

# Calculation method of the Regional Difference Index of Consumer Prices

<b>I. Introduction</b> .....	2
<b>II. Method of calculating the RDI</b> .....	2
1. Calculation formula for the RDI .....	2
(1) Quasi- Fisher formula .....	2
(2) Quasi- Laspeyres formula .....	2
(3) Quasi- Paasche formula .....	3
2. Calculation of average prices .....	3
(1) Price data .....	3
(2) Procedure of calculating average prices .....	3
(3) Treatment of items that are not surveyed in the Structural Survey .....	5
3. Calculation of weights .....	5
(1) Preparation of expenditures for calculating weights .....	5
(2) Procedure for calculating weights .....	5
<b>III. Related information</b> .....	8

## I. Introduction

The Regional Difference Index of Consumer Prices (RDI) is an index that indicates the regional differences of the price level based on the average prices of Japan of goods and services purchased by households nationwide. The indices in each region (10 districts, prefectures, and capital cities and ordinance-designated cities<sup>1</sup>) will be published in the year following the survey year.

The RDI is calculated from the result of the Retail Price Survey (RPS) (the Trend Survey and the Structural Survey<sup>2</sup>). The items to perform the calculation of the RDI (hereinafter “RDI items”) are the items used in the calculation of the CPI, except for the “imputed rent”. (See “List of items” for details.)

Also the RDI for prefectures was published in the National Survey of Prices<sup>3</sup>, which had been conducted once every five years, was ended after the last survey in 2007. However, a simple comparison is impossible owing to the differences of the sampling method and the survey period.

## II. Method of calculating the RDI

### 1. Calculation formula for the RDI

#### (1) Quasi- Fisher formula

The RDI is calculated by the following Quasi- Fisher formula (the geometric mean of the RDI obtained by the Quasi- Laspeyres formula and the RDI obtained by the Quasi- Paasche formula),

$$I_{ag} = \sqrt{I_{ag}^L \cdot I_{ag}^P},$$

$I$  : RDI of Quasi - Fisher formula

$I^L$  : RDI of Quasi - Laspeyres formula

$I^P$  : RDI of Quasi - Paasche formula

$a$  : Comparative Regions (10 districts, Prefectures, capital cities and ordinance - designated cities)

$g$  : Item group

where, the Quasi- Laspeyres formula and the Quasi- Paasche formula are defined as follows:

#### (2) Quasi- Laspeyres formula

The RDI of Quasi- Laspeyres formula for a group  $g$  at a region  $a$  is calculated as a weighted arithmetic mean of item prices for  $a$  based on the average prices for Japan with respect to weights  $W_{0i}$  for Japan. The average prices used in this formula are the arithmetic mean values.

---

<sup>1</sup> The ordinance-designated cities here are similar to the ordinance-designated cities of the 2020 based Consumer Price Index (CPI), which have been delegated by June 25, 2019.

<sup>2</sup> Refer to the website of the Statistics Bureau of Japan for the details of the Trend Survey. In regards to the Structural Survey, see “Outline of the Structural Survey” for details.

<sup>3</sup> Refer to the website of the Statistics Bureau of Japan for the details of the National Survey of Prices.

$$I_{ag}^L = \frac{\sum_{i \in g} \left( \frac{\bar{P}_{ai}}{\bar{P}_{0i}} \right) W_{0i}}{\sum_{i \in g} W_{0i}} \times 100 \quad ,$$

$0$  : Japan  
 $i$  : Item  
 $\bar{P}$  : Average price (weighted arithmetic mean)  
 $\frac{\bar{P}_{ai}}{\bar{P}_{0i}}$  : Price index of item  $i$   
 $W_{0i}$  : Weight of item  $i$  for Japan

### (3) Quasi- Paasche formula

The RDI of Quasi- Paasche formula for a group  $g$  at a region  $a$  is calculated as a weighted harmonic mean of item prices for  $a$  based on the average prices for Japan with respect to weights  $W_{ai}$  for the region  $a$ . The average prices used in this formula are the harmonic mean values.

$$I_{ag}^P = \frac{\sum_{i \in g} W_{ai}}{\sum_{i \in g} \left( \frac{\hat{P}_{ai}}{\hat{P}_{0i}} \right)} \times 100 \quad ,$$

$\hat{P}$  : Average price (weighted harmonic mean)  
 $\frac{\hat{P}_{ai}}{\hat{P}_{0i}}$  : Price index of item  $i$   
 $W_{ai}$  : Weight of item  $i$  for region  $a$

## 2. Calculation of average prices

### (1) Price data

- A. The price data surveyed by the Trend Survey of the year.
- B. The price data surveyed by the Survey on Price Differences between Regions (conducted in an odd month) of the Structural Survey of the year.

Note that, since the Structural Survey is not conducted in even month whereas the Trend Survey is conducted in every month, the prices of even month for each municipality covered by the Structural Survey should be estimated, in order to fill the price differences between odd month and even month. The estimation will be done as following procedure.

- (a) Calculating the ratio of the average price of even month to the average price of previous odd month for each 10 district by using the price data of the Trend survey (the data of A).
- (b) Estimating the price data of even month of the Structural Survey by multiplying the price data of previous odd month of the Structural Survey by the ratio of corresponding district.

### (2) Procedure of calculating average prices

The average price of each item by municipality is calculated by the following procedure. Note that, the treatment of items that are not surveyed by the Structural Survey is explained in “2. (3) Treatment of items that are not surveyed in the Structural Survey”.

- A. Calculation of monthly average prices of each item by municipality
  - (a) Basic formula

The average monthly price of each item by municipality is calculated from the price data of (1) by the simple arithmetic mean. Note that, for fresh food and cut flowers, whose daily price changes are large, surveys are conducted three times a month (every 10 days in a month) to determine the exact price for the month. The average price for those items per a month is calculated by averaging prices for each 10-day period. Prices in the observation period during the current month are calculated as the simple arithmetic mean of the average prices for each 10-day period.

(b) Model formula (Items with complicated rate structures = Model item)<sup>4</sup>

Some items such as electricity, water and sewerage charges are not appropriate to calculate their average prices with the basic formula, since they have various rate structures, with prices that vary according to the purchased conditions. Those items have been specified by several specifications according to the purchased conditions, and then the average prices for those items are calculated with special formulae, called model formulae, which are designed by using a typical utilization case of each item as a model. It is in principle based on the CPI method.

B. Calculation of annual average price of each item by municipality ( $\bar{P}_{ji}$ ,  $j$ : municipality)

The annual average price of each item (except for flesh foods) by municipality is calculated as the simple arithmetic mean of the average prices for 12 months. Note that, the average prices for fresh foods are calculated as the weighted arithmetic mean of the average prices for 12 months with respect to the monthly weights<sup>5</sup>.

If the specification is changed in the middle of the year, it is necessary to adjust the price differences (quality differences) between new and old specifications caused by the revision of specification, for the calculation of the annual average price. The adjustment is done by multiplying the rink coefficient, which is created by month, to pertinent price data.

C. Calculation of annual average price of each item by region (Japan, districts, prefectures)

(a) Average prices by weighted arithmetic mean: Used for the Quasi- Laspeyres formula

The average price of each item  $i$  by region is obtained as a weighted arithmetic mean of the average price for each municipality  $\bar{P}_{ji}$  with respect to weight of all items by municipality  $j$  ( $C_j = \sum_i W_{ji}$ ).

$$\bar{P}_{ki} = \frac{\sum_{j \in k} C_j \bar{P}_{ji}}{\sum_{j \in k} C_j}$$

$k$ : Japan, districts, prefectures  
 $W_{ji}$ : Weight for item  $i$  in municipality  $j$   
 $C_j$ : Weight of all items in municipality  $j$

(b) Average prices by weighted harmonic mean: Used for the Quasi- Paasche formula

The average price of each item for each region (Japan, districts, prefectures) is obtained as a weighted harmonic mean of the average price for each municipality  $\bar{P}_{ji}$  with respect to weights for item  $i$  by municipality  $j$  ( $W_{ji}$ ).

<sup>4</sup> Appropriate items are the items that the symbol of the column of “Model items” in “List of Items” is “○”.

<sup>5</sup> Since monthly purchase quantities greatly fluctuate by item, in the calculation of CPI, the annual average prices of fresh foods are calculated by the weighted arithmetic mean of the monthly prices with respect to the monthly weights. The treatment of the annual average prices of fresh foods in the CPI is adopted also for the calculation of the RDI.

$$\hat{P}_{ki} = \frac{\sum_{j \in k} W_{ji}}{\sum_{j \in k} \frac{1}{P_{ji}} W_{ji}} \left( = \frac{\sum_{j \in k} \bar{P}_{ji} Q_{ji}}{\sum_{j \in k} Q_{ji}}, \quad \bar{P}_{ji} Q_{ji} = W_{ji} \right)$$

$Q_{ji}$  : Quantity for item  $i$  in municipality  $j$

### (3) Treatment of items that are not surveyed in the Structural Survey

The items that are not surveyed in the cities covered by the Structural Survey are treated in accordance with the price substitution criteria for CPI as follows. See “List of Items” for the price substitution criteria for each item. Note that, the items whose criteria symbol is blank correspond to the items that are surveyed in all municipalities of the Trend Survey (D).

#### A. The items with uniform price throughout the country

The uniform price throughout the country surveyed in the Trend Survey is substituted for the price of the Structural Survey.

#### B. The items with uniform price within each prefecture

The uniform price surveyed throughout the prefecture in the Trend Survey is substituted for the price of the Structural Survey within each prefecture.

#### C. Other items

The average annual price surveyed in a similar city in the same prefecture in the Trend Survey (the city with the most similar population and economic sphere in the prefecture; however, in the case of items surveyed only in cities that are the seats of prefectural governments, the price data in the city with a prefectural government) is substituted.

### 3. Calculation of weights

#### (1) Preparation of expenditures for calculating weights

##### A. Expenditure data

The data is the results of latest five years of Family Income and Expenditure Survey (FIES) (including agricultural, forestry and fisheries two or more persons households).

The scope of the FIES items used for the calculation of weights is limited to the household consumption expenditure.

Note that, the following items of consumption expenditure are excluded from the calculation of the weights: Remittances, money gifts, religious contributions, other obligation fees (fees for neighborhood association, firefighting and street lamps) and donation<sup>6</sup>.

##### B. Calculation of the average expenditures by FIES item for FIES municipalities per a month of one household

###### (a) Calculation of the monthly average expenditures (for 12 months) for each year

By using the data of A, the monthly average expenditures (for 12 months) by FIES municipality is calculated.

###### (b) Calculation of the monthly average expenditures for five years

<sup>6</sup> The reasons for excluding these items from the calculation of the weights are as follows: Markets do not generally exist for such items; the relationship between payment and counter value is not clear or they involve income transfer to other households.

By using the data of (a), the monthly average expenditures for five years are calculated.

Note that, for the FIES items that are not suitable to use the results of five years of FIES results caused by the revision of the budget item classification and the change of various systems, the results of FIES under the latest classification and systems are used to calculate the average expenditures.

(c) Correction of the expenditures by means of the district wise prorated ratio

By using the average expenditures of (b), calculate the district-wise prorated ratio for each correction target FIES item, which prorate the expenditure of the subgroup containing the target item to its component items. Next, correcting the expenditure of each target FIES item is corrected with the multiplication of the above ratio to the expenditure of subgroup containing the target item.

Note that, as a principle, this procedure is adopted for the subgroups having a large amount of expenditure rate of its component items whose dispersion among FIES municipalities and the years is large. For the items that are not estimated their expenditure by proration, the average expenditure calculated in (b) is used for the weights.

(2) Procedure for calculating weights

A. Weights by FIES municipality

The weights by FIES municipality is calculated by allocating the FIES items into the RDI items, in accordance with the latest allocation criteria (2015 based criteria) of the weights for the CPI.

- (a) When there is one to one correspondence between the FIES item and the RDI item, the correspondence is maintained.
- (b) When there are no RDI items corresponding to the FIES items, the amount of expenditure of the FIES item is split or integrated with the data being allocated to the corresponding RDI item, in accordance with the latest allocation criteria of the weights for the CPI.

## B. Allocation of municipalities

(a) Allocate the FIES municipalities into the municipalities of the RPS (the municipalities combined the Trend Survey and the Structural Survey; say “RDI municipality” for short).

(i) Allocation to the municipalities of the Trend Survey

Since there is one-to-one correspondence between the FIES municipalities and the municipalities of the Trend Survey according to the strata<sup>7</sup> of FIES, as the weights of each municipality of the Trend Survey, is substituted for the weights of corresponding FIES municipality.

(ii) Allocation to the municipalities of the Structural Survey

As the weights of each municipality of the Structural Survey, is substituted for the weighted arithmetic mean of the weights for FIES municipalities with respect to the latest number of household for tabulation after the adjustment for each stratum in FIES by the corresponding district and the city group.

(b) Revision in accordance with the actual situation of RDI municipalities

For some RDI items such as Water & sewerage charges and Kindergarten fees, the weights are revised in accordance with the actual situation of RDI municipalities.

(c) Adjustment of the expenditure in each RDI municipality with the consideration of the number of households

The weights obtained from the above (b) do not consider the number of households in each RDI municipality. In order to consider the number of households in each municipality, the adjustment coefficient calculated from the number of households consisting of two or more persons in each municipality obtained from the latest Population Census is multiplied to the weight of (b), and then the final weights ( $W_{ji}$ ) are obtained.

## C. Aggregated items and regions

(a) Aggregated items

The weights for groups are aggregated from the weight for each RDI item. (See “List of Aggregation from Items to Groups” for details.)

(b) Aggregated regions (Japan:  $W_{0i}$ , regions:  $W_{ai}$ )

The weights for Japan and regions are aggregated from the weight for each RDI municipality obtained by the above (a).

---

<sup>7</sup> Stratum is a classification of all municipalities in Japan in order to extract the municipalities surveyed, in accordance with the population size, the geographic location, and the industrial traits. The stratum for extracting the municipalities of the RPS is equal to that of the FIES.

### III. Related information

Related information	URL
1) About the Structural Survey	<a href="https://www.stat.go.jp/english/data/kouri/kouzou/index.html">https://www.stat.go.jp/english/data/kouri/kouzou/index.html</a>
2) List of Items	(Excel file) <a href="https://www.stat.go.jp/english/data/kouri/kouzou/zuhyou/hinmoku_2020_e.xlsx">https://www.stat.go.jp/english/data/kouri/kouzou/zuhyou/hinmoku_2020_e.xlsx</a> (PDF file) <a href="https://www.stat.go.jp/english/data/kouri/kouzou/pdf/hinmoku_2020_e.pdf">https://www.stat.go.jp/english/data/kouri/kouzou/pdf/hinmoku_2020_e.pdf</a>
3) List of Aggregation from Items to Groups	<a href="https://www.stat.go.jp/english/data/kouri/kouzou/pdf/aggre_2020_e.pdf">https://www.stat.go.jp/english/data/kouri/kouzou/pdf/aggre_2020_e.pdf</a>
4) Notes on the Statistical Tables	<a href="https://www.stat.go.jp/english/data/kouri/kouzou/pdf/note_e.pdf">https://www.stat.go.jp/english/data/kouri/kouzou/pdf/note_e.pdf</a>
5) Terminology	<a href="https://www.stat.go.jp/english/data/kouri/kouzou/pdf/terminology_e.pdf">https://www.stat.go.jp/english/data/kouri/kouzou/pdf/terminology_e.pdf</a>
6) National Survey of Prices	<a href="https://www.stat.go.jp/english/data/zenbutu/index.html">https://www.stat.go.jp/english/data/zenbutu/index.html</a>