

## Method for Estimating the 2020-base Household Consumption Trend Index (CTI micro) - From January 2024 -

### 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 (CTI micro)	Total		Two-or-more-person		One-person	
		Original series	Seasonally adjusted series	Original series	Seasonally adjusted series	Original series	Seasonally adjusted series
1-a-b	Consumption expenditures						
	The Ten Major Expense Groups						
	The Category of Goods and Services						

Adjusted by the Distribution of Household by Number of Household Members and Age Group of Household Head

2-a-b	Consumption expenditures						
	The Ten Major Expense Groups						
	The Category of Goods and Services						

“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.

“ ” indicates that the index and the index for Worker’s household are provided.

“ ” indicates that the index is provided.

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 <sup>\*1</sup>

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. The trend-cycle estimates are calculated based on the indices (real).

\*1 Trend-cycle estimates are the indices which are to delete the irregular components from the input indices (real).

## 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. <sup>\*2</sup>

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 The propensity score is estimated as the probability that the sample will be assigned to EMS. By correcting

each weight of EMS households based on the propensity score, we estimate the amount of expenditure that households would spend if they responded to EMS in the FIES sample. (Hoshino (2005), Hoshino (2009))

(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 ( $X'_{i,j,k,m}$ ).

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 ( $j, k$ ).

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

(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 ( $\bar{w}_{j,k}$ ) 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 ( $X_{h,i,m}^a$ ,  $X_{h,m}^a$ ), which is adjusted to the distribution of household in the base year.

$$X_{h,i,m}^a = \frac{\sum_{j,k \in G_h} \bar{w}_{j,k} X_{i,j,k,m}}{\sum_{j,k \in G_h} \bar{w}_{j,k}}$$

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

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

(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 ( $\bar{X}_h$ ) to calculate the indices where the monthly average of consumption expenditure in the base year is 100 ( $I_{h,i,m}$ ,  $I_{h,m}$ ).

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

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

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

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\*4.

\*4 Due to seasonal adjustment, the average of the seasonally adjusted series and the trend-cycle estimates for the base year can be other than 100.

(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. However, for the three age groups listed separately in the table for reference by age group of householders (29 and under, 30-39, and 65 and over), the amount of expenditure is calculated using age group categories that differ from those used in the index calculation. Therefore, the weights listed separately are different from those used to calculate the index, and the "Weight" for these three categories are not shown. The other values shown in the tables for reference, which are from "Weight" to "Rate of owned dwellings," are calculated by 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 "Weight" to "Rate of owned dwellings"

The change over the year and contributions in the table for reference are calculated using the amount of expenditures ( $X_{h,i,m}$ ) by household type ( $h$ ) and by item ( $i$ ). The consumer price index ( $P_{i,m}$ ) corresponding to each item is used to calculate the real value. The calculation method for each is as follows.

Change over the year (nominal)	$\frac{X_{h,i,m} - X_{h,i,m-12}}{X_{h,i,m-12}} \times 100$
Contribution (nominal)	$\frac{X_{h,i,m} - X_{h,i,m-12}}{X_{h,0,m-12}} \times 100$ ( $X_{h,0,m}$ is the composite amount of consumption expenditure in aggregate category $h$ .)
Contribution to the total household (nominal)	$\frac{\frac{\sum_{a \in G_h} w_{a,m}}{\sum_{a \in G_{Total}} w_{a,m}} X_{h,i,m} - \frac{\sum_{a \in G_h} w_{a,m-12}}{\sum_{a \in G_{Total}} w_{a,m-12}} X_{h,i,m-12}}{X_{0,0,m-12}} \times 100$ ( $w_{a,m}$ is the weight of household $a$ , $X_{0,0,m}$ is the composite amount of total household consumption expenditure.)
Change over the year (real)	$\frac{X_{h,i,m}/P_{i,m} - X_{h,i,m-12}/P_{i,m-12}}{X_{h,i,m-12}/P_{i,m-12}} \times 100$
Contribution (real)	$\frac{X_{h,i,m}/P_{i,m} - X_{h,i,m-12}/P_{i,m-12}}{X_{h,0,m-12}/P_{0,m-12}} \times 100$ ( $P_{0,m}$ is the index value of the CPI "All items, less imputed rent.")
Contribution to the total household (real)	$\frac{\frac{\sum_{a \in G_h} w_{a,m}}{\sum_{a \in G_{Total}} w_{a,m}} X_{h,i,m}/P_{i,m} - \frac{\sum_{a \in G_h} w_{a,m-12}}{\sum_{a \in G_{Total}} w_{a,m-12}} X_{h,i,m-12}/P_{i,m-12}}{X_{0,0,m-12}/P_{0,m-12}} \times 100$

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	-	-	
Table 4 Expenditures of Commodities per Household - Change over the year			

#### 4 Main points of the 2020-base revision and the revision in January 2024

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 (CTI micro)	<ul style="list-style-type: none"> <li>• The index reference period of the CTI is revised from 2015 to 2020.</li> <li>• The indices by the category of goods and services are started to be released.</li> <li>• The integration procedure of FIES, EMS and SHE is reformed.</li> <li>• The indices before December 2019 are converted into the 2020-base and linked.</li> <li>• The real values are revised due to CPI revision.</li> <li>• The tables of the rates of change are expanded from several indices to all.</li> </ul>
Seasonally Adjusted Series	<ul style="list-style-type: none"> <li>• The seasonally adjusted indices are revised due to revision of the original indices.</li> <li>• The tables of the rates of change are expanded from several indices to all.</li> </ul>
Tables for Reference	<ul style="list-style-type: none"> <li>• The integration procedure of FIES, EMS and SHE is reformed.</li> </ul>

We made several revisions, including the start of publishing seasonally adjusted index for "Education" beginning with the January 2024 release. A summary of the revisions is as follows.

Original Series	<ul style="list-style-type: none"> <li>• Revision of the "Education" connection</li> <li>• Revision of connection index</li> </ul>	Two-or-more-person households: From January 2002 Total households, one-person households: From January 2017, from the first quarter of 2002, from 2002
Seasonally Adjusted Series	<ul style="list-style-type: none"> <li>• Start of "Education" publication</li> <li>• Discontinue of "working households"</li> <li>• Discontinue of 10 major expense categories, for indices adjusted to the distribution of household in the base year</li> </ul>	Two-or-more-person households: From January 2002 Total households, one-person households: From January 2017, from the first quarter of 2002
Tables for Reference	<ul style="list-style-type: none"> <li>• Revision of the calculation method in the table of reference</li> <li>• Start of "Contribution" and "Contribution to the total household" publication</li> <li>• Start of "Weight" publication</li> <li>• Start of amount of expenditures for goods and services categories publication</li> </ul>	From January 2024

#### 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, "Other consumption expenditure" and the index for goods and services category before December 2019 cannot be calculated as the 2020-base, converted into the 2020-base, and linked. As a result, seasonally adjusted indices for services category will not be prepared for the time being. Since there is no significant difference in seasonality between the 2015 and 2020 basis for "Education," we created a connection index and provided seasonally adjusted index starting with the January 2024 release.

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. Connection index

For 2019 and earlier, the Household Economy Consumption Index and another index are connected to the 2015-based CTI micro and converted to the connected index with 2020 as 100. A summary of the 2015-based index used for the connection is as follows.

Before December 2014	Concerning consumption expenditures, the 2015-based Household Economy Consumption Index is directly connected to the index below (January 2015 to December 2016). On the other hand, for each of the 10 major expense categories, the 2015 average is adjusted to the index converted to match the 2015 average of the index below (January 2015 to December 2016). Therefore, for the period prior to December 2014, the sum of the indices for the 10 major expenses can be other than consumption expenditures.
January 2015 to December 2016	Index calculated by combining monthly results of FIES and SHE in accordance with the method used to create CTI micro.
January 2017 to December 2020	2015-based CTI micro. For the results from January to December 2018, the index is adjusted for changes due to the impact of the change in survey methodology in the January 2018 the FIES.

Note 3. 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)).

Note 4. Revision of the calculation method in the table of reference

The amount of expenditures in the table of reference are calculated in the same way used to calculate the index. However, until the release of the December 2023, the classification of household attributes used in the integration of FIES with EMS and SHE differed between the table of reference and the index values, so the composite amounts shown in the table of reference can be other than the expenditure amounts used in the index calculation from the January 2020 to the December 2023.



#### Note 5. Revision of the coefficients of connection

For the link coefficient to convert the 2015-based CTI micro, the ratio between the 2015-based and 2020-based average monthly consumption expenditures in 2020 was used until the December 2023 release. Starting with the January 2024 release, the connection index is calculated using the ratio of the 2015 average to the 2020 average of 2015-based CTI micro.

#### Note 6. Start of "Weight" publication

Beginning with the January 2024 release, we provide "Weight" for all household types (total households, two-or-more-person households, and one-person households) which is the ratio of the number of households in each category to the number of total households. As a result, the "Distribution of households," which had been posted until December 2023, was discontinued.

#### References

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消費統計研究会（平成29年度 第1回～第3回，令和2年度 第1回，令和3年度 第1回）資料  
<https://www.stat.go.jp/info/kenkyu/skenkyu/index.html>