Bank of Japan Review

2006-E-7

Core Indicators of Japan's Consumer Price Index

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November 2006

The primary objective of the Bank of Japan (BOJ) in conducting monetary policy is to promote sustainable growth by achieving price stability. The price stability that needs to be achieved is regarded as not just short-term and temporary, but sustainable in the medium to long term, which is the common understanding among major central banks. To fulfill this mandate, the BOJ is required to identify the underlying trend of inflation by excluding various idiosyncratic disturbances from measured price developments in price indexes. This paper examines the effects of idiosyncratic disturbances on Japan's consumer price index (CPI), computes several core indicators to capture the underlying trend of inflation, and compares their performances. Empirical evidence reveals that the CPI excluding fresh food and 10-percent trimmed mean show somewhat better performances than other indicators in terms of tracking the underlying trend of inflation and forecasting the future direction of headline inflation. In examining consumer price developments, it is thus deemed important to monitor various indicators, including the CPI excluding fresh food that has drawn most of the focus. This enables us to identify the underlying trend of inflation by capturing the nature and size of idiosyncratic disturbances behind consumer price dynamics.

I. Introduction

The primary objective of the Bank of Japan (BOJ) in conducting monetary policy is to promote sustainable growth by achieving price stability. The price stability that needs to be achieved is regarded as not just short-term and temporary, but sustainable in the medium to long term, which is the common understanding among major central banks.

Basic indicators for gauging price developments in conducting monetary policy are required to cover goods and services consumed by households. In particular, given the timeliness of statistics, the consumer price index (CPI) plays a key role.[1]

While the headline inflation indicator is influenced by idiosyncratic disturbances in the short term, these effects diminish in the long term. Therefore, medium- to long-term price stability should be assessed by the headline indicator that comprehensively covers household expenditures on goods and services.

Since the headline indicator is subject to the influence of various idiosyncratic disturbances in the short run, it is difficult to assess the underlying trend of inflation by the headline indicator alone. Hence, core indicators that exclude idiosyncratic disturbances from the headline indicator have been used to judge and explain trend inflation.

For example, comparison of the headline indicator with the core indicators enables us to identify the effects of idiosyncratic disturbances on headline inflation dynamics. The use of core indicators in assessing price developments enables us to explain the current price developments in relation to medium- to long-term price stability.

This paper first summarizes the basic ideas concerning core price indicators and then examines the characteristics of Japan's CPI developments. Bearing these characteristics in mind, the paper further explores what types of indicator with certain items excluded the BOJ should focus on as core indicators in order to identify more accurately the underlying trend of inflation.[2]

II. Basic Concept of Core Indicators

In formulating core indicators to capture the underlying trend of inflation, it is crucial to appropriately exclude the effects of idiosyncratic disturbances.

[Chart 1]Extraction of underlying changes

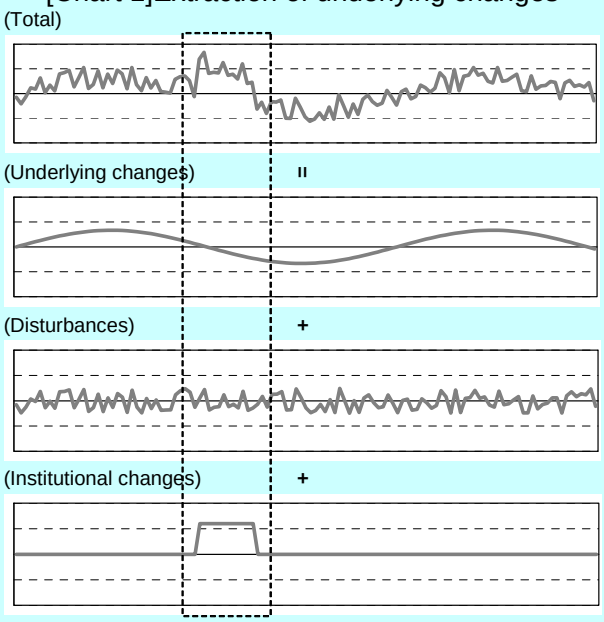
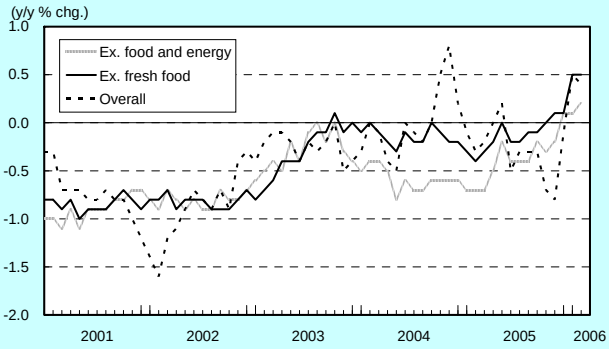


Chart 1 summarizes this point by using hypothetical examples. Changes in the headline inflation (top panel) correspond to the sum of: (i) the underlying component that moves on a cyclical trend (second panel), (ii) the idiosyncratic component that fluctuates from time to time (third panel), and (iii) the one-time component, including institutional changes, that rises/declines for a certain period of time and then vanishes (bottom panel). Therefore, headline inflation tends to move up and down in the short-term due to the influence of various disturbances, thereby making it difficult to identify its underlying trend.

Focusing on the period surrounded by dotted lines, headline inflation first picks up, and then drops sharply. However, this movement is influenced by changes in the institutional component and underlying trends start to decline when headline inflation rises.

As core price indicators used in Japan (Chart 2), the CPI excluding fresh food that shows volatile price fluctuations depending on weather conditions (the CPI

[Chart 2] Japanese CPI



Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."
Note: Food excludes alcoholic beverage. Energy includes electricity, manufactured and piped gas, liquefied propane, kerosene, and gasoline.

[Chart 3] Core CPI Used by Major Central Banks

Country / Economic area	Core indicator	Weight	Target indicator	Notes
Japan	CPI excluding fresh food	95.5%	—	
USA	PCE deflator less food and energy	80.2%	—	Shifted from CPI less food and energy in February 2000.
Euro area	HICP less non-processed food and energy	83.4%	Headline HICP	
UK	RPIX	—	Headline CPI	Target indicator was changed from RPIX to Headline CPI in December 2003.
Canada	CPI excluding eight most volatile components adjusted for changes in indirect taxes	82.8%	Headline CPI	Shifted from CPI less food and energy in 2001.
New Zealand	CPI excluding energy and fuel; CPI for tradables and non-tradables; trimmed mean	—	Headline CPI	Headline CPI changed to exclude interest rates and housing prices after 1999.
Australia	CPI excluding fruit, vegetables, and gasoline; trimmed mean	—	Headline CPI	
Sweden	CPI excluding mortgage interest payments, indirect taxes, and subsidies	94.4%	Headline CPI	
Norway	CPI excluding tax, energy	n.a.	Headline CPI	
Switzerland	15-percent trimmed mean	70.0%	Headline CPI	CPI excluding food, beverages, tobacco, seasonal products and energy; CPI excluding food, beverages, tobacco, seasonal products, energy, and administrative prices.

Notes: 1. Weight for the core indicator is computed relative to the headline indicator.
2. The target indicator indicates a price indicator used for setting the target value of inflation and numerical definition of price stability.
3. Canada's core indicator excludes eight components: fruits, vegetables, gasoline, fuel oil, natural gas, mortgage interest costs, intercity transportation, and tobacco products.

excluding fresh food) has been widely used. In recent years, in order to exclude the effects of oil prices hovering at all-time highs, the index that excludes food and energy-related items (the CPI excluding food [except alcoholic beverages] and energy)[3] has also been published.

Core indicators that exclude idiosyncratic disturbances from headline indicators by using information from individual item indexes have been used in major advanced countries (Chart 3).[4] However, the excluded items vary from country to country. For example, besides fresh food and energy, which show volatile price fluctuations, in some cases the effects of institutional factors such as housing mortgage interest rates and indirect taxes are excluded. In addition, in order to contain the arbitrariness in choosing items to be excluded, an indicator called the trimmed mean, which mechanically discards a certain percentage from each tail of the price change distribution of item indexes, is also used (Chart 4).[5]

[Chart 4] Trimmed mean (illustration)

mean=2.00%

item	(1)	(2)	(3)	(4)	(5)
weight	10	30	30	20	10
y/y chg.	-1.8	0.5	2.0	2.8	8.7

10-percent trimmed mean=1.64%

item	(1)	(2)	(3)	(4)	(5)
weight	~~10~~	30	30	20	~~10~~
y/y chg.	~~-1.8~~	0.5	2.0	2.8	~~8.7~~

Notes: Simple mean is a weighted average of changes in item prices (upper panel). 10-percent trimmed mean is computed as a weighted average of individual prices after excluding items in upper and lower tails for 10 percent (lower panel). In this chart, since items with the highest and lowest increases have 10 percent weight, the 10-percent trimmed mean corresponds to a weighted average after excluding the two items in the upper and lower tails.

III. Effects of Idiosyncratic Disturbances

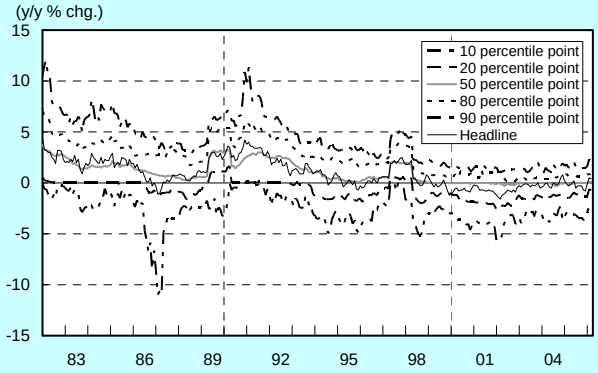
In the following, this paper explores what kind of idiosyncratic disturbances are contained in Japan's consumer prices by examining the characteristics of price changes in more detailed classifications and item groups.

A. Source of idiosyncratic disturbances

In order to broadly grasp the effects of idiosyncratic disturbances on headline CPI inflation, Chart 5 plots the relationship between the distribution of the year-on-year changes in item indexes and those in the headline CPI. This chart shows the 10-percentile point, 20-percentile point, 50-percentile point (median), 80-percentile point, and 90-percentile point, whose cummulative weight are 10%, 20%, 50%, 80%, and 90%, respectively.

Looking at the distribution of the year-on-year changes in the item indexes, the 10- and 20-percentile points decline substantially as the year-on-year changes in the headline CPI fall. Conversely, the 80- and 90-percentile points increase substantially as the year-on-year changes in headline CPI rise. In other words, the distribution of the year-on-year changes in item indexes tends to be skewed toward the direction of the changes in headline inflation.

[Chart 5] Distribution of Price Changes for Individual Items in the CPI



Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."
Note: X percentile point shows the rate of price change of the item whose cumulative weight is equal to X%.

For example, during 1986-87, the year-on-year changes in the headline CPI temporarily became negative, with substantial declines in the 10-percentile point, reflecting the yen appreciation after the Plaza Accord and the oil price plunge due to reverse oil-shock. During the period around the end of the bubble economy in 1990-91, the year-on-year changes in the headline CPI increased, with the 90-percentile point substantially increased, reflecting partly the effects of the oil price hike due to the Gulf War.

Next, Chart 6 summarizes the items included in the 10-percent tail of the distribution of the year-on-year changes in item indexes to identify which items distort the price change distribution. This chart shows that large weights are observed for items that are strongly influenced by temporary factors —agricultural and aquatic products, including fresh food, energy-related items, and public services and utility charges. The prices of agricultural and aquatic products, including fresh food, are quite volatile, reflecting the effects of weather conditions. The prices of energy-related items are influenced mainly by overseas factors such as crude oil prices and foreign exchange rates. Public services and utility charges are substantially influenced by institutional changes.

The effects of the idiosyncratic factors on the headline CPI are examined by computing the contributions of the above four components on the

[Chart 6] Weight for Items in the Upper and Lower Tails of Distribution of Price Changes

(Unit: percent)

Period	Fresh food	Agri. & aqua. products	Energy	Public services & utilty charges
(Upper 10-percentile)				
1981-85	2.5	0.3	0.8	2.3
1986-90	2.3	0.4	0.5	1.3
1991-95	1.7	0.6	0.2	1.6
1996-00	1.7	0.7	1.1	1.2
2001-05	1.6	1.2	1.5	1.8
(Lower 10-percentile)				
1981-85	2.8	0.8	1.7	1.6
1986-90	1.9	0.6	3.2	0.4
1991-95	2.1	0.9	0.9	1.4
1996-00	1.9	0.9	1.9	0.6
2001-05	1.5	0.6	0.7	1.2

Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."

Notes: 1. Figures in the table shows the average for each period.
2. Energy includes electricity, manufactured piped gas, liquefied propane, and gasoline.
3. Weights for agricultural and aquatic products and public services and utility charges exclude those for fresh food and energy, respectively, to avoid the double counting.

deviations between headline inflation and its HP-filtered trend (Chart 7). HP-filtering is a statistical method of extracting smooth components from time-series data as underlying trends.

Chart 7 shows that the deviations are mostly explained by the fluctuations in fresh food except for the period of 1986-87. During this period, the contribution of energy-related items became large because of the yen appreciation after the Plaza Accord and the oil price plunge due to the reverse oil-shock

B. Characteristics of idiosyncratic disturbances

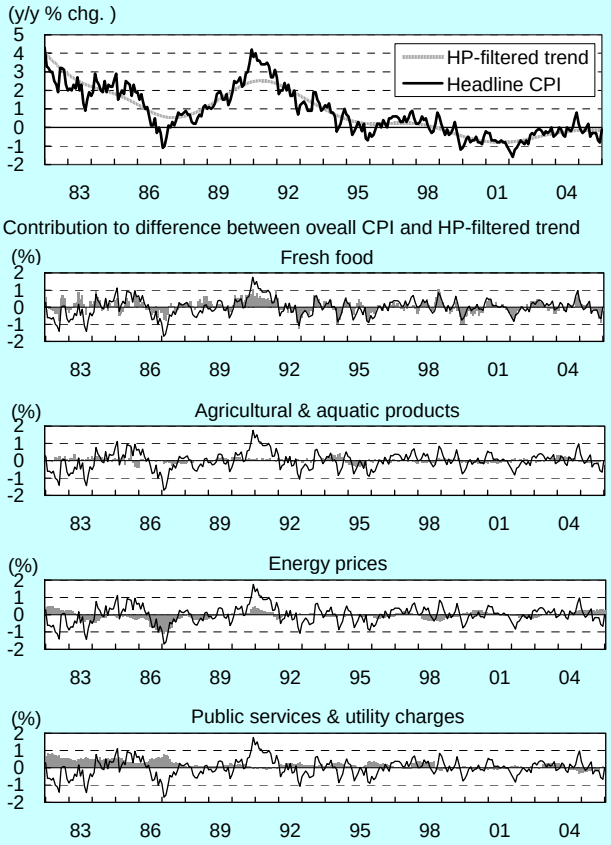
Next, the characteristics of year-on-year changes are examined using subgroup indexes with a higher degree of aggregation than item indexes (Chart 8).

When computing the standard deviations of the year-on-year changes, the high-ranking subgroups are agricultural and aquatic products (fresh vegetables, eggs, and fresh fruits) and oil products (gasoline, kerosene, and liquefied propane), which are subject to idiosyncratic disturbances like weather conditions.

However, even among the subgroups with large standard deviations, the persistency of price changes differs substantially across subgroups. This point is confirmed by computing the autocorrelation of the year-on-year changes with a different lag period.

For example, the autocorrelation of year-on-year changes for fresh vegetables, fresh fruits, and cut flowers rapidly declines as the lag period is extended. In other words, these subgroups fluctuate up and down substantially from month to month, thus showing low persistency in their price fluctuations.

[Chart 7] Deviations between Headline Inflation and Its Trend



Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."

Notes 1. The trend is computed by applying the HP-filter to the overall index.
2. In the contribution charts, the bold line shows the differences between the overall index and its HP-filtered trend. The shaded area shows the contribution of each item.
3. The contribution of agricultural and aquatic products and public services and utility charges exclude fresh food and energy prices, respectively, to avoid double counting.

In contrast, the autocorrelations of year-on-year changes for other subgroups decline more gradually. Such subgroups, while having large year-on-year fluctuations, tend to continuously change in the same direction for a certain period of time.

We are thus required to differentiate two cases for the nature of price changes in subgroups with substantial influences of idiosyncratic disturbances: whether the effects of idiosyncratic factors diminish in the short term or continue for a certain period of time. This point becomes important when judging whether to exclude certain components as temporary factors to gauge underlying price trends.

In this regard, it is deemed appropriate to exclude agricultural and aquatic products as temporary factors since they show volatile movements mainly reflecting weather conditions.

In contrast, oil products are not that straightforward. While the standard deviations of year-on-year changes are large, the autocorrelations

[Chart 8] Time-Series Properties of Subgroup Indexes

Rank	Category	Weight (%)	Standard deviation			Autocorrelation (lag)					
			1982-05	1982-93	1994-05	1	2	3	6	9	12
1	Fresh vegetables	1.7	15.9	16.8	14.7	0.70	0.43	0.25	0.11	-0.01	-0.48
2	Eggs	0.2	13.9	16.9	9.6	0.88	0.77	0.69	0.44	0.19	-0.14
3	Fresh fruits	1.1	11.6	12.5	10.7	0.80	0.61	0.46	0.20	0.01	-0.38
4	Cut flowers	0.4	8.3	10.2	4.5	0.35	0.20	0.20	0.19	0.05	-0.30
5	Rice	1.0	6.9	2.0	9.3	0.96	0.87	0.75	0.32	-0.12	-0.40
6	TV license charges	0.8	6.5	8.6	1.1	0.92	0.84	0.75	0.50	0.25	-0.00
7	Oil products	3.0	6.5	7.6	4.8	0.97	0.91	0.84	0.60	0.36	0.13
8	Processed fruits	0.1	6.3	7.4	3.0	0.97	0.94	0.88	0.68	0.46	0.27
9	Other charges	0.6	6.1	7.8	2.1	0.94	0.87	0.81	0.63	0.46	0.27
10	Amusement durables	1.2	5.4	2.8	5.4	0.98	0.95	0.92	0.84	0.74	0.66

Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."

remain high up to longer lags. This implies that whether or not to exclude them depends on factors behind such price fluctuations. A key aspect here is that the recent price hike in crude oil was caused partly by the increased demand in emerging market economies, including China, due to their high economic growth. This increasing trend of crude oil demand differs from supply constraints, thus suggesting that their exclusion as temporary factors is not necessarily appropriate. In addition, the prices of amusement durables reflect a declining trend of prices for home information appliances due to technological progress, thus making it difficult to tell whether to exclude such items.

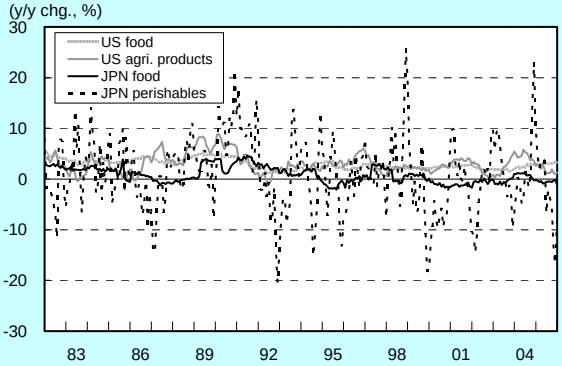
It should be noted that the effects of idiosyncratic disturbances differ depending on each country's economic circumstance and the method used to compile price indexes (see Box). Therefore, the characteristics of each country's price developments should be taken into account when specifying which components should be excluded as temporary factors.

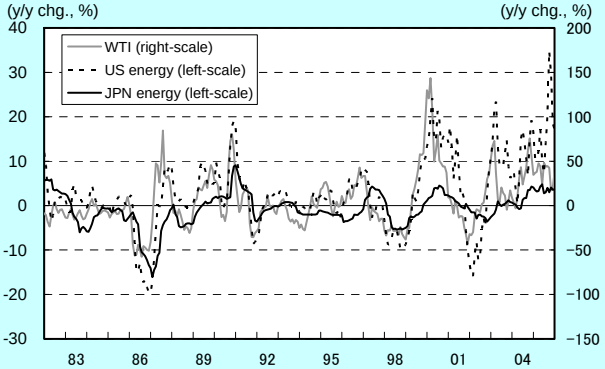
IV. Core Indicators in Japan

Next, several candidates for the core indicator of Japan's CPI are constructed to compare their performances. In doing so, it is important to appropriately exclude idiosyncratic disturbances in line with the characteristics of Japan's CPI, based on the analysis so far. The following two criteria are employed to assess the performances of the candidate indicators from the viewpoint of identifying the underlying trend of inflation: (i) the ability to track the underlying trend of inflation, and (ii) the ability to forecast the future direction of headline inflation.

[BOX] Food and Energy Price Developments: Japan-US Comparison

It should be noted that the effects of disturbances on fluctuations in price indexes differ from country to country depending on their economic environment and methods of compiling price indexes. For example, a comparison of food and energy prices between Japan and the US reveals the following: (i) the volatility of fresh food in Japan is far larger than that in the US; (ii) fluctuations of food prices excluding fresh food show persistent movements both in Japan and the US; (iii) energy prices in the US fluctuate up and down, reflecting fluctuations of crude oil prices; and (iv) fluctuations of energy prices in Japan become smaller after the second half of the 1990s, compared with larger fluctuations before the early 1990s. These observations seem to provide some justification for the practice in Japan that the core indicator excludes only fresh food, which differs from the practice in the US of excluding both food and energy.





Sources: Ministry of Internal Affairs and Communications, "Consumer Price Index"; US Bureau of Labor Statistics, "Consumer Price Index."

A. Candidates for core indicators

In the following, candidates for the core indicator are chosen based on three criteria: (i) continuity of definition over time, (ii) the least arbitrariness in selecting items to be excluded, and (iii) possibility of computing in real time and free from retroactive revision. Specifically, there are four candidates: (a) excluding fresh food (95.5% weight of the 2000-base headline index), (b) excluding food and energy (68.7% weight),[6] and (c) excluding agricultural and aquatic products, energy, and public services and utility charges (70.7% weight), and (d) 10-percent trimmed mean (80.0%).

Each indicator's weight against the headline index increases over time, reflecting the diminishing expenditure on food year after year. Past expenditure on food is higher; for example, the CPI excluding food and energy only covers less than 60% before the 1980-base index.

As more items are excluded and the coverage shrinks, the risk increases that not only temporary factors, but also information about underlying trends, are excluded. Therefore, the optimal range of items to be excluded in constructing the core indicator depends on a trade-off between the reliability of precisely excluding temporary factors and the possibility of excluding information about the underlying trend of inflation.

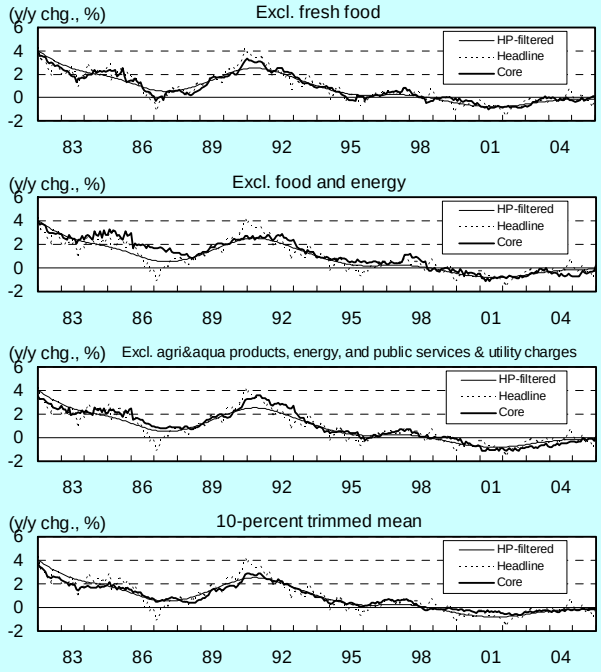
B. The ability to track the underlying trend

Next, the ability of candidate indicators to track trend inflation is compared by using the HP-filtered trend as a benchmark (Chart 9).[7]

When looking at the developments of year-on-year changes, the core indicators as a whole are more stable than the headline indicator and are closer to the movement of the HP-filtered trend. However, a closer look at the chart indicates that the size of the decline differs across candidate indicators in the mid-1980s depending on whether energy-related items are excluded or not, reflecting the effects of the yen appreciation after the Plaza Accord and the oil price plunge due to the reverse oil-shock.

The ability of tracking trend inflation is compared more rigorously by using a root mean squared error (RMSE) that shows average deviations from the HP-filtered trend. The deviations for the 10-percent trimmed mean and the CPI excluding fresh food are small, while those for the CPI excluding food and energy are rather large. RMSEs are computed by dividing the sample period into two in order to see the difference across sample periods. The chart suggests that deviations are larger in the former period than in the latter. However, it should be noted that deviations of the indicator excluding food and energy have been relatively large for both periods.

[Chart 9] Deviations of Year-on-year Changes of Core Indicators from Trend



(Root Mean Squared Errors)

	Overall	Excl. fresh food	Excl. Food / Energy	Excl. Agr. / energy / pub. ervices & utility charges	10-percent trimmed mean
1982-05	0.506	0.325	0.523	0.396	0.294
1982-93	0.623	0.401	0.663	0.502	0.338
1994-05	0.353	0.226	0.328	0.249	0.242

Source: Ministry of Internal Affairs and Communications, "Consumer Price Index."

Notes: 1. Trend is computed by applying HP-filter to headline indictor (smoothing parameter is set as standard value for monthly data of 14,400).
2. Root mean squared errors are used for quantitative assessment for the degree of deviation from the trend.

C. Information about the future direction of headline inflation

Finally, how the current gap between core and headline inflation predicts the future direction of headline inflation is examined in order to see how precisely each indicator excludes idiosyncratic disturbances.

We will estimate the specification below:

$$\pi_{t+h} - \pi_t = \alpha + \beta(\pi_t^{CORE} - \pi_t) + \varepsilon_t,$$

where π denotes the rate of inflation in the headline CPI and π^{core} refers to that in one of the core indicators. The parameter *h* takes the values of 12, 18 and 24 (months).

This formula focuses on how the gap between core and headline inflation, if any at present, will be closed in the future. Namely, if the core indicator excludes idiosyncratic disturbances and precisely tracks the underlying trend of inflation, the headline indicator that initially deviates from the core indicator due to idiosyncratic disturbances will converge to the core indicator as the idiosyncratic disturbances diminish.

Full-sample estimations with all data ranging from 1982 to 2005 (Chart 10, upper panel), and rolling estimations with 10-year subsample data for the robustness check against changes in sample periods (Chart 10, lower panel) are carried out. An overall assessment of the estimates is that, regardless of the type of indicator used, the headline indicator tends to be adjusted toward the core indicator as idiosyncratic disturbances diminish. Among core indicators, the CPI excluding fresh food and the 10-percent trimmed mean show better performances than the others.

Technically speaking, the criteria for assessing the estimates are summarized below: if estimates of β are positive in a statistically-significant manner, it implies that the headline indicator is adjusted toward the core indicator as idiosyncratic disturbances diminish; if β is not different from one in a statistically-significant manner, it implies that the core indicator accurately captures the effects of idiosyncratic disturbances on headline inflation.

The results of the full-sample estimation show that, for all indicators, estimates are statistically significant at the 99-percent level in all estimations for one year, one and a half years, and two years ahead.[8] In particular, with respect to changes up to one year ahead, the core indicator excluding fresh food and 10-percent trimmed mean are not only positive, but also are not different from one in a statistically-significant manner. In addition, as the forecasting period is extended to one and a half years and two years ahead, the 10-percent trimmed mean shows relatively better performances than others in the sense that the decline of parameter value for the estimates is small.

Checking the robustness of the estimates against changes in the sample periods from the results for rolling estimations with subsamples of every 10 years, all indicators are positive in a statistically-significant manner. Therefore, it is deemed robust against changes in the sample period that headline inflation has the tendency to be adjusted toward the core inflation as the effects of idiosyncratic disturbances diminish.

In particular, estimates of the CPI excluding fresh food are not only positive in a statistically-significant manner, but also are not different from one for almost the whole periods, which confirms that the indicator has stable information content and effectively adjusts for idiosyncratic disturbances. The 10-percent trimmed mean has a relatively narrow confidence interval for the estimates, and shows high accuracy as a whole. However, the parameter estimates exceed one in a statistically-significant manner for the sample period after about the year 2000. This suggests the possibility that estimates are biased upward, because items with rapid price decline, including personal computers adopted at the time of the revision to the 2000-base year, are constantly excluded. In addition, the CPI excluding food and energy has a relatively narrow confidence interval and the overall estimation accuracy is high. In contrast, the indicator excluding agricultural and aquatic products, energy, and public services and utility charges, in general, has a wide confidence interval and its estimation accuracy is somewhat low.

D. Evaluation of core indicators

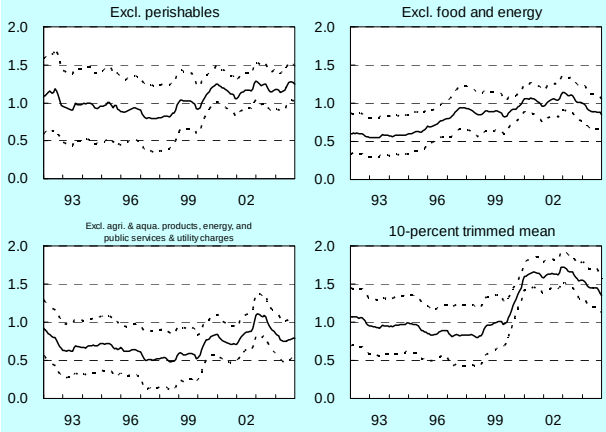
To summarize, empirical evidence suggests no

[Chart 10] Information Content of Deviation between Overall and Core Indicators

(Full-sample estimations)

Forecast period	Excl. fresh food	Excl. Food / Energy	Excl. Agri. / Energy / public services & utility charges	10-percent trimmed mean
1-y ahead	1.022 (0.126)	0.624 (0.080)	0.692 (0.100)	1.065 (0.106)
1.5-y ahead	0.424 (0.105)	0.365 (0.066)	0.351 (0.081)	0.723 (0.085)
2-y ahead	0.348 (0.091)	0.346 (0.057)	0.329 (0.071)	0.670 (0.072)

(Rolling estimations for one-year ahead forecasts)



Notes: 1. Figures in the charts show estimates for β.
2. Full sample estimates are computed using data from January1982 to December 2005. Figures in the parentheses are standard errors.
3. Rolling estimations are conducted using subsamples of 120 months ending at each month on the horizontal axis. Bold lines shows estimates, and dotted lines show 95-percent confidence intervals

decisive difference among the candidates in their performances as core indicators. In ranking their performances, the CPI excluding fresh food and the 10-percent trimmed mean show better performances, compared with the CPI excluding food and energy and that excluding agricultural and aquatic products, energy, and public services and utility charges.

The CPI excluding fresh food, while minimizing the range of items to be excluded, adequately adjusts idiosyncratic disturbances, and shows stable performances in terms of its ability to track the underlying trend of inflation and forecasting future headline inflation. That is why this indicator has long been used, and, given its popularity in Japan, it seems reasonable to continue giving it due credit as the core indicator.

The 10-percent trimmed mean shows, as a whole, high performances as the core indicator. This suggests the possibility that items to be excluded from the headline indicator in tracking the underlying trend of inflation are changing all the time, depending on economic and price developments. As mentioned above, while its ability to forecast future headline inflation seems to be affected by the 2000-base year revision, such negative effects are likely to diminish as data after the base year revision is accumulated.

Meanwhile, the CPI excluding food and energy and that excluding agricultural and aquatic products, energy, and public services and utility charges exclude a somewhat wide range of items, resulting in low coverage against the headline CPI. Therefore, they may exclude even necessary information reflecting the underlying trend of inflation, thus resulting in lower performances as a core indicator. In particular, while both indicators exclude energy, its validity depends on factors such as causes of crude oil price fluctuations. For example, with respect to the recent crude oil price hike, a key aspect seems to be that the demand is increasing because of the high growth in emerging market economies, including China. This growth trend in crude oil demand is different from supply constraints and thus it is not necessarily appropriate to exclude it as a temporary factor. In addition, the CPI excluding food and energy excludes food items other than fresh food, which does not necessarily show volatile movements, thus suggesting that it is not necessarily an appropriate indicator, given the characteristics of Japan's CPI fluctuations.

V. Concluding Remarks

This paper compared the performances of several core indicators upon summarizing the characteristics of Japan's CPI movements. When core indicators' performances were compared by using statistical methods, we could not find any single indicator that was decisively superior to the others, but found that, as a whole, the performances of the indicator excluding fresh food and the 10-percent trimmed means were somewhat better than other indicators. Therefore, in order to examine consumer price developments, it is deemed important to monitor the CPI excluding fresh food, which has been given importance, as well as several other consumer price indicators. This will make it possible to identify the underlying developments of consumer prices while capturing the characteristics and size of idiosyncratic disturbances that affect consumer price fluctuations.

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[1] While this paper examines various indicators that track the underlying trend of inflation, it should be noted that there are various arguments as to which price index should be used to assess price stability. A detailed discussion on this point can be found in Hiroshi Ugai and Keiko Sonoda, "Kin-yu seisakuno setsumeini tsukawareteiru bukka shisuu" (in Japanese. Bank of Japan Review 2006-J-2, 2006).

[2] Major central banks are quite active in conducting empirical analyses on indicators to track the underlying trend of inflation, and recent literature includes the following:

Todd E. Clark, "Comparing Measures of Core Inflation" (Federal Reserve Bank of Kansas City Economic Review, Second Quarter 2001)

Seamus Hogan, Marianne Johnson, and Thérèse Lafleche, "Core Inflation" (Technical Report No. 89, Bank of Canada, January 2001)

European Central Bank, "Measures of Underlying Inflation in the Euro Area" (ECB Monthly Bulletin, July 2001)

Alan Mankikar and Jo Paisley, "What Do Measures of Core Inflation Really Tell Us?" (Bank of England Quarterly Bulletin, Winter 2002)

Ivan Roberts, "Underlying Inflation: Concepts, Measurement and Performance" (Research Discussion Paper No.2005-05, Reserve Bank of Australia, July 2005)

Robert Rich and Charles Steindel, "A Review of Core Inflation and an Evaluation of Its Measures" (Staff Report No. 236, Federal Reserve Bank of New York, December 2005)

[3] The CPI excluding food and energy is computed consistent with the U.S. core CPI. In the United States, alcoholic beverages over the counter and at restaurants are excluded, while in Japan, beer provided at restaurants is not excluded. It should be noted that in Japan's CPI, expenditure for alcoholic beverages provided at restaurants is all included under the category of beer (at a restaurant) and amounts to 1.4% of the headline CPI, which is almost equivalent to the sum of alcoholic beverages over the counter sale.

[4] There are other approaches such as using the VAR (vector auto regression) model to distinguish between demand shock and supply shock, and decompose the observed rate of inflation into "demand-side inflation rate" and "supply-side inflation rate." As an application of this approach to Japan, see Hitoshi Mio, "Identifying Aggregate Demand and Aggregate Supply

Components of Inflation Rate: A Structural Vector Autoregression Analysis for Japan" (*Monetary and Economic Studies*, vol. 20 No. 1, Institute for Monetary and Economic Studies, Bank of Japan, 2002).

[5] For trimmed mean, see Shigenori Shiratsuka, "Inflation Measures for Monetary Policy: Measuring the Underlying Inflation Trend and Its Implication for Monetary Policy Implementation" (*Monetary and Economic Studies*, vol. 15, No. 2, Institute for Monetary and Economic Studies, Bank of Japan, 1997), and Higo, Masanori and Hitoshi Mio, "Underlying Inflation and the Distribution of Price Change: Evidence from the Japanese Trimmed-Mean CPI" (*Monetary and Economic Studies*, vol. 17, No. 1, Institute for Monetary and Economic Studies, Bank of Japan, 1999).

[6] In line with the U.S. standard, beer (restaurant), which corresponds to expenditure for alcoholic beverages, is also excluded.

[7] The results remain almost unchanged when the long-term moving average is used as an indicator of trend changes.

[8] In order to check the possibility that the core indicator will be adjusted toward the headline indicator, we conducted a similar estimation by using changes in the core indicator for *h*-period ahead as the explained variable. In this case, if the parameter estimate of β becomes negative in a statistically significant manner, it will show that the core indicator will tend to be adjusted toward the headline indicator. The estimates for 10-percent trimmed mean are different from zero in a statistically significant manner, thus confirming that there is no tendency to adjust toward the headline indicator. While other core indicators become negative in a statistically significant manner, the absolute value of estimates is considerably small and thus the extent those core indicators had been adjusted toward the headline indicators is low.

Bank of Japan Review is published by the Bank of Japan to explain recent economic and financial topics for a wide range of readers. This report, 2006-E-7, is a translation of the original Japanese version, 2006-J-7, published in April 2006 before the 2005-base year revision in August. All the analyses in the paper are thus based on the 2000-base CPI. The views expressed in the Review are those of the authors and do not necessarily represent those of the Bank of Japan. If you have comments and questions as well as requests for hard copies, please contact Satoshi Yamaguchi, Director, Monetary Affairs Department (satoshi.yamaguchi@boj.or.jp). Bank of Japan Review E-series and Bank of Japan Working Paper E-series can be obtained through the Bank of Japan's Web site (http://www.boj.or.jp).