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Markups and Pass-through Along the Supply Chains*

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Abstract

The rising trend in markups documented in the United States and many other countries posed concerns in recent decades. This paper estimates firm-level markups using Japanese data during 2000--2021. First, we find that the markups overall have barely changed in the past 20 years. However, when we restrict the sample to the manufacturing sector, the markups decreased between 2000 and 2009 and increased between 2010 and 2021. There appears to be little change over the period of COVID-19. Second, we additionally exploit firm-level buyer-supplier linkage information to study the relationship between buyer and supplier markups. Our findings show that there is positive and significant correlation between markups of firms on both sides of the transactions. This result suggests the potential pass-through of prices along the supply chains.

Keywords: markups; supply chains; productivity
JEL classification: L11, L13, L16, O33

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1 Introduction

There have been dramatic changes in the business environment over the last couple of decades, accompanied by declining productivity growth, a falling labor share, and rising markups. These phenomena have been documented in the United States and many other countries (e.g., Autor et al., 2021; de Loecker et al., 2020; de Loecker et al., 2023). This could be concerning because the rising markups imply higher prices for a given level of marginal costs, which is damaging to consumer welfare.

It is also important to investigate how firm-level markups are along the supply chains correlated. Recent increasing inflation raises concerns for both firms and households. On firm side, it is detrimental for firms' survival whether firms' input price increases can be passed on to their output prices. On household side, the increase in prices lead to reducing living standards if wage increase does not come up with price increase. Having these as the motivational background, this paper studies the trend in markups in Japan and investigate the relationship between buyer and supplier markups.

The existing evidence is somewhat mixed whether the markups in Japan is increasing over the decades. Some studies find a stagnating trend in firm-level markups (e.g., Nakamura and Ohashi, 2019; Nishioka and Tanaka, 2019), whereas other studies find a persistent declining trend (see Aoki et al., 2023). The difference partly comes from the difference in the sampling frame and period of the data. Nakamura and Ohashi (2019) use firm-level data covering relatively large firms in Japan, and Nishioka and Tanaka (2019) use plant-level data covering only manufacturing firms. Aoki et al. (2023) utilize firm-level data that uniquely cover many small and medium-sized firms.

This paper exploits the Basic Survey of Japanese Business Structure and Activities (BSJBSA) conducted by the Ministry of Economy, Trade and Industry (METI). The data cover firms in various industries and are used in Nakamura and Ohashi (2019). We construct the panel data from 2000–2021. Following the so-called 'production function approach', we obtain estimates of firm-level productivity and markup. We additionally draw on the buyer-supplier linkage information from annual surveys conducted by a credit reporting company, Tokyo Shoko Research, Ltd. (TSR).

We find that the increasing trends documented in the US and other countries are not present in Japan. In particular, we find the stagnating trends in markups among Japanese firms. However, when we focus on the manufacturing sector, the markups has a decreasing trend between 2000 and 2009 and then an increasing trend between 2010 and 2021. These changes appear to be stronger in larger firms.

Then, we exploit the information of buyer-supplier linkages to examine the relationship

between buyer and supplier markups. We find that buyer markups are positively correlated with supplier markups. When a suppliers' markups increase by 10%, a buyer firms' markup becomes higher by 1% point on average, controlling for productivity, supplier concentration measure, and other covariates. Our results also confirm positive exporting premium in firm-level markups that is observed in de Loecker and Warzynski (2012).

Lastly, we find suggestive evidence of pass-through. Subsample regressions imply that the relationship between buyer and supplier markups are stronger among larger firms. The coefficient of supplier markup for large firms is about 1.6 as large as that for small firms. Also, the relationship is stronger among continuing transactions rather than dropped or newly started ones. However, longer transactions appear to hamper the correlation between buyer and supplier markups. In this sense, the findings suggest that there is relational pass-through.

The rest of the paper is structured as follows. Section 2 provides background information on the datasets that we use in this paper. Section 3 describes the methodology to estimate firm-level productivity and markup and the trend of markups during 2000–2021. Also, we show the relationship between markup and firm size. Section 4 presents the regression results to study the relationship between buyer and supplier markups. We also conduct subsample regressions based on firm size classifications. Finally, Section 5 concludes.

2 Data

2.1 The Basic Survey of Japanese Business Structure and Activities (BSJBSA)

Our main data come from the Basic Survey of Japanese Business Structure and Activities (BSJBSA), the Ministry of Economy, Trade and Industry (METI), covering firms from 2000 to 2021. This survey targets firms with 50 or more employees and capital or investment funds of 30 million yen or more. Therefore, it focuses on medium- to large-sized firms. The survey includes industries such as manufacturing, mining, wholesale and retail trade, and food services, as well as information and communication services and professional services. As for the survey conducted in 2023, the response rate is 89.1%.[1]

From BSJBSA data, we can observe firm-level sales, the number of employees, firm age, cost of goods sold (COGS), selling, general and administrative expenses (SG&A), labor cost, etc. The rich amount of information in the BSJBSA data allows us to estimate firm-level productivity and markup.

[1]Source: The Ministry of Economy Trade and Industry.

2.2 TSR Data

We supplement our data with the information of large-scale buyer-supplier linkages in Japan. The source of information is annual surveys conducted by a private credit reporting company, Tokyo Shoko Research, Ltd. (TSR), and we refer to the data as the TSR data. The TSR data are not census but they cover approximately 70% of all incorporated firms in Japan, including both listed and non-listed firms. We merge TSR data with BSJBSA data using Japanese corporate number. The combined dataset covers the period between 2007 and 2021. The total number of observations is around 0.38 million, which indicates that there were approximately 25,000 observations for each year. The unique number of firms in the dataset is 44,562, which implies that a firm, on average, appears in the data for about 8 years.

Table 1 below shows the number of firms across sample years. Also, we divide the number of firms, separately for manufacturing and non-manufacturing sectors. Those numbers are stable across years, except for the fact that we have the relatively small number of firms in 2016 and the relatively large number of firms in 2021.

Table 1. The Number of Firms

Year	All	Percent	Manufacturing	Non-manufacturing
2007	22,698	5.97	10,668	12,030
2008	24,049	6.32	11,190	12,859
2009	24,787	6.52	11,376	13,411
2010	25,106	6.60	11,291	13,815
2011	25,963	6.83	11,466	14,497
2012	25,951	6.82	11,312	14,639
2013	26,085	6.86	11,343	14,742
2014	25,866	6.80	11,153	14,713
2015	25,070	6.59	10,883	14,187
2016	26,035	6.84	11,151	14,884
2017	25,626	6.74	11,022	14,604
2018	25,209	6.63	10,932	14,277
2019	24,025	6.32	10,491	13,534
2020	25,158	6.61	11,027	14,131
2021	28,755	7.56	12,297	16,458

Note: "All" indicates the number of firms observed each year. "Percent" represents the proportion of observations for each year relative to the total. "Manufacturing" and "Non-Manufacturing" show the number of firms classified as manufacturing and non-manufacturing sectors, respectively.

2.3 Summary Statistics

Table 2 below shows the summary statistics. From Panel A, the mean of the number employees is about 530 and the median is 164, which implies that our data cover relatively large firms in Japan. This is also confirmed with the descriptive statistics of firm sales, age, the amount of registered capital. This is because of the sampling frame of the BSJBSA. About 23% of firms in the data participate in either exporting or importing. Even after restricting to arm's length, there are still about 20% of firms directly involving in trade activities.

Panel B shows firm-level productivity and markup estimated in the methodology described below. COGS and OPEX refer to two measures of the variable input used in estimating productivity and markup. Productivity is demeaned within 3-digit industry level that each firm belongs to. Estimated markups and productivity are winsorized with top and bottom 5%.

Table 2. Summary Statistics

	# of obs	Mean	Median	SD	Max	Min
Panel A: Firm characteristics						
Firm sales	380,383	24,686,898.082	4,854,000	1.572e+08	1.273e+10	1,000
Firm age	380,375	44.039	45	20.468	140	0
Employment	335,740	529.615	164	2,082.538	153,405	1
Registered capital	380,383	1,633,922.276	90,000	1,633,922.276	1.644e+09	30,000
Export	380,383	0.233	0	0.423	1	0
Export (Arm's length)	380,383	0.204	0	0.403	1	0
Import	380,383	0.236	0	0.424	1	0
Import (Arm's length)	380,383	0.200	0	0.400	1	0
Panel B: Productivity and Markups						
Productivity (COGS)	344,228	-0.004	0.002	0.111	0.236	-0.235
Productivity (OPEX)	358,680	-0.004	-0.001	0.059	0.126	-0.151
Markups (COGS)	344,228	1.148	0.992	0.522	2.714	0.567
Markups (OPEX)	358,680	1.096	1.046	0.217	1.670	0.770

Note: The units of sales and registered capital are 1,000 yen. Employment shows the number of employees. COGS and OPEX refer to two measures of the variable input when estimating productivity and markup. Productivity is demeaned within 3-digit industry level that each firm belongs to. Estimated markups and productivity are winsorized with top and bottom 5%.

3 Estimation of Markups

3.1 Framework

Here, we explain the procedure to estimate firm-level markup. We adopt the production function approach proposed by de Loecker and Warzynski (2012), and, in particular, follow Nakamura and Ohashi (2019) to estimate productivity and markup of Japanese firms. As conducted in previous studies, we consider firms' cost minimization problem given input prices and obtain firm-level markup from production function estimation (see, among others, de Loecker and Warzynski 2012, and de Loecker, Eeckhout, and Unger 2018).

Let the production function of firm i in industry j at time t be

$$Y_{it} = F_j\left(X_{it}, L_{it}, K_{it}, \omega_{it}\right)$$

where Y_{it} is output, X_{it} is variable input, L_{it} is labor, K_{it} is capital stock, and ω_{it} is productivity. Productivity is observable by the firm itself but unobservable to the analyst.

Assuming that firms minimize production costs, the corresponding Lagrange function is given by

$$\begin{aligned}\mathcal{L}\left(X_{it}, L_{it}, K_{it}, \lambda_{it}\right) = P_{it}^X X_{it} + w_{it} L_{it} + r_{it} K_{it} \\ + \lambda_{it}\left(Y_{it} - F_j\left(X_{it}, L_{it}, K_{it}, \omega_{it}\right)\right),\end{aligned}$$

where P_{it}^X is the unit price of the variable input, w_{it} is the wage rate, and r_{it} is the user cost of capital.

The first-order condition for the variable input is written as

$$\frac{\partial \mathcal{L}(\cdot)}{\partial X_{it}} = P_{it}^X - \lambda_{it}\frac{\partial F_j}{\partial X_{it}} = 0.$$

If we denote the elasticity of the variable input in the production function $\frac{\partial F_j}{\partial X_{it}}\frac{X_{it}}{Y_{it}}$ as β_{it}^X, the first-order condition can be rewritten as

$$\frac{P_{it}^X X_{it}}{P_{it} Y_{it}} - \lambda_{it}\frac{\beta_{it}^X}{P_{it}} = 0.$$

The Lagrange multiplier λ_{it} is given by $\lambda_{it} = \frac{\partial \mathcal{L}}{\partial Y_{it}}$. Since λ_{it} represents the marginal cost of production, the markup μ_{it} can be written as

$$\mu_{it} = \frac{\beta_{it}^X}{\alpha_{it}^X}.$$

Here, α_{it}^X is defined as

$$\alpha_{it}^X \equiv \frac{P_{it}^X X_{it}}{P_{it} Y_{it}}.$$

The term α_{it}^X is observable from the data as the ratio of nominal intermediate input to nominal sales revenue, and β_{it}^X can be obtained as an estimated value of the input elasticity in the production function.

3.2 Data for Markup Estimation

The data used for the markup estimation consists of firms included in BSJBSA from 2000 to 2021. While the analysis using the estimated markups is conducted with data from 2007 onwards to align with TSR data, the estimation of markups itself uses data from 2000 onwards.

The variables used for estimating the production function need to be deflated. For this purpose, we utilize the JIP Database 2023 provided by The Research Institute of Economy, Trade and Industry (RIETI) to create deflators for sales, intermediate inputs, capital investment, and labor hours, thus deflating each variable. The deflators are calculated as the ratio of nominal to real values provided in the JIP Database. The real net capital stock is created following Nishimura et al. (2005) using real capital investment. All deflators are based on the year 2011. Additionally, these deflated variables are winsorized at the 1% level on both sides to mitigate the influence of outliers. Furthermore, we obtain information on industry-specific man-hours per person from the JIP Database and multiply it by the number of employees to calculate the total labor input for each firm.

3.3 Estimation of the Production Function and Markup

In this paper, we use the translog-type production function, following Nakamura and Ohashi (2019):

$$\begin{aligned}\log Y_{it} =& \beta_l \log L_{it} + \beta_{ll} (\log L_{it})^2 + \beta_k \log K_{it} + \beta_x \log X_{it} + \beta_{xx} (\log X_{it})^2 \\ &+ \boldsymbol{Z_{it}\gamma} + \omega_{it} + \epsilon_{it},\end{aligned}$$

where vector Z_{it} represents additional control variables, and ϵ_{it} is the error term. All parameters are assumed to be time-invariant but industry-specific. The estimation of the production function is performed using the method proposed by Levinsohn and Petrin (2003).

For the variable input X_{it}, we use the cost of goods sold (COGS) less labor cost as the main variable. This corresponds to material, fuel, and energy inputs. Alternatively, we use operating expense (OPEX), defined as COGS plus selling, general, and administrative

expenses (SG&A), minus labor costs, incorporating costs related to marketing and management. Additional control variables Z_{it} include year dummies, five-year interval dummies for firm age, and the firm's sales share within its industry.

By estimating this production function, the markup μ_{it} can be estimated based on the following equation:

$$\widehat{\mu}_{it} = \frac{\widehat{\beta}_{it}^{X}}{\widehat{\alpha}_{it}^{X}},$$

where $\widehat{\alpha}_{it}^{X}$ is defined as

$$\widehat{\alpha}_{it}^{X} = \frac{P_{it}^{X} X_{it}}{P_{it} Y_{it} / \exp\left(\hat{\epsilon}_{it}\right)}.$$

3.4 Estimated Markups

Figure 1 shows the estimated markups for the period between 2000 and 2021. The markups are averaged using sales share as weights. In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. From the figure, we find that the markups for the entire set of industries have barely changed in the past 20 years. However, when we restrict the sample to the manufacturing sector, the markups have decreased between 2000 and 2009 and increased between 2010 and 2021. There appears to be little change over the period of COVID-19. As observed in Nakamura and Ohashi (2019), the manufacturing sector has higher markups than non-manufacturing sector over the sample period. They point out that manufacturing goods are more differentiated than non-manufacturing service in Japan.

Appendix Figure A.1 shows the estimated markups for the period between 2000 and 2021. In the estimation, we use another measure of the variable input such as the sum of COGS and selling, general, and administrative expenses (SG&A), less labor cost, proposed by Traina (2018). As seen from Appendix Figure A.1, the trend of markups estimated with the second measure of the variable input is similar with what is shown in Figure 1.

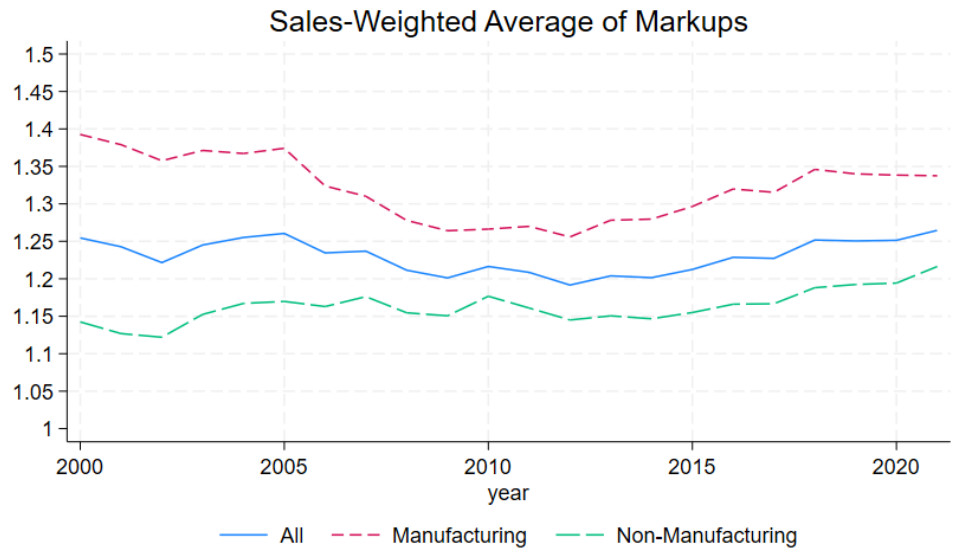
Appendix Figure A.2 shows the estimated markups separately for the metropolitan area and the rest of Japan. It is shown that the markups are higher in the metropolitan area throughout the sample period. However, the trends are similar in both regions.

Our estimates of markups are within the range of those reported in previous studies. First, our findings are consistent with Nakamura and Ohashi (2019) as both studies exploit the same data, i.e., the BSJBSA data. We extend their data to cover 2000–2021, and find that the markups in the manufacturing sector are in the increasing trend until 2021. Second, Nishioka and Tanaka (2019) use the plant-level data of the manufacturing sector and find the mean of around 1.3. Their findings is similar to ours although we exploit firm-level data

and our data include the non-manufacturing sector as well.

Third, Aoki et al. (2023) exploit the information of financial statements that capture many small and medium-sized enterprises (SMEs) in Japan. They find that the level of markups (mean) persistently goes down from around 1.3 in FY2005 to around 1.0 in FY2020, and that both manufacturing and non-manufacturing sectors have the similar pattern. The pattern of persistent decline in the markups is different from what we find in this paper. This difference may come from the differences in their data and ours. Their data include mainly SMEs, whereas our sample is composed of relatively large firms in Japan. As shown below, we find that smaller firms in our sample have smaller markups. Therefore, the sampling difference between their and our data would cause the difference in markup estimates.

Figure 1. Markups during 2000–2021

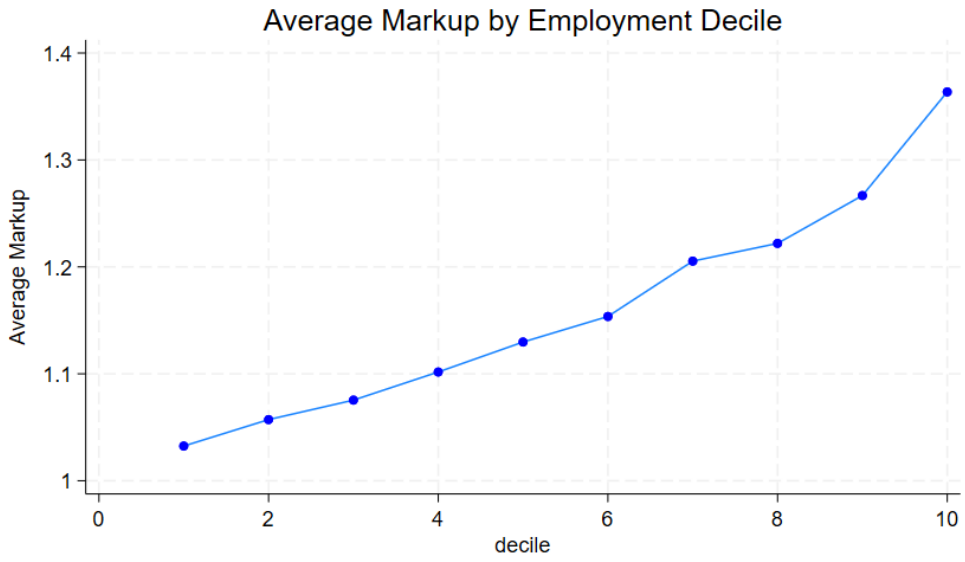


Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. This figure covers the period from 2000 to 2021. The blue solid line is for the entire set of industries, the red short-dashed line is for the manufacturing sector, and the green long-dashed line is for the non-manufacturing sector.

3.5 Markups over Firm Size Deciles

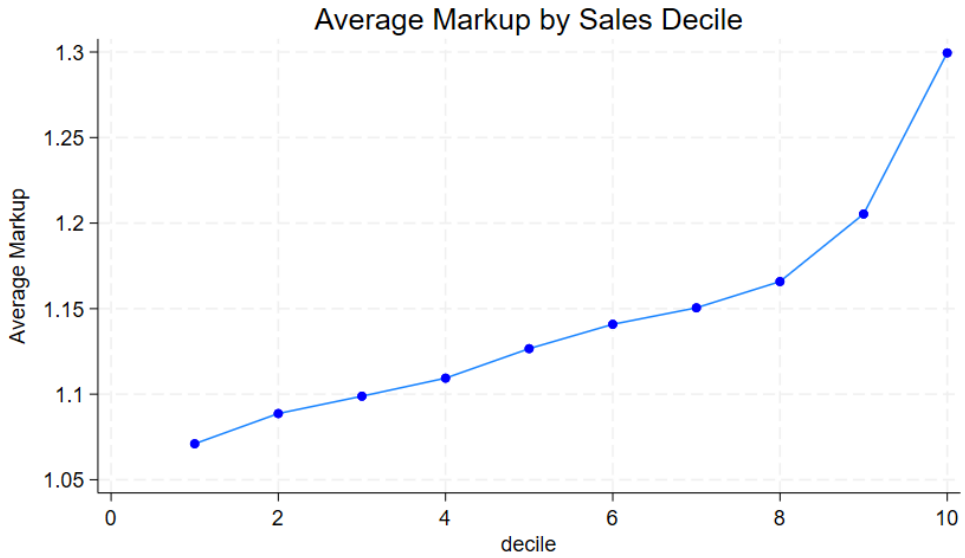
We then study the relationship between the size of estimated markups and firm size measured by sales or employment. Figures 2 below shows the estimated markups over the decile of employment. Similarly, Figures 3 below shows the estimated markups over the decile of sales. Both figures show that larger firms have higher markups, whereas markups increase more disproportionately in the nineth and tenth deciles of sales.

Figure 2. Markups over Employment Decile



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. This figure covers the period from 2007 to 2021. The blue line is for the entire set of industries.

Figure 3. Markups over Sales Decile



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. This figure covers the period from 2007 to 2021. The blue line is for the entire set of industries.

3.6 Markups and Firm Size Classification

We now show the trend of estimated markups for each firm size classification. We exploit two measures of firm size classification. The first measure is based on the number of employees. In the case of the manufacturing sector, firms with less than 301 employees are categorized as small. The current government newly create the category of medium-sized firms resulting in three classes of firms in total. Then, firms with 301–2000 employees are categorized as medium, and firms with more than 2000 employees are categorized as large enterprises.[2]

Figure 4 below shows the trend of markups separately for these three groups. Interestingly, medium- and large-sized enterprises share the similar trend and level of markups, whereas large enterprises appear to have higher markups since 2017. On the other hand, small enterprises have the stagnated trend in markups, i.e., the level of markups barely change over 15 years.

The second measure of firm size classification is based on the amount of registered capital. In the case of the manufacturing sector, firms with registered capital up to JPY 30 million (about USD 200,000) are categorized as small enterprises. The rest of firms are categorized as large enterprises. Figure 5 shows the trend in markups based on the second measure. Again, larger firms have higher markups compared to smaller ones. We find that there is an increasing trend in markups among small firms as well as large ones. Provided that we now only have two classes, the increasing trend would be mostly coming from medium-sized firms categorized as small in terms of the amount of registered capital.

4 Empirical Results

4.1 The Model of Estimation

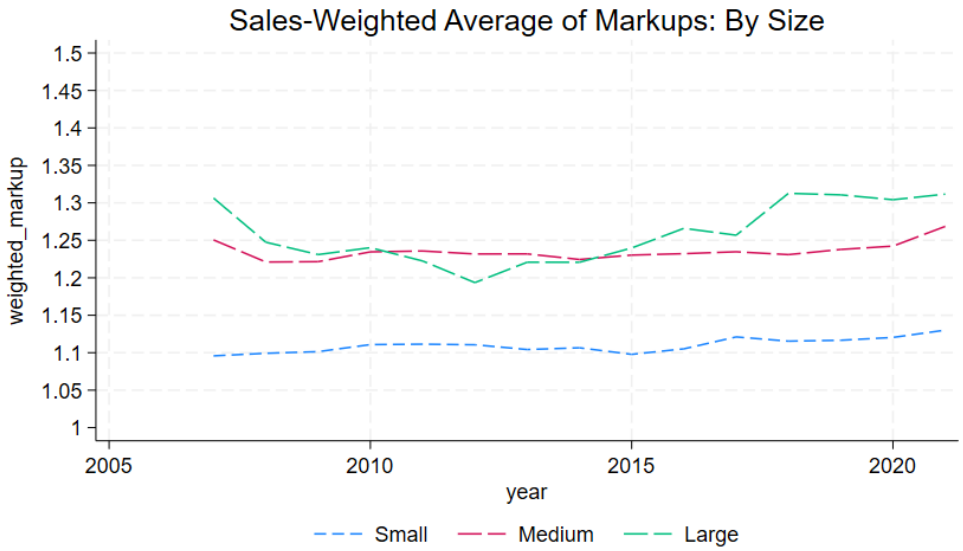
In order to study the relationship between buyer and supplier markups, we run the following regression:

$$m_{it} = \beta m_{it}^S + \gamma X_{it} + \tau_t + \nu_k + \epsilon_{it}, \tag{1}$$

where m_{it} is buyer firm i's markup in year t, and m_{it}^S is supplier markup that is averaged over buyer firm i's suppliers in year t. X_{it} refers to firm covariates including firm age, productivity, the average value of the HHI for the industries to which the suppliers of firm i belong, and exporting and importing dummies. We also include year fixed effects τ_t and 3-digit industry fixed effects, ν_k. The parameter of interest is β. The standard errors are two-way clustered with prefecture and 3-digit industry.

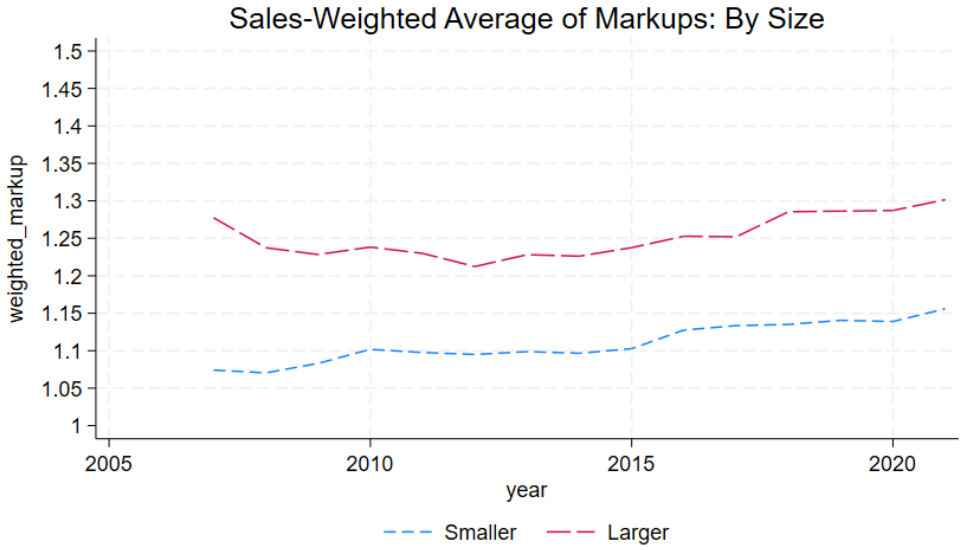
[2]The criteria are for the manufacturing sector.

Figure 4. Markups and Employment Size Classification



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. This figure covers the period from 2007 to 2021. The green long-dashed line corresponds to the markups for firms with the number of employees larger than 2000. The red long-dashed line corresponds to the markups for firms with the number of employees between 301 and 2000. The blue short-dashed line corresponds to the markups for firms with the number of employees smaller than and equal to 300.

Figure 5. Markups and Registered Capital Classification



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use cost of goods sold (COGS) less labor cost as the variable input. This figure covers the period from 2007 to 2021. The red long-dashed line corresponds to the markups for firms with registered capital larger than the threshold. The blue short-dashed line corresponds to the markups for firms with registered capital smaller than the threshold.

4.2 Baseline Results

We begin by investigating the relationship between buyer and supplier markups. The question here is whether the buyer markup is related with supplier markup, and we estimate the parameter β in equation (1). Table 3 shows the baseline results including all the industries. Here, we use COGS as the variable input for estimating productivity and markup.

The results are as follows. In Column (1), we conduct bivariate regression only using supplier markup as the independent variable. This gives a significant and positive coefficient of 0.0947, indicating that when a supplier markup increase by one standard deviation (0.522), then buyer markup increases by about 4.3% from the mean. It is also the case when we additionally control for productivity and supplier HHI in Column (2). The size of the coefficient of supplier markup remains similar, and productivity and supplier HHI do not have significant coefficients.

In Columns (3) and (4), we include exporting dummies. The exporting dummy used in Column (4) only deals with exporting in arm's length. In both cases, the coefficient of supplier markup is almost the same as before. The coefficient of exporting dummies are positive and significant, indicating that exporting firms have higher markups. We also use similar dummies for importing in Columns (5) and (6). The coefficient of importing dummies is positive and significant, whereas the sizes are smaller than those of exporting dummies.

Finally, in Columns (7) and (8), we control for both exporting and importing dummies. The coefficient of supplier markup remains positive and significant with similar magnitude as before. Also, we find that the coefficients of exporting and importing dummies are positive and significant. The sum of the coefficients of these dummies is about 0.20, which means that firms both exporting and importing have higher markups by about 18% from the mean.

4.3 Manufacturing vs Non-manufacturing

Table 4 and Table 5 separately shows the results for the manufacturing and non-manufacturing sectors, respectively. The numbers of observations are balanced with about 150,000 for both subsamples. We use COGS as the variable input for estimating productivity and markup.

The coefficients of supplier markups are positive and significant in all specifications. However, the coefficient is larger for the manufacturing sector than for the non-manufacturing sector. It is tempting to interpret that manufacturing firms are more likely to pass through the increase in suppliers' prices, but we need to be cautious against giving causal interpretation since we now only study the correlation between buyer and supplier markups.

Throughout all the specifications in Table 4, the coefficients of productivity are positive and significant. On the other hand, the coefficients of supplier HHI are negative and signifi-

cant. This is in stark contrast to Table 5. Throughout all the specifications, the coefficients of productivity are negative and significant, whereas the coefficients of supplier HHI are positive and slightly significant.

Exporting and importing dummies have positive and significant coefficients in all specification for both sectors. These results imply that there are exporting and importing premium, the former of which is confirmed in de Loecker and Warzynski (2012).

Table 3. Baseline

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.0947***	0.0946***	0.0962***	0.0957***	0.0979***	0.0972***	0.0975*	0.0969***
	(0.0245)	(0.0240)	(0.0209)	(0.0210)	(0.0208)	(0.0211)	(0.0201)	(0.0202)
Productivity		-0.0923	-0.144	-0.137	-0.136	-0.128	-0.155	-0.146
		(0.245)	(0.233)	(0.234)	(0.235)	(0.237)	(0.231)	(0.232)
Supplier HHI		0.0668	0.0609	0.0624	0.0509	0.0530	0.0540	0.0558
		(0.0755)	(0.0700)	(0.0703)	(0.0686)	(0.0691)	(0.0670)	(0.0673)
Export			0.169***				0.128***	
			(0.0260)				(0.0235)	
Export (Arm's Length)				0.172***				0.136***
				(0.0276)				(0.0256)
Import					0.139***		0.0728***	
					(0.0231)		(0.0216)	
Import (Arm's Length)						0.136***		0.0734***
						(0.0244)		(0.0232)
Observations	305,406	305,406	305,406	305,406	305,406	305,406	305,406	305,406
R-squared	0.033	0.034	0.051	0.051	0.047	0.045	0.054	0.053
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.139	1.139	1.139	1.139	1.139	1.139	1.139	1.139

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.116***	0.112***	0.103***	0.101***	0.111***	0.110***	0.103***	0.101***
	(0.0220)	(0.0235)	(0.0218)	(0.0214)	(0.0223)	(0.0221)	(0.0216)	(0.0211)
Productivity		0.660***	0.581***	0.589***	0.602***	0.612***	0.573***	0.579***
		(0.105)	(0.106)	(0.107)	(0.105)	(0.105)	(0.106)	(0.107)
Supplier HHI		-0.157***	-0.152***	-0.148***	-0.164***	-0.162***	-0.154***	-0.150***
		(0.0566)	(0.0525)	(0.0518)	(0.0553)	(0.0551)	(0.0525)	(0.0518)
Export			0.172***				0.157***	
			(0.0156)				(0.0169)	
Import					0.109***		0.0278**	
					(0.0105)		(0.0109)	
Export (Arm's Length)				0.190***				0.172***
				(0.0140)				(0.0146)
Import (Arm's Length)						0.118***		0.0407***
						(0.0102)		(0.00961)
Observations	148,938	148,938	148,938	148,938	148,938	148,938	148,938	148,938
R-squared	0.047	0.063	0.091	0.095	0.075	0.075	0.091	0.096
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.166	1.166	1.166	1.166	1.166	1.166	1.166	1.166

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Non-Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.0866**	0.0895**	0.0950***	0.0940***	0.0959***	0.0946***	0.0970***	0.0956***
	(0.0337)	(0.0329)	(0.0311)	(0.0314)	(0.0290)	(0.0296)	(0.0292)	(0.0296)
Productivity		-0.467**	-0.501**	-0.492**	-0.501**	-0.495**	-0.510***	-0.501**
		(0.188)	(0.176)	(0.178)	(0.178)	(0.179)	(0.175)	(0.177)
Supplier HHI		0.172*	0.162*	0.164*	0.149*	0.153*	0.149*	0.152*
		(0.0903)	(0.0823)	(0.0841)	(0.0766)	(0.0778)	(0.0757)	(0.0771)
Export			0.143***				0.0637***	
			(0.0507)				(0.0214)	
Import					0.163**		0.130**	
					(0.0585)		(0.0516)	
Export (Arm's Length)				0.122***				0.0495***
				(0.0394)				(0.00788)
Import (Arm's Length)						0.147**		0.124**
						(0.0584)		(0.0583)
Mean of Dep. Var	1.113	1.113	1.113	1.113	1.113	1.113	1.113	1.113
Observations	156,468	156,468	156,468	156,468	156,468	156,468	156,468	156,468
R-squared	0.026	0.037	0.045	0.043	0.050	0.047	0.051	0.048
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4.4 Firm Size Classification

We exploit the two ways of classifying firm sizes and conduct subsample regressions. Table 6 presents the regression results for subsamples categorized by firm size, based on the number of employees: Small (300 or fewer employees), Medium (301–2000 employees), and Large (more than 2000 employees). For the supplier markup, the estimated coefficients are statistically significant and positive across all firm sizes in most specifications. Particularly for Large firms, the coefficients are larger compared to Small and Medium firms. Although in some specifications the coefficients for Medium firms are not statistically significant, overall, the coefficients for Small and Medium firms are of similar magnitude. For the exporting dummy, the coefficients are significant and positive across all firm sizes, with notably larger estimates for Large firms. For the importing dummy, the coefficients are significant and positive for Small and Medium firms, but not significant for Large firms.

Table 7 presents the results of subsample regressions based on firm size categorized by capital. Firms are divided into two groups: Large firms, with a capital size exceeding JPY 100 million, and Small firms, with a capital size of JPY 100 million or less. The sample size of Small is about twice as large as that of large. The estimated coefficients for supplier markup are significant and positive for both Large and Small firms across all specifications. The magnitude of the coefficients is slightly larger for Large firms compared to Small firms. Additionally, the estimated coefficients for both the exporting dummy and the importing dummy are significant and positive across all specifications. For the exporting dummy, the magnitude of the coefficients varies depending on the definition of the variable. In contrast, the coefficients for the importing dummy are consistently larger for Large firms for both definitions.

Table 6. Firm Size Classification: Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Supplier Markup	0.0737***	0.0701	0.134***	0.0763***	0.0784*	0.119***	0.0763***	0.0764*	0.118***
	(0.0263)	(0.0443)	(0.0193)	(0.0238)	(0.0398)	(0.0214)	(0.0238)	(0.0402)	(0.0220)
Productivity				-0.389	-1.237***	0.242	-0.388	-1.229***	0.256
				(0.238)	(0.407)	(0.184)	(0.238)	(0.407)	(0.188)
Supplier HHI				0.0281	0.256	0.0748	0.0286	0.257	0.0824
				(0.0463)	(0.193)	(0.0876)	(0.0460)	(0.197)	(0.0879)
Export				0.0980***	0.105***	0.206***			
				(0.0243)	(0.0326)	(0.0258)			
Import				0.0544***	0.0995***	0.0395			
				(0.0152)	(0.0329)	(0.0298)			
Export (Arm's length)							0.111***	0.0962***	0.205***
							(0.0293)	(0.0243)	(0.0233)
Import (Arm's length)							0.0578***	0.0949***	0.0480
							(0.0146)	(0.0351)	(0.0334)
Observations	187,311	73,114	44,981	187,311	73,114	44,981	187,311	73,114	44,981
R-squared	0.045	0.041	0.082	0.062	0.095	0.111	0.064	0.092	0.109
Size Category	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.095	1.258	1.127	1.095	1.258	1.127	1.095	1.258	1.127

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Firm Size Classification: Registered Capital

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.0824***	0.0934***	0.0831***	0.0941***	0.0858***	0.0982***	0.0858***	0.0966***
	(0.0253)	(0.0177)	(0.0243)	(0.0185)	(0.0219)	(0.0158)	(0.0216)	(0.0161)
Productivity			-0.281	-0.334	-0.314	-0.378	-0.313	-0.368
			(0.232)	(0.291)	(0.225)	(0.283)	(0.224)	(0.284)
Supplier HHI			0.0657	0.0536	0.0561	0.0534	0.0552	0.0568
			(0.0549)	(0.125)	(0.0510)	(0.115)	(0.0507)	(0.117)
Export					0.109***	0.112***		
					(0.0216)	(0.0338)		
Import					0.0542**	0.0708***		
					(0.0205)	(0.0233)		
Export (Arm's length)							0.127***	0.103****
							(0.0244)	(0.0336)
Import (Arm's length)							0.0609***	0.0690***
							(0.0211)	(0.0258)
Observations	195,820	109,586	195,820	109,586	195,820	109,586	195,820	109,586
R-squared	0.031	0.051	0.035	0.055	0.046	0.073	0.048	0.070
Size Category	Small	Large	Small	Large	Small	Large	Small	Large
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.088	1.229	1.088	1.229	1.088	1.229	1.088	1.229

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

4.5 Robustness Check

We have conducted several robustness checks. First, we divide the sample into quartiles based on each of firm sales, age and employment. Appendix Tables B.1 to B.3 divide the sample into quartile and conduct subsample regressions. We also conduct robustness checks by estimating firm-level productivity and markup with OPEX as an alternative measure of variable input. The results are overall consistent with what we find with COGS as the variable input. Appendix Tables B.4 to B.11 show the results. These results show the similar pattern with our findings shown in the above.

5 Heterogeneity Analyses

In this section, we conduct additional analyses to look in to dynamic aspects of firm-to-firm transaction relationships. To begin with, we focus on the churning of supply chains. Firms usually churn their supply chains over time. We address whether supply chain churning matters for the correlation between buyer and supplier markups. Also, we compare long and short relationships to investigate buyer and supplier markups.

5.1 Supply Chain Churning

From period to period, firms decide whether to continue or drop a transaction with each transaction partner. They keep the transactions that are profitable to them, i.e., continue the transactions. Otherwise, they drop the transactions and, in some cases, search for a new transaction partner. Previous studies show that there are frequent churnings in supply chains (see, e.g., Kawakubo and Suzuki, 2022; Miyauchi, 2024).

We define 3 types of relationships. First, we define the continuing relationships in period t as the ones observed in both period t and $t+1$. Second, we define the dropped relationships in period t as the ones observed in period t but not in $t+1$. Third, we define the newly started relationships in period t as the ones not observed in period t but observed in $t+1$.

Table 8 shows the results. As before, we conduct subsample regressions by dividing the sample of buyer firms into small, medium-sized, and large ones. Here, firm size classification is based on the number of employees. We calculate average supplier markups separately for continuing, dropped, and newly started relationships. Columns (1) to (3) only include those supplier markups apart from year and industry dummies. From Columns (4), we additionally include other covariates that we use in previous tables.

Table 8. Supply Chain Churning

	Dependent Variable: Buyer Markup								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size Category	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Supplier Markup (Cont)	0.0692**	0.0653	0.113***	0.0849***	0.101**	0.104***	0.0847***	0.0986**	0.102***
	(0.0287)	(0.0488)	(0.0189)	(0.0277)	(0.0472)	(0.0224)	(0.0276)	(0.0476)	(0.0229)
Supplier Markup (Drop)	0.0312*	0.0281	0.0634***	0.0440**	0.0429	0.0564***	0.0438**	0.0430	0.0564***
	(0.0175)	(0.0261)	(0.0131)	(0.0166)	(0.0273)	(0.0119)	(0.0166)	(0.0276)	(0.0119)
Supplier Markup (New)	0.00952	0.00533	0.0127	0.0204	0.00843	0.00620	0.0212	0.00838	0.00627
	(0.0146)	(0.0144)	(0.0154)	(0.0129)	(0.0114)	(0.0160)	(0.0132)	(0.0115)	(0.0155)
Export				0.0981***	0.103***	0.179***			
				(0.0240)	(0.0289)	(0.0234)			
Import				0.0532***	0.0911***	0.0305			
				(0.0148)	(0.0287)	(0.0285)			
Export (Arm's Length)							0.110***	0.0928***	0.177***
							(0.0291)	(0.0202)	(0.0212)
Import (Arm's Length)							0.0563***	0.0879***	0.0389
							(0.0143)	(0.0315)	(0.0315)
Missing Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep.Var.	1.092	1.255	1.125	1.092	1.255	1.125	1.092	1.255	1.125
Observations	178,903	68,612	42,295	178,889	68,608	42,289	178,889	68,608	42,289
R-squared	0.042	0.040	0.081	0.064	0.106	0.117	0.065	0.104	0.115

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

From Table 8, we find that for small and large buyer firms, their markups are positively and significantly correlated with supplier markups. That relationship is strong among continuing relationships and weak among dropped ones. In contrast, the correlation is not significant among newly started transactions.

5.2 Length of Relationship

The length of transaction relationship is a good measure of stickiness or bonding. This has been used in previous studies including Boehm et al. (2024). By using this measure, we investigate whether long relationships hamper or accelerate the correlation between buyer and supplier markups. To do so, we define "long relationship" as follows: (1) For buyers, we calculate average years of relationships with suppliers at each point in time; (2) For each year, we define buyers as those having long relationships if their average years of continuing relationships are above the median.[3]

Tables 9 and 10 show the results. Table 9 corresponds to the sample of buyer firms in short relationship (i.e., below median length), whereas Table 10 corresponds to the ones in long relationship (i.e., above median length). In both tables, we conduct subsample regressions dividing into three firm size categories as before. The set of independent variables that we use in the regressions is the same as in Table 8.

First, Table 9 focuses on buyer firms in shorter transactions and investigate the relationship between buyer and supplier markups. The findings imply that regardless of buyer size, markups are positively and significantly correlated with supplier markups. It is strong among continuing relationships and weak among dropped ones. The correlation is not significant among newly started transactions.

Second, Table 10 is for buyer firms in longer transactions. We find that only for large buyers, markups are positively and significantly correlated with supplier markups. For small and medium-sized buyers, the correlation is mostly insignificant. These results imply the importance of firm's bargaining power in determining markups, i.e., only large buyer firms have sufficient bargaining power to increase the markups when suppliers increase the markups in long-term relationship.

Therefore, our findings suggest that long relationships hamper the correlation between buyer and supplier markups, especially among small and medium-sized buyer firms. In other words, this is suggestive evidence of relational path-through.

[3] In 2015, the median length of the relationship was 6.25.

Table 9. Length of Relationship: Short

	Dependent Variable: Buyer Markup in Short Relationship with Suppliers								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size Category	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Supplier Markup (Cont)	0.0957***	0.0755**	0.115***	0.109***	0.104***	0.115***	0.109***	0.103***	0.114***
	(0.0245)	(0.0298)	(0.0209)	(0.0253)	(0.0329)	(0.0240)	(0.0251)	(0.0333)	(0.0243)
Supplier Markup (Drop)	0.0419***	0.0379**	0.0629***	0.0468***	0.0479**	0.0604***	0.0465***	0.0474**	0.0606***
	(0.0146)	(0.0178)	(0.0165)	(0.0149)	(0.0188)	(0.0176)	(0.0148)	(0.0188)	(0.0173)
Supplier Markup (New)	0.0254	0.0143	0.0252	0.0220	0.00800	0.0204	0.0237	0.00745	0.0201
	(0.0176)	(0.0228)	(0.0249)	(0.0171)	(0.0143)	(0.0240)	(0.0177)	(0.0145)	(0.0235)
Export				0.101***	0.110***	0.202***			
				(0.0249)	(0.0299)	(0.0261)			
Import				0.0631***	0.109***	0.0354			
				(0.0185)	(0.0357)	(0.0348)			
Export (Arm's Length)							0.112***	0.105***	0.203***
							(0.0304)	(0.0220)	(0.0265)
Import (Arm's Length)							0.0661***	0.100**	0.0360
							(0.0175)	(0.0376)	(0.0381)
Missing Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep.Var.	1.098	1.258	1.134	1.098	1.258	1.134	1.098	1.258	1.134
Observations	91,820	35,888	22,327	91,820	35,887	22,327	91,820	35,887	22,327
R-squared	0.039	0.044	0.083	0.064	0.124	0.114	0.065	0.121	0.111

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10. Length of Relationship: Long

	Dependent Variable: Buyer Markup in Long Relationship with Suppliers								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size Category	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Supplier Markup (Cont)	0.0425	0.0539	0.112***	0.0648*	0.0928	0.100***	0.0648*	0.0895	0.0979***
	(0.0333)	(0.0762)	(0.0297)	(0.0333)	(0.0708)	(0.0311)	(0.0333)	(0.0710)	(0.0315)
Supplier Markup (Drop)	0.0188	0.0160	0.0596***	0.0298	0.0279	0.0430***	0.0299	0.0281	0.0425***
	(0.0211)	(0.0366)	(0.0153)	(0.0208)	(0.0361)	(0.0131)	(0.0207)	(0.0364)	(0.0129)
Supplier Markup (New)	-0.00642	-0.00276	-0.00241	-0.00317	-0.00264	-0.0191	-0.00347	-0.00212	-0.0196
	(0.0133)	(0.0134)	(0.0167)	(0.0109)	(0.0130)	(0.0151)	(0.0108)	(0.0132)	(0.0149)
Export				0.0929***	0.0945***	0.149***			
				(0.0239)	(0.0315)	(0.0236)			
Import				0.0405***	0.0707***	0.0206			
				(0.0111)	(0.0239)	(0.0240)			
Export (Arm's Length)							0.106***	0.0783***	0.147***
							(0.0283)	(0.0231)	(0.0193)
Import (Arm's Length)							0.0442***	0.0743***	0.0343
							(0.0114)	(0.0266)	(0.0279)
Missing Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep.Var.	1.086	1.253	1.115	1.086	1.253	1.115	1.086	1.253	1.115
Observations	87,083	32,723	19,966	87,082	32,723	19,966	87,082	32,723	19,966
R-squared	0.053	0.047	0.095	0.070	0.092	0.143	0.072	0.090	0.143

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

6 Conclusion

The rising markups documented in the United States and many other countries have posed concerns (e.g., Autor et al., 2021; de Loecker et al., 2020; de Loecker et al., 2023).

It is also important to investigate how correlated firm-level markups are along the supply chains. Recent increasing inflation raises concerns for both firms and households. On firm side, it is detrimental for firms' survival whether firms' input price increases can be passed on to their output prices. On household side, the increase in prices lead to reducing living standards if wage increase does not come up with price increase. Having these as the motivational background, this paper studies the trend in markups in Japan and investigate the relationship between buyer and supplier markups.

This paper draws on two data sources. The first data come from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) conducted by the Ministry of Economy, Trade and Industry (METI). This data cover firms in various industries and allow us to observe firm-level input and output. We construct the panel data from 2000–2021. Following the so-called 'production function approach', we obtain estimates of firm-level productivity and markup. The additional information on the buyer-supplier linkage information comes from annual surveys conducted by a credit reporting company, Tokyo Shoko Research, Ltd. (TSR). We use the information to study the relationship between buyer and supplier markups.

We find that the increasing trends documented in the US and other countries are not present in Japan. In particular, we obtain the stagnating trends in markups among Japanese firms. However, when we focus on the manufacturing sector, the markups has a decreasing trend between 2000 and 2009 and then an increasing trend between 2010 and 2021. These changes appear to be stronger in larger firms.

Then, we exploit the information of buyer-supplier linkages to examine the relationship between buyer and supplier markups. We find that buyer markups are positively correlated with supplier markups. When a suppliers' markups increase by 10%, a buyer firms' markup becomes higher by 1% point on average, controlling for productivity, supplier concentration measure, and other covariates. Our results also confirm positive exporting premium in firm-level markups that is observed in de Loecker and Warzynski (2012).

Third, we find suggestive evidence of pass-through. By subsample regressions, we find that the relationship between buyer and supplier markups are stronger among larger firms. The coefficient of supplier markup for large firms is about 1.6 as large as that for small firms. Also, the relationship is stronger among continuing transactions rather than dropped or newly started ones. However, longer transactions appear to hamper the correlation between

buyer and supplier markups. In this sense, the findings suggest that there is relational pass-through.

In this paper, we address the trend in markups and study the relationship between buyer and supplier markups. Although the results do not speak to the causality, we obtain meaningful findings that suggest buyer and supplier markups are positively correlated and that there is stronger correlation among larger buyer firms compared to smaller ones. This potentially suggests that larger firms have more capacity to pass through input price increases to their output prices. We believe that it is a promising area for future research to examine the causal effects and investigate the pass-through along the supply chains.

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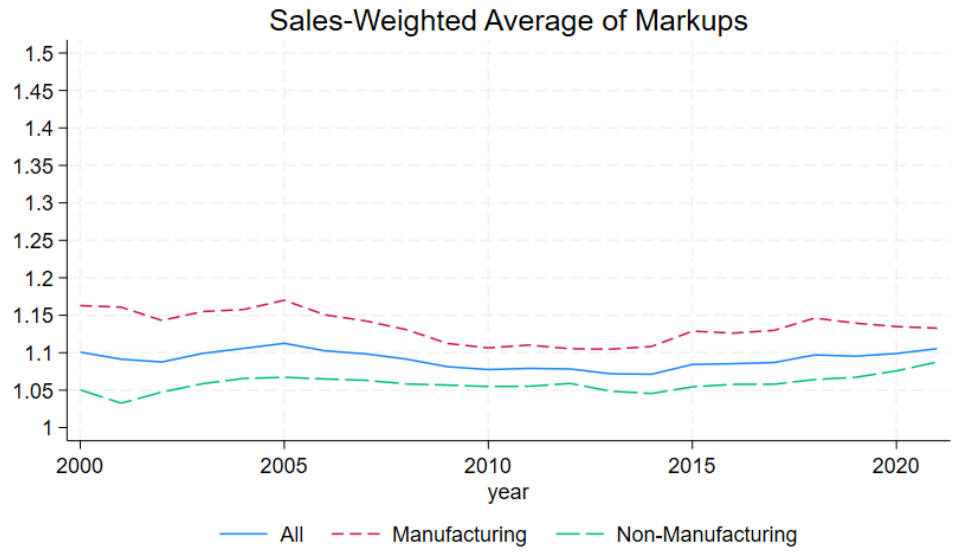
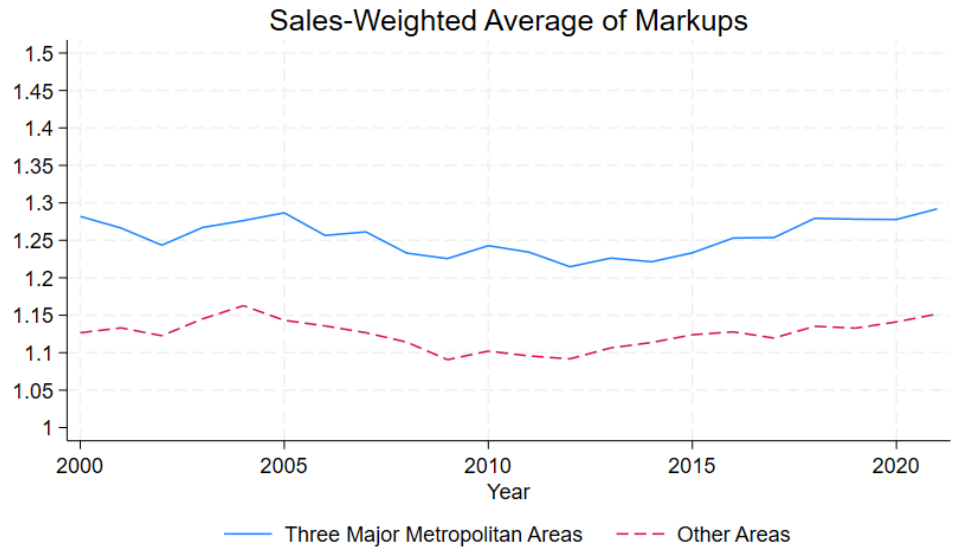
Appendix A Figures

Figure A.1. Markups during 2000–2021



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019). In the estimation, we use the sum of cost of goods sold (COGS) and and selling, general, and administrative expenses (SG&A), less labor cost as the variable input. This figure covers the period from 2000 to 2021. The blue solid line is for the entire set of industries, the red short-dashed line is for the manufacturing sector, and the green long-dashed line is for the non-manufacturing sector.

Figure A.2. Markups: Metropolitan Area vs The Rest of Japan



Note: This figure shows the sales-weighted average of the markups estimated following Nakamura and Ohashi (2019), separately for the metropolitan area and the rest of Japan. The blue solid line corresponds to the markups in three major metropolitan areas (i.e., Tokyo, Osaka and Nagoya). The red dashed line corresponds to the markups for the rest of Japan.

Appendix B Tables

Table B.1. COGS, Firm size: Sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.103***	0.101***	0.0651**	0.0808***	0.0981***	0.0954***	0.0604*	0.0785**
	(0.0172)	(0.0304)	(0.0285)	(0.0294)	(0.0172)	(0.0288)	(0.0309)	(0.0324)
Productivity					0.957**	-1.614***	-2.269***	-0.789
					(0.372)	(0.275)	(0.347)	(0.555)
Supplier HHI					0.0816	0.0935	0.0932	0.0742
					(0.0610)	(0.0689)	(0.0795)	(0.151)
Observations	63,513	73,209	77,942	83,684	63,513	73,209	77,942	83,684
R-squared	0.035	0.045	0.044	0.061	0.052	0.094	0.150	0.074
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.068	1.095	1.137	1.232	1.068	1.095	1.137	1.232

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.2. COGS, Firm size: Emp.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.0684**	0.0778***	0.0909**	0.0842*	0.0673**	0.0801***	0.0885**	0.0832*
	(0.0281)	(0.0240)	(0.0351)	(0.0451)	(0.0278)	(0.0249)	(0.0333)	(0.0459)
Productivity					0.127	-0.772***	-1.520***	-0.763
					(0.261)	(0.191)	(0.242)	(0.466)
Supplier HHI					0.0224	0.0405	0.180	0.125
					(0.0581)	(0.0471)	(0.118)	(0.170)
Observations	61,778	66,276	70,003	74,811	61,778	66,276	70,003	74,811
R-squared	0.061	0.050	0.038	0.044	0.061	0.070	0.104	0.059
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.036	1.097	1.168	1.285	1.036	1.097	1.168	1.285

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.3. COGS, Firm size: Age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.113***	0.117***	0.0875**	0.0596**	0.116***	0.117***	0.0850**	0.0558**
	(0.0195)	(0.0196)	(0.0387)	(0.0276)	(0.0202)	(0.0190)	(0.0364)	(0.0265)
Productivity					-0.509***	-0.0907	0.0460	0.196
					(0.160)	(0.274)	(0.323)	(0.268)
Supplier HHI					0.0806	0.0683	0.101	0.0327
					(0.0662)	(0.109)	(0.0805)	(0.0861)
Observations	69,618	75,616	79,634	80,538	69,618	75,616	79,634	80,538
R-squared	0.033	0.039	0.044	0.067	0.044	0.039	0.044	0.069
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.144	1.124	1.128	1.158	1.144	1.124	1.128	1.158

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.4. OPEX, Baseline

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.168***	0.172***	0.167***	0.166***	0.171***	0.171***	0.167*	0.166***
	(0.0139)	(0.0219)	(0.0237)	(0.0237)	(0.0230)	(0.0227)	(0.0239)	(0.0238)
Productivity		-0.356	-0.351	-0.350	-0.355	-0.355	-0.352	-0.350
		(0.262)	(0.269)	(0.269)	(0.264)	(0.264)	(0.268)	(0.269)
Supplier HHI		-0.0465	-0.0471	-0.0469	-0.0472	-0.0473	-0.0464	-0.0466
		(0.0488)	(0.0481)	(0.0481)	(0.0477)	(0.0478)	(0.0478)	(0.0478)
Export			0.0254***				0.0296***	
			(0.00638)				(0.00436)	
Export (Arm's length)				0.0280***				0.0299***
				(0.00562)				(0.00469)
Import					0.00781		-0.00752	
					(0.00943)		(0.00901)	
Import (Arm's length)						0.00994		-0.00383
						(0.00761)		(0.00703)
Observations	315,630	315,630	315,630	315,630	315,630	315,630	315,630	315,630
R-squared	0.068	0.078	0.080	0.081	0.078	0.078	0.080	0.081
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.088	1.088	1.088	1.088	1.088	1.088	1.088	1.088

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.5. OPEX, Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.186***	0.195***	0.186***	0.184***	0.195***	0.194***	0.187***	0.184***
	(0.0112)	(0.0125)	(0.0127)	(0.0125)	(0.0127)	(0.0126)	(0.0126)	(0.0124)
Productivity		0.207***	0.228***	0.232***	0.206***	0.209***	0.220***	0.229***
		(0.0579)	(0.0591)	(0.0598)	(0.0570)	(0.0577)	(0.0575)	(0.0588)
Supplier HHI		-0.0456	-0.0448	-0.0439	-0.0455	-0.0457	-0.0432	-0.0430
		(0.0273)	(0.0272)	(0.0267)	(0.0274)	(0.0274)	(0.0270)	(0.0266)
Export			0.0273***				0.0382***	
			(0.00503)				(0.00403)	
Export (Arm's length)				0.0339***				0.0400***
				(0.00457)				(0.00434)
Import					-0.000958		-0.0207***	
					(0.00482)		(0.00426)	
Import (Arm's length)						0.00404		-0.0138***
						(0.00398)		(0.00365)
Observations	149,199	149,199	149,199	149,199	149,199	149,199	149,199	149,199
R-squared	0.078	0.080	0.084	0.085	0.080	0.080	0.085	0.086
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.6. OPEX, Non-Manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.157***	0.179***	0.175***	0.176***	0.177***	0.177***	0.175***	0.176***
	(0.0222)	(0.0438)	(0.0462)	(0.0459)	(0.0451)	(0.0447)	(0.0460)	(0.0457)
Productivity		-0.616***	-0.621***	-0.619***	-0.621***	-0.619***	-0.622***	-0.620***
		(0.187)	(0.189)	(0.189)	(0.187)	(0.188)	(0.188)	(0.188)
Supplier HHI		-0.0433	-0.0447	-0.0444	-0.0462	-0.0457	-0.0460	-0.0456
		(0.0673)	(0.0659)	(0.0660)	(0.0645)	(0.0649)	(0.0646)	(0.0649)
Export			0.0300***				0.0200***	
			(0.00926)				(0.00462)	
Export (Arm's length)				0.0258***				0.0171***
				(0.00852)				(0.00487)
Import					0.0266**		0.0164**	
					(0.00996)		(0.00768)	
Import (Arm's length)						0.0231**		0.0150*
						(0.00891)		(0.00720)
Observations	166,431	166,431	166,431	166,431	166,431	166,431	166,431	166,431
R-squared	0.045	0.080	0.083	0.082	0.083	0.082	0.083	0.082
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.068	1.068	1.068	1.068	1.068	1.068	1.068	1.068

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.7. OPEX, Firm size: Employment (300, 2000)

	(1)	(2)	(3)	(4)	(5)	(6)
Supplier Markup	0.130***	0.197***	0.194***	0.129***	0.194***	0.199***
	(0.0102)	(0.0333)	(0.0187)	(0.0106)	(0.0332)	(0.0227)
Productivity				-0.515	-0.823	-0.181
				(0.340)	(0.660)	(0.176)
Supplier HHI				-0.0455	-0.0558	0.00404
				(0.0398)	(0.0845)	(0.0396)
Observations	192,926	75,589	47,115	192,926	75,589	47,115
R-squared	0.072	0.074	0.076	0.085	0.102	0.079
Size Category	Small	Medium	Large	Small	Medium	Large
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.072	1.114	1.109	1.072	1.114	1.109

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.8. OPEX, Firm size: Registered Capital

	(1)	(2)	(3)	(4)
Supplier Markup	0.152***	0.189***	0.155***	0.189***
	(0.0190)	(0.0142)	(0.0238)	(0.0182)
Productivity			-0.438	-0.312
			(0.329)	(0.254)
Supplier HHI			-0.0587	-0.0242
			(0.0456)	(0.0498)
Observations	203,222	112,408	203,222	112,408
R-squared	0.062	0.098	0.073	0.105
Size Category	Small	Large	Small	Large
Year FE & Industry FE	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.081	1.100	1.081	1.100

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.9. OPEX, Firm size: Sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.143***	0.161***	0.204***	0.191***	0.144***	0.151***	0.186***	0.186***
	(0.0197)	(0.0297)	(0.0376)	(0.0317)	(0.0186)	(0.0195)	(0.0178)	(0.0251)
Productivity					0.292	-1.002**	-1.012*	-0.186
					(0.669)	(0.480)	(0.544)	(0.377)
Supplier HHI					-0.00887	-0.0406	-0.0768	-0.0517
					(0.0402)	(0.0383)	(0.0576)	(0.0387)
Observations	67,446	75,866	80,017	85,047	67,446	75,866	80,017	85,047
R-squared	0.048	0.070	0.080	0.138	0.050	0.096	0.114	0.139
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.092	1.082	1.085	1.092	1.092	1.082	1.085	1.092

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.10. OPEX, Firm size: Emp.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.101***	0.153***	0.137***	0.208***	0.101***	0.149***	0.136***	0.19***
	(0.0167)	(0.0184)	(0.0231)	(0.0345)	(0.0208)	(0.0156)	(0.0214)	(0.0288)
Productivity					-0.239	-0.792**	-1.016**	-0.471
					(0.422)	(0.365)	(0.399)	(0.595)
Supplier HHI					-0.0356	-0.0219	-0.0837	-0.0494
					(0.0328)	(0.0245)	(0.0766)	(0.0651)
Observations	64,024	68,669	72,239	76,691	64,024	68,669	72,239	76,691
R-squared	0.074	0.073	0.068	0.099	0.076	0.100	0.115	0.108
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.057	1.077	1.092	1.119	1.057	1.077	1.092	1.119

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table B.11. OPEX, Firm size: Age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier Markup	0.157***	0.167***	0.119***	0.149***	0.158***	0.172***	0.129***	0.149***
	(0.0107)	(0.0215)	(0.0214)	(0.0177)	(0.0114)	(0.0143)	(0.0129)	(0.0232)
Productivity					-0.358	-0.343	-0.393	-0.241
					(0.270)	(0.310)	(0.272)	(0.180)
Supplier HHI					-0.00177	-0.00972	-0.0332	-0.0841*
					(0.0327)	(0.0378)	(0.0310)	(0.0482)
Observations	72,004	78,351	82,349	82,926	72,004	78,351	82,349	82,926
R-squared	0.066	0.080	0.111	0.118	0.074	0.088	0.123	0.124
Size Category	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Year FE & Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Dep. Var	1.092	1.089	1.085	1.086	1.092	1.089	1.085	1.086

Note: Robust standard errors clustered at the level of the firm in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.