JSPS Grants-in-Aid for Creative Scientific Research

Understanding Inflation Dynamics of the Japanese Economy

Working Paper Series No.71

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April 8, 2011

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April 7, 2011

Abstract

This paper investigates price rigidity arise out of the specific market structures, such as degree of market concentration and pricing decisions of retailers and manufacturers. Using Japanese scanner data that contains transaction prices and sales for more than 1,600 commodity groups from 1988 to 2008, we find statistically significant negative correlation between the degree of market concentration and the frequency of price changes, including both bargain price changes and regular price changes. The results of two-way analysis of variance suggests that the variation of the frequency of price changes depends on the differences among manufacturers as well as those among retailers.

JEL classification codes: L11, E31, C41
Key words: Price stickiness, Market structure, Degree of concentration

*I would like to thank Kanemi Ban, Tsutomu Watanabe, Naohito Abe, Akiyuki Tonogi for invaluable advice. I am grateful to the participants at the spring meeting of Japanese Economic Association in 2009, the Summer Workshop on Economic Theory 2009, the 4th Applied Econometrics Conference, and workshops at Osaka University for helpful comments. Any remaining errors are my own responsibility. This study is financially supported by the research fellowships of the Japan Society for the Promotion of Science for Young Scientists. This research is a part of the project entitled: Understanding Inflation Dynamics of the Japanese Economy, funded by JSPS Grant-in-Aid for Creative Scientific Research (18GS0101). Tel.: +81 90 5009 4141. E-mail: matsuoka@ier.hit-u.ac.jp

1 Introduction

The relationship between price rigidity and market structure has been discussed since the American economist, Gardinar C. Means suggested that the downward rigidity of price during the Great Depression had a relationship to industrial concentration in a Senate Document in 1935.[1] The implication of Means' findings is that the prices of less competitive markets tend to be sticky. This is referred to as the "administered prices" hypothesis (Domberger, 1979) and still attracts considerable attention.[2] This is partly because empirical literature in this field found strong heterogeneity in price stickiness across commodity items and is interested in the determinants of item-levels variation in the frequency of price changes.[3]

Concerning the relationship between market concentration and price stickiness, the results in the existing literature are mixed. Bils and Klenow (2004) examined 231 items in the U.S. CPI and found a statistically significant negative correlation between the four-firm concentration rate and the frequency of price changes. They concluded that the degree of concentration is not a robust predictor, because the effect on the frequency of price changes is no longer significant if controlled for item-group dummies. According to Álvarez and Hernando (2006), however, a recent survey from firms in the Euro area reveals that higher competition leads to more frequent price changes, which is consistent with the administered price hypothesis.

Major obstacles for the investigation are that the number of observations is highly restrictive due to the availability of price data, as well as data on the market share of individual firms. For example, Domberger (1979) regress partial adjustment coefficient, which is the measure of price adjustment rate, on the Herfindahl index and a concentration ratio using a 21 industry sample in the United Kingdom. The signs of the coefficient are both positive, which

[1]"Industrial Prices and Their Relative Inflexibility," Senate Document 13, 74th Congress, First Session. Means (1936) classified the wholesale price index into ten groups according to how many times prices are changed in a given time period and show that price index with low frequency of price changes tend to fall less in the Great Depression during the early 1930s.

[2]The relation between price stickiness and market competition is addressed in a series of theoretical studies, in which the firm endogenously chooses the frequency of price changes. (See, for example, Barro, 1972; Sheshinski and Weiss, 1977; Romer, 1990; and Dotsey, King, and Wolman, 1999.) Wolman (2000) discusses the administered price in the context of theoretical development of menu cost models and provides a historical review of the empirical literature on price rigidity.

[3]Two major determinants are the cost structure and the degree of market competition. See Álvarez (2007) for details. With regard to the former, substantial part of the literature, for example, Álvarez and Hernando (2007) and Higo and Saita (2007), report that the inverse relation between the share of labor cost and the frequency of price changes.

is inconsistent with the inverse relation of the speed of price adjustment and the degree of market concentration. Carlton (1986) could include 27 observations in the OLS equation of the average price age regressed on a four-firm concentration ratio. His result is consistent with the hypothesis in that the average duration becomes relatively long for a highly concentrated industry. However, Carlton points out that the result should be considered with some caution because of the limited number of observations. Ariga and Ohkusa (1998) examine the relation between the average response to shocks in target prices and the Herfindahl index using 68 samples from the Japanese Consumer Price Index series. The expected sign of the coefficient is negative, but the estimation result is positive and a statistically insignificant effect of market concentration.

Our scanner data is particularly useful for analysing the relation between the market structure and price rigidity. One reason is that it contains daily transaction prices and sales of products, which is not aggregated in any dimension so that we can calculate various statistics accurately from the data at the most disaggregated level. The other reason is that data covers more than 1,600 commodity groups so that we can precisely conduct statistical inference at the industry level as well.[4] At the inter-industry level, we examine the relation between the frequency of price changes and the degree of market concentration, measured by Herfindahl-Hirschman Index and n-firm concentration ratio. At the intra-industry level, we investigate the source of heterogeneity in price setting behavior focusing on the vertical relation between retailers and manufacturers.

The empirical results are summarized in four findings. First, we find a statistically significant negative correlation between the frequency of price changes and the degree of market concentration. Second, investigating a panel of 1,661 commodity groups over 21 years (1988–2008), we find that market concentration has a negative and significant effect on the frequency of price changes. This means that, holding the commodity-group characteristics constant, prices tend to become stickier when the market becomes less competitive. Third, 90% of the commodity groups reject both hypotheses that the mean frequencies of price changes are equal across manufacturers and that mean frequencies of price changes are equal across retailers. This result suggests that the variation of the frequency of price changes depends on the differences among manufacturers as well as those among retailers. Finally, for a relatively small proportion of groups, we found that the degree of price stickiness tends to be equal and uniformly high among manufacturers

[4] Researchers on the issue of price indexes also interests in these feature of scanner data. See Feenstra and Shapiro (2001) and ILO et al. (2004).

as the degree of market concentration becomes higher, but the same does not hold for retailers.

The remainder of this chapter is structured as follows. In Section 2, we describe our scanner data. After discussing the empirical strategy used in our analysis in Section 3, we discuss the estimation results in Section 4. Section 5 concludes our analysis.

2 Data

This paper employs voluminous scanner data collected by Nikkei Digital Media inc.[5] The contents of products in the data set are largely classified into foods and daily commodities sold in the supermarkets located in Japan. Specifically, goods are divided into homogeneous sub-classes according to the three-digit and six-digit classification provided by Nikkei Digital Media Inc. Figure 1 illustrates the item classification structure of the data. Our dataset contains 215 commodity groups at the three-digit classification and 1,661 groups at the six-digit classification. In the following analysis, we use the classification of the commodities as the definition of market and calculate the indices of market concentration at the six-digit-group level.

Individual items are distinguished by an identification code, known as JAN code.[6] Identical items in the sense that they have the same JAN code in common are further subdivided according to individual store where they are sold. At the most disaggregate level, our scanner data records the price, sales and quantity of item sold in certain outlet within a day. Each record is not aggregated in any dimension except that it is aggregated on a daily basis because an item is identified by both JAN code and store code. From this minimum unit of record, we construct various statistics with different levels of aggregation.

The advantages of our scanner data is that we can further identify producer of the item from JAN code. In the case of 13-digit code, the first 2-digit number is country code (45 or 49 for Japan) and the following 7- or 5-digit code is a company prefix according to the year the company is registered. The company prefix are allocated to member company by EAN Association and managed by the Distribution System Research Institute (DSRI) in Japan.[7] Matching the company prefix provided by DSRI, we can calculate

[5]Abe and Tonogi (2010) use the same dataset to provide detailed information on the characteristics of sample stores and location distribution of stores.

[6]In Japan, commodity items are allocated 13- or 8-digit JAN code. See Abe and Kondo (2006) for details.

[7]The DSRI administrates the database of item information corresponding to JAN code,

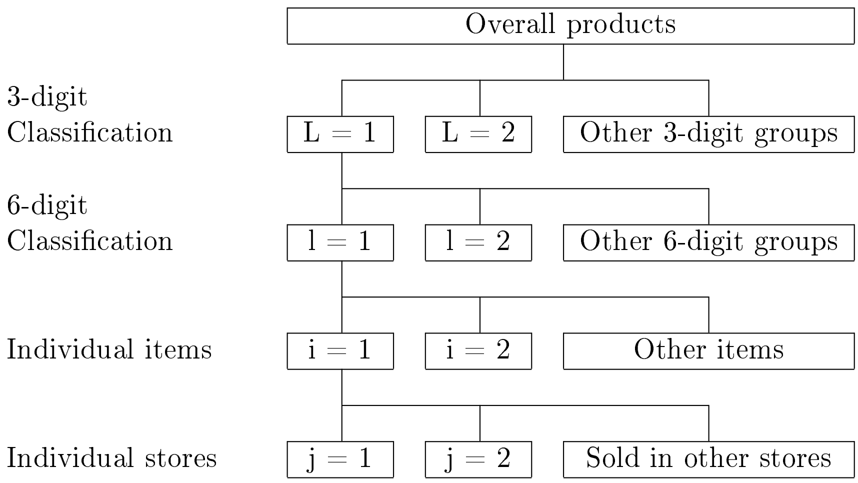

Figure 1: Item classification structure of the scanner data. The entire set of commodities are divided into homogeneous sub-classes according to the three- and six-digit classification defined by Nikkei Digital Media Inc. Individual items are distinguished by JAN code. Items which have the same JAN code are further subdivided according to individual store where they are sold.

company-specific statistics such as company's sales share within an industry and mean frequency of price changes calculated by company.

To make our data understandable, we classify the 1,661 six-digit commodity groups into larger categories according to the JICFS classification provided by DSRI. As shown in Table 1, our dataset composition is 82.1% food and 17.9% daily necessities, and is subdivided into a total of 12 categories. The largest category in the food sector is processed food, with a share of 48.1%. In the sector of daily necessities, cosmetics and miscellaneous goods, such as shampoo, detergents, tooth paste, and sanitary goods, account for a relatively high proportion. Our dataset does not contain categories such as fresh food, medicines, and do-it-yourself goods.

3 Empirical Strategy

We shall infer the relation between market concentration and price stickiness directly by calculating the mean frequency of price changes and the measure of market concentration, such as four-firm concentration ratio and the Herfindahl-Hirschman Index. We calculate the frequency of price changes

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which is called JICFS/IFDB. The information is available at http://www.dsri.jp/.

	Number of Groups	Share (%)	Frequency of price changes	Herfindahl index
Food	1,200	82.1	0.278	0.224
Processed food	748	48.6	0.287	0.218
Cakes and candies	204	12.5	0.226	0.198
Beverages	217	18.7	0.314	0.266
Other food	31	2.3	0.083	0.140
Daily necessities	461	17.9	0.115	0.282
Miscellaneous goods	151	7.1	0.153	0.281
Cosmetics	96	5.7	0.068	0.213
Household utensils	100	3.0	0.137	0.414
Pet accessory	31	0.8	0.104	0.222
Other commodities	3	0.3	0.067	0.560
Stationery	64	0.7	0.062	0.252
Car goods	2	0.0	0.045	0.645
Home electronics	14	0.5	0.100	0.293
All groups	1,661	100	0.249	0.234

Table 1: Frequency of price changes and the degree of market concentration by item groups. The number of groups is a total of six-digit commodity groups in the large commodity group. Share is the proportion of total sales for the entire observation period: 1988-2008. Japanese scanner data collected by Nikkei Digital Media inc.

for the industry by first calculating the frequency that is specific to the item defined by JAN code sold in a particular outlet. This is the basic building block on which our analysis based. Formally, let F_{ij}^l be the frequency of price changes of the ith item $(i = 1, \dots, I)$ sold in the jth store $(j = 1, \dots, J)$ within the lth groups at the six-digit classification. The frequency of price changes is calculated as

$$F_{ij}^l = \frac{D_{ij}^l}{T_{ij1}^l + \cdots + T_{ijM}^l}, \tag{1}$$

where D_{ij}^l is the number of price changes in the ith item sold in the jth store and T_{ijm}^l is the mth price duration of the corresponding item. The denominator equals total observation time for the item in the outlet. This statistic is naturally interpreted as how many times prices are changed during the observation period.

As mentioned in the previous section, our data records the price, sales and quantity of item on a daily basis. The price of an item is defined as the daily unit value, that is, the total sales divided by the total quantity of that item sold within the outlet during a day. Following this definition of prices, the unit value of an item may become a decimal, when the item is on a time sale: a retailer sells an identical item at two or more different prices in one day.[8] We regard the price change arising from decimal prices as evidence of price flexibility, and so we do not adjust the original series of price data in this paper. We also note that our calculation of the number of price changes, D^l_{ij}, do not exclude price changes due to retailers' temporary price markdown. Thus, our estimates of the frequency of price changes include at least three types: price changes due to a time sale, a temporary (though not an intraday) price markdown, and a non-sale price, which referred to as a regular price.[9]

We construct our industry level frequency of price changes F^l by taking weighted average of F^l_{ij} by weighting the total sales of ith item sold in the jth store q^l_{ij}, that is,

$$F^l = \sum_{i=1}^{I}\sum_{j=1}^{J} q^l_{ij} F^l_{ij}. \tag{2}$$

The Herfindahl-Hirschman index (HHI) and n-firm concentration ratio (CR_n) of the lth industry is calculated from firm's sales volume within the industry. Let q^l_k is the total sales of the kth firm ($k = 1, \ldots, K$) in the lth industry. The Herfindahl-Hirschman index is defined as

$$HHI^l = \sum_{k=1}^{K}(s^l_k)^2, \tag{3}$$

where s^l_k is the market share of the kth firm in the lth industry measured by the firm's sales volume, i.e., $s^l_k = q^l_k / \sum_{k=1}^{K} q^l_k$.

The n-firm concentration ratio is defined as follows: Let $r^l_1 > r^l_2 > \cdots > r^l_K$ represent the descending order of $q^l_1, q^l_2 \ldots, q^l_K$. The n-firm concentration ratio can be written as

$$CR^l_n = \frac{\sum_{k=1}^{n} r^l_k}{\sum_{k=1}^{K} r^l_k}. \tag{4}$$

The advantage of our approach is that the frequency of price changes, HHI, and CR_n are all suitably defined by the available information in our scanner data.

[8] Abe and Tonogi (2010) observe that a time sale, a typing error, or a buy-one-get-one-free sale lead to a decimal price, and the exact cause of this phenomenon is impossible to identify.

[9] For each type of price change, we shall examine the significance of market competition as a cause of price flexibility in a future study.

In the next section, we shall show the cross section estimates and panel estimates of the effect of market concentration on price stickiness. In the cross section analysis, we use the sample of entire observation period in the calculation of the frequency of price changes. As for HHI and CR_n, we first calculate both statistics on an annual basis and then take the average across years. In the panel data analysis, we construct a panel of 1,661 six-digit commodity groups over 21 years, 1988–2008. By incorporating the panel data, we can control for the sector-specific unobserved factor affecting price stickiness. Specifically, we estimate the following regression:

$$F_t^l = \alpha + \beta X_t^l + \gamma W_t^l + u^l + \epsilon_t^l, \tag{5}$$

where X_t^l represents the Herfindahl index or n-firm concentration ratio of the commodity group l for the year t ($t = 1988, \ldots, 2008$) and W_t^l includes the annual sales of the group.

In order to find the source of heterogeneity in the frequency of price changes at the intra-industry level, we employ the frequency of price changes of the ith item sold in the jth store, F_{ij}^l again. Our motivation is to find out where the variation of F_{ij}^l comes from the difference of the producers, or from the difference of retailers, or from both.[10] For this purpose, we shall conduct two-way analysis of variance test of equality of mean frequency of price changes.[11] The two-way analysis of variance model can be written as

$$F_{ij}^l = (constant) + \alpha_k^l + \beta_j^l + Z_{ij}^l, \tag{6}$$

subject to $\alpha_1^l + \cdots + \alpha_K^l = 0$, $\beta_1^l + \cdots + \beta_J^l = 0$, and $Z_{ij}^l \sim$ i.i.d. $N(0, \sigma^2)$. The hypotheses of interest are there is no significant difference of mean frequency of price changes among manufacturers, that is,

$$H_{0A} : \alpha_1^l = \cdots = \alpha_K^l; \tag{7}$$

and there is no significant difference of mean frequency of price changes among retailers, that is,

$$H_{0B} : \beta_1^l = \cdots = \beta_J^l. \tag{8}$$

We shall test these hypotheses at the six-digit-classification level and show the number of commodity groups in which these hypotheses are rejected in the next section.

[10] In the recent contributions to the empirical study, researchers focus on the price-setting behavior of producers and the one of retailers as well. See for example, Dutta, Bergen, and Levy (2002) and Nakamura (2008).

[11] See Fisher (1973) for details.

4 Results

As shown in Table 1, the weighted mean frequency of price changes across 1,661 commodity groups is 0.249 per day, which means that an average price spell lasts less than five days.[12]

The result clearly distinguishes between the price rigidity of food and articles for daily use. Prices in the food sector are far more flexible than those in the daily necessities sector: the weighted mean frequency in the food sector is 0.278, whereas that in the daily necessities sector is 0.115. The difference in the frequency of price changes is also reported in Abe and Tonogi (2010), where they show an example that the mean frequency in the food (domestic articles) sector is 0.164 (0.077) from 1988 to 1993. Table 1 also illustrates the difference in the degree of market concentration between food and articles for daily use. According to the result of the Herfindahl-Hirschman index, the food sector (average 0.224) is more competitive than the daily necessities sector (average 0.282).

The evidence that we have discussed so far is consistent with the "administered price" hypothesis, which predicts an inverse relationship between the degree of price flexibility and market concentration. Figure 2 shows the scatter plot for the frequency of price changes and the Herfindahl-Hirschman index at the six-digit classification level. The number of points is the same as the total of six-digit commodity groups, i.e., 1,661. Each point represents the degree of price flexibility and market concentration of the group. The graphical representation suggests that the frequency of price changes tend upward in the lower range of market concentration. Indeed, the weighted least squares linear fit to the data illustrates that there is an inverse relationship between these variables.

Table 2 summarizes the cross section estimates of the effect of market concentration on the frequency of price changes. As expected from the "administered prices" hypothesis, the sign of variables corresponding to the degree of market concentration is negative for the two different specifications of the regression model and these variables are highly significant (Models (1) and (2)).[13] Following the previous discussion, however, we may interpret the result as a consequence of the unobserved group characteristics in the food and daily necessities sectors. In order to control the group characteristics, we add commodity group dummies in the regression equation.

The degree of market concentration has a negative and significant effect on the frequency of price changes after we include commodity group dummies

[12] The median frequency of price changes is 0.228 per day.

[13] The regression line in Figure 2 corresponds to the estimates of Model (1) in Table 2.

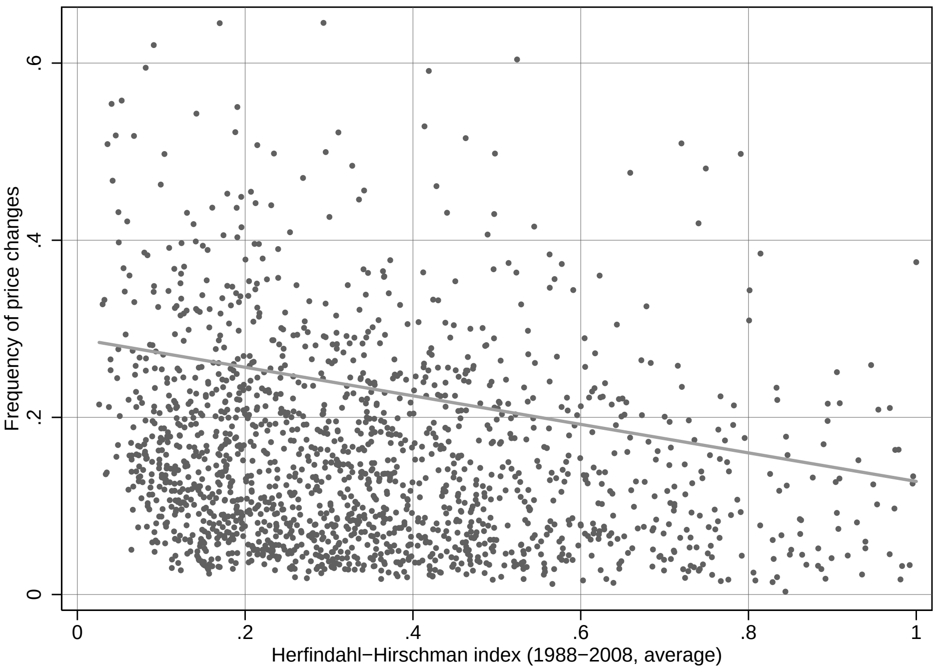

Figure 2: Herfindahl-Hirschman Index and frequency of price changes: The total number of observations is 1,661. Gray line represents the prediction for the frequency of price changes from a weighted least squares regression. Japanese scanner data collected by Nikkei Digital Media Inc.

Dependent variable:	Cross Section Estimate			
Frequency of price changes	(1)	(2)	(3)	(4)
HHI	-0.161		-0.160	
	(0.019)		(0.017)	
CR4		-0.175		-0.144
		(0.016)		(0.015)
Commodity group dummies			✓	✓
Constant	0.289	0.376	0.359	0.425
	(0.006)	(0.012)	(0.008)	(0.013)

Table 2: The degree of market concentration and the frequency of price changes at the six-digit commodity groups. Weighted least squares regression with weights given by the group's total sales for the observation period: 1988-2008. All equations are based on 1,661 observations. ✓: 11 dummy variables for commodity group are included in the regression equations. Standard errors in parenthesis.

(Models (3) and (4)).[14] The same regression equations are considered in the earlier literature, such as Bils and Klenow (2004). They conclude that the degree of market concentration is not a robust predictor of price rigidity because the effect is not significant after controlling the commodity group dummies. In contrast, our result shows the robustness of these models.[15]

The estimation results we mentioned above is based on a pure cross-section analysis. We confirm the effect of market concentration on price stickiness, however, this analysis ignores the dynamic nature of commodity markets. The degree of market concentration may fluctuate according to the entry and exit of firms and the variation of market shares within the market. As shown in Table 3, the degree of market concentration, especially, the Herfindahl index, tends to become lower year by year for the observation periods while the commodity prices tend to become more flexible. Technically, the previous cross-section analysis runs the risk of obtaining the biased results because of the unobserved heterogeneity which is specific to the commodity group. Considering these aspects, panel data analysis may provide a

[14]For constructing commodity group dummies, we follow the JICFS classification, shown in Table 1, according to which, the number of subgroups is 12 (four in the food sector and eight in the daily necessities sector), so that Models (3) and (4) each contain 11 dummies.

[15]The results do not qualitatively change if we incorporate the logit transformation of the frequency of price changes, $\log(\frac{F_l}{1-F_l})$, as a dependent variable. If we regress the dependent variable on $CR3$ or $CR8$ instead of $CR4$, the corresponding coefficients become negative and significant in all models in Table 2.

Variable	Year						
	1988	1989	1990	1991	1992	1993	1994
Frequency of price changes	0.157	0.160	0.157	0.158	0.167	0.170	0.173
HHI	0.280	0.262	0.256	0.257	0.259	0.257	0.247
CR4	0.757	0.737	0.728	0.727	0.725	0.730	0.720
Variable	1995	1996	1997	1998	1999	2000	2001
Frequency of price changes	0.169	0.163	0.173	0.175	0.181	0.203	0.226
HHI	0.247	0.247	0.244	0.242	0.245	0.237	0.230
CR4	0.719	0.712	0.705	0.708	0.717	0.707	0.701
Variable	2002	2003	2004	2005	2006	2007	2008
Frequency of price changes	0.249	0.267	0.419	0.450	0.443	0.450	0.490
HHI	0.226	0.228	0.224	0.228	0.227	0.220	0.214
CR4	0.701	0.710	0.707	0.718	0.716	0.704	0.692

Table 3: The degree of market concentration and the frequency of price changes by year, 1988–2008. Weighted averages across six-digit commodity groups weighted by the annual total sales for the period are reported. Same data as in Table 1.

better inference as to the relationship between the market concentration and the price stickiness.

Table 4 shows the results from panel estimates. The unit of the commodities is defined according to the six-digit classification which is the same as the previous cross-section analysis, so that we have a panel of 1,661 commodity groups over 21 years, 1988–2008. We consider four different specifications and fit the fixed-effects model for each specification on the basis of Hausman's specification test. Table 4 clearly illustrates that the market concentration has a negative and significant effect on the frequency of price changes. We can understood the result as, holding the commodity-group characteristics constant, the price stickiness tends to be higher when the market becomes less competitive. We largely obtain the same result, controlling for the time-series of annual sales in the commodity group in Models (3) and (4). These models demonstrate that the increase of annual sales has a positive and significant effect on price flexibility.[16] Moreover, they illustrate that market concentration continues having a negative effect on the flexibility of prices

[16]One reasonable explanation of this result is the process of gradual increase in price flexibility shown in Table 3 and the steady growth of annual sales during the observation period. The sales index to the base year of 1988 is as follows: 2.70 in 1992, 8.25 in 1997, 12.6 in 2002, and 15.0 in 2007.

Dependent variable:	Panel Estimate			
Frequency of price changes	(1)	(2)	(3)	(4)
HHI	-0.286		-0.212	
	(0.009)		(0.009)	
CR4		-0.299		-0.174
		(0.011)		(0.011)
Annual sales			0.039	0.039
(in billion yen)			(0.001)	(0.001)
Constant	0.317	0.463	0.263	0.337
	(0.002)	(0.008)	(0.002)	(0.008)

Table 4: The degree of market concentration and the frequency of price changes. The results from a panel of 1,661 six-digit commodity groups over 21 years, 1988–2008, are expressed by the fixed-effects model with weights given by the group's total sales for the observation period. Standard errors in parenthesis.

apart from the evolution of the market.

Table 5 illustrates the two-way analysis of variance tests of equality of mean frequency of price changes. We obtain these figures in the table after excluding groups that did not pass the F-test for joint significance of all variables.[17] First of all, the figures in the last column tell us 90% of groups reject both H_{0A}: mean frequencies of price changes are equal across manufacturers and H_{0B}: mean frequencies of price changes are equal across retailers. This result suggests that there is significant heterogeneity in mean frequency of price changes across manufacturers and that across retailers as well in this large part of the commodity groups. The number of the groups that reject only H_{0A} and that reject only H_{0B} is both 71, which account for 5 percent of the whole groups. Though proportion of groups is rather small, the test results of these groups indicate us the important feature of the item groups. This is because, in these groups in which reject only H_{0A} (H_{0B}), there is no significant difference in price stickiness among retailers (manufacturers).

In order to figure out if these test results relates to the degree of concentration or price stickiness of the commodity groups, we divide 1,533 item groups into quantiles according to the four-firm concentration ratio in Table 5[18]. The result in the second and third rows in Table 5 implies the degree of price stickiness tends to be equal and uniformly high among manufacturers

[17]These groups amount to 128. Subtracting 128 groups from total of 1,661 groups, we get total of 1,553 item groups.

[18]The corresponding four-firm concentration ratio for each group: very low ($CR4 <$ 0.65), low ($0.65 \leq CR4 < 0.83$), high ($0.83 \leq CR4 < 0.95$), very high ($CR4 \leq$0.95)

	Degree of Concentration				
Test Result	very low	low	high	very high	Total
Reject H_{0A} and H_{0B}	376	365	345	297	1,383
	(24.5)	(23.8)	(22.5)	(19.4)	(90.2)
Reject only H_{0A}	17	18	18	18	71
	(1.11)	(1.17)	(1.17)	(1.17)	(4.63)
Reject only H_{0B}	2	10	19	40	71
	(0.13)	(0.65)	(1.24)	(2.61)	(4.63)
Both Retained	2	1	3	2	8
	(0.13)	(0.07)	(0.20)	(0.13)	(0.52)
Total	397	394	385	357	1,533
	(25.9)	(25.7)	(25.1)	(23.3)	(100)

Table 5: Market concentration and two-way analysis of variance tests of equality of mean frequency of price changes. The null hypotheses are H_{0A} (H_{0B}): mean frequencies of price changes are equal across manufacturers (retailers). The corresponding concentration ratio for each group: very low (less than 0.65), low (0.65–0.83), high (0.83–0.95), very high (greater than 0.95). Cell percentage is given in parenthesis.

as the degree of concentration becomes higher (third row) but the same does not hold for retailers (second row). This fact may be understood as that the degree of concentration is the manufacturers' side of characteristics and thus is irrelevant to the price stickiness (or flexibility) associated with the retailers' pricing behavior.

5 Concluding remarks

This paper investigates how price rigidity arises out of the specific market structures, such as degree of market concentration and pricing decisions of retailers and manufacturers. Existing evidence is insufficient to confirm the importance of market structure as a determinant of price stickiness; therefore, we attempt to examine the relationship in a precise and thorough way.

Using Japanese scanner data that contains transaction prices and sales for more than 1,600 commodity groups from 1988 to 2008, we find statistically significant negative correlation between the frequency of price changes and the degree of market concentration after controlling commodity-group dummies. Investigating a panel of 1,661 commodity groups over 21 years, we find that market concentration has a negative and significant effect on the frequency of price changes.

We establish the fact that there is significant heterogeneity in mean frequency of price changes across manufacturer and that across retailers as well in this large part of the item groups. For relatively small proportion of the groups, we found that the degree of price stickiness tends to equally high among manufacturers as the degree of market concentration becomes higher but the same does not hold for retailers.

It is noted that our results are based on price data in which we observe fairly frequent price changes due to temporary price markdowns by retailers. Calculating the frequency of price changes, we do not distinguish sale prices from regular prices. For more precise interpretation of our results, we need to study whether the effect of market concentration on price rigidity still holds, using only the series of regular prices independent of the retailer's temporary price-setting behavior.

As a natural extension, we can analyze the relation between the rate of price inflation and market structure. The reason why we stress the importance of market structure on the issue of prices is that market structure affects the price-setting behavior of firms and thus it eventually characterizes the fluctuation in prices. The causes of inflation or deflation are still worth exploring, and a part of them can be precisely analyzed using the same scanner data. For example, expanding our knowledge of the magnitude of sectoral price change, we can examine the interesting hypothesis of Means (1936) that the downward rigidity of price in recession relates to the degree of market concentration. The evidence shown in this paper provides promising results for further empirical investigations on the relation between market structure and the behavior of prices.

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