Price-setting Behavior of SMEs*
－Evidence from Japanese Business Survey Data－

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Abstract

In this paper, using micro data of the Monthly Survey on SME Trends, which is conducted by the JFC Research Institute, we examine the price-setting behavior of small and medium enterprises (SMEs), and investigate the cause of the prolonged deflation in Japan. The main findings are as follows. First, the estimation of the probability of price adjustment shows that the probability has declined with the passage of time and price-setting behavior has become stickier. Second, through a regression analysis using sales price change (increase or decrease) as the explained variable, we find that state-dependent pricing has negligible impact on SMEs' price-setting behavior. However, the impact of state-dependent factors is much smaller than that of time-dependent factors. Third, the examination of change in the coefficients in individual intervals of the sample period shows a steep decline in the coefficient of the purchase price. This finding is consistent with the "entrenchment of the practice of keeping prices unchanged" in Japan, which is pointed out by Watanabe (2018).

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1. Introduction

Since November 2012, Japan has been in an economic expansion phase, supported by the Bank of Japan's massive monetary easing and the recovery of overseas economies. In the meantime, the unemployment rate has declined and the supply-demand gap has shrunk, but the growth rate of consumer prices has remained low. The prospects still remain unclear for overcoming deflation.

Why has Japan failed to escape from deflation even though economy has recovered? In recent years, there has been an increasing number of arguments that attribute Japan's deflation to a supply-side factor, namely firms' price-setting behavior. Those arguments reflect Japanese firms' tendency to keep their prices unchanged even when demand has grown or cost has risen. They argue that this tendency has been growing year after year and becoming a contributing factor of deflation. Watanabe (2018) describes this situation as the "entrenchment of the practice of keeping prices unchanged."

Arguments that attribute the deflation to firms' price-setting behavior are easy to understand intuitively. Firms become overly afraid of losing customers by raising prices. As a result, they refrain from passing a rise in cost on to prices. At a time when consumers are becoming increasingly price-conscious, the tendency to keep price unchanged is expected to grow.

However, it is not easy to examine firms' price-setting behavior based on data. If the purpose of the analysis is to examine the price stickiness, the use of macro data would be sufficient. But these data do not make clear how individual firms reflect changes in demand and cost in their sales prices.

On the other hand, in the case of analysis using micro data, data constraints pose a problem. In the past, many studies using micro data of the consumer price index were conducted to examine the frequency of price adjustment on an item-by-item basis. However, the use of such data does not make it possible to identify firms' price-setting behavior that lies behind item-by-item price changes.

The analysis of firms' price-setting behavior requires data sets that track not only changes in sales prices but also changes in the situation faced by each firm. One such dataset is micro-level data of business survey, such as the Bank of Japan's "Tankan survey". Although there have been some studies that analyze price-setting behavior using business surveys, their number is small. Also, there have been no such studies in Japan, as that kind of micro data is not made public. Japanese firms' price-setting behavior may be different from the behavior in other countries.

In this paper, we examine SMEs' price-setting behavior using micro data of the Monthly Survey on SME Trends, which is conducted by JFC Research Institute, and investigate the cause of the prolonged deflation in Japan. We pay particular attention to how SMEs reflect changes in their own situation in sales prices, and how the changes in price-setting behavior have affected the deflation.

Due to the nature of the data used, the analysis in this paper covers only SMEs' price-setting behavior.

However, considering the huge impact of SMEs on the entire economy, we believe analyzing Japanese SMEs' price-setting behavior has an important meaning.

This paper is structured as follows. In Section 2, we review past studies concerning firms' price-setting behavior. In Section 3, we examine how the frequency of price adjustment by SMEs has changed over time using survival analysis. In Section 4, we identify the determinant factors of SMEs' price-setting behavior and changes in the behavior through regression analysis. Based on these results, we examine the impact of changes in the price-setting behavior on the deflation that has continued until now. In Section 5, we analyze the differences in the passing of cost increases on to sales prices by firm attribute. In Section 6, we examine the background to the increasing stickiness of SMEs' price-setting behavior. In Section 7, we summarize our analysis and refer to future research topics.

Table-1 Question items and reply options in the Trend Survey

Question item	Reply option		
Sales (Month to Month)	Increase	Unchanged	Decrease
Sales price (Month to Month)	Increase	Unchanged	Decrease
Purchase price (Month to Month)	Increase	Unchanged	Decrease
Overtime (Month to Month)	Increase	Unchanged	Decrease

Source: JFC Research Institute "Monthly Survey of SME Trends"

Before starting our analysis, we explain the overview of the Monthly Survey on SME Trends (hereinafter referred to the "Trend Survey"). The Trend Survey is conducted every month by the JFC Research Institute in order to keep track of the economic trends of Japanese SMEs. The survey samples are 900 firms with which Japan Finance Corporation's SME Unit has business dealings. The regions covered by the survey are limited to the three major metropolitan areas (Tokyo, Chubu and Kinki). Of the survey samples, 70% engage in the manufacturing, 20% in the wholesale, and 10% in other industries. Firms engaging in the retail and services are not included.

The survey questionnaire includes questions concerning monthly sales, profits and prices. Respondent firms are asked to choose one from among the three reply options corresponding to positive, neutral, and negative assessments. For example, regarding sales, the three reply options are "increase," "unchanged," and "decrease" compared with the previous month. In our analysis, we use data concerning four question items: sales, sales price, purchase price, and overtime. Table-1 shows the questions and their reply options.

Among firms in the sample group, we replace only those whose responses have been infrequent. As a result, the sample group includes many firms which have continued to provide valid replies for many years. In this paper, we use micro-level data of the Trend Survey over the 21-year period from January 1997 to December 2017.

2. Related Literature

Many past studies that analyze firms' price-setting behavior use micro data of consumer price index (CPI). Among them, representative studies are Dhyne et al. (2006), which analyze the characteristics of the frequency of price adjustment based on CPI micro data in 10 European countries, and Klenow and Kryvtsov (2008), which use CPI micro data in the U.S.. Among studies that analyze price-setting behavior in Japan, representative studies are Ikeda and Nishioka (2006), which estimate the hazard function of price adjustment based on CPI micro data, and Saita and Higo (2007), which analyze the frequency of price adjustment based on retail price survey.

On the other hand, there have been some studies, even though the number is not large, that analyze firms' price-setting behavior based on micro data of business surveys.

Lein (2010) analyzes the determinant factors of price-setting behavior of manufacturing firms based on micro data of a quarterly business survey conducted by KOF Swiss Economic Institute. This study conducts analysis regarding the impact of state-dependent and time-dependent pricing on price-setting behavior and shows that the state-dependent pricing has a significant role and that the impact of purchase price is markedly large. Schenkelberg (2013) also analyzes firms' price-setting behavior based on micro data of a monthly business survey conducted by ifo Institute for Economic Research in Germany and leads the similar conclusions as in Lein (2010).

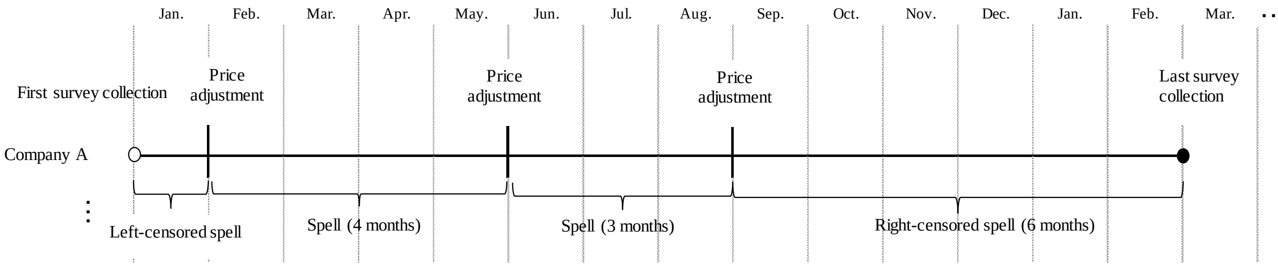
On the other hand, Loupias and Sevestre (2013) analyze firms' state-dependent pricing based on micro data of a monthly business survey conducted by the Banque de France, the French central bank. This study shows that a state-dependent pricing has an important role as in Lein (2010) and that changes in purchase price are the main driver of sales price changes.

Stahl (2010) analyzes the impact of contracts concerning price adjustment based on a special survey conducted by ifo in 2004. Linking those data with micro data of ifo business climate index, Stahl (2010) conducts comparison of the hazard rates of price adjustment. As a result, Stahl (2010) confirms that even firms which have contracts regarding price adjustment duration show a state-dependent pricing behavior.

Bachmann et al. (2018) study how firms' price-setting behavior is affected by uncertainty based on micro data of ifo business climate index. As a result, Bachmann et al. (2018) show that an increase in uncertainty leads to a rise in firms' price adjustment probability, as argued by theoretical studies à la Vavra (2014).

However, as most of the abovementioned data include large and middle-sized enterprises, there is a lack of clarity over the determinant factors of SMEs' price-setting behavior. In addition, there has been no study that conducts similar analysis based on micro data of Japanese business surveys, so it remains unclear what factors determine Japanese firms' price-setting behavior. Moreover, no past study has focused

Figure-1 Concept data used in the survival analysis



Source: Prepared by the author

attention on time-sequential changes in price-setting behavior.

Compared with these past studies, the analysis in this paper is distinctive in the following points: (1) concentrating exclusively on SMEs price-setting behavior; (2) focusing attention on the price-setting behavior of firms in Japan, a country where deflation has continued for many years; (3) focusing attention on changes in time-sequential changes in price-setting behavior.

3. Changes in the sales price adjustment probability

How has the frequency of sales price adjustment by SMEs changed over time? In this section, we examine the probability of sales price adjustment by SMEs and changes in the probability based on a survival analysis, following Stahl (2010).

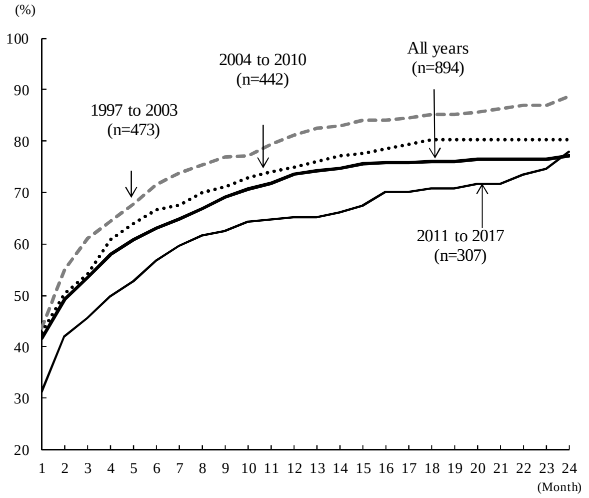
The survival analysis is a method which estimates the average probability of continuing a certain event. In our study, survival time is defined as the period during which a firm keeps its sales price unchanged since the last price adjustment. Then cumulative survival rate can be defined as the average probability of a firm keeping its sales price unchanged in certain period. Here, price adjustment corresponds to "increase" or "decrease" in sales price, while keeping price unchanged corresponds to "unchanged" (Table-1).

Figure-1 shows the concept of data used in our estimation. A data set of successive responses given by a firm is called a price trajectory. The period from one price adjustment to the next is defined as a spell, and the length of a spell corresponds to the period during which the sales price remains unchanged.

The spell that includes the first response to the first price adjustment (located at the left end of price trajectory) is defined as a left-censored spell. On the other hand, the spell in which the survey collection is terminated before its next price adjustment (located at the right end of price trajectory) is defined as a right-censored spell. For example, in Figure-1, the price trajectory includes one left-censored spell, two spells and one right-censored spell.

The cumulative survival rates for individual firms are calculated based on their spells. However, left-censored spells are excluded from the calculation because the timing of the last price adjustment is unknown. Furthermore, price trajectory includes multiple spells and this could cause an estimation bias.

Figure-2 Changes in the probability of price adjustment



Source: JFC Research Institute, "Monthly Survey on SME Trends "(the same applies to the following figures).
Notes: The samples are limited to spells that are extracted from price trajectories of at least 12 months.
(hereinafter, the same applies in Figures-3 and -4.)

Figure-3 Changes in the probability of price adjustment
(price increase→price increase)

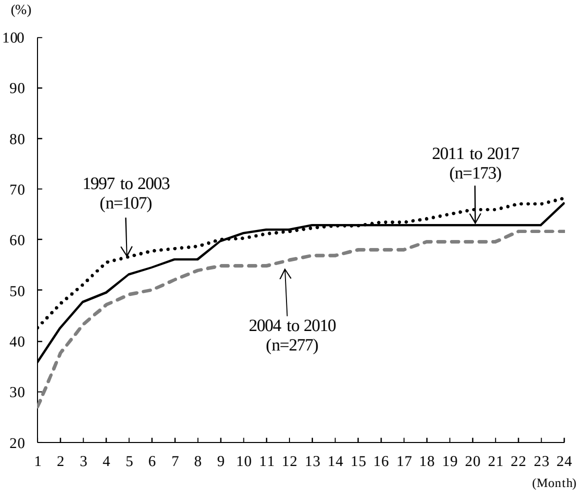
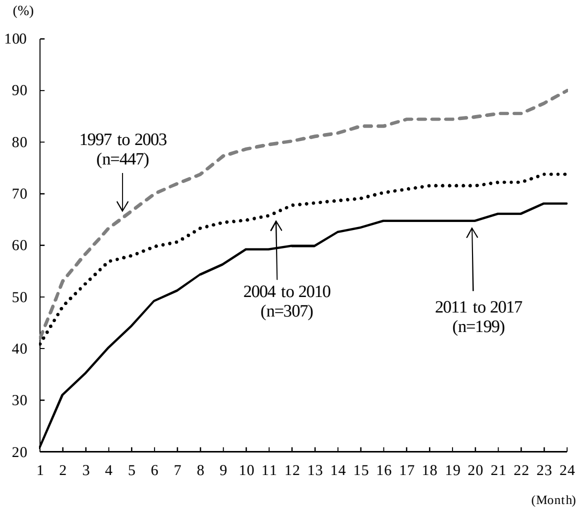


Figure-4 Changes in the probability of price adjustment
(price decrease→price decrease)



Therefore, we select one spell per firm at random. For example, in the case of Firm A, we select one spell from among its one right-censored spell and two spells.

Using the selected spells, we calculate the survival rate for each month. Then cumulative survival rate can be calculated by multiplying each survival rate. The cumulative survival rate represents the average probability of the firm keeping price unchanged during *t* months after the last price adjustment.

In the following analysis, we define the price adjustment probability as the cumulative survival rate differential (1 minus the cumulative survival rate). A firm's price adjustment probability can be interpreted as the average probability of the firm making price adjustment after *t* months from the last price adjustment.

Figure-2 shows firms' price adjustment probability. First, looking at the price adjustment probability calculated with the whole period, the probability of price adjustment by the end of the first month is around 40%. The probability gradually rises, reaching around 70% by 12 months later. Thereafter it remains almost flat. In other words, around 70% of the sample firms make price adjustment at least once every year, while around 30% tend to keep price unchanged after a year.

Next, we divide the sample period into three intervals (from January 1997 to December 2003, from January 2004 to December 2010, and from January 2011 to December 2017) and examine changes in firms' price adjustment probability during each interval. In the graph, an increase in price stickiness is expressed as a downward shift of the line.

Figure-2, which describes the line in each interval, shows a downward shift of the line. For example, during the interval from 1997 to 2003, the price adjustment probability after 24 months is around 90%. However, during the interval from 2011 to 2017, the price adjustment probability after 24 months is down to around 70%.

Note that the definition of the price adjustment includes both price increase and decrease. Is this fall in the price adjustment probability attributable to a change in price increase or decrease? To answer the question, we conduct similar estimation using price increase (decrease), instead of price adjustment. Here, the price adjustment probability means the probability of price increase (or decrease) being implemented by the *t* months after the last price increase (or decrease).

Figure-3 shows that the adjustment probability is highest during the interval from 1997 to 2003. During the interval from 2004 to 2010, the probability declines, but during the interval from 2011 to 2017, it rises again. This means that in recent years, sales prices have become likelier to rise compared with the interval from 2004 to 2010.

On the other hand, according to Figure-4, which shows the probability of price decrease, the line shifts downward with the passage of time. In other words, in recent years, sales prices have become likelier not to decline compared with the previous trend.

As shown in Figure-2, SMEs' price adjustment probability declines, indicating that prices have become stickier than before. However, the increased price stickiness is attributable in large part to a reduced likelihood of price decrease, rather than a reduced likelihood of price increase. From this finding alone, it appears as if the pricing environment has improved.

However, it should be kept in mind that the analysis so far conducted does not take into consideration the impact of change in the economic situation of companies. For example, the analysis period in this paper includes a period when purchase prices rose steeply due to a crude price increase. Therefore, the reduced likelihood of sales price decrease may be attributable to purchase price increase. In that case, we cannot say that the pricing environment for SMEs has improved. The important issue is the extent to which firms can reflect change in purchase price and other factors in their sales prices and whether or not their ability to do that has improved.

4. Determinant Factors of Price-Setting Behavior and Changes in the Behavior

(1) Determinant Factors of Price-Setting Behavior

In this section, we estimate a regression model to examine the firms' price-setting behavior. Before explaining our model, we review two theories that have been presented in many past studies in order to explain firms' price-setting behavior. One is the state-dependent pricing, which argues that timing of price-setting reacts to the idiosyncratic and aggregate shocks that firms are faced with. For example, if firms' sales have increased significantly and their production capacity has become tight, increasing prices is a desirable choice for profit maximization. On the other hand, if purchase prices have increased, retaining the profit margin by passing the increase on to their sales prices may be a desirable for firms. However, sales price adjustment needs additional cost. Therefore, firms adjust their sales prices only when the degree of change in their state has surpassed a certain level.

The other theory is the time-dependent pricing, which argues that the timing of price change is exogenously determined and irrespective of economic situation. Typical models used to explain this pricing include Taylor model (Taylor, 1980), which assumes that prices can be adjusted only at certain timings because the duration of the contract concerning price setting is prefixed, and Calvo model (Calvo, 1983), which assumes that probability of a price adjustment is exogenously determined.

Naturally, firms' actual price-setting behavior cannot be classified simplistically as either state-dependent or time-dependent. Our focus of interest here is whether Japanese SMEs' price-setting behavior is more of a state-dependent nature or of a time-dependent nature.

In our model, we consider two types of explanatory variables-state-dependent variables and time-dependent variables-based on these two theories. First, we include three types of state-dependent variables-cumulative change in sales, cumulative change in purchase price, and cumulative change in overtime-following Loupias and Sevestre (2013). These variables represent the cumulative change in individual variables during the spell between the last price adjustment and the next. For example, when we calculate the cumulative change in sales, we assign values to three reply options selected by survey respondents as follows: "1" for "increase", "0" for "unchanged" and "-1" for "decrease." Next, we check the changes that have occurred until now since the last price adjustment and add the assigned values accordingly. If the respondent selects "increase," "unchanged," and "increase," the value of cumulative change comes to 2.

The larger the value of the cumulative change is, the farther the current sales price level deviates from the optimum level. For example, if a firm continues to record a month-to-month increase in sales, its production capacity becomes tighter, and this leads to a rise in the optimum price level. When the deviation reaches a certain level, this triggers a sales price increase by the firm.

The same approach can be applied to purchase price and overtime. Note that overtime is used as a proxy variable for change in personnel cost. Therefore, an increase (decrease) in overtime can be interpreted as an increase (decrease) in personnel cost.

Next, following Lein (2010) and Schenkelberg (2013), we include Taylor dummies as time-dependent variables. Taylor dummies (t months) are variables that take the value "1" when the last sales price adjustment occurred t months ago and the value "0" in other cases. If a firm makes price adjustment at a

Table-2 Determinant factors of price-setting behavior (All years)

Explained variable	Price increase	Price increase	Price decrease	Price decrease
Estimation method	OLS	2SLS	OLS	2SLS
Cumulative change in sales	0.002 ***	0.015 ***	-0.003 ***	-0.023 ***
	(0.000)	(0.001)	(0.000)	(0.001)
Cumulative change in purchase price	0.001 ***	0.038 ***	-0.004 ***	-0.038 ***
	(0.000)	(0.002)	(0.000)	(0.002)
Cumulative change in overtime	0.000 ***	0.001 *	0.001 ***	-0.004 ***
	(0.000)	(0.000)	(0.000)	(0.001)
Taylor dummy (1 month)	0.140 ***	0.191 ***	0.320 ***	0.303 ***
	(0.008)	(0.010)	(0.008)	(0.009)
Taylor dummy (3 months)	0.019 ***	0.063 ***	0.041 ***	0.026 ***
	(0.004)	(0.005)	(0.006)	(0.007)
Taylor dummy (6 months)	0.011 ***	0.044 ***	0.011	-0.006
	(0.004)	(0.005)	(0.007)	(0.008)
Taylor dummy (12 months)	-0.009 **	0.010	-0.004	-0.016 *
	(0.005)	(0.006)	(0.009)	(0.010)
Sample size	48,672	45,625	48,672	45,625

Notes :
1. Each estimation includes seasonal dummies, year dummies, and industry-specific dummies, but the results concerning them are omitted.
2. ***,** and * indicate statistical significance at the 1%, 5%, and 10% levels. The figures in the parentheses indicate robust standard errors (hereinafter, the same applies except in Tables-4 and -6 and Figure-5).
3. Cumulative changes in sales, purchase price, and overtime are regarded as endogenous variables and the lag terms concerning changes in individual variables until the fourth period are used as instrumental variables (hereinafter, the same applies except in Figure-5 and Table-6).
4. Left-censored spells are excluded from the samples (hereinafter, the same applies except in Figure-5 and Table-6).
5. The samples are limited to price trajectories for which the respondents gave replies for at least 12 consecutive months from the first price adjustment (hereinafter, the same applies except in Figure-5 and Table-6).

fixed interval, the coefficient of the Taylor dummy takes a statistically significant positive value. In this paper, we use four Taylor dummies corresponding to four different intervals-1 month, 3 months, 6 months and 12 months.

Card and Sullivan (1988) show that cumulative variables used in our analysis lead to endogeneity issues. In addition, there is reverse causality in that a sales price increase leads to a sales increase. Therefore, when we estimate the model, we have to tackle these endogeneity problems. As the explained variable in our model is a binary, we would normally need to tackle these problems based on a non-linear model, such as a probit model. However, in our analysis, we solve these endogeneity problems by using a two-stage least squares based on a linear regression approach for convenience's sake.

If Japanese firms have a strong tendency to keep price unchanged irrespective of changes in their situation, the value of the coefficients of state-dependent variables is expected to be small. On the contrary to that, if they can adjust prices only at fixed intervals irrespective of change in their situation, the coefficients of time-dependent variables is expected to be large.

Table-2 shows the estimation results during the interval from January 1997 to December 2017. The explained variable is a price increase (decrease) which is a binary variable that takes the value "1" in the cases of price increase (decrease) and the value "0" in other cases. The left two columns show the estimation using price increase as the explained variable. A comparison of the results of the estimations that used the ordinary least squares and the two-stage least squares shows that there are differences in the coefficient of the cumulative change in sales and in purchase price. In the following discussion, we conduct analysis based on the two-stage least squares.

Concerning sales price increase, is firms' behavior more of a state-dependent nature or of a time-dependent nature? Looking at the estimated coefficients in the second column of Table 2, the coefficients of the cumulative change in sales and the cumulative change in purchase price are positive and significant at the 1% level. The finding that an increase in sales or purchase price leads to a rise in the probability of sales price increase is consistent with the state-dependent pricing theory.

However, the impact of change in sales or purchase price is not large. The impact of one unit change of purchase price on the probability of sales price increase is only 3.8 percentage points. Also, the impact of one unit change of sales is only 1.5 percentage points. State-dependent pricing has negligible impact on SMEs' price-setting, but the degree of state dependency is relatively small.

The coefficient of the cumulative change in overtime is positive and significant at the 10% level, but its value is smaller than that of the cumulative change in sales or purchase price. The impact of one unit change of overtime on the probability of sales price increase is only 0.1 percentage point.

Next, we will check the time-dependent aspect of price-setting behavior. The coefficients of the Taylor dummies except for the 1 month is significant at the 1% level, which means that time-dependent pricing has crucial role in Japanese SMEs' price-setting behavior. In addition, although a simple comparison is difficult, the coefficients of time-dependent variables are larger than those of state-dependent variables. For example, the impact of the Taylor dummy (3 months) on price increase is 6.3 percentage points.

A similar trend is observed when we conduct estimation using sales price decrease as the explained variable. The fourth column of Table-2 shows that the coefficients of all state-dependent variables-sales, purchase price, and overtime-are negative and significant at the 1% level. However, as in the case of price increase, the coefficient is relatively small.

In conclusion, state-dependent pricing has negligible impact on Japanese SMEs' price setting behavior. However, the degree of state dependency is relatively small and their behavior has more of the time-dependent nature. This tendency is observed with respect to either sales price increase or decrease.

(2) Increasing Stickiness of Price-Setting Behavior

Has it become easier or more difficult for firms to reflect change in purchase price in sales price? According to the argument concerning "the practice of keeping prices unchanged", the coefficients of state-dependent variables are supposed to decrease with the passage of time.

Table-3 shows the estimation results in the second column of Table-2 as divided into the three intervals of the analysis period. The coefficient of cumulative change in sales in the interval from 2004 to 2010 is higher than in the previous interval, but in the most recent interval, it falls again, down to 0.012. This means that a rise of one unit of sales (increase compared with the previous month) leads to a rise of only 1.2 percentage points in the probability of price increase. In the most recent interval, during which the

Table-3 Changes in price-setting behavior (Price increase)

Explained variable	Price increase	Price increase	Price increase	Price increase
Sample period	All years	1997 to 2003	2004 to 2010	2011 to 2017
Cumulative change in sales	0.015 ***	0.010 ***	0.019 ***	0.012 ***
	(0.001)	(0.001)	(0.002)	(0.002)
Cumulative change in purchase price	0.038 ***	0.085 ***	0.036 ***	0.023 ***
	(0.002)	(0.006)	(0.002)	(0.002)
Cumulative change in overtime	0.001 *	-0.001 ***	0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Taylor dummy (1 month)	0.191 ***	0.065 ***	0.284 ***	0.236 ***
	(0.010)	(0.006)	(0.015)	(0.014)
Taylor dummy (3 months)	0.063 ***	0.006	0.076 ***	0.085 ***
	(0.005)	(0.005)	(0.010)	(0.010)
Taylor dummy (6 months)	0.044 ***	-0.001	0.056 ***	0.052 ***
	(0.005)	(0.006)	(0.011)	(0.009)
Taylor dummy (12 months)	0.010 **	-0.012	0.000	0.017
	(0.006)	(0.010)	(0.011)	(0.010)
Sample size	45,625	16,399	15,844	13,382

economy entered an expansion phase, the degree of state dependency of Japanese SMEs' price-setting behavior is limited.

The coefficient of cumulative change in purchase price decreases with the passage of time, from 0.085 to 0.036 to 0.023. This means that it is becoming more and more difficult for Japanese SMEs to pass an increase in purchase price on to sales price.

On the other hand, compared with the level during the interval from 1997 to 2003, the coefficient of the Taylor dummies rise in the following intervals. SMEs' price-setting behavior has been becoming more and more time-dependent, rather than state-dependent. This may be because SMEs find it difficult to increase sales price at timings of their own choosing due to increased pressure from business clients. In addition, an estimation using sales decrease as the explained variable also finds that the coefficients of state-dependent variables decline with the passage of time.

In recent years, Japanese SMEs' tendency to keep prices unchanged in response to change in demand and cost has grown. This finding is consistent with the "entrenchment of the practice of keeping prices unchanged" that is pointed out by Watanabe (2018).

To what extent has practice contributed to prolonged deflation in Japan? In this subsection, we answer this question using the Blinder=Oaxaca decomposition method. The Blinder=Oaxaca decomposition is a method that decomposes the change in the explained variable into the impact of changes in the level of explanatory variables and the impact of changes in their coefficients. Here, we call first term as "the impact of the difference in the average value" and the second term as "the impact of change in firm behavior." For example, the average purchase price rise leads to a rise in the probability of sales price increase. This is the impact of the difference in the average value. On the other hand, when firms have ceased to reflect an increase in purchase price in sales price, the coefficient becomes smaller, which means a fall in the probability of sales price increase. This is the impact of change in firm behavior.

Our interest here is the impact of change in the coefficients of state-dependent variables on the probability of sales price increase.

Table-4 Blinder=Oaxaca decomposition (in the case of price increase)

	(1) 1997 to 2003		(2) 2004 to 2010		(3) 2011 to 2017		Change from (1) to (2)		Change from (2) to (3)	
Probability of price increase (Average value)	0.034		0.100		0.071		0.066		-0.030	
Explanatory variable	Coefficient	Average value	Coefficient	Average value	Coefficient	Average value	Difference in the average value	Change in firm behavior	Difference in the average value	Change in firm behavior
Cumulative change in sales	0.010	-0.609	0.019	-0.695	0.012	-0.213	-0.002	-0.006	0.006	0.002
Cumulative change in purchase price	0.085	0.055	0.036	1.820	0.023	1.960	0.064	-0.088	0.003	-0.025
Cumulative change in overtime	-0.001	-1.519	0.001	-2.282	-0.001	-1.887	-0.001	-0.005	0.000	0.003

Note: The coefficients are based on the estimation in Table-3. The results concerning Taylor dummies, seasonal dummies, year dummies, industry-specific dummies and interaction terms are omitted.

Table-4 shows the estimation results. The probability of sales price increase rises 6.6 percentage points from interval (1) to interval (2) but fall 3.0 percentage points from interval (2) to interval (3). Table 4 shows that the rise in the probability of sales price increase from interval (1) to interval (2) is attributable in large part to the difference in the average value of cumulative change in purchase price (6.4 percentage points). On the other hand, the impact of change in firm behavior is negative with respect to all variables, and the impact of change in firm behavior related to purchase price in particular is large (minus 8.8 percentage points). As for change from interval (2) to interval (3), the impact of change in firm behavior related to sales and overtime is positive but relatively small. In addition, the impact of change in firm behavior related to purchase price is negative (minus 2.5 percentage points).

What is the intensity of the impact of change in firm behavior? The total impact of change in firm behavior from interval (1) to interval (2) is -9.9 percentage points. Also, the total impact of change in firm behavior from interval (2) to interval (3) is -2.0 percentage points. Overall, change in firms' price-setting behavior pushed down the probability of sales price increase by 11.9 percentage points from interval (1) to interval (3). Given that the probability of sales price increase in the recent interval is only 7.1%, we can say that the negative impact of change in firms' price-setting behavior has been substantial.

5. Passing of Cost Increase On to Prices

(1) Passing of Cost Increase On to Prices as Viewed through Regression Analysis

As described above, SMEs’ price-keeping practice is becoming more and more entrenched. In particular, the tendency to reflect change in purchase price in sales price has weakened with the passage of time. In which industries and among which sizes of firms is this trend conspicuous? In this section, as a supplementary analysis, we examine differences by firm attribute in price-setting behavior, particularly in terms of how much change in purchase price is reflected in sales price.

First, based on the regression analysis conducted in the previous sections, we examine differences in price-setting behavior by industry. Here, we add the interaction terms between industry-specific dummies and cumulative change in purchase price into the estimation that is shown in Table-2.

Table-5 shows the estimation results. As the wholesale trade industry is used as the reference variable, we can interpret that industries for which the coefficient is positive find it easy to reflect purchase price increase in sales price compared with the wholesale industry and vice versa.

Among industries for which the coefficient is positive and significant are non-ferrous metals (0.080), lumber and wood (0.059), and iron and steel (0.050). Since these industries are materials-related ones, it may be relatively easy to pass change in purchase price onto sales price.

On the other hand, the coefficient is negative and large for transportation equipment (-0.061), transport (-0.055), and printing (-0.053). Sales price increasing may be difficult for transportation equipment, since these firms mostly do sub-contracting work. In the case of transport and printing, excessive competition has been pointed out, so the result is easy to understand intuitively.

Table-5 Interaction term of industry-specific dummies and cumulative change in purchase price

Industry	Coefficient
Food	-0.032 *** (0.008)
Textiles	0.005 (0.011)
Lumber and wood	0.059 *** (0.018)
Paper	0.003 (0.011)
Chemicals	-0.002 (0.007)
Ceramics, stone, and clay	-0.049 *** (0.006)
Iron and steel	0.050 *** (0.011)
Non-ferrous metals	0.080 *** (0.017)
Metal products	-0.026 *** (0.006)
General-purpose machinery	-0.047 *** (0.005)
Electronic parts and devices	-0.044 *** (0.005)
Transportation equipment	-0.061 *** (0.008)
Precision instruments	-0.025 *** (0.009)
Other manufacturing	-0.043 *** (0.008)
Construction	-0.015 ** (0.008)
Printing	-0.053 *** (0.006)
Transport	-0.055 *** (0.006)
Wholesale trade	(Reference variable)

Note:
As additional instrumental variables for the interaction terms of industry-specific dummies and cumulative change in purchase price, we use the lag terms concerning these variables.

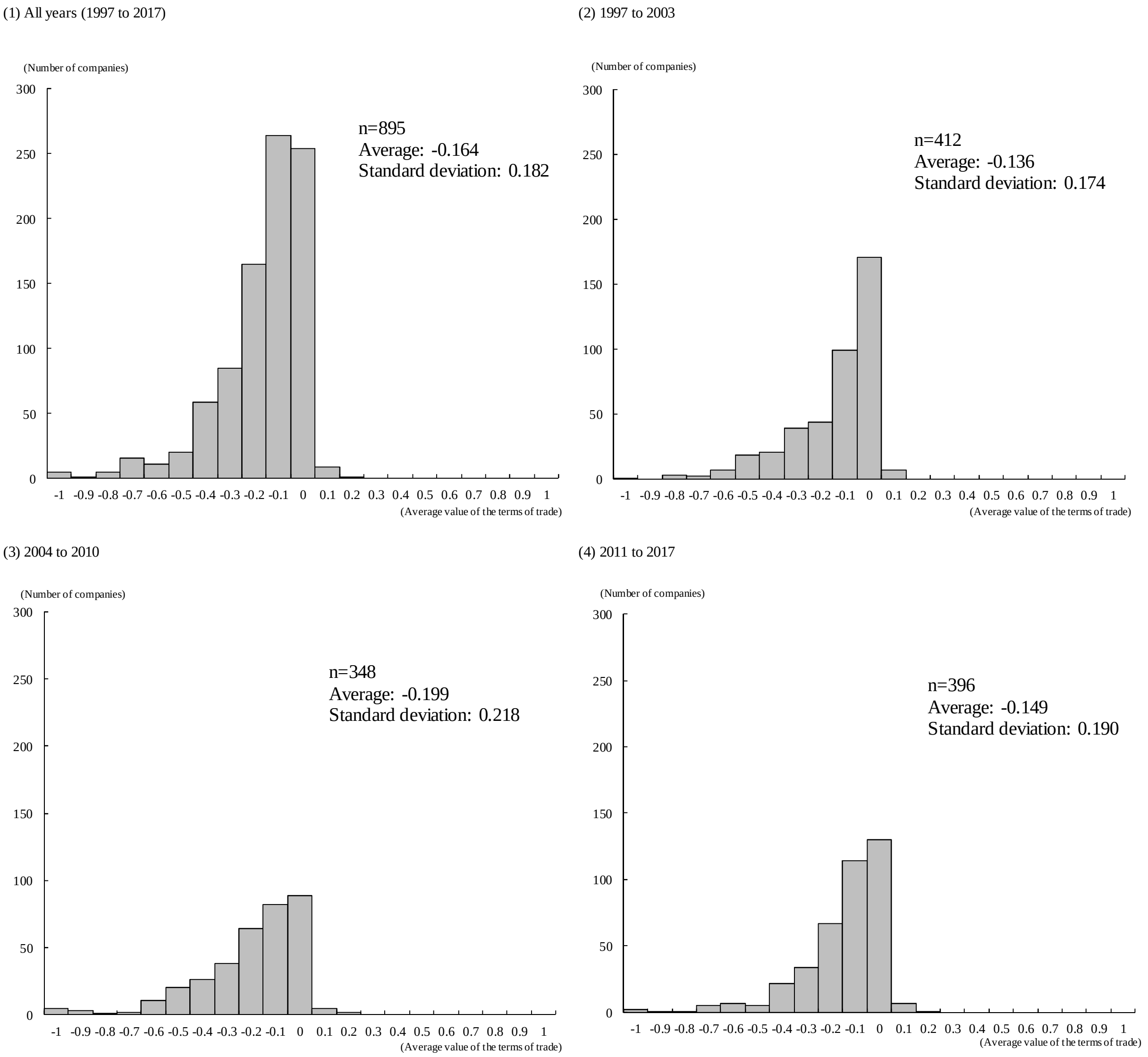
(2) Terms of Trade

Next, in order to look at differences in the passing of cost increase on to sales price by firm attribute from another viewpoint, we calculate the terms of trade based on micro data and examine the distribution of obtained values and differences in the terms of trade.

The terms of trade, which refers to the ratio of sales price to purchase price, is an indicator of firms' profitability[1]. In the case of diffusion index, the terms of trade is obtained by subtracting the purchase price DI from the sales DI. In this subsection, we calculate the terms of trade based on micro data.

[1] The terms of trade is usually defined as the ratio of export price to import price. However, the ratio of a firm’s sales price to purchase price is also called the terms of trade in some cases.

Figure-5 Distribution of the average value of the terms of trade (by sample period)



The calculation method is as follows. First we assign value to replies to the questions concerning sales and purchase prices as follows: "1" for "increase" "0" for "unchanged" and "-1" for "decrease." Next, we subtract the value given in relation to purchase price from the value given in relation to sales price. For example, when a firm selects "unchanged" in relation to sales price and "increase" in relation to purchase price, the terms of trade for the firm is -1. The terms of trade takes a value ranging from -2 to 2.

Figure-5 shows histograms of the average value of the terms of trade. As the number of responses by firm differs from interval to interval, a simple comparison may be misleading. For example, it would not be appropriate to compare a firm which responds only once with a firm which responds more than 60 times. Here, we conduct comparison only among firms which responds more than 60 times in each interval.

As in the previous case, the histograms represent the results in all sample period and the results in the three intervals of the period. First, looking at the histogram that represents the results in the whole period, there is a dense concentration of the values in the negative column. The average value is -0.164. This

Table-6 Changes in the terms of trade (by sample period, by workforce size, and by industry)

(Unit: cases, %)

(1) By sample period

1997 to 2003

	Improvement	Neutral	Deterioration
Sample Size	2	208	202
Share	(0.5)	(50.5)	(49.0)

2004 to 2010

	Improvement	Neutral	Deterioration
Sample Size	3	110	235
Share	(0.9)	(31.6)	(67.5)

2011 to 2017

	Improvement	Neutral	Deterioration
Sample Size	4	167	225
Share	(1.0)	(42.2)	(56.8)

(2) By workforce size

less than 30 employees

	Improvement	Neutral	Deterioration
Sample Size	2	115	198
Share	(0.6)	(36.5)	(62.9)

30 to 99 employees

	Improvement	Neutral	Deterioration
Sample Size	1	125	281
Share	(0.2)	(30.7)	(69.0)

100 or more employees

	Improvement	Neutral	Deterioration
Sample Size	2	44	127
Share	(1.2)	(25.4)	(73.4)

(3) By industry

Manufacturing

	Improvement	Neutral	Deterioration
Sample Size	4	194	475
Share	(0.6)	(28.8)	(70.6)

Wholesale trade

	Improvement	Neutral	Deterioration
Sample Size	1	71	83
Share	(0.6)	(45.8)	(53.5)

Construction

	Improvement	Neutral	Deterioration
Sample Size	0	19	48
Share	(0.0)	(28.4)	(71.6)

Printing

	Improvement	Neutral	Deterioration
Sample Size	12	8	41
Share	(19.7)	(13.1)	(67.2)

Transport

	Improvement	Neutral	Deterioration
Sample Size	0	11	30
Share	(0.0)	(26.8)	(73.2)

Sub-categories of manufacturing

Food

	Improvement	Neutral	Deterioration
Sample Size	0	18	30
Share	(0.0)	(37.5)	(62.5)

Textiles

	Improvement	Neutral	Deterioration
Sample Size	2	16	29
Share	(4.3)	(34.0)	(61.7)

Metal products

	Improvement	Neutral	Deterioration
Sample Size	1	30	69
Share	(1.0)	(30.0)	(69.0)

General-purpose machinery

	Improvement	Neutral	Deterioration
Sample Size	1	13	80
Share	(1.1)	(13.8)	(85.1)

Electronics parts and devices

	Improvement	Neutral	Deterioration
Sample Size	0	17	38
Share	(0.0)	(30.9)	(69.1)

Transportation equipment

	Improvement	Neutral	Deterioration
Sample Size	0	13	30
Share	(0.0)	(30.2)	(69.8)

indicates that many firms have been unable to pass purchase price increase on to sales price.

In addition, in all histograms that represent the results by interval, there is a dense concentration in the negative column. The concentration in the negative column is particularly dense in the interval from 2004 to 2010, with the average value at -0.199. A resource price rise is probably the main factor behind the dense concentration. The crude oil price, which was around 30 dollars/barrel in 2004 rose to around 140 dollars/barrel in the peak year of 2008. The resource price rise is presumed to have aggravated many SMEs' terms of trade.

Next, we divide firms into those which experience improvement, neutral, and deterioration in the terms of trade, and we look at their shares in the total number. Here, firms whose average value of terms of trade is positive and significantly above zero are defined as "improvement". Firms whose average value of terms of trade is negative and significantly below zero are defined as "deterioration" and firms the average value of which is not significantly above or below zero as "neutral". Then we calculate the share of each category of firms. We set the significance level as 5%.

Table-6 shows the shares of "improvement" "neutral" and "deterioration" firms. In (1), which shows the share in each interval, the share of "neutral" firms is 50.5% in the interval from 1997 to 2003 but fall to 31.6% in the interval from 2004 to 2010. In the subsequent interval from 2011 to 2017, the share rises, but only to 42.2%. In the interval from 2011 to 2017, which mostly coincides with the economic expansion phase in Japan, as much as 56.8% of firms experience "deterioration" in the terms of trade.

Next, we look at the share by firm attribute. Table-6 (2) shows the shares by workforce size. Unexpectedly, the share of "deterioration" tends to be large among firms with a larger size. Although firms with a larger size may be presumed to be in a stronger price-negotiating position, the actual trend is not consistent with that presumption. Even if the sample firms are further divided by industry, this trend is also observed, although the results of analysis based on the subdivision are not shown in the table. At least, a simple cross-tabulation indicates that the larger the firm size is, the larger the share of "deterioration" is. It may be because their larger number of business clients leads to a situation which increases the cost of sales price adjustment.

Table-6 (3) shows the shares of firms by industry. Regarding the breakdown of the manufacturing industry into sub-categories, only the results concerning sub-categories whose sample size is at least 40 firms are indicated. The share of "neutral" is larger in the wholesale trade than in the manufacturing. On the other hand, in industries where excessive competition has been pointed out as well as in the manufacturing industry, the share of "deterioration" is large.

6. Factors behind Change in Price-Setting Behavior

Using the micro-level data of the Trend Survey, we examine the price-setting behavior of Japanese SMEs and show that the price-keeping practice is spreading among Japanese SMEs. What factors have caused firms' price-setting behavior to become stickier? Watanabe and Watanabe (2015) cite two hypotheses to explain the contributing factors.

One of the hypotheses is that structural changes have caused firms' price-setting behavior to become stickier. For example, changes such as intensifying competition between firms due to globalization and consumers' growing preference for lower prices are likely to make it difficult for firms to increase prices. If firms' sense of uncertainty over the future grows, they may become afraid of increasing prices, resulting in increased stickiness of the price-setting behavior. Those are exogenous factors that cannot be controlled through firms' efforts.

The other hypothesis is that when the inflation rate is low, it is inevitable for firms' price-setting behavior to become stickier. If firms refuse to increase prices when the inflation rate is high—namely when other firms are raising prices—the amount of profits they lose by keeping prices unchanged would be large. Then, they have incentive to increase their prices. On the contrary to that, when the inflation rate is low, the cost of making price change would outweigh the loss of profits, so keeping prices unchanged is likely to be the best strategy. According to this argument, change in price-setting behavior can be explained by the low inflation rate.

Table-7 Impact of the Corporate Goods Price Index on corporate behavior (in the case of price increase)

Explained variable	Price increase		Price increase		Price increase	
Sample period	1997 to 2003		2004 to 2010		2011 to 2017	
Cumulative change in sales	0.009 ***	0.009 ***	0.014 ***	0.013 ***	0.011 ***	0.010 ***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Cumulative change in purchase price	0.051 ***	0.049 ***	0.030 ***	0.026 ***	0.026 ***	0.023 ***
	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Cumulative change in overtime	-0.001	-0.001	0.000	0.000	-0.002 *	-0.002 *
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Corporate Goods Price Index		0.003 **		0.007 ***		0.008 ***
		(0.001)		(0.001)		(0.001)
Sample size	11,721	11,721	11,143	11,143	8,708	8,708

Source: Bank of Japan "Corporate Goods Price Index"

Note: The results concerning Taylor dummies, seasonal dummies, year dummies, and industry-specific dummies are omitted.

Although it is difficult to verify the former hypothesis based on the data obtained through our analysis, it is possible to verify the latter hypothesis. Specifically, we add the price index as an additional explanatory variable into the regression analysis and calculate its coefficient. If the latter hypothesis is valid, adding the price index as an additional explanatory variable is supposed to eliminate the change in firms' price-setting behavior—namely the decline in the coefficients of state-dependent variables.

Here, we use the year-on-year growth rate of the Bank of Japan's Corporate Goods Price Index (CGPI). As the scope of product items covered by the index is limited, only 14 of the industries indicated in Table-4—from food to other manufacturing—are included in the analysis. We estimate regression model similar to the one the results of which are shown in Table-3 by including the industry-by-industry corporate goods price index corresponding to each industry as the explanatory variable.

Table-7 shows the results. Here, in order to clarify the impact of the CGPI as an additional variable, we compare the results that don't use the CGPI and that use the CGPI. Although the coefficient of the CGPI is positive, it is not large. For example, during the most recent interval, the probability of sales price increase is risen only 0.8 percentage points by 1 percentage point rise of CGPI.

Does the inclusion of the CGPI eliminate the decline in the coefficients of state-dependent variables indicated in Table-3? A comparison of the estimation shows that the use of this additional variable does not have any significant impact on the coefficients of state-dependent variables. For example, the coefficient of cumulative change in purchase price changes only slightly, from 0.051 to 0.049 over the first interval, from 0.030 to 0.026 over the second interval, and from 0.026 to 0.023 over the third interval. As a result, the coefficient of cumulative change in purchase price continues to decline with the passage of time when the CGPI is used as an additional variable. This means that the impact of the inflation rate alone is unlikely to explain changes in firms' behavior.

Therefore, it may be difficult to uphold the hypothesis that when the inflation rate is low, it is inevitable for firms' price-setting behavior to become stickier. The other hypothesis—that structural changes leads to change in firms' price-setting behavior, probably explains the change, although further examination is necessary.

7. Conclusion

In this paper, we examine the price-setting behavior of SMEs, and show that firms' price-keeping practice has become more and more entrenched with the passage of time. As this trend has lasted too long, many SMEs have presumably been preoccupied with how to curb their costs without considering the option of negotiating with business clients over price increase. Of course, in light of the balance of power with clients and price competition with other firms, behaving in this way may have been a rational strategy. However, as the rise in materials price and personnel cost continues over the medium to long term, the strategy of continuing to keep prices unchanged will reach its limits in due course. In order to keep business afloat, it will become necessary sooner or later to revise the pricing strategy.

Recently, there have been signs of change in firms' price-setting behavior in Japanese firms. In October 2017, a major transport firm raised delivery fares for the first time in 27 years. This has changed the mood in the transport industry, and we often hear it said that it has become easier for small and medium transport firms to engage in price-raising negotiations. Raising fares has become possible presumably because it has become easier to obtain users' understanding as a result of media reports about the labor shortage and the overtime problem in the transport industry.

The positive mood for price increase is not limited to the transportation industry but has started to spread to a broader range of industries. In Japan, the perception that prices do not change has been pervasive for many years. That is true not only among consumers but also among firms. However, normally, flexibly changing prices should be an effective way for firms to pursue profits. Rather than regarding sales price as a given that cannot be changed, SMEs must rethink and look at sales price as a business strategy element.

Finally, we refer to future research topics. First, because of the data constraint, our analysis focused exclusively on SMEs price-setting behavior. Therefore, it is difficult for us to compare the characteristics of SMEs' price-setting behavior with that of large and middle-sized firms. Intuitively, SMEs, which mostly do subcontracting work, are more likely to be unable to change prices at the timings of their own. However, as shown by Table-6, the analysis results sometimes defy intuition. One future research topic is analyzing differences in price-setting behavior by firm size.

Second, in this paper, we are unable to fully analyze the factors behind the increased stickiness of price-setting behavior due to data constraints. For example, we cannot say anything definite about how price-setting behavior is affected by the factors cited in Section 6, including changes in the competitive environment and consumers' preferences. In addition, there is the possibility that growing uncertainty may be affecting the increased stickiness of price-setting behavior. Bachmann et al. (2018) analyze the impact of the uncertainty index, which is developed based on ifo business climate index, on price-setting behavior.

As a result, Bachmann et al. (2018) shows that an increase in uncertainty causes a rise in the probability of price adjustment. An uncertainty index can also be calculated based on micro-level data of the Trend Survey. Therefore, it may possible to identify the impact of the uncertainty index on price-setting behavior in Japan. In the case of Japan, there is the possibility that uncertainty has constrained firms' price-setting behavior through the so-called "wait-and-see effect."[2]

Third, the Trend Survey data used in this paper are categorical, so our analysis cannot take into consideration the quantitative change in sales and purchase price. However, in the analysis of price-setting behavior, it is important to examine not only whether firms increased or decreased prices but also how much prices changed. Therefore, it may be important to take into consideration not only the frequency of price adjustment but also the quantitative aspect of price change in future analysis.

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[2] According to Vavra (2014), an increase in uncertainty exercises two kinds of effects on price-setting behavior. One is the volatility effect, which refers to a rise in the probability of price adjustment, and the wait-and-see effect, which is attributable to the price adjustment cost. If the wait-and-see effect outweighs the volatility effect, an increase in uncertainty lowers the probability of price adjustment.

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