A guide | Producer Price Index

Abstract: The Producer Price Index (October 2012=100), is an outcome of close to two and half years work , by the Statistics Division of the Department of National Planning , under project on system of national accounts and International comparison program by International monetary fund. This document highlights the methodology and compilation process, the data sources used and improvements and changes made in the new system. The document would also look into the limitations and recommendations for future improvements.

December 2013
Maldives

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1 - INTRODUCTION

1.1 What is a price index?

A price index is a measure of the proportionate or percentage changes in a set of prices over time. Each month, prices are collected for a group of well-defined and clearly described products. These prices collected during a specific point in the month are compared with prices at another point in the past. One well-known example of a price index is a Consumer Price Index (CPI); however, there exists another important price index – the Producer Price Index (PPI).

1.2 What is the Producer Price Index?

The PPI measures the average change over time in the prices received by domestic producers of goods and services. The PPI is very important to Maldives for a variety of reasons. Up to the present, the Statistics Division, Department of National Planning, publishes the CPI on a monthly basis, while PPI was published infrequently and largely used internally on a quarterly basis for national accounts purposes. A CPI measures changes over time in the prices paid by consumers for a representative set of goods and services. The introduction of an updated and revised PPI in Maldives will provide a more complete picture of price movement and trends for policy-makers and private sector decision-makers.

The PPI provides a weighted average of the price changes in a group of products between one time period and another. The average price change over time cannot be directly observed and must be estimated by measuring actual prices at different points in time. Price index numbers are compiled from the collected price observations through time; their significance lies in a series of index numbers referencing the comparison prices between a particular period and a reference base. For an index to provide information on price changes, at least two index numbers from the same series need to be available, and these index numbers must relate to the same basket of goods and services

The PPI does not attempt to measure the actual level of prices but is limited to the measurement of the average change in prices from one period to another. The PPI does not measure the value of production or cost of production.

In general terms a PPI can be described as an index designed to measure the average change in the price of goods and services either as they leave the place of production or as they enter the

production process. Thus, producer price indices fall into two clear categories: input prices (that is, at purchaser prices) and output prices (that is, at basic or producer prices). The 1993 SNA (paragraph 6.205, page 151) defines basic and producer prices as follows:

> The ***basic price*** is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer;
>
> The ***producer's price*** is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, or similar deductible tax, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer.

Similar to many countries, in Maldives PPI is compiled at basic prices. The difference between basic and producer prices is generally the per unit subsidy that the producer receives and taxes on production. While basic prices are preferred in the PPI because they represent the per unit revenue received by the producer, producer prices may have to be used when information on subsidies is not available. In most cases producers do not receive subsidies, so the basic and producer prices will be the same.

Thus, output prices should be the basic prices received by the producer. The output price index measures the average price change of all covered goods and services resulting from an activity and sold on the domestic market and also on export markets.

PPI prices should be actual transaction prices, which can be directly recorded. The price should be recorded at the time when the transaction occurs (ownership changes) rather than when the goods are ordered, which in certain cases can be significantly different.

1.3 Why is the Producer Price Index important?

The PPI is an important economic indicator for Maldives and any individual economy. Producer Price Indices are used for many purposes by government, business, labor, universities, and other kinds of organizations, as well as by members of the general public. .Uses of the PPI include:

A) **Short- term Indicator of inflationary trends** – Maldives' monthly PPI with detailed industry data will serve as a leading indicator of price change in the economy. A monthly

or quarterly PPI with detailed product and industry data allows short-term price inflation to be monitored through different stages of production and is a key use of the PPI. The key users of the PPI as a short-term indicator are central banks and government finance ministries or departments. Also, many companies (including investment banks and brokerage firms) and government agencies require the data for macroeconomic forecasting.

A) **Deflator of economic series** – The PPI will be used to deflate gross domestic product (GDP) estimates to create a series in constant terms. Other important economic data series can also use the PPI to remove the effect of prices changes to produce estimates of real change over time. In other words a vital use of the PPIs is as a deflator of output or sales data for the compilation of production volumes and the deflation of capital expenditure and inventory data for use in the national accounts.

B) **Productivity analysis** – The PPI can be used to deflate the nominal value added of an industry into a real value added. These industry measures of real value added are then divided by labor input to the industry to form estimates of industry labor productivity or are divided by an index of industry primary input usage to form estimate of industry total factor productivity. Productivity increases act as a primary driver of a higher standard of living, so it is of some interest to try to determine which industries are the main drivers of productivity improvements.

C) **Contract escalation** – The PPI can be used as an escalator to index long-term contracts for goods and services. In this case, the PPI can be used to adjust the value of the monetary amounts stipulated in the goods and services based on the increase or decrease in the level of a specific index. The main purpose of the indexation is to take the inflationary risk out of the contract. The PPI provides an independent measure of the change in prices of the good(s) or service(s) being considered. Indexation is common to long-term contacts, where even relatively small levels of inflation can have a substantial effect on the real value of the revenue flows.

D) **Current cost accounting** – The PPI can be used for current cost accounting by businesses. Current cost accounting is a method of accounting for the use of assts in which the cost of using the assets in production is calculated at the current price of those assets rather than by using the historic cost (the price at which the asset was originally purchased). In current cost accounting, the price index used should not be a general price index but should be specific to the asset being used. Thus the PPI can be used to estimate the current value of a business' capital assets.

A) **Business analysis** – the PPI enables business owners to make a comparison of trends in their own business with those of the industry group. Detailed PPIs can be useful to businesses and researchers looking at specific products and markets. Companies can use PPIs to compare the growth rate of their own prices with those of the representative index for the industry or the commodity. This can be done at a very detailed level, where fine PPI aggregations are published. Researchers looking at specific markets can also gain an understanding of conditions in the market by examining PPIs.

B) **Policy-making** – The PPI is used as an important tool during the design and formulation of policies and analysis of inflation by the Maldives Monetary Authority and other governmental ministries; such as the Ministry of Finance.

Hence private business firms use PPI data to assist their operations in a variety of ways, in addition to using the data for general economic analysis or deflation as just discussed. PPIs frequently are cited in price escalation clauses of long-term sales or purchase contracts as a means of protecting both the buyer and the seller from unanticipated surges or drops in prices. Private companies also can compare changes in the prices they charge for their own output with changes in the PPI for the same kind of product.

1.4 How does the Producer Price Index differ from the Consumer Price Index?

While both the PPI and CPI measure price change over time for a fixed set of goods and services; they differ in two critical areas: (1) the composition of the set of goods and services, and (2) the types of prices collected for the included goods and services.

The target set of goods and services included in the PPIs is the main marketed output of Maldivian producers. The set includes both goods and services purchased by other producers as inputs to their operations or as capital investment, as well as goods and services purchased by consumers either directly from the service producer or indirectly from a retailer. Because the PPI target is the output of the producers, imports are excluded.

The target set of items included in the CPI is the set of goods and services purchased for consumption purposes by a typical household. This set includes imports.

The price collected for an item included in the PPIs is the revenue received by its producer. Sales and excise taxes are not included in the price because they do not represent revenue to the producer.

The price collected for an item included in the CPI is the out-of-pocket expenditure by a consumer for the item. Sales and excise taxes are included in the price because they are necessary expenditures by the consumer for the item.

The differences between the PPI and CPI are consistent with the different uses of the two measures. A primary use of the PPI is to deflate revenue streams in order to measure real growth in output. A primary use of the CPI is to adjust income and expenditure streams for changes in the cost of living.

1.5 How is an index interpreted?

An index is a tool that simplifies the measurement of movements in a numerical series. Movements are measured with respect to the base period, when the index is set to 100. Currently, PPIs price reference is October 2012 = 100. An index of 110, for example, means there has been a 10-percent increase in prices since the base period; similarly, an index of 90 indicates a 10-percent decrease. Movements of price indexes from one month to another are usually expressed as percent changes rather than as changes in index points because index point changes are affected by the level of the index in relation to its base period, while percent changes are not. An advantage of calculating percent changes is that the result will be the same no matter what base period is specified. The example below demonstrates the computation of index point and percent changes.

Producer Price Index	Jan	Feb	Index point change	Index Percent change
Fishing	106	107	1.0	0.9
Tourism	112	115	3.0	2.7

Note:

- Index point change is the difference of current index and previous index. (107-106= -1.0)
- Index percent change is index point change divided by the previous index multiplied by 100. (1.0/106*100= 0.9)

1.6 PPI System

The Producer Price index is compiled using the Price Index Processor - Version 3.0: Producer Price Index System (PPI System). It is application software developed for assisting IMF member countries in compiling their PPIs. The system can also be used for teaching, training, and research purposes. Its main function is to compile PPI for all items by industry, by product, by establishment, and by geographic location.

The PPI System follows the guidelines of the Manual – Producer Price Index Manual: Theory and Practice – (2004), Washington D.C. International Monetary Fund, et al. URL: http://www.imf.org/external/np/sta/tegppi/, which provides guidance about concepts, definitions, classifications, coverage, valuation, recording data, aggregation procedures, formulas, and so on.

The PPI System calculates indices as weighted averages of the percentage price changes for a specified set, or basket of products, the weights reflecting their relative importance in producer goods in some period.

2- WEIGHTS AND THEIR SOURCES

The PPI is calculated from many prices collected from all types of establishments, covering the selected economic activities and products. Because some products have greater production or sales than others, each product is given a weight to represent its importance in total output or sales during the reference (base) period for the weights. To arrive at the aggregate index figure, the price relatives of the individual products are multiplied by these weights to derive a weighted average aggregate index.

Thus, the weights are key elements in the construction of a PPI. They determine the impact that a particular price change will have on the overall index. For example, in the Hotels and restaurants industry, a 5 percent rise in the price of *beach villa* would have a much greater impact on the average rate of price change in the producer sector than a 5 percent increase in the price of Coca-Cola because the output value of *beach villa* is higher than that for Coca-Cola.

Without weights, relative price changes for all commodities in the PPI basket would be given equal importance in the calculation of the index above. Of course, if there is no dispersion of price changes, then weights would be unimportant.

Over time, establishment production levels shift in response to economic conditions. Some products and industries become more important while others become less important. Weights in the PPI should be updated periodically to reflect these changes in market structure. Best practice suggests that this be done at least once every five years.

Preferably value weights are most appropriate as PPI is used as a deflator for output (production) and a measure of inflation and the value weights that are most appropriate for these uses would be the value of output (sales plus changes in inventories). If production values are not available, then sales or value of shipments could be used. The value weights should

reflect quantities produced valued at basic prices (excluding taxes and transport fees, often referred to as "ex-factory gate prices").

Generally the sources of weights are the

1. Economic or Establishment Censuses

   Usually includes complete coverage of all enterprises over a certain size and a sample of smaller enterprises and includes information on detailed product sales and unsold finished goods for a calendar year. Information should be reported by establishment and can be used for weights at the industry, establishment and product level within establishment.

2. Enterprise or Industry Surveys

   Similar information as reported in census, but as detailed and is sample based estimates for particular strata rather than complete coverage. Generally provides estimates for industry and by product line, but only limited detail by establishment and product within establishment

3. Business Registers

   Usually contains information on industry, enterprise location, and measure to determine the size and typically does not contain detailed product information. If a register is used, it will generally require additional sampling within establishment to derive product and transaction weights.

2.1 Weights at Industry level

From the above mentioned sources for deriving weights, the Maldives had conducted its first Economic survey in 2007. However the data obtained was not sufficient enough for the purpose of deriving weights as some important industries were not covered adequately.

Alternatively, since PPI is a measure of change in the prices received by domestic producers for their outputs or of the change in the prices paid by domestic producers for their intermediate inputs, PPI weights are calculated from gross output. Specifically, the value aggregate from the national accounts framework that aligns with the basic price received by the producer of goods and services is the value of production. Thus, when estimating the PPI using the weighted average of long-term relatives formula (that is, the current price divided by the base-period price, the best approach would be to have value of production weights at basic prices for all

levels of index aggregation (from the elementary aggregate level of product/ commodity within the establishment to the total output index by industry or product).

PPI's base is equal to 2007 and reference period is equal to October 2010. The industry weights were drawn from the Maldives supply and use table (SUT) 2007. In the SUT 2007, the data for the domestic production in the supply table as well as intermediate consumption in the use table were predominantly taken from the Economic Survey 2007 (ES). As for hotels industry, being the major economic activity of the country, ES data was not sufficient enough to cover the input and output of tourist resorts, safari vessels, hotels and guest houses. Therefore data from the annual financial accounts of enterprises were used to complement the data from the ES. The final sample data, accounted for about half of the total tourist bed-nights for the year. The total number of bed-nights was used to raise the sample data to the population levels. The total income was then divided in to different product categories using the ratios from SUT 2003.

The appropriate data source for deriving weights for PPI would be the Establishment Survey (ES). However, the response rate was not adequate enough for deriving weights so far. As a temporary solution, weights have been derived using different other data sources. In this process, the basic weight structure by ISIC was taken from the SUT 97, which provided the distribution of gross output and value added by industries and by institutional sectors (excluding government sector).

For the purpose of weight calculation, distribution of gross output as well as of value added for major ISIC division was taken only for non-financial corporation sector. The percentage distribution of gross output by ISIC derived from SUT 2007 is presented below.

Table 1.1: Contribution of industry groups to Gross output, in %
(Derived from SUT-2007)

Industry description	GO MRV 000s	% share SUT	New PPI Weights	old PPI weights
Fishing	660,921	1.22%	2.82	6.02
Manufacture of fish products	1,603,763	2.97%	6.85	4.60
Manufacture of beverages	174,126	0.32%	0.74	1.13
Manufacture of other food products	88,737	0.16%	0.38	0.48
Wearing apparel	388,081	0.72%	1.66	4.30
Manufacture of paper and paper products; Publishing, printing	144,609	0.27%	0.62	0.67
Manufacture of motor vehicles, trailers and semi-trailers; other transport equipment (Boat Building)	345,898	0.64%	1.48	0.22
Electricity, gas, steam and hot water supply	1,247,889	2.31%	5.33	2.81
Collection, purification and distribution of water	201,542	0.37%	0.86	0.53
Hotels and restaurants	13,132,998	24.32%	56.06	57.38
Water transport	871,152	1.61%	3.72	4.87
Air transport	1,053,080	1.95%	4.49	7.48
Post and telecommunications	1,691,839	3.13%	7.22	6.02
Education	933,144	1.73%	3.98	1.27
Health and social work	890,847	1.65%	3.80	0.01
TOTAL GO	53,991,045	43%	100.00	

Out of the total of non-financial sectors, above table has included only those activities, which are included in the index system. For example, agriculture, mining and quarrying and some service sectors are excluded. The selections of industries were made such that all industries to be deflated by PPI in the GDP compilation system were included. Additionally electricity and 'collection, purification and distribution of water' sectors were included as price movements of these sectors are vital. Conversely 5 manufacturing sectors (namely furniture, chemical products, cement products, structural metal products and machine tools) were omitted in the new PPI which constituted 2 percent in PPI 2001. Initial weights calculated for activities were proportionally allocated.

The base weight as well as the number of products and transactions selected for PPI is given below.

Table 1.2: Number of selected establishments, products and weight structure for PPI by ISIC

Industry description	Weights	No of Establishments	No of Products	No of Transactions
Fishing	2.82	4	8	13
Manufacture of fish products	6.85	6	21	29
Manufacture of beverages	0.74	4	5	13
Manufacture of other food products	0.38	6	17	45
Wearing apparel	1.66	3	4	15
Manufacture of paper and paper products; Publishing, printing	0.62	7	25	64
Manufacture of motor vehicles, trailers and semi-trailers; other transport equipment (Boat Building)	1.48	2	4	10
Electricity, gas, steam and hot water supply	5.33	3	7	16
Collection, purification and distribution of water	0.86	1	3	15
Hotels and restaurants	56.06	34	97	243
Water transport	3.72	4	13	30
Air transport	4.49	2	3	22
Post and telecommunications	7.22	2	6	11
Education	3.98	8	33	70
Health and social work	3.80	7	34	65
Total	**100.00**	**93**	**280**	**661**

2.2 Weighs at Establishment, Production and transaction level

Since the establishment survey was not adequate enough and the fact that a comprehensive business register is not established as yet in the Maldives, the establishments were selected purposively. When using purposive sampling (also known as judgmental or subjective samplings), the samples are selected purely by judgment. Hence the establishments selected were judgmental.

The table below shows the number of establishments selected by industry and the number of respondents.

Table 1.3: Sample size

Industry description	New PPI Weights	No of Establichments		
		Intial Basket	Final basket	Rejects
Fishing	**2.82**	**4**	**4**	**0%**
Manufacturing	**11.72**	**41**	**28**	**32%**
Manufacture of fish products	6.85	6	6	0%
Manufacture of beverages	0.74	4	4	0%
Manufacture of other food products	0.38	7	6	14%
Wearing apparel	1.66	7	3	57%
Manufacture of paper and paper products; Publishing, printing	0.62	12	7	42%
Manufacture of motor vehicles, trailers and semi-trailers; other transport equipment (Boat Building)	1.48	5	2	60%
Electricity, gas, steam and hot water supply	**5.33**	**9**	**3**	**67%**
Collection, purification and distribution of water	**0.86**	**1**	**1**	**0%**
Hotels and restaurants	**56.06**	**50**	**34**	**32%**
Water transport	**3.72**	**8**	**4**	**50%**
Air transport	**4.49**	**2**	**2**	**0%**
Post and telecommunications	**7.22**	**3**	**2**	**33%**
Education	**3.98**	**12**	**8**	**33%**
Health and social work	**3.80**	**14**	**7**	**50%**
Total	**100.00**	**144**	**93**	**35%**

3: METHODOLOGY

PPI is calculated using a modified/two-stage Laspeyres index and the aggregation is made by geometric means and hence is occasionally referred as Geometric Laspeyres index; and is defined as the weighted geometric average of the current to base period price relatives using the value shares of the base period as weights.

3.1 The Modified or Two-stage Laspeyres Approach

There are several reasons why the Modified Laspeyres Approach is superior to the standard formula.

- First, in the standard formula, the price relatives are compared for the current period to the base period. In practice, the editing of the current period's price data is done by comparing the prices for the collection period for an item with those charged for the same item in the previous period. Any large variations falling outside a predetermined range checks (e.g. 0.8000 to 1.1000) might indicate either the wrong item has been priced or some kind of error has been made in recording the price.

- Second, the standard formula involves a comparison of changes in prices for each item over long time periods, requiring the continuity of priced item specifications. In practice varieties become permanently missing or unrepresentative and need to be replaced with new varieties for which there is no price in the reference period 0 to compare with. In these circumstances, it is advisable to apply a modified version of the Laspeyres formula that makes use of $\left(\frac{p_i^t}{p_i^o}\right)$ the price relative to the previous period so that a new variety can be introduced as soon as two successive price quotes are available.

- Third, when varieties are temporarily missing imputed prices may be used based on the overall price change of the product group in question. Imputations over the short run are likely to be more reasonable than long-run ones.

The basic formula for computing the PPI can be written as:

(1) $$I_{0\to t} = \frac{\sum_{i=1}^{N}\left[\frac{p_i^t}{p_i^{t-1}}\right]\times p_i^{t-1}q_i^0}{\sum_{i=1}^{N} p_i^0 q_i^0} \text{ x 100}$$

where $p_{t-1,i}q_{0,i} = p_i^0 q_i^0 \times \frac{p_i^1}{p_i^0}\times\frac{p_i^2}{p_i^0}\times\ldots\times\frac{p_i^{t-1}}{p_i^{t-2}}$

Formula (1), is considered more versatile than the formula using long-term price relative to the base period, as the linking process used facilitates the introduction of new varieties and/or items or substitution when the need arises and enables more reasonable imputations.

Formula (1) can also be rewritten as:

(2) $$I_{0\to t} = \sum_{i=1}^{N} w_i^0 \times\left[\frac{p_i^t}{p_i^{t-1}}\right]\times\left[\frac{p_i^{t-1}}{p_i^0}\right]$$

which can be interpreted as

(3) $$I_{0\to t} = \sum_{i=1}^{N} w_i^{t-1} \times\left[\frac{p_i^t}{p_i^{t-1}}\right]$$

where $w_i^{t-1} = w_i^0 \times \frac{p_i^{t-1}}{p_i^0}$ is an updated weight sometimes referred to as a "cost weight" of item i.

In other words, to obtain the index for the current period t, the Modified Laspeyres Approach involves multiplying individual price relatives of the latest price compared period

$\left[\frac{p_i^t}{p_i^{t-1}}\right]$ by the previous period's updated weight ( ), and then summing them.[1]

The Modified Laspeyres formula has obvious advantages over the standard Laspeyres formula when we consider the problems arising from permanently unobservable varieties, and the need in due course to bring in a new variety to replace the missing one. There is a need to impute a base period price if the standard Laspeyres formula is used. Such imputation is unnecessary while using the Modified Laspeyres formula, in which case the current period weight for the replacement item is obtained by simply multiplying the last updated weight for the replaced item by the current period's short-term price relative of the replacement item.

The system uses the modified Laspeyres approach to calculate PPI based on monthly price quotations (or monthly average price quotations) and weights information. The price index is assigned a value of 100 in the base period and value of the index for other periods of time, which indicate the average proportionate, or percentage, change in price levels.

Formula (2) can also be rewritten as:

$$I_{0\to t} = \sum_{i=1}^{n} w_{0,i} \times STPR_{t\to 1,i} \times LTPR_{t-1\to 0,i}$$

Where $STPR_{t\to 1,i}$ is the short-term relative of item *i* for current period $\left[\frac{p_i^t}{p_i^{t-1}}\right]$ and

$LTPR_{t-1\to 0,i}$ is the long-term price relative of the item *i* for previous period $\left[\frac{p_i^t}{p_i^0}\right]$

3.2 The Geometric Laspeyres or Young Indices

Aggregation can be either arithmetic, as above, or geometric. The geometric version of the modified Laspeyres index, a weighted geometric average is taken of the price relatives using the output revenue shares of period 0 as weights. It is defined as:

$$I_{0\to t} = \prod_{i=0}^{N} \left[\left(\frac{p_i^{t-1}}{p_i^0}\right) \times \left(\frac{p_i^t}{p_i^{t-1}}\right)\right]^{w_i^0}$$

Similarly, the geometric version of the Young Index if period b ≠ 0, that is, the output revenue shares are different from price reference period 0:

$$I_{0\to t} = \prod_{i=0}^{N} \left[\left(\frac{p_i^{t-1}}{p_i^0} \right) \times \left(\frac{p_i^t}{p_i^{t-1}} \right) \right]^{w_i^b}$$

Users should note that period *b* weights should not be price-updated to period *0* if using the Geometric formula, i.e. a geometric Young may be used but not Geometric Lowe. The user chooses between these formulas by the type of weights inputted: Geo-Young if not updated and Geo-Lowe if updated.

Further, whether the index is a Geometric Laspeyres or Geometric Young depends on whether the user enters weights for period 0 or a preceding period b, and whether the index is an arithmetic Laspeyres or Young or Lowe depends on whether the user enters weights for period 0 or a preceding period b, or price updated weights from b to 0.

The software uses the terminology "Laspeyres" of "Laspeyres-type" leaving it to the user to define the exact nature of the formula by virtue of the weights used. Laspeyres-type formulas are generally used by countries at the higher level and geometric means at the lower level. In spite of this, the geometric Laspeyres-type index has some advantages.

Geometric means are

(i) not as sensitive as arithmetic means to the extreme values,

(ii) are circular, i.e., fulfill a multi-period transitivity property that the product of the price index change going from a period 1 to a period 2 times the price index change going from period 2 to a period 3 should equal the price index going directly from period 1 to 3; and

(iii) more likely to lie between the Laspeyres and Paasche bounds, a desirable property.

3.3 Matched Price Observations

An average price is calculated for each variety comprising the PPI basket. The calculation of average prices would be simple if a set of price quotations were available for the current and previous month. In reality, this does not always happen. Quite often, some of the respondents are unable to quote a price for a particular variety because it is out of stock. Whenever a particular price observation is missing from either the previous month or the current month, the corresponding price observations are eliminated from the other period. This is equivalent to imputing the price of variety 1 in period t by the short-run price change of the other varieties in the product group. This ensures that the price averages are calculated on the basis of "matched observations", i.e., a consistent sample of price quotations in each period.

In the following example we consider that item's prices are collected for eight representative varieties. In the previous month (jan) *transaction 5*'s price cannot be collected (is missing). In the current month (feb) transaction 3's price is also missing.

Transaction	Industry Resorts and Hotels		Month *t-1* Jan	Month *t* Feb
1	Resort a	Beach villa	5,300	5,000
2	Resort a	Delux beach villa	7,000	6,800
3	Resort b	Delux beach villa	10,500	-
4	Resort b	Water villa	13,000	13,200
5	Resort c	Executive beach villa	-	15,000
6	Resort c	Water villa	18,000	18,000
Average			**10,760**	**11,600**
Average for matched observations			**10,825**	**10,750**
(exluding transaction 3 and 5)				
Short-term relative for resorts and hotels $\left[\frac{p_i^t}{p_i^{t-1}}\right]$			=(10,750/10,825)	**0.993**
Geometric mean for matched observations			**9,652.67**	**9,480.50**
(exluding transaction 3 and 5)				

For the PPI calculation of month t, the geometric average price for month t-1 should be recalculated based on matched observations as $(5000*6800*13200*18000)^{(1/4)}$ = **9480.5** and not $(5000*6800*13200*15000*18000)^{(1/5)}$ = 10391.6.

The month t's short-term price relative for item i is then **0.993** (=10750/10825) and not 1.078 (=11600/10760).

3.4 Impute Missing Indices & Prices

Missing price index is estimated using its parent index as the proxy, i.e., if a specific variety's index is missing due to the missing prices, the index of the product or item it belongs to will be taken to be representative. The system always uses the next available level index data in the same group or item for the missing index, e.g., if level 4 index is missing, level 3 index will be used; if level 3 index is missing, level 2 index will be used so on so forth.

Level	Description
1	Manufacturing
2	Manufacture of food products and beverages
3	Manufacture of other food products
4	Manufacture of bakery products
5	Pastry
6	Croissant (Chocolate)
6	Croissant (Plain)
6	Chocolate Danish

Above is a real example. If *Chocolate Danish's* index is missing it will be imputed by the *pastry's* (level 5) index. If Pastry's index is missing it'll be imputed by level 4 – *Manufacture of bakery product's* index.

Holding missing prices for a variety constant by carrying the last observation forward (i.e., making the short-term price relative for that variety equal to 1.0) during a period of high inflation would cause short-term distortion in the index, because it would understate inflation while the variety was unavailable and then show a large increase in the index when the variety became available. The imputation method therefore does not use carry-forward prices.

The price for the same variety in another outlet is not used to represent the missing price in this outlet. Thus if *frozen yellow-fin tuna* index (refer to table below) is missing in outlet a, the system will not take the other outlet's (outlet b's) *frozen yellow-fin tuna* index as a proxy, instead it will take the broader level's index in the same outlet to represent that of *frozen yellow-fin tuna* which would be 103.3.

Outlet	Level	Description	Jan
	1	Manufacturing	102.7
	2	Manufacture of food products and beverages	101.0
	3	Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats	104.5
	4	Processing and preserving of fish and fish products	103.3
a	5	Frozen YellowFin Tuna	
a	5	Chilled yellow fin tuna chunks	103.0
b	5	Frozen YellowFin Tuna	105.0
b	5	Frozen Skipjack Tuna Cut piece -local market	102.0

Since parent group price changes are always calculated as geometric mean changes, imputations are based on geometric means.

Missing prices of one or some varieties then are estimated by multiplying the previous period's price by the current period's short-term price relative of that variety, which in turn was estimated using the index of the item/group. If the previous period's price is not available, the missing price will be estimated by multiplying the reference/base period price by the LTPRs. If both previous period price and base period price are not available, missing price will/can not be imputed.

If no price is collected for any variety covered by a product (the prices for whole product is missing), its price relatives will be imputed using average price relatives from the item group of the missing price.

3.5 Detection of Outliers

What is an outlier?

An observation that is unusually large or small relative to the other values in a price relatives data set is called an outlier. Outliers are the observations that appear to be inconsistent with the remainder of the collected data.

There are several possible sources for outliers:

1. The price quotation of a transaction or variety is observed, recorded, or entered into the computer incorrectly.
2. The price quotation come from a different population, or quality of that transaction/variety has been changed.
3. The price quotation entered is correct, but represents a rare event or unique phenomenon.

Outliers occur when the relative frequency distribution of the data set is extremely skewed. Such distributions have a tendency to include extremely large or small observations.
Two procedures are applied to identify the possible errors and outliers. The first one is non-statistical procedure, which is to find whether specific price observation falls outside some pre-specified acceptance interval usually 20%.
The second one is the statistical procedure, in which three methods are implemented. In both cases outlier detection should not result in automatic deletion. Often price changes are undertaken after some time and the "pent-up" prices changes are unusually large. To delete them would bias the index downwards. The outlier detection is to alert the compiler about a possible error that needs further investigation.

3.51 Method of using z-score:

In a z-score test, the mean and standard deviation of the entire data set are used to obtain a z-score for each data point, according to following formula:

$$Z_i = \frac{(x_i - \bar{x})}{s}$$

where $s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$

If the observations have a bell shaped distribution (standard normal distribution), the interval from $\bar{x} - s$ to $\bar{x} + s$ will contain approximately 68% of the measurements; the interval from $\bar{x} - 2s$ to $\bar{x} + 2s$ will contain approximately 95% of the measurements, and the interval from $\bar{x} - 3s$ to $\bar{x} + 3s$ will contain approximately all of the measurements.

In the case of price relatives, the underlying distribution of data set is unknown. Many studies of price change show that price relatives are not normally distributed. Thus Chebyshev's theorem which applies to all possible distributions is used. According to Chebyshev's theorem, for any set of measurements and any number $k \geq 1$, the interval from $\bar{x} - s$ to $\bar{x} + s$ will contain at least (1 - 1/k2)*100 percent of the measurements.

Thus, at least 88.8 percent of all the observations in a data set will have z-score less than 3 in absolute value i.e. fall into the interval($\bar{x}-3s, \bar{x}+3s$) and at least 75 percent will fall within 2 standard deviations, where $\bar{x}$ is the mean and *s* is the standard deviation of the sample. Therefore, the observations with z-score greater than 3 will be potential outliers

Example

The short-term price relatives measured by dividing current period prices by previous period prices are recorded in following table.

Sample Data for Short-Term Price Relatives

100	98	103	**121**	104	102
101	102	101	102	105	105
103	110	100	104	106	102
85	102	101	103	110	101
101	104	105	106	107	100

For this data set, $\bar{x}$ =103.1333, s= 5.4818, 3s=16.4454,
Z-score of the observation of 121 is

$$Z_{121} = \frac{(x_i - \bar{x})}{s}$$
$$= \frac{(121-103.333)}{5.4818} = 3.2593$$

Z-score of 85 is

$$Z_{85} = \frac{(x_i - \bar{x})}{s}$$
$$= \frac{(85-103.333)}{5.4818} = -3.3079$$

Since the absolute values of z-score of 121 and 85 are more than 3, the price relatives 121 and the 85 are outliers in the data set.

The Z-score method is biased by the problem that both the mean and standard deviation are affected by the outliers.

3.52 Box Plots Method

Another procedure for detecting outliers is to construct box plots of the price relatives' data. They make no distributional assumptions and, since they rely on the median and quartiles as parameters, the method of detection is not influenced by the outliers themselves. Below are the steps implemented in constructing the box plots.

The median M, lower and upper quartiles, QL and QU, and the inter-quartile range, IQR = QU - QL are calculated for the data set.

Two sets of limits on the box plot are constructed: inner fences are located a distance of below QL and above QU; outer fences are located a distance of below QL and above QU.

Observations that fall between the inner and outer fences are called suspect outliers. Locate the suspect outliers on the box plot using asterisks (*).Observations that fall outside the outer fences are called highly suspect outliers.

How the Quartile is Calculated?

Quartile calculation depends on the percentiles definition. The First quartile is the 25th percentile (noted Q1), the Median value is the 50th percentile (noted Median), and the Third quartile is the 75th percentile (noted Q3)

The method to calculate the quartiles in the application is same as that used in Excel. It uses n-1 instead of n. the p-th percentile is defined by:

$$y = (1-g)\times x(j+1) + g\times(j+2)$$

Where $(n-1)\times p = j + g$

And $x(0)$ is taken to be $x(1)$

Let n be the number of observations in a data set (here $n=4$), *and X(1)…X(n)* the ordered values of a data set. Let p be the p-th percentile to be calculated (e.g. p=0.25, 0.5, or 0.75). Calculate the product $n\times p$. The product $n\times p$ can be split up between j and g, where j is the integer part of $n\times p$ and g is the decimal part of $n\times p$.

Example
To better understand this method, an example is illustrated below.

The data set studied is:

Variable	X1	X2	X3	X4
Value	2	1	4	3

Once ordered it becomes:

Variable	X1	X2	X3	X4
Value	1	2	3	4

In this example, for Q1, p=0.25, n=4,

$$\begin{aligned}(n-1)\times p &= 3\times 0.25\\ &= 0.75\times X(2)\\ &= (0.25\times 1) + (0.75\times 2)\end{aligned}$$

$$= 1.75$$

thus the 25th percentile is 1.75 with this method.

3.53 Log-normal Method

Another procedure that has been implemented into the software to identify the possible errors and outliers is to use 2s from the log-normal distribution, excluding price relatives of 100 (no change of prices from previous to current period). It takes the natural logarithms of price relatives data, which is assumed log-normally distributed. The standard deviation and mean of the logged of all price relatives in the sample are calculated. Those price relatives that fall outside of 2 standard deviations (with 95% confidence level) are considered as possible outliers.

3.6 Calculating Adjusted Weights

If sampling establishments so that some are selected with certainty, say as a cut-off sample, and some are selected to be representative of the remaining establishments the weights of each establishment in the latter need to be adjusted. Further, establishments may disappear from the active sample and it may be necessary to redistribute the weight across the active sample. These two effects are picked up in an adjustment routine for the weights. The establishment adjusted weight is calculated based on the sample group to which the establishment is classified. For the sample group selected with certainty, an establishment adjusted weight is equal to the establishment assigned weight. They only represent themselves, w_i^c. For the probability selected establishments, p, the weights are assumed equal for each establishment and assigned as

$$w_i^p = \frac{W^T - \sum w_i^c}{n}$$

Where W^T is the total weight for the sample group and

n is the number of establishments in the probability group.

However, if establishment(s) disappears from the sample, though still sell goods and services in reality, the weights of the remaining establishments can be adjusted so that those still active get allocated a *prorata* share of those that are "inactive" within its sample segment. If there were 5 selects initially and they each had a value weight of 20 and one disappears and 4 remain, each would get a weight of 25.

An establishment adjusted value weight is equal to an establishment assigned value weight (20) divided by the total value weight of establishments that are active in the product group (80), then times the total value weight of establishments (both active and inactive establishments) of the product group (100) i.e.

$$W^{adj} = \frac{W_i^{Assigned}}{\sum_i^n W^{active}} \times \sum_i W_i^{Total}$$

in which W^{adj} is adjusted weight of an establishment i;

$W_i^{Assigned}$ is assigned weight of an establishment i,

$\sum_i^n W^{active}$ is the total weight of active establishments and

$\sum_i W_i^{Total}$ is the total weights of all the establishments.

This is to say that weights of those inactive establishments will be taken and redistributed to the active establishment based on its share in total active weights.

In the probability selected group, the adjusted weight for an establishment being selected with probability is:

$$W^{adj} = \frac{\overline{W}^{Active}}{\sum_i W_i^{active}} \times \sum_i W_i^{Total} = \frac{1}{n} \sum_i W_i^{Total}$$

and the adjusted weight to represent establishments no longer active is:

$$W^{adj} = \frac{\frac{1}{n} \sum_i W_i^{Total}}{\sum_i W_i^{active}} \times \sum_i W_i^{Total}$$

4. REBASED PPI

4.1 Data sources and collection methods

Data sources are the selected establishments from which monthly data are collected on a quarterly basis. All chosen establishments are based in capital Male' with the exception of resorts. All prices are requested for the 15th of each month or the nearest date. Data is requested from 10th to 15th on the last month of each quarter. Data is required to report by the end of these months.

PPI in the past was compiled quarterly with quarterly data. But in the rebased PPI, although the frequency of collection is still quarterly the data will be monthly which is the most common practice.

When collecting prices for a particular period, there are two basic choices of collection period: point-in time or period averages. In the past the prices obtained were period averages but in the rebased series the data is collected for a particular point in time.

Medium of data collection

The data is solely collected through emails, which allows the survey form to be delivered and returned electronically. It is also useful as a reminder technique, since it offers speedy contact with respondents. Follow up and enquiries are dealt by both email and phone

Point-in-time

Point-in-time prices relate to the price of a product on a particular date in the month—for example, first day, first Monday, the nearest trading day to the fifteenth of the month, etc. This approach makes the collection date straightforward, and it should be well understood by the business establishment that prices provided relate to transactions on that date. Current price collection is asked for the 15^{th} of each month or the nearest trading day.

The main advantage of point-in-time pricing is that comparisons from month to month will be consistent, which is particularly important when there are step changes in prices taking place during the month, such as a general price increase or duty changes. One of the disadvantages of a set point in time for producer price indices is that a transaction may not have taken place on the specified date. If this happens, respondents can be asked to provide details of a transaction that occurred as near as possible to the specified date. Another problem is that point-in-time estimates are more susceptible to short-term external influences (for example, extreme weather, labor stoppages) that could affect the price on the particular day of price collection. They may also miss short-term price changes (for example, rise and fall) that occur between pricing dates.

4.2 Product Specification

Unlike the old PPI, the specifications of the new PPI are very tightly specified which will help to avoid quality differences in the prices changes from period to period. Price collection is a vital part of the overall PPI compilation process. Without good quality price collection procedures, it is difficult or impossible to produce accurate and reliable results, regardless of how rigorous the subsequent processing is throughout the remaining steps of producing the PPI.

A price observation or product specification is defined as the price of a specific product at the point in time or for the period of price collection and its terms of sale. To ensure consistency in the final index, the price observation should compare like with like for each period. The product should be defined as tightly as possible so that the returned price is consistent from period to period and changes in quality can be identified. The price should be one that a customer has paid for the specified product and include all available discounts and special offers— that is, a real transaction price. If the product specification changes from one period to another, the price needs to be adjusted to ensure consistency.

The PPI's aim is to measure actual prices paid to or received from producers for goods or services. These are commonly referred to as transaction prices. By definition, these prices include all discounts or rebates given. The price of goods or services as quoted in a catalogue or advertisement is often referred to as the list price, book price, or recommended retail price. These prices are typically higher than transaction prices, as discounts or rebates apply to transaction prices. It is usually easier for a respondent to provide a list price rather than a transaction price. For the reasons already stated, this is not appropriate. Because it is difficult to price a transaction, to achieve constant quality, compilers should ensure that the product priced is the same as that priced in the previous period.

There are a number of different aspects of product specification. For example, simply giving a product name will not be sufficient if the size of the package changes, which would, in turn, affect the price received. The essential purpose of a good product specification is to ensure that a consistent price is collected from period to period, relating to a consistent product with the same terms of sale in each period. Table 4.1 lists the main criteria that could affect the price of a product and could form part of a specification.

Table 4.1. Criteria That Affect a Product's Price

Item	Criteria / Reason
Product name	Company's name for the product within the specified product group. Thisshould ideally contain information on the model/variety of the product.
Serial number	For the company's reference. This allows for changes in product name.
Description	In addition to the product name, this gives an opportunity for the company tospecify what (if any) enhancements or add-ons are included in the product. For example, with cars, a number of options are usually available (metallic paint, sunroof), all of which could affect the price of the product.
Size of transaction	The amount of the product sold in the transaction and whether volume discounts apply.
Units of sale	Units used in describing the product.
Class of customer	Some companies may have different pricing structures for different customers (for example, retail and trade). A reference number can be used to maintain customer confidentiality.
Discounts	Many companies offer trade, volume, competitive, or preferred customer discounts. All applicable discounts should be described.
Payment terms	Companies may have different prices for different payment or credit terms.
Carriage terms	Whether transport costs are included and what type of transport.
Currency	Currency the price will be provided in.

Rebased PPI basket has 280 products from 93 establishments within the 10 Industries. From the 280 products, 661 transactions will be priced. (refer to table 2)

4.3 Initiation

The PPI price collection survey is unusual compared with most business surveys, since there is a requirement to get a detailed product specification from respondents before the routine monthly collection can begin; this process is often called initialization or recruitment.

All the chosen establishments' were invited for individual meetings (annex 1) and detailed information was given on the initiation process and objective. The initiation process is to draw information through a form to derive weights at establishment, product and transaction level. The initiation form (annex 2) provides information on product/service lines and different transactions by each product/service line. The sales value or contribution of the product line, product and transaction together with the total sales value for the particular year provides the weights at establishment, product and transaction level as depicted in the table below.

For example – Clinic x

Level	Description	Provided data	Calculated Sales (%)	Calculated Value (mvr)	Calculated Weights (%)	source
Industry	Health Sector				3.8	from SUT
Establishment	Total Sales 2010	*1 Million*		1,000,000	0.13	from all establishments in health sector
	Product/Service Group					
Product	Consultation	*60%*		600,000	0.67	=0.6/(0.6+0.3)
Product	Scan	*30%*		300,000	0.33	=0.3/(0.6+0.3)
	Physiotherapy	*10%*		100,000		not selected
	Product/Service Group					
	Consultation					
Transaction	Gynecologist	*35%*			0.44	=0.35/(0.35+0.45)
Transaction	Pediatrician	*45%*			0.56	=0.45/(0.35+0.45)
	Scan					
Transaction	Whole abdomen	*180,000*	0.45		0.75	=0.45/(0.45+0.15)
Transaction	Anamoly Scan	*60,000*	0.15		0.25	=0.15/(0.45+0.15)

To determine the product line weights product line to be sampled within establishment should be selected and the establishment weight should be distributed to each product line according to the relative importance of the product line among those selected.

Transaction weights can then be allocated. Depending on the size of the establishment, transactions should be selected within product line. Weight for the transaction can be determined the same way by distributing the product weight to each transaction using its relative importance.

4.4 Verification and Validation

Verification aims to identify potentially incorrect prices as early in the process as possible, consult with the respondent, and amend the data if necessary. Three key checks are required:

- Data reported were accurately entered into the processing system,
- All requested data were provided, and
- Data reported were valid (outlier detection).

Validation assesses whether the data returned by respondents are credible in relation to other data for the same industry or commodity.

The first stage in the verification process is to determine that the data entered into the system for further processing are an accurate reflection of the data returned. This can be achieved through either a manual audit or an automated system. These checks should determine whether

(i) All data fields required have been completed,
(ii) The data entered in the database agree with those reported, and
(iii) All data fields are completed within an expected parameter range.

When the data have been accurately recorded by the statistical office but basic data checks are not passed, the analyst will need to contact the respondent to verify the information or to get the correct data. Returned prices may be compared with those received for the previous period. If the price change is outside a specified range, then the price should be marked for further investigation. Respondents providing dubious prices can then be contacted to check that the large change is correct and to provide a reason for the large change. Large price changes fall into two main categories: those that are erroneous and those that are correct but genuinely unusual.

The second category is more difficult to deal with because they could be outliers, which might result in the need for special treatment within the estimation procedure.

Logically, the purpose of detecting errors and outliers is to exclude errors or the effects of outliers from the index calculation. Errors may be falsely reported prices, or they may be used by recording or coding mistakes. Also, missing prices because of nonresponse may be dealt with as errors. Possible errors and outliers are usually identified as observations that fall outside some pre-specified acceptance interval or are judged to be unrealistic by the analyst on some other ground. It may also be the case, however, that even if an observation is not identified as a potential error, it may actually show up to be false. Such observations are sometimes referred to as inliers. On the other hand, the sampling may have captured an exceptional price change, which falls outside the acceptance interval but has been verified as correct. In some discussions of survey data, any extreme value is described as an outlier. The term is reserved here for extreme values that have been verified as being correct.

When a possible error has been identified, it would ds to be verified whether it is in fact an error or not. This is usually accomplished by asking the respondent to verify the price, or by comparison with the price change of similar products. The error can be corrected if the respondent can provide the correct price or, where this is not possible, by imputation or omitting the price from the index calculation. If it proves to be correct, it should be included in the index. If it proves to be an outlier, it can be accepted or corrected according to a predefined practice—for example, omitting or imputation.

4.5 Publication and Dissemination

4.6 Release

PPI will be released on the 20th of May, August, November and February. PPI for first quarter will be released on 20th May and second quarter on 20th August and likewise.

The work plan illustrated below.

Task	Dates	Months
Request for data	10-15	Mar, Jun, Sep Dec
Receive data	15-30	Mar, Jun, Sep Dec
Follow up & Data entry	1-30	Apr, Jul, Oct, Jan
Validation	5-15	Apr-May, Jul-Aug, Oct-Nov, Jan-Dec
Report Writing	1-20	May, Aug, Nov, Feb
Release	20	May, Aug, Nov, Feb

5. Limitations

1. The establishment weights are from Supply and use table 2007 while product and transaction weights are from 2010 and the price reference is October 2012. The gap between these references may produce bias.

2. The sample is selected purposively or referred to as non-probability sampling or expert choice. Judgmental sampling may be justified when sample sizes are small, but the samples are subject to biases. However, in practice the non-probabilistic methods are frequently used by the statistical agencies.

3. The number of samples per industry is very limited. There are 3 industries with just 2 reporting samples. There are new prominent entrants in some industries but since the initiation process where the product and transaction weights were obtained is for 2010, such companies were not operational. For example, Mega Maldives and Flyme in the air transport sector.

4. As of now the telecommunication industry is providing average revenue per service line instead of actual prices.

5. The index is not popular amongst government or private sector, which questions the useable and hence affects the response rate.

6. Recommendations

1. More emphasis should be given to promote the use and need of PPI among both government and private sectors.
2. Establishment survey should be carried out to cater for the weights of PPI which would enable the weights reference and price reference to be proximate.

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