

The new procedure for calculating seasonal items indices in Japanese chained CPI

Shunichi SHIMAKITA¹
Compiling CPI section chief,
Statistics Bureau of Japan

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Abstract

In this paper, we will discuss the procedure for calculating seasonal items indices in Japanese chained CPI. It is very important to calculate the contribution of price changes in seasonal items to total CPI exactly, because weights of those items are relatively large in Japan. We plan to release the results of the annually chained index monthly including fresh foods from Aug. 2016. Because chained index is very sensitive to weights and prices fluctuation, we have carefully examined weighting sources, sampling of items, calculation procedure of weights, periods of link which overlap between new and old weight indices. We also discuss price bouncing effects by seasonal and non-seasonal items on Japanese chained CPI.

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The views expressed in this paper are solely those of the author and do not necessarily reflect those of Statistics Bureau of Japan.

1. Introduction

In Japan, we publish the CPI with the fixed base Laspeyres formula as the main official series², and the chain index is used as a reference series. So far it has created a monthly chain index only series excluding fresh foods, and a monthly chain index including fresh foods will be scheduled to begin in the summer of 2016.

Due to the relatively large weight of seasonal items (fresh foods items) in Japan, it is very important to calculate the contribution of price changes in seasonal items to total CPI exactly. Because chained index is very sensitive to weights and prices fluctuation, we have carefully examined weighting sources, sampling of items, calculation procedure of weights, periods of link which overlap between new and old weight indices. In this paper, we describe these studies contents. We also discuss price bouncing effects by seasonal and non-seasonal items on Japanese chained CPI.

2. General feature for chained indices

(1) Overview

Here, we define the “chain index” as the updated weight and reference price which is used to integrate item price index for the higher level index once a year, which is compiled by linking the index before and after the updating. It should be noted that, in general, the frequency of updates and the link may be even less (see ILO manual 9.107). In contrast to this, the one which performs the update and connection every five years is the main official series in Japan, which is referred to as the “fixed base index³”.

We can describe the characteristics of the chain index as “quickly reflect changes in consumption structure”, “the consumption structure of a particular year not dragged on for a long period of time”, the “reset of the index” as a benefit. On the other hand, “the occurrence of price bouncing effects”, “failure of additive consistency”, “complicated calculation” is cited as a disadvantage. In the following, we will look at each individually.

(2) Quickly reflect changes in consumption structure

The chain index, in addition to being able to reflect the most recent consumption structure to the weight, can perform the rapid abolition of the survey items. Especially the technological innovation early new goods and services we considered to be effective

² The term “the main official index” is in the sense that it is a series that is treated as a headline in the Bureau of Statistics press release, in addition to being used for legal use, such as for the adjustment of pension payments

³ Since the base year we officially named the index the “fixed base index”, and the index that linked the index by the earlier criteria is distinguished as the “linked index”. Here, for simplicity, collectively these will be referred to as the “fixed base index”.

under the circumstances to spread rapidly (see ILO manual 9.132).

(3) The consumption structure of a particular year not dragged on for a long period of time

When used by fixing the weights of a base year for several years, the influence of the temporary appeared consumption structure in base year starts to affect the index for several years. For example, due to the switch to digital broadcasting TV in July 2011 in Japan, bulging large replacement demand will increase the weight of the TV in 2010 which is the base year of the CPI. Then, as the consumption of television is also reduced in the reaction, price fluctuations of TV continued to contribute significantly to the overall “fixed base index”. In this regard, the ILO manual says, “When the weights are to be fixed for several years, the objective should be to adopt weights that are not likely to change much in the future rather than precisely reflect the activity of a particular period that may be abnormal in some way” (see ILO manual 4.53). However, to quantitatively distinguish abnormal consumption and normal consumption is difficult in practice.

(4) Reset of the index

The “affected by the reset” of the index means that by returning to the index value for each item 100, the contribution of each item to the rate of change of the higher-level indices, such as “all items index”, is changed. This contribution of each item is, rather than proportional to the change rate of the price index for each item, is proportional to the variation in the price index for each item (see ILO Manual 9.127 to 9.130). For the reset effect, it is particularly necessary to pay attention to when the product category price index has risen or fallen monotonically. For example, when the price of durable goods fell monotonically as seen in Japan a few years ago, and the index wasn’t reset for many years, the negative contribution of those items was evaluated as small. If performing the chain annually, such distortion can be suppressed.

(5) Price bouncing effects

Here, we define “price bouncing effects” as the case that since the chain index is shifted upward or downward due to a temporary price and weight fluctuation, the upper level index doesn’t return the original level even though almost all subclass items indexes return to the original level. As it is mentioned in the ILO Manual 15.84, we need to think about the occurrence of this phenomenon in the context of regular seasonal fluctuations. It is to be noted that the cases with the occurrence of price

bouncing effects in Japan are listed in detail in section 10.

(6) Failure of additive consistency

In general, a chain index is no longer matched to the higher classification index to be a weighted average of the subclass index (there is no additive consistent with this). In extreme cases, in the exponent of the upper item, there is also a value that is out of the range of the index of a breakdown item, so it would be difficult to intuitively understand this situation.

(7) Complicated calculation

When the chain index is compared to the “fixed base index”, the calculation process becomes complicated. As for calculation itself, even now with sufficient performance of ICT equipment, it does not mean there is trouble in the summary itself in the Bureau of Statistics. On the other hand, when the user tries to reproduce the results, user reproducibility from the calculation preparation becomes complicated and is inevitably reduced. This is because it can become a factor of causing the black box of the calculation process also taking into the statistics bureau. Because of this, fostering professional staff becomes more important.

In addition, even if that rarely occurs, the sign of change for item price index is not consistent with the sign of contribution to a higher level index. That situation will increase the difficulty of explanation for the results.

3. Source of weights for Japanese CPI

(1) Overview

The weight of Japanese official CPI has been created based on the consumption expenditure per household of the annual average for one month of the “Family Income and Expenditure Survey”, utilized to calculate various surveys other than the Family Income and Expenditure Survey. Here, we outlined information sources that were used in calculating the Japanese CPI weights or are not currently utilized although there is the possibility of them actually being utilized.

(2) Family Income and Expenditure Survey

Family Income and Expenditure Survey is the main CPI weight source. This survey began (including predecessor surveys) in 1946. Thereafter, it has been carried out without interruption until now, and has continued to publish monthly results. Because the results of one month from the 1st to the last day of the survey month have been

published at the end of next month, we can very quickly grasp the current details of the expenditure situation by item.

The households are surveyed across the country, with the exception of one-person student households, long-term hospitalizations and foreign households. The number of survey households is about 9000 households. Of these, about 8000 households are assigned to two-or-more-person households. Meanwhile, one-person households account for 32% of the population in the 2010 population census. The survey has been designed with a reduced number of one-person households in comparison with this. This design is due to the fact that the one-person household survey is more difficult. It should be noted that almost half of the one-person households are more than 50 years old in Japan.

The survey municipality is 168 municipalities in the Family Income and Expenditure Survey and the weight of the CPI has also been created for each municipality. However, for one-person households, the number of households for research is small in population size in small cities, towns and villages. Therefore, for the total households (two-or-more person households that are combined one-person households), it is not possible to create municipal weights, and are creating a weight of the whole country only.

Investigation is performed by an investigator visiting the target households. On the survey they are asked to fill every payment on a day-to-day basis in the account book format questionnaire. The tabulation is carried out in the after-code system from the questionnaire. Therefore, the questionnaire original is details filled with expenditure contents, even if new goods and services are rapidly spreading; it is possible to grasp the weights in near real time.

[Quantity survey of fresh foods]

Since monthly purchase quantities greatly fluctuate by item, the monthly weights of fresh food are calculated in Japanese CPI. In the Family Income and Expenditure Survey, a weight survey has been conducted for purchases in foods including fresh foods, so it is possible to reflect the proper aggregation of the CPI weights seasonal changes in the purchase quantity of fresh food.

[Two-or-more-person households and total households⁴]

In the Family Income and Expenditure Survey, we publish both the results of total household and of two-or-more-person households. Correspondingly, we release the index for total households which has a weight of total household consumption structure, we also even release the index for two-or-more-person households. Both have been compiled

⁴ The sum of two-or-more-person households and one-person households

and published monthly, but we adopt the main official series as the two-or-more-person household weight.

We adopt that since one-person households of municipal weight cannot be obtained, and when the consumption expenditure of the total households were population estimates, increases restore magnification of the small survey number of one-person households, and sampling error of weight is expanding in it is for this cause. Therefore, we don't position the total households as the main official series although they have large coverage. But, we release the index for total households at the same time as the official CPI, and the deviation index is always able to be verified due to the difference in coverage of the weight.

(3) National Survey of Family Income and Expenditure

The National Survey of Family Income and Expenditure has been implemented and positioned as a large-scale once every five years survey by the household account book format (survey household number is 56,400 households). The survey period is from September to November. Consumer spending throughout the year cannot be obtained from the National Survey of Family Income and Expenditure, so we don't adopt it as a weight of the CPI. However, the weight calculation of "owner-occupied of imputed rent" is an important source of information.

In addition, in the Family Income and Expenditure Survey, aggregate expenditure that cannot be grasped by the questionnaire registrant is classified as "pocket money" because these are personal expenditures of household members other than questionnaire registrants. Further, expenditures such as social gathering fees that cannot be grasped by the questionnaire registrant are classified as "relationship expenses" because it is spending outside the surveyed household. These expenses are classified based on the results of "investigation by the individual account book", which is implemented as part of the National Survey of Family Income and Expenditure. This survey investigates the personal income and expenditure of each household member over the age of 18. As a result, for example, about 30% of the expenditure of the "allowance" is eating out (especially drinking fee), cooking food such as lunch, drinks, and tobacco⁵.

(4) Household Consumption Survey

The Household Consumption Survey was started in 2001 for the purpose of covering

⁵ Other than allowance, the spending percentage of the sum of eating out, cooking food, drinks and tobacco is nearly 10%.

ICT-related purchases, consumption on the Internet, and capturing the consumption of expensive goods and services purchased less frequently in a stable manner. In particular, the purchase frequency is lower with expensive goods and services, so it is difficult to obtain a stable result from the constraints of the number of samples in the Family Income and Expenditure Survey. The Household Consumption Survey, with the monthly 30,000 households as the number of samples, was designed specifically to grasp these items. Therefore, this survey is conducted for 48 items by the pre-coding scheme, rather than the after-code scheme in the Family Income and Expenditure Survey. The survey results along with the Family Income and Expenditure Survey, have been utilized in estimates of the household final consumption expenditure of the GDP. It should be noted that in estimating the GDP for Japan, particularly for being positioned as the main demand side estimates in preliminary estimates, the results of the Family Income and Expenditure Survey and Household Consumption Survey is an important estimate source.

On the other hand, from the fact that the Household Consumption Survey results are tabulated by a pre-code system, it is difficult to match the classified contents of the Family Income and Expenditure Survey whose items are classified by the after-code system. This is not a big problem in order to estimate the change of consumption expenditure in GDP statistics⁶. On the other hand, the proportion of consumption expenditure is important information for estimating CPI weights, so it is a major challenge for integrating both survey results. For this reason, the Household Consumption Survey is not being used to the weight estimate of CPI.

In addition, the grasp of total expenditure using the Internet was only grasped until 2014. But since 2015, the expenditure breakdown of 22 items began to be investigated. The study results also in future CPI, it is considered that there is a potential use in creating a synthesized price index with the price of traditional stores and internet shop.

(5) Statistics compiled by other governmental organizations, private organizations, company hearings, or special investigation

For estimating weights for CPI, we also use statistics compiled by other governmental organizations and private organizations. Also, we conduct company hearings or special

⁶ Household final consumption expenditure of GDP, after putting weight in the base year by item of expenditure by industry input-output tables, the rate of change of each item from the base year estimates from a variety of statistics, the base year percentage changes for each item by item expenditure of the reference year are stacked calculated and by multiplying the expenditure. Therefore, even if we estimate the rate of change in inconsistent statistics with each other for each item, as long as it can ensure consistency in the industry input-output table, we believe that a certain degree of consistency can be collateral to the counting after the extension estimates.

investigation for households.

For example, with “car purchase” in the Family Income and Expenditure Survey, we grasp that the price on that is subdivided into six items such as “normal sized car” in CPI by the automobile standards. For this reason, for the weight resulting from the expenditure of “car purchase” in the Family Income and Expenditure Survey, there is a need to allocate them to 6 items after subdivision. However, since it is difficult to determine the weight allocation for the six items by the Family Income and Expenditure Survey, we estimate the allocation rate by the new vehicle registration number by model, compiled in private statistics.

(6) National Accounts

As described so far, the weight of Japanese official CPI has been compiled by information sources in the household expenditure survey, such as the Family Income and Expenditure Survey. By the way, when viewed internationally, the source of CPI weights are roughly classified based on household expenditures surveys and based on national accounts (ILO manual 4.16). In particular, for the recent years of European countries, it has been defined to use the national accounts as information sources of the weight for the HICP in principal since 2010. (The regulation does not prohibit the use of the household expenditure survey, but it has received exceptional treatment: if the household expenditure survey has sufficient accuracy, they can use it.) However, in Japanese official CPI (including chain index), we continue to be decided on using the Family Income and Expenditure Survey for the following reasons.

The first is that the Family Income and Expenditure Survey result of Japan is published very quickly. We publish the expenditures breakdown of the annual average on the last day of January in the Family Income and Expenditure Survey, and that will not be revised after release. From this, it is possible to reflect the weight of the referenced chain index of the previous year's expenditure based on the necessary and sufficient accuracy from the February CPI. On the other hand, in Japanese national accounts, the breakdown of household final consumption is found to be in February because the household survey results have been used to estimate the 1st GDP preliminary figures. So, we cannot reflect the results of the previous year of national accounts to compile the February CPI. Note that in the HICP, preliminary results for National Accounts from before last year have been adopted to the weight of the chain index.

Second is that revisions, counting the SNA, is performed. In the household final consumption of SNA, it would be revised to “secondary QE” from “primary QE”

announcement after less than one month. That is revised after about one year, and is also revised by the base revision conducted every five years. On the other hand, the official Japanese CPI (year-on-year percentage change) is used for the adjustment of the pension amount. If we performed the revise CPI results, people would be confused by the amount of pension that have been paid. If we introduce SNA weights, we are forced to permit post-revision of CPI by post revisions of the weight, or for the weight to be fixed in a very short period only officially counting treat figures such as GDP 1st preliminary figures (officially treated until the publication of 2nd preliminary figures). In addition, the household final consumption expenditure deflator has been published at the same time as the nominal value in SNA. Therefore, in order for the user to confirm the price trends of household consumption in the SNA concept weight, it is believed to be sufficient if you look at the deflator, which is co-published.

Finally, the breakdown estimate of SNA household final consumption at the time of this writing is that it is under the accuracy improvement process. We estimate SNA household final consumption breakdown by the assumption the input-output structure that is based on the 2005 Input-Output Tables. Then we estimate it by the change rates of each item output value obtained by the supply-side statistics⁷ (the Commodity Flow Method). On the other hand, the Economic Census for Business Activity was first conducted in Japan in February 2011. As a result, including the service industries which are captured have been said to be insufficient so far, and the whole industry-wide input-output structure has been grasped. These results will reflect the 2011 Input-Output Tables (bulletin in December 2014 has been announced already, final estimates scheduled to be published in June 2015), and then those results will reflect the revised SNA which will be released in 2016. Large weight of services spending in the household consumption and accuracy improvement of this area in the SNA household final consumption after base revision is expected.

It should be noted, the SNA deflator for the household final consumption has been compiled by the item price index of the CPI in principle. On the other hand, especially in the range weight and price concept of household final consumption for the financial and insurance sector, the SNA and the CPI are significantly different, and the movement of the CPI and household final consumption expenditure deflator has become one of the somewhat different factors.

⁷ In the case of final estimates. In the 1st or 2nd preliminary estimates, it is estimated from both the supply-side statistics and demand-side statistics, such as the Family Income and Expenditure Survey

4. Choice of survey items

(1) Base revision

Main revision of survey items are conducted in the “Base Revision” every 5 years. Standards for the selection of items are as below.

< Standards for the selection of included items >

- i) Items whose importance in the living expenditure increased due to change in the consumption structure owing to the appearance and spread of new goods and services, and taste changes.
- ii) Items that can contribute to improve accuracy and to retain representativeness of subgroup indices.
- iii) Items whose prices can be smoothly collected and correctly represent their price changes.

Items that meet all standards of i) to iii) above are to be the included items.

< Standards for the selection of omitted items >

- i) Items whose importance for living expenditure has decreased, due to changes in the consumer patterns.
- ii) Items that even when eliminated do not affect the ability to ensure the accuracy and representativeness of the subgroup indices.
- iii) Items that become difficult to collect smoothly or those where the price changes cannot be clearly shown.

Items corresponding to any of the three conditions (i to iii) above are omitted. However, when omission of these items may adversely affect the accuracy of the subgroup indices, they are not omitted.

In the above standards, the “importance” means 1 of 10 thousand for living expenditure. We confirmed an excess of 1 of 10 thousand of living expenditure for selection of included items, which was confirmed by re-tabulation of Family Income and Expenditure Survey. Selected including items will be surveyed for at least 5 years, so we checked that this expenditure expansion is not based on a temporary craze and considered any sampling error in the Family Income and Expenditure Survey. By these procedures, we decided to include items such as “hearing aids” whose expenditure expands slowly reflected by population aging in Japan.

Please refer to Hirota (2015) for details about the 2015 Base Revision.

(2) Midpoint-year review

When there is a rapid influx of new products or a radical change in consumption patterns, the items are reviewed in a midpoint year during the 5-year period before the next revision year (midpoint-year review). As a result of examination of the need for addition of new items during the 2010-base, it was decided that an index for the combination of conventional-type cellular phones and smartphones should be calculated since January 2013 by incorporating the prices of smartphones in the existing items, “cellular phones” and “mobile telephone charges”, and also it was decided that an index for the combination of laptop computers and tablet computers should be calculated since January 2014 by incorporating the prices of tablet computers in the existing items, “personal computers (notes)”.

In the Family Income and Expenditure Survey, which is the main source for weights, living expenditures are classified by the after-coding method, so we can detect the expenditure expansion in new goods and services. The weights for chained CPI necessarily reflect the newly included items expenditures in the midpoint-year review in 2013 and 2014.

5. Weighting procedure for chained CPI in Japan

(1) Coverage for weight

The coverage for CPI weights is the “Living Expenditure” as defined in the Family Income and Expenditure Survey. But the following items in the living expenditure are excluded from CPI weights because markets do not generally exist for such items, and the relationship between payment and counter value is not clear or they involve income transfer to other households. The excluded items are “Religious contributions”, “Money gifts”, “Remittances” etc.

The living expenditure includes indirect tax such as consumer tax, but does not cover direct taxes and social insurance premiums or disbursements for retrieval of assets such as purchase of houses and land.

(2) Revision of weights for chained index

The Family Income and Expenditure Survey release monthly results on the end date of the preceding month, so we can use the calendar year data at the end of Jan. in the preceding year. Following this release, we revise the weights for the chained index on release of the Feb. results in CPI. The preliminary report of Jan. results uses the weights of the year before last, but Jan. results are revised by the latest weights with the release of the Feb. results.

In many countries, weights of the official index don't refer to the latest year expenditure. But, we can refer to the latest yearly expenditure for weights of the chained index because we can use the early tabulation with sufficient precision on the Family Income and Expenditure Survey.

(3) Rates of allocation

When several CPI items correspond to one Family Income and Expenditure Survey item, the rates of allocation are determined by expenditure ratios which are obtained from other statistics such as a special tabulation of the FIES and other various statistics.

Ex.) <Items in FIES*> <Items in CPI>
"Purchases of Automobiles" → "less than 660cc", "more than 2000cc", ...
(Divided into 6 items)

*:Family Income and Expenditure Survey

When we compile allocation rates on the base revision, we conduct a special tabulation of the Family Income and Expenditure Survey, or we collect various data such as the official or private statistics. We use these data for compiling accurately allocation rates. Whereas on compiling weights for the chained index other than the base year, we use constant allocation rates of the base year. In case of using the fixed allocation rate, there is some possibility that the precision of weightings could be affected, such as an undesirable difference between the before and after base revision. So, we will adopt yearly revisions for allocation rates.

(4) "Pocket money" and "social expenses"

"Pocket money" and "social expenses" are allocated to CPI items by the rates of allocation on the basis of "private living expenditure" in the National Survey of Family Income and Expenditure. These allocation rates are constant for 5 years because the National Survey of Family Income and Expenditure data are only available every 5 years.

(5) Weights for the imputed rent

Weights for the imputed rent are calculated based on the "Imputed rent" in the National Survey of Family Income and Expenditure. On compiling weights for the chained index other than the base year, we use the following multiplied figures. One is the change rate of the price index during the base year to the reference year. The other is the weight of "Imputed rent" in the base year.

(6) Weights by municipalities

We compile the base year weights by municipalities obtained from the Family Income and Expenditure Survey results by municipality. Whereas we compile the weights for the chained index other than the base year obtained from the Family Income and Expenditure Survey results for Japan's expenditure as a whole. We don't compile the weights for the chained index by municipalities.

(7) Monthly weights for fresh foods

Monthly weights for fresh foods in the base year are obtained from purchase quantities in the Family Income and Expenditure Survey, and the ratio of purchase quantity of each month to the yearly average of monthly purchase quantity is calculated by item. As for quantities, the average of two years (year previous to the base year and the base year) is used.

For the monthly released chained index for fresh foods, which will be released from the summer of 2016, we need to calculate monthly weights for every year. When we calculate it, we could revise the ratio of purchase quantities for every year. If we do so, there are some possibilities of generating price bouncing caused by including fracture variance in weights. So, we will adopt the constant ratio of purchase quantities for 5 years.

For the international comparison, most countries adopt annual weights for the fresh foods, whereas France adopts monthly weight in the same manner as Japan.

In many countries adopted annual weights, the weight of fresh foods is relatively small. In these countries, the out of season prices are;

- estimated from the imputed from upper level index etc. (for U.K., Canada, Italy)
- not generated because the weights of the items which have out of season periods are very small and neglect such items on CPI tabulation (for Germany)

13 items (weight are 0.70%) of 18 fresh fruit items (weights are 0.92%) have out of season periods in Japan. When we adopt annual weights, excluding seasonal item from tabulation or imputing from other items in the same item group needs to be done. But in the case of Japan, we consider these treatments have many negative points. So, we plan to adopt monthly weights for fresh foods continuously.

(8) Treatment of the one-person households

In the Japanese Laspeyres index, we release the index by weights for "Total household" expenditure, which combine "two-or-more-person household" and

“one-person household”, besides the official index whose weights are limited in “two-or-more-person households”.

But, we don't release the chained index whose weights for “Total household”, because the Family Income and Expenditure Survey expenditure for “Total household” has relatively large sampling errors caused by the small sample scale in “one-person household”⁸.

6. Link period between old and new index series

(1) Two types of link period: a month (December) or a yearly average

There are two types of link periods: link refers to the last December price, and refers to the last yearly average price.

In many governmental statistical offices, link periods refer to the last December price. These countries adopt this method because there are “undesirable index differences” by the linking last yearly average price method. In Japan, we adopt the linking last December price method in the monthly index series other than fresh foods.

The “undesirable index difference” is caused by weight difference and level shift between December and the following January.

“Undesirable index difference” is the change of the link point between December and the following year in January, and the level of weight and index cause of the problem that is to be adjusted. As a result, even if there is no change in the index of December and January in the following year in the “fixed base index”, the index value in the last year of the average price link varies. I show here the case about the public high school fees in April 2010 in Japan as a typical example of “undesirable index difference”. The “school fees, etc.” index is positioned at the upper level item from the item “public high school fee”. The “public high school fee” has become free of charge by a policy change in Apr. 2010. That change induced the index of “public high school fee” which began in April 2010. In this case, when we estimated in the previous year the average price link to the “school fees, etc.” index, despite that there was no index change to all items in the breakdown in December 2010-January 2011, in “school fees, etc.” the index rises from 95.2 to 96.7. Thus, the magnitude of the “undesirable index difference” occurring in the last yearly average price link cannot be ignored.

Meanwhile, the “last yearly average price link” is compared to “last December price link”, although the “undesirable index difference” there is a disadvantage that may occur is advantageous in that it is less affected by seasonal or temporary price fluctuations. For this reason, an item's impact of seasonal (such as fresh foods) and

⁸ If there is a sudden change in the weights, which may cause price bouncing effects

temporary price fluctuation is larger, so there is a need to also consider the adoption of the “last yearly average price link.”

In the case of fresh food, for example, if we create a fresh fish index in the “last December price link”, a large price bouncing effect is generated by the price of seasonality of a breakdown item “cuttlefish”. For this reason, those of the “last yearly average price link” is appropriate for the weather and seasonal effects susceptible to fresh food.

For an example of the status of the price bouncing effect that occurs in the “last December price link” index of fresh food, check “fresh fish.”

Among the components of the “fresh fish”, the index of “cuttlefish” usually records the lowest level every December by the seasonality. There is often a certain level in one year, generally made about 10% lower compared to the annual average index. Among the basic item (“cuttlefish”) index, the ratio of “index on each month” to “last December index” is always greater than that to “index on last annual average”.

The contribution of the “cuttlefish” to “fresh fish” is whereas proportional to the year-on-year in the December index ratio of “cuttlefish” in the last December price link index, proportional to the year-on-year average index ratio in the last year average price link index. For this reason, the index of “fresh fish” is more than that in the last year December price link index; they tend to remain higher than the previous yearly average price link index.

In addition, “fresh vegetables” or “fresh fruit” observed a tendency the same as that of “fresh fish”.

(2) Treatment on official CPI in other countries

If you look at the price link period such as the chain index internationally, many countries have adopted the last December link regardless of the fresh foods or items other than fresh foods. Since it uses a fixed annual weight to the weight of fresh food in these countries (see 5.(7)), it is considered that eliminating the “undesirable index difference” problem has precedence over the price bouncing effect problem.

On the other hand, in France, they have adopted a monthly weight in fresh food and the last yearly average price link to fresh food, etc., whereas the other items have the adopted last December link. In addition, it has also adopted a similar link method in the “fixed base index” in Germany.

(3) Aggregation method since the 2015 standard index in Japanese chained CPI

In view of the above, weight and link type since the 2015 standard index in Japanese

chained CPI will be as follows.

Fresh food (“fresh fish”, “fresh vegetables”, “fresh fruit”) ... monthly weight / last yearly average price link

Class index other than fresh food ... fixed annual weight / last December price link

Upper level class index including both fresh foods and other than fresh foods (e.g. “All items index” including fresh foods) ... Using the formula of the “class index of other than fresh food”, the synthesis of each class index such as the “fresh fish” index etc. and the “class index other than fresh foods” calculated in the above.

7. Formula for time series and figures of yearly average

(1) Initial term

For the index of each month during the reference year 2010, the currently officially released chain index (other than fresh foods) are the same figures as calculated by the “fixed based index” rather than the figures that were created by the link index. For the chain index since 2011, it is calculated by linking the link index of the current month to the December 2010 index calculated by a “fixed base index”.

On the other hand, if it is going to connect from the past continuously assumed to be the “native chain index”, the figure of December 2010 in the native chain index should be compiled by “the price index on December 2009 by item” and weight referred to in the 2009 yearly average consumption. For example, in the “durable goods for reading and recreation”, the figure of December 2010 in the “fixed base index” is somewhat deviated downward from the native chain index. The currently officially released monthly index of 2011 to be linked to this is also deviated downward from the native chain index.

For calculation of the initial year figure of the chain index, making the chain index equivalent with a figure of the “fixed base index” has been done in other price indexes in Japan. But if the “initial year of calculation” was earlier than the “reference year of the index”, the above problem does not occur during the following year of “the initial year of calculation”, as of other price indexes. In contrast, if the “reference year of the index” was the “initial year of calculation”, a divergence is generated, as in the currently officially released chain index.

In order to solve this discrepancy, we will compile the figures of each month in 2010 by “the price index on December 2009 by item” and weight referred to in the 2009 yearly average consumption.

In addition, the divergence mentioned here occurs in the year-on-year change in 2011 figures and the index level in the following year. For the year-on-year change since 2012,

it is not affected for the middle level index, and the impact of the higher index, such as the “all items index”, is minor.

(2) Change the formula for the annual average

The currently officially released chain index has adopted a different formula in the annual average and the monthly index.

Annual average index: compiled by “the price index on the last yearly average” and weight referred to in the last yearly average consumption

Monthly index (excluding fresh foods): compiled by “the price index on last December” and weight referred to in the last yearly average consumption

For this reason, the “12-month average of the monthly index” and “the annual average index” do not necessarily match⁹. To eliminate this inconsistency, we will assume that the annual average index redefined as the 12 months simple average of the monthly index since the 2015 standard index in Japanese chained CPI.

8. Basic formula for price index

From the above discussion, we will expect the chain index since the 2015 standards index to be calculated by the following formula.

Fresh food (“fresh fish”, “fresh vegetables”, “fresh fruit”):

$$(\text{link index}) I_{y,m}^{(L)} = \frac{\sum_{i=1}^n \frac{I_{y,m,i}}{I_{y-1,i}} w_{y-1,m,i}}{\sum_{i=1}^n w_{y-1,m,i}}$$

$$(\text{chain index}) I_{y,m}^{(C)} = I_0 \times \prod_{Y=1}^{y-1} I_Y^{(L)} \times I_{y,m}^{(L)} \quad \text{where } I_Y^{(L)} = \frac{1}{12} \sum_{m=1}^{12} I_{Y,m}^{(L)}$$

Class index other than fresh food:

$$(\text{link index}) I_{y,m}^{(L)} = \frac{\sum_{i=1}^n \frac{I_{y,m,i}}{I_{y-1,12,i}} w_{y-1,i}}{\sum_{i=1}^n w_{y-1,i}}$$

⁹ Until now it had been a mismatch due to the following circumstances.

The annual average index has been released since the 1975 base index. It had been released for indexes including fresh food. We didn’t take the last Dec. link method because there were not monthly indices. On the other hand, the monthly index is created for the series with the exception of fresh food from the 2005 standard, which initially had been the annual average price link as well as the annual average index. However, due to the “high school fees”, “undesirable index differences” is increased as mentioned in 6.(1) and was switched to Dec. link in the 2010 standard. At this time, since the monthly chain index of fresh food is not present, creating an annual average index containing fresh foods was originally not by the 12 months simple average of monthly index.

This time, it becomes possible to include fresh food by monthly index and it becomes possible to eliminate the inconsistency of the year index and the monthly index.

$$\text{(chain index)} I_{y,m}^{(C)} = I_{0,12} \times \prod_{Y=1}^{y-1} I_{Y,12}^{(L)} \times I_{y,m}^{(L)}$$

$(I_{y,m,i}$: price index for item i , m month of y year $w_{y,(m),i}$: weight for item i , (m month of) y year

$I_{y,m}^{(L)}$: link index $I_{y,m}^{(C)}$: chain index)

Upper level class index including both fresh foods and other than fresh foods (e.g. “All items index” including fresh foods):

Using the formula of the “class index of non-perishable food”, the synthesis of each class index such as the “fresh fish” index etc. and the “class index other than fresh foods” calculated in the above.

9. Formula for contribution decomposition

We decompose the formula of year to year change on the index for all items to the contribution of “fresh foods” and “items other than fresh foods”. At this stage, since the chain index is compiled by last December prices links, the contribution formula also reflects it. In the next stage, the “fresh foods” are decomposed to the respective contribution of the breakdown of the item. “Items other than fresh foods” are so on.

The contribution of “items other than fresh foods” compose, in the boundary in December of link time, “the contribution from m month of $y-1$ year to Dec. of $y-1$ year” and “the contribution from Dec. of $y-1$ year to m month of y year”. This deployment scheme is in accordance with the method that has been used the Office of National Statistics in the United Kingdom.

Similarly for “fresh foods”, the contribution compose “the contribution from m month of $y-1$ year to Dec. of $y-1$ year” and “the contribution from the yearly average of $y-1$ year to m month of y year”. The latter includes the adjustment of the index difference between “Dec. of $y-1$ year” and “average of $y-1$ year”.

As a result, it is the contribution decomposition by the following formula.

<Fresh foods>

$$\text{contribution of item } i = \frac{1}{I_{y-1,m}^{(L)n}} \cdot \frac{I_{y-2}^{(L)j}}{I_{y-2,12}^{(L)j}} \cdot \left(\frac{I_{y-1,12,i} \cdot w_{y-2,12,i} - I_{y-1,m,i} \cdot w_{y-2,m,i}}{I_{y-2,i} \cdot \sum_{i=1}^n w_{y-2,i}} \right) + \frac{I_{y-1,12}^{(L)n}}{I_{y-1,m}^{(L)n}} \cdot \left(\frac{I_{y-1}^{(L)j}}{I_{y-1,12}^{(L)j}} \cdot \frac{I_{y,m,i}}{I_{y-1,i}} - 1 \right) \cdot \frac{w_{y-1,m,i}}{\sum_{i=1}^n w_{y-1,i}}$$

<Items other than fresh foods>

$$\text{contribution of item } i = \frac{1}{I_{y-1,m}^{(L)n}} \cdot \left(\frac{I_{y-1,12,i} - I_{y-1,m,i}}{I_{y-2,12,i}} \right) \cdot \frac{w_{y-2,i}}{\sum_{i=1}^n w_{y-2,i}} + \frac{I_{y-1,12}^{(L)n}}{I_{y-1,m}^{(L)n}} \cdot \left(\frac{I_{y,m,i}}{I_{y-1,12,i}} - 1 \right) \cdot \frac{w_{y-1,i}}{\sum_{i=1}^n w_{y-1,i}}$$

(j : aggregate in fresh foods k : aggregate in other than fresh foods n : aggregate all items)

10. Price bouncing effects

(1) Overview

Among “energy”, “fresh vegetables” and “fresh fruit”, the difference between the cumulative value of the contribution of those items in the “fixed base index” and that in the chain index is large during the 2002-2012 year-on-year change basis. We describe the price movements among these items from the view point that these price movements may be caused by price bouncing effects.

(2) Energy price hikes in 2008

For the “gasoline”, after the price index rose from 93.2 in 2005 to 117.0 in 2008, in 2009 it fell to 90.4. On a monthly basis, the price index was 116.7 in December 2007 and 137.8 in August 2008, then plummeted, in December 2008. It was 87.8.

The year-on-year contribution of the “gasoline” in 2009 can analyze i) that it is proportional to “the ratio of 2009 each month price index to the December 2008 price index” and the 2008 weights, and ii) that it is proportional to “the ratio of the 2008 each month price index to the December 2007 price index” and the 2007 weights. Of these, i) is plus since the December 2008 “gasoline” index (87.8) is lower than the 2009 average (90.4). Also, in ii), the December 2007 index (116.7) is reset to 100, and falling contribution of the chain index is smaller than that of the “fixed base index”. For this reason, the decline of the contribution of the “gasoline” is smaller than the “fixed base index” towards the chain index.

Similar cases are also seen in “kerosene”.

With these, the contribution of the “energy” chain index (-0.78), the negative contribution is smaller than the fixed reference system index (-0.95).

(3) Fresh vegetables in 2004

The contribution of “fresh vegetables” is mainly proportional to the ratio for the December 2003 price in the chain index. In contrast, that is proportional to the ratio for the 2003 yearly average index in the “fixed base index”. For the “fresh vegetables” index of 2003, since the December index is below the annual average index of 10%, the 2004 index (up from December 2003) on December 2003 price is higher than that on the 2003 average index. For this reason, the contribution of the chain index (+0.12) is greater than the “fixed base index” (+0.10).

Similar cases are also seen in 2002 and 2010.

(4) Fresh fruits in 2005

For the “fresh fruit” index of 2005, since the December index has less than the annual average index of 13%, the 2006 index (up from 2005) on December 2005 price is higher than that on the 2005 average index. For this reason, the contribution of the chain index (+0.07) is greater than the “fixed base index” (+0.04).

11. Summary

In Japan, we publish the CPI with the fixed base Laspeyres formula as the main official series, and the chain index is used as a reference series. So far it has created a monthly chain index only series excluding fresh foods, and a monthly chain index including fresh foods will be scheduled to begin in the summer of 2016.

Due to the relatively large weight of seasonal items (fresh foods items) in Japan, it is very important to calculate the contribution of price changes in seasonal items to total CPI exactly. Because chained index is very sensitive to weights and prices fluctuation, we have carefully examined the following issues.

We continue to be decided on using the Family Income and Expenditure Survey for weighting sources. We revise the survey items at every 5 years review. Also if there is a rapid influx of new products or a radical change in consumption patterns, the items are reviewed in a midpoint year during the 5-year period before the next revision year, such as adding smartphones in 2013, or tablets in 2014.

The weight type and link period between the old and new index series will be as follows.

Fresh food (“fresh fish”, “fresh vegetables”, “fresh fruit”) ... monthly weight / last yearly average price link

Class index other than fresh food ... fixed annual weight / last December price link

Upper level class index including both fresh foods and other than fresh foods (e.g. “All items index” including fresh foods) ... Using the formula of the “class index of other than fresh food”, the synthesis of each class index such as the “fresh fish” index etc. and the “class index other than fresh foods” calculated in the above.

This combination leads to chained CPI that is free from undesired bias and price bouncing.

Also, we still pay attention for price bouncing effects. In Japan, that effect seemed to appear due to energy price hikes in 2008.

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