

Recent Developments in the Linkage between Wages and Prices*

Research and Statistics Department
OZAKI Tatsuya, JIMBO Masahiro, YAGI Tomoyuki, YOSHII Akihito

May 2024

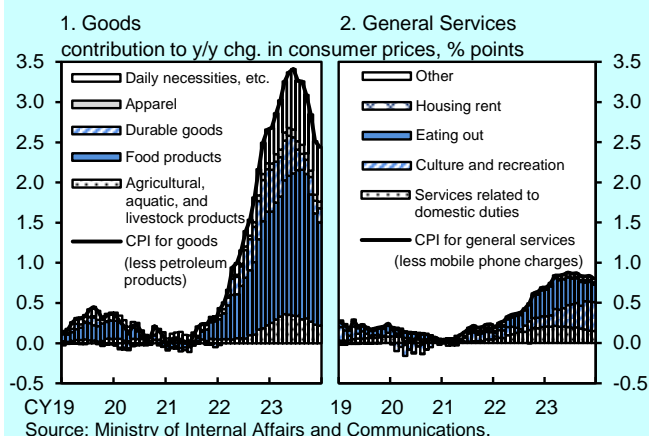
The prices of many items making up the CPI are affected by past significant fluctuations in import prices. As a result, it is not easy to identify upward pressure on prices stemming from the linkage between wages and prices. In this article, a number of different approaches are used to quantitatively measure the linkage between wages and prices. Results of analyses based on cost structures of items making up the CPI and analyses using time-series models suggest that moves to reflect wage increases in output prices are gradually spreading. It is important to determine developments in the linkage between wages and prices by continuously carrying out quantitative analyses from various standpoints including those approaches taken in this article, as well as by conducting qualitative analyses, such as interviews with firms, carefully.

Introduction

The year-on-year rate of increase in the consumer price index (CPI, all items less fresh food and energy) rose significantly through the middle of 2023, mainly in goods, reflecting a substantial rise in import prices since 2021 (Chart 1). Meanwhile, there has been an increase in firms, even those that have maintained a long-standing cautious stance toward raising prices, shifting toward actively raising their output prices (Chart 2).¹ Thereafter, the rate of increase for goods has also been decelerating recently, as upward pressure on costs led by the past rise in import prices has gradually waned. In contrast, the rate of increase for services prices has been rising. With regard to the outlook for prices, according to the Bank of Japan's *Outlook for Economic Activity and Prices*, while the effects of the past rise in import prices are expected to wane further, the linkage between wages and prices is likely to strengthen as labor shortage levels remain elevated, and underlying inflation expected to increase gradually.²

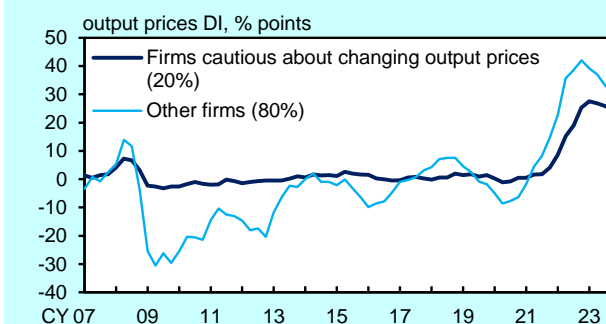
This article examines the effects of cost-push factors due to fluctuations in import prices on recent developments in the CPI. Then, we attempt to quantitatively evaluate changes in firms' wage- and price-setting behavior (such as moves to reflect wage increases in output prices) and look at the extent to which such changes are taking hold using several different approaches. In addition, we conclude with a discussion of the results of the analysis.

[Chart 1] CPIs for Goods and Services



Note: Figures are the contribution to changes in the CPI (less fresh food and energy). Figures are staff estimates and exclude mobile phone charges and the effects of the consumption tax hike, policies concerning the provision of free education, and travel subsidy programs.

[Chart 2] Changes in Firms' Price-Setting Stance

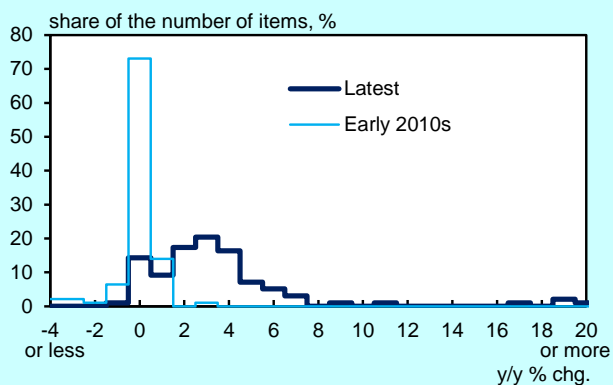


Note: Figures are based on microdata from the *Tankan*. Figures for "firms cautious about changing output prices" are for firms that replied that their output prices were "unchanged" for at least about 95 percent of the period from 1991 to 2019.

Impact of Past Significant Fluctuations in Import Prices

A simple way to identify upward pressure on prices stemming from the linkage between wages and prices, by eliminating impact of past significant fluctuations in import prices, is to focus on the price of services. The wage costs of services account for a high share of output prices and the correlation with wages is high. That being said, the details warrant attention, such as in items like dining out and services related to housing repairs and maintenance where the inflation rate has been increasing in the current phase, due to the strong impact of the past rise in import prices. Indeed, a look at the distribution of changes in the price of services by item shows that the distribution overall has shifted to the right. However, this is partly due to the rise in items such as dining out and services related to housing repairs and maintenance mentioned above (Chart 3).

[Chart 3] Price Change Distribution (General Services)



Source: Ministry of Internal Affairs and Communications.

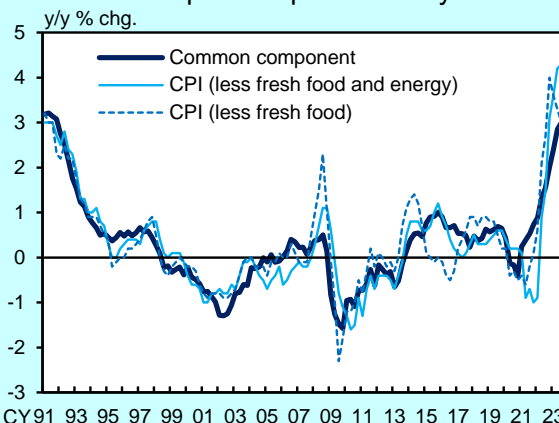
Notes: 1. Figures show the CPI for general services less housing rent.
2. Figures for the early 2010s are as of December 2012 and the latest figures are as of December 2023.

Moreover, in the current phase, an attempt to identify the trend in price developments by extracting a common component across items through principal component analysis only results in developments due to large fluctuations in import prices to be extracted as a common component, causing the trend to rise significantly as with the CPI (Chart 4).³ Similarly, the trimmed mean, the weighted median, and the mode -- all of which are published by the Bank of Japan -- have been rising substantially as many CPI items have been affected by the past rise in import prices.⁴

These points show the difficulty in identifying underlying inflation in a phase like the current one, where prices go up significantly in a broad range of items, stemming from the rise in import prices. In the following sections, we attempt to identify changes in

firms' recent behavior through (1) an approach that focuses on cost structure of each item and (2) an approach based on quantitative analyses using time-series models.

[Chart 4] Common Component Extracted by Principal Component Analysis



Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Ministry of Finance; Bank of Japan.

Notes: 1. Figures for the common component are estimated by principal component analysis using 16 subgroups of CPI series (food, furniture and household utensils, transportation and communication, culture and recreation etc.), 4 wage series (scheduled cash earnings from the *Monthly Labour Survey* and labor cost per employee from the *Financial Statements Statistics of Corporations by Industry*, by manufacturing and non-manufacturing, respectively), domestic supply and demand conditions DI based on the *Tankan* (by manufacturing and non-manufacturing), and the output gap.

2. The CPI figures are staff estimates and exclude the effects of the consumption tax hikes, policies concerning the provision of free education, and travel subsidy programs.

Approach 1: Utilizing Information on Cost Structure

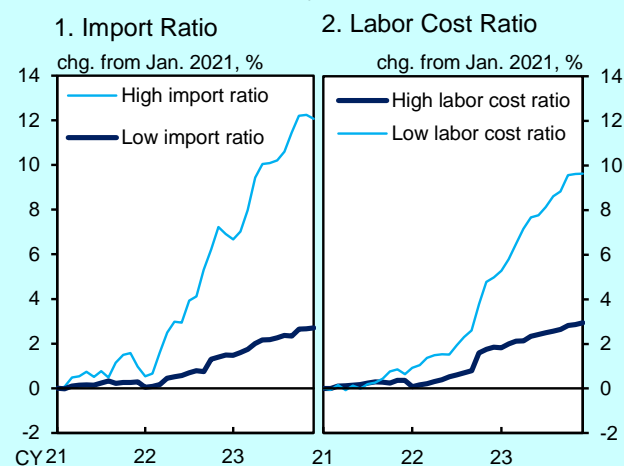
In this approach, we extract CPI items that are (a) not susceptible to the past rise in import prices and (b) where it is easy to identify the spillover from wages to prices, and observe their developments.

First, we focus on the ratio of import costs to total costs. While CPI items with a high ratio of import costs to total costs are strongly affected by the past increase and decrease in import prices, such impact is limited for CPI items with a low ratio of import costs to total costs. Developments in items with a low ratio of import costs to total costs show that though they have been flat, they are now rising moderately to date. This suggests that firms' price-setting behavior has begun to change even for items that are not very susceptible to import prices (Chart 5).

Next, we shift our focus to the ratio of labor costs to total costs. CPI items with a high ratio of labor costs to total costs include many items in the services sector that are not very susceptible to cost-push pressure stemming from import prices. Looking at

developments in those items with a high ratio of labor costs to total costs shows that they have been rising moderately to date, albeit at a relatively limited pace. These developments suggest that wages have been increasing and moves to pass such increases on to output prices have been spreading gradually in items with a high ratio of labor costs to total costs.

[Chart 5] CPI by Cost Structure



Source: Ministry of Internal Affairs and Communications.

Notes: 1. Based on staff calculations using the CPI excluding fresh food, energy, mobile phone charges, and imputed rent.

2. CPI items are matched to the items in the 2015 Input-Output Tables for Japan and grouped in terms of their "total imports coefficient" or the share of "wages and salaries" and other labor costs in the domestic output of those items. Figures in the chart are the weighted averages of the items grouped in the top (bottom) 25 percent.

Approach 2: Utilizing Time-series Models

Analyses using time-series models also show signs of change in firms' wage- and price-setting behavior.

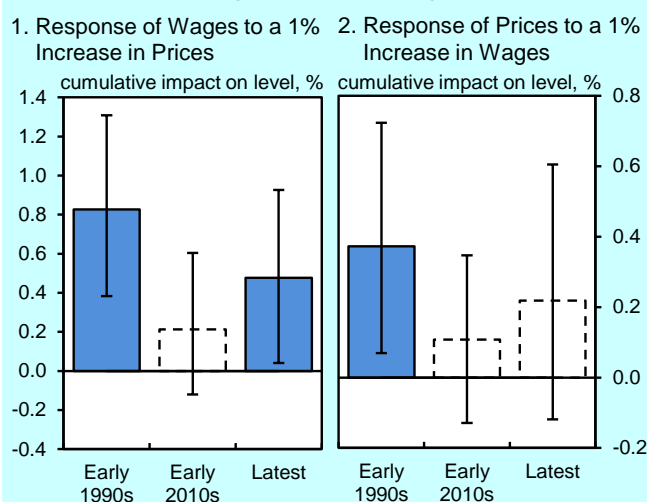
Linkage between Wages and Prices

A macroeconomic assessment of the linkage between wages and prices using a quantitative measure (a time-varying parameter vector autoregression [VAR] model) suggests the possibility that the situation in Japan, in which wages had not shown a significant response to a rise in prices, and vice versa, is beginning to change recently (Chart 6).

First, with regard to spillovers from prices to wages, its elasticity has been increasing recently in a statistically significant manner, although it has not reached the level seen in early 1990s where stable inflation was achieved. Such an increase appears to be reflecting the spread of moves to raise wages at the 2023 annual spring labor-management wage negotiations on the back of, for example, the past price increases. Second, as for spillovers from wages to prices, its elasticity has been increasing recently

compared to the 2010s when both wages and prices had been hovering at around 0 percent. However, statistically significant changes have not been observed at this time. That being said, some changes have been actually observed in firms' behavior, as seen in a gradual increase in the number of firms identifying labor costs as one of the reasons for price increases in anecdotal information and investor relations information from firms.⁵

[Chart 6] Linkage between Wages and Prices



Sources: Ministry of Internal Affairs and Communications; Cabinet Office; Ministry of Health, Labour and Welfare; Bank of Japan.

Notes: 1. Figures show the estimation results of a time-varying parameter VAR model consisting of the output gap, nominal wages, and the CPI (less fresh food). Import prices are added as an exogenous control variable. The CPI figures are staff estimates and exclude temporary factors.

2. Figures are 4-quarter cumulative impulse responses. The bands indicate the 75 percent confidence intervals, while the broken lines indicate that the results are not statistically significant.

3. Figures for the early 1990s are as of 1991/Q2, those for the early 2010s are as of 2012/Q2, and the latest figures are as of 2023/Q3.

In the following section, we attempt to carry out quantitative analyses in two steps using time-series models to identify upward pressure on prices stemming from the linkage between wages and prices.

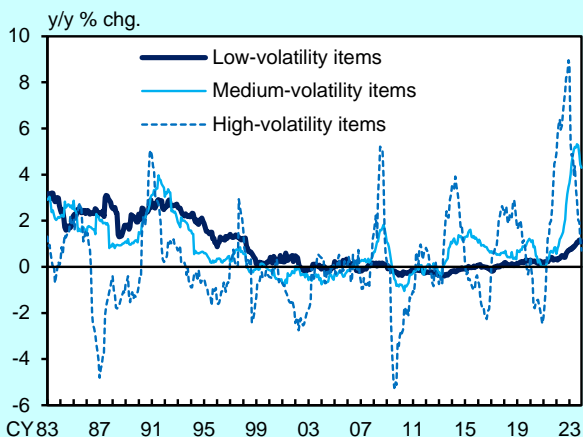
CPI Items by Degree of Price Volatility

First, we classify CPI items into three groups, according to the degree of price volatility measured in the past. We call these three groups "high-volatility items," "medium-volatility items," and "low-volatility items," respectively (Chart 7).⁶

High-volatility items include many commodities that are susceptible to changes in import prices, such as food (for example, "cakes & candies" and "oils, fats & seasonings") and daily necessities (for example, "rolled toilet paper") (Chart 8). Low-volatility items include many services items that are susceptible to changes in labor costs, such as personal care services (for example, haircut charges) and culture and recreational services

(for example, lesson fees for English conversation school). Medium-volatility items include goods whose prices are relatively less volatile, such as clothes and medicines. Based on this classification, in Chart 9, and using VAR analyses, we examine to which shocks -- import prices, output gap, or wages -- each of high-, medium-, and low-volatility items are susceptible.⁷

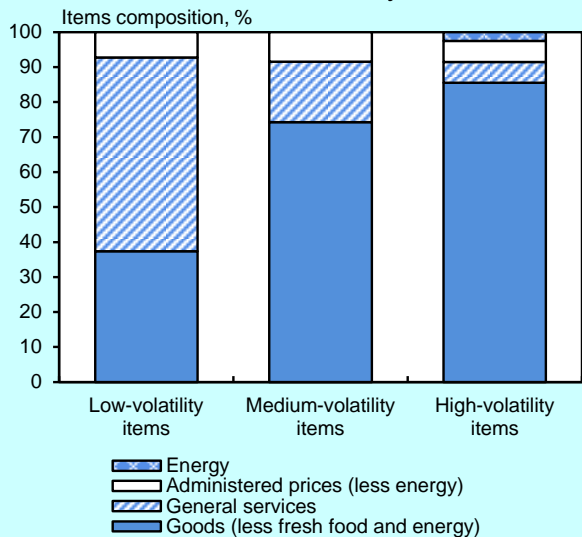
[Chart 7] CPIs by Degree of Price Volatility



Source: Ministry of Internal Affairs and Communications.

- Notes: 1. The CPI items are classified into three groups based on their volatility using long-term time-series data for the CPI (less fresh food).
 2. The CPI figures are staff estimates and exclude mobile phone charges and the effects of the consumption tax hikes, travel subsidy programs, policies concerning the provision of free education, etc.

[Chart 8] Composition of CPI items by Degree of Price Volatility



Source: Ministry of Internal Affairs and Communications.

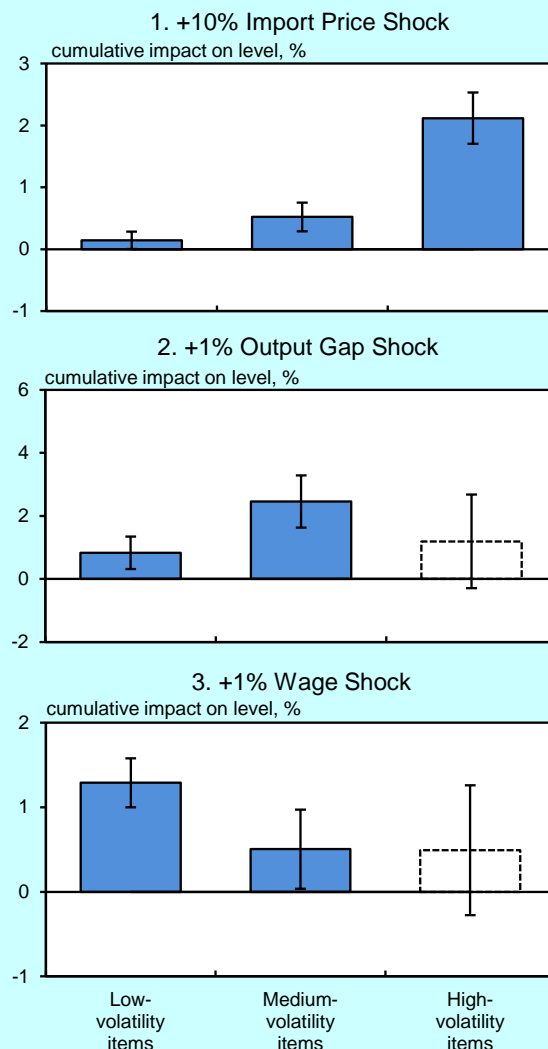
Note: Figures exclude fresh food and mobile phone charges.

As we look at developments in these items and impulse responses, high-volatility items that consist of many goods are not very susceptible to wages, while they tend to fluctuate considerably due to exogenous cost-push pressures such as changes in import prices. Medium-volatility items are susceptible mainly to output gap, as well as to wages and import prices. Low-

volatility items are highly susceptible to wages, as they include many services items.

Accordingly, to assess moves to reflect changes in wages in output prices, it would be useful to focus on developments in low-volatility items. Low-volatility items saw a relatively high level of increase until the 1990s, when the linkage between wages and prices was evident. Their rate of change hovered at around 0 percent thereafter for a long time. Recently, they have begun to rise moderately as the pace of increase in wages has been accelerating gradually. Meanwhile, high-volatility items saw a significant increase reflecting a rise in import prices. Their rate of change, however, has decreased recently, suggesting a waning of the past cost-push pressure.

[Chart 9] Impulse Responses of CPIs



Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Bank of Japan.

Notes: 1. Figures show the estimation results of a 4-variable VAR model comprising import prices (yen basis), the output gap, wages (scheduled cash earnings of full-time employees), and CPI (low-, medium-, and high-volatility). The estimation period is from 1980/Q4 to 2023/Q3.

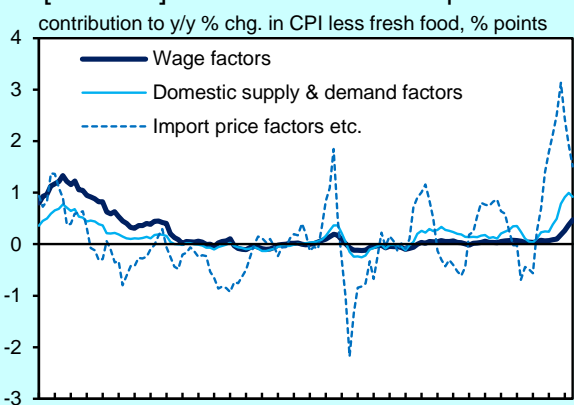
2. Figures are 6-quarter cumulative impulse responses. The bands indicate the 75 percent confidence intervals, while the broken lines indicate that the results are not statistically significant.

Factors in CPI Developments

Second, we attempt to decompose factors affecting the CPI using developments by degree of price volatility and the results of the VAR analyses. Specifically, we conduct the analysis outlined above using rolling VAR models, and using the weight we can obtain from the variance decomposition, we decompose high-, medium-, and low-volatility items into "import price factors," "domestic supply and demand factors," and "wage factors." In Chart 10, we present the total of factors for each group of items.⁸

Results of the analysis show that, while the contribution of the import price factors -- which has previously pushed up the rate of increase of the CPI -- has been decreasing recently, the contribution of the wage factors has been increasing gradually, albeit at a moderate pace. Moreover, as Japan's economy has been recovering moderately, the rate of change of the contribution of the domestic supply and demand factors has been increasing.⁹

[Chart 10] Factors in CPI Developments



Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Bank of Japan.

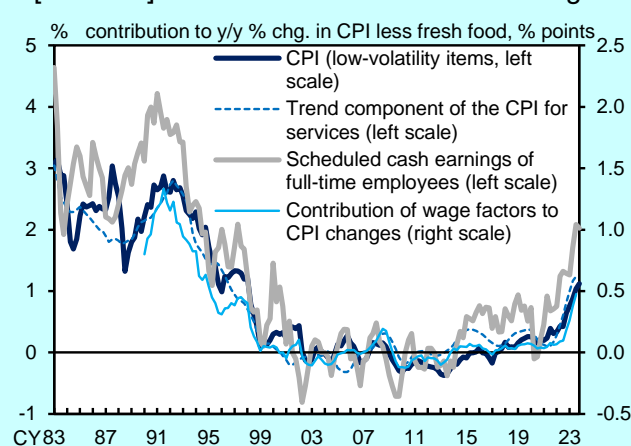
Notes: 1. Figures are estimated using a 4-variable VAR model comprising import prices (yen basis), the output gap, wages (scheduled cash earnings of full-time employees), and price indices for low-, medium-, and high-volatility items in the CPI. The estimates are obtained using 20-year rolling regressions for low-, medium-, and high-volatility CPI items. Figures for import price factors etc. include errors other than wage factors and domestic supply & demand factors.

2. The CPI (less fresh food) are staff estimates and exclude mobile phone charges and the effects of the consumption tax hikes, travel subsidy programs, policies concerning the provision of free education, etc.

Next, we examine the developments in low-volatility CPI items and in the wage factors we obtained from the two steps above (Chart 11). In the chart, we also display the trend in services prices we obtained using a quantitative method.¹⁰ All of low-volatility items, the wage factors, and the trend in services prices have followed similar developments to that in wages, but they have begun to rise recently, coupled with the rise in wages. This suggests that the situation in which wages and prices do not increase easily has been

changing gradually. Going forward, it will be necessary to closely monitor whether the linkage between wages and prices will strengthen and underlying inflation will rise. In addition, considering the results of the analysis of factors affecting the CPI, if the economy continues to recover moderately and the contribution of the domestic supply and demand factors continues to be positive, they are likely to push up the inflation rate.

[Chart 11] CPI and Scheduled Cash Earnings



Sources: Ministry of Internal Affairs and Communications; Ministry of Health, Labour and Welfare; Bank of Japan.

Notes: 1. Figures for low-volatility CPI items and scheduled cash earnings of full-time employees are year-on-year percentage changes, while those for the trend component of the CPI for services are the 6-quarter backward moving averages of annualized quarter-on-quarter percentage changes.

2. Figures for scheduled cash earnings of full-time employees before 1994 are those for regular employees. Moreover, figures from 2016 onward are based on continuing observations following the sample revisions.

3. Figures for the contribution of wage factors to CPI changes are estimated using a 4-variable VAR model comprising import prices (yen basis), the output gap, wages (scheduled cash earnings of full-time employees), and price indices for low-, medium-, and high-volatility items in the CPI. The estimates are obtained using 20-year rolling regressions for low-, medium-, and high-volatility CPI items.

Concluding Remarks

In this article, we attempt to quantify upward pressure on prices stemming from the linkage between wages and prices, such as moves to reflect wage increases in output prices, using various approaches. The results of the analyses using information on cost structure and the analyses using time-series models suggest that moves to reflect wage increases in output prices have been spreading gradually. That being said, it is not easy to identify underlying price developments. In this article, we attempt to eliminate the exogenous impact of the past rise in import prices as much as possible, and grasp the underlying inflation. However, it is hard to say that such an impact has been eliminated completely. For example, attention should be paid to the fact that the results of the VAR analysis in Chart 9 show not only low-volatility items are very susceptible to wages but

they are also affected by import prices, although the impact of the latter is small. Moreover, it is natural to think that if a sustainable rise in wages takes hold in Japan, such a rise would exert some effects on the price setting of medium- and high-volatility items. It is therefore necessary to pay attention to developments in wages and prices of these items.

Based on the above, broad perspective analyses are essential to assess the relationship between wages and

prices and the underlying price developments that could be susceptible to the linkage. It is therefore important to examine upward pressure on prices stemming from the linkage between wages and prices thoroughly by carrying out quantitative analyses from various standpoints, not just the approaches presented in this article, and by conducting qualitative analyses, such as interviews with firms, carefully.¹¹

* This report is an English translation of the Japanese original published in February 2024.

¹ Ikeda *et al.* (2022) analyze firms' price-setting stance using microdata from the *Tankan* (the Short-Term Economic Survey of Enterprises in Japan) and point out that firms that had not changed their selling price-setting stance for a long time have been making changes to their behavior in the current phase. For details, see the article below.

Ikeda, S., T. Kondo, Y. Kurachi, T. Matsuda, and T. Yagi (2023), "Firms' Recent Price-Setting Stance: Evidence from the *Tankan*," Bank of Japan Review Series 2023-E-2.

² See Bank of Japan (2024), *Outlook for Economic Activity and Prices (January 2024)*.

³ The European Central Bank (ECB) extracts the Persistent and Common Component of Inflation (PCCI) from the CPIs of 12 countries in the euro area. The Federal Reserve Bank of New York in the U.S. Federal Reserve System extracts the Underlying Inflation Gauge (UIG) using economic indicators such as the labor market and financial variables such as interest rates, in addition to the CPI and the Producer Price Index (PPI).

Bañbura, M. and E. Bobeica (2020), "PCCI – a data-rich measure of underlying inflation in the euro area," ECB Statistics Paper Series No38.

Amstad, M., S. Potter, and R. Rich (2014), "The FRBNY Staff Underlying Inflation Gauge: UIG," Federal Reserve Bank of New York Staff Reports, No. 672.

⁴ The Bank attempts to identify underlying developments in the CPI through the trimmed mean, the weighted median, and the mode it publishes regularly. They are constructed by automatically excluding the impact of outliers from the distribution of price changes of items that make up the CPI. In the current phase, prices rose in a wide range of items reflecting an increase in import prices. Consequently, these indicators also increased significantly. See the article below for details of the constructing method.

Hogen, Y., T. Kawamoto, and M. Nakahama (2015), "Core Inflation and the Business Cycle," Bank of Japan Review Series 2015-E-6.

⁵ With regard to qualitative information, Box 3 of the *Outlook for Economic Activity and Prices (January 2024)* analyzes firms' comments in the *Economy Watchers Survey* and shows that the number of firms that identified labor costs as one of the reasons for price increases has increased slightly.

⁶ Volatility in the past (standard deviation) is calculated using data from January 1980 through September 2023. CPI items are then classified into three groups so that they are equally divided on a weight basis.

⁷ Shocks are identified by the Cholesky decomposition in the order of import prices, output gap, wages, and the CPI.

⁸ As the degree of the linkage between the CPI and

macroeconomic variables differs depending on the degree of volatility, calculating the contribution separately by the degree of volatility and adding them up allows to calculate a more precise level of contribution.

The results from the calculation using rolling VAR models show that, in recent years, (1) for high-volatility items, the impact (weight) of the import price factors has been increasing reflecting a significant rise in import prices and (2) for low-volatility items, the impact of the wage factors has been increasing gradually amid a moderate recovery in the linkage between wages and prices.

⁹ Recently, the output gap, which the Bank calculates, has been following a moderate improving trend. In this situation, the rate of increase of medium-volatility items which are susceptible to changes in the output gap is a relatively high level and is contributing to an increase in the domestic supply and demand factors as shown in Chart 10. It should be noted that, as each factor is highly susceptible to short-term fluctuations of CPI items, their developments need to be interpreted with considerable margin of error.

¹⁰ The trend in services prices is obtained by calculating and combining a trend that is specific to services prices and a trend common in both services prices and wages, using the methods proposed by Stock and Watson (2016) and Kiley (2023). For the details of the calculating method, see Ueno (2024).

Kiley, M. T. (2023), "The Role of Wages in Trend Inflation: Back to the 1980s?" Finance and Economics Discussion Series (Washington: Board of Governors of the Federal Reserve System), no. 2023-022.

Stock, J. H. and M. W. Watson (2016), "Core Inflation and Trend Inflation," *The Review of Economics and Statistics* 98, no. 4: 770-784.

Ueno, Y. (2024), "Linkage between Wage and Price Inflation in Japan," mimeo.

¹¹ In addition, to monitor price developments appropriately, it is necessary to pay attention to structural changes surrounding prices including de-globalization.

The Bank of Japan Review Series is published by the Bank to explain recent economic and financial topics for a wide range of readers. This report, 2024-E-2, is a translation of the Japanese original, 2024-J-2, published in February 2024. Views expressed are those of the authors and do not necessarily reflect those of the Bank. If you have any comments or questions, please contact Research and Statistics Department (E-mail: post.rsd27@boj.or.jp). The Bank of Japan Review Series and the Bank of Japan Working Paper Series are available at <https://www.boj.or.jp/en/index.htm>.