Price Effects of Market Leadership Volatility in Japan

Noriyuki Doi

Abstract

An attempt has been made to test the effects of market leadership volatility on industry price change in Japanese manufacturing industries. The results suggest that market leadership volatility has a definite influence on domestic price change, providing empirical support for its effect of a downward movement of prices. But, it is necessary to note that its effect is not strong enough to offset the concentration's effect, since concentration still is positively related to price change. Also, import intensity has a negative association with price change. Distribution involvement has a positive effect. Thus, market leadership volatility is important as a determinant of market behavior from the viewpoint of competition policy as well as business strategy. Public policy makers should be concerned about market leadership volatility.

Key Words:　market leadership volatility; price changes; concentration; dynamic competition

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Price Effects of Market Leadership Volatility in Japanese Industries

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Introduction

The dynamics of firm market positions and leadership has attracted more industrial economists. For example, the surging interest is reflected in an increasing number of studies on the turnover and mobility of firms and in particular leaders in an industry (hereafter firm mobility); Baldwin [1995], Geroski and Toker [1996], Caves [1998], Rosenbaum[1998], Sutton [2007], Etro [2007], and Hannaford[2007] 1). At first, the problem was posed by the qualification of concentration ratios as static indicator, because high concentration might be consistent with considerable instability in the market positions of firms.

Recently, innovation and globalization may have an influence on competition. They are likely to induce larger intra-industry firm mobility in "progressive" industries. On the contrary, it is sometimes asserted that asymmetrical firm position configurations are fixed in progressive industries such as browser and search engine. Also, firms are frequently "challenging between cooperation and competition" (Doi [2008], Doi *et al.* [2008]). The influences of such diversified business strategies on competition also are setting spurs on study on firm mobility (for example Dosi *et al.* [2008]). It is necessary to re-examine the competition mechanism in dynamic industries.

In Japan, little study has been concerned with firm mobility in an industry. Recently some studies (Kato and Honjo [2006, 2007], Sutton [2007]) tried to examine the mobility. Doi [2001] is the first to compute the intensity of firm mobility at "an industry" level, not changes in individual market share of leading firms, and in particular the volatility in positions of market leaders (hereafter market leadership volatility) in Japanese manufacturing industries; One of major interesting findings is that industries with higher concentration tend to have less volatility. The finding is supported by Kato and Honjo [2007]. Therefore, it can be concluded that concentration may be still a reasonable indicator of market power in an industry. Also, it is worth to note that volatility is on average small in particular in "dominant firm (or asymmetrical) oligopoly" industries. Third, there is no discernible association between market leadership volatility and R&D intensity, suggesting that innovations still might not restructure significantly industries (largely "traditional industries") over the period in question.

Similarly, although many studies emphasize the importance of firm mobility, there is scarcely research on the effects of firm mobility on industry behavior and performance (except for Baldwin [1995]). It is not clear how firm mobility or market leadership volatility has an influence on market behavior and performance.

This paper has the purpose to examine the effects of mobility on pricing in Japanese manufacturing industries, using an indicator of firm mobility constructed in Doi [2001]. The organization of the paper is as follows; Section 1 examines the effects on a theoretical ground briefly. Section 2 explains empirical methodology used. Section 3 examines the results from estimations. And finally Section 4 concludes, with suggesting further studies.

I. Market Leadership Volatility and Pricing: Deriving an Estimated Equation

In general, competition or rivalry is likely to lead to price competition, causing firms to undercut each other until finally, profitability in the industry declines. Rivalry can be induced by mobility in their market positions. Or, mobility may be a direct measure of the intensity of rivalry or competition. Thus, put alternately, greater instability in market leaders' positions may reduce the likelihood of implicit or explicit collusion in an industry.

Now, examine the determinants of price under an oligopoly structure. The examination starts based on the pricing formula called the "target profit pricing principle" [2), since the principle is strategic in character. In the first stage, target profit rate (return on capital) is strategically determined. When an industry is uncompetitive, firms and in particular leaders can set higher target profit rate. In the second stage, capacity utilization ratio is determined strategically; in the third stage, total average costs under predetermined capacity utilization ratio are counted; in the fourth stage, target price is computed by the above-mentioned three factors. Finally, the target price is adopted or revised taking into account competition and demand conditions in an industry.

Now, suppose that a target price is adopted as final judgement. The formula and its proceeding are explained as follows;

$$P = AC + \{ \Pi / K \} \cdot \{ K / Q^* \} \cdot \{ Q^* / Q \} \quad (1)$$

where P is price in a domestic market, AC total average costs, Π profits, K capital, Q output, and Q* capacity output. Producer price is determined by total average costs (AC), target profit rate (Π/K), capital- output ratio (K/Q*) and capacity utilization ratio (Q/Q*. An inverse of the ratio is shown in the formula). In this case, target profit rate and capacity utilization ratio are both strategically determined by firms, while capital-output ratio is technologically given or predetermined. The strategic factors may be, as suggested earlier, affected by the intensity of competition and the condition of demand.

The above equation can be rewritten as follows;

$$P = W/Q + M/Q + F/Q + \Pi/Q = w + m + f + \pi \quad (2)$$

where W is total labor costs, M total material costs, F total fixed costs, and w, m, f, and π are labor costs, material costs, fixed costs and profits per unit of output respectively. The target return on capital (and therefore profits per unit of output: Π/Q) is likely to reflect the intensity of competition, and capacity utilization ratio is subject to the influence of demand condition. Therefore, π is a function of competition and market growth.

Dividing both sides of the equation of change in price by P leads to the following equation of percentage price change (notation d shows change);

$$dP/P = \{dw/w\} \cdot \{w/P\} + \{dm/m\} \cdot \{m/P\} + \{df/f\} \cdot \{f/P\} + \{d\pi/\pi\} \cdot \{\pi/P\} \quad (3)$$

This equation can be rewritten furthermore into the ratio type of equation in terms of variables at two different points in time;

$$P_1/P_o = \{w_1/w_o\} \cdot \{w_o/P_o\} + \{m_1/m_o\} \cdot \{m_o/P_o\} + \{f_1/f_o\} \cdot \{f_o/P_o\} + \{\pi_1/\pi_o\} \cdot \{\pi_o/P_o\} \quad (4)$$

where number 1 and 0 stand for the initial and final years of a given period respectively.

Thus, price change ratio consists of change ratios of labor costs, material costs and fixed costs, and profits, which are weighted by the ratio of value of each of cost elements to output in the initial year [3].

The above-mentioned equation (4) was used in this study as well. These factors (*i.e.*, changes in labor costs, material costs, fixed costs, and profits) may have a positive influence on price changes. But, fixed costs were excluded from the estimation, since data on fixed costs were not available. Industry concentration, barriers to new entry and to intra-industry mobility of incumbents (*i.e.*, growth of lower-ranking firms), imports and market growth may be among the possible determinants of expected profit change, and then of price change.

$$P_1/P_o = \{w_1/w_o\} \cdot \{w_o/P_o\} + \{m_1/m_o\} \cdot \{m_o/P_o\} + F(X_v) \quad (5)$$

where $F(X_v)$ is a function of determinants X_v ($v = 1 \sim n$) of profit change (*i.e.*, $\{\pi_1 / \pi_o\} \cdot \{\pi_o / P_o\}$).

Market leadership volatility also may be one of the possible determinants, since it is likely to reflect the intensity of competition. In industries with greater volatility, profit change (π_1/π_o) may be lower, which suggests that price change (P_1/P_o) also is likely to be lower. In other words, there may be a negative relationship between market leadership volatility and price changes. This expectation may be consistent with Baldwin [1995]'s finding, since the finding shows that "profits are negatively related to mobility", providing *a priori* support for the expectation.

In addition, $F(X_v)$ may include as determinants of profit change, concentration, import competition and distribution channel burden for the intensity of competition, and also industry demand growth and time period for the demand conditions.

II. Empirical Methodology

The inter-industry and inter-temporal variations in price changes, as suggested in equation

(6), may be explained by the following linear-form model including the possible determinants such as concentration and market leadership volatility:

$$PC = \beta_0 + \beta_1(WC) + \beta_2(MC) + \beta_3(CR) + \beta_4(MV) + \beta_5(IM) + \beta_6(DIS) + \beta_7(IG) + \beta_8(PD1) + \beta_9(PD2) + \gamma \quad (6)$$

where *PC* is domestic price change, *WC* change in labor costs, *MC* change in material costs, *CR* 5-firm concentration ratio, *MV* market leadership volatility index (*MV1, MV2*), *IM* industry import intensity, *DIS* industry distribution intensity, *IG* industry demand growth. Also, dummy variables are used to account for variation by period in macro economy. *PD1* is 1 for period 1987-92, and 0 otherwise, and *PD2* is 1 for period 1982-87, and 0 otherwise. γ is the error term. βi (i=0～9) is regression coefficients. The variables all involve letters *f* (industry) and *t* (time) which index observations by industry and by period respectively, but in the equation, the industry and time indexes are excluded for simplicity.

A cross-sectional analysis has a qualification when changes over time are examined. Therefore, cross-sectional data was complemented with time series information, to compile a panel data set of 80 industries across 3 six-years periods (from 1977 to 1992): periods 1977-82, 1982-87, and 1987-92. The sample size was 240 pooled observations (= 80 industries × 3 periods), based on the availability of data. The sample industries are mostly of 4-digit level of SIC industry classification. The independent variables are very likely to be predetermined or exogenous. Therefore, the equation can be estimated as a single equation rather than as part of a simultaneous equation system. The equation was estimated by the OLS method, and also by the GLS method because of a pooled data set.

Next, we will present the measurement of the variables used in turn.

(1) Price change (*PC*). Change in prices is the ratio of price at the final year to price at the initial year over a given period: P_1/P_0. It was computed based on domestic wholesale price index, available from the Bank of Japan [various years].

(2) Change in labor costs (*WC*). The variable, as suggested in equation (5), is $\{w_1/w_0\}\cdot\{w_0/P_0\}$. It was computed by the following method;

$$w_1/w_{00} = \{W_1 / Q_1\} / \{W_0 / Q_0\} = \{W_1 / W_0\} \cdot \{VS_0 / P_0\} / \{VS_1 / P_1\} \quad (7)$$

$$w_0/P_0 = \{W_0 / Q_0\} / \{VS_0 / Q_0\} = W_0 / VS_0 \quad (8)$$

where VS_j (j= 0, 1) is value of shipments at the initial (j=0) and final (j=1) years of a given period. Labor costs (W) and value of shipments (VS) of an industry are both from MITI [various years].

(3) Change in material costs (*MC*). The weighted variable $\{m_1 / m_0\}\cdot\{m_0 / P_0\}$ was constructed similarly to the change in labor costs.

$$m_1 / m_0 = \{M_1 / Q_1\} / \{M_0 / Q_0\} = \{M_1 / M_0\} \cdot \{VS_0 / P_0\} / \{VS_1 / P_1\} \quad (9)$$

$$m_0 / P_0 = \{M_0 / Q_0\} / \{VS_0 / Q_0\} = M_0/VS_0 \quad (10)$$

Material costs are from MITI [various years]. Both changes in labor costs and in material costs are expected to have a positive influence on price change (*i.e.*, $\beta_1 > 0$, $\beta_2 > 0$).

(4) Concentration (*CR*). Many existing studies (for example Doi [1990]) found that concentration tended to be positively related to price change, suggesting that higher concentration is likely to lead to greater price power by implicit or explicit collusion. The finding suggests two-fold interpretations; the first "structural" relationship is that higher concentration industries may have skewness in firm size distribution biasing against smaller firms; the second "behavioral" effect implies that in those industries leading firms can take strategies of giving smaller firms disadvantages. In a highly concentrated industry, leader firms can set prices at discretion and collusively without fearing counterattack or reaction from smaller firms. Thus, concentration is expected to be positively related to price change (*i.e.*, $\beta_3 > 0$).

Concentration was measured by 5-firm concentration ratio (based on production) at the initial year of a given period. It is from JFTC [various years].

(5) Market leadership volatility index (*MV1* and *MV2*). Market leadership volatility may be measured by two indicators: relative and absolute volatility indexes. The "relative" index (*MV1*) is:

$$MV1 = \{\sum_i | Si1 - Sio | + \sum_j EXjo + \sum_k ENk1\} / \{\sum_i Sio + \sum_j EXjo\} \cdot \{1/2\} \quad (5 = i + j = i + k) \qquad (11)$$

where Sit (Si1, Sio)is share in the final year (1), of a firm (i) surviving through the period, Sio its share in the initial year (0), EXjo share in the initial year, of an exiting firm (j) which existed in the initial year, but was not within the top 5 in the final year, and ENk1 share in the final year, of an entering firm (k) which was not within the top 5 in the initial year, but was within the top 5 in the final year. And, the denominator is equivalent to cumulative concentration of 5 largest firms (*i.e.*, 5-firm concentration ratio) in the initial year. The magnitude of the index means the equivalent of percentage of the initial total market shares of top 5 firms which changed hands over the period.

The "absolute" index (*MV2*) is the numerator of equation (11) : $MV2 = \{\sum_i | Si_1 - Sio | + \sum_j EXjo + \sum_k ENk_1\} \quad (5 = i + j = i + k)$.

These indexes were constructed and used in Doi [2001]. The above-mentioned examination suggests that these indexes both are negatively related to price change (*i.e.*, $\beta_4 < 0$). These were available from Doi [2001], which computed those indexes using JFTC's unpublished data of firms' market shares. These indexes were computed from 3 periods: 1977 to 1982, 1982 to 1987, and 1987 to 1992.

(6) Import intensity (*IM*). According to many existing studies, import pressure has been found to have a significant and negative influence on firm or industry profitability. The conduct implication of this finding is that import penetration or pressure is likely to affect negatively price change (*i.e.*, $\beta_5 < 0$). In fact, the relationship has been supported by Doi [1990].

Import intensity used is 3-year average, of the ratio of industry imports to apparent consumption (*i.e.*, output – exports + imports) among the second, fourth and final years of a period. The intensity was computed from largely AMA [various years] and MITI [various years], and for some industries from JFTC [various years] and NKS [various years].

(7) Distribution intensity (*DIS*). The distribution channels established between manufacturers and their buyers may play a role of barriers to new entry and to growth of incumbents, since the channels frequently mean closed "relational transactions". Such stable relationships may contribute to greater price power, in particular among leaders. In fact, Doi [1990] show that distribution channels have a positive influence on price-costs margin in Japanese manufacturing. This evidence suggests a positive relationship between the intensity of an industry's involvement in distribution (hereafter distribution involvement) and price change (*i.e.*, $\beta_6 > 0$).

The distribution intensity is captured by: the ratio of distribution margins incurred in an industry to its output in the fourth year of a period (*i.e.*, 1980 for period 1977-82, 1985 for period 1982-87, and 1990 for period 1987-92). In some sample industries, computed and used was the intensity of a larger classification industry in which the sample industry was included. The data source is AMA [various years].

(8) Industry demand growth (*IG*). Greater demand growth is likely to lead to higher price. Therefore, this factor is expected to have a positive influence on price change (*i.e.*, $\beta_7 > 0$).

Industry demand growth was measured by the ratio of final-year value of shipments to initial -year value of shipments in a period. Values of shipments were available from MITI [various years].

(9) Period dummy variables (*PD1* and *PD2*). The dummy variables were used to account for "by period" variations in the data in time-series model. In this formulation covering 3 periods (1977-82, 1982-87, and 1987-92), 2 dummy variables are required to represent 3 periods; *PD1* = 1 for period 1987-92, and 0 otherwise, and *PD2* = 1 for period 1982-87, and 0 otherwise. β_8 (and β_9) shows the extent to which the expected value of price change in the period 1987-92 (and in the period 1982-87) differs from its expected value in the period 1977-82, the omitted condition.

III. Estimated Results

Now, we will examine the specific results in turn[4]. The estimated results are shown in Table 1. The significance test of regression coefficients is based on the two-tailed test. The OLS estimation may have the serial correlation, which is usually solved by the GLS estimation. The Durbin-Watson statistics indicate that the test is inconclusive, suggesting that there is neither rejection of serial correlation nor its acceptance. But, the findings by the GLS estimation are not different from the OLS results qualitatively, although the estimates of the regression coefficients and their t-values have smaller variations. It is supposed that the lag between a shock and its final impact on a system was likely to be included in a period because the period was relatively long. In this paper, the OLS estimations are shown.

＜Table 1 around here＞

First, both changes in labor costs and in material costs (*WC* and *MC*), as expected, have a positive association with price change. Changes in costs were significantly imputed to price changes.

Second, concentration (*CR*) has a positive and significant coefficient, suggesting that industries with greater concentration tend to have a discretionary price-setting power. This result is consistent with the findings of existing studies (such as Doi [1990]) for price changes, and also with the conduct implication from the results of many previous studies on the concentration – profitability relationship.

Third, needless to say, our major concern is with the effects of market leadership volatility. Both relative and absolute indexes (*MV1* and *MV2*) are of negative sign and statistically significant. The effects are stable and robust. Therefore, it is concluded that increases in market leadership volatility are likely to induce more vigorous price competition.

Also, the interaction variable *CR / MV1* was introduced, since the two separate variables *CR* and *MV1* were significantly and negatively correlated. The variable was of positive sign and statistically significant. The result implies that concentration and market leadership stability (an inverse of market leadership volatility in this case) were combined to affect price change. Thus, both the level of concentration and the intensity of market leadership volatility are likely to have an influence on price settings.

Fourth, import intensity (*IM*) also has a negative and significant effect. This result is consistent with the conduct implication from the negative effects of imports on industry profitability in many existing studies. Therefore, it is concluded that import competition is among the sources of effective competition.

Fifth, distribution intensity (*DIS*) is positive and significant, implying that industries with greater distribution involvement have larger changes in prices. The finding may have two interpretations: structural and behavioral. Larger distribution intensity may reflect the extent of barriers to new entry and to growth of smaller incumbents, since, as suggested earlier, larger distribution involvement reflects closed distribution relationship (*i.e., keiretsu*), which in turn provides disadvantages against new entrants or smaller incumbents. Also, the effect may suggest that distribution costs are imputed to price changes.

Six, industry demand growth (*IG*) has a positive sign, but is not significant. This result is against our *a priori* expectation. It may be due to the fact that Japanese economy then was at the stage of lower economic growth.

Finally, the period dummy variables (*PD1* and *PD2*) show a little different results. *PD1* is of negative sign, but is unstable in statistical significance test. Therefore, price changes over period 1987-92 were marginally lower than over period 1977-82. On the other hand, *PD2* is negative and significant. The robust result suggests that price changes over period 1982-87 were significantly lower than over period 1977-82. Thus, those results mean that price changes over period 1982-87 were significantly lower than counterparts over other periods. In fact, domestic wholesale price index continued to decline during the period. It is inferred that price downs due to the depression of "stronger yen" were more severe.

IV. Concluding Remarks

An attempt has been made to test the effects of market leadership volatility on industry price change in Japanese manufacturing industries. This study is the first to empirically examine the effects.

First of all, the results suggest that market leadership volatility has a definite influence on price change. This finding provides empirical support for the conduct implication from the theoretical examination of firm mobility or turnover in market positions. But, it is necessary to note that the volatility's effect is not strong enough to offset the concentration's effect, at least over the period 1977 to 1992.

Next, the other main findings here are summarized as follows; 1) Concentration and distribution involvement are positively related to price change; 2) Import intensity has a negative association with price change; 3) Demand growth has no discernible effect; 4) Both changes in labor costs and in material costs, as expected, have a positive influence on price change; and finally 5) Price changes over period 1982-87 differ significantly from counterparts over other periods 1977-82 and 1987-92, suggesting that the recession due to stronger yen induced a downward movement in price changes.

Thus, market leadership volatility is important as a determinant of market behavior from the viewpoint of public policy as well as business strategy. Competition policy should be the type of policy which creates the volatility of market leadership. Also, it should be noted that other structural elements such as concentration and import competition have a definite impact on price change. Therefore, public policy makers must be still concerned about underlying market structure characteristics including market leadership volatility.

However, there remain some problems to be examined. It is difficult for variables picking up changes during a period to capture various patterns within a period, since the variables were measured by the difference between the initial year's value and the final year's value. Also, in particular, we need to empirically examine the relationship between market leadership volatility and industry profitability, which is the performance implication of this finding. In addition, it is interesting to examine the effects of market leadership volatility on non-price behavior such as R&D and sales promotion activities. Finally, this study has some bias in sample selection due to availability of data, since the sample involves largely the "traditional industries" and a small number of "progressive industries".

Note

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1) Existing studies of firm mobility are excellently surveyed by for example Baldwin [1995] and Caves [1998].
2) The target profit pricing principle is theoretically discussed in Doi [1986].
3) The equation of price change can be formulated based on the profit maximization principle as well.
4) The separate estimations were made for each of 3 periods respectively. The findings by period did not differ from the pooled ones shown in Table 1. Therefore, there was no inter-temporal variation in the relationships between price change and its determinants.

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Table 1 Estimated Equations: 1977 to 1992, and 80 industries

Variables	Equation No.			
	1	2	3	4
Constant	0.554 *a*	0.669 *a*	0.575 *a*	0.579 *a*
	(8.932)	(12.398)	(10.641)	(9.589)
WC	0.782 *a*	0.806 *a*	0.829 *a*	0.835 *a*
	(6.153)	(6.328)	(6.713)	(6.775)
MC	0.573 *a*	0.536 *a*	0.564 *a*	0.565 *a*
	(11.328)	(10.984)	(11.833)	(11.528)
CR (x 10-2)	0.104 *a*			0.114 *a*
	(3.138)			(3.551)
MV1		−0.059 *a*		
		(3.402)		
CR / MV1 (x 10-3)			0.120 *a*	
			(5.158)	
MV2 (x 10-2)				−0.280 *a*
				(4.033)
IM (x 10-2)	−0.428 *a*	−0.349 *b*	−0.379 *a*	−0.336 *b*
	(3.177)	(2.552)	(2.905)	(2.532)
DIS (x 10-2)	0.176 *a*	0.169 *a*	0.173 *a*	0.170 *a*
	(3.309)	(3.213)	(3.393)	(3.308)
IG (x 10-2)	0.147	0.296	0.494	0.452
	(0.113)	(0.230)	(0.396)	(0.361)
PD1	−0.033	−0.040 *c*	−0.031	−0.035 *c*
	(1.528)	(1.864)	(1.520)	(1.708)
PD2	−0.100 *a*	−0.101 *a*	−0.091 *a*	−0.094 *a*
	(4.326)	(4.398)	(4.061)	(4.185)
R^2	0.544	0.547	0.573	0.572
[F]	[36.573]	[37.042]	[41.127]	[36.465]
Durbin-Watson	1.628	1.681	1.748	1.739
N	240	240	240	240

Note: 1) R^2 is adjusted for the degree of freedom.

2) ( ) for t-value, and [ ] for F-value.

3) Significance level (two-tailed test): *a* for 1%, *b* for 5%, and *c* for 10%.

4) Notations are shown in the text.