Method for Estimating the 2020-base Household Consumption Trend Index (CTI micro)

1 Overview of the Household Consumption Trend Index (CTI micro)

The Household Consumption Trend Index (CTI micro) is an index that shows the trend of the average amount of household consumption expenditure in Japan. The average of the monthly consumption expenditure is calculated by combining monthly results of the Family Income and Expenditure Survey (FIES), the Survey of Household Economy (SHE), and the Expenditure Monitor Survey for One-person Households (EMS). The index is based on the monthly average of consumption expenditure in the base year, which is 100. The index is calculated monthly for total households, two-or-more-person households, and one-person households. For total households and two-or-more-person households, the index for worker's households is also calculated. In addition to calculating the indices by the ten major expenditure groups, which are a breakdown of the index of the amount of consumption expenditure, the indices by the category of goods and services are calculated as well.

Changes in consumption expenditure of total households and two-or-more-person households include the effects of changes in the distribution of the number of household members and the age of the household members. For this reason, we also calculate the index adjusted by the distribution of household, which uses the household distribution in the base year for calculation.

For all of these indices, we also calculate the real value of the index adjusted for price change by the CPI. Seasonally adjusted series are also calculated for the indices (nominal and real).

The published tables are as follows. Each table contains indices (nominal and real) for monthly, quarterly, and annual periods.

Table Number	Table of Household Consumption Trend Index	Type of Household		
		Total	Two-or-more-person	One-person
Table1-a-b	The Ten Major Expense Groups			
	The Category of Goods and Services			
Table2-a-b	The Ten Major Expense Groups - Adjusted by the Distribution of Household by Number of Household Members and Age Group of Household Head			-
	The Category of Goods and Services - Adjusted by the Distribution of Household by Number of Household Members and Age Group of Household Head			

"a" is 1 for the original series and 2 for the seasonally adjusted series.
"b" is 1 for index and 2 for rate of change.

In addition, the tables showing the expenditure of commodities per household are published monthly and annually for reference.

2 Outline of the Estimation Procedure

(1) Adding the sample of EMS to the sample of FIES

Before adding the samples, the weights of EMS were adjusted to account for differences in the survey methods. The EMS sample is then added to the FIES sample to obtain FIES with EMS.

(2) Integration of FIES with EMS and SHE

The weighted averages of expenditures on high-priced goods and services that are purchased infrequently are calculated by the group of household attributes in SHE as well as FIES with EMS. Those expenditures of FIES with EMS and SHE are weighted averaged by each group of the household attributes.

(3) Calculation of the composite expenditure by household attribute

Based on FIES with EMS and (2), we calculate the amount of expenditure by the group of household attributes.

(4) Calculation of the amount of expenditure by type of household

We calculate a weighted average of the composite expenditure by each type of household, total households, two-or-more-person households, and one-person households. The weights used in the calculation are the number of households by the groups of household attributes in the current month or the base year.

(5) Calculation of indices (nominal, real), seasonally adjusted series, and trend-cycle estimates [*1]

We divide the amount of expenditure obtained in (4) by the monthly average of consumption expenditure in the base year to calculate an index where the monthly average of consumption expenditure in the base year is 100. Using the CPI, the real value is calculated from this index. Based on the indices (nominal and real) except for some indices described Chapter 4, the seasonally adjusted series are calculated, as well as the trend-cycle estimates.

*1 Trend-cycle estimates are calculated from the index of original series, which is not seasonally adjusted, to delete the seasonal and irregular components. Please note that the monthly values can change depending on the values of the latest month.

3 Estimation Method

(1) Adding the sample of EMS to the sample of FIES

The EMS is a survey of one-person households under the age of 70. The sample of EMS is selected from monitors who are registered as a monitor for a survey conducted by a corporation. Considering that EMS does not use a random sampling, we assign weights to the sample of EMS as follows.

At first, for each household in the EMS sample, we assign a FIES weight corresponding to its gender and age. Secondly, the weight for each household in EMS is corrected based on a propensity score.[*2]

Thirdly, the weights of one-person households under the age of 70 in both surveys are corrected so that the total weights of one-person households under the age of 70 are the same before and after FIES and EMS are merged. When making that correction, the ratio of the sum of EMS weights to the sum of the weights for one-person households under age 70 in FIES is adjusted to 0.65:0.35, which is the ratio of the inverse of the variance of household consumption expenditure in EMS and FIES.

We acquire FIES with EMS by merging the records of EMS and FIES with those weights corrected above.

(2) Integration of FIES with EMS and SHE

For expenditures on high-priced goods and services that are purchased infrequently, we calculate the weighted average of the current month (m)'s expenditures by the ten major expenditure groups (i) by the six groups of household members (j) by the six age groups of household heads (k)[*3] in FIES with EMS and SHE. As a result, we obtain expenditures on those goods and services of FIES with EMS ($X_{i,j,k,m}^{F}$) and SHE ($X_{i,j,k,m}^{S}$).

The Groups of Household Attributes Used by Integration of FIES with EMS and SHE

			The Six Age Groups of Household Heads					
			Less than 40	Less than 50	Less than 60	Less than 70	Less than 80	80 years & older
The Six Groups of Household Members	One-Person	Men					Merged	
		Women					Merged	
	Two-Persons							
	Three-Persons							
	Four-Persons						Merged	
	Five-or-More-Persons						Merged	

The Groups of Household Attributes Used by Integration of FIES with EMS and SHE for Workers' Households

			The Six Age Groups of Household Heads					
			Less than 40	Less than 50	Less than 60	Less than 70	Less than 80	80 years & Older
The Six Groups of Household Members	One-Person	Men				Merged		
		Women				Merged		
	Two-Persons					Merged		
	Three-Persons					Merged		
	Four-Persons					Merged		
	Five-or-More-Persons					Merged		

To calculate the amount of expenditure on high-priced goods and services that are purchased infrequently ($X_{i,j,k,m}^{FS}$), the previously calculated expenditures ($X_{i,j,k,m}^{F}$, $X_{i,j,k,m}^{S}$) are weighted averaged for each group of the ten major expenditure groups (i) and the household attributes (j, k). For the weights, we use the inverse of the variance of FIES with EMS and SHE by the household attributes ($V_{j,k}^{F}{}^{-1}$, $V_{j,k}^{S}{}^{-1}$), which are calculated in advance.

$$X_{i,j,k,m}^{FS} = \frac{\frac{1}{V_{j,k}^{F}}X_{i,j,k,m}^{F} + \frac{1}{V_{j,k}^{S}}X_{i,j,k,m}^{S}}{\frac{1}{V_{j,k}^{F}} + \frac{1}{V_{j,k}^{S}}} = \frac{V_{j,k}^{S}X_{i,j,k,m}^{F} + V_{j,k}^{F}X_{i,j,k,m}^{S}}{V_{j,k}^{F} + V_{j,k}^{S}}$$

*3 Adjacent age groups are combined because the sample size of a group can be too small.

(3) Calculation of the composite expenditure by household attribute

We calculate the amount of expenditure for goods and services other than (2) in FIES with EMS by the ten major expenditure groups and the groups of household attributes ($X'^F_{i,j,k,m}$).

To obtain the amount of expenditures by the ten major expenditure groups and the groups of household attributes ($X_{i,j,k,m}$), the amount of expenditure for (2) and for other than (2) are added up for each of the ten major expenditure groups (i) and the household attributes (j, k).

$$X_{i,j,k,m} = X^{FS}_{i,j,k,m} + X'^F_{i,j,k,m}$$

(4) Calculation of the amount of expenditure by type of household

Using the number of households by the household attribute in the current month ($w_{j,k,m}$) as the weight, we weighted average the expenditure by the household attributes ($X_{i,j,k,m}$) to compute the amount of expenditure by the type of household ($X_{h,i,m}$, $X_{h,m}$). The weight is a 12-month backward moving average calculated in advance from the results of the Labour Force Survey.

$$X_{h,i,m} = \frac{\sum_{j,k \in G_h} w_{j,k,m} X_{i,j,k,m}}{\sum_{j,k \in G_h} w_{j,k,m}}$$

$$X_{h,m} = \sum_i X_{h,i,m}$$

G_h : The whole of the combination of the household attributes corresponding to the type of household (h)

Using the monthly average of the number of households in the base year ($\overline{w}_{j,k}$) as the weight, we weighted average the expenditure by the household attributes ($X_{i,j,k,m}$) to calculate the amount of expenditure by the type of household ($X^a_{h,i,m}, X^a_{h,m}$), which is adjusted to the distribution of household in the base year.

$$X^a_{h,i,m} = \frac{\sum_{j,k \in G_h} \overline{w}_{j,k} X_{i,j,k,m}}{\sum_{j,k \in G_h} \overline{w}_{j,k}}$$

$$X^a_{h,m} = \sum_i X^a_{h,i,m}$$

$$\overline{w}_{j,k} = \frac{\sum_{m \in 2020.1 \sim 12} w_{j,k,m}}{12}$$

(5) Calculation of indices (nominal, real), seasonally adjusted series, and trend-cycle estimates

We divide the amount of expenditure by the type of household ($X_{h,i,m}$, $X_{h,m}$) by the monthly average of consumption expenditure in the base year ($\overline{X}_h$) to calculate the indices where the monthly average of consumption expenditure in the base year is 100 ($I_{h,i,m}$, $I_{h,m}$).

$$I_{h,i,m} = \frac{X_{h,i,m}}{\overline{X}_h} \times 100$$

$$I_{h,m} = \frac{X_{h,m}}{\bar{X}_h} \times 100$$

$$\bar{X}_h = \frac{\sum_{m \in 2020.1 \sim 12} X_{h,m}}{12}$$

To obtain the indices adjusted by household distribution ($I_{h,i,m}^a$, $I_{h,m}^a$), which are indices using the household distribution in the base year as weight, we replace $X_{h,i,m}$ and $X_{h,m}$ above with $X_{h,i,m}^a$ and $X_{h,m}^a$, and do not replace, still use $\bar{X}_h$, then we follow the same procedure used to calculate the index ($I_{h,i,m}$, $I_{h,m}$).

Using the CPI corresponding to each of the ten major expenditure groups, we realign the index. Based on the census adjustment method (X-12-ARIMA), we calculate the seasonally adjusted series and the trend-cycle estimates as well.

(6) The tables showing the expenditure of commodities for reference

The amount of expenditure shown in the tables for reference is calculated using the same procedure used to calculate the index except for the groups of household attributes used from "(2) Integration of FIES with EMS and SHE" to "(4) Calculation of the amount of expenditure by type of household" which are as follows, the six groups of household members and the eight age groups of household heads. For this reason, please note that the amount of expenditure shown in the tables for reference may not be the same as that used to calculate the index.

The other values shown in the tables for reference, which are from "Distribution of households" to "Rate of owned dwellings," are also calculated by using the six groups of household members and the eight age groups of household heads. We calculate those values using only FIES with EMS ($X_{i,j,k,m}^F$) and not SHE ($X_{i,j,k,m}^S$).

$$X_{h,i,m} = \frac{\sum_{j,k \in G_h} w_{j,k,m} X_{i,j,k,m}^F}{\sum_{j,k \in G_h} w_{j,k,m}}$$

i : From "Distribution of households" to "Rate of owned dwellings"

The Groups of Household Attributes Used by Integration of FIES with EMS and SHE for the Tables for Reference

| | | | The Eight Age Groups of Household Heads | | | | | | | |
			Less than 30	Less than 40	Less than 50	Less than 60	Less than 70	Less than 80	80 years & Older	65 years & Older
The Six Groups of Household Members	One-Person	Men								
		Women								
	Two-Persons									
	Three-Persons									
	Four-Persons									
	Five-or-More-Persons									

For the table for reference, the monthly and annual results are published as follows.

Table for Reference	Type of Household		
	Total	Two-or-more-person	One-person
Table 1 Expenditures of Commodities per Household by Number of Household Members		-	-
Table 2 Expenditures of Commodities per Household by Age Group of Household Heads			-
Table 3 Expenditures of Commodities per Household by Sex and Age Group	-	-	

4 Main points of the 2020-base revision

We began to release the 2020-base CTI in September 2021. We release the 2020-base index from January 2020 retroactively, and the indices before December 2019 are converted into the 2020-base and linked to enable time-series analysis. Main points of the 2020-base revision are as follows.

Household Consumption Trend Index	The index reference period of the CTI is revised from 2015 to 2020. The indices by the category of goods and services are started to be released. The integration procedure of FIES, EMS and SHE is reformed. The indices before December 2019 are converted into the 2020-base and linked. The real values are revised due to CPI revision. The tables of the rates of change are expanded from several indices to all.
Seasonally Adjusted Series	The seasonally adjusted indices are revised due to revision of the original indices. The tables of the rates of change are expanded from several indices to all.
Tables for Reference	The integration procedure of FIES, EMS and SHE is reformed.

Note 1. Index for goods and services categories

In principle, the classification of goods and services is the same as in the FIES classification <https://www.stat.go.jp/data/kakei/9.html> except for the classification of tuition and other fees paid directly to a corporation by a sending household. The CTI revised its classification from "Remittance" to "School fees" from January 2020. Therefore, the 2020-base indices, "Education," "Other consumption expenditure" and the index for goods and services category before December 2019 cannot be calculated as the 2020-bese, converted into the 2020-base, and linked. As a result, seasonally adjusted indices for "Education" and the goods and services category, will not be prepared for the time being.

As with the 2015-base, we do not calculate seasonally adjusted indices for "Education" for one-person households and "Other consumption expenditure" by the 2020-base.

Note 2. Integration procedure of FIES, EMS and SHE are reformed

The ratio of one-person households under the age of 70 in FIES to EMS in the integration was roughly 0.5:0.5 on the 2015-base. For the 2020-base, we use the inverse ratio of the variances of the consumption expenditures

in each survey, 0.35:0.65, to correct each household weight of FIES and EMS when records of FIES and EMS are merged (Refer to 3 Estimation Method (1)).

In the 2015-base, FIES with EMS and SHE were integrated using a weighted average by the ten major expenditure groups in each survey. For the weights, uniform ratios were used for each type of household, which were 111:220 for total households, 80:200 for two-or-more-person households, and 31:20 for one-person households.

In the 2020-base, using the inverse ratio of the variance of the consumption expenditure by the household attributes, the expenditure by the group of household attributes of FIES with EMS and SHE are weighted averaged by each group of the household attributes. Using the number of households by the household attributes as the weight, the expenditure by the household attributes is used to calculate the amount of expenditure by the type of household (Refer to 3 Estimation Method (2)).

However, due to differences of the groups of household attributes used in the weighted average, the amount of expenditure by the type of household used in the index calculation may not match the expenditure shown in the tables for reference (Refer to 3 Estimation Method (6)).

References

Takahiro Hoshino. (2005). "Propensity Score Weighted *M* Estimation for General Parametric Models for Groups with Complete Missingness and its Application to Intervention Effects," *The Japanese journal of behaviormetrics*, 32(2), 121-132.

Takahiro Hoshino. (2009) ″ ″ *Iwanami Shoten, Publishers.*
　　　　　　　　　29
https://www.stat.go.jp/info/kenkyu/skenkyu/index.html