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The Turnover of Market Leaders in Japanese Manufacturing Industries

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Abstract

This paper explores the turnover of market leaders, using data on Japanese manufacturing industries over the period 1975–2002. By applying survival data techniques, we describe industry differences in the turnover of market leaders over time. Our empirical results suggest that market leaders tend to maintain their positions in concentrated industries and consumer good industries. On the other hand, it is found that the turnover of market leaders is more likely to occur in growing industries and R&D-intensive industries. Furthermore, we provide evidence that leadership positions are more stable in industries where cartels were legally sanctioned.

Keywords: Industry differences, market leaders, survival data techniques, turnover.

JEL Classifications: L10, L60

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I. Introduction

Market leaders are generally regarded as enjoying more market power than their rivals. Indeed, market leaders maintain their positions over a long period in some industries. By contrast, the turnover of market leaders is often observed in other industries. What causes the turnover of market leaders? This paper explores the turnover of market leaders, using data on Japanese manufacturing industries over the period 1975–2002, and describes industry differences in the turnover of market leaders.

For many companies, obtaining or sustaining market leadership positions may be a key managerial goal to exploit competitive advantages and scale economies, which are more likely to be associated with superior performance. In addition, as noted by Geroski and Toker (1996, p.141), many managers are concerned with their rank at the top of the markets they operate in. The findings from research on the turnover of market leaders may provide some insight into the management strategy of firms.

In the field of industrial organization, a number of empirical studies have addressed the turnover of market leaders to measure the extent of market mobility. For instance, Joskow (1960) proposed a turnover measure by means of the rank correlation coefficient.[1] Caves and Porter (1978) examined the market share instability of leading firms as a measure of market mobility. However, most studies on mobility tended to employ cross-section data, which does not reflect intra-industry changes over time. Since market mobility may depend on an adjustment process in the market system over time rather than at a given point in time, we analyze the turnover of market leaders, using a long-term data set. The lack of turnover of market leaders

[1] Gort (1963) also proposed two indices: the correlation coefficient of market shares and the geometric mean of the two regression coefficients of market shares during each of two periods. For additional discussion on market mobility measures, see, for example, Scherer and Ross (1990), Baldwin (1995), and Caves (1998).

over time may signal that the adjustment process to a new equilibrium is not sufficiently effective, which, it is expected, would provide an important clue in assessing the dynamics of competition in industries.

Furthermore, as is often argued, Japanese domestic markets appear to have special characteristics. For example, several types of cartels, such as recession cartels, rationalization cartels, and export-import cartels, had been exempted from the application of Antimonopoly Act, in order to protect domestic industries by avoiding overt competition under the rapid macroeconomic growth.[2] The industries where cartels were legally sanctioned may still have a historical legacy, even if the cartels are not exempted from the application of Antimonopoly Act today. Then, the historical background may impede competition between firms. In this respect, research that focuses on Japanese industries might be of some interest to the discussion of competition policy.

The remainder of the paper is organized as follows. Section II describes data employed in the analyses. Section III explains the methods used and discusses the estimation results. The final section includes some concluding remarks.

[2]Cartels exempted from the application of Antimonopoly Act were abundant until the early 1990s, but most of them had been abolished until 1999. However, only a few, such as special legislation cartels for several service industries, are still sanctioned today. According to the *JFTC Annual Reports* (*Nenji Hokoku*), the total number of legally sanctioned cartels was 1079, and reached a peak level in 1966. In particular, legally sanctioned cartels were commonly seen in industries, such as textiles, clothing, nonferrous metals, printing and publishing, stone, clay and glass, steel products, and food products. For additional discussion on legally sanctioned cartels, see, for example, the *JFTC Annual Reports*, Caves and Uekusa (1976), Nakazawa and Weiss (1989), and Goto and Suzumura (1999).

II. Data

The data set employed in this paper comes from the *National Survey of Concentration Ratio on Production and Shipment* (*Seisan Shukka Shuchudo Chosa*) (hereafter, the *CRPS*), which has been surveyed for the purpose of monitoring market structure by the Fair Trade Commission of Japan (JFTC).[3] In the *CRPS*, most industries surveyed are classified at the six-digit or eight-digit Standard Industrial Classification (SIC) level. The *CRPS* contains data on concentration and market shares, based on production or shipment since 1975.

Using the *CRPS*, we attempt to identify market leaders in industries. Most, if not all, market leaders have the largest market shares in industries, and the first-ranked firms may tend to act as market leaders. In this paper, the market leader is defined as the first-ranked firm, based on firms' market shares in each industry. The *CRPS* covers data from 1975, and the data set is restricted to industries surveyed in 1975. As a result, we observe market leadership positions over 1975–2002. It is generally recognized that Japan has experienced stable economic growth since the first oil shock of 1973–1974. The observation period corresponds to the phase of stable growth the Japanese economy has entered.

Since data on industry-specific characteristics other than concentration and industry growth were not obtainable from the *CRPS*, we collected data on advertising, research and development (R&D), exports, imports, and legally sanctioned cartels, using other data sources. The *Data Report (1) of 1975-1980-1985 Linked Input-Output Tables* (hereafter, the *IO Tables*),

[3]There are several data sources detailing market shares in Japan, including *Market Share in Japan*, *Statistics Monthly* (*Tokei Geppo*), and the *Handbook of Market Shares*, which are published annually by Yano Research Institute Ltd., Toyo Keizai Inc., and Nihon Keizai Shimbun Inc., respectively. In this paper, the *CRPS* was employed, since the data source includes a greater number of industries over a long period of time.

which is compiled by the Management and Coordination Agency, was used to obtain data on advertising, exports, and imports classified at the four-digit or six-digit SIC level. In addition, data on R&D intensity was taken from the values estimated by Goto and Suzuki (1989). The R&D intensity was measured as R&D expenditures divided by value added at the roughly three-digit SIC level. Furthermore, data on cartels that had been exempted from the application of the Antimonopoly Act were obtained from the *JFTC Annual Reports* (*Nenji Hokoku*).

However, several problems arose when the *CRPS* was used to construct the data set. First, although we tracked market leaders over a long time, some industrial classification codes were changed or eliminated during the observation period. That is, some observations were occasionally censored. To deal with such cases, we attempt to apply survival data techniques, which will be explained later. Also, the measurement units for concentration and market shares vary across industries—some are measured by unit volume and others by the value. In this paper, we simply calculated concentration and market shares without conversion into unit volume, because of the lack of appropriate deflators. We employed data on concentration and market shares based on production in the analyses, since the sample size obtainable is larger than based on shipment.[4] In addition, there are no differences of data on advertising, R&D, export, and import intensity between some industries, because the industrial classification of the *CRPS* differs from those of the other data sources.

As a result, our sample consisted of 379 manufacturing industries over the period 1975–2002. Table 1 describes the distribution of industries used

[4]Although we also examined the turnover of market leaders, using data based on shipment, the results were almost consistent with those using data based on production. In this paper, therefore, we reported the estimation results using data based only on production.

in the sample and the extent of changes in the identity of the first-ranked firm, namely, the turnover of market leaders, by the two-digit SIC level. As is shown in Table 1, the turnover of market leaders was observed in 246 industries during the observation period. In addition, an important finding is that the extent of turnover varies across industries, although it should be noted that the extent of turnover in Table 1 simply indicates the number of industries where the identity of the market leader changed at least once during the observation period regardless of whether the observations are censored. Taking into account industry-specific characteristics, in the following section, we explore industry differences in the turnover of market leaders over time.

III. Methods

As already mentioned, while market leaders maintain their positions in some industries, they are displaced from their positions in others. Part of the reason may be due to the differences of market structure between industries. This paper therefore highlights industry differences in the turnover of market leaders. In particular, the paper focuses not only on whether market leaders maintain their positions, but also on how long they maintain their positions in industries. Here, the duration of market leadership is defined as the period from the initial observation year, 1975, to the year when the identity of the first-ranked firm changes. By measuring the duration of market leadership, we will provide evidence that industry-specific characteristics account for the difference in the turnover of market leaders.

Moreover, as mentioned earlier, we track market leaders over a long time, but observations are censored in some industries because the industry classification codes have been changed or eliminated during the observation period. In these industries, market leaders can be observed only until censored. To take into account the censored observations, we apply survival data techniques, nonparametric and parametric approaches, in order to explore the turnover of market leaders.

1. Nonparametric approach

By using a nonparametric method proposed by Kaplan and Meier (1958), we estimate the duration of market leadership.[5] If all the times at which the event occurs in the sample are ordered, and labeled $t_j (j = 1, 2, \ldots, m)$, such that $t_1 \leq t_2, \ldots, \leq t_m$, then the Kaplan-Meier estimator, $\hat{S}(t)$, which is a standard method to estimate the survival function is given by

$$\hat{S}(t) = \prod_{j|t_j \leq t} \left(1 - \frac{d_j}{n_j}\right), \tag{1}$$

where d_j is the number of individuals who experience the event at time t_j, and n_j is the number of individuals who have not yet experienced the event at that time and therefore still "at risk" of experiencing it (including those censored at t_j). Here, let d_j denote the number of industries in which the identity of the first-ranked firm changed at time t_j.[6] Also, let n_j denote the number of industries in which the identity of the first-ranked firm has not yet changed at t_j and therefore still 'at risk' of experiencing it.

Following the Kaplan-Meier estimator, we show life tables for the duration of market leadership in Table 2. Table 2 indicates that 29% of market leaders in 1975 were observed to maintain their positions throughout the observation period. On the other hand, about 40% of market leaders were displaced from leadership positions within five years. Also, Figure 1 illus-

[5] For more discussion on nonparametric methods, see, for example, Klein and Moeschberger (2003) and Rabe-Hesketh and Everitt (2004).

[6] Since the ranking of market shares are reported in each year, t is measured by year in this paper.

trates the survival function for the duration of market leadership, by using the Kaplan-Meier estimates in Table 2.

Table 3 shows the Kaplan-Meier estimates calculated by stratification, in order to clarify whether the duration of market leadership varies between industries with different characteristics. The results of significance tests, log-rank and Wilcoxon tests, are also shown in Table 3 to test the equality of survival functions of subsamples. First, Table 3 gives the Kaplan-Meier survival estimates by concentration class. Based on the Hirshman-Herfindahl index in 1975 (HHI), 379 industries in the sample were classified into low concentration ($HHI < 0.18$) and high concentration subsamples ($HHI \geq 0.18$).[7] As shown, it is clearly found that market leaders of the high concentration subsample are more likely to maintain their positions than the counterparts of the low concentration subsample. Also, the estimated survival functions differed significantly between low concentration and high concentration subsamples. This result indicates that market leaders are more likely to maintain their positions in concentrated industries. Also, this is consistent with the findings of some previous studies (e.g., Mueller, 1986; Kato and Honjo, 2005).

We also examine whether the duration of market leadership differs between low advertising intensity and high advertising intensity industries. As is often argued, advertising may encourage product differentiation, which has been viewed as an entry or mobility barrier. In practice, some studies (e.g.,

[7]The Hirshman-Herfindahl index (HHI), which is defined as the sum of squared market shares of all firms in an industry, has often been used to capture industry concentration. In practice, the JFTC regards a market in which HHI is less than 0.18 as *not* highly concentrated. The U.S. Department of Justice (DOJ) and Federal Trade Commission have also used the Hirschman-Herfindahl index to measure industry concentration for purposes of antitrust enforcement. According to the DOJ's Horizontal Merger Guidelines, the agency regards a market in which the post-merger HHI is less than 0.10 as "unconcentrated," between 0.10 and 0.18 as "moderately concentrated," and more than 0.18 as "highly concentrated."

Sakakibara and Porter, 2001) found that advertising has a negative effect on the mobility of leading firms. Conversely, other studies (e.g., Eckard, 1987; Das et al., 1993) have suggested that advertising does not reduce mobility in an industry. In this respect, more advertising may lead to the turnover of market leaders. On the basis of advertising intensity in 1975 (ADV), the sample was divided into low advertising intensity ($ADV < 0.003$) and high advertising intensity subsamples ($ADV \geq 0.003$) to show the difference in the duration of market leadership. As shown in Table 3, the Kaplan-Meier estimates were almost similar between the two subsamples. The finding suggests that advertising does not affect the turnover of market leaders.

Further, the survival functions of low R&D intensity and high R&D intensity industries are estimated to identify whether the duration of market leadership differs between these subsamples. R&D investment generally plays an important role in innovative activities, and it tends to generate technological progress and new products. Davies and Geroski (1997, p.389) also concluded that R&D and innovation play major roles in affecting the turbulence of market leaders. In this respect, market leaders may be less likely to maintain their positions in R&D-intensive industries. Based on R&D intensity in 1975 (RD), the sample is grouped into low R&D intensity ($RD < 0.05$) and high R&D intensity subsamples ($RD \geq 0.05$) to identify whether the duration of market leadership differs between the two subsamples. The result is shown in Table 3, which indicates that market leaders tend to maintain their positions in the low R&D intensity subsample rather than the high R&D intensity subsample. This suggests that R&D intensity is an important factor in the turnover of market leaders. It also concurs with Davies and Geroski's (1997) argument.

Moreover, we examine whether the duration of market leadership differs between industries with cartels and others. In Japan, as already mentioned, several cartels, such as recession cartels, rationalization cartels, export-import cartels, small and medium-sized business cartels, and industry-specific cartels, were exempted from the application of the Antimonopoly Act. These legally sanctioned cartels allow cartel members cooperative arrangements at production, price, investment, capacity, and so on. In case of export-import cartels, for example, a trade association restricts the activities of cartel members in the industry. In practice, legally sanctioned cartels have been seen in some industries, and interfirm competition may be more restricted in industries with legally sanctioned cartels than in those without the cartels. The industries where cartels were legally sanctioned before may still have a historical legacy, even though legally sanctioned cartels have been already abolished. Moreover, Bradburd and Over (1982) suggested that once an industry cooperative equilibrium is allowed to form, it will tend to persist, even if industry concentration subsequently declines substantially. In these respects, market leaders in industries that experienced legally sanctioned cartels may tend to maintain their positions, compared with the others, because of the lack of competition through cooperative arrangements. As shown in Table 3, cartels were legally sanctioned in 93 industries of the sample during the observation period.[8] In Table 3, the survival estimates indicate that market leaders tend to maintain their positions in industries where cartels were legally sanctioned rather than others. This might suggest that legally sanctioned cartels are associated with less turbulence of market leaders.

[8]Most cartels legally sanctioned were classified into export-import cartels. As argued by Sakakibara and Porter (2001), they have not necessarily restricted or tempered domestic competition, unlike other types of cartels. However, since the number of legally sanctioned cartels other than export-import cartels was very small, we examined the duration of market leadership without distinguishing export-import cartels from other types of cartels. In practice, we also examined whether the duration of market leadership differs between industries with export-import cartels and others. The result was generally consistent with above one.

Finally, the sample was divided into consumer good and producer good industries. As shown in Table 3, market leaders in the consumer good industries appear to maintain their positions than those in producer good industries. The log-rank and Wilcoxon tests verified that the survival estimates are significantly different between consumer good and producer good industries.

2. Semiparametric approach

In the previous subsection, the duration of market leadership was examined by applying the Kaplan-Meier method in order to explain industry differences in the turnover of market leaders. In addition, two significance tests, log-rank and Wilcoxon tests, were used to test if the duration of market leadership varies significantly between two subsamples with different characteristics. The results suggest that some industry-specific characteristics affect significantly the turnover of market leaders. Then, by applying a proportional hazards model proposed by Cox (1972), we attempt to identify the effects of industry-specific characteristics on the turnover of market leaders.

The proportional hazards model is well-known as a semiparametric approach for survival data and, particularly, it is useful to show the effects of covariates on the hazard of individuals. In the proportional hazards model, the hazard function that represents the instantaneous failure rate, $h(t; \boldsymbol{x}_i)$, is assumed to be

$$h(t; \boldsymbol{x}_i) = h_0(t)\exp(\boldsymbol{\beta}^T \boldsymbol{x}_i), \tag{2}$$

where $h_0(t)$ is the baseline hazard function, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, and $\boldsymbol{x}_i$ is a vector of covariates for individual i. Let $t_1 < t_2 < \cdots < t_k$ denote the ordered event times during the observation period, and R_i is a set of individuals who have not yet experienced the event before just prior to time t_i.[9] That is, R_i indicates industries in which the market leader continues to maintain the first-ranked position until the leader was displaced from the position in industry i. To estimate the parameters, the partial likelihood, $L(\boldsymbol{\beta})$, is given by

$$L(\boldsymbol{\beta}) = \prod_{i=1}^{k} \frac{h(t; \boldsymbol{x}_i)}{\sum_{j \in R_i} h(t; \boldsymbol{x}_j)} = \prod_{i=1}^{k} \frac{\exp(\boldsymbol{\beta}^T \boldsymbol{x}_i)}{\sum_{j \in R_i} \exp(\boldsymbol{\beta}^T \mathbf{x}_j)}. \tag{3}$$

The log-likelihood function is written as

$$\log L(\boldsymbol{\beta}) = \sum_{i=1}^{k} \left[\boldsymbol{\beta}^T \boldsymbol{x}_i - \log \sum_{j \in R_i} \exp(\boldsymbol{\beta}^T \mathbf{x}_j) \right]. \tag{4}$$

Maximizing $\log L(\boldsymbol{\beta})$ gives the estimated parameters without specifying a function form of $h_0(t)$.

(1) Covariates

As some studies suggested, collusion among leading firms may be more likely to occur and their market shares appear to be more stable in highly concentrated industries. Shepherd (1970), for example, argued that successful collusion would tend to hold market shares virtually constant. The stability of market shares, therefore, would tend to occur in oligopolistic industries, since it is more likely to be associated with collusion among leading firms. Kato and Honjo (2006) also found that the market shares of leading firms are more stable in highly concentrated industries. Therefore, it is predicted that concentration is negatively correlated with the turnover of market leaders. In practice, the result of nonparametric approach suggests that market leaders are more likely to maintain their positions in concentrated industries. Thus, concentration would have a positive impact on the duration of

[9] Here, simultaneous events are ignored, but the approximated formulations to calculate the likelihood function are established by some previous studies. In this paper, the Breslow's (1974) approximation method is used.

market leadership, and the degree of concentration is here measured by the Hirschman-Herfindahl index (HHI).

In addition, industry growth (IG) is employed as a covariate. The high growth of market demand presumably provides potential entrants more opportunities for new entry.[10] At the same time, industry growth may accelerate the disequilibration among incumbents including leading firms within an industry. Moreover, some studies (e.g., Gort and Klepper, 1982; Klepper, 1996) suggested that the market shares of leading firms tend to be less stable in the formative stages of industry life cycle, while they are more likely to be stable in the mature stages. Therefore, more turbulence of market leaders may occur in growing industries. It is predicted that the coefficient of industry growth on the hazard rates has a positive sign.

To control industry-specific conditions associated with nonprice rivalry, advertising intensity is included in the model. As already mentioned, advertising may encourage product differentiation and act as an entry or mobility barrier. If advertising reduces the mobility of leading firms, then it may decrease the probability of turnover of market leaders. On the other hand, since advertising may induce fierce competition, there is the possibility that more advertising leads to the turbulence of market leaders. In addition to advertising intensity, R&D intensity is included in the model in order to take into account the impact of nonprice rivalry. As argued, R&D investment may play a major role in affecting the turbulence of market leaders. In addition, as already shown in Table 3, market leaders are more likely to be displaced in R&D-intensive industries. In these respects, R&D intensity (RD) would have a negative influence on the duration of market leadership.

Export intensity (EXP) and import intensity (IMP) are also included in the model. In addition to domestic market conditions, international com-

[10] In fact, a number of studies have found that high industry growth is associated with a high entry rate. See, for example, Geroski and Schwalbach (1991).

petition would have some influence on the mobility and turnover of market leaders. In practice, some studies have provided empirical evidence that international competition have significant effects on market mobility. For example, Baldwin and Caves (1998) found that international competition increases the turnover of firms in Canadian manufacturing industries. Doi (2001) also found that exports have a volatility effect on market leadership, whereas Baldwin (1995) suggested that import competition increases mobility in industries. Hence, these covariates are predicted to have positive effects on the hazard rates.

As already explained, several types of cartels have been legally sanctioned in Japanese industries. In addition, as shown in Table 3, the Kaplan-Meier estimates differ between industries with legally sanctioned cartels and others. The result suggests that leadership positions tend to be stable over longer periods in industries where cartels were legally sanctioned. To clarify the effect of cartels on the duration of market leadership, a dummy variable for legally sanctioned cartels ($DCAR$) is used as a covariate. The dummy variable takes a value of one if cartels are legally sanctioned at any point in the observation period. Furthermore, a dummy for consumer good industries ($DCONS$) is included in the model. As already shown in Table 3, leadership positions tend to be more stable in consumer good industries than in producer good industries. Therefore, it is predicted that the coefficient of $DCONS$ indicates a negative sign.

Maximizing Equation (4), we estimated the coefficients of the above covariates. The covariates, HHI, ADV, RD, EXP, and IMP are measured by values in 1975. And the covariate, IG, is measured by the difference in the logarithm of domestic production between the initial year, 1975, and the year when the identities of market leaders changed or the observation were censored, divided by the number of observation years.[11] The definitions and summary statistics for these covariates employed in the analysis are given in Table 4.

(2) Results

By applying the semiparametric approach, Table 5 shows the estimation result using a proportional hazards model. In the analysis, Breslow's (1974) approximation method for tied events is used, and in this approximation each of tied times is treated as though it occurred just before the others.

First, the coefficients of concentration (HHI) were negative and statistically significant in Table 5, suggesting that market leaders are more likely to maintain their positions in concentrated industries. This is also consistent with the result of Table 3. From the perspective of competition policy, these results may indicate that market leaders have less mobility in concentrated industries.

Then, as predicted, industry growth (IG) had a positive effect on the hazard rates. This indicates that market leaders are less likely to maintain their positions over time in growing industries, which is consistent with the findings of Mueller (1986) and Kato and Honjo (2006). In addition, since the coefficients of IG were statistically significant at the 1% level in any models, industry growth appears to be fairly important in explaining the turnover of market leaders.

With respect to advertising intensity (ADV), any significant coefficients were not found in the analysis, although it was predicted that advertising has some influence on the duration of market leadership. This is consistent with the result of nonparametric approach. On the other hand,

[11] We also estimated the model using the variable for industry growth measured as a slope coefficient of log-linear regression of domestic production on time trend. However, its result was generally consistent with that using the above measure.

the effect of R&D intensity (RD) was found to be positive and significant, which is consistent with the result of Table 3. This suggests that market leadership is less likely to persist in R&D-intensive industries. Therefore, it implies that R&D and innovation play important roles in the turnover of market leaders, which concurs with Davies and Geroski (1997).

Also, the coefficients of export intensity (EXP) indicated significantly positive signs in Table 5. This suggests that market leadership tends to be less persistent in industries where exports are more intensive. Therefore, export competition may have an impact to increase the mobility of leading firms. On the other hand, the coefficients of import intensity (IMP) also indicated positive signs, although the coefficients were not significant throughout estimation results. Our results imply that the turnover of market leaders within domestic market is associated with international competition.

Furthermore, the dummy for legally sanctioned cartels ($DCAR$) had a significantly negative effect in Table 5, suggesting that market leadership is more persistent in industries with legally sanctioned cartels. This is consistent with the result of nonparametric approach. From these results, we cannot conclude that legally sanctioned cartels lead to less competition, since the impacts of duration of market leadership on firms' behavior or performance were not examined in the analyses. However, if less turbulence of market leaders is associated with the lack of competition, then the results might indicate that competitive pressure is less effective in such industries.

Finally, the effect of the dummy for consumer good industries ($DCONS$) was found to be significantly negative throughout estimation results, which is consistent with the result of Table 3. This indicates that market leaders tend to maintain their positions for longer periods in consumer good industries than in producer good industries. Part of this may relate to the difference of buyer structure between these industries. That is, the buyers of firms consist of relatively smaller number of firms in producer good industries than those of firms in consumer good industries, composed of a great number of individuals. As some studies (e.g., Lustgarten, 1975; Schumacher, 1991) suggested, the difference of buyer structure that is likely to be associated with buyer power may have some influence on competition in industries. For this reason, our findings may indicate that the turnover of market leaders is more likely to occur in producer good industries.

IV. Concluding remarks

This paper explores the turnover of market leaders, using data on Japanese manufacturing industries over the period 1975–2002. By applying survival data techniques, we explain industry differences in the turnover of market leaders over time. Our empirical results suggest that market leaders tend to maintain their positions in concentrated industries and consumer good industries. On the other hand, it is found that the turnover of market leaders is more likely to occur in growing industries and R&D-intensive industries. Furthermore, we provide evidence that leadership positions are more stable in industries where cartels were legally sanctioned.

This paper has attempted to shed some light on the turnover of market leaders, by estimating the duration of market leadership. First, we examined the duration of market leadership, using the Kaplan-Meier method as a nonparametric approach. In the analysis, the survival functions were estimated by using both the full sample and the subsamples, respectively. The results indicate that the survival estimates vary between the subsamples with different characteristics. Then, we also examined the duration of market leadership, using the proportional hazards model as a semiparametric approach. The results revealed the determinants of the duration, and reinforced the results of the nonparametric estimation.

By applying the survival data techniques to our data set, we attempted to identify whether market structure, nonprice rivalry, international competition, and public policy affect the turnover of market leaders with both nonparametric and semiparametric approaches. From these findings, the paper would contribute to a better understanding of the dynamics of competition.

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Table 1: The distribution of industries and the turnover of market leaders

Industry	N (A)	Turnover (B)	B/A (%)
Food	33	13	39.4
Textiles	15	11	73.3
Timber and Furniture	5	4	80.0
Paper and pulp	14	7	50.0
Chemicals	69	39	56.5
Petroleum and coal products	12	11	91.7
Plastic products	8	5	62.5
Rubber	6	5	83.3
Ceramic stone and clay	18	10	55.6
Iron and steel	36	14	38.9
Nonferrous metal	8	4	50.0
Fabricated metal	15	8	53.3
General machinery	55	48	87.3
Electrical machinery	51	41	80.4
Transportation machinery	21	16	76.2
Precision machinery	8	7	87.5
Miscellaneous	7	3	42.9
Total	379	246	64.9

Note: N indicates the number of observations. Turnover means the number of industries where changes in the identity of the first-ranked firm were observed during the observation period.

Table 2: Life tables for survival data and Kaplan-Meier estimates

Year	At risk	Turnover	Censored	K-M estimates	Std. Error
1976	379	66	4	0.826	0.020
1977	309	41	0	0.716	0.023
1978	268	16	0	0.674	0.024
1979	252	19	0	0.623	0.025
1980	233	10	3	0.596	0.025
1981	220	13	0	0.561	0.026
1982	207	7	2	0.542	0.026
1983	198	11	0	0.512	0.026
1984	187	10	1	0.484	0.026
1985	176	8	0	0.462	0.026
1986	168	3	5	0.454	0.026
1987	160	8	2	0.431	0.026
1988	150	5	3	0.417	0.026
1989	142	6	0	0.399	0.026
1990	136	1	7	0.396	0.026
1991	128	2	0	0.390	0.026
1992	126	5	2	0.375	0.026
1993	119	4	0	0.362	0.025
1994	115	1	46	0.359	0.025
1995	68	1	0	0.354	0.026
1996	67	2	6	0.343	0.026
1998	59	2	15	0.332	0.026
1999	42	1	0	0.324	0.027
2000	41	1	1	0.316	0.027
2001	39	1	0	0.308	0.028
2002	38	2	36	0.292	0.029

Note: The K-M estimates indicate the cumulative survival function estimated by the Kaplan-Meier method.

Table 3: Kaplan-Meier survival functions by stratification and equality tests

Stratification	N	1980	1985	1990	1995	2000
(Concentration)						
Low ($HHI < 0.18$)	230	0.500	0.361	0.300	0.240	0.216
High ($HHI \geq 0.18$)	149	0.744	0.618	0.545	0.522	0.462
Log-rank test = 28.37***, Wilcoxon test = 27.78***						
(Advertising intensity)						
Low ($ADV < 0.003$)	190	0.616	0.492	0.409	0.356	0.335
High ($ADV \geq 0.003$)	189	0.576	0.433	0.383	0.348	0.297
Log-rank test = 0.65, Wilcoxon test = 0.27						
(R&D intensity)						
Low ($RD < 0.05$)	175	0.651	0.565	0.485	0.445	0.431
High ($RD \geq 0.05$)	204	0.547	0.372	0.318	0.273	0.222
Log-rank test = 12.82***, Wilcoxon test = 7.54***						
(Cartels exempted from the application of Antimonopoly Act)						
Yes	93	0.653	0.531	0.473	0.447	0.425
No	286	0.577	0.440	0.371	0.323	0.281
Log-rank test = 5.24**, Wilcoxon test = 4.43**						
(Consumer good and producer good industries)						
Consumer good industries	110	0.696	0.582	0.525	0.483	0.452
Producer good industries	269	0.555	0.414	0.344	0.300	0.253
Log-rank test = 10.34***, Wilcoxon test = 11.47***						
Full sample	379	0.596	0.462	0.396	0.354	0.316

Note: N represents the number of observations. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Table 4: The definitions and summary statistics for covariates

Covariate	Definition	Mean	S.D.
HHI	Sum of the squares of market shares.	0.181	0.143
IG	Difference of the logarithm of domestic production, divided by the number of observation years.	0.045	0.147
ADV	Advertising divided by domestic production.	0.008	0.011
RD	R&D expenditures divided by value added.	0.064	0.042
EXP	Exports divided by domestic production.	0.150	0.154
IMP	Imports, divided by domestic production minus exports plus imports.	0.050	0.059
$DCAR$	Dummy variable: 1 if any cartels are allowed, 0 otherwise.	0.245	0.431
$DCONS$	Dummy variable: 1 if consumer good industries, 0 otherwise.	0.290	0.454

Note: The number of observations is 379. All monetary values are millions of yen. S.D. indicates standard deviation.

Table 5: Estimation results: a proportional hazards model

	(i)	(ii)	(iii)
HHI	-3.893^{***}	-3.870^{***}	-3.641^{***}
	(0.585)	(0.577)	(0.553)
IG	1.696^{***}	1.692^{***}	1.959^{***}
	(0.560)	(0.561)	(0.512)
ADV	-2.881		4.985
	(5.085)		(4.606)
RD	4.086^{***}	3.749^{***}	
	(1.233)	(1.077)	
EXP	0.692^{*}	0.697^{*}	0.795^{**}
	(0.366)	(0.366)	(0.380)
IMP	0.515	0.451	0.327
	(1.060)	(1.051)	(1.067)
$DCAR$	-0.356^{**}	-0.353^{**}	-0.365^{**}
	(0.167)	(0.167)	(0.168)
$DCONS$	-0.289^{**}	-0.313^{**}	-0.389^{***}
	(0.143)	(0.136)	(0.139)
Wald χ^2	94.07^{***}	95.14^{***}	84.45^{***}
Log pseudo likelihood	-1307.940	-1308.025	-1310.648
N	379	379	379

Note: Standard errors adjusted for 379 clusters are in parentheses. N represents the number of observations. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Figure 1: Kaplan-Meier survival function