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Abstract

This paper explains the revision of the estimation method for the "Consumption Activity Index (CAI)," which is published by the Research and Statistics Department of the Bank of Japan periodically. This revision of the CAI is based on the revision of Japan's GDP statistics to the 2020 base and recent structural changes in consumption behavior.

The key updates include the following: (1) updating weights of the CAI to be based on the revision of GDP statistics, and (2) reflecting structural changes in household consumption behavior observed since the COVID-19 pandemic by utilizing newly available EC-related data and value-added based related statistics for non-durable goods and service consumption. Additionally, (3) in order to more accurately reflect long-term consumption trends, for periods where Second Annual Estimate values of GDP statistics are available, a level adjustment was performed to align the CAI with GDP statistics on an annual basis.

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1. *Introduction*

In order to provide the actual movements of private consumption in a timely manner, the Research and Statistics Department at the Bank of Japan compiles the Consumption Activity Index (CAI) on a monthly basis, and publishes it online as "Research Data" (Chart 1). Since its initial release in 2016, the CAI has been continuously updated in response to the revisions and abolition of available statistics and changes in consumption behaviors (Nakamura et al. (2016a), Nakamura et al. (2016b), Kanafuji et al. (2018), and Takahashi et al. (2021)).

Chart 1: The CAI Series Published as "Research Data"[1]

Index (s.a.)
Consumption Activity Index <Nominal, Real>
Consumption Activity Index (travel balance adjusted) <Nominal, Real>
Real Consumption Activity Index Plus
Real Durable Goods Index
Real Non-durable Goods Index
Real Services Index

In December 2025, a quinquennial benchmark revision of the System of National Accounts in Japan (hereafter, GDP statistics) was implemented, shifting the base year from 2015 to 2020. In this revision of the CAI, while ensuring consistency with the base revision of GDP statistics, several changes were made to incorporate newly available statistics (since the previous revision in 2021), and to reflect changes in consumption behavior since the COVID-19 pandemic.

The key points of the revision are summarized as the following three points: (1) updating the weights of the CAI to be based on the revision of GDP statistics, (2) reflecting structural changes in household consumption behavior observed since the COVID-19 pandemic by utilizing newly available EC-related data and value-added based related statistics for non-durable goods and service consumption, and (3) in order to more accurately reflect long-term consumption trends, for periods where Second Annual Estimate values of GDP statistics are available, a level adjustment was performed to align the CAI with GDP statistics on an annual basis.

The remainder of the paper is structured as follows. Section 2 describes the contents of the revisions. Section 3 concludes with a discussion of future challenges.

[1] In conjunction with this revision, the "Real Consumption Activity Index Plus," which was previously calculated separately to capture online commerce and content delivery, has been discontinued because some of such items have been integrated into the main series.

2. Contents of the Revision[2]

2-1. Update of Goods/Services Weights

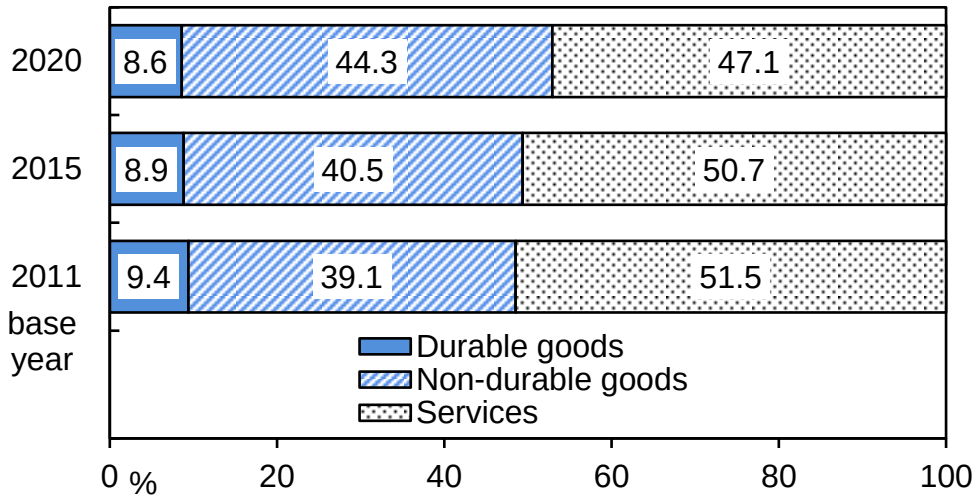
The CAI is compiled using two types of weights. First, (1) type weights (durable goods, non-durable goods, and services) use the weights in the domestic final consumption expenditure of households of GDP statistics. Then, (2) item weights (e.g., for individual items such as "Food and beverages" or "Clothes"), which are more detailed breakdowns, are calculated by multiplying the type weights by the weight of each individual item in consumption by type (which are estimated based on Input-Output Tables).

The previous CAI used 2015-based weights. In this revision, the type and item weights are updated to the 2020 base to be consistent with the base revision of GDP statistics implemented in December 2025.[3] Accordingly, the base year for the CAI was also changed from 2015 to 2020.

(1) Type Weights

The updated type weights for the CAI are as shown in Chart 2. Comparing before and after the revision, services decreased while non-durable goods increased.[4]

Chart 2: Type Weights in CAI



Sources: Bank of Japan, etc.

[2] For detailed data sources used in the revised CAI, please refer to Charts A1 and A2.

[3] These adjustments were applied only to data from 2020 onwards. For pre-2020 figures, the previous weights (2003-2014: 2011 base; 2015-2019: 2015 base) continue to apply.

[4] The decline in the share of services in the base-year weights for 2020 may be attributed to the sharp decrease in face-to-face service consumption, such as food services during the COVID-19 pandemic (and the increase in non-durable goods consumption as a substitute), which may have made the weight of such services smaller than in normal times.

(2) Item Weights

Item weights were updated from those based on the 2015 Input-Output Tables to those based on the 2020 Input-Output Tables to ensure consistency with the 2020-base GDP statistics.[5, 6]

The updated item weights reflecting these revisions are detailed in Chart 3. For items under durable goods, the weights of all items have slightly decreased. For items under non-durable goods, the weight of "Food and beverages" has increased, while the weight of "Clothes" has decreased. For items related to services, the weights for "Communications" and "Medical and other health care services" have increased, while the weight for "Food services" has decreased.[7] Additionally, "Internet based services" has been added as a new item, as explained below.

[5] In alignment with COICOP 2018 standard, the 2020-base GDP statistics employs 116 categories of detailed classifications of domestic final consumption expenditure of households of GDP statistics, instead of previous 88 categories. As the weights for these new categories are unpublished, estimates using Input-Output Tables have been used, based on the method Kanafuji et al. (2018) proposed.

[6] For items "Game software," which is not listed on the Input-Output Tables, corresponding weights were derived using the share of game software sales in "Software products" from the Current Survey of Selected Service Industries (Ministry of Economy, Trade and Industry) in 2020 and scaled to the corresponding "Computer programming and miscellaneous software services" weight in the Input-Output Tables.

[7] For item "Ceremonial occasions, etc.," the weight has been updated to include photographic studios, following the 2020-base revisions of the Indices of Tertiary Industry Activity (Ministry of Economy, Trade and Industry).

Chart 3: Item Weights in the CAI

Item	Before revision		After revision	
Durable goods	8.9	—	8.6	—
Automobiles	4.1	<46.6>	4.0	<46.5>
Household electrical appliances	4.7	<53.4>	4.6	<53.5>
Non-durable goods	40.5	—	44.3	—
Food and beverages	19.6	<48.4>	22.7	<51.2>
Clothes	4.9	<12.0>	3.9	< 8.8>
Fuel	2.7	< 6.8>	2.3	< 5.2>
Drugs, cosmetics, etc.	6.5	<16.1>	8.9	<20.1>
Electricity	2.2	< 5.4>	2.5	< 5.7>
Gas	1.1	< 2.6>	0.7	< 1.5>
Water	0.8	< 1.9>	0.8	< 1.9>
Newspapers	0.4	< 0.9>	0.2	< 0.5>
Books and magazines	0.3	< 0.8>	0.4	< 0.9>
Game software	0.2	< 0.6>	0.2	< 0.4>
Tobacco	1.9	< 4.6>	1.7	< 3.8>
Services	50.7	—	47.1	—
Food services	11.3	<22.3>	8.4	<17.8>
Travel services	0.2	< 0.4>	0.0	< 0.1>
Medical and other health care services	5.0	< 9.9>	5.2	<11.1>
Care services	1.8	< 3.6>	1.9	< 3.9>
Communications	5.2	<10.2>	6.0	<12.7>
Railway	2.6	< 5.1>	1.7	< 3.7>
Bus	0.8	< 1.7>	0.4	< 0.8>
Taxi	1.1	< 2.1>	0.4	< 0.8>
Air	1.1	< 2.1>	0.3	< 0.7>
Postal services	0.1	< 0.2>	0.1	< 0.2>
Services for amusement and hobbies	4.8	< 9.5>	4.6	< 9.7>
Accommodations	1.8	< 3.5>	1.3	< 2.9>
Supplementary tutorial schools	1.3	< 2.6>	1.4	< 3.0>
Ceremonial occasions, etc.	1.4	< 2.7>	1.2	< 2.7>
Public broadcasting	0.4	< 0.7>	0.5	< 1.0>
Automobile parking	1.3	< 2.5>	1.5	< 3.3>
Financial services	1.8	< 3.6>	2.4	< 5.1>
Life insurance	6.0	<11.8>	5.4	<11.5>
Non-life insurance	1.2	< 2.3>	1.2	< 2.4>
Automobile maintenance	1.6	< 3.2>	1.8	< 3.8>
Internet based services	—	—	1.2	< 2.6>

Note: Figures in angular brackets show the weights within each type. Non-durable goods include goods classified as "Semi-durable goods" in the GDP statistics. Services exclude imputed rent.

Sources: Bank of Japan, etc.

2-2. Addition of Items and Revision of Estimation Methods

The CAI utilizes a wide range of publicly available statistics from both government and private entities to capture consumption trends by item. This revision utilized statistics that became newly available since the last revision in 2021. Specifically, the focus was on (1) capturing the impact of diversifying sales channels such as E-Commerce and (2) capturing consumption trends on a value-added basis in service consumption.

(1) Capturing Sales Channel Diversification

(1-1) Revision of Source Statistics for "Clothes"

In recent years, sales channels for apparel have diversified—owing to developments such as the expansion of E-Commerce (hereafter referred to "EC") during the COVID-19 pandemic. Previously, the Current Survey of Commerce (Ministry of Economy, Trade and Industry), which is a sales-side statistic, was used for the estimation of "Clothes," but it was difficult to classify and thus EC-only retailers were not included.[8] Consequently, differences in movement arose with GDP statistics, which capture clothes consumption from supply-side statistics such as production statistics.[9] As shown in Chart 4, the CAI-based pre-revision "Clothes" series continued to stagnate at a low level after a decline during the COVID-19 pandemic, whereas the GDP statistics-based "Clothing and footwear" series clearly showed a recovery. This suggests that the previous CAI might not fully reflect the impact of the diversification in sales channels especially after the COVID-19 pandemic.

To address this issue, the revised series introduces supply-side data, drawing on GDP statistics as a reference. Specifically, the revised method estimates domestic supply by combining nominal shipments, imports, and exports, using each weight[10] from the 2020 Input-Output Tables. Nominal shipments are calculated by multiplying shipment volumes of "Textile products and crude fiber products" from the Indices of Industrial

[8] While the sales of EC-only companies are captured under "nonstore retailers" in the Current Survey of Commerce, itemized sales data is unavailable, making it difficult to classify specific items, thereby these are excluded from the CAI. Note that EC sales of physical retail stores are included as part of sales by retail format.

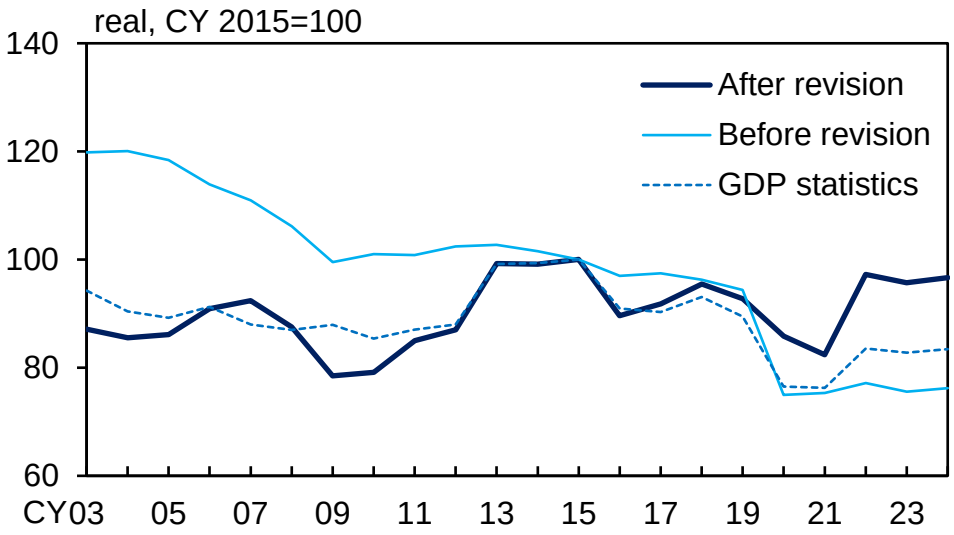
[9] The Quarterly Estimates of GDP (QE) uses Indices of Industrial Production (Ministry of Economy, Trade and Industry) and Trade Statistics (Ministry of Finance) in order to estimate value-added from supply-side data. Specifically, the total domestic supply of goods and services, calculated as the sum of shipment and import subtracting export, is assumed to be distributed to intermediate goods, inventories, consumption, or fixed capital formation, known as commodity flow estimation method. For details, please refer to Cabinet Office (2025a) and Cabinet Office (2025b).

[10] To adjust for the commercial margins associated with domestic production and imports, the "Total demand" in the Input-Output Tables is proportionally allocated using weights derived from domestic production and imports, excluding commercial margins.

Production by the "Textile products" price index from the Corporate Goods Price Index (Bank of Japan). Nominal imports are derived from the total import value for "Textile yarn, fabrics," "Clothing and accessories," and "Bags" in the Trade Statistics. Nominal exports are derived from the total export value of "Textile yarn, fabrics." All values were standardized using the base year value and combined using the weights from the Input-Output Tables to compute nominal domestic total supply as: Nominal Domestic Total Supply = Nominal Shipments + Nominal Imports - Nominal Exports. Assuming that the proportion of domestic final consumption expenditure of households in the total nominal domestic supply remains unchanged from the base year, nominal domestic final consumption expenditure of households for clothes is calculated. The nominal consumption amount was then deflated using the "Clothes & footwear" and "Personal effects excluding wrist watches" indices of the Consumer Price Index (Ministry of Internal Affairs and Communications) to convert it into real values.

The revised real series for "Clothes" shows that the downward trend observed in the pre-revision series has eased, and has recovered since the COVID-19 pandemic, bringing it closer to the movement of GDP statistics in the long run (Chart 4).

Chart 4: Revision of "Clothes"



Note: "GDP statistics" refers to "Clothes and footwear" in Final Consumption Expenditure of Households.
Sources: Cabinet Office; Bank of Japan, etc.

(1-2) Revision in the Estimation Methodology for "Food and Beverages"

The "Food and beverages" series in the CAI has shown a consistent decline in recent years. While this trend is partially explained by a decrease in consumption volume due to rising food prices since 2022, it is also likely related to diversification of sales channels—such

as the increased prevalence of EC platforms particularly after the COVID-19 pandemic, in addition to the increasing sales share through drugstores.

In fact, a comparison between non-durable goods in GDP statistics—primarily comprising food items—and the non-durable goods in the CAI, shows that the CAI has a weaker trend compared with the GDP statistics, with the gap expanding in recent years. Based on these points, in this revision, (1) revisions are made to reflect the expansion of food sales at drugstores, and (2) EC food sales are estimated under certain assumptions and incorporated into the food consumption amount.

Regarding (1), "Health foods" and "Food" sales from drugstores, which were previously classified under "Drugs, cosmetics, etc.," are reclassified into the "Food and beverages" category, and corresponding deflator of "Drugs, cosmetics, etc." is also refined by excluding food-related items from the category.[11]

Regarding (2), in the previous CAI, a separate series called the "Consumption Activity Index Plus" was compiled and published, which incorporated data from JCB Consumption NOW (provided by Nowcast Inc./JCB, Co., Ltd.) that captures EC expenditure based on credit card settlement information. CAI plus had been published alongside CAI, partly due to reasons such as the limited time span of EC consumption data at the time of previous revision, as pointed out by Takahashi et al. (2021). In this revision, given the additional accumulated time series of credit card transaction data, EC consumption data was incorporated into the main series of the CAI. Looking at EC food sales created from JCB Consumption NOW data, it accounts for 4 percent of total food sales, and the ratio continues to rise even after significantly increasing due to stay-at-home requests during the COVID-19 pandemic (Chart 5). For periods such data are unavailable, annual EC food consumption figures from the E-Commerce Market Survey (Ministry of Economy, Trade and Industry) are used to retrospectively estimate a relatively long-term series of EC food sales.[12]

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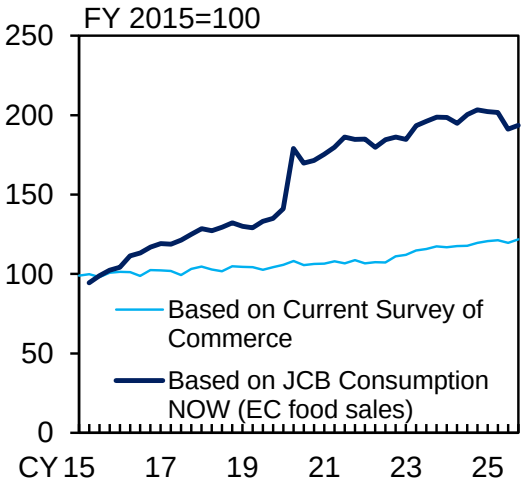
[11] The previous CAI uses CPI goods excluding "Electricity, manufactured & piped gas & water charges," "Clothes," "Shirts, sweater & underwear," "Tobacco," "Agricultural, aquatic & livestock products," "Petroleum products," and "Durable goods." After the revision, "Food excluding meals outside the home" is newly excluded.

[12] The specific methodology for compilation is as follows:

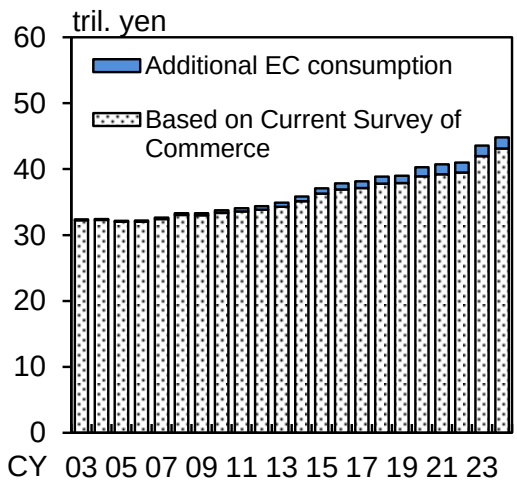
1. From January 2016 onward: The methodology adheres to the previous procedure for constructing the "Consumption Activity Index Plus" (see Takahashi et al. (2021) for details). The EC ratio was updated to reflect the figure as of 2020, based on data for total households in the Survey of Household Economy (Ministry of Internal Affairs and Communications), etc. Additionally, to exclude the EC consumption amounts included in the Current Survey of Commerce from the weight calculation, the proportion of food and beverage internet sales accounted for by non-store retailers, based on the 2021 Economic Census for Business Activity (Ministry of Internal Affairs and Communications and Ministry of Economy, Trade and Industry), was applied to the EC ratio. Using this updated weight, the

Chart 5: Integration of EC Consumption in Food and Beverages

(1) Food and Beverage Consumption through EC



(2) Total Consumption of Food and Beverage



Sources: Ministry of Internal Affairs and Communications; Ministry of Economy, Trade and Industry; Nowcast Inc./ JCB, Co., Ltd., "JCB Consumption NOW."

The revised "Food and beverages" series shows that the previously observed downward trend in recent years has eased by incorporating sales through drugstores and EC consumption (Chart 6(1)). On the other hand, the revised "Drugs, cosmetics, etc." decreases on a nominal bases compared to before due to the exclusion of food sales from drugstores; the real value has been revised upward in recent periods due to revising down in the deflator (Chart 6(2)).

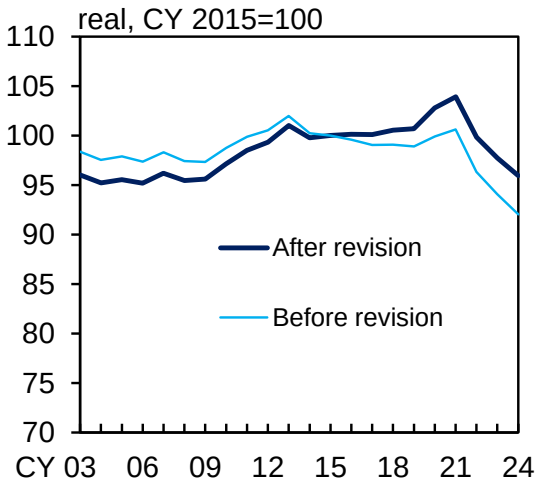
food and beverage sales figures based on the Current Survey of Commerce were combined with the above series using a weighted average.

2. From January 2004 to December 2015: The annual EC consumption amount for food and beverages, as estimated in the E-Commerce Market Survey, was used and connected to the series compiled according to step 1 above. For monthly data during this period, the proportional Denton method (explained in detail later) was employed to apportion the annual EC consumption figures using the monthly food and beverage sales from the Current Survey of Commerce as a proxy series.

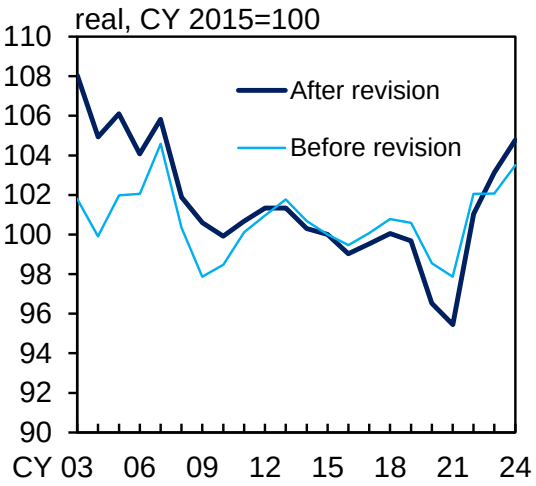
3. Before December 2003: The food and beverage sales figures based on the Current Survey of Commerce were used to extend the series retrospectively.

Chart 6: Revision of "Food and Beverages", etc.

(1) Food and Beverages



(2) Drugs and Cosmetics, etc.

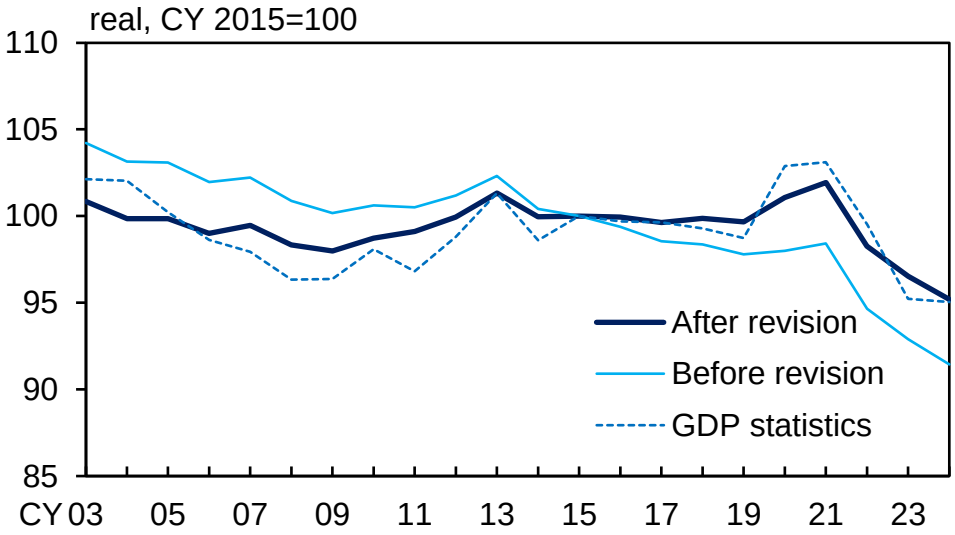


Sources: Bank of Japan, etc.

Consequently, the updated "Food and beverage" series under the non-durable goods category now aligns more closely with GDP statistics (Chart 7(1)). In fact, the Mean Absolute Error (MAE) between the CAI and GDP statistics has decreased, demonstrating reduced discrepancies in the revised series (Chart 7(2)).

Chart 7: Food and Beverages, and Tobacco

(1) CAI and GDP statistics



(2) Mean Absolute Errors

	Level	YoY
Before Revision	2.54	1.09
After Revision	1.06	1.05

Note: The GDP statistics represent the total value of the "Food and non-alcoholic beverages" and "Alcoholic beverages and tobacco" series. To ensure consistency for comparison purposes, the Consumption Activity Indexes before and after revision also utilize the food and beverages + tobacco series. The period for calculating the Mean Absolute Error (MAE) spans from CY2003 to CY2023, during which the Second Annual Estimate values of GDP statistics are available.

Sources: Cabinet Office, Bank of Japan, etc.

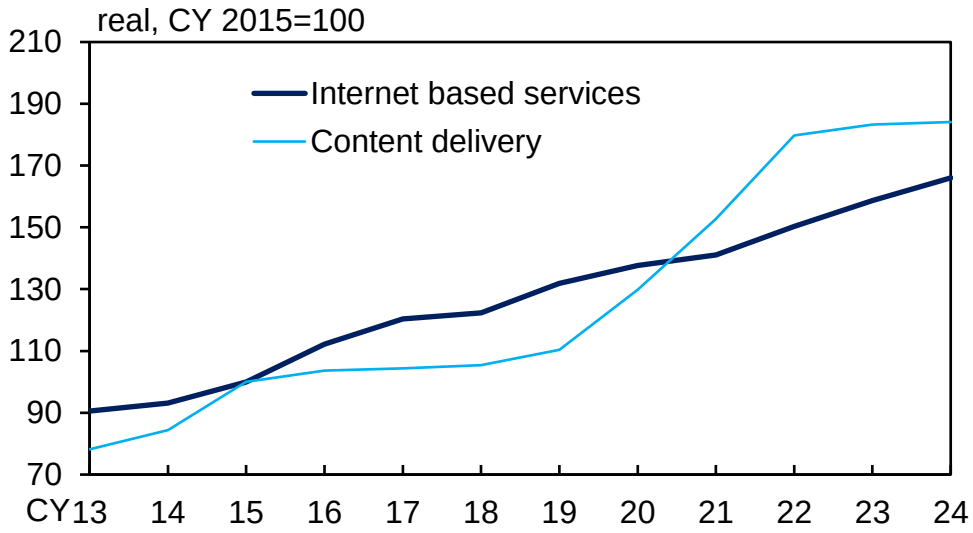
(1-3) Addition of "Internet based Services"

Against the backdrop of notable growth in online consumption including music and video streaming and other internet-based subscription services, it is becoming increasingly important to capture the trends of these online forms of consumption. In the 2021 revision, the CAI began incorporating credit card transaction data from JCB Consumption NOW to estimate consumption for "Content delivery" services, which were published as the "Consumption Activity Index Plus." In this revision, the sales in the "Internet based services" from the Monthly Business Survey of Services (Ministry of Internal Affairs and Communications), were incorporated into the main CAI series as "Internet based services."[13] This category broadly captures online service consumption, not only content

[13] The deflator for "Internet based services" is based on the Services Producer Price Index (Bank of Japan) for "Internet based services." This index provides a broader representation of related services than services covered by the Consumer Price Index like "Internet connection charges" or "Charges for web content," making it a more appropriate deflator for tracking "Internet based services" revenue.

delivery services such as music and video streaming, but also fees associated with shopping and auction services. The "Internet based services" series exhibited a clear upward trend, nearly doubling in real value between 2013 and 2024 (Chart 8).

Chart 8: Internet based Services



Sources: Nowcast Inc./ JCB, Co., Ltd., "JCB Consumption NOW."; Bank of Japan, etc.

(1-4) Revision of the Source Statistics for "Accommodations"

In the previous CAI, the source statistics for "Accommodations" were solely based on the Monthly Business Survey of Services. As the lodging industry has been facing significant changes with the rise of private residential lodging services ("mimpaku")—where private residences are utilized to provide accommodation for travelers—gaining substantial traction alongside traditional hotels and ryokan (Japanese-style inn) services (Chart 9(1)). However, the trends in "mimpaku" lodging do not appear to be fully captured by the existing statistics, such as the Monthly Business Survey of Services or the Overnight Travel Statistics Survey (Japan Tourism Agency).[14] To address this caveat, the revised CAI incorporates Performance of Private Lodging Business (Japan Tourism Agency) as source statistics for the "mimpaku" segment.

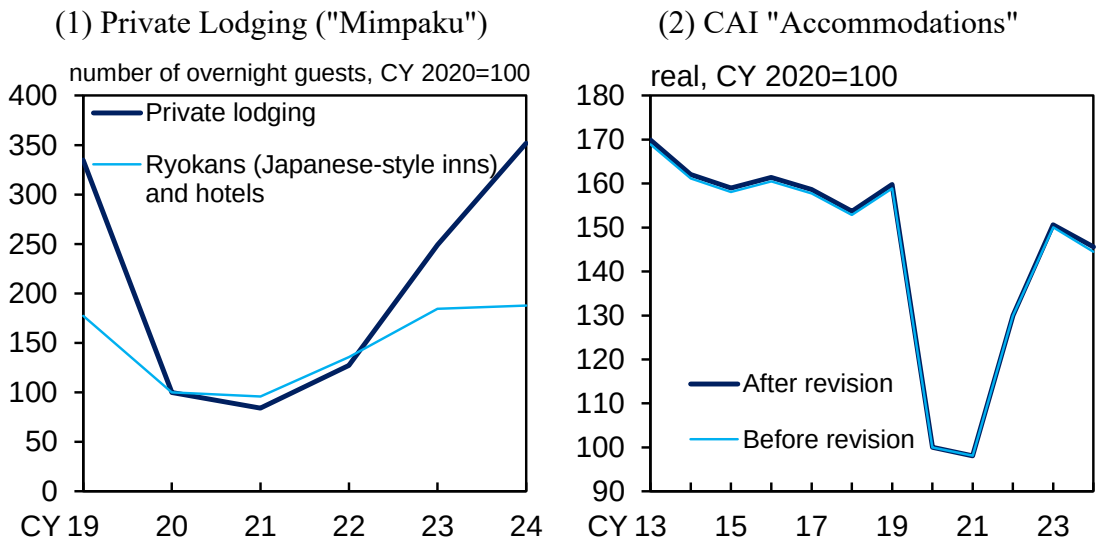
To incorporate this data into the CAI, the monthly data of mimpaku guest nights is calculated by allocating the bi-monthly figures into individual months based on monthly

[14] In the Monthly Business Survey of Service, private lodging ("mimpaku") is, by definition, included as part of accommodation services under "lodging places, n.e.c." However, while the number of registered private lodging properties is approximately 20,000 as of 2021, the number of "lodging services n.e.c." is only around 5,000 business establishments in the Economic Census for Business Activity, the population statistics of the Monthly Business Survey of Service, at the same point in time.

trends in guest nights for hotels and ryokans reported in the Overnight Travel Statistics Survey. The ratio of monthly mimpaku guest nights to the combined guest nights at hotels and ryokans is then used as a weight. The year-on-year change in the "accommodations" category from the Monthly Business Survey of Services (2020 onward) is weighted together with the year-on-year change in mimpaku guest nights to form the CAI series for "Accommodations."

Although the mimpaku business is growing rapidly, the share of it was approximately 1 percent relative to hotels and ryokans as of 2024. As a result, a comparison of pre- and post-revision results shows that revised "Lodging" series received only a slight upward adjustment (Chart 9(2)). However, should the mimpaku segment continue to expand in the future, it could potentially make a significant contribution to "Accommodations."

Chart 9: Revision of "Accommodations"



Sources: Ministry of Land, Infrastructure, Transport and Tourism; Japan Tourism Agency; Bank of Japan, etc.

(2) Capturing Consumption Trends on a Value-Added Basis - "Railway," "Services for Amusement and Hobbies," and "Automobile Maintenance"

The CAI previously used the Indices of Tertiary Industry Activity for "Railway" and "Services for amusement and hobbies," and the Number of Motor Vehicles Owned (Ministry of Land, Infrastructure, Transport and Tourism) for "Automobile maintenance" as source statistics. In 2025, the Monthly Business Survey of Service was launched as a new comprehensive statistical survey for the service industry, integrating the Monthly

Survey on Service Industries (Ministry of Internal Affairs and Communications) and the Current Survey of Selected Service Industries into a designated fundamental statistical survey which investigates issues such as business operators' sales. This survey is expected to contribute to a more accurate understanding of actual consumption trends by capturing not only the changes in quantity that were traditionally observed, but also changes in value-added components—such as variations in travel distances or the enhancement of value-added services during transit in "Railway"—through the lens of company sales data. Since there is sufficient time-series data from this new survey, and through its predecessor surveys, the CAI has begun to reflect these statistics as a source for "Railway," "Services for amusement and hobbies" and "Automobile maintenance."[15, 16]

Comparisons of movements before and after the revision are as follows. Regarding "Railway," the revised series indicates a much sharper decline during the COVID-19 pandemic compared to the previous series (Chart 10(1)). This reflects a decrease not only in passenger numbers but also reductions in long-distance travel, which lowered per-capita trip revenues and thus overall sales. With respect to "Services for amusement and hobbies," the revised series displays a sharper decline and slower recovery compared to the past (Chart 10(2)).[17] Finally, regarding "Automobile maintenance," the revised series shows a declining trend in the post-pandemic period (Chart 10(3)).

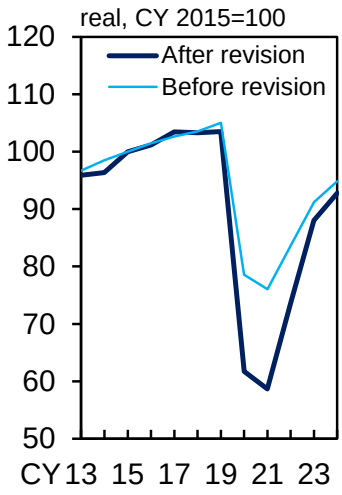
[15] The predecessor to the Monthly Business Survey of Services, the Monthly Survey on Service Industries, started its publication close to its current form since 2013. While Kanafuji et al. (2018) explored the use of this survey for inclusion in the CAI, it wasn't adopted due to limited time-series data (only about 5 years at the time) and issues with stabilizing seasonal adjustments. Later, Takahashi et al. (2021) partially incorporated this survey in order to make it consistent with GDP for food services and accommodations. Since the Monthly Business Survey of Services has a wide sample including small and medium-sized enterprises, it is thought to be able to comprehensively capture consumption in related industries. However, it should be noted that sales may be biased if newly opened establishments are not captured in the statistical sample, particularly in industries with high opening and closing rates such as food services.

[16] The deflators for "Railway," "Services for amusement and hobbies," and "Automobile maintenance" are unchanged from the previous CAI, using corresponding Consumer Price Index. For details, please see Chart A-2.

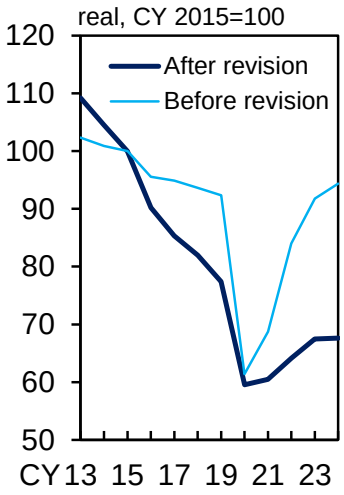
[17] These movements in "Services for amusement and hobbies" are influenced by the weakness of "Pachinko parlors," whose weight increased in this revision. In the previously used Indices of Tertiary Industry Activity, weights were based on the value-added amount in the Input-Output Tables, and the weight of Pachinko parlors in the entertainment industry was about 35 percent. On the other hand, in the 2021 Economic Census for Business Activity, the population statistics for the Monthly Business Survey of Services, weights are calculated based on sales. Reflecting differences in the value-added ratio to sales by industry, the weight of Pachinko parlors is now about 60 percent.

Chart 10: Revision of Items in Services Category

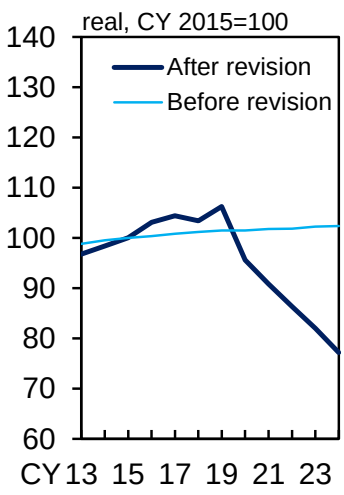
(1) Railway



(2) Services for Amusement and Hobbies



(3) Automobile Maintenance



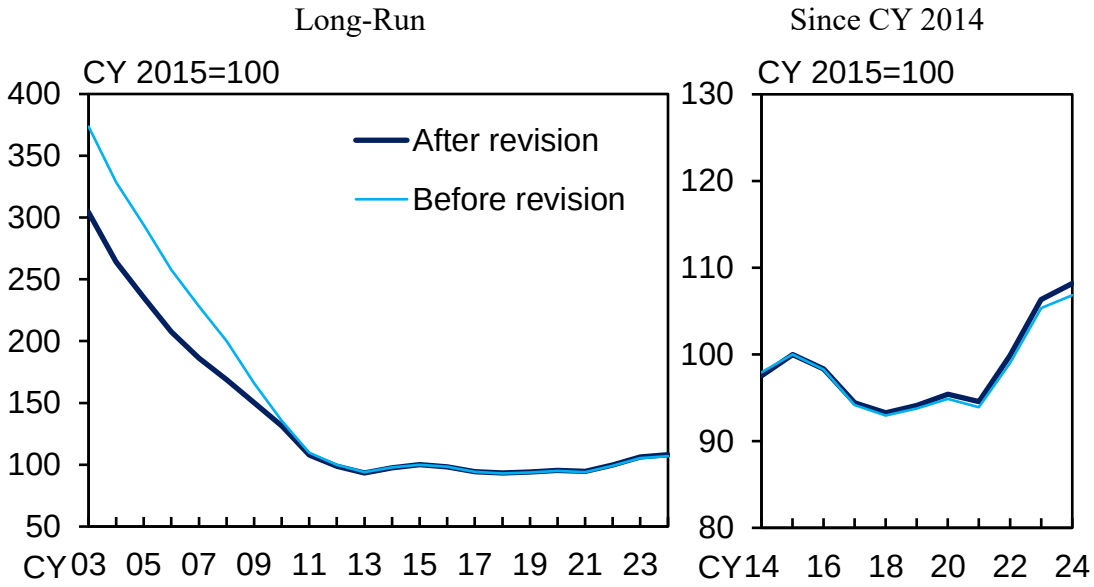
Sources: Bank of Japan, etc.

(3) Other Revisions (Revision of the Deflator for "Household Electrical Appliances")

Previously, the deflator for "Household electrical appliances" in the CAI was calculated as the *geometric* mean of related items to mitigate biases arising from declines in computer prices.[18] However, in GDP statistics, deflators are calculated on an item by item basis at initial estimation stage, and a consumption deflator is later derived by dividing nominal values for aggregated consumption-related items by their corresponding real values. In this regard, this approach resembles a *weighted* mean. To align the CAI methodology with GDP statistics, the deflator for "Household electrical appliances" is now calculated using a *weighted* mean of related items. This modification results in a slower rate of decline in the deflator during the 2000s compared to the previous geometric mean-based methodology. Nevertheless, the trends for the deflator from 2010 onwards remain roughly the same (Chart 11).

[18] Mathematically, it is known that if expenditure shares of goods (price times quantity) remain constant when relative price changes—a situation where falling prices lead to increased quantity purchased—the Laspeyres weighted average index tends to exhibit a downward bias, while geometric indices do not have such bias (Research and Statistics Department, Bank of Japan 1998). Since the 1990s, rapid quality improvements and significant price reductions for computers led to increased household adoption, presenting the strong downward bias in the Laspeyres index. Since mid-2010s, with the deceleration of rapid price declines, the advantages of geometric indices have become less significant.

Chart 11: Revision of Deflator for Household Electrical Appliances



Sources: Bank of Japan, etc.

2-3. CAI reflecting these Revisions

The time series of the CAI reflecting the update of (1) type/item weights, and (2) the revision of calculation methods for selected items discussed above, is as shown in Chart 12.

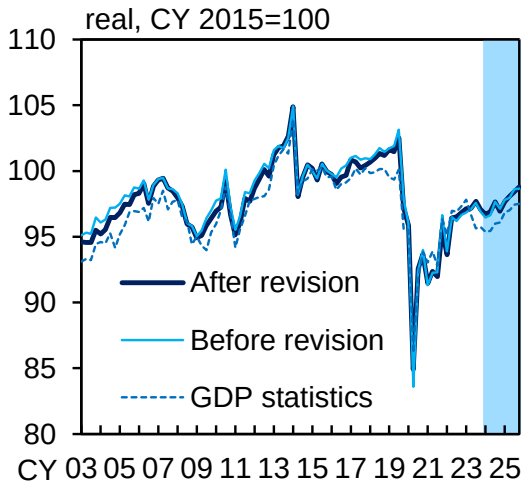
Comparing before and after the revision, the declining trend that was prominent in the pre-revision CAI for non-durable goods has eased post-revision, bringing it closer to the trend in GDP statistics. This is because this revision made it possible to more accurately capture the impact of diversifying sales channels for food and beverages and clothes, as mentioned above. Similarly, for services, particularly during the period since 2022, the movement has become closer to GDP statistics by using value-added based statistics in this revision. On the other hand, for durable goods, while the observed discrepancy with GDP statistics in the 2000s has eased somewhat after the revision due to the change in the deflator calculation method, no prominent change is made before and after the revision for other periods.

Comparing the correlation coefficient of year-on-year changes between the CAI and GDP statistics for the period where Second Annual Estimate values are available (Chart 13), the post-revision correlation with GDP statistics is higher except for durable goods. Furthermore, comparing the MAE before and after the revision, the error has

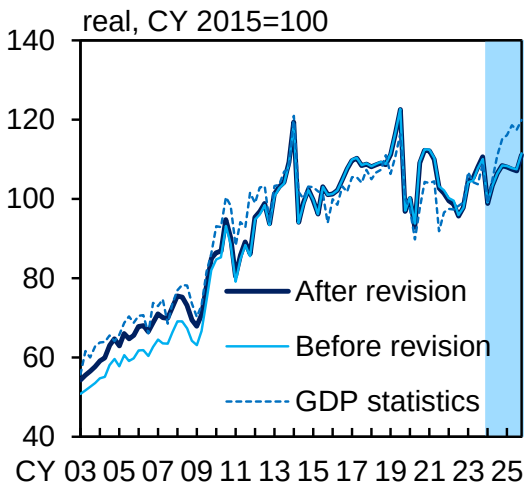
shrunk post-revision except for durable goods.

Chart 12: Revised CAI

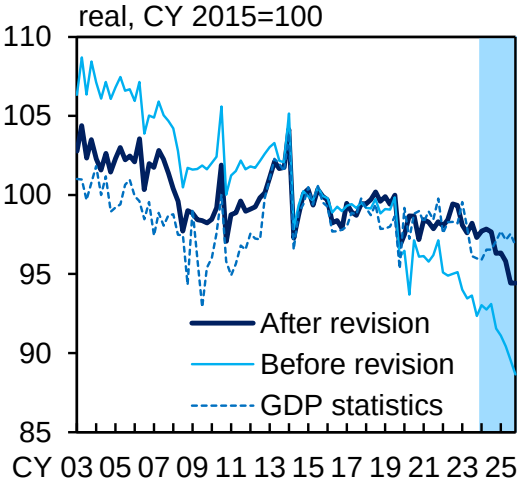
(1) Consumption Activity Index (travel balance adjusted)



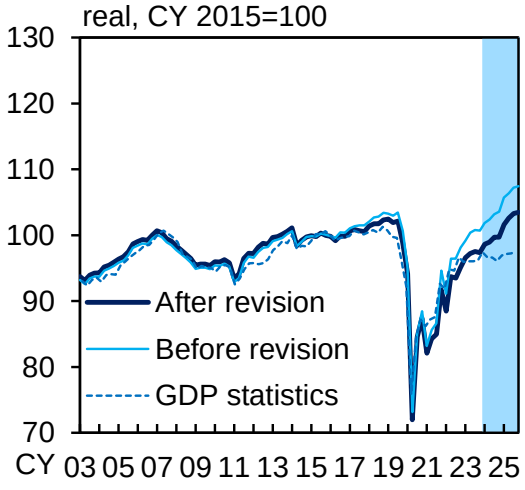
(2) Durable Goods



(3)Non-Durable Goods



(4) Services



Note: Shaded areas denote periods after Second Annual Estimate values of GDP statistics. "GDP statistics" in (3) include goods classified as "Semi-durable goods" in the GDP statistics. Services exclude imputed rent.
Sources: Cabinet Office; Bank of Japan, etc.

Chart 13: Performance Evaluation

	(i)Correlation with YoY of GDP statistics		(ii)MAE in YoY of GDP statistics	
	Before Revision	After Revision	Before Revision	After Revision
CAI (travel balance adjusted)	0.96	0.97	0.55	0.46
Durable Goods Index	0.89	0.87	2.52	2.59
Non-durable Goods Index	0.61	0.78	1.03	0.79
Services Index	0.97	0.98	2.94	2.75

Note: All figures are in real terms. The estimation period for both (i) and (ii) spans from CY2004 to CY2023.

Thus, in terms of year-on-year change, the performance of the CAI from the perspective of linkage with GDP statistics has generally improved with this revision. However, from a longer-term perspective, even after this revision, a trend discrepancy in levels remains between the CAI and the Second Annual Estimate values of GDP statistics (currently up to 2023). This arises because the CAI, calculated to capture monthly consumption fluctuations, is basically based on monthly high frequency statistics, but the trend of these high frequency statistics does not necessarily match the trend of low-frequent structural statistics (typically the Annual Business Survey or Economic Census for Business Activity) used in the Second Annual Estimate value of GDP statistics. While such long-term trend discrepancies are not a major problem for analyzing short-term consumption trends, they can cause non-negligible problems when using the CAI for long-term analysis (e.g., analysis of long-term relationships with disposable income).

(2-4) Level Adjustment of Past Series Using GDP Statistics

To address the above problem, the revised CAI incorporates certain adjustments so that the level of the CAI is consistent with the level of the Second Annual Estimate values of GDP statistics on an annual basis. Specifically, the calendar year values of the Second Annual Estimate of GDP statistics are used as a "benchmark," and this is split into monthly data using a proxy series via the Denton proportional method to calculate the "level-adjusted CAI" (see Appendix for details on the Denton proportional method). In applying the Denton proportional method, the revised CAI series explained in the previous sections is utilized as the "proxy series," thereby basically retaining the short-term fluctuation of CAI (Chart 14). For periods where Second Annual Estimate values of GDP statistics are not available (currently from 2024 onwards), the month-on-month changes of the CAI are used for extrapolation. During this period, as with previous

methodology, the CAI will move independently of the GDP statistics (First Annual Estimates and Quarterly Estimates).

Chart 14: Benchmarks and Proxy Series

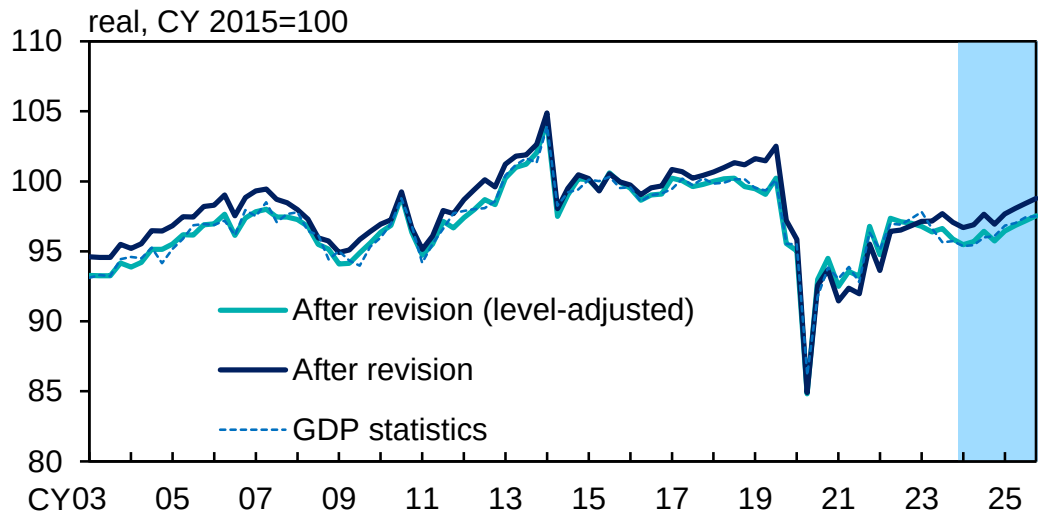
Benchmark (GDP statistics)	Proxy Series (CAI)
Domestic Final Consumption	Consumption Activity Index
Consumption of Households	Consumption Activity Index (travel balance adjusted)
Durable Goods	Durable Goods Index
Non-Durable Goods + Semi-Durable Goods	Non-durable Goods Index
Services	Services Index

Note: The benchmarks exclude imputed rents for owner-occupied housing. The proxy series are seasonally adjusted.

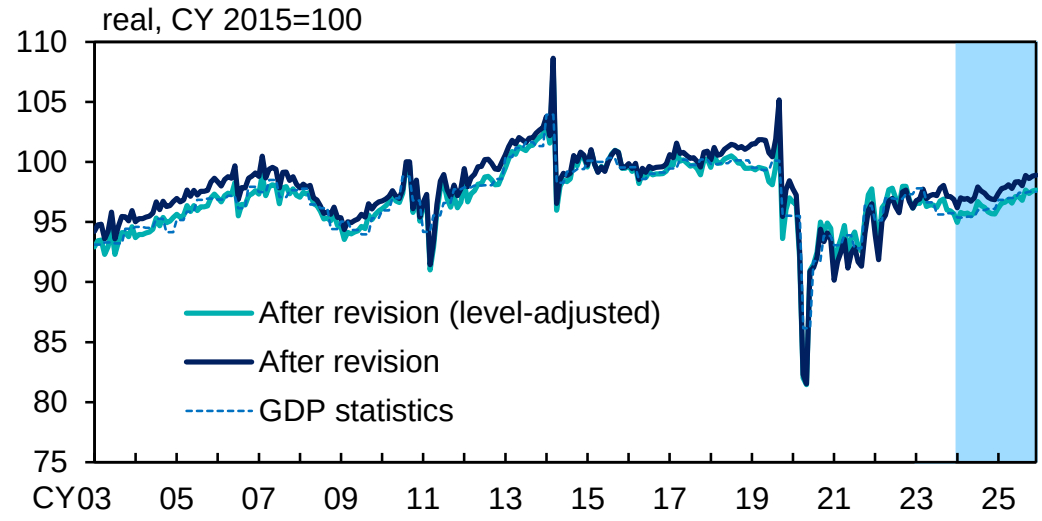
Looking at the results after level adjustment via the Denton proportional method, while the trend discrepancy between the CAI and GDP statistics has been resolved, the monthly fluctuations of CAI are maintained (Charts 15, 16). For example, the pre-level-adjustment CAI (travel balance-adjusted) had a larger drop during the COVID-19 pandemic compared to GDP statistics, but such a discrepancy is resolved by level adjustment via the Denton proportional method. On the other hand, for the most recent period where Second Annual Estimate values are not available (currently from 2024 onwards), the CAI is estimated independently from GDP statistics, so the levels do not necessarily match.

Chart 15: Revised CAI (travel balance adjusted)

(1) Quarterly



(2) Monthly

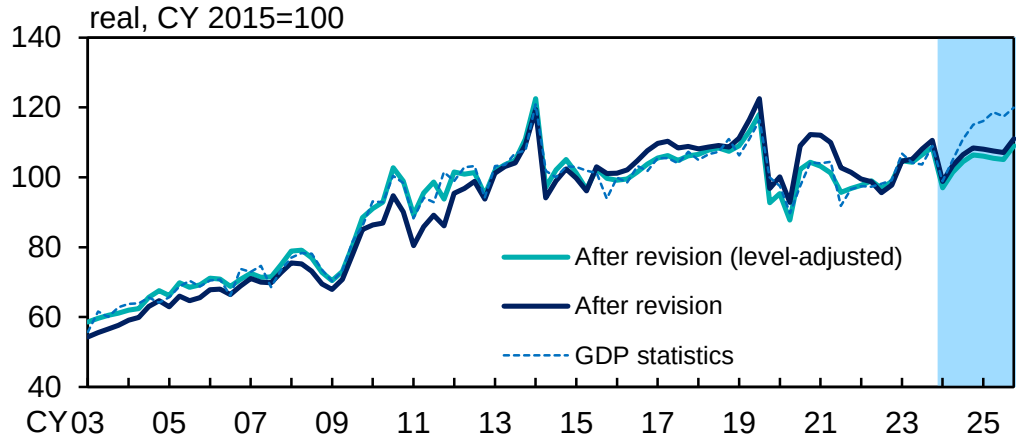


Note: Shaded areas denote periods after Second Annual Estimates of GDP statistics. Figures exclude imputed rent.

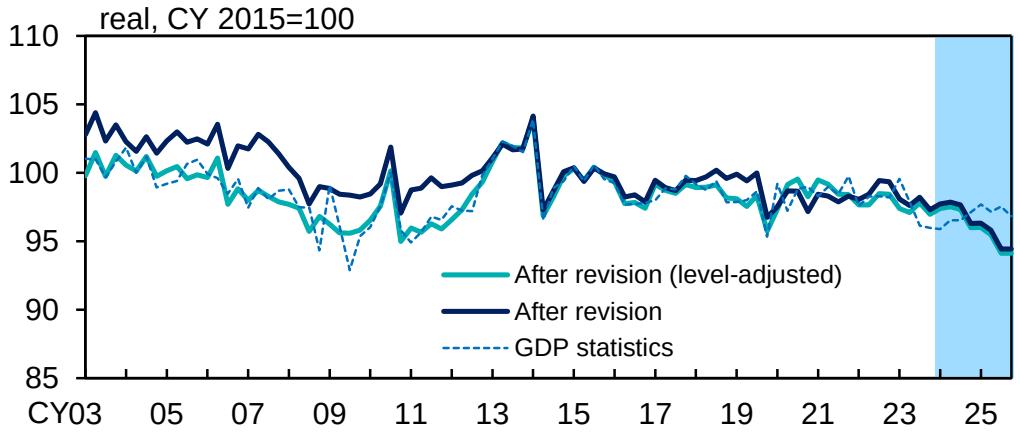
Sources: Cabinet Office; Bank of Japan, etc.

Chart 16: Revised Indices by Type

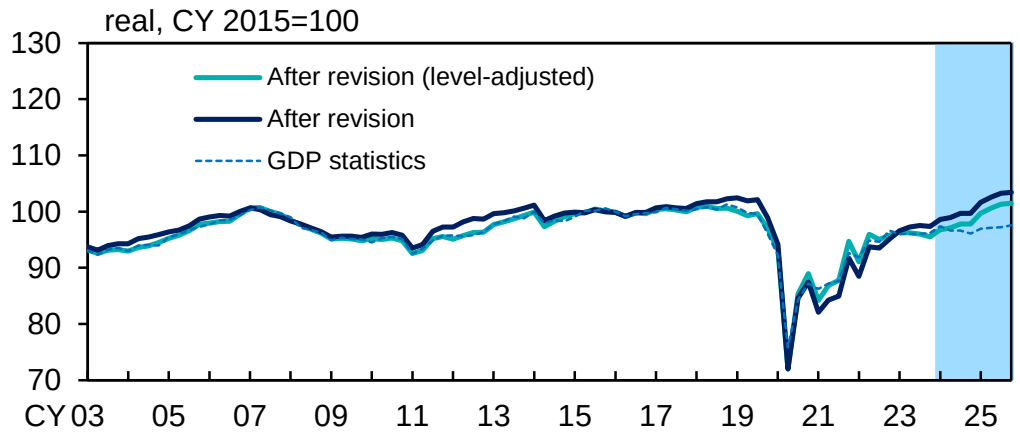
(1) Durable Goods (Quarterly)



(2) Non-Durable Goods (Quarterly)



(3) Services (Quarterly)



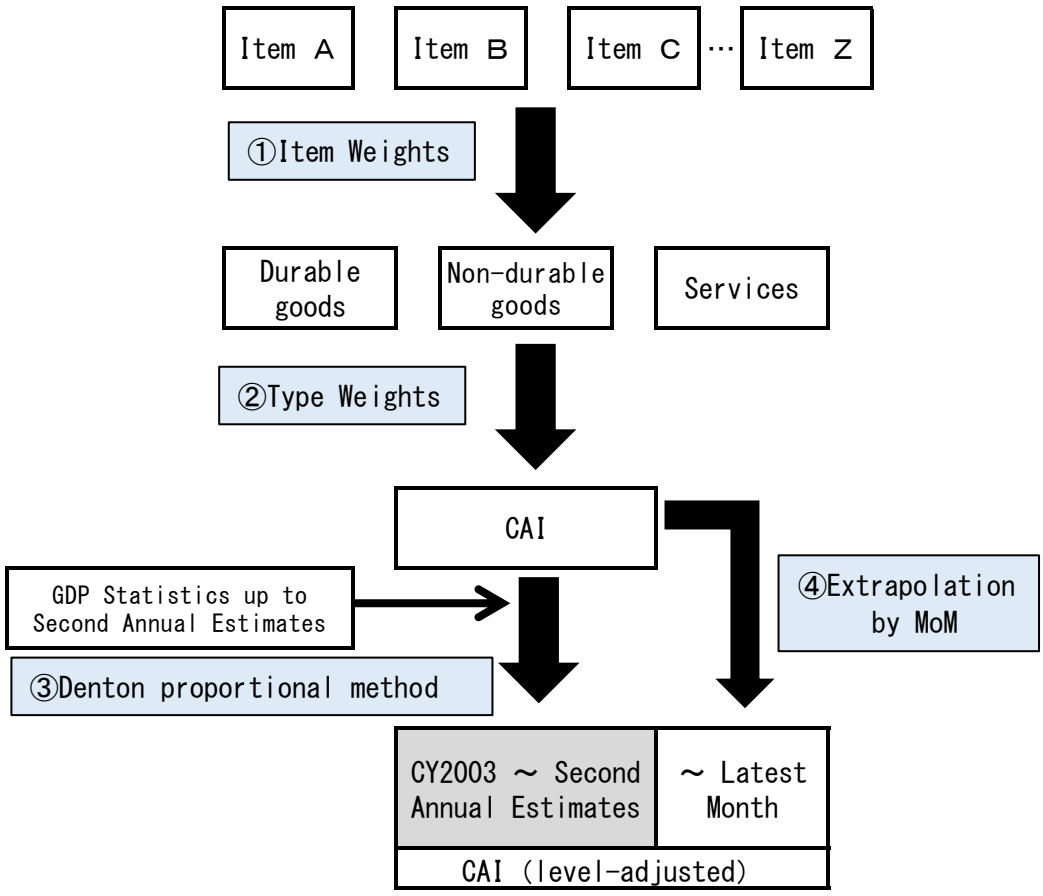
Note: Shaded areas denote periods after Second Annual Estimate values of the GDP statistics. "GDP statistics" in (2) include goods classified as "Semi-durable goods" in the GDP statistics. Services exclude imputed rent.

Sources: Cabinet Office; Bank of Japan, etc.

(2-5) Summary of the Revision

Based on the revisions outlined above, this sub-section explains the aggregation procedure for the CAI (Chart 17). As a first stage, item series are created and aggregated using item weights to construct type series. Then, as a second stage, using type weights, the CAI is aggregated.[19] As third stage, for the period where Second Annual Estimate values of GDP statistics are available, the Denton proportional method is used to adjust the calendar year values of the CAI to the same level as the calendar year values of GDP statistics. In the end, as a fourth stage, for the period where Second Annual Estimate values are not available, the index is extrapolated using the month-on-month changes of the CAI.

Chart 17: Procedures for Compiling the CAI



[19] In the CAI, consistent with GDP private consumption, the travel balance adjusted CAI, which shows consumption trends of resident consumers, is calculated and published by subtracting inbound consumption and adding outbound consumption. The approach to travel balance adjustments remains unchanged.

Annual estimates of GDP statistics are usually published around December. Each year, the most recent year's values represent the First Annual Estimate, the values for the prior year represent the Second Annual Estimate. And the values from two years prior are the Third Annual Estimate. After the GDP annual estimates are published, the CAI will be re-estimated to incorporate the latest estimates up to Second Annual Estimate values of GDP statistics using the Denton proportional method. As a result, the past figures of the CAI will be revised retrospectively when re-estimation is performed after the publication of annual estimate values of GDP statistics each year.

3. Conclusion and Future Work

This paper has explained the latest revisions in the CAI. Through this revision, the CAI has been harmonized with the 2020-base GDP statistics and accurately reflects recent changes in consumption behavior such as the expansion of EC consumption. It is expected that the use of this revised CAI will lead to a more accurate assessment of consumption in Japan.

However, future challenges remain. Specifically, how the CAI can better (1) capture online consumption beyond "Clothes" and "Food and beverages," (2) account for services with significant weight, such as "Residential rents" and "Education," and (3) incorporate new consumption behaviors like cross-border online subscription services. These issues were not addressed in the revision mainly due to statistical limitations. However, it remains essential to continue efforts to improve the CAI's methodology by considering advancements in available statistics and the utilization of alternative data, towards enhancing the CAI's performance.

References :

Chen, B. (2007). "An Empirical Comparison of Methods for Temporal Distribution and Interpolation at the National Accounts," BEA Papers 0077, Bureau of Economic Analysis.

Cholette, P. A. (1984). "Adjusting Sub-annual Series to Yearly Benchmarks," *Survey Methodology*, 10, 35-49.

Denton, F. T. (1971). "Adjustment of Monthly or Quarterly Series to Annual Totals: An Approach Based on Quadratic Minimization," *Journal of the American Statistical Association*, 66(333), 99-102.

IMF (2017). "Quarterly National Accounts Manual 2017 Edition," Chapter 6.

Kanafuji, A., R. Mandokoro, N. Kato, and T. Sugo (2018). "Revision of the Consumption Activity Index to Address the 2008 SNA and Improve Accuracy," Bank of Japan Research Papers.

Cabinet Office (2025a). "Explanation of Estimation Methods for National Accounts (Annual Estimation Edition)." (in Japanese)

Cabinet Office (2025b). "Explanation of Estimation Methods for National Accounts (Quarterly GDP Preliminary Estimate (QE) Edition)." (in Japanese)

Nakamura, K., H. Kawata, M. Tanaka, and L. Uemae (2016a). "The Consumption Activity Index," Bank of Japan Research Papers.

Nakamura, K., K. Miura, and T. Maruyama (2016b). "The Consumption Activity Index: Improvements of Release Contents and Revisions of Compilation Methodology," Bank of Japan Research Papers.

Research and Statistics Department, Bank of Japan (1998). "Release of a Reference Wholesale Price Index Using a Geometric Mean Formula," Bank of Japan, Quarterly Bulletin, August 1998.

Takahashi, M., T. Kondo, K. Munakata, T. Okubo, and Y. Iwasaki (2021) "Revision of the Consumption Activity Index to Capture Recent Changes in Consumption Patterns," Bank of Japan Research Papers.

Appendix: Level Adjustment using the Denton proportional method

This appendix explains the Denton proportional method used to calculate the "level-adjusted CAI" in Section 2-4 and statistically verifies whether the revised CAI has desirable properties for using this method.

The Denton proportional method, proposed by Denton (1971) and Cholette (1984), is a statistical technique for disaggregating low-frequency "benchmarks" into high-frequency data by utilizing a high-frequency "proxy series." As shown in the equation below, the method, which is also used when dividing annual GDP data into quarterly number in official GDP statistics, optimizes the allocation of the benchmark values such that the change in the Benchmark-to-Indicator Ratio (BI ratio)—the ratio of the disaggregated benchmark to the proxy series—is minimized while preserving the aggregate annual totals:[20]

$$\min \sum_{t=2}^{T} \left[\frac{m_t}{a_t} - \frac{m_{t-1}}{a_{t-1}} \right]^2 \; s.t. \sum_{t=12y-11}^{12y} m_t = A_y, y \in \{1, \dots, \beta\}$$

m_t : level-adjusted CAI at time *t*

a_t : pre-adjusted CAI at time *t* (proxy series)

A_y : GDP statistics up to Second Annual Estimate in calendar year *y* (benchmark)

The Denton proportional method reflects short-term dynamics in instances where the BI ratio prior to disaggregation is stable. Hence, it is desirable that the movement of the proxy series aligns closely with that of the benchmark to achieve accurate reflections in the adjusted figures (IMF, 2017). To evaluate this, based on Chen (2007), the MAE of the month-on-month ratio between (1) pre-adjusted CAI and (2) level-adjusted CAI is calculated. If the MAE is small, it confirms that the movements of the benchmark and proxy series are closer and the month-on-month ratio is not significantly distorted by the Denton proportional method.

Comparing the MAE calculated for (1) the pre-revision index and (2) the post-revision index, the latter has a smaller MAE, confirming it has more desirable properties

[20] For dividing benchmarks, the pro rata method (splitting benchmarks by the composition ratio of proxy series) is another option. Compared to the Denton proportional method, however, it has the disadvantage that level steps are more likely to occur at the transition between benchmarks (in this case, between the end of one calendar year and the start of the next).

for using the Denton proportional method (Appendix Chart). The level-adjusted CAI is a useful indicator because it captures long-term trends using structural statistics information from GDP statistics up to the Second Annual Estimate values of GDP statistics while maintaining monthly statistics information from the original CAI.

Appendix Chart: Performance Assessments

	MAE in MoM between indicators and modified values	
	Before Revision	After Revision
CAI (travel balance adjusted)	0.55	0.46
Durable Goods Index	2.52	2.59
Non-durable Goods Index	1.03	0.79
Services Index	2.94	2.75

Note: Figures are based on real indexes. The estimation periods are from CY2004 to CY2023.

Chart A1-1: Source Statistics for the CAI

Item		Adopted Series	Source
Durable goods			
	Automobiles	・Unit sales of passenger car (light, small, and standard vehicle) ・Retail price (light, small, and standard vehicle)	・Japan Automobile Dealers Association, "Japan Motor Vehicle Sales" ・Japan Light Motor Vehicle and Motorcycle Association, "Sales Data of Mini Vehicles" ・Retail Price Survey (MIC)
	Household electrical appliances	・Retail sales (machinery & equipment, and household electric appliances at departmentstores and supermarkets)	・"Current Survey of Commerce" (METI)
Non-durable goods			
	Food and beverages	・Retail sales (food & beverages (excluding convenience stores), food & beverages at departmentstores, supermarkets and drugstore) ・EC food sales	・"Current Survey of Commerce" (METI) ・"Family Income and Expenditure Survey" (MIC) ・"Survey of Household Economy" (MIC) ・"E-Commerce Market Survey" (METI) ・"JCB Consumption NOW" (Nowcast Inc./JCB, Co., Ltd.) ・"Economic Census for Business Activity" (MIC and METI)
	Clothes	・Shipments index by industry (textile products, and crude fiber products) ・Producer price index (textile products) ・Value of imports (textile yarn, fabrics, clothing & accessories, and bags) ・Value of exports (textile yarn, and fabrics)	・"Indices of Industrial Production" (METI) ・"Corporate Goods Price Index" (BOJ) ・"Trade Statistics of Japan" (MOF)
	Fuel	・Retail sales (fuel)	・"Current Survey of Commerce" (METI)
	Drugs, cosmetics, etc.	・Retail sales (medicine & toiletry stores (excluding food & beverages at drugstores), others, and others at departmentstores and supermarkets)	・"Current Survey of Commerce" (METI)
	Electricity	・Actual Electricity Demand (electric light <total>)	・Agency for Natural Resources and Energy, "Electric Power Investigation Statistics"
	Gas	・Amount of product gas (residential use)	・Agency for Natural Resources and Energy, "Current Survey of Production Concerning Gas Industry"
	Water	・Index (Water Supply and Sewage)	・"Indices of Tertiary Industry Activity" (METI)
	Newspapers	・Index (Newspaper publishers)	・"Indices of Tertiary Industry Activity" (METI)
	Books and magazines	・Index (Publishers, except newspapers)	・"Indices of Tertiary Industry Activity" (METI)
	Game software	・Software products of which game software ・Sales of game software	・"Current Survey of Selected Service Industries" (METI) ・Industry statistics
	Tobacco	・Shipments index by industry (foods and tobacco (excluding foods related indices)) ・Sales amount of heat-not-burn tobacco	・"Indices of Industrial Production" (METI) ・Tobacco Institute of Japan, "Heat-not-burn tobacco data"

Note: The terms in the table represent the following: "MIC" refers to the Ministry of Internal Affairs and Communications, "METI" refers to the Ministry of Economy, Trade and Industry, "MOF" refers to the Ministry of Finance, and "BOJ" refers to the Bank of Japan.

Chart A1-2: Source Statistics for the CAI

Item	Adopted Series	Source
Services		
Food services	・Amounts of sales (eating and drinking places, and food take out and delivery services)	・"Monthly Business Survey of Services" (MIC)
Travel services	・Outlays for travel (domestic, and overseas)	・Japan Tourism Agency, "Market Trend Survey of the Food Services Industry"
Medical and other health care services	・Index (medical and other health services)	・"Indices of Tertiary Industry Activity" (METI)
Care services	・Index (social welfare)	・"Indices of Tertiary Industry Activity" (METI)
Communications	・Amounts of sales (communications)	・"Monthly Business Survey of Services" (MIC)
Railway	・Amounts of sales (railway transport)	・"Monthly Business Survey of Services" (MIC)
Bus	・Index (bus)	・"Indices of Tertiary Industry Activity" (METI)
Taxi	・Index (taxi)	・"Indices of Tertiary Industry Activity" (METI)
Air	・Index (air passenger transport)	・"Indices of Tertiary Industry Activity" (METI)
Postal services	・Index (postal activities, including mail delivery)	・"Indices of Tertiary Industry Activity" (METI)
Services for amusement and hobbies	・Amounts of sales (services for amusement and hobbies)	・"Monthly Business Survey of Services" (MIC)
Accommodations	・Amounts of sales (accommodations) ・Number of overnight guests	・"Monthly Business Survey of Services" (MIC) ・Japan Tourism Agency, "Performance of Private Lodging Business" ・Japan Tourism Agency, "Overnight Travel Statistics Survey"
Supplementary tutorial schools	・Index (supplementary tutorial schools)	・"Indices of Tertiary Industry Activity" (METI)
Ceremonial occasions, etc.	・Index (miscellaneous living-related and personal services)	・"Indices of Tertiary Industry Activity" (METI)
Public broadcasting	・Number of NHK reception contracts	・NHK
Automobile parking	・Index (automobile parking)	・"Indices of Tertiary Industry Activity" (METI)
Financial services	・Index (financial services)	・"Indices of Tertiary Industry Activity" (METI)
Life insurance	・Output value of life insurance	・The Life Insurance Association of Japan, "Summary of Life Insurance Business" ・IR Materials
Non-life insurance	・Index (non-life insurance institutions)	・"Indices of Tertiary Industry Activity" (METI)
Automobile maintenance	・Amounts of sales (automobile maintenance services)	・"Monthly Business Survey of Services" (MIC)
Internet based services	・Amounts of sales (internet based services)	・"Monthly Business Survey of Services" (MIC)

Note: The terms in the table represent the following: "MIC" refers to the Ministry of Internal Affairs and Communications, "METI" refers to the Ministry of Economy, Trade and Industry, "MOF" refers to the Ministry of Finance, and "BOJ" refers to the Bank of Japan.

Chart A2: Deflators for the CAI

Item	Price Index for Converting	Conversion
Durable goods		
Automobiles	・Automobiles	N→R
Household electrical appliances	・Durable goods assisting housework, heating & cooling appliances, lighting apparatus, electric bulbs & lamps, sphygmomanometers, mobile phones, TV sets, video recorders, personal computers (desktop), personal computers (notes), tablet computers, PC printers, cameras, computer games for domestic use, game softwares, memory cards, batteries, and electric shavers	N→R
Non-durable goods		
Food and beverages	・Food (excluding Meals outside the home)	N→R
Clothes	・Clothes & footwear, and personal effects (excluding wrist watches)	N→R
Fuel	・Gasoline, liquefied propane, and kerosene	N→R
Drugs, cosmetics, etc.	・Goods (excluding electricity, manufactured & piped gas & water charges, tobacco, food <excluding meals outside the home>, petroleum products, and durable goods)	N→R
Electricity	・Electricity	R→N
Gas	・Gas, manufactured & piped	R→N
Water	・Water & sewerage charges	R→N
Newspapers	・Newspapers	R→N
Books and magazines	・Books, and magazines	R→N
Game software	・Game software	R→N
Tobacco	・Tobacco	R→N
Services		
Food services	・Eating out	N→R
Travel services	・Package tours to overseas, package tours (domestic) made by hotel charges, railway fares, and airplane fares	N→R
Medical and other health care services	・Revision rate of medical fee *Ministry of Health, Labour and Welfare	N→R
Care services	・Charges for nursing care	R→N
Communications	・Telephone charges (fixed-line phone), telephone charges (mobile phone), and internet connection charges	N→R
Railway	・Railway fares (excluding JR), and railway fares (JR)	N→R
Bus	・Fixed route bus fares, and expressway bus fares	R→N
Taxi	・Taxi fares	R→N
Air	・Airplane fares	R→N
Postal services	・Postcards, and letters	R→N
Services for amusement and hobbies	・Admission & game charges	N→R
Accommodations	・Hotel charges	N→R
Supplementary tutorial schools	・Tutorial fees	R→N
Ceremonial occasions, etc.	・All items, less imputed rent	R→N
Public broadcasting	・Charges for NHK TV license	R→N
Automobile parking	・Charges for garage rental, and charges for parking	R→N
Financial services	・Money transmission and receipt, and commissions from banking services (except Money transmission and receipt) * "SPPI" (BOJ)	R→N
Life insurance	・All items, less imputed rent	N→R
Non-life insurance	・Insurance services * "SPPI" (BOJ)	R→N
Automobile maintenance	・Automotive maintenance charges (regular inspections), and automotive maintenance charges (puncture repairs)	N→R
Internet based services	・Internet based services * "SPPI" (BOJ)	N→R

Note: Unless otherwise noted, this refers to the item names in the Consumer Price Index. In the "Conversion" column, "R→N" indicates series where real values are the base statistics and are converted into nominal values using a deflator. "N→R" indicates series where nominal values are the base statistics and are converted into real values using a deflator. The terms in the table represent the following: "BOJ" refers to the Bank of Japan and "JR" refers to the Japan Railways.