is updated annually from the latest CMA. The resultant IIP growth rates will better reflect the structure and performance of the manufacturing sector.

6. The additive property of the IIP means that indices at an aggregated level (e.g. total manufacturing level) can be derived by multiplying the sub-aggregate indices with their respective weights. The additive property is present in the fixed weight method from the base year onwards but is generally not present in the chain link method. This is due to the inherent mathematical property of annual chain linking, where industry weights are applied to derive the indices at aggregated levels before the chaining occurs.

7. Table 1 summarises the advantages and drawbacks of the fixed weight and chain link methodologies in the computation of the IIP.

**Table 1: Comparison of Fixed Weight and Chain Link methodologies**

| Methods | Advantages | Drawbacks |
|---|---|---|
| **Fixed weight method** | Additive property of sub-aggregate series holds from base year onwards | IIP growth rates become less accurate overtime as the weight-pattern becomes outdated |
| **Chain link method** | IIP growth rates are more reflective of the current manufacturing structure and performance as the weights are more up-to-date | Additive property of sub-aggregate series does not hold |

## D) Linking Historical Series to the New Chain Link Series

8. The historical IIP up to 2018 are linked to the new chain link series starting from 2019 to ensure there is a continuous time series for analysis. Known as multi-period linking, this methodology is advantageous in that it preserves the year-on-year as well as the month-on-month growth rates for the newly linked series. The series prior to 2019 are linked to the new series by normalising them to the new base year using the formula below:

$$\textit{Linked 2019-based Index} = \textit{2015-based index} \times \textit{factor}$$

$$\textit{Whereby factor} = \frac{annual\ (2019-based\ )\ index}{annual\ (2015-based)\ index}$$