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Price Markups and Wage Setting Behavior of Japanese Firms

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Abstract

We estimate price markups and wage markdowns of Japanese firms using a newly constructed dataset of individual firms' financial statements -- which covers about 80 percent of the Economic Census in terms of sales size. We find that Japanese firms have secured profits by increasing markdowns amid a declining trend in markups, which has ultimately led to the stabilization of the labor share in the long run. We also find that this trend has been more pronounced among small firms in the non-manufacturing sector. Comparing our results with the U.S., (1) markdowns have increased in both Japan and the U.S., however, (2) the decline in markups in Japan is in stark contrast to the U.S., where the rise of the so-called superstar firms with strong market power has led to expansions of markups for the whole corporate sector.

JEL Classifications: E24, E31, J30, J42, L12

Keywords: Price markup; Wage markdown; Monopsony; Labor share

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1 Introduction

In recent years, following the methodological progress on the measurement of price markups using firm-level data, measurement of markups has advanced in many countries. In economics, a markup of a firm resembles the gap between its sales price and marginal cost, which reflects the firm's market power in the product market where they sell their products. In the U.S. and Europe, rise of the so-called superstar firms with strong market power has led to expansions of markups and ultimately, declines in labor shares (De Loecker et al. (2020), Autor et al. (2020)). In Japan, in the absence of firms with such strong market power, the situation is different where markups have declined (Nakamura and Ohashi (2019)), and the labor share has been fairly stable in the long run (Fukao (2021)).

Building on the analogy of markups in product markets, recent studies have focused on firms' monopsony power in labor markets. In these studies, a wage markdown of a firm -- the gap between its marginal revenue product of labor (MRPL) and wages -- reflects firm's monopsony power in the labor market.[1] Yeh et al. (2022) measure markdowns of manufacturing firms in the U.S., and find that rises of the aggregate markdown has been a large factor in explaining the declining trend of the labor share. Other studies, focusing on labor markets in developed countries also point to rising monopsony power of firms driven by forces such as declining unionization rates (Akcigit et al. (2021), etc.). In Japan, wages have hardly increased since the 2000s. Some notable explanations for this are given by, for example, the dual structure of the labor market and the severe price competition caused by persistently low inflation (Genda (2017), Fukunaga et al. (2023), Ohashi (2021)).[2] There is also the view that firms' wage bargaining power has strengthened due to not only the decline of the unionization rate but also increasing number of part-time employees who do not belong to unions (Fukao and Perugini (2021)).

Price and wage setting behavior of a firm are not mutually independent of each other. That is, a firm's market power in the product market can depend not only on the firm's price setting stance, but also on its wage setting behavior. Conversely, the wage setting stance of a firm can also be affected by the firm's market power in product markets. Under these circumstances, measuring markups and markdowns in a consistent manner may provide an

[1] The marginal revenue product of labor is how much sales vary with changes in labor input, and includes factors such as productivity.

[2] The dual structure of the labor market is the idea that the wage determination mechanism is viewed as different for regular employees, whose employment is stable, and non-regular employees, whose employment is fluid (Genda (2011), Yamaguchi (2017), Suzuki (2018)).

alternative explanation for why it has been so difficult for firms in Japan to raise prices and wages.

In this paper, we simultaneously estimate price markups and wage markdowns of Japanese firms, using the methodology of Yeh et al. (2022). Furthermore, we discuss relationships between markups and markdowns and their implications for the labor share. A novel feature of this paper is that we estimate markups and markdowns with a newly built firm-level dataset (hereafter referred to as the "DB"), which combines several databases, including those for large firms and small and medium-sized enterprises (SMEs).[3] To the best of our knowledge, this is the first study to estimate markdowns with a production-function approach using firm-level data in Japan, and there have not been cases where markups and markdowns have been estimated simultaneously by including small firms in the non-manufacturing sector.

There are three main contributions of this paper. First, we confirm that markups of Japanese firms have been declining. While this trend is consistent with the results of Nakamura and Ohashi (2019), our estimates of aggregate markups are lower and the magnitude of the decline is larger, partly due to the inclusion of more SMEs in our dataset. In fact, we find that the decline of markups is larger for small firms in the non-manufacturing sector. Declining markups can also be considered as a persistent force for pushing down inflation in Japan. This is consistent with the results of Saito et al. (2012), where they use a DSGE model to decompose developments of inflation in Japan and find that the decline of markups has been a persistent factor for driving down inflation.

Second, wage markdowns of Japanese firms have expanded, which indicates that wages have been suppressed compared to the MRPL. This is consistent with the view that Japanese firms' monopsony power in the labor market has strengthened due in part to the declining unionization rate and the rises in the share of part-time workers who do not belong to unions. Furthermore, the heterogeneity of markdowns among different sectors and firm sizes was found to be large, with the expansion of markdowns being particularly pronounced among small firms in the non-manufacturing sector. We also find a tendency for markdowns to increase in industries where markups have been declining significantly. These results are consistent with the view of Kondo (2017), which argues that in the service sector in Japan, intensifying price competition has suppressed wages and led to labor shortages. A comparison between Japan and the U.S. shows that although both countries

[3] This DB covers about 80 percent of the Economic Census of Activity, an all-inclusive survey of Japanese firms, in terms of the size of firm sales.

share the same characteristic that markdowns have increased, a notable feature of the U.S. could be that wages have been suppressed considerably at superstar firms with high productivity (Autor et al. (2020)).

Third, we find that the long-run stability of the labor share in Japan is due in part to the fact that the effects of declining markups and increasing markdowns have to some extent offset each other. This can be interpreted as a result of firms' efforts to secure profits by holding down wages as markups contracted due to intensifying competition and declining market power. Looking at recent developments, the labor share in Japan has gradually been rising since the mid-2010s, which possibly reflects factors such as an increase in the social security burden borne by firms, and the halt in the rise of monopsony power of firms as the ratio of part-time workers have plateaued (Hoshi and Kashyap (2021), Fukunaga et al. (2023)).[4]

The remainder of this paper is organized as follows: section 2 reviews the related literature; section 3 describes the economic model used for the measurement of markups and markdowns; section 4 provides an overview of the data and the methodology used in the estimation; and section 5 presents our estimation results of markups and markdowns and some additional analysis such as the implications for the labor share. Finally, section 6 discusses the implications for future work and some thoughts on key issues for future price and wage increases in Japan.

2 Related Literature

This paper is related to three strands of literature: measurement of price markups, monopsony in the labor market, and the low price and wage inflation in Japan. In the following, we examine these in turn.

First, following the seminal work by De Loecker and Warzynski (2012), measurement of markup in product market using firm-level data has advanced in many countries.[5] For the U.S., De Loecker et al. (2020) show that aggregate markups have increased, mainly driven by large firms. Similar results are also found for European firms (Kouvavas et al.

[4] Levels and fluctuations of the labor share can vary greatly depending on the data used, calculation method, etc. (see, e.g., Japan Institute for Labor Policy and Training (2023)).

[5] De Loecker and Warzynski (2012) extended the production-function approach of Hall (1986, 1988, 1990) by considering firm cost minimization and addressed the endogeneity issue by applying IV (instrument variable) estimation techniques developed by Olley and Pakes (1996), Lebinsoh and Petrin (2003), and Ackerberg et al. (2015).

(2021)). For Japan, Nakamura and Ohashi (2019) find that markups have been gradually declining since the mid-2000s, and point out that this is mainly due to the absence of superstar firms such as those in the U.S. and Europe.

Second, a number of studies, using data from advanced economies, have pointed to the rising monopsony power of firms in labor markets. IMF (2019) analyzes that the decline in unionization rates in advanced economies has been a dominant factor in explaining the secular decline of the labor share in these economies. Krueger (2018) points out that strengthening of monopsony in the labor market is analogous to a negative productivity shock, where negative shocks to the potential growth rate puts downward pressures on employment and wages. He also points out that weakness of wage growth spills over to low price inflation, which puts pressure on monetary policy to be more accommodative from the perspective of price stability. For the U.S. manufacturing sector, Yeh et al. (2022) show that the labor share has declined significantly due to expansions of labor markdowns. Autor et al. (2020) point out that wages have been suppressed especially at superstar firms which has been a factor in explaining the decline of the labor share in the U.S.[6] Azar et al. (2020) show that about 60 percent of jobs in the U.S. job posting market are occupied by a handful of firms and reported a negative relationship between the degree of concentration of postings and firms' wage offers. Mertens (2022), using firm-level data for the manufacturing sector in Germany, shows an increasing trend of monopsony power in the labor market. In Japan, many studies indicate that the labor share has been stable in the long run (Fukao (2021), Hirakata and Koike (2018)). Fukao and Perugini (2021) mention that the decline in the unionization rate and the rise of non-regular employee ratio have strengthened the bargaining power of firms, putting downward pressure on the labor share. In addition to this, Kawaguchi (2018) finds that in Japan, higher market concentration of temporary staffing providers is associated with lower wage payments to temporary workers.

Third, this paper contributes to the literature on the persistently low inflation (for both prices and wages) in Japan since the second half of the 1990s. In this literature, it is said that firms had hard times raising prices in Japan due to various structural factors, such as the entrenchment of low inflation norms, deregulation, and the rise of emerging economies (Nishizaki et al. (2014), Watanabe and Watanabe (2018)). A leading hypothesis for why

[6] The trend toward a lower labor share in the U.S. has been discussed in terms of the increasing offshoring of labor-intensive industries (Elsby et al. (2013)) and the tendency for wages to be suppressed in superstar firms, which are relatively more likely to benefit from the relative decline in capital goods prices that has accompanied technological progress (Karabarbounis and Neiman (2014), Eggertsson et al. (2021)).

wages have remained sluggish despite the growing concern of labor shortages is given by, for example, the dual structure of the labor market (Kato (2017), Kawaguchi and Hara (2017), Fukunaga et al. (2023)), the rising ratio of part-time workers, and the severity of price competition (Kondo (2017)).[7] In terms of the severity of price competition in product markets, according to a survey of business managers of various countries around the world, Japanese firms had the highest share of those feeling "caught up in competition" (Small and Medium Enterprise Agency (2020)). Related to this issue, Kondo (2017) points out that in the service sector in Japan, intensifying price competition has suppressed wages and led to firm's increased perception of labor shortages.

3 Model

Existing studies that use a production-function approach in measuring price markups do not take into account the heterogeneity in factors of production (De Loecker et al. (2020), among others). In contrast, Yeh et al. (2022) consider an environment in which labor input is heterogeneous, and assume firm's monopsony in labor markets in order to measure firms' wage markdowns. This paper follows their formulation and considers the following economic model.

We assume that firms use labor inputs, intermediate inputs, and capital stock for production. Firms possess monopsony power in the labor market but other factor markets are competitive. Firms supply their products in a monopoly market. Specifically, the production function $F(L_{it}, X_{it}, K_{it})$ for firm i is given by:

$$Y_{it} = A_{it} L_{it}^{\theta^L} X_{it}^{\theta^X} K_{it}^{\theta^K}, \tag{1}$$

where Y_{it} is output, A_{it} is total factor productivity (TFP), L_{it} is labor input, X_{it} is intermediate inputs, K_{it} is capital stock, and θ^k are the output elasticities of production factor k $(k = L, X, K)$.[8]

Household labor supply for firm i (L_{it}) is an increasing function of wage (w_{it}) as:

[7] Such an increase in the ratio of part-time workers is likely to be influenced by the growing uncertainty resulting from the progress of globalization (Kawamoto and Shinozaki (2009)) and the declining importance of firm-specific skills (Asano et al. (2013)).

[8] As noted below, the production function is estimated for specific industries using a five year rolling window. Hence, the output elasticity θ is assumed to be time-varying, but time subscripts are omitted for the sake of brevity.

$$L_{it} = B_t w_{it}^{\varepsilon_{it}^s}, \tag{2}$$

where ε_{it}^s is the wage elasticity of labor supply and B_t is the number of labor participants.

In order to analyze firm *i*'s optimal choice of labor input, let us consider a situation in which firm *i*'s choice of production inputs except labor are optimized (we denote X_{it}^* and K_{it}^* as optimal intermediate inputs and capital stock, respectively). Then the optimal choice of labor input (L_{it}) can be found by solving the following profit maximization problem subject to the households' labor supply curve (2):

$$\max_{L_{it}} \pi(L_{it}) = P(L_{it})Y(L_{it}) - (w(L_{it})L_{it} + P_{it}^X X_{it}^* + r_{it}K_{it}^*)\,.$$

Since the firm has monopoly power in its product markets, the sales price of the firm depends on the amount of their labor input: $P(L_{it})$. Also, the firm has monopsony power in the labor market, so it endogenizes the effect of changing labor input on wages: $w(L_{it})$. In addition, P_{it}^X represents the price of intermediate inputs and r_{it} represents rental rate of capital. The first-order condition with respect to labor input is then expressed as:

$$\frac{dP(L_{it})}{dL_{it}}Y(L_{it}) + P(L_{it})\frac{dY(L_{it})}{dL_{it}} = \frac{dw(L_{it})}{dL_{it}}L_{it} + w(L_{it}). \tag{3}$$

The left hand side of equation (3) is the marginal revenue product of labor (MRPL_{it}). Also, the inverse of the labor supply in equation (2) and its derivative with respect to labor input are given by:

$$w(L_{it}) = \left(\frac{L_{it}}{B_t}\right)^{\frac{1}{\varepsilon_{it}^s}},$$
$$\frac{dw(L_{it})}{dL_{it}} = \frac{1}{\varepsilon_{it}^s L_{it}} w(L_{it}). \tag{4}$$

Substituting equation (4) into equation (3), MRPL_{it} is expressed as:

$$\mathrm{MRPL}_{it} = \frac{1}{\varepsilon_{it}^s} w(L_{it}) + w(L_{it}).$$

We define labor markdown (ν_{it}) as the ratio of marginal revenue product of labor to wages ($\nu_{it} = \mathrm{MRPL}_{it}/w_{it}$). It is expressed as:

$$\nu_{it} = \left(\frac{1}{\varepsilon_{it}^{S}} + 1\right). \tag{5}$$

Next, we consider the cost minimization problem of the firm at the optimal production volume $\bar{Y}_{it}$:

$$\min_{L_{it}, X_{it}, K_{it}} (w(L_{it})L_{it} + P_{it}^{X} X_{it} + r_{it} K_{it}) \qquad \text{s.t.} \qquad \bar{Y}_{it} = F(L_{it}, X_{it}, K_{it}).$$

The first-order conditions with respect to labor input, intermediate inputs, and capital stock are given by:

$$\begin{gathered}\left(\frac{1}{\varepsilon_{it}^{S}} + 1\right) w_{it} = \lambda_{it} \theta^{L} \frac{Y_{it}}{L_{it}}, \\ P_{it}^{X} = \lambda_{it} \theta^{X} \frac{Y_{it}}{X_{it}}, \\ r_{it} = \lambda_{it} \theta^{K} \frac{Y_{it}}{K_{it}},\end{gathered} \tag{6}$$

where λ_{it} denotes the Lagrange multiplier associated with the optimal production constraint, which represents the firm's marginal cost. Defining the price markup as $\mu_{it} (= P_{it}/\lambda_{it})$, based on the first-order condition with respect to intermediate inputs in equation (6), markup is expressed as:

$$\mu_{it} = \theta^{X} \frac{P_{it} Y_{it}}{P_{it}^{X} X_{it}}. \tag{7}$$

Substituting equation (6) and (7) into equation (5), wage markdown ν_{it} is expressed as follows:[9]

$$\nu_{it} = \left(\theta^{L} \frac{P_{it} Y_{it}}{w_{it} L_{it}}\right) / \mu_{it}. \tag{8}$$

In the next section, we measure price markup μ_{it} and wage markdown ν_{it} in (7) and (8)

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[9] In Yeh et al. (2022) and Brooks et al. (2021), the concept of employment markup exists. The price markup does not include the wage markdown, while the employment markup is the price markup plus the wage markdown; specifically, the employment markup is expressed as $\theta^{L} PY/wL$.

from firm-level data.

4 Data and Methodology for Estimating Price Markups and Wage Markdowns

4.1 Data

In order to measure price markups and wage markdowns for the whole corporate sector, it is necessary to increase the coverage of data as much as possible.[10] However, due to lack of data availability, especially those for SMEs, prior studies have limited their scope to large (listed) firms (De Loecker et al. (2020), De Loecker and Eeckhout (2021), Kouvavas et al. (2021), etc.), otherwise focused on a certain industry such as manufacturing (Yeh et al. (2022), Mertens (2021)). An exception is Nakamura and Ohashi (2019), who use firm-level data with 50 or more employees in Japan. However, firms with less than 50 employees account for about 40 percent of the whole economy in Japan.[11]

Against this background, we build a dataset merging several sources spanning from large firms to SMEs in Japan. Specifically, we merge three data sources: (1) the Development Bank of Japan's "Corporate Financial Databank," which covers listed companies (about 2,500 firms per year), (2) the "Basic Survey of Japanese Business Structure and Activities," which covers listed and non-listed companies with 50 or more employees (about 20,000 firms per year), and (3) the "Credit Risk Database"[12] (about 1 million firms per year, hereafter CRD).[13] As a result, the total number of firms in our dataset is approximately

[10] An international comparison of the percentage of SMEs (percentage of firms with 250 or fewer employees) shows that Japan is 52.8 percent, which is higher than the 42.4 percent in the U.S. (OECD (2019)). In this regard, the average size of Japanese firms are smaller, which has raised some concerns that Japanese firms are unable to fully enjoy scale merits, leading to severe competition (Ohashi (2021)). In light of these concerns, it is desirable to capture SMEs when estimating markups and markdowns for Japan.

[11] Firms with less than 50 employees account for about 40 percent of the economy (Economic Census, 2016).

[12] The CRD is a database that consolidates financial information collected from credit guarantee associations and financial institutions.

[13] When merging the three databases, duplicate firms are removed using stock market codes and firm names. In addition, although almost all firms in the data for SMEs have reported figures for total sales and expense, about 30 percent of firms lack some information in the details of cost items. In order to capture the macroeconomic structure of the economy as much as possible, we interpolate these missing values, using the information obtained from other firms in the same sector. Specifically, for each of the medium classifications of the Japan Standard Industrial Classification (104 sectors in total), we calculate the ratios of individual items in cost of sales and SG&A expenses using the information obtained from firms with detailed information. If a firm in an industry has a missing item, we multiply the total amount of top-line costs (cost

2.7 million for the entire sample period. The coverage of our DB is more than 80 percent of the "Economic Census" (Figure 1) -- which is an all-inclusive survey of the whole corporate sector conducted every five years in Japan -- in terms of sales volume. The distributions of firm size, the number of employees, and the number of firms are similar enough to those of the Economic Census, therefore our DB captures the characteristics of the Economic Census reasonably well at an annual frequency.

A notable feature of our database is the use of the CRD, which covers mainly SMEs in Japan. The CRD includes firm-level financial statements from 2002 onward and has information on firm characteristics (industry classification, etc.), income statements, and balance sheet information. For income statements, in addition to total sales and operating income, details of cost of sales and SG&A expenses (Selling, General, and Administrative Expenses such as labor costs) are available. Therefore, as in other DBs, variable costs of firms can be divided into intermediate inputs and labor inputs. In estimating the production function, nominal variables are transformed to real variables using industry-specific deflators, etc. (De Loecker et al. (2020), De Loecker and Eeckhout (2021), Kouvavas et al. (2021), Yeh et al. (2022)).[14]

4.2 Estimation Method

In this section, we present details of the production-function approach we use to estimate price markup μ_{it} and wage markdown ν_{it} (De Loecker and Warzynski (2012), De Loecker et al. (2020), Autor et al. (2020)). Specifically, we take the logarithm of firm *i*'s production function (1) and estimate the following equation:

of sales or SG&A) with these ratios. In order to check whether this operation has led to any sort of bias, we checked if there is a significant difference in the cost ratios between companies with low and high response rates (e.g., missing items in some periods). As a result, we find no statistical difference in the ratios of detailed cost items. In addition, the number of samples obtained for each sector is reasonably large, so this type of interpolation works well under the law of large numbers.

[14] All nominal variables are transformed to real variables by the deflator of the industry to which the firm belongs. Details are as follows: real output (Y_{it}) is nominal sales ($P_{it}Y_{it}$) divided by the value-added deflator; real intermediate goods input (X_{it}) is nominal intermediate goods costs ($P_{it}^X X_{it}$: cost of sales - rents - labor - taxes and dues) divided by the intermediate input deflator; real labor input (L_{it}) is labor cost ($w_{it}L_{it}$) divided by total cash wages per hour (by industry from the monthly labor statistics); and capital stock (K_{it}) is total fixed assets ($P_{it}^K K_{it}$) divided by capital investment deflator. Industry classification is based on the major categories of the Japan Standard Industrial Classification (excluding fishing industry, financial and insurance industry, and multiple services; wholesale and retail industry are broken down into two categories).

$$y_{it} = \theta_t^L \ell_{it} + \theta_t^X x_{it} + \theta_t^K k_{it} + a_{it} + \epsilon_{it}$$

where y_{it}, l_{it}, x_{it}, k_{it} and a_{it} are the logarithmic values of real output, real labor input, real intermediate inputs, real capital stock, and total factor productivity, respectively. ϵ_{it} is a white noise measurement error, and the sum of a_{it} and ϵ_{it} is assumed to follow an AR (1) process. In terms of the timing convention, we assume that firm i observes total factor productivity a_{it} at the beginning of the period, before determining its labor input and intermediate goods input. In this setting, an endogeneity problem arises; therefore we follow the literature and estimate the equation by a two-stage least squares method using real capital stock of the current period and the one-period lag of each factor of production as instrument variables (De Loecker et al. (2020)). Estimation is conducted in a five-year rolling window for each industry.[15] Sectoral aggregation is done by using nominal intermediate cost weights for markups and labor cost weights for markdowns. See Appendix A.1 for a discussion on addressing measurement biases that may arise from observation errors, resulting from missing details of cost items.

5 Estimation Results

In this section, we report our estimation results of price markups and wage markdowns in Japan, and analyze their relationships between the two as well as implications for the labor share.

5.1 Price Markups

Our estimates of price markups of Japanese firms have a declining trend. This suggests that Japanese firms' market power in product markets have weakened and the competition among firms has become more severe (Figure 2). Aggregate figures show that in cumulative terms, markups have declined at an annual pace of approximately 1 percent from fiscal year 2005 to fiscal year 2020. We find that the degree of the decline is especially large for small firms in the non-manufacturing sector (e.g., transport and postal services;

[15] Industry classification in the estimation is based on the major categories of the Japan Standard Industrial Classification (we distinguish between wholesale and retail trade sectors), and output elasticity is estimated for each sector. We follow Yeh et al. (2022) and use a five-year period as the rolling window in order to adjust for shifts in TFP. In addition, the estimation equation includes a constant term.

accommodations, eating and drinking services; and construction) (Figures 3 and 4).[16] Comparing our estimates with existing studies, such as De Loecker and Eeckhout (2021), which focuses on large firms, and Nakamura and Ohashi (2019), which covers firms with 50 or more employees, our estimates of markups are lower and the degree of decline is larger. Our lower estimates of markups may result from the fact that our dataset has much larger coverage of small firms compared with theirs.[17] As mentioned in Uesugi (2022), the reason for the larger reduction in price markups for small firms may be due to their larger indebtedness, which limits their activities for improving their products and services, and ultimately, manifesting in incentives for price competition.

Developments of markups in Japan are in stark contrast with those for the U.S. That is, markups in the U.S. have been rising (De Loecker et al. (2020)), while those in Japan have been on a declining trend (Nakamura and Ohashi (2019)). The decomposition exercise of markups by De Loecker and Eeckhout (2021) is informative in understanding the differences in trend between the two countries. In their paper, first-order variations of markups are mainly divided into two components: the "within-firm" effect -- contributions of changes in individual firms -- and the "reallocation" effect -- contributions of composition of firms. According to their paper, markups have increased in the U.S., mainly due to the reallocation effects, that is, increases in weights of some firms with large markups (i.e., superstar firms).[18] We conduct this breakdown for Japan, which shows that, contrary to the U.S., the reallocation effects have pushed down markups in Japan, while the within-firm effects have made an even larger negative contribution (Figure 5). This suggests that there are less firms with strong market power in Japan than in the U.S., and the decline of markups is an economy-wide phenomenon for firms in Japan. In terms of the relationship between the degree of concentration and markups, indicators of concentration such as the Herfindahl-Hirschman-Index has increased in both Japan and the U.S. (Ohashi (2021), Autor et al. (2020)). However, some studies argue that, in the face of a declining population, the decline of markups has been influenced by the fact that Japanese firms had hard times raising their prices since this would reduce demand for their products through a relative price channel (Ohashi (2021)).

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[16] As for differences in price markups across industries, the level of price markups in the manufacturing sector is larger than in the non-manufacturing sector, in part because of the cost containment benefits of overseas production. This characteristic is also observed in previous studies (e.g., Nakamura and Ohashi (2019)).

[17] Nakamura and Ohashi (2019) estimates of price markups (LP1) are around 1.20 for the average of all industries, 1.25 for manufacturing, and 1.18 for non-manufacturing (as of 2016).

[18] See Appendix A.2 for details on the analytical methodology of De Loecker and Eeckhout (2021).

Changes in markups also have implications for price inflation. The downward trend of markups in Japan has likely served as downward pressure on inflation. In this regard, results from macro model analysis are informative, which report that negative markup shocks have continuously pushed down inflation in Japan (Saito et al. (2012), Hasumi et al. (2018), Hogen and Okuma (2018)). Among them, Saito et al. (2012) report that the decline in markups has pushed down inflation rate by about -1 percentage point per year from the mid-1990s to the mid-2000s. Our estimates of markups have declined by approximately 25 percent from 2005 to 2020, which is quantitatively close to their results. This suggests that the deflationary effect of the declining markups has continued since the mid-2000s and supports Saito et al. (2012)'s results from a firm-level perspective. Put differently, our results are consistent with a view that firms have long been conscious of the behavior of their competitors, making it difficult for them to pass on higher costs to consumer prices for their fears of losing their customers (Kuroda (2022), Ikeda et al. (2023)).

5.2 Wage Markdowns

Second, wage markdowns of Japanese firms have been rising, which indicates that wages have been suppressed compared to the MRPL (Figure 6). At the aggregate level, markdowns have increased cumulatively by about 10 percent from fiscal year 2005 to fiscal year 2020. Changes in the non-manufacturing sector (15 percent) are twice as large as those in the manufacturing sector (7 percent).

There are several things to note about sector specific results. First, in the manufacturing sector, markdowns have been rising more for firms with less than 100 employees (Figure 7). This tendency may reflect intensifying competition in SMEs product markets (Forbes (2019), Auer et al. (2017)). In this regard, the Trade in Value Added (TiVA) statistics published by the OECD suggest that in recent years, Japanese firms producing high value-added intermediate goods, are facing tough competitions against firms in China and other countries (Saito (2019)). This suggests that competition of Japan's SMEs with overseas firms has intensified, and this may have led firms to secure profits by increasing wage markdowns.

Second, results for the non-manufacturing sector show that expansions of markdowns are relatively larger for small firms (Figure 7). In addition, markdowns have increased in industries with larger decline in markups (e.g., transport and postal services; accommodations, eating and drinking services; and construction) (Figure 8). These results are consistent with the view that wage growth has been suppressed in the service sector due to severe price competition (Kondo (2017), Fukao and Perugini (2021)).

To take a closer look at the trends of each sector, we use the formula for markdowns ($\nu_{it} \equiv \text{MRPL}_{it}/w_{it}$) to decompose its variations into MRPL and wages. The decomposition results show that in the wholesale and retail trade and other sectors, markdowns have increased significantly as wages have been suppressed relative to rises of the MRPL, which reflects factors such as productivity growth (Figure 9). In the construction industry, wage growth has been relatively higher due to tight labor market conditions, but is far less than the increase of MRPL. On the other hand, the trend of MRPL in living-related and personal services and amusement services differs from other sectors, which is consistent with the observation that productivity growth has been relatively sluggish due to delays of labor saving investments and firm consolidations (METI (2022)).

Finally, firms in Japan and the U.S. share the same characteristic that wage markdowns have increased (Yeh et al. (2022)). In the U.S., it is argued that wages have been suppressed considerably relative to earnings at superstar firms (Autor et al. (2020)). In light of the factor decomposition framework, their finding imply that the reallocation effects are dominant in explaining the expansion of markdowns. We conduct a decomposition of markdowns for Japanese firms, which shows that the contribution of the reallocation effects is small, where the main driver is within-firm effects (Figure 5). These results suggest that markdowns are increasing in Japan across a wide range of firms. The reallocation effects are small in Japan than in the U.S. maybe because there are less superstar firms, or because labor market mobility is lower (Fukunaga et al. (2023)).

5.3 Relationship between Markups and Markdowns

This section investigates a relationship between price markups and wage markdowns in Japan.

First, a scatterplot of firm-level estimates shows a negative correlation between markups and markdowns in terms of both level and cumulative changes (Figure 10). Mertens (2022) finds a similar negative relationship in German data and argues that this relationship can be explained by a "rent-sharing" model. According to this class of models, firms with large (or increasing) markups share their extra rent with their employees, which results in smaller (shrinking) markdowns. Such mechanism can be also at work among Japanese firms.

Next, we investigate firm-level heterogeneity of markdowns by using a variance decomposition method. Taking the logarithm of the markdown expressed in equation (8), markdown of a firm can be written as follows:

$$\ln \nu = \ln \theta^L + \ln \frac{PY}{wL} - \ln \theta^X \frac{PY}{P^X X},$$

where $\ln(\theta^L)$ on the right-hand side is the "output elasticity factor," $\ln(PY/wL)$ is the "labor cost ratio factor ($\ln(\alpha)$)," and $\ln\left(\theta^X \frac{PY}{P^X X}\right)$ is the "markup factor ($\ln(\mu)$)."[19] Taking the variance of this expression, the variation of markdowns $\mathrm{Var}(\ln(\nu))$ across firms can be expressed as:

$$\mathrm{Var}(\ln(\nu)) = \mathrm{Var}(\ln(\theta^L)) + \mathrm{Var}(\ln(\alpha)) + \mathrm{Var}(\ln(\mu))$$
$$-2\left[\mathrm{Cov}(\ln(\theta^L), \ln(\alpha)) - \mathrm{Cov}(\ln(\theta^L), \ln(\mu)) + \mathrm{Cov}(\ln(\alpha), \ln(\mu))\right].$$

The decomposition results are shown in Figure 11 which shows that variations of markups have a significant impact on variations of markdowns across firms in Japan. In other words, this result suggests that firms with weaker market power in product markets are more likely to suppress wages through markdowns. On the contrary, Yeh et al. (2022) report that, in the U.S. manufacturing sector, the severity of the competitive environment in product markets is not tightly linked to markdowns. Although further investigation is needed, one possible interpretation of these results is that this may reflect changes in Japan's position in the global value chain, where existing firms are facing tougher competition with emerging economies compared to the U.S. Under such environment, workers in Japan might accept larger markdowns in favor of job security amid high level of competition.

5.4 Implications for the Labor Share

Finally, we draw some implications of the changes in markups and markdowns for the labor share (Yeh et al. (2022)).

Our measure of the labor share (labor costs / value added) calculated from our DB shows a similar patterns to those calculated from the official statistics: "Financial Statements Statistics of Corporations by Industry (Ministry of Finance)." This confirms that our DB built from firm-level data, replicates these official statistics fairly well (Figure 12(1)). Japan's labor share has been stable in the long run, but has been rising since the mid-2010s, mainly due to the impact of economic downturns (Cabinet Secretariat (2021), Fukao

[19] Estimates cover all companies from fiscal year 2005 to fiscal year2020.

(2021), Hirakata and Koike (2018)). In the following, we take a deeper look at the relationship between the labor share, markups, and markdowns.

Taking the inverse of the macro labor share (η_t), we obtain:

$$\begin{aligned}\eta_t^{-1} &= \sum_{i=1}^{N_t} \frac{P_{it}Y_{it} - P_{it}^X X_{it}}{\sum_{j=1}^{N_t} w_{jt}L_{jt}} \\ &= \sum_{i=1}^{N_t} \left(\frac{P_{it}Y_{it}}{w_{it}L_{it}} - \frac{P_{it}^X X_{it}}{w_{it}L_{it}}\right)\left(\frac{w_{it}L_{it}}{\sum_{j=1}^{N_t} w_{jt}L_{jt}}\right),\end{aligned} \tag{9}$$

where $\sum_i P_{it}Y_{it}$ is nominal sales, $\sum_i P_{it}^X X_{it}$ is the cost of intermediate inputs, $\sum_i w_{it}L_{it}$ represents labor costs, and N_t represents the number of firms at time t. Using equations (7) and (8), $P_{it}Y_{it}/w_{it}L_{it}$ and $P_{it}^X X_{it}/w_{it}L_{it}$ in equation (9) can be written as:

$$\frac{P_{it}Y_{it}}{w_{it}L_{it}} = \left(\theta^L \frac{P_{it}Y_{it}}{w_{it}L_{it}}\right) \Big/ \left(\theta^X \frac{P_{it}Y_{it}}{P_{it}^X X_{it}}\right) \cdot \frac{1}{\theta^L}\left(\theta^X \frac{P_{it}Y_{it}}{P_{it}^X X_{it}}\right) = \nu_{it}\frac{\mu_{it}^X}{\theta^L},$$

$$\frac{P_{it}^X X_{it}}{w_{it}L_{it}} = \left(\theta^L \frac{P_{it}Y_{it}}{w_{it}L_{it}}\right) \Big/ \left(\theta^X \frac{P_{it}Y_{it}}{P_{it}^X X_{it}}\right) \cdot \frac{\theta^X}{\theta^L} = \nu_{it}\frac{\theta^X}{\theta^L}.$$

Substituting these equations into (9), the inverse of the labor share (η^{-1}) can be expressed as a function of markup (μ_{it}), markdown (ν_{it}), output elasticity (θ_t^L, θ_t^X), and wages (w_{it}) as follows:

$$\begin{aligned}\eta_t^{-1} &= \sum_{i=1}^{N_t} \left(\nu_{it}\frac{\mu_{it}}{\theta^L} - \nu_{it}\frac{\theta^X}{\theta^L}\right)\left(\frac{w_{it}L_{it}}{\sum_{j=1}^{N_t} w_{jt}L_{jt}}\right) \\ &= \sum_{i=1}^{N_t} \nu_{it}\left(\frac{\mu_{it} - \theta^X}{\theta^L}\right)\left(\frac{w_{it}L_{it}}{\sum_{j=1}^{N_t} w_{jt}L_{jt}}\right).\end{aligned}$$

Therefore, the labor share (η) can be expressed by taking the inverse of this expression:

$$\eta_t = \left[\sum_{i=1}^{N_t} \nu_{it}\left(\frac{\mu_{it} - \theta^X}{\theta^L}\right)\frac{w_{it}L_{it}}{\sum_{j=1}^{N_t} w_{jt}L_{jt}}\right]^{-1}.$$

Here, we refer to factors that involve ν_{it} as "wage markdown factors," μ_{it} as "price markup factors," and others as "weight factors, etc."

The decomposition of the labor share (η_t) is shown in Figure 12(2). The figure suggests that the labor share has been stable over time because the effects of declining price markups and those of increasing wage markdowns have offset each other. The labor share in Japan has gradually been rising since the mid-2010s, which possibly reflects factors such as an increase in the social security burden borne by firms, and the halt in the rise of monopsony power of firms as the ratio of part-time workers has plateaued (Hoshi and Kashyap (2021), Fukunaga et al. (2023)).

It is also worth noting that developments of the labor share has a one-to-one correspondence with developments of the corporate profits on an operating income basis (1 - labor share) (Figure 13).[20] In fact, looking at the profit margins (as a percentage of value added) of Japanese firms, while the operating profit margin has remained flat over the long term, the ordinary profit margin has reached all-time highs in recent years. The reason for the operating profit margin being flat is in parallel to the discussion of the labor share; the expansion of markdowns has offset the downward pressure on earnings caused by the contraction of markups. In addition, factors such as increasing net receipts of income from abroad, which are not explicitly modeled in this paper, are likely to have had an impact on pushing up the ordinary profit margin.[21]

6 Conclusion

In this paper, we examine the price and wage setting behavior of Japanese firms by simultaneously estimating price markups and wage markdowns by using firm-level data. A unique feature of our study is that we expand the data coverage as much as possible and construct a new big dataset, which covers about 80 percent of the "Economic Census" in terms of sales, at an annual frequency.

First, we find that price markups of Japanese firms have declined, and that the competitive environment has become severe, especially for small firms in the non-manufacturing sector. This contraction in markups can be viewed as putting downward pressure on inflation. Second, our results suggest that Japanese firms have secured their earnings in this competitive environment by increasing wage markdowns. In particular,

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[20] See, e.g., Macallan et al. (2008) for a discussion of the relationship between price markups and firm earnings.

[21] This is also confirmed by a similar decomposition as we did for the labor share.

markdowns have been particularly large for small firms in the non-manufacturing sector. The declining markups is a unique feature of Japanese firms, in contrast to the U.S. and Europe.

There are some remaining issues to be addressed for future research. The first is to extend the economic model by allowing price elasticity of demand for goods and the wage elasticity of labor supply to vary (Matsuyama and Ushchev (2017)). Such an extension may enable to analyze how markups and markdowns are related to the number of firms and other factors. Second, it would be useful to look at how demographic changes affect markups and the relationship between markdowns and the degree of market concentration in the labor market. Third, it would be useful to consider how the strengthening of monopsony in the labor market affects the transmission mechanism of monetary policy, as pointed out by Krueger (2018). Fourth, it may be worthwhile to use methods other than the production-function approach to estimate markups and markdowns. While the production-function approach has the advantage that estimation of markups and markdowns are not dependent on particular assumptions for firms' pricing decisions, it cannot fully characterize the economic mechanism behind variations in markups and markdowns. Therefore, as pointed out by Ohashi (2021), an alternative approach, such as those using a demand function approach, which estimates elasticity of households' demand faced by firms, could provide a more structural view on the developments of markups.

Finally, there are two additional points of our analysis, given the recent environment surrounding prices and wages in Japan.

First is the possibility that firms' price and wage setting stances may be changing. The year-on-year growth rate of the CPI in Japan has been rising, albeit not to the same extent as in the U.S. and Europe, and has reached the highest level in about 40 years by the end of 2022. As Ikeda et al. (2023) point out, there are signs of a change in the pricing behavior of firms as costs are rising more significantly. In this sense, there is a possibility that the trend of declining markups found in this paper could also change. However, small firms in the non-manufacturing sector still find it difficult to pass through their production costs to their prices in the domestic product market. Under these circumstances, the mechanism found in this paper, whereby intensifying competition in product markets could lead to suppression of wages, may work more strongly in the future, especially among SMEs that face difficulties in retaining earnings under rising costs.

The second point concerns the relationship between changes in the labor supply-demand environment and the stance on wage setting. As noted earlier in this paper, the trend of increasing wage markdowns may have eased somewhat in the latter half of the 2010s, partly due to changes in the labor supply environment. In this regard, a change in the trend of household labor participation may have occurred around the time of the spread of COVID-19. In other words, the labor supply of the elderly, who have been driving the rise in the ratio of part-time workers, has reached a plateau, and other changes have also occurred in the trend of the labor participation rate (Fukunaga et al. (2023)). In addition, if job changes become more active and employment mobility increases, it may become more difficult for companies to respond to intensifying competition in product markets by restraining wages. Under these circumstances, there is a reasonable possibility that the monopsony power of firms in the labor market will decline, making it easier for firms to raise wages.

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Appendix

A.1 Dealing with the Measurement Bias of Price Markups and Wage Markdowns

In this paper's DB, smaller firms tend to lack detailed information on their intermediate input and labor costs. Considering the possibility that this effect could distort the estimation of the production function, we measure price markups and wage markdowns while eliminating these biases using a state-space model.[22] In the state-space model, there are two state variables: markup μ and markdown ν, which are assumed to have a deterministic trend (β_t) following a random walk. In the observational equations, we assume that there are biases (δ) in the observed markup (μ_t^O) and employment markup (μ_t^{LO}), respectively.

State equations

$$\mu_t = \beta_{t-1}^{(1)} + \gamma^{(1)}\mu_{t-1} + \varepsilon_t^{(1)}$$

$$\nu_t = \beta_{t-1}^{(2)} + \gamma^{(2)}\nu_{t-1} + \varepsilon_t^{(2)}$$

$$\beta_t^{(1)} = \beta_{t-1}^{(1)} + \varepsilon_t^{(3)}$$

$$\beta_t^{(2)} = \beta_{t-1}^{(2)} + \varepsilon_t^{(4)}$$

Observation equations

$$\mu_t^O = \delta^{(1)} + \mu_t + \xi_t^{(1)}$$

$$\mu_t^{LO} = \delta^{(2)} + \mu_t + \nu_t + \xi_t^{(2)}$$

Note that γ is a parameter, and ε_t and ξ_t are observation errors.

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[22] It has been pointed out that the use of a common value-added deflator for an industry sector can lead to biases in the parameters (Klette and Griliches (1996), Bond et al. (2021)) over the production function approach. In this regard, De Loecker (2021) points out the validity of the production function approach by reporting that the results do not change when estimates are done using actual observed production. In this paper, the above approach is used to address these observational errors. In addition, as a robustness test of the markups, we compare the results with those obtained by estimating variable costs (De Loecker and Warzynski (2012)) and by weighting the price and employment markups, and find generally similar qualitative features.

A.2 Decomposition of Price Markups and Wage Markdowns

This appendix explains how to decompose price markups and wage markdowns into individual firm factors and reallocation effects (De Loecker and Eeckhout (2021)).

When denoting firm $i's$ price markup at time t as μ_{it}, their weight as m_{it}, and the average markup across the economy as μ_t $(\sum m_{it} \cdot \mu_{it})$, the change in the average markup from the base year T, $\varDelta\mu_t$ (the following $\varDelta$ also deviates from the base year), can be written as:

$$\varDelta\mu_t = \sum_i m_{it}\varDelta\mu_{it} + \sum_i \varDelta m_{it}\tilde{\mu}_{iT} + \sum_i \varDelta m_{it}\varDelta\mu_{it}. \qquad \text{(A1)}$$

Here, $\varDelta\mu_{it}$ and $\varDelta m_{it}$ represent changes in firm i's markup and weights (intermediate inputs), respectively, and $\tilde{\mu}_{iT}$ represents the deviation of firm i's markup from the economy-wide average in base year T. We refer to the first term in this equation as "within-firm effects" and the sum of the second and third terms as the "reallocation effects."

Changes in employment markup $(\mu_{it}^L = \theta^L \cdot (P_{it}Y_{it})/(w_{it}L_{it}))$ can be written as:

$$\varDelta\mu_t^L = \sum_i m_{it}^L\varDelta\mu_{it}^L + \sum_i \varDelta m_{it}^L\tilde{\mu}_{iT}^L + \sum_i \varDelta m_{it}^L\varDelta\mu_{it}^L, \qquad \text{(A2)}$$

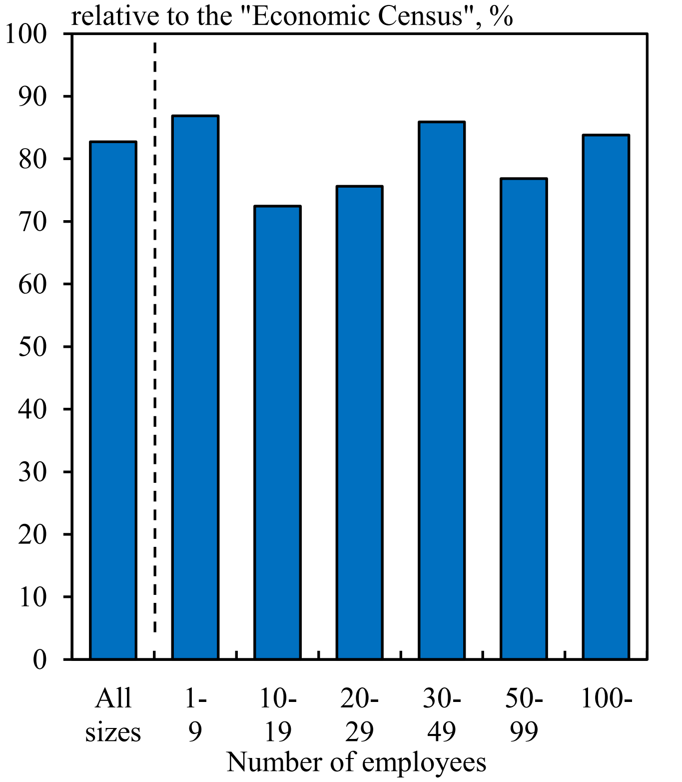
where $\varDelta\mu_{it}^L$ and $\varDelta m_{it}^L$ denote changes in firm i's labor markup and weight (labor costs), respectively, and $\tilde{\mu}_{iT}$ represents the deviation of firm i's employment markup from the economy-wide average in base year T.

Analogously, markdowns are decomposed into the "within-firm effects" and the "reallocation effects" based on (A1) and (A2).

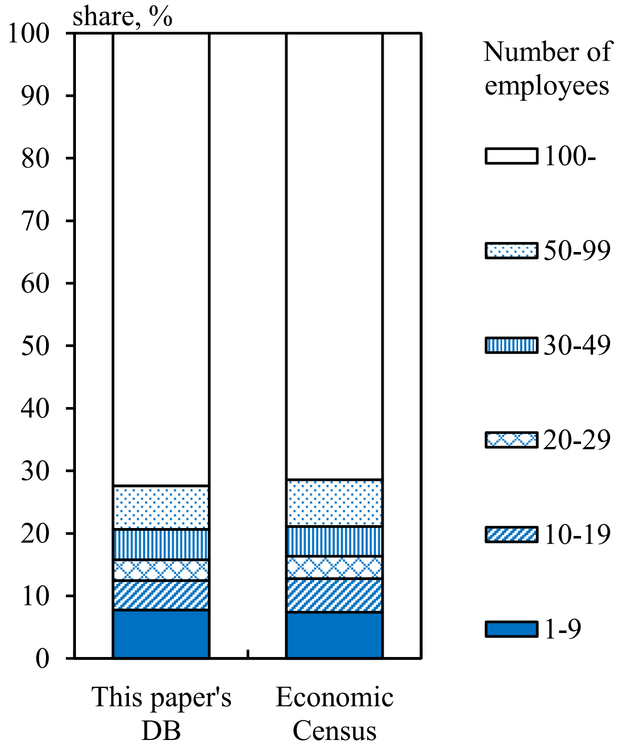
Figure 1

Comparison of this paper's database and official statistics ("Economic Census")

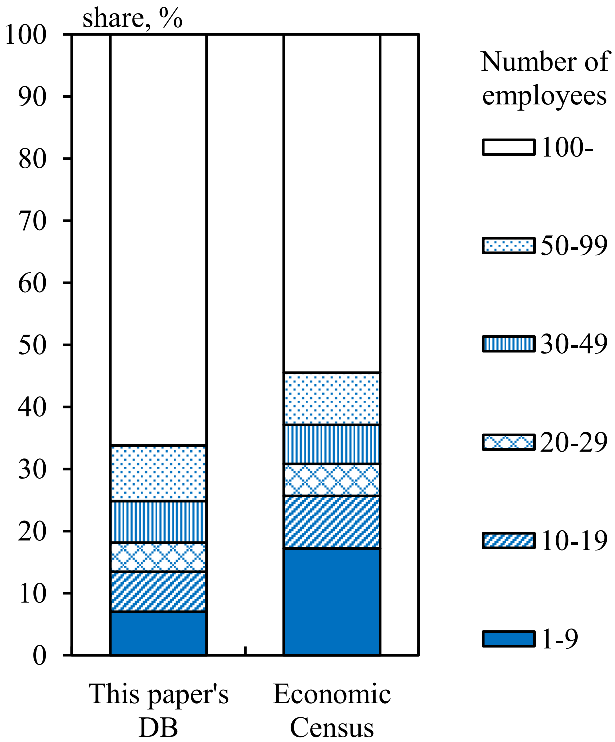
(1) Data coverage relative to the "Economic Census" in terms of sales



(2) Distributions of sales by firm size



(3) Distributions of employees by firm size



(4) Distributions of the number of firms by firm size

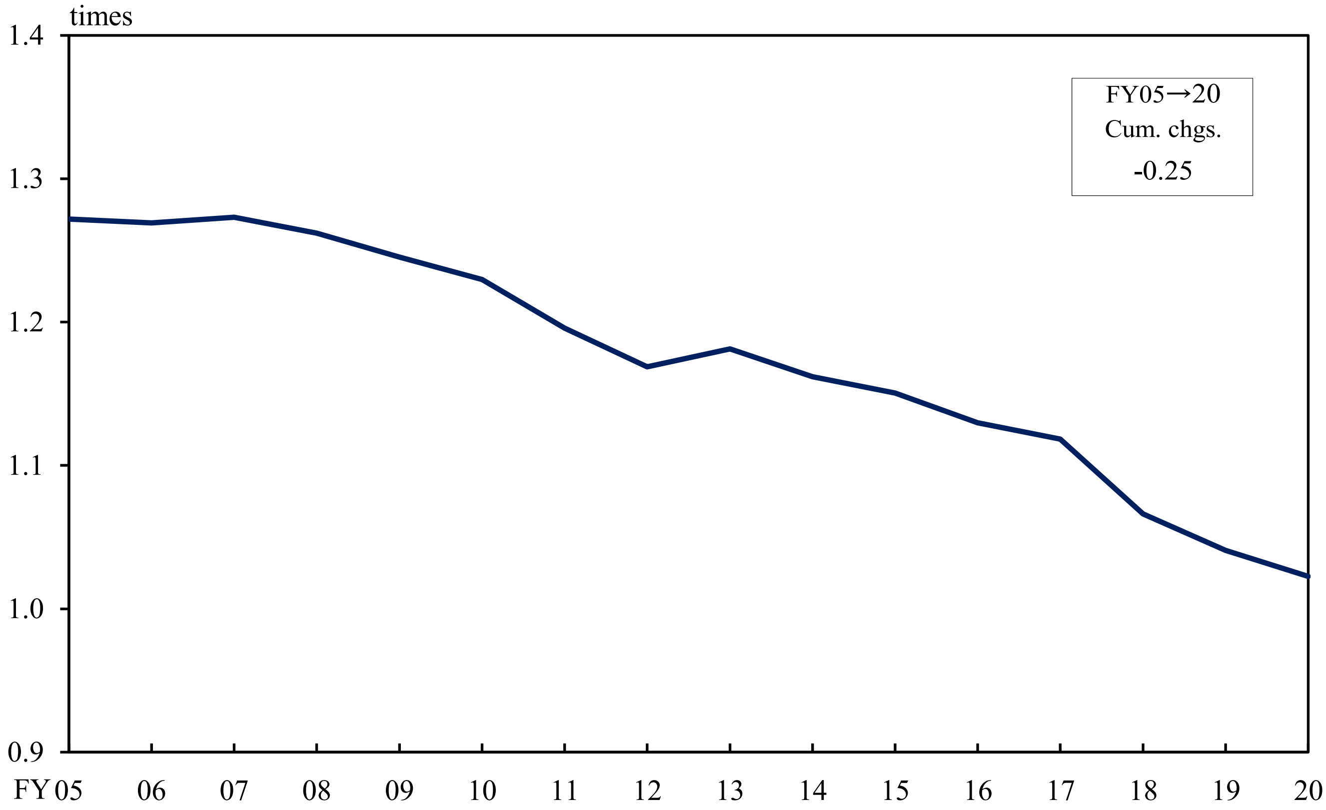
Note: Excluding fisheries; finance and insurance; and compound services (same below unless otherwise noted). As of FY2015.

Sources: Ministry of Economy, Trade and Industry; Ministry of Health, Labour and Welfare; Ministry of Finance; Ministry of Internal Affairs and Communications; Cabinet Office; Development Bank of Japan; CRD Association (same below).

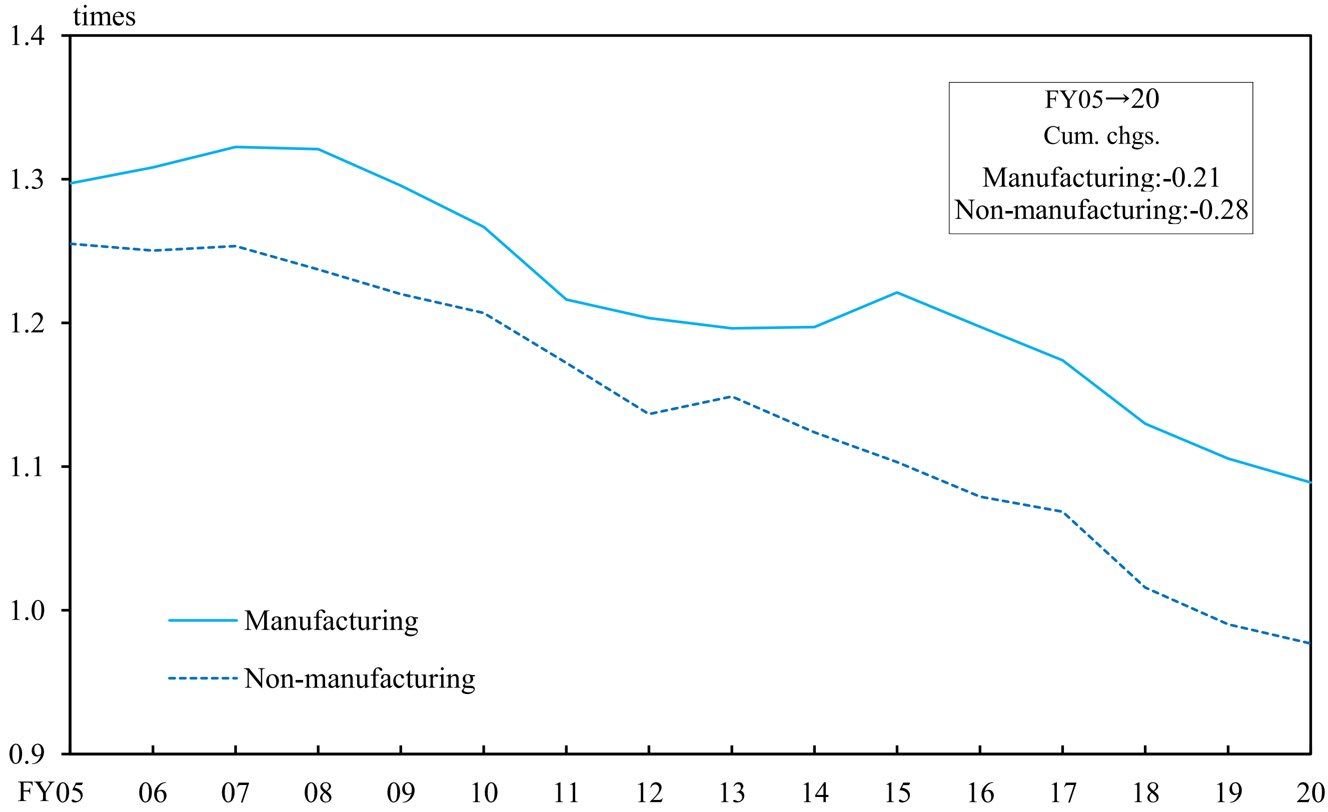
Figure 2

Price markups (all firm sizes)

(1) All industries

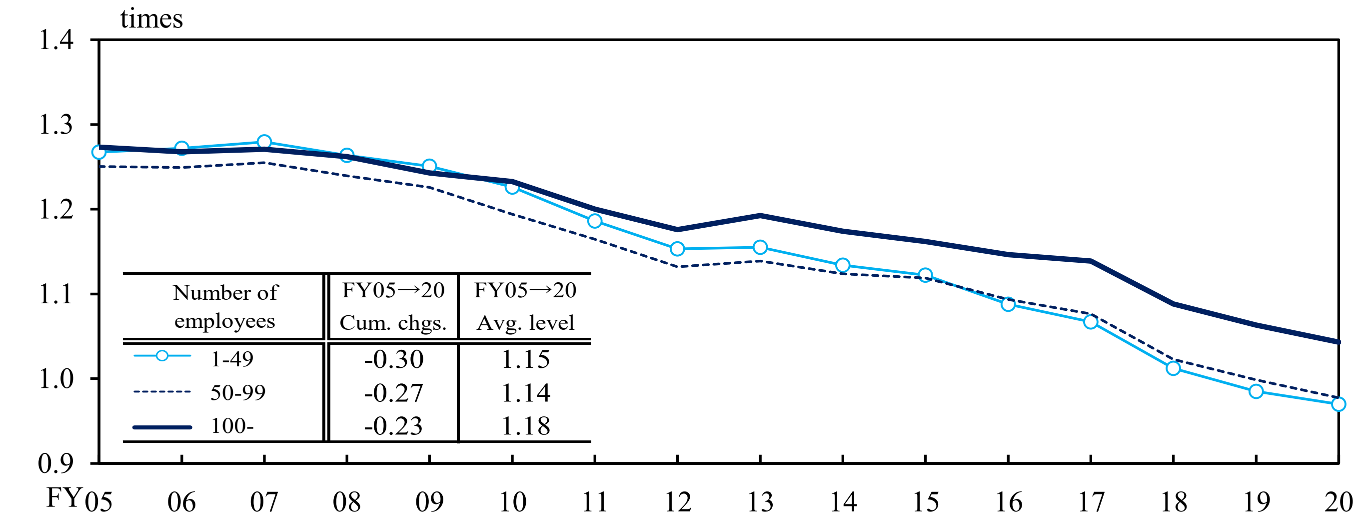


(2) Manufacturing and non-manufacturing

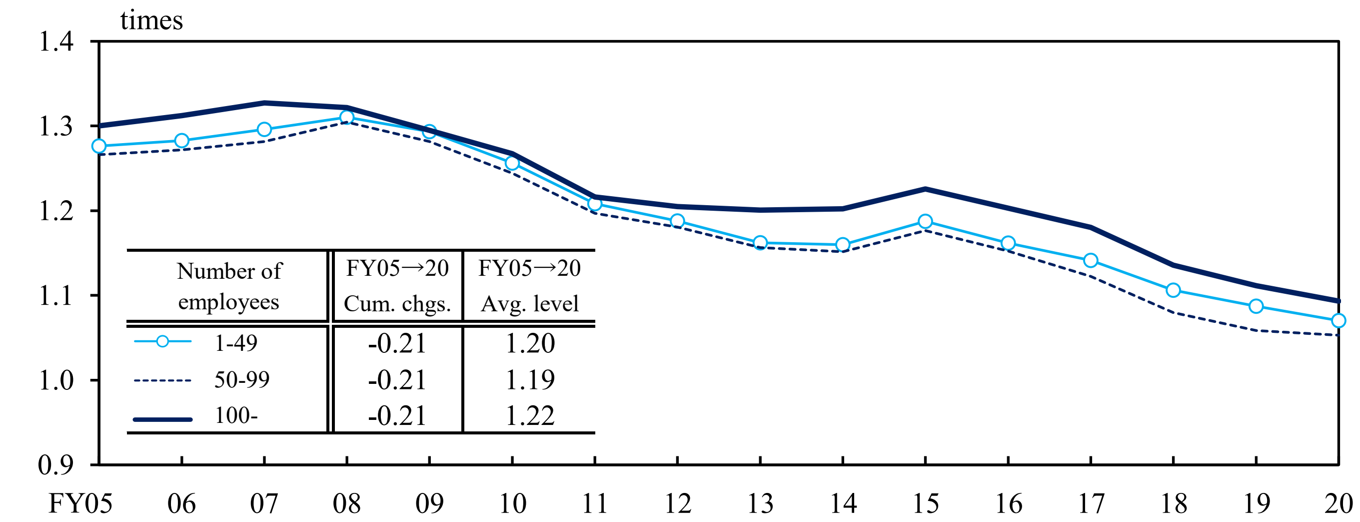


Price markups by industry and firm size

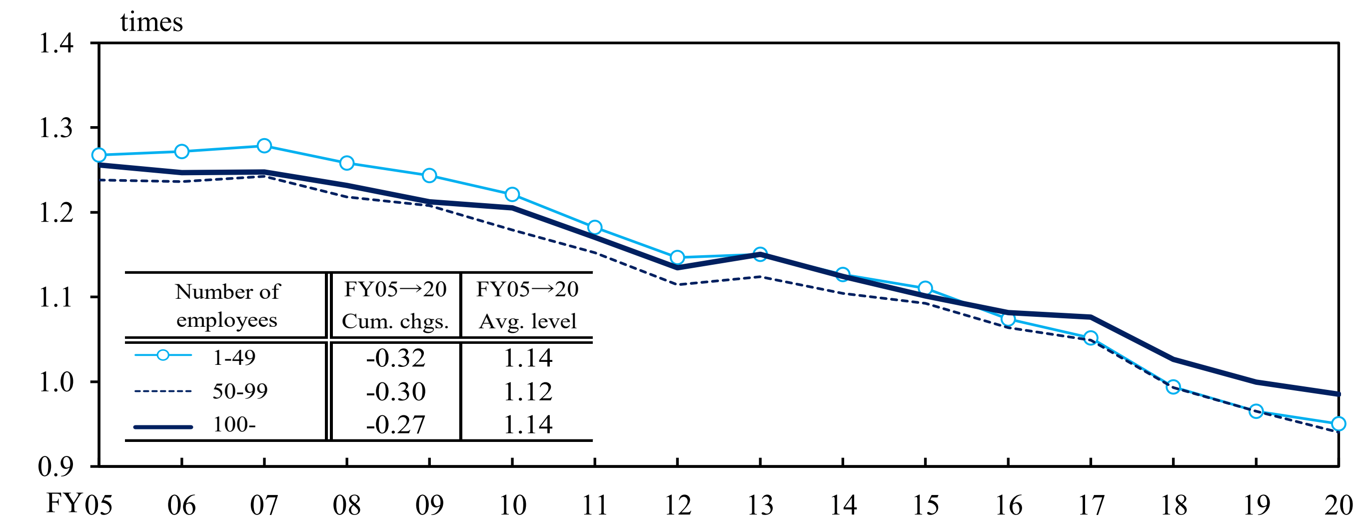
(1) All industries



(2) Manufacturing

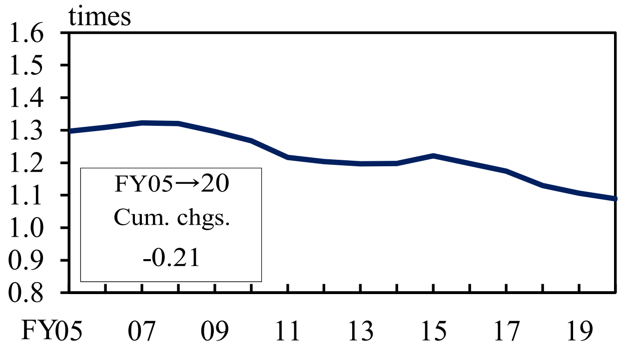


(3) Non-manufacturing

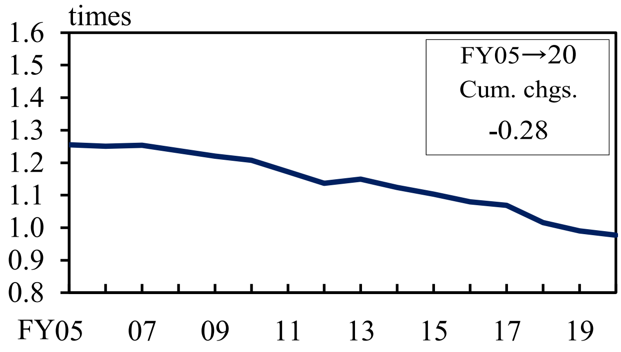


Price markups by industry (all firm sizes)

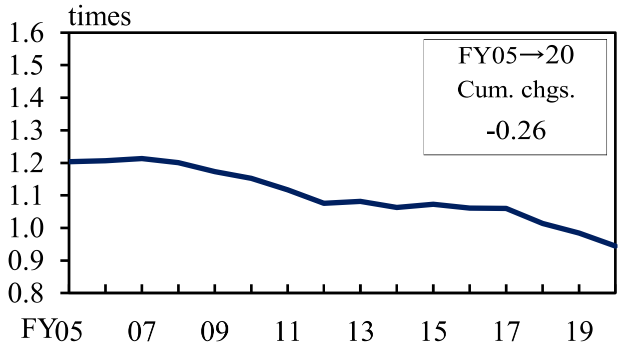
(1) Manufacturing



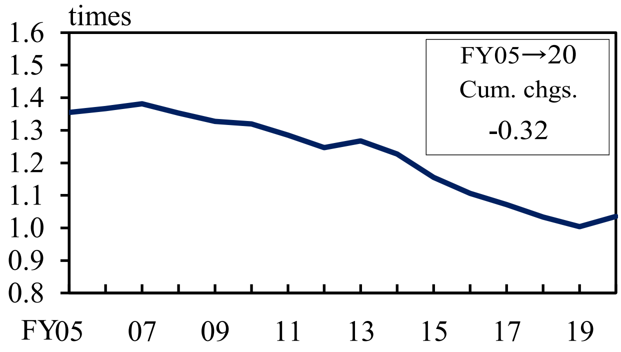
(2) Non-manufacturing



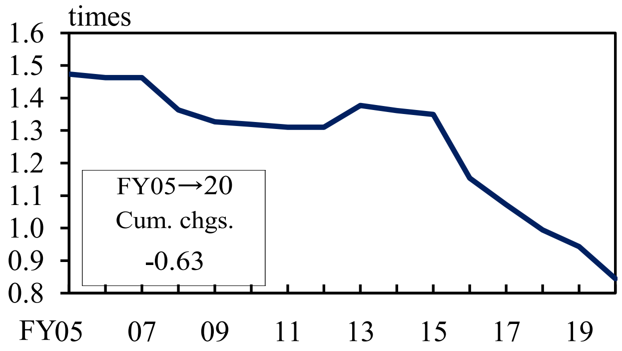
(3) Wholesale trade



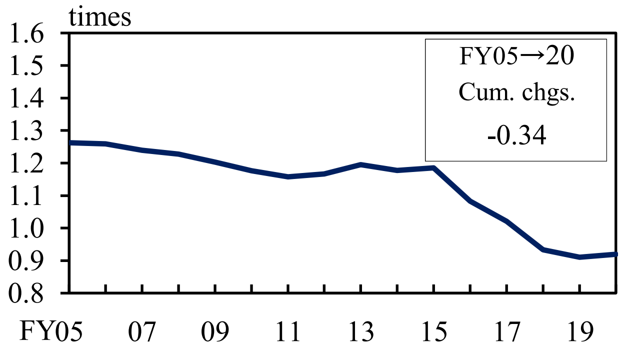
(4) Retail trade



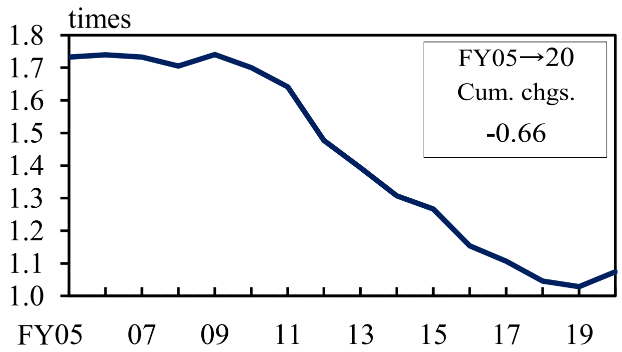
(5) Transport and postal services



(6) Construction



(7) Accommodations, eating and drinking services



(8) Living-related and personal services and amusement services

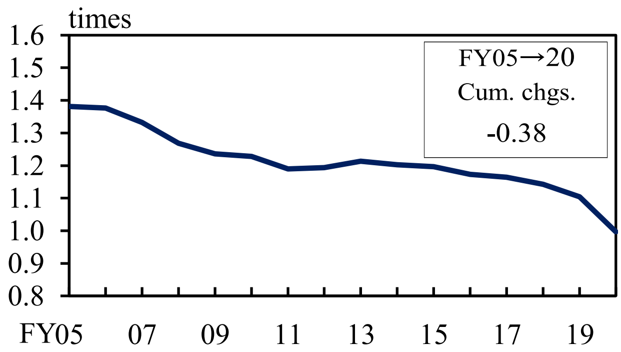
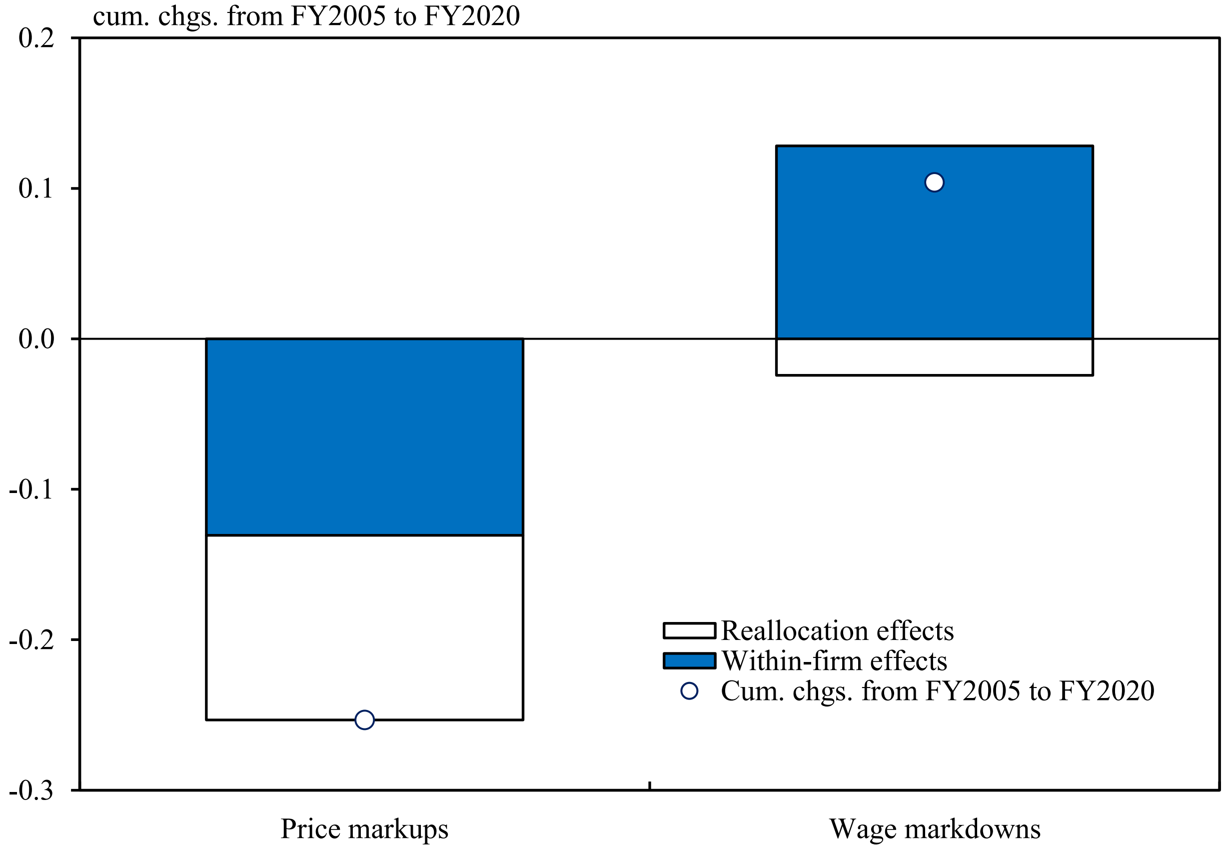


Figure 5

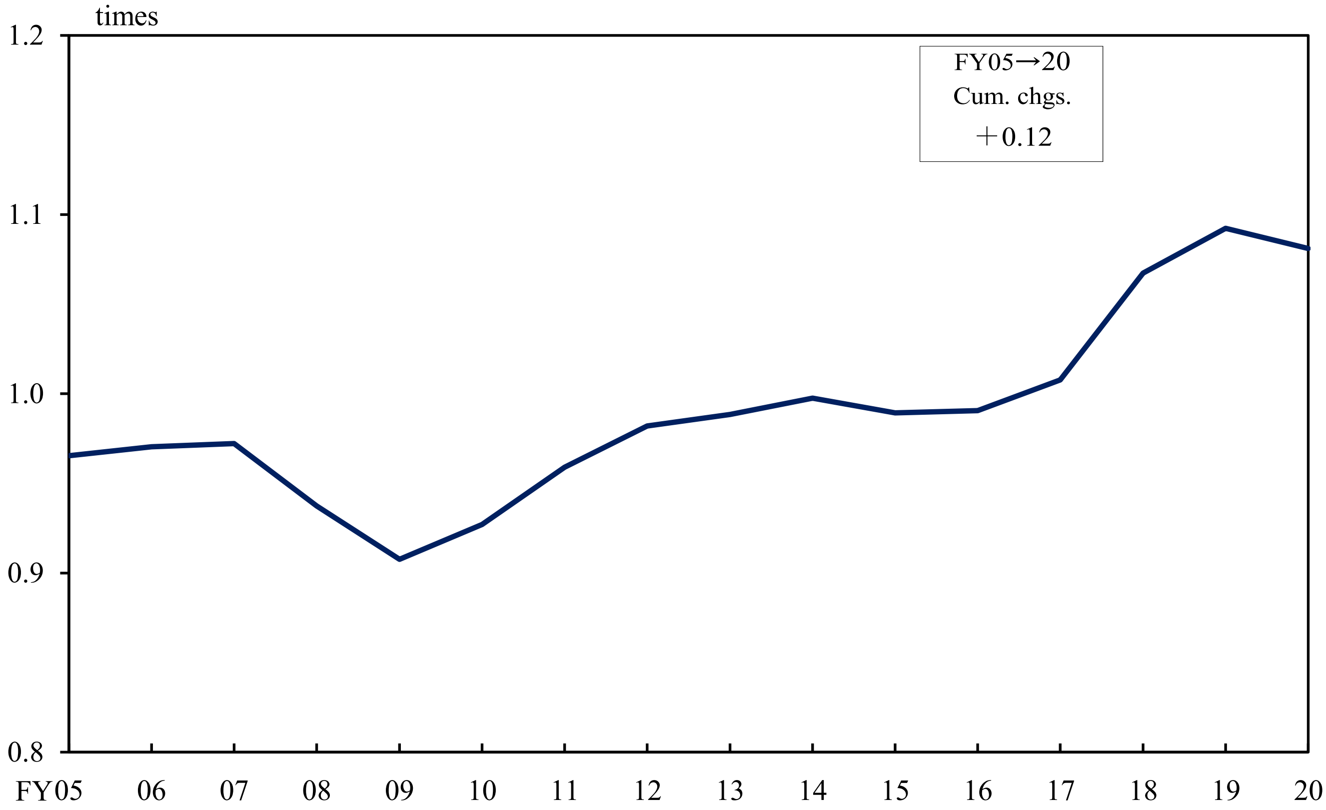
Price markups and wage markdowns: within-firm and reallocation effects



Note: Excluding fisheries; agriculture and forestry; finance and insurance; medical, health and welfare; compound services; and services, N.E.C.

Wage markdowns (all firm sizes)

(1) All industries



(2) Manufacturing and non-manufacturing

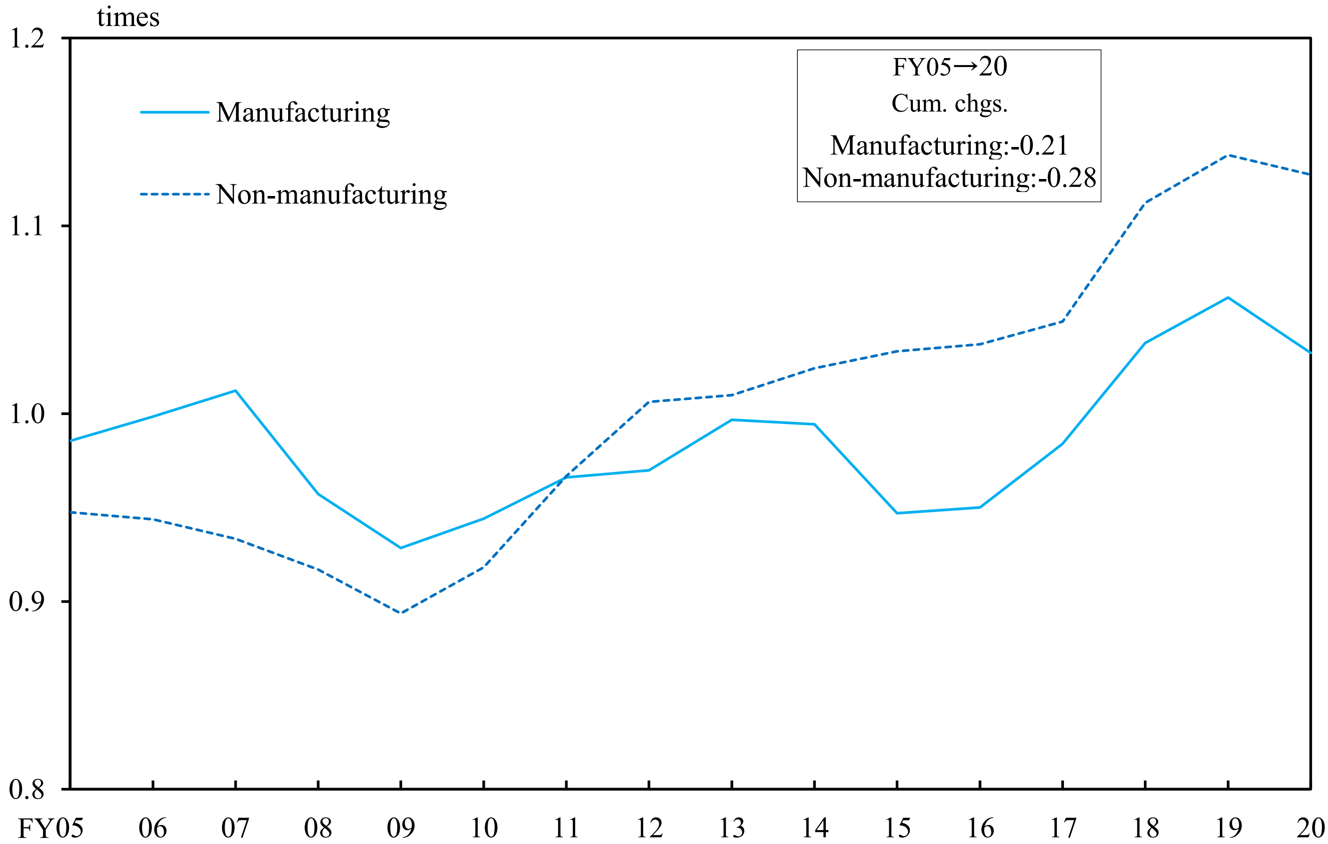
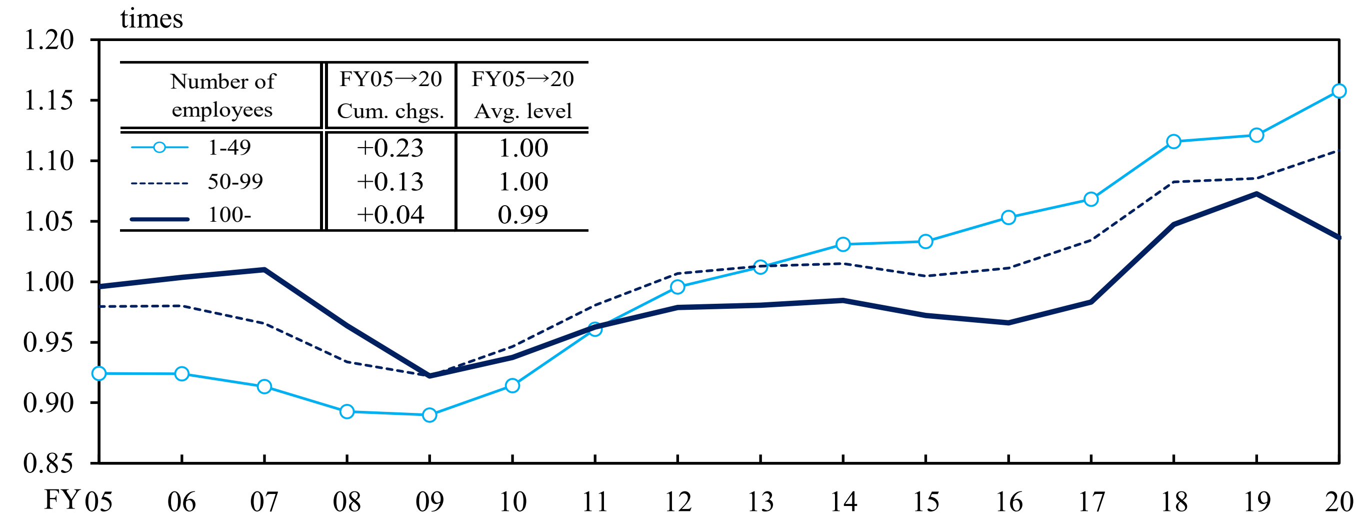


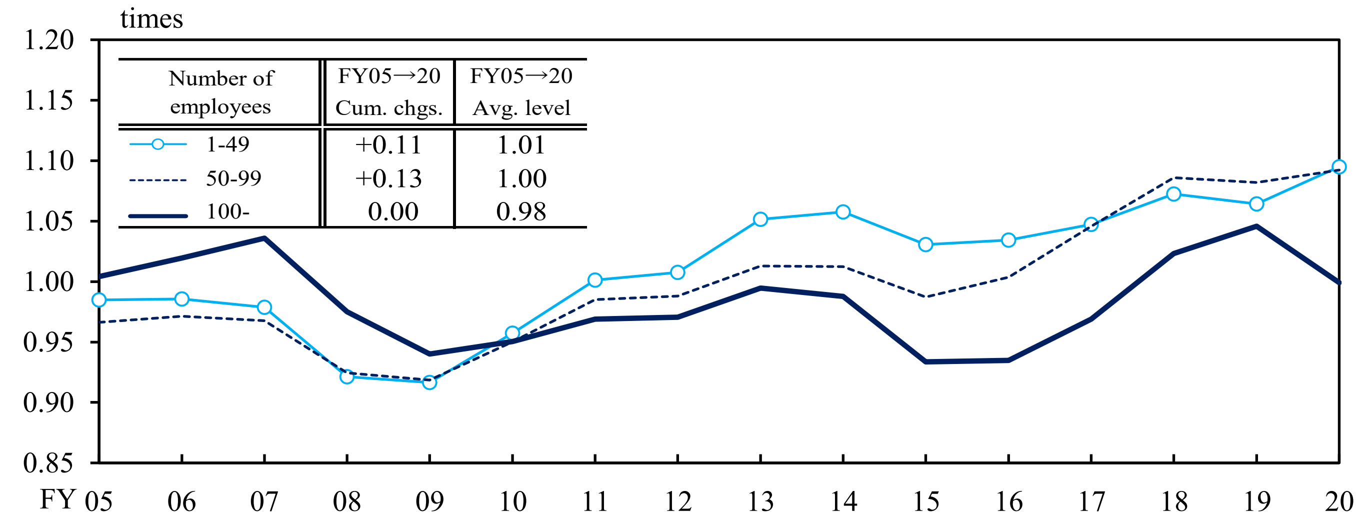
Figure 7

Wage markdowns by industry and firm size

(1) All industries



(2) Manufacturing



(3) Non-manufacturing

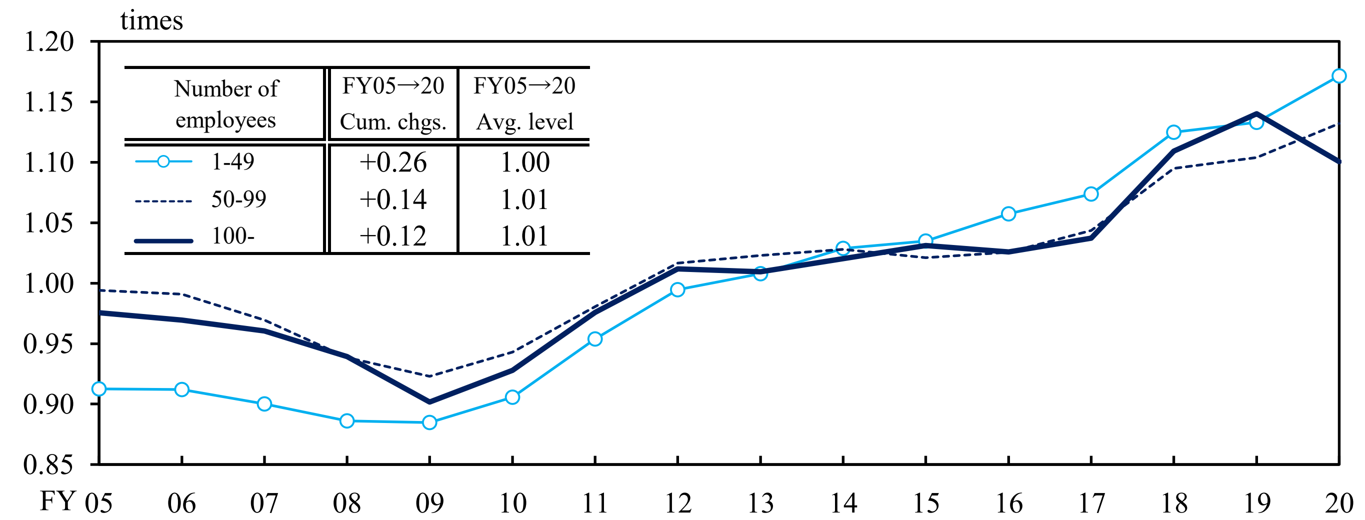
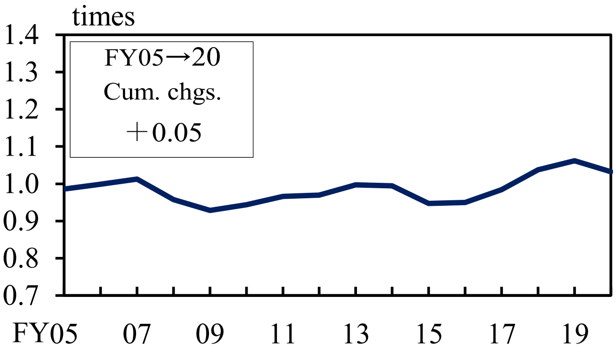


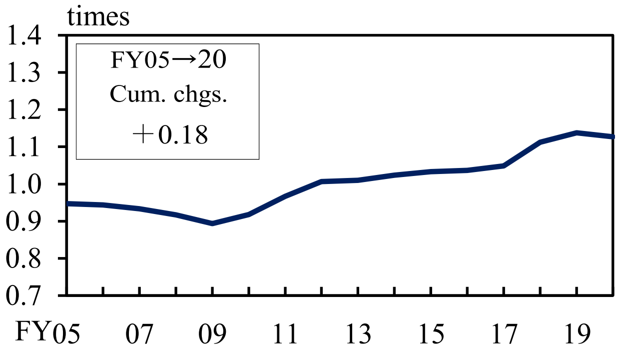
Figure 8

Wage markdowns by industry (all firm sizes)

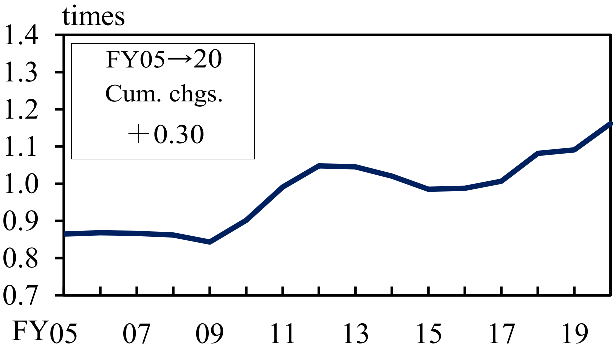
(1) Manufacturing



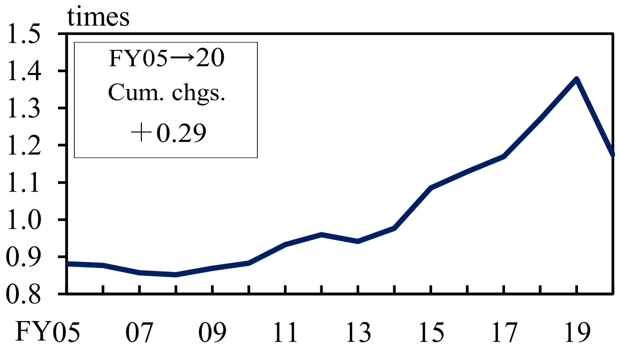
(2) Non-manufacturing



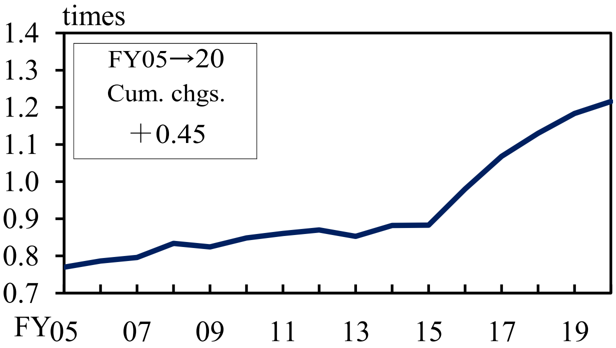
(3) Wholesale trade



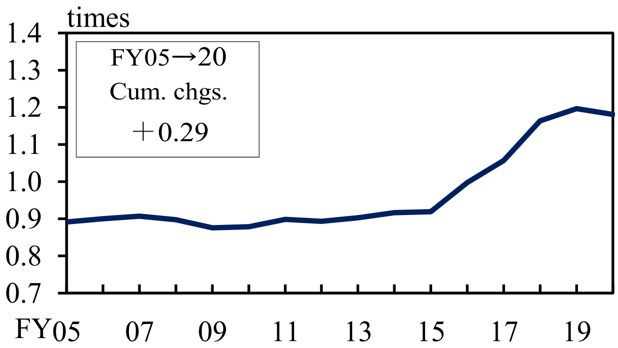
(4) Retail trade



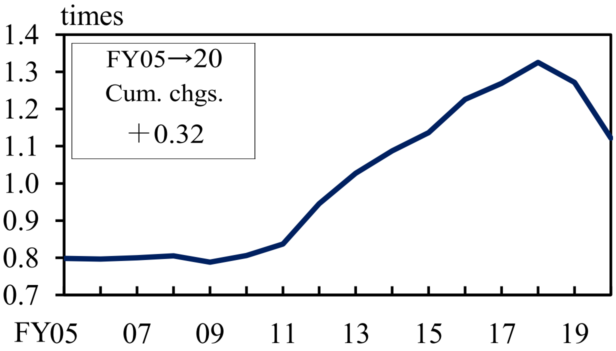
(5) Transport and postal services



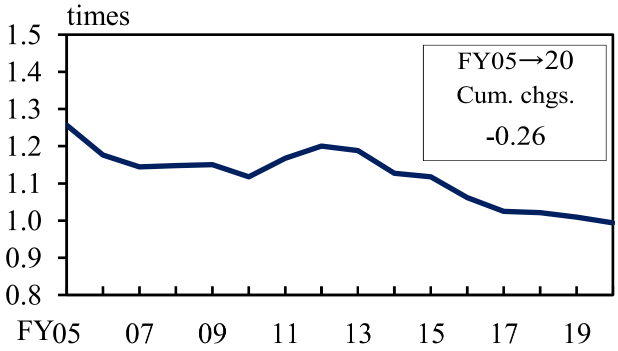
(6) Construction



(7) Accommodations, eating and drinking services

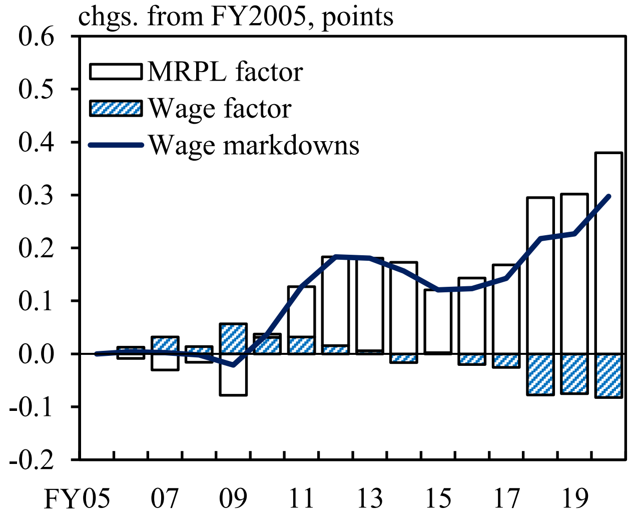


(8) Living-related and personal services and amusement services

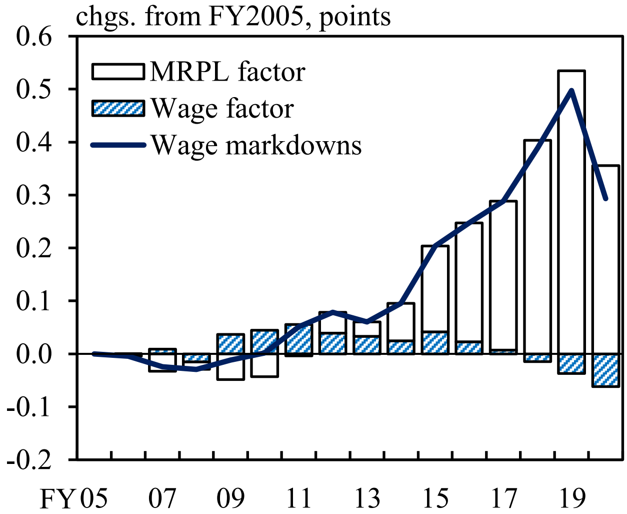


Decomposition of changes of wage markdowns in non-manufacturing industries

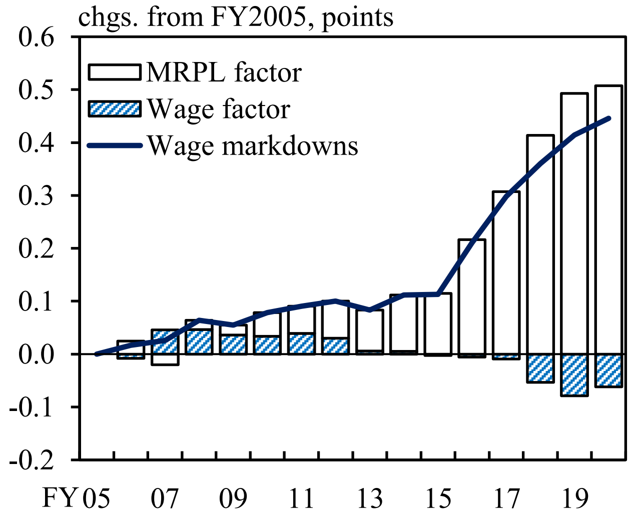
(1) Wholesale trade



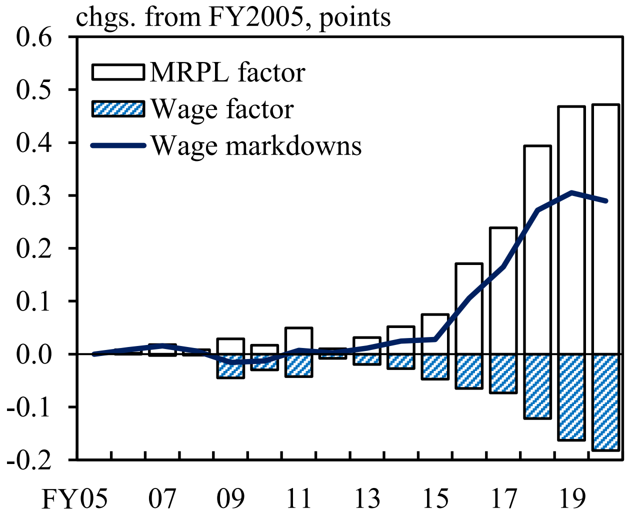
(2) Retail trade



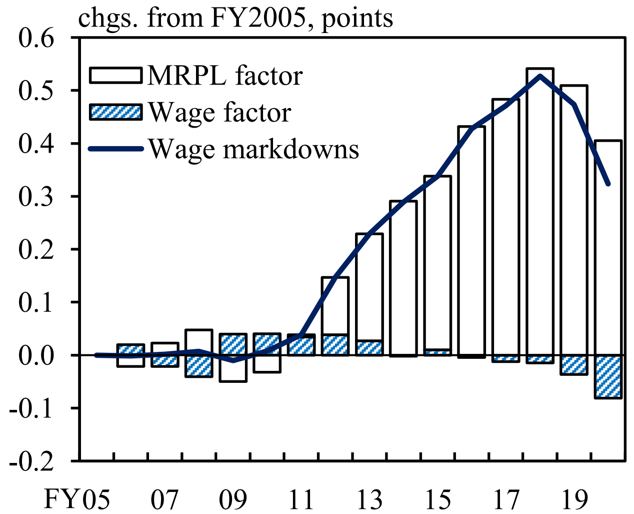
(3) Transport and postal services



(4) Construction



(5) Accommodations, eating and drinking services



(6) Living-related and personal services and amusement services

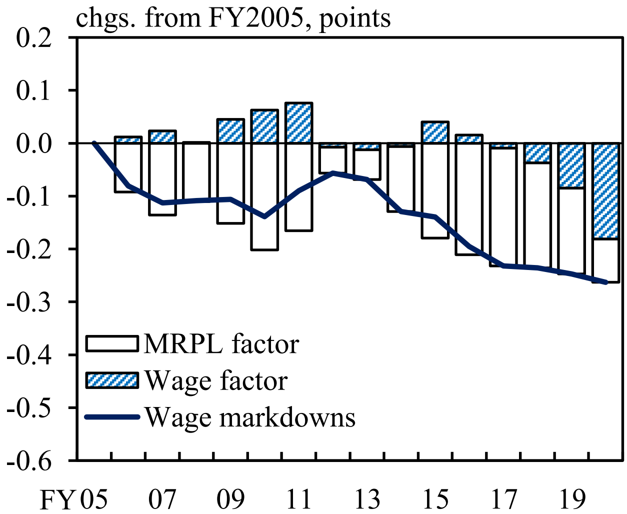
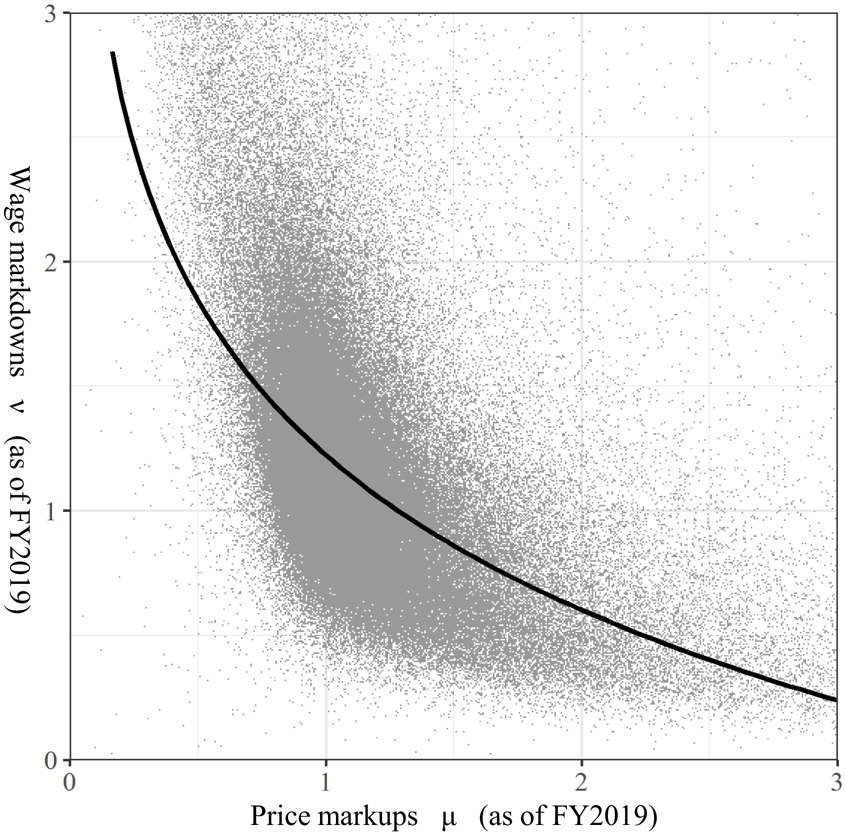


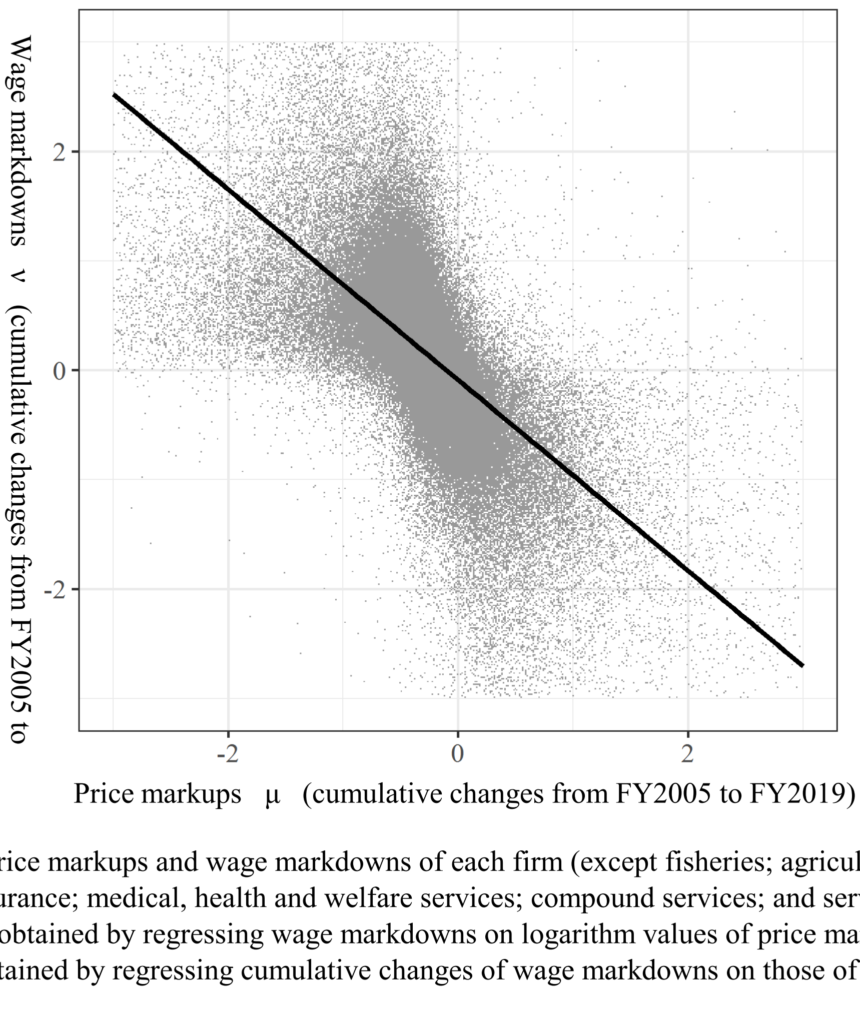
Figure 10

Relationship between price markups and wage markdowns (scatterplot)

(1) Level (as of FY2019)



(2) Cumulative changes (from FY2005 to FY2019)



Note: Scatterplot of price markups and wage markdowns of each firm (except fisheries; agriculture and forestry; finance and insurance; medical, health and welfare services; compound services; and services, N.E.C.) The line in Figure (1) is obtained by regressing wage markdowns on logarithm values of price markups, and that in Figure (2) is obtained by regressing cumulative changes of wage markdowns on those of price markups.

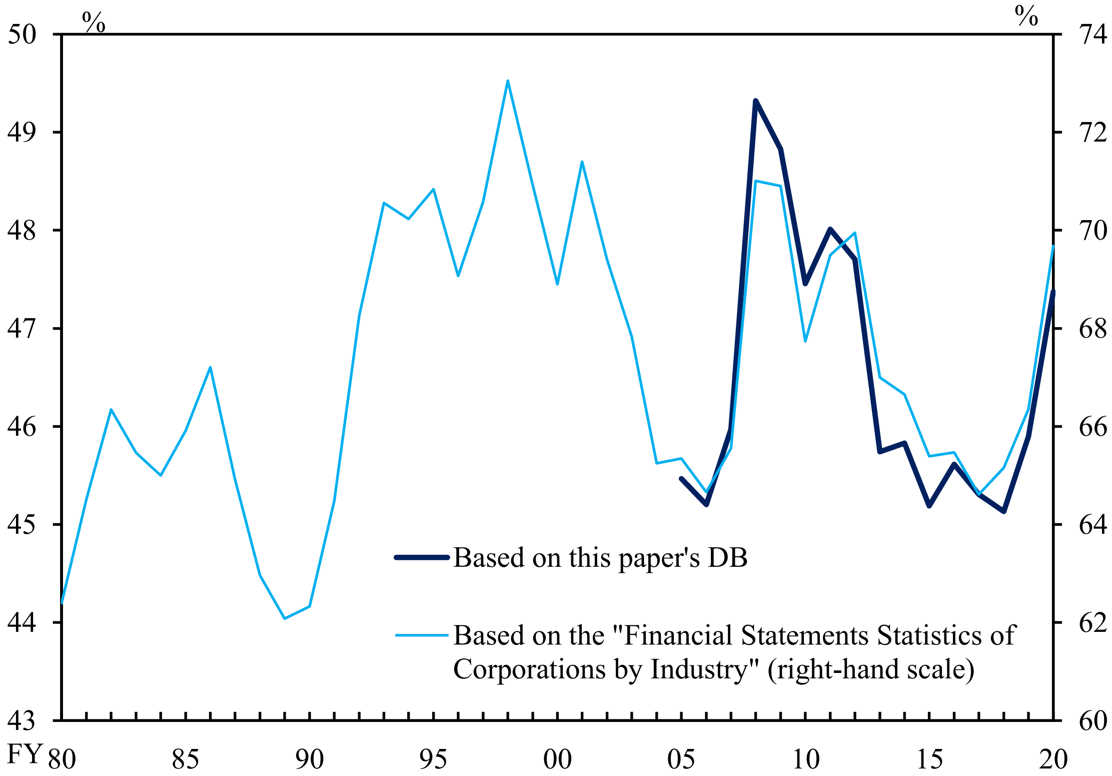
Variance decomposition of wage markdowns

			Japan (All industries)	Japan (Manufacturing)	United States (Manufacturing)
Variance of wage markdowns			0.2634	0.1772	0.1696
	(1) Output elasticity		0.0320	0.0007	0.3149
	(2) Labor cost ratio		0.1413	0.0885	0.3813
	(3) Price markups		0.1467	0.0881	0.0276
	Cross terms	(1) and (2)	0.0531	0.0022	-0.5609
		(1) and (3)	0.0044	0.0020	0.0120
		(2) and (3)	0.0079	-0.0001	-0.0054

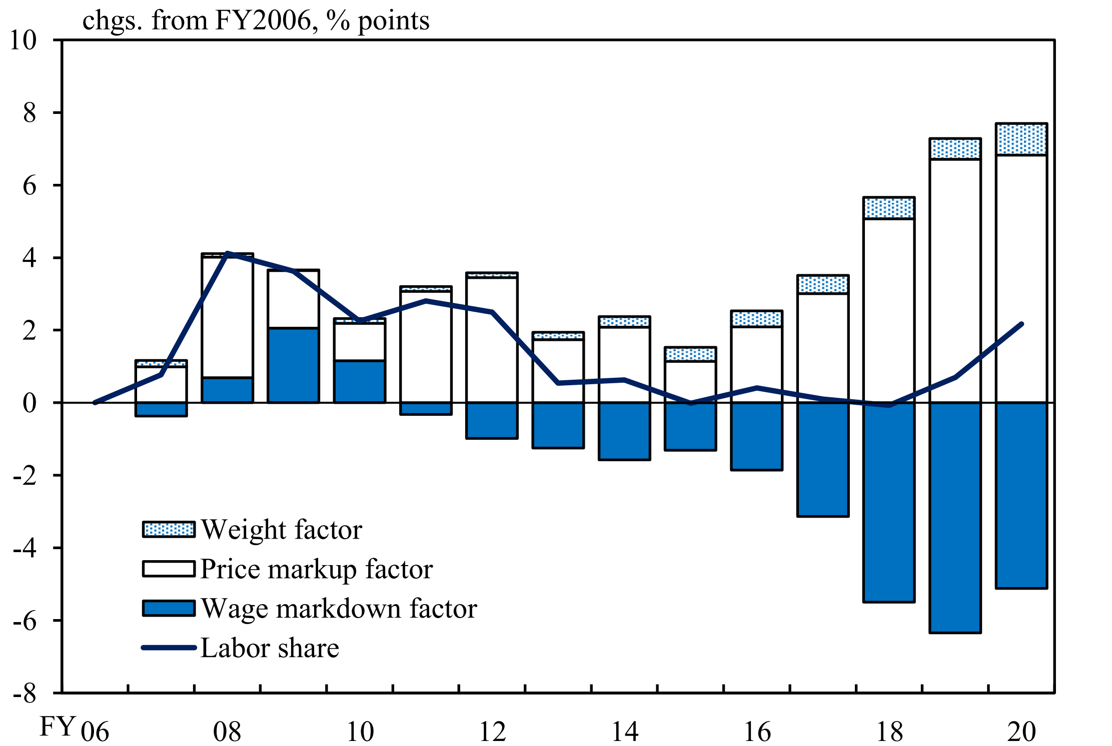
Note: Excluding fisheries; agriculture and forestry; finance and insurance; medical, health and welfare services; compound services; and services, N.E.C. Figures for the United States are based on Yeh et al. (2022).

Labor share

(1) Labor share

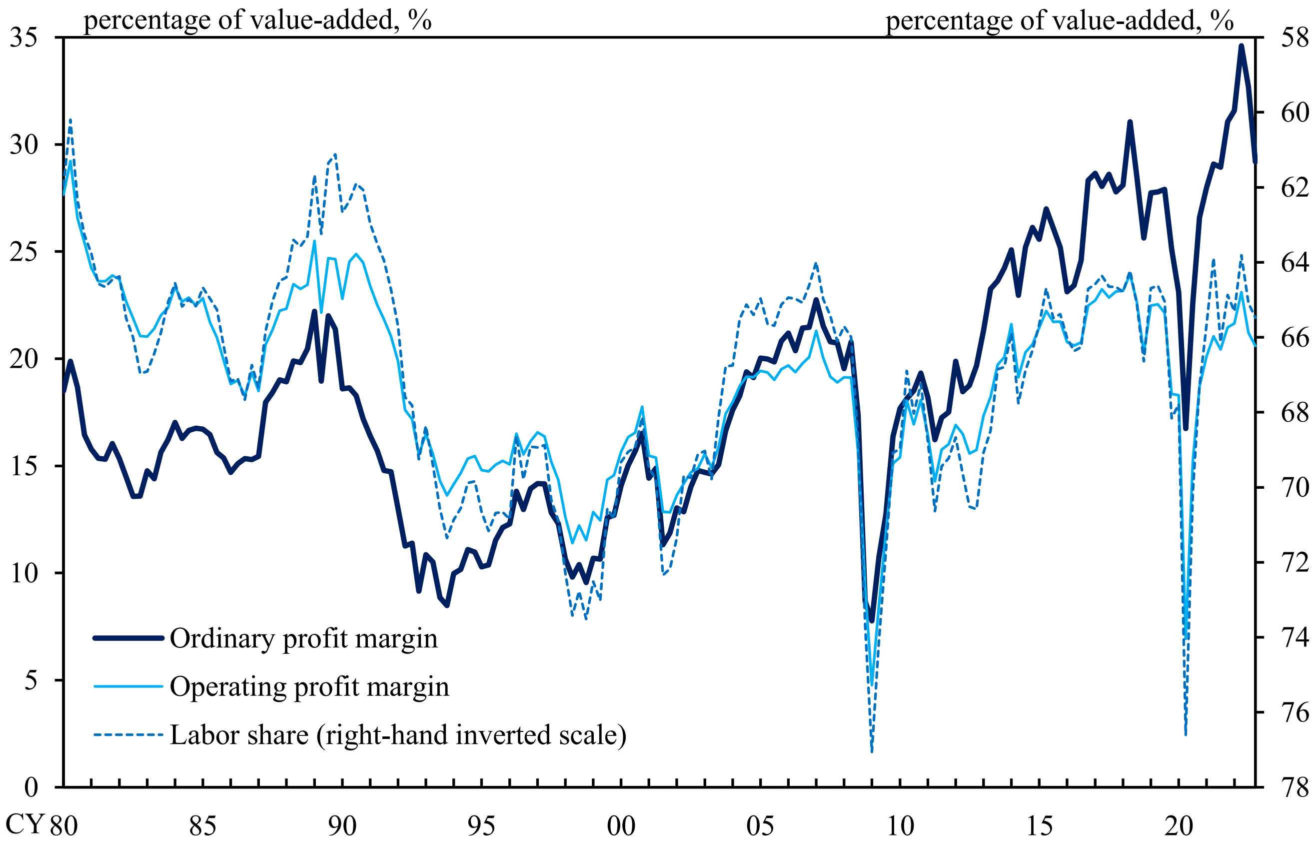


(2) Decomposition of changes in the labor share



Note: Labor share based on the "Financial Statements Statistics of Corporations by Industry" in Figure (1) is calculated as follows: labor costs / value-added (value-added = operating income + labor costs + depreciation costs). Labor share based on this paper's DB is calculated as follows: labor costs / (sales - intermediate input costs excluding labor costs). Intermediate input costs are equal to costs of goods sold excluding rental fees (such as factories and equipment) and tax and public dues. "Weight factor" in Figure (2) includes factors such as cross term effects.

Relationship between labor share and profit margins



Note: Based on the "Financial Statements Statistics of Corporations by Industry." Figures are for all industries and enterprises (excluding finance and insurance. Figures from 2009/Q2 exclude pure holding companies). Labor share = labor costs / value-added. Value-added = operating profits + labor costs + depreciation expenses.