Calculation of the Regional Difference Index of Prices

1. Characteristics of the regional difference index of prices

The index is calculated to measure regional differences in the prices of goods and services purchased by households nationwide.   It is based on the average prices for all Japan (= 100) and another index based on the average prices for prefectures (=100).

2. Index formula and calculation methods

The regional difference index of prices was calculated using a quasi-Fisher formula (the geometrical mean of the index obtained by a quasi-Laspeyres formula and that obtained by a quasi-Paasche formula).

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

I: Regional difference index (Fisher type)

I^{L}: Regional difference index (Laspeyres type)

I^{P}: Regional difference index (Paasche type)

a: Comparative region (municipality or upper class regeion)

g: Item group (Basic group or Goods and services group)

The quasi-Laspeyres formula and quasi-Paasche formula mentioned above are as follows:

[Quasi-Laspeyres formula]

The index for the lowest group was calculated as a weighted arithmetic mean of item prices for a comparative region using the average prices for all Japan as the base prices and weights for all Japan.

$$I_{as}^{L} = \frac{\sum_{i \in s} \left(\dfrac{\overline{P}_{ai}^{A}}{\overline{P}_{0i}^{A}} \right) W_{0i}}{\sum_{i \in s} W_{0i}} \times 100$$

0 : All Japan

i : Item [specification]

s : The lowest group (Item)

$\overline{P}^{A}$: Average price (Arithmetic mean)

$\dfrac{\overline{P}_{ai}^{A}}{\overline{P}_{0i}^{A}}$: Price index of Item [specification]

W_{0i} : Weight of Item[specification] for All Japan

The lowest index thus obtained was averaged with weight corresponding to that group to obtain the index for the group immediately above the lowest. Repeating the same procedure, the indices for the upper groups were obtained in succession.

To obtain the index based on average prices for prefectures, the average prices and weights for the relevant prefectures were used instead of those for all Japan.

To obtain the index by characteristics of households based on average prices for all Japan, the average prices for all Japan and weights for all Japan prepared for each characteristics of households were used.

[Quasi-Paasche formula]

The index for the lowest group was calculated as a weighted harmonic mean of item prices for a comparative region using the average prices for all Japan as base prices and weights for a comparative region.

$$I_{as}^{P} = \frac{\displaystyle\sum_{i \in s} W_{ai}}{\displaystyle\sum_{i \in s} \frac{W_{ai}}{\left(\dfrac{\overline{P}_{ai}^{H}}{\overline{P}_{0i}^{H}}\right)}} \times 100$$

$\overline{P}^{H}$: Average price (Harmonic mean)

$\dfrac{\overline{P}_{ai}^{H}}{\overline{P}_{0i}^{H}}$: Price index of Item [specification]

W_{ai} : Weight of Item [specification] for comparative region

The index thus obtained was averaged with weights corresponding to that group to obtain the index for the group immediately above the lowest. Repeating the same procedure, the indices for the upper groups were obtained in succession.

To obtain the index based on average prices for prefectures, the average prices and weights for the relevant prefectures were used instead of those for all Japan.

To obtain the index by characteristics of households based on average prices for all Japan, the average prices for all Japan and weight for a comparative region prepared for each characteristic of household were used.

3. Price data

The price data used in calculating the indices were prices surveyed by the 2007 National Survey of Prices (180 items [337 specifications], excluding online/mail-order sales prices), the Retail Price Survey conducted by the Ministry of Internal Affairs and Communications (MIC) (42 items [50 specifications] in the results of November 2007), and the 2003 Housing and Land Survey conducted by MIC (2 items [3 specifications]) .

4. Weights of items

(1) Weights for each municipality [W_{ij}, j : Municipality]

a. The average expenditure per household of each item group for each characteristic of household (Note) for each city with a prefectural government (including Kawasaki-shi and Kitakyushu-shi) was derived from the 2007 results of the monthly Family Income and Expenditure Survey (FIES) by MIC (concerned with households with two or more persons, including agricultural, forestry and fisheries households) for each city.

The average expenditure per household of each item group for each characteristic of household

for each of the other municipalities surveyed was derived from the 2007 results of FIES for city groups by district.

Note: The characteristics of household are the following eight classifications: All households, five groups classified by age of the head of households (up to 29; 30-39; 40-49; 50-59; and 60 or older), household living in own houses; and household living in privately owned rented houses.

b. The average expenditure of item group of food (except for eating out) for each municipality surveyed (except for the cities with prefectural government, Kawasaki-shi and Kitakyushu-shi) was adjusted based on the following results of the 2004 National Survey of Family Income and Expenditure (NSFIE) by MIC for each municipality:

- For cities with a population of 100,000 or more, the result for each city covered by NSFIE;
- For cities with a population of less than 100,000 and towns and villages, the result for each population size group within prefectures covered by NSFIE

c. The average expenditure of each survey item [specification] was obtained by allocating each item group prepared by the procedures a and b above (FIES survey item) to each corresponding survey item [specification] of the National Survey of Prices (NSP), in accordance with the following procedures:

- In case the FIES survey item corresponded on a one-to-one basis with the NSP survey item [specification], allocation was made with the items as they were.
- In case the FIES survey item did not correspond on a one-to-one basis with the NSP survey item [specification], the amount of expenditure of the FIES survey item was split or integrated by using various statistic materials, with the data being allocated to the corresponding NSP survey item [specification].

Among the expenditures in the FIES survey, remittance, money gifts, religious contribution, family alter and gravestones, other ceremonials (except for wedding expenses and funeral expenses), obligation fees related to dwelling and other obligation fees(e.g., neighborhood expenses, fire fighting expenses, streetlamp expenses) were excluded in calculating the weight.

d. The weight of each item for each municipality (W_{ij}) was obtained by multiplying the average expenditure of each survey item and 1/10,000 the number of households[1] consisting of two or more persons of each municipality surveyed (or the area from which a municipality was sampled).

However, since the 2005 Population Census did not tabulate the results for households consisting of two or more persons in each municipality, 1/10,000 the number of general households including single-person households was used for households living in owned houses and households living in privately owned rented houses among the classifications of characteristics of household.

[1] Result of the 2005 Population Census

(2) Weights for all Japan $[W_{0i}]$

The weights for all Japan (W_{0i}) were obtained by adding up the weight for each municipality (W_{ij}).

(3) Weights for city groups, districts, prefectures and blocks within prefectures, etc.

The weights for city groups, districts, prefectures and blocks within prefectures (Note), etc. were obtained in the same way as the weights for all Japan.

Note: The blocks within prefectures were set by combining municipalities in accordance with the economical regions, etc. within each prefecture.

5. Average prices

(1) Average prices for each municipality $[\overline{P}_{ij}]$

a. The survey prices in each municipality were initially divided into the following six types of outlets: "Conventional retail outlet" (including outlets categorized in "Others"), "Supermarket," "Discount store" (including "Pharmacy (drug store)"), "Convenience store," "Department store" and "Consumers' cooperative store." The average prices of each item by type of outlet ($\overline{P}_{ijk}$) were then calculated as a weighted arithmetic mean of prices using the reciprocals of sampling ratios of the outlet classification (Note) to which each outlet surveyed belongs ($\left(\dfrac{N}{n}\right)_x$).

$$\overline{P}_{ijk} = \frac{\sum_x \left(\dfrac{N}{n}\right)_x P_{ijkx}}{\sum_x \left(\dfrac{N}{n}\right)_x}$$

k: Type of outlet (purchase places)

x: Outlet surveyed

N: Number of outlets in parent population (for each outlet classification in each municipality)

n: Number of outlets surveyed (for each outlet classification in each municipality)

Note: The outlet classifications are groups of outlets surveyed that were classified in accordance with the size of sales floor space, industrial classification, etc.   They were classified into 12 groups of large-scale outlets (those with sales floor space of 1,000 m^2 or more) and 23 groups of small-scale outlets (with sales floor space of less than 1,000 m^2).

b. Next, the average price of each item (specification) for each municipality ($\overline{P}_{ij}$) was obtained as a weighted harmonic mean of the average price by type of outlet. The weights (E_{ijk}) were calculated on the basis of expenditure by type of outlet as derived from the results of the 2004 National Survey of Family Income and Expenditure.

$$\overline{P}_{ij} = \frac{\sum_k E_{ijk}}{\sum_k \dfrac{1}{\overline{P}_{ijk}} E_{ijk}}$$

Each type of outlet (*k*) corresponds to the following type of purchase place in the result of the National Survey of Family Income and Expenditure as follows:

Type of outlet in the National Survey of Prices	Type of purchase place in the National Survey of Family Income and Expenditure
Conventional retail outlet and Others	Retail store (Note)
Supermarket	Supermarket
Discount store and Pharmacy (drug store)	Discount store and mass sales specialty store
Convenience store	Convenience store
Department store	Department store
Consumers' cooperative store	Cooperative store and commissary store

Note: Regarding the items of Beverages (except green tea and fermented lactic drinks) and Liquor among those surveyed in the National Survey of Prices, "Others" was included, in addition to "Retail store" among suppliers of the National Survey of Family Income and Expenditure. These suppliers were made to correspond to the type of outlet, "Conventional retail outlet" and "Others" in the National Survey of Prices.

As for service charges and fees (e.g., eating out, bus fares), the average price of each item (specification) for each municipality was calculated as a simple arithmetic mean of prices surveyed in each municipality.

(2) Average prices for all Japan

a. Arithmetic average prices (average prices used in quasi-Laspeyres formula)

The average price of each item (specification) for all Japan was obtained as a weighted ($\sum_i W_{ij}$) arithmetic mean of the average price for each municipality ($\overline{P}_{ij}$).

$$\overline{P}_{0i}^A = \frac{\sum_j C_j \overline{P}_{ij}}{\sum_j C_j} \quad \left(C_j = \sum_i W_{ij} \right) \qquad W_{ij}: \text{Weight of item [specification] } j \text{ in municipality } i$$

Note: In the quasi-Laspeyres formula, in case index I_a^L is prepared using the average prices of all Japan calculated by the weighted (W_{ij}) harmonic mean of the average prices of municipalities ($\overline{P}_{ij}$) with the weight of municipality for each item [specification], when given that $I_a^L = 100$, then $I_b^L > 100$ ($b \in a$) in all areas constituting the breakdown of Area *a*, or $I_b^L < 100$ in all areas, that is "Inconformity of mean values" is likely to occur. In order to avoid this, the weighted arithmetic mean using weight (C_j) that does not rely on Item *i* was selected as the average prices to be used in the quasi-Laspeyres formula.

b. Harmonic average prices (average prices used in quasi-Paasche formula)

The average price of each item (specification) for all Japan was obtained as a weighted (W_{ij}) harmonic mean of the average price for each municipality ($\overline{P}_{ij}$).

$$\overline{P}_{0i}^{H} = \frac{\sum_{j} W_{ij}}{\sum_{j} \frac{1}{\overline{P}_{ij}} W_{ij}} \qquad \left(= \frac{\sum_{j} \overline{P}_{ij} Q_{ij}}{\sum_{j} Q_{ij}}, \qquad \overline{P}_{ij} Q_{ij} = W_{ij} \right) \qquad Q: \text{Quantity}$$

(3) Average prices for city groups, districts, prefectures and blocks within prefectures, etc.

The average prices for city groups, districts, prefectures and blocks within prefectures, etc. were obtained in the same way as the average prices for all Japan.

The arithmetic average prices and the harmonic average prices for each municipality were equal to the average prices for each municipality as mentioned in paragraph (1) above.

6. Special treatment for the calculation of indices

(1) Nationally fixed prices

As for the following 20 items [20 specifications], nationally fixed prices were adopted:

Medical treatment, air fares, toll road fares, cars, rent-a-car rates, automobile insurance premiums (voluntary), postage, study books, pianos, compact discs, newspapers (national paper), weekly magazines, books, hotel and inn charges, overseas package tour, TV reception fees (excluding NHK and cable), theme park admission, Internet connection fees, cigarettes and accident insurance premiums.

(2) Prefecturally fixed prices

As for the following 27 items [33 specifications], prefecturally fixed prices were adopted:

Hamburgers, bathtubs, toilet seats with warm water bidet, hot-water supply equipments, kitchen unit, plumbing, fence construction, carpentering, domestic help, mop-rental fees, women's "kimono," hospital charges for delivery, railway fares [JR] (railway fares, express fares, commuters' season tickets), automobile insurance premiums (liability), delivery service, P.T.A. membership fees (elementary and junior high schools), private junior high school fees, high school fees (public and private), college and university fees (national and private), vocational school fees, DVD software, newspapers (local and block papers), TV reception fees (NHK and cable TV), movie admission, golf fees, museum admission fees and bathing charges.

(3) Substitution of prices

All items [specifications] were not necessarily surveyed in all municipalities for the purpose of collecting prices, but there were some municipalities where some items [specifications] could not be surveyed. In such cases, the prices of items [specifications] not surveyed were substituted by the average prices of the same items [specifications] in municipalities of the same population size group or the nearest large population size group of the same block within the prefecture.

In case there was no municipality surveyed in the population size group of a block within a prefecture, the price of each item [specification] for the region was substituted in the same way as mentioned above.

(4) Compensation for lack of prices

　　Where some prices were still lacking after the processes described in paragraph (3) above were taken, compensation was made for such prices (see "Reference" on the next page).

7. Notes on the utilization of indices

　(1) The indices used in this survey (2007) were calculated by using a quasi-Fisher formula.

　　The indices obtained by the 1997 model formula (i.e., quasi-Paasche formula for average prices for all Japan and quasi-Laspeyres formula for regional difference indices) were also calculated for reference, and are available for access on the Internet, etc.

　(2) In conducting the National Survey of Prices, prices were surveyed by designating certain standards (specifications) for the goods and services surveyed, and the regional differences indices of prices were calculated by using such prices.　It is possible to compare the prices of different regions by using these indices, but the quality of items may differ depending on the items surveyed, even when the difference is within the range of the designated standards.　Care is required here since no adjustment of quality was made in preparing the Regional Difference Index of Prices.

In case of any lacking price, the procedure below was used to compensate for the relevant data.

a. The provisional average price of item [specification] for all Japan was calculated excluding the lacking prices as follows:

$$\bar{p}_i^A = \frac{\sum_j c_j \bar{p}_{ij}}{\sum_j c_j} : \text{(Provisional) arithmetic mean of price}$$

$$\bar{p}_i^H = \frac{\sum_j w_{ij}}{\sum_j \dfrac{w_{ij}}{\bar{p}_{ij}}} = \frac{W_i}{\sum_j \dfrac{w_{ij}}{\bar{p}_{ij}}} : \text{(Provisional) harmonic mean of price}$$

$$\bar{p}_i^G = \sqrt{\bar{p}_i^A \bar{p}_i^H} : \text{(Provisional) geometrical mean of price}$$

where,

i : Item [specification]; j : Municipalities (excluding the lacking prices)

w_{ij} : Weight of item [specification] i for municipality j

$c_j = \sum_i w_{ij}$: Total weight of municipality j (including the weight of items [specifications] with no prices)

$W_i = \sum_j w_{ij}$: Total weight of item [specification] i (excluding the weights of municipalities with no prices)

$\bar{p}_{ij}$: Average price of item [specification] i for municipality j

b. In case the price of item [specification] d in municipalities j' was lacking, the provisional regional difference index was calculated using the prices of items [specifications] belonging to the same class as d as follows:

$$I_{j's}^L = \frac{\sum_{i' \in s} W_{i'} \dfrac{\bar{p}_{i'j'}}{\bar{p}_{i'}^G}}{\sum_{i' \in s} W_{i'}} : \text{(Provisional) regional difference index (Laspeyres type)}$$

$$I_{j's}^P = \frac{\sum_{i' \in s} w_{i'j'}}{\sum_{i' \in s} \dfrac{w_{i'j'}}{\bar{p}_{i'j'}} \bar{p}_{i'}^G} : \text{(Provisional) regional difference index (Paasche type)}$$

$$I_{j's} = \sqrt{I_{j's}^L I_{j's}^P} : \text{(Provisional) regional difference index (Fisher type)}$$

where,

j' : Municipality existing item [specification] d with no price

s : Lowest group including item [specification] d

i' : Items [specifications] with prices belonging to group s

$W_{i'}$: Total weight of item [specification] i' (including the weights of municipalities with no prices)

c. The provisional regional difference index of said groups was used to compensate for lacking prices.

$$\dot{p}_{j'd} = I_{j's} \bar{p}_d^G$$

where,

$\dot{p}_{j'd}$: Compensated (average) price of item [specification] d for municipality j'

$\bar{p}_d^G$: (Provisional) geometrical mean price for lacking price d