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Abstract

In this paper, we explain revisions made to the Consumption Activity Index (CAI) compilation methodology. The revisions aim to address those made to the *System of National Accounts* in Japan (SNA) which consists of the introduction of the 2008 SNA, a new international statistical standard for National Accounts, as well as the benchmark year revision. First, we update the weights of goods and services in accordance with the revised National Accounts. In calculating these weights, we adopt a methodology based on the *Input-Output Table for Japan*, instead of one based on demand-side statistics which had been adopted to date. Second, we change the compilation method for durable goods, automobiles and household electrical appliances, and incorporate new source statistics for non-durable goods such as tobacco and services such as financial services, thus improving the accuracy of the index. Owing to these revisions, the revised CAI is consistent with the current *Annual Report of National Accounts* (ARNA), while maintaining the merits of the original CAI. In addition, the discrepancy between private consumption in the ARNA and those by type as well as the CAI itself decreased.

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1. Introduction

In May 2016, the Research and Statistics Department at the Bank of Japan proposed the Consumption Activity Index (CAI) as a comprehensive measure of private consumption, to be released in a timely fashion, with a high level of accuracy and only small statistical fluctuations (Nakamura et al. (2016a)). In October 2016, the CAI was updated and extended (Nakamura et al. (2016b)). We have compiled monthly indicators for the CAI and utilized them as statistic sources to assess economic conditions. The CAI is posted to the Bank of Japan's website as "Research Data." In addition, we aim to make the CAI an open-source indicator, improving it on an ongoing basis by calling for user opinions and requests. To that end, we have also posted the source data, such as the weights of goods and services. The CAI is utilized by those who are mainly interested in finance and economies, including media and academic papers (Chart 1).[1]

Chart 1: The CAI series posted as "Research Data"

Index (CY 2010=100, s.a., monthly)	Other Data
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	Background Data including nominal index, real index, deflator and weights As of October 2016

In December 2016, the *System of National Accounts* in Japan (SNA) was revised in line with the 2008 SNA, the new international standard for National Accounts. While there were few changes with respect to private consumption in this benchmark year revision, the discrepancy between private consumption in the ARNA[2] and the CAI increased. In this paper, we implement revisions to the overall indexes such as incorporating goods and services in order to improve the accuracy of the index, in addition to address the revisions made in the SNA such as updating weights. We explain the results in following sections.

In section 2, we explain the revisions in more detail. In section 3, we examine the performance of the revised CAI. In section 4, we mention some challenging potential revisions that we examined but did not adopt. Section 5 concludes.

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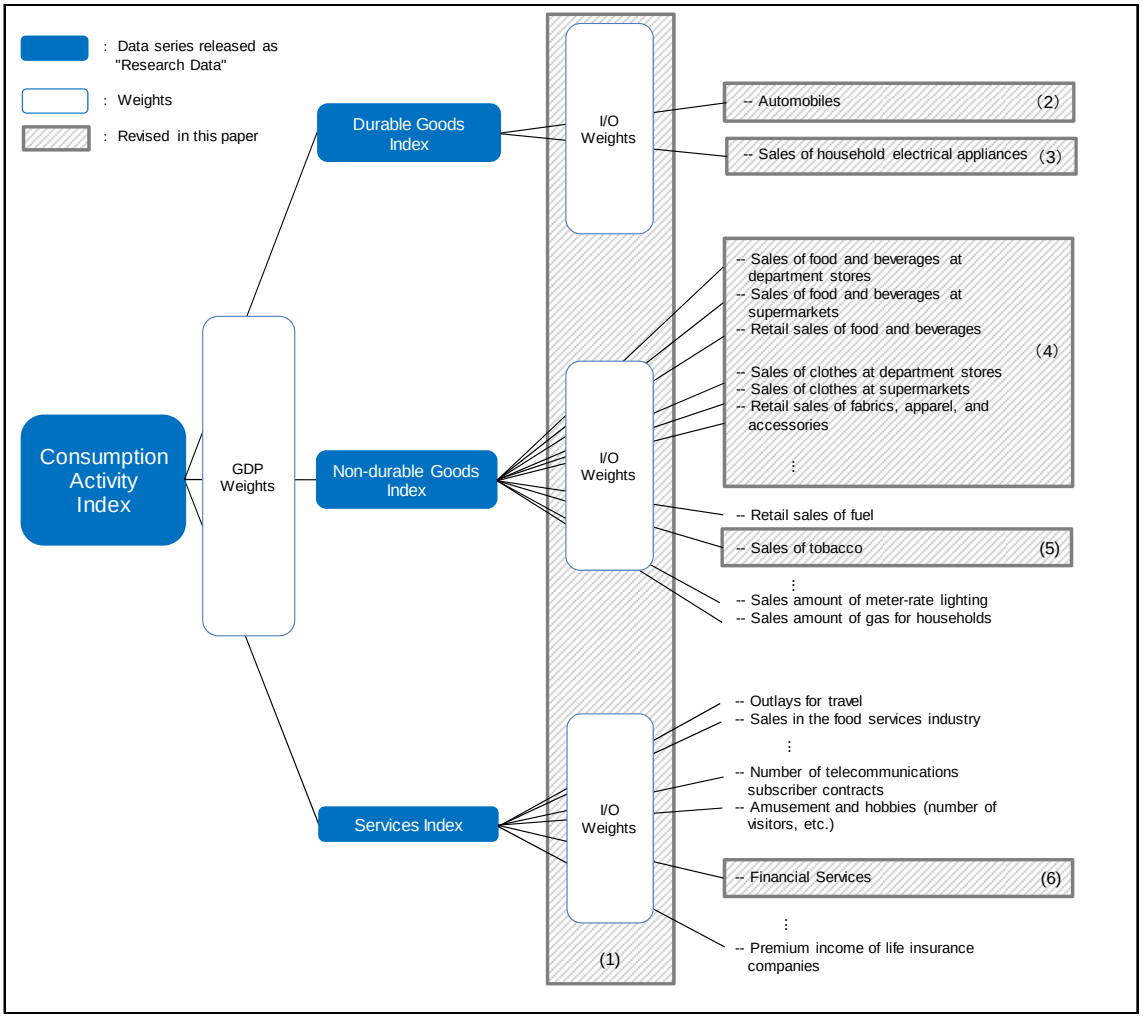
[1] "The Consumption Activity Index," which is a series of the research data, is posted to the Bank of Japan's website at: http://www.boj.or.jp/en/research/research_data/cai/index.htm/

[2] In this paper, private consumption in the ARNA refers to "consumption of households excluding imputed rent."

2. Content of the revised CAI

Chart 2 shows the overview of the revisions in this paper. In this revision, we have implemented the following: (1) a fundamental revision of the weights of goods and services, (2) a change in the compilation method of the adopted series for Automobiles and Household electrical appliances, and (3) a change in the underlying source statistics for goods and services such as Food and beverages, Clothes, Tobacco, and Financial services. In addition, we change the benchmark year to 2011 in line with the SNA. We explain in detail below.

Chart 2: The framework of the CAI after revisions



Notes: 1. Shaded area indicates revisions in this paper. Figures in the parentheses indicate the corresponding subsection in section 2.
2. GDP weights used for compiling CAI component Index are also revised from those in CY 2010 to 2011.

(1) Overall update of goods and services weights

In accordance with the revision of the GDP statistics in December 2016, the benchmark year in the *National Accounts* has been changed from 2005 to 2011. Accordingly, the weights used in compiling each item of private consumption are based on the values of the 2011 *Input-Output Table for Japan*, which is the benchmark year of the *National Accounts*.[3]

The original CAI was compiled using consumption expenditure weights by type drawn from the *Family Income and Expenditure Survey* in 2010, which is demand-side statistics. There was no choice but to use them as (1) the benchmark of the CAI is set as 2010, and (2) the *Input-Output Table for Japan*, which is consistent with the GDP statistics and more detailed, has not yet been released for 2010. Because the benchmark year of the GDP statistics has been changed to 2011, (1) the weights can be taken from 2011 *Input-Output Table for Japan*, and (2) the 88-purpose classification of domestic final consumption expenditure of households in the SNA and their weights can be reproduced as the description on the disaggregated deflator by item is noted in the SNA manual (see the appendix for the detail of the weights calculation methodology).[4, 5] It is noted that the revised CAI does not directly use demand-side statistics, such as the *Family Income and Expenditure Survey*, after the revision of the weights.[6]

Compared with the weights of the original CAI, the main change in the weights of services is that the relative weights of Communications and Travel services/Accommodations shrink, while those of Services for amusement and hobbies and Finance and Insurance expand (Chart 3).

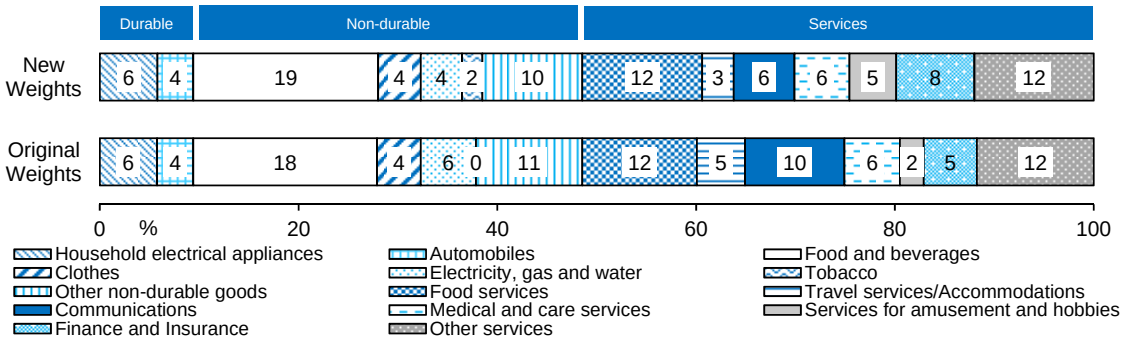
[3] In response to the comprehensive revision of the GDP statistics for 2008 SNA, Automobile maintenance has been reclassified as a non-durable good to a service from the release of the May 2017 CAI. The weights of all types of goods and services in the Consumption Activity Index have not been revised.

[4] Regarding the detail on the SNA manual, see Cabinet Office (2018) or Moriya (2017).

[5] Since nominal consumption expenditure based on the 88-purpose classification is not open to the public, it is noted that the weights in the revised CAI are not necessarily the same as those in the GDP statistics. Despite this, we can confirm that the weights compiled in this revision correspond largely with those of the 12-purpose classification and nominal consumption expenditure by type in the GDP statistics.

[6] Strictly speaking, demand-side statistics are indirectly used through the CPI weights.

Chart 3: Weights of the Consumption Activity Index



(2) Update of automobiles

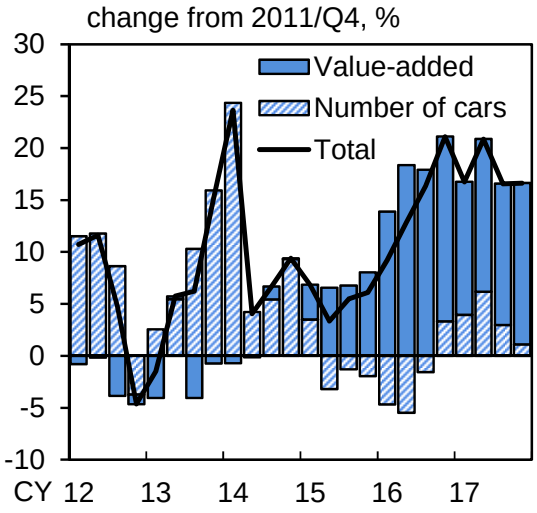
In the original CAI, the number of new passenger car registrations was regarded as the real consumption of automobiles. While this method is simple to compile, it differs from that of the SNA in that there is no discrimination made between difference of value in large and small passenger cars. In the revision, we change the compilation method so that, first, (1) the nominal sales value of automobiles is calculated as the number of the new passenger car registrations multiplied by the unit price. Then, (2) the real consumption is calculated as the nominal sales value divided by the quality-adjusted deflator. The unit prices used in the calculation of (1) are those automobiles in the *Retail Price Survey* ("motor vehicle," "small motor vehicle," and "light motor vehicle with engine size of 660cc or less"). The deflator used in (2) is the CPI, which is quality-adjusted. It is noted that the changes in the unit price of the *Retail Price Survey* are largely associated with changes in the surveyed items. In this revision, assuming that the change in the unit price due to the change in surveyed items is derived from the difference of the quality between the new and original items, we adjust the unit price so that change beyond a certain threshold is linked back to the level of the previous period.[7]

Based on the number of the new passenger cars, with the new compilation methodology, the real value of automobiles grows at a faster pace than that of the original methodology. Chart 4 shows that, in recent years, the real consumption of automobiles has increased mainly due to the value-added factor.

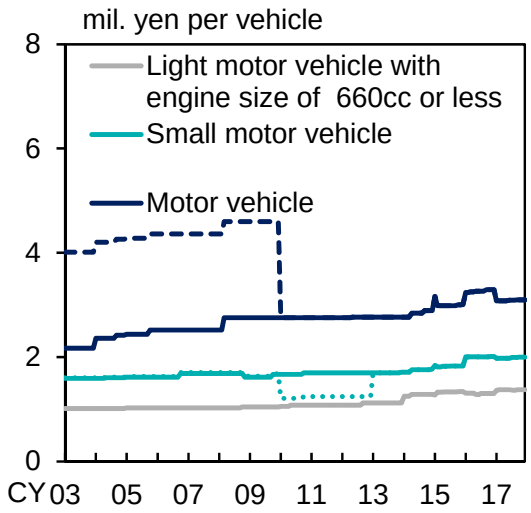
[7] If the unit value at time t in the future, P_t, changes from that of previous month by more than about plus/minus 20 percent, and if it can be verified by public information such as prices in catalog that the change in price is due to the change in surveyed items, then we will adjust the price level so that it is equal to that of the previous month, i.e. $P^*_t = P_{t-1}$. Regarding the value already released, the price level in the previous month was adjusted so that it is equal to that at time t so that the price level in 2015, which is the benchmark year of the CPI, remains unchanged, i.e. $P^*_{t-1} = P_t$.

Chart 4: Automobiles

(1) Breakdown of Automobiles (Real)



(2) Unit Price in the *Retail Price Survey*



Note: Dashed lines indicate unit price before the adjustment as described in footnote 7.

Sources: Japan Automobile Dealers Association; Japan Light Motor Vehicle and Motorcycle Association; Ministry of Internal Affairs and Communications.

(3) Update of household electrical appliances

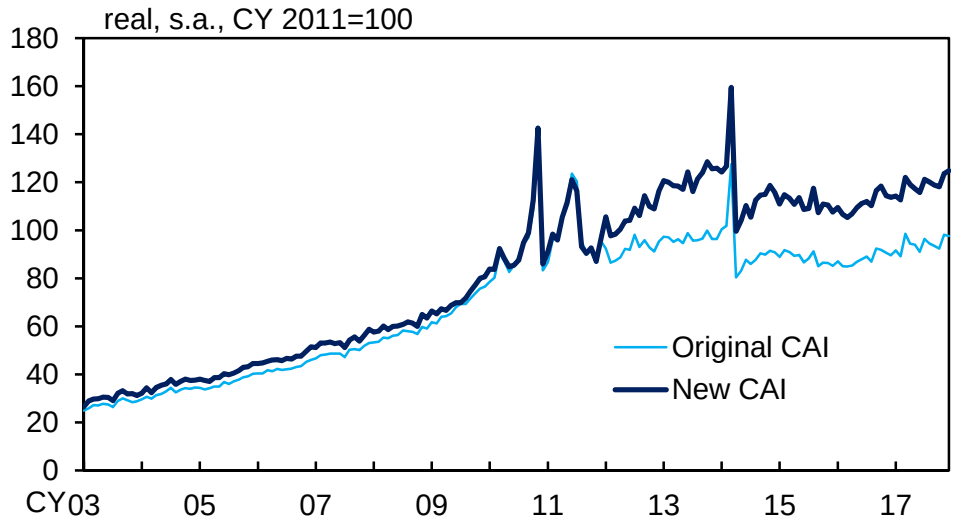
We use retail sales of machinery and equipment in the *Current Survey of Commerce* (CSC) as the source statistics for "Household electrical appliances." The CSC are sampling statistics whose populations are firms surveyed in the *Census of Commerce* and the *Economic Census.* In the past, the levels of the retail sales in the CSC were regularly adjusted so as to match those of retail sales in the *Census of Commerce* and the *Economic Census*. The discrepancy of levels from those in the 2012 *Economic Census* and the 2014 *Census of Commerce*, however, has not been corrected. For this reason, the level of the CSC has remained below that of the *Census of Commerce* and the *Economic Census*. Based on the fact that the discrepancy looks like that of the Durable Goods Index in the original CAI and the durable goods in the SNA, this discrepancy is considered to cause the low level of accuracy of the CAI. To rectify this discrepancy, the values of retail sales of the machinery and equipment in the CSC are corrected to match those of the *Census of Commerce* and *Economic Census*.[8] More specifically, by following the method outlined in the "Notes for use,"[9] we calculate the corrected-value of retail sales and treat it as the value for "Household electrical appliances" in the CAI. As a result, the "Household electrical appliances" value is

[8] We decided not to apply the level correction to other series in CSC since it does not improve accuracy of the CAI.

[9] http://www.meti.go.jp/english/statistics/tyo/syoudou/pdf/h2snotee.pdf

revised upward (Chart 5). In addition, the Durable Goods Index of the revised CAI and those of the SNA track each other closely, demonstrating the improvement in accuracy of the CAI (Chart 10 (2)). It is noted that the compilation method here does not affect the fluctuation after CY 2014, even though it changes the levels of the CSC corresponding to those of the 2014 *Census of Commerce* in most recent data.

Chart 5: Sales of Household Electrical Appliances



Sources: Ministry of Economy, Trade and Industry; Ministry of Internal Affairs and Communications.

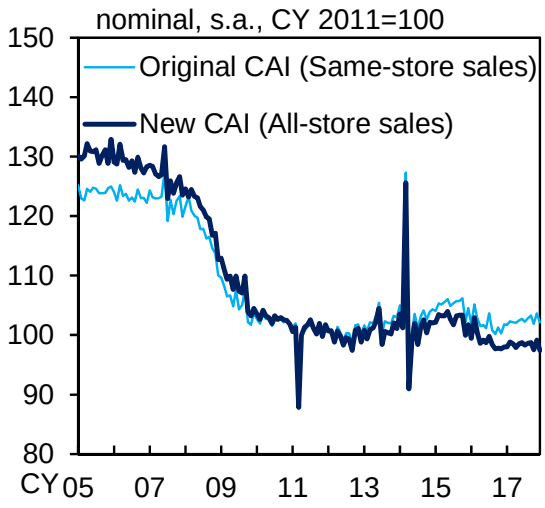
(4) Expanding the coverage of retail stores

We expand the coverage of retail stores with respect to Food and beverages as well as Clothes, which account for a large amount of the weights in non-durable consumer goods. Regarding Food and beverages, (1) we use the statistics based on all establishments, instead of using statistics after the number of establishments have been adjusted (Chart 6). In addition, (2) instead of using the sales value of convenience stores in the CSC, we will use the sales value of Food and beverages, which is the upper category in the CSC. By applying (2), we are able to largely capture the development of small supermarkets and individually-run stores, which cannot be covered in the original CAI. Likewise, regarding Clothes, we will use statistics based on all establishments of supermarkets and department stores, instead of using the statistics after the number of establishments have been adjusted.[10]

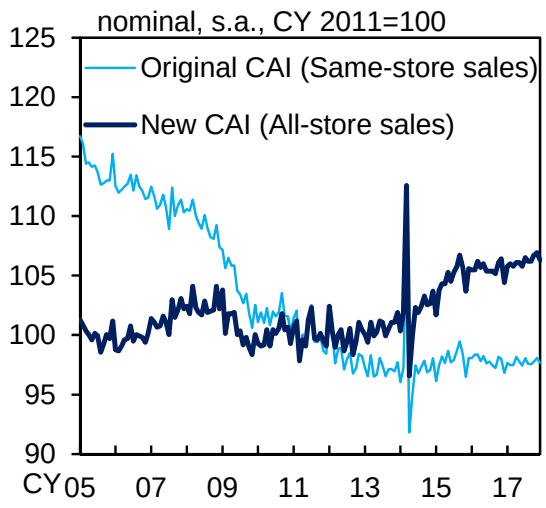
[10] In addition to the above-mentioned change, in the new CAI we combine the sales values of items other than food and beverages, as well as clothes in the supermarkets and department stores, with those in drugstores and others and define the series as "Drug, cosmetics, etc." In the original CAI,

Chart 6: Sales at Department Stores and Supermarkets

(1) Department Stores



(2) Supermarkets



Source: Ministry of Economy, Trade and Industry.

(5) Adding the Tobacco series

In this revision, we explicitly add the series of "Tobacco" as a subcategory of non-durable goods because of its high share in private consumption, around 2% shown in Chart 3, and its distinctive movement caused from the institutional factors such as tobacco tax hike. More specifically, we use the number of monthly sales of domestic and imported tobacco released from the Tobacco Institute of Japan as the real consumption of tobacco, and use the real value multiplied by CPI "Tobacco" as its nominal consumption.[11, 12]

The sales of tobacco have a down trend and track the front-loaded increase and subsequent decline in demand prior to and after the tobacco tax hike in 2010.

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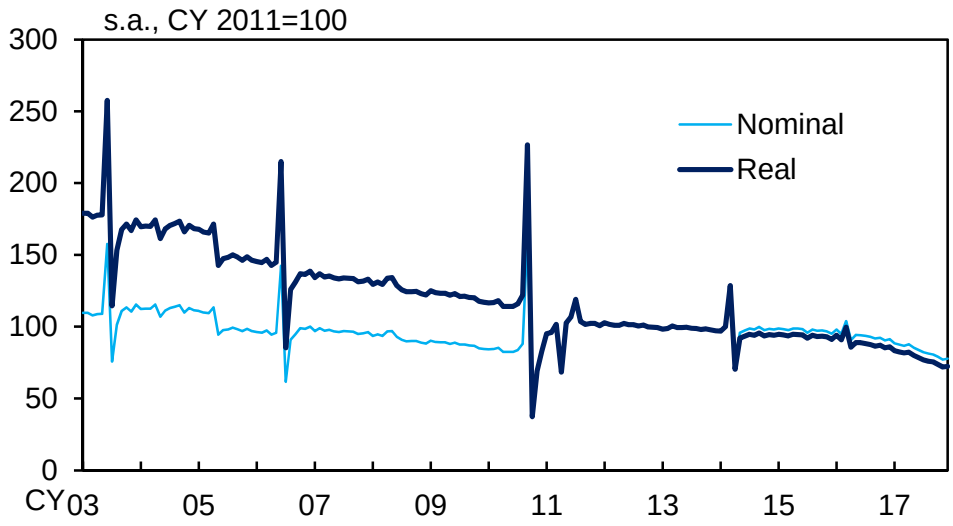
we used the CPI for Goods (excluding gasoline) as a deflator of the "Drug, cosmetics, etc." In this revision, we refine the deflator by removing the following with weights adjusted from the CPI for "Goods": "Electricity, manufactured & piped gas & water charges," "Clothes," "Shirts, sweaters & underwear," "Tobacco," "Agricultural, aquatic & livestock products," "Petroleum products," and "Durable goods."

[11] Before March 2006, the series are retroactively generated using the shipments drawn from *Indices of Industry Production*.

[12] In the original CAI, tobacco is conceptually included as a component of the "Drug, cosmetics, etc." in non-durable goods. However, "Drug, cosmetics, etc." cannot sufficiently capture the development of tobacco consumption, mainly as tobacco sales in convenience stores are not captured. In this revision, (1) we explicitly add the series "Tobacco" and (2) reduce the weight of the old "Drug, cosmetics, etc." by that of "Tobacco."

Chart 7: Tobacco

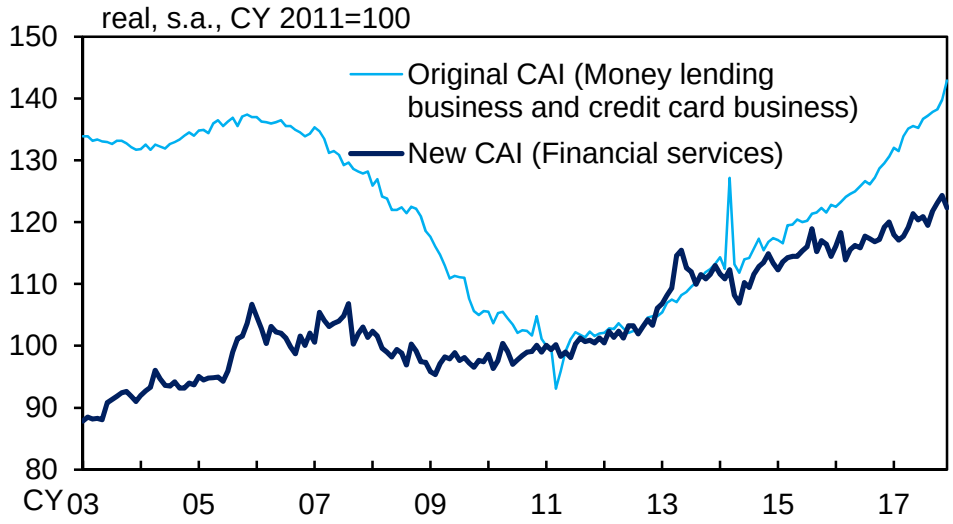


Sources: Ministry of Economy, Trade and Industry; Tobacco Institute of Japan; Ministry of Internal Affairs and Communications.

(6) Change in statistics for financial services

Regarding financial services in service consumption, we used source statistics of sectors whose developments were regarded as being driven by *only* private consumption. More specifically, we used Money lending business and credit card business in the *Indices of Tertiary Industry Activity* (ITA). However, in terms of financial services related to consumers and their costs, there are some services which are not covered by the original CAI, such as settlement services through banks and their costs as well as the trading of securities through brokers and their fees. The caveat of taking these services into account is that their developments include not only those of private consumption, but also those relating to business-to-business transactions. Regarding financial services, according to the 2011 *Input-Output Table for Japan* etc., it is implied that there are considerable amounts of private consumption which are not captured by the Money lending business and credit card business category. Therefore, in this revision, we use Financial services, which is the upper category of Money lending business and credit card business in the ITA, instead of using the lower level Money lending business and credit card business category only (it is equivalent to assume that time-series changes in household consumption and corporate consumption are the same). The revised series (based on Financial services) is on the slower increasing trend recently than in comparison to the original ones (based on Money lending business and credit card business) (Chart 8).

Chart 8: Financial Services



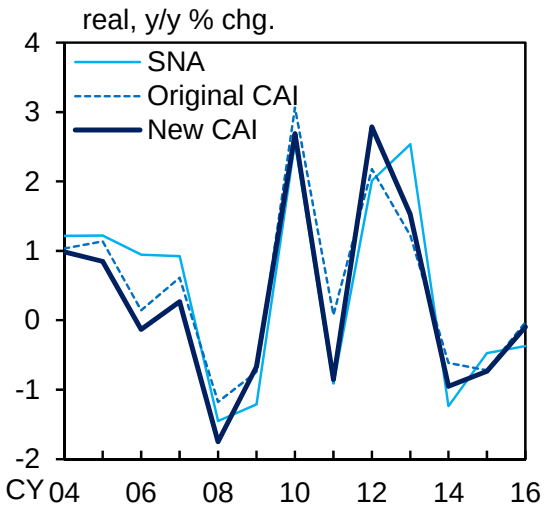
Source: Ministry of Economy, Trade and Industry.

3. Performance of the revised CAI

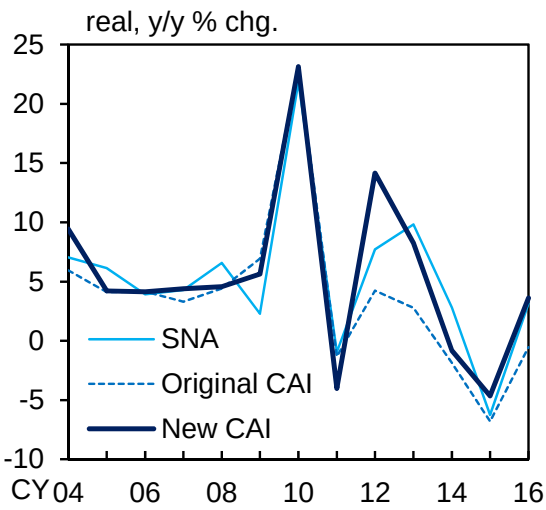
In this section, we examine how the performance of the CAI has changed as a result of the revisions described in the previous section. Compared with the ARNA, which captures private consumption the most comprehensively, the discrepancy between the revised CAI and the ARNA is smaller than that of the original CAI, showing a higher correlation of the revised CAI with the ARNA (Chart 9). Looking at consumption by type, the original CAI shows weaker development than that of the ARNA in Durable goods consumption, while it shows a stronger uptrend than the ARNA in Service consumption (Chart 10). In the revised CAI, these biases are resolved and the discrepancy between the ARNA and the CAI shrinks drastically. Regarding Non-durable goods consumption, though the discrepancy of recent movements in the revised CAI with the ARNA seems to increase, the correlation calculated on a growth-rate basis increases as seen in Chart 9. It is noted that the correlations with consumption-related confidence indicators increased after the revisions (Chart 11). Since the revisions largely improve the CAI's performance, in particular its accuracy of consumption by type, the CAI becomes much more useful to assess economic conditions.

Chart 9: Performance of the CAI Before and After Revisions (Annual)

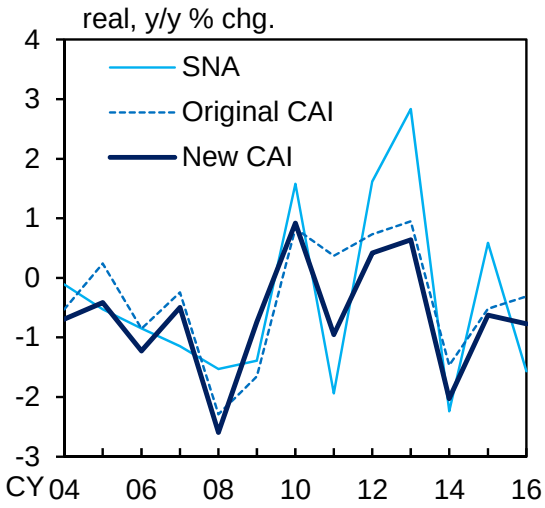
(1) Private Consumption



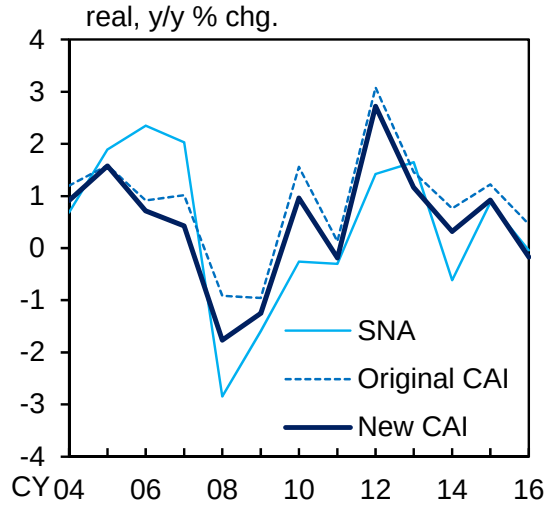
(2) Durable Goods



(3) Non-durable Goods



(4) Services

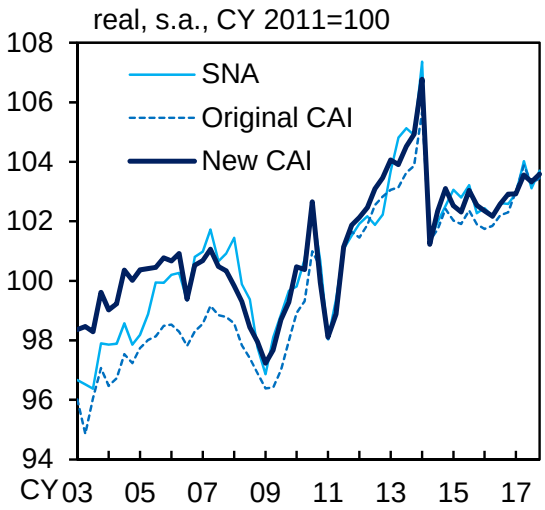


	Private Consumption		Durable Goods		Non-durable Goods		Services	
	Original	New	Original	New	Original	New	Original	New
RMSE	0.60	**0.56**	3.18	**2.71**	1.10	**0.97**	1.11	**0.92**
MAE	0.48	**0.46**	2.47	**2.16**	0.93	**0.82**	0.94	**0.73**
Correlation	0.91	**0.92**	0.91	**0.93**	0.68	**0.81**	0.73	**0.78**

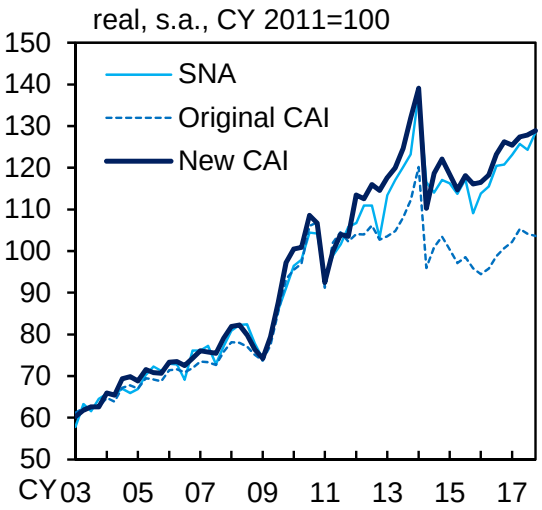
Note: RMSE (Root Mean Squared Error), MAE (Mean Absolute Error), and correlation are calculated in relation to private consumption in the ARNA (sample period: CY 2004-2016), using year-on-year change data.
Source: Cabinet Office.

Chart 10: Developments of CAI Components (Quarterly)

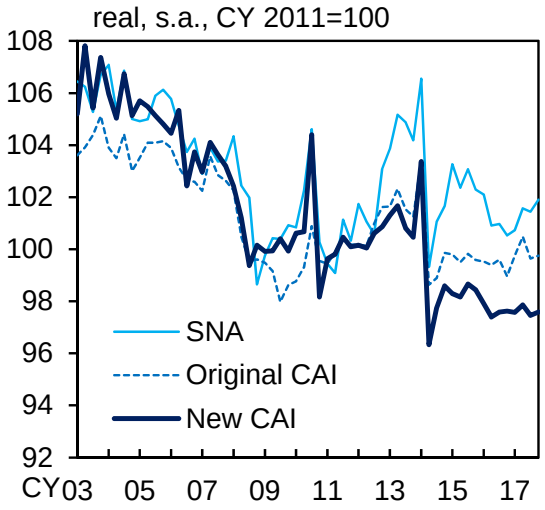
(1) Private Consumption



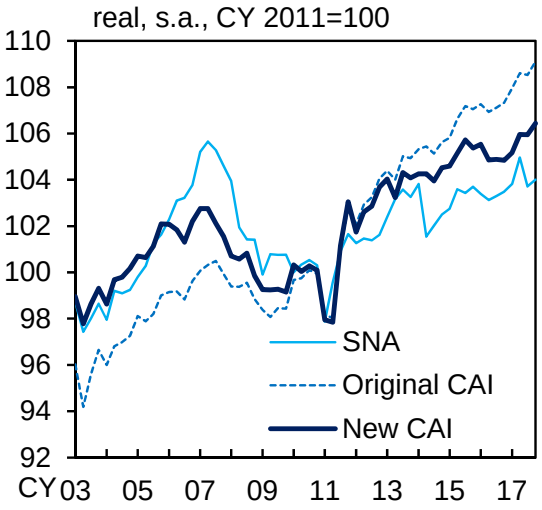
(2) Durable Goods



(3) Non-durable Goods



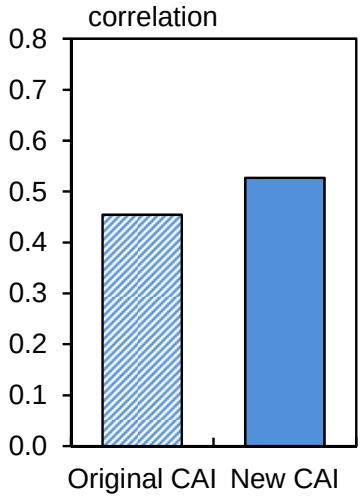
(4) Services



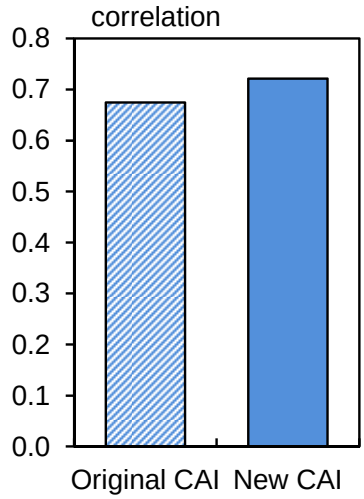
Source: Cabinet Office.

Chart 11: Correlation between the CAI and Consumption-related Confidence Indicators

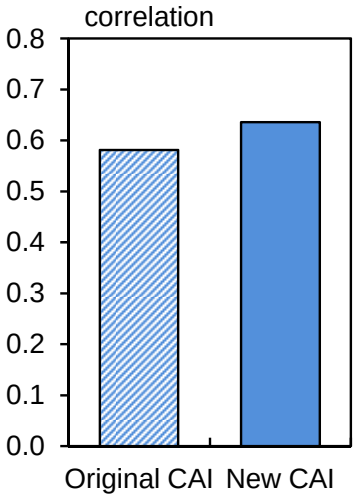
(1) Consumer Confidence Index



(2) Economy Watcher Survey (Household activity)



(3) *Tankan* Related to Private Consumption



Note: In calculating correlation coefficients, confidence indicators are deviations from the average in the sample period. Consumption indicators are percent deviations from the linear trends of each indicator. Correlation coefficients are calculated using monthly/quarterly data. Sample period is CY2003-2017.
Sources: Cabinet Office; Bank of Japan.

4. Challenges which are not revised in this paper

We explain here potential revisions that were considered for further enhancement, but are left as future challenges.

(1) Adoption of source statistics drawn from the *Monthly Survey on Service Industries*

In the benchmark revision of the SNA in December 2016, some source statistics of service consumption such as Services for amusement and hobbies and Food services are adopted from the *Monthly Survey on Service Industries*, instead of the *Current Survey of Selected Services Industries*, for example, used in the original CAI. However, we decide not to adopt these source statistics from the *Monthly Survey on Service Industries* for the following three reasons: (1) even though the *Monthly Survey on Service Industries* are available on the current basis from 2013 on,[13] it is not clear at this moment how the

[13] The *Monthly Survey on Service Industries*, which was established in July 2008, had an update of its survey content in January 2013. Since then, the time series of the *Monthly Survey on Service Industries* are released up to December 2012 and from January 2013 on, respectively.

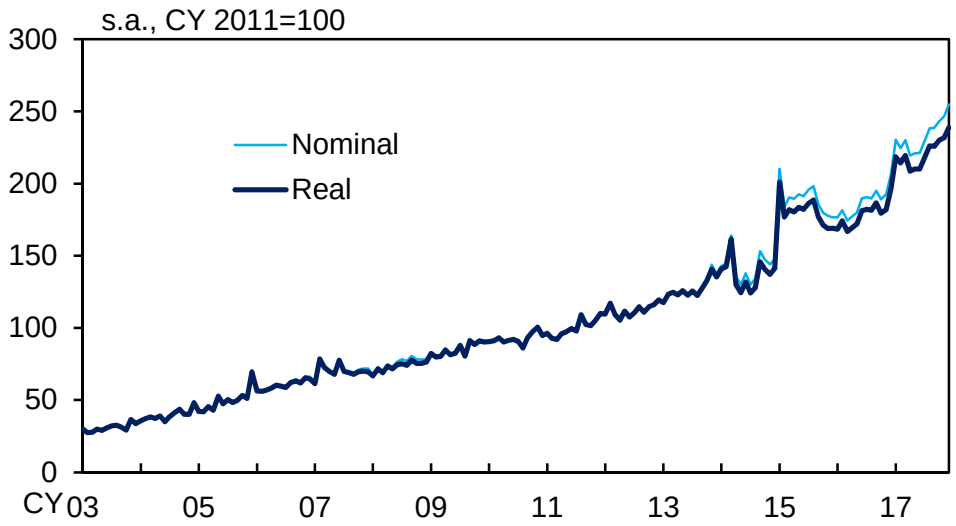
values before 2012 are treated in the SNA statistics, (2) since the time series are not long enough, it is difficult to remove their seasonality in a stable manner, and (3) while the source statistics originally used are easily incorporated into the CAI thorough the ITA, it is more complicated to incorporate the *Monthly Survey on Service Industries* as it is not part of the source statistics of the ITA, thereby contradicting the motivation of the CAI as being "easy-to-produce." That said, since the update which will integrate the *Monthly Survey on Service Industries* and the *Current Survey of Selected Services Industries* is currently being implemented, it is likely that it will be incorporated into the CAI in the future, depending on the outcome of this update.

(2) Explicit adoption of online consumption

These days there are more and more channels to purchase goods, as is seen from the fact that the share of private consumption via the internet has increased (Chart 12). It is likely that the CAI represents only a part of private consumption if the CSC or other statistics used as source statistics in the CAI cannot capture consumption activity through these new purchasing channels.[14] Though we did examine whether the e-books sales or online content charges should be included in the CAI in the last version, they were not adopted. Based on the same motivation, we examined how we could explicitly adopt online consumption in this revision, but reached the conclusion that it was difficult to do so. We hope for the enhancement of existing sales statistics and the publication of new statistics which could potentially be used as source data.

[14] In the CSC the online sales values are counted if retailers owning stores sell goods online, while the sales values of establishments owning no stores are reported as "Non-store retailers." That said, the online sales values are not captured in cases where (1) establishments implementing online sales are not subject to being surveyed by the *Census of Commerce*, which is the population of the CSC, (2) establishments do not report online sales values, and (3) establishments which are not categorized as Retail Trade in the Japan Standard Industrial Classification implement have online sales.

Chart 12: Internet Consumption



Source: Ministry of Internal Affairs and Communications.

5. Conclusion

In this paper, we explain revisions of the compilation methodology of the CAI which addresses the 2008 SNA revisions and improves the CAI's accuracy as a consumption indicator. Regarding the 2008 SNA revisions, we update the weights of the goods and services based on the 2011 *Input-Output Table for Japan*, which mainly affects developments in service consumption. Regarding the revisions aimed at improving the accuracy of the index, we expand the coverage of the surveyed retail stores and incorporate new source statistics for tobacco in non-durable goods consumption. In addition, we extend the coverage of financial services for service consumption.

Owing to these revisions, the revised CAI shows a smaller discrepancy with private consumption in the ARNA, while maintaining the merits of the original CAI as an economic indicator, such as a high correlation with consumption-related confidence indicators. Moreover, the accuracy of consumption developments by type has improved. Therefore, the performance of the revised CAI has largely improved and it is much more useful in assessing economic conditions.

There remain, however, some items that cannot be captured in the CAI such as online consumption in terms of private consumption trends. By adopting other more source statistics if available and eliciting opinions from users, we will continue on with our project to further improve the CAI as an "open source" economic indicator.

Appendix: calculation methodology of the weights of goods and services

In this appendix, we explain in detail the calculation methodology of the weights of goods and services adopted in this revision. In principle, the weights are based on Consumption expenditure of households (valued at the purchasers prices) of the basic sector in the input table, in the 2011 *Input-Output Table for Japan* (see the Appendix Chart).

More specifically,

(1) If an item of the CAI explicitly corresponds to the one in the input table, then the value from the input table is used.
(2) If an item consists of multiple basic sectors in the input table, we calculate the 88 purposes of Domestic final consumption expenditure of households (not public) by utilizing information from the SNA manual, the consumption expenditure by 12-purpose classification, and consumption by type (public), which we then use them as weights.
(3) In the case where an item, such as Travel services, is more detailed than those in the input table of the 2011 *Input-Output Table for Japan*, the weights based on the input table are distributed to each item using the weights of the ITA.

In the revised CAI, we first calculate the weights of durable goods consumption, non-durable goods consumption and service consumption by using the nominal consumption expenditure by type in 2011 released from the Cabinet Office. Then, we calculate the weights by item in the CAI using the weights as calculated in the above manner. Charts 2 and 3 show the weights of each item in the CAI.

Appendix Chart: Weights Definition by Type of Goods

Item	Definitions of weights
Durable goods（9.4）	
Automobiles	"Automobiles"
Household electrical appliances	"Household appliances," "Therapeutic equipment," "Radio, TV and video equipment," "Photographic/cinematographic equipment and optical instruments," "Information processing equipment," "Personal computers"
Non-durable goods（39.1）	
Food and beverages	"Foods and non-alcoholic beverages" drawn from the 12-purpose classification, "Alcoholic beverages"
Clothes	"Garments," "Other clothes and clothing accessories," "Shoes and other footwear," "Other personal effects"
Fuel	"Liquid fuels," "Fuels and lubricants"
Drugs, cosmetics, etc.	The remainder of the amount classified as Non-durable goods.
Electricity	"Electricity"
Gas	"Gas"
Water	"Water supply"
Newspapers	The sum of "Books" and "Newspaper and periodicals" is distributed to Newspapers and Books and magazines.
Books and magazines	The sum of "Books" and "Newspaper and periodicals" is distributed to Newspapers and Books and magazines.
Game software	"Computer programming and miscellaneous software services"†
Tobacco	"Tobacco"
Services（51.5）	
Food services	"Wining/dining service"
Travel services	"Package tour" and the remainder of "Passenger transport by railway," "Passenger transport by air" and "Accommodation service" which are not distributed to Railway, Air and Accommodations.
Medical and other health care services	"Outpatient services," "Hospital stay services"
Care services	"Nursing care services"
Regional and long-distance telecommunications	"Fixed telecommunications"†
Internet service provider	"Miscellaneous telecommunications"†
Mobile telecommunications	"Mobile telecommunications"†
Railway	The amount of "Passenger transport by railway" is distributed to Railway and Travel services.
Bus	The amount of "Passenger transport by road" is distributed to Bus and Taxi.
Taxi	The amount of "Passenger transport by road" is distributed to Bus and Taxi.
Air	The amount of "Passenger transport by air" is distributed to Air and Travel services.
Postal services	"Postal services"
Services for amusement and hobbies	"Amusement and recreational services" from the 190 sector classification of the I/O table.
Accommodations	The amount of "Accommodation service" is distributed to Accommodations and Travel services.
Supplementary tutorial schools	"Supplementary tutorial schools, instruction services for arts, culture and technical skills"†
Ceremonial occasions	"Ceremonial occasions"†
Public broadcasting	"Public broadcasting"†
Automobile parking	"Facility service for road transport"†
Financial services	"Financial services"
Life insurance	"Life insurance"
Non-life insurance	"Non-life insurance"
Automobile maintenance	"Motor vehicle maintenance services"†
Digital contents delivery services	"Internet based services"†

Notes: 1. The terms in the double quotations marks are drawn from the 88 purposes of Domestic final consumption expenditure of households unless otherwise mentioned.
2. The terms in the double quotations with a dagger symbol are drawn from the Basic sector classification of the I/O table.
3. Figures in the parentheses indicate weights in the CAI.

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