

Special aggregate index of the Services Producer Price Index (SPPI) based on labor cost ratio

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Focusing on the cost structure of service production activities, this paper reclassifies the Services Producer Price Index (SPPI) based on the labor cost ratio. Services with low labor cost ratio are strongly affected by input goods' prices and market conditions, while services with high labor cost ratio are strongly affected by labor market conditions, as well as wage trends, reflecting the impact of labor costs on overall costs. The "Special aggregate index based on labor cost ratio," which was first included in the SPPI 2020 base index, will help capture the impact of labor costs on the underlying inflation trend of the SPPI.

Introduction

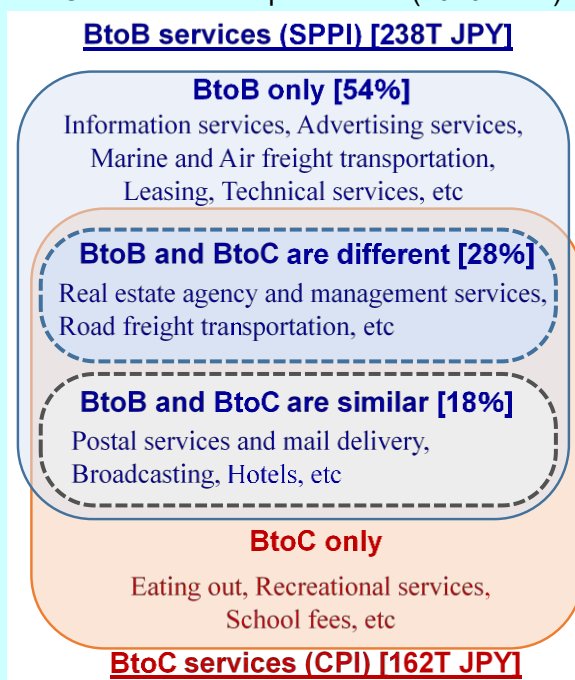
The Services Producer Price Index (SPPI) measures the prices of services provided to businesses. The SPPI reflects supply-demand balance for services provided to businesses, as well as pricing behavior based on the changing costs producer firms face. However, some argue that because of its broad coverage, it is challenging to use the index as an economic indicator, and also to assess factors driving index fluctuations. In other words, similar to the Consumer Price Index (CPI) for services, the SPPI is affected by both input goods' prices and labor costs, which complicates the extraction of underlying inflation trends. Therefore, this paper focuses on the cost structure of services covered by the SPPI to capture the impact of labor costs on the underlying inflation of the SPPI. Specifically, it presents reclassified price indices based on the labor cost ratio.

Services covered by SPPI and their cost

(Services covered by SPPI)

The SPPI is a price index for services provided by businesses to other businesses (business-to-business) (Chart 1). This index is comparable to the global standard "Producer Price Index for Services," but it excludes services provided by producer firms to individuals (business-to-consumer). Therefore, in principle, the SPPI covers services that are not captured by the Consumer Price Index (CPI) of the Ministry of Internal Affairs and Communications, which surveys

Chart 1: The scope of SPPI (2020 base)



Notes: 1. Transaction volume of BtoB services is the total volume of BtoB services (73.6% of which are covered by the SPPI) calculated from Updated Input-Output Table, and that of BtoC services is the volume of domestic household final consumption expenditure of services. Both of them are the average of CY2019 and CY2020 data.

2. The ratio of the SPPI is based on weights of Basic grouping index (2020 base)

Source: Cabinet Office

transaction prices at the consumer level. However, the SPPI covers services that are surveyed by the CPI but are also required by firms (e.g., broadcasting and postal services).

The SPPI covers a wide variety of services. For example, it includes: (i) services that are traded only between companies (B to B only), like "Advertising services" and "Information services"; (ii) those that

provide different services to businesses and households (where B to B and B to C are targeted differently), like "Real estate services" and "Road freight transportation"; and (iii) those that provide similar services to businesses and households (similar targets for B to B and B to C), including services such as "Broadcasting services," "Postal services," and "Hotels".

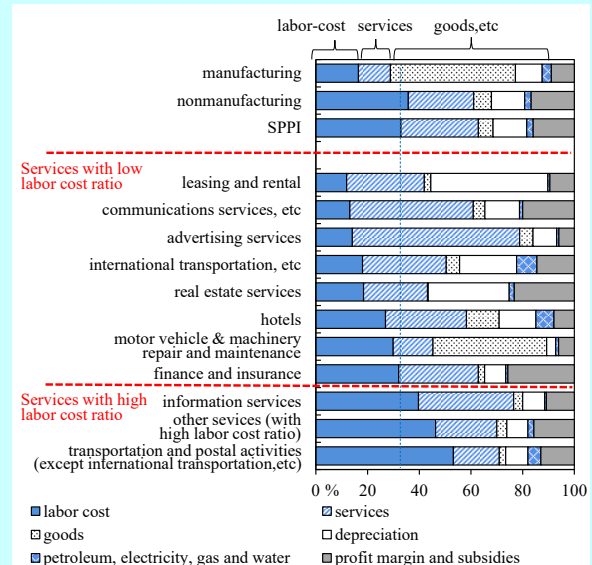
It is well known that the price of services are more difficult to measure than that of goods. Nevertheless, the SPPI has been steadily expanding its survey coverage since Bank of Japan began publishing it in 1991 (with data dating from 1985). Survey coverage, which was initially around 40%, has risen to the mid-70% mark in the 2020 base (including reference indices base). The SPPI publishes a monthly "basic group index" of 146 items (based on 2020). The SPPI also publishes higher-level classification indices, such as the "all items index," which represents a weighted average using the inter-company transaction values calculated from the Ministry of Internal Affairs and Communications' "Input-Output Table."

(Characteristics and cost structure of services covered by SPPI)

Business-to-business prices covered by the SPPI are often determined through direct transactions between firms. Consequently, depending on suppliers' pricing power, these producers frequently set difference prices based on the preferences of the firm which requires the service. It is for this reason that prices covered by the SPPI are considered to be more flexible than household service prices, which are often offered to consumers at uniform prices. In order to assess these price trends, it is important to consider the costs producing firms face as well as the supply and demand conditions. In this regard, it is often pointed out that the ratio of labor costs to overall costs is higher in service production than in goods production. In fact, the cost structure of each industry derived from the "Input-Output Table" shows that the ratio of labor costs to production value is higher in the non-manufacturing industry than in the manufacturing industry (Chart 2)¹.

However, there are significant variations in cost structures among services, based on detailed industry classifications. For example, the following services have a high labor cost ratio in the SPPI: "Information services" provided by system engineers; "Transportation and postal activities" including road freight and passenger transportation (truck transportation, cab, bus, etc.) in which many drivers are

Chart 2: The ratio of labor cost to the output



Notes: 1. This chart is calculated from Updated Input-Output Table in 2019 and 2020 (2015 base). Details are on Box.

: 2. Nonmanufacturing refers to industries classified into "G Information and Communications" to "S Government, except elsewhere classified" in Japan Standard Industrial Classification.

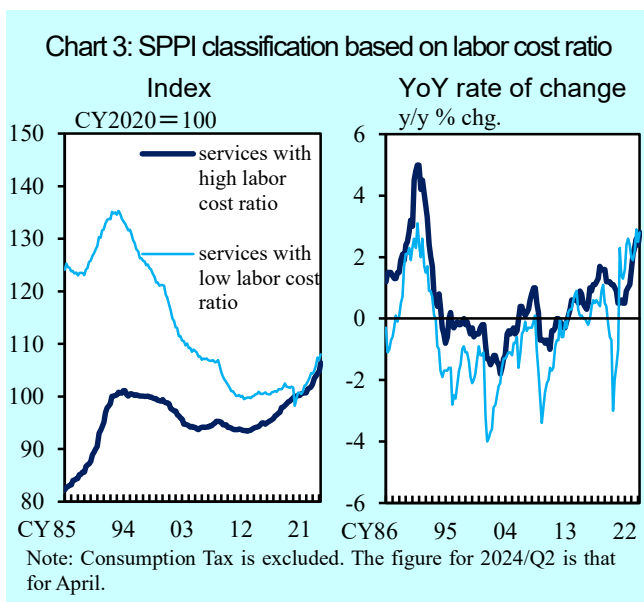
Source: Ministry of Internal Affairs and Communications

involved; "Professional services" including judicial, and accounting services; and "Various services" including security, cleaning, and worker dispatch services. On the other hand, the following services have a higher input ratio of goods and equipment: "Leasing and rental," whose main business is the rental of goods; "Motor vehicle & machinery repair and maintenance" requiring a large input of parts; and "Marine and air transportation" among transportation and postal services, which consumes a large amount of fuel. Thus, there is a variation in the cost structure of services.

Special aggregate index based on labor cost ratio

Therefore, this study reclassifies the SPPI based on cost structures in order to capture price developments from a cost perspective. In this paper, we present 'Special aggregate index based on labor cost ratio' reclassified based on the ratio of labor costs to production value, to capture the impact of labor costs on the SPPI (see Chart 2)². Taking into account changes in the item classification organization from past bases, the services covered by the SPPI are reclassified into 11 categories that can be consistently identified over a long-term time series. The services covered were then reclassified into two groups (services with high labor cost ratio and services with low labor cost ratio) based on the labor cost ratio of the entire SPPI (average for 2019 and 2020: 32.7%).

Looking at the long-term trend of the index, prices for services with low labor cost ratio, such as those for "Leasing and rental" (especially information and communication equipment like PCs) and "Communication services" (including mobile phone and internet access charges for example), showed a significant decline from the early 1990s to around 2010 with fluctuations, reflecting the downward trend in prices of goods offered for these services (Chart 3)³. Subsequently, while experiencing a significant fluctuation due to the COVID-19 pandemic since 2020, prices for services with low labor cost ratio have been on an upward trend since the early 2010s. On the other hand, prices for services with high labor cost ratio peaked in the early 1990s and then declined, similar to prices for services with low labor cost ratio, but at a relatively slower pace. From the early 2000s, they remained generally flat. Subsequently, as with prices for services with low labor cost ratio, they have been on an upward trend since the mid-2010s.



Moreover, when looking at the year-on-year rate of changes, it is more evident that services with low labor cost ratio show larger price fluctuations compared to those with high labor cost ratio. In particular, in 2020 prices for services with low labor cost ratio experienced a significant decline, impacted heavily by the pandemic, while those for services with high labor cost ratio continued to rise, albeit at a slower pace. This demonstrates that even among the services surveyed by the SPPI, there is a significant difference in price fluctuations based on the ratio of labor costs to production value.

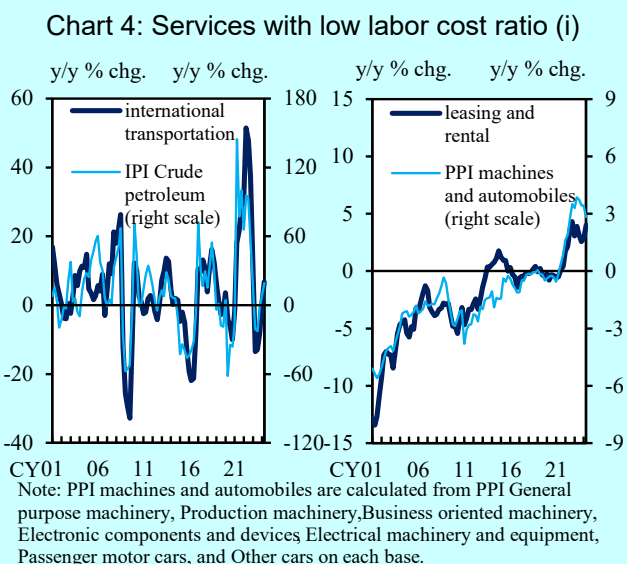
Characteristics of special aggregate index based on labor cost ratio

In order to understand the background behind the differences in trends of the high and low labor cost rate service price indexes, we examine the characteristics of the services classified into each index.

(Factors driving price fluctuations for services with low labor cost ratio)

Firstly, while services with low labor cost ratio, such as those in "International transportation" consisting of ocean tankers, international air freight and passenger transportation are influenced by factors such as fluctuations in transportation demand and supply shocks due to geopolitical events, the price of crude oil, which directly affects fuel costs (Chart 4) has the greatest influence on these prices. In addition, "Leasing and rental" have been significantly influenced by the price trends of leased goods, such as information and communication equipment, machinery, and automobiles, as interest rate fluctuations have been limited in recent years. Similarly, "Motor vehicle & machinery repair and maintenance" is greatly influenced by the prices of automobile parts and machinery used in repair and maintenance. The inflation rate of these services has significantly increased since 2022, reflecting the rise in prices of goods used in these services. However, from the latter half of 2023 onwards, the inflation rate for these services either decreases or levels off, reflecting the stabilization in prices of these goods.

Additionally, among services with low labor cost ratio, there are services that are significantly affected by the market environment they face (Chart 5). For instance, "advertising services," which includes mass

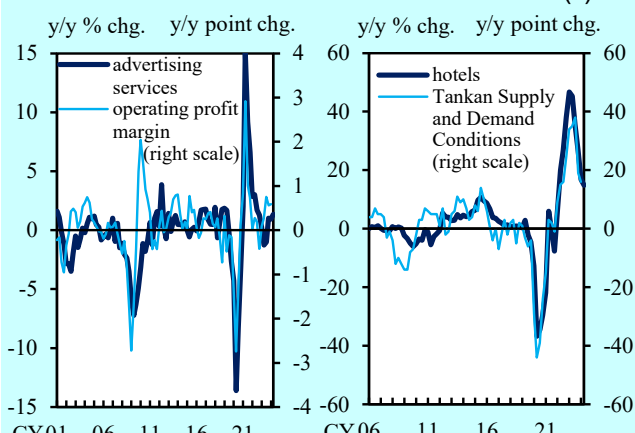


media advertising (television, newspapers, magazines, radio) and internet advertising, is significantly influenced by the financial performance of companies placing the advertisements. Furthermore, "Hotel" services, which covers accommodation prices for corporate travel, often exhibits a price fluctuation linked strongly to supply and demand conditions, as many hotels employ dynamic pricing.

Finally, the year-on-year rate of change in the price of services with low labor cost ratio are decomposed into the sub-groups.

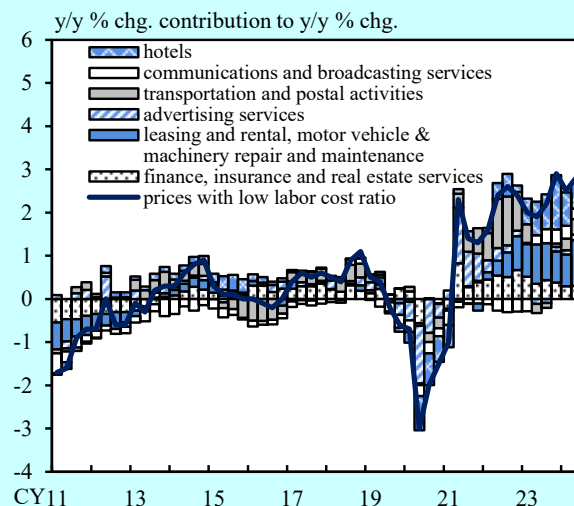
In the 2010s, the price of services with low labor cost ratio showed slight fluctuations as a result of the influence of "Transportation and postal services," which are affected by changes in crude oil prices through fuel costs. However, in 2020, immediately after the spread of COVID-19, the price of services with low labor cost ratio experienced a significant decline, mainly due to factors such as the deterioration of corporate earnings impacting "Advertising services"; "Hotel" services affected by a significant reduction in human traffic, and the decline in crude oil prices impacting "Transportation and postal services" (Chart 6). Subsequently, in 2021, together with a rebound in corporate earnings, the prices for "Advertising services" recovered. In 2022, "Transportation and postal services," including international transportation was affected by a surge in fuel costs due to high crude oil prices, while the increases in prices for "Leasing and rental" and "Motor vehicle & machinery repair and maintenance" was caused by the rising price of input goods. These factors all contributed to the upward pressure on services with low labor cost ratio.

Chart 5: Services with low labor cost ratio (ii)



Note: Operating profit margin is calculated from the Financial Statements Statistics of Corporations by Industry. Hotels excludes the impact of National Travel Support.
Source: Ministry of Finance

Chart 6: Details on Services with low labor cost ratio

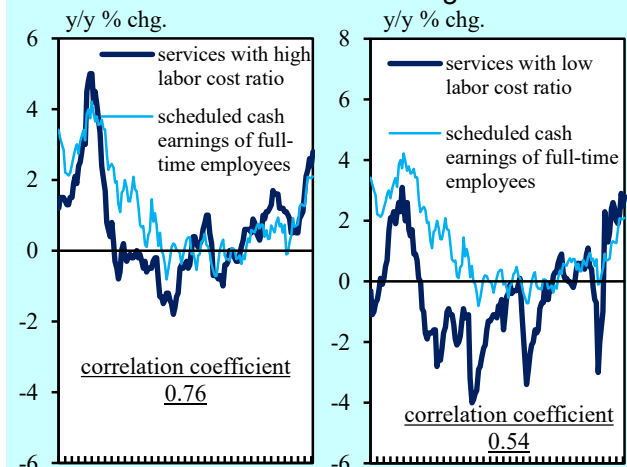


As these examples show, services with low labor cost ratio are often significantly influenced by fluctuations in the price of goods due to the international commodity market and by the market environment they face.

(Factors driving price fluctuations for services with high labor cost ratio)

For the price of services with high labor cost ratio, there is a strong correlation with wages (the scheduled cash earnings of full-time employees), reflecting the high proportion of labor costs (Chart 7). There was a significant growth around the bubble period, but it decelerated sharply afterward. Subsequently, both the price of services with high labor cost ratio and wages showed a certain degree of stability, reflecting the downward wage rigidity. From the mid-2010s, both move into an upper trend. On the other hand, while

Chart 7: SPPI and wage

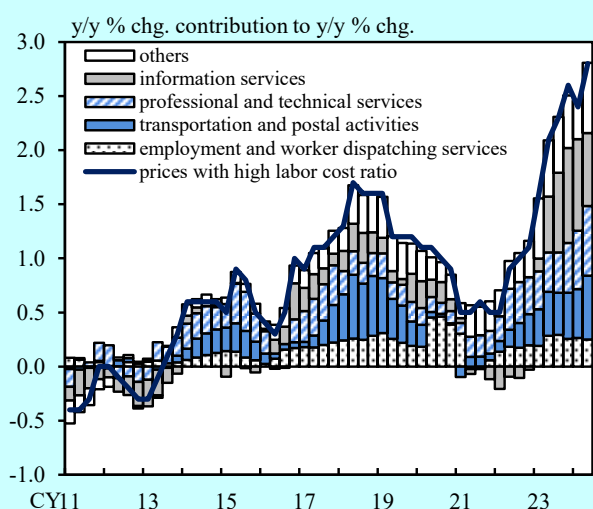


Note: Figures for scheduled cash earnings of full-time employees before 1992 are those for regular employees. Moreover, figures from 2016 onward are based on continuing observations following the sample revisions.
Source: Ministry of Health, Labour and Welfare

there is a moderate correlation between the price of services with low labor cost ratio and wages, the price of such services continued to decline consistently until the mid-2010s. Furthermore, the continued significant fluctuations indicate that the price of services with low labor cost ratio show a greater deviation from wage trends compared to those of services with high labor cost ratio. This divergence between wages and service prices with low labor cost ratio seems to be strongly influenced by the price of input goods and the market conditions, as mentioned above.

When decomposing the year-on-year rate of change in prices of services with high labor cost ratio into sub-groups, it is evident that since the mid-2010s, despite fluctuations, there has been a noticeable expansion in the range of services experiencing price increases (Chart 8). In other words, in the mid-2010s, sectors such as "Transportation and Postal Services," which includes road freight transportation, and "Professional and Technical Services," which includes architectural and civil engineering design service, were the main drivers of an increase in the price of services with high labor cost ratio. Additionally, in the latter half of the 2010s, there were increases in broad sectors such as "Employment and worker dispatching services," and "Others," particularly in security and building services, which have a high number of part-time employees. Thus, in recent years, the price of services with high labor cost ratio have, on average, increased their inflation rates while expanding the range of services.

Chart 8: Details on Services with high labor cost ratio



(Prices for services with high labor cost ratio and employment status)

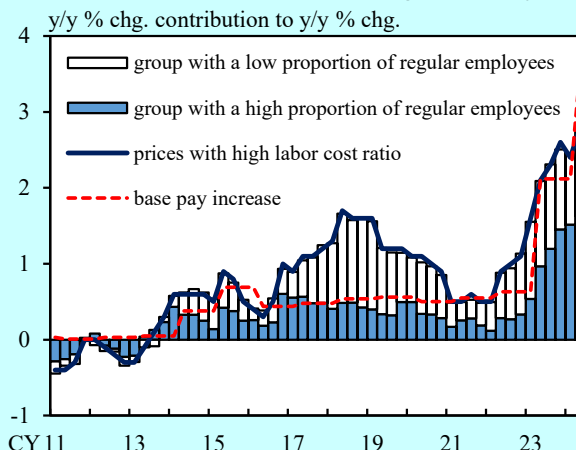
We reclassified the service prices with high labor cost ratio from the perspective of employment status. Specifically, we further classified services with high

labor cost ratio into two groups using industry-specific employment status based on the Ministry of Health, Labor and Welfare's "Labor Force Survey" (i.e., the relative proportion of regular and non-regular employees among those employed). The group with high labor costs and a high proportion of regular employees includes the following: "Information services (such as software development)," "Technical services (such as architectural design, civil engineering design, etc.)," and "Professional services (such as legal and accounting services)." The other group with high labor costs and a low proportion of regular employees includes the following: "Building maintenance and security services (cleaning, facility management etc.)," "Employment and worker dispatching services," "Others (training and development services, health and hygiene, laundry, etc.)," "Road freight and passenger transportation."

Comparing prices of the two service groups, prices for the latter group (with a high labor cost and non-regular employees) are elastic, while prices for the former group (high labor cost and regular employees) are sticky (Chart 9). One of the factors behind these differences is the dual structure of the labor market in Japan, where employment status leads to a clear difference in the ease of wage adjustment and adjustment of the number of employees. That is, wages for part-time and non-regular employees tend to be more elastic than those for full-time and regular employees, and a similar trend is observed in terms of an employment adjustment.

In fact, the year-on-year rate of prices for services with high labor cost ratio and a high proportion of regular employees has maintained a stable positive

Chart 9: Services with high labor cost ratio classified based on a proportion of regular employees



Note: Classified into two groups based on the relative proportion of regular employees among those employed so that weights of each group are roughly equal.

Sources: Central Labour Relations Commission, Japanese Trade Union Confederation

trend even throughout the period of COVID-19 expansion, since the return of a base pay increase in fiscal year 2014. Furthermore, the inflation rate of these service prices has increased further in fiscal year 2023, which saw a significant increase in base pay. The fact that differences in employment status and the wage determination structure leads to differences in prices—even among services with high labor cost ratio—indicates that high labor cost services are a group of services strongly influenced by labor cost trends.

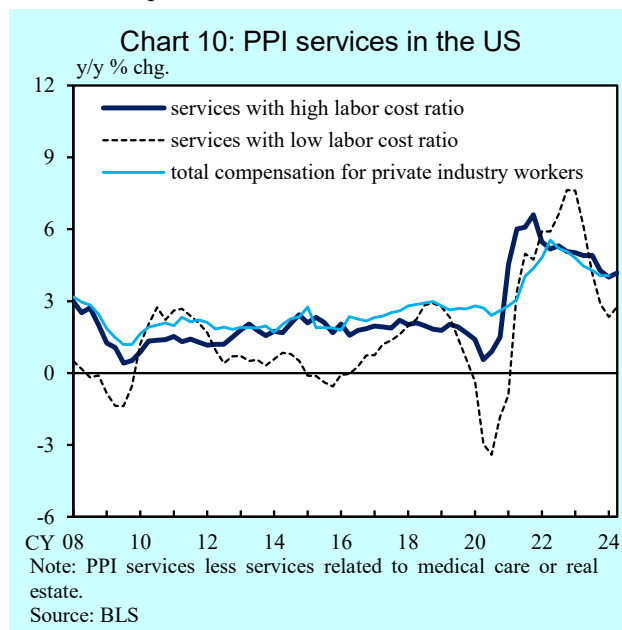
So far, we have examined the relationship between the prices of services with high labor cost ratio and labor costs. It is reasonable to assume that labor costs also have an influence on the price of services with low labor cost ratio to some extent. However, these prices are often influenced by other factors such as the prices of input goods and supply-demand conditions in a service market, which may lead to price fluctuations. On the other hand, the price of services with high labor cost ratio strongly reflect the influence of labor costs. Therefore, reclassifying SPPI based on the labor cost ratio is useful to examine the relationship between labor costs and service prices.

Comparison with service PPIs in other countries

Are the characteristics of reclassifying Japan's SPPI based on the ratio of labor cost inputs commonly observed in the service PPIs of other countries? We calculated price indexes for services of the U.S. PPI, for which data is as extensive as in Japan, by classifying them into two groups by labor cost ratio, based on the U.S. input-output table (Chart 10)⁴. The classification of services based on labor cost ratio in Japan and U.S. follows the same approach, but the composition of services differs due to the differences in the economic structures of the two countries.

From the calculated U.S. PPI for services, the trend is similar to Japan's SPPI, where prices for services with low labor cost ratio show relatively large fluctuations, while prices for services with high labor cost ratio tend to remain stable with small fluctuations. As in Japan, in the United States, prices for services with low labor cost ratio showed a significant decline after the COVID-19 outbreak in 2020, while prices for services with high labor cost ratio remained positive. This trend closely resembles the price dynamics observed in Japan. Additionally, there is a high correlation between prices of services with high labor cost ratio and wage trends, which is also common in both Japan and the United States. That is, after the

global financial crisis, from around 2010 until before the spread of the infectious disease in 2020, while wages continued to grow steadily, the growth of prices for services with high labor cost ratio also remained stable at around 2-3%. However, since 2021, with a significant increase in wages, the inflation rate of service prices has also risen, highlighting a strong correlation between wages and prices for services with high labor cost ratio. Thus, while there are differences in the magnitude of changes in wages and prices, it is common in both Japan and the United States that prices for services with high labor cost ratio show a high correlation with wages among inter-company transaction prices.



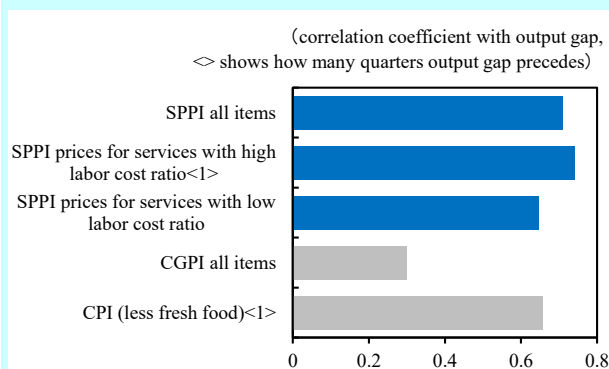
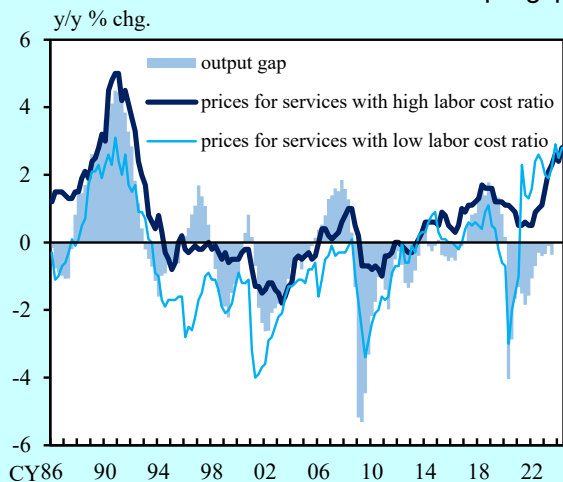
Macroeconomic output gap and SPPI

Thus far, we have focused on the cost aspects of service production, particularly labor costs. Finally, we examine a relationship between the overall economic supply-demand conditions including labor, and the SPPI (Chart 11). The SPPI is known to have a high correlation with the "output gap."⁵ This strong correlation can also be observed in the SPPI classified by the labor cost ratio. Specifically, it is suggested that prices of services with low labor cost ratio respond more quickly to economic fluctuations, while prices of services with high labor cost ratio respond with some lag, through labor supply and wages.

In particular, the price of services with high labor cost ratio show a very high correlation with the "output gap" of the Japanese economy, as they are less directly affected by the prices of goods, including those determined internationally, such as resource prices. This suggests that in the SPPI, the pass-through of labor

costs to prices is relatively smooth compared to the consumption stage. For example, looking at trends in the 2010s, in the first half of the decade, amid negative "output gap" caused by the global financial crisis, prices of SPPI with high labor cost ratio also showed a slight year-on-year decrease. In the latter half of the decade, when the "output gap" turned positive, the inflation rate of SPPI with high labor cost ratio also turned positive and gradually expanded. Particularly in the late 2010s, amid a widening of the positive "output gap", unlike the lack of expansion in the inflation rate of CPI services, the price of services with high labor cost ratio in the SPPI continued to expand their inflation rate. In this context, it is notable that there was a flexible pass-through of labor cost to sales prices in services with high labor cost ratio, particularly those with a high proportion of non-regular employment. This flexibility in pass-through of labor cost to prices is attributable to the dual structure of Japan's labor market, as mentioned above (see Chart 9)⁶. Additionally, this flexibility implies a high correlation between the SPPI and the "output gap".

Chart 11: Correlation between SPPI and output gap



Notes on preliminary SPPI

While we have presented an approach to reclassify SPPI data based on labor cost ratio, it is important to

consider the "timeliness" of SPPI when handling these data. Each month, preliminary SPPI data are published in the last third of the following month, but revisions are possible every month for the next three months. Further delayed revisions are also possible, implemented in September of the following year. For example, over a period when SPPI data are revised in the same manner (since January 2021), the average absolute revision of the all-items index of SPPI is approximately 0.1 points on average, with a maximum absolute revision of 0.3 points. As many services with high labor cost ratio are surveyed based on companies' accounting information, price revisions often observed around the beginning of the fiscal year are frequently reflected later. When evaluating the SPPI, it is necessary to consider that revisions may occur ex post.

Conclusion

This paper reclassifies the SPPI based on labor cost ratio by focusing on the cost structure, and aims to capture the underlying inflation trend of the SPPI. It shows that the prices of services with low labor cost ratio are heavily influenced by the cost of input goods and market conditions. On the other hand, the prices of services with high labor cost ratio are shown to have a high correlation with a wage trend. Furthermore, upon closer examination of the prices of services with high labor cost ratio, prices of services with high proportion of non-regular employees fluctuate, while those with a high proportion of regular employees show a strong correlation with base pay increases, indicating a strong correlation with labor costs.

While the price of services with low labor cost ratio are certainly influenced by labor costs, it is challenging to assess the impact of labor costs based solely on index trends due to the substantial impact of other factors. It should be noted that the price of services with high labor cost ratio can also fluctuate due to factors other than labor costs. However, considering the characteristics presented in this paper, it is useful to focus on the price of services with high labor cost ratio to capture the impact of labor costs on the underlying inflation of the SPPI.

In the 2020 base SPPI, the "Special aggregate index based on labor cost ratio" is published monthly, and the long-term time series data of the SPPI, including this reclassified index, can also be obtained from the website "BOJ Time-Series Data Search." We hope that the "Special aggregate index based on labor cost ratio" can help users capturing the impact of labor costs on the SPPI.

BOX Classification of the SPPI based on labor cost ratio (2020 base)

Services with high labor cost ratio (weight: 538)	Services with low labor cost ratio (weight: 462)
	Major Group “Finance and insurance”
	Major Group “Real estate services”
Major Group “Transportation and postal activities” (S) Road passenger transportation (G) Overland freight transportation (S) Marine cargo handling (S) Packing for freight (S) Services relating to water transport (S) Airport & air traffic control and services relating to air transport (S) Travel arrangement services (G) Third-party logistics services (I) Domestic postal services and mail delivery	Major Group “Transportation and postal activities” (S) Railroad passenger transportation (S) Water passenger transportation (S) Domestic air passenger transportation (S) Coastal and inland water freight transportation (S) Domestic air freight transportation (S) Warehousing and storage (S) Facility services for road transport (R) International transportation (5 items)
Major Group “Information and communications” (G) Information services	Major Group “Information and communications” (G) Communications services (G) Broadcasting services (G) Internet based services (G) Image and character information production
	Major Group “Leasing and rental”
	Major Group “Advertising services”
Major Group “Other services” (G) Sewage and waste disposal (G) Professional services (G) Technical services (G) Employment and worker dispatching services (G) Building maintenance and Security services (S) Training and development services (S) Health and hygiene (S) Call centers (S) Meal supply services (S) Laundry services (S) Sport facility services	Major Group “Other services” (G) Motor vehicle & machinery repair and maintenance (S) Hotels

Note: (G) is Group, (S) is Subgroup, (I) is Item and (R) is Reference

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¹ The labor cost ratio is calculated based on the breakdown of payments for goods (such as components and fuel), services, and labor (employee income) utilized in the production of each sector, as indicated in the "columns" of the input-output tables.

² The weights of services with high and low labor cost ratio are as follows: for the 1985 base year, high:low = 46:54; for the 1990 base year, high:low = 38:62; for the 1995 base year, high:low = 41:59; for the 2000 base year, high:low = 45:55; for the 2005 base year, high:low = 46:54; for the 2010 base year, high:low = 53:47; for the 2015 base year, high:low = 49:51; for the 2020 base year, high:low = 54:46.

³ This paper uses the SPPI data on June 18th, 2024.

⁴ In the reclassification of the U.S. Producer Price Index (PPI) for services in this paper, similar to the SPPI, we have calculated a weighted average using the inter-company transaction amounts in the Input-Output Tables as weights. Therefore, it is necessary to note that the weights used in this calculation differ from those used in the published series of the U.S. PPI, which are calculated using weights at the final and intermediate demand stages (i.e., the calculated indices in this paper are not breakdowns of the U.S. published series).

⁵ It has long been recognized that there is a high correlation between the SPPI and the "output gap." For example, see "The Japanese Economy from the Perspective of the Corporate Services Price Index," Bank of Japan Review Series, 2010-J-8 (available only in Japanese).

⁶ Against the backdrop of the dual structure of the labor market in Japan, it has been noted that in the latter half of the 2010s, as the tightening of labor conditions became more pronounced, the wage growth rate of part-time employees accelerated and the wage growth rate of full-time employees remained modest. For example, see "BOX 3: Dual Structure of the Labor Market and the Outlook for Wages" in the Bank of Japan's Outlook Report (January 2023).

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