JAPANESE FIRM RESPONSE TO CHANGING REGULATION: A DYNAMIC STRATEGIC GROUP ANALYSIS

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ABSTRACT

Firms must repeatedly respond to changes in the regulatory environment. Rather than focusing only on the response of the industry as a whole, we investigate the variation in response at the firm level. We postulate and find that the firm level response will be contingent on the resource base of the firm and the firm's degree of isomorphism to past regulatory and competitive conditions. Firms that are most isomorphic appear less able to adjust strategically to drastic environmental shifts. Using dynamic strategic group methodology, we demonstrate this response variation in a sample of Japanese pharmaceutical firms.

Key Words: Japan, pharmaceutical industry, government regulation, globalization, strategic groups, competitiveness

INTRODUCTION

Individual firms attempt to create and maintain competitive advantage in markets. Yet this simple model of strategy pays little attention to the interaction that a firm has with its environment. It is often change in the environment that allows for changes in competitive position, and this change is often initiated by changes in regulation faced by all firms in the market. As some firms are better able to take advantage of regulatory changes, there can be significant shifts in the competitive complexion of

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the industry, with some firms moving to substantially different positions in the marketplace. With the substantial changes in regulatory rules that are accompanying the increasing globalization of industries around the world, additional research on the interaction between regulatory rules and competitive position can make an important contribution to our understanding of international business.

This study allows us to contribute to that line of research. We choose a period of domestic regulatory change and increasing globalization of the Japanese pharmaceutical industry and examine the changes in strategic groupings of firms within the industry that accompany these environmental changes. Because we construct our study on the firm level, we are able to introduce firm and product level market share data as additional measures of performance. Dynamic strategic group methodology, combined with detailed historical insight into the regulatory and competitive changes in the industry deepens our understanding of the interaction between regulation and competition.

There is no lack of studies on the overall industry impact of government regulation and the change in that regulation. For example, studies look at the impact of the changes in the nature of pharmaceutical patents on profits for the industry. One study in Japan finds an excess return of 26 percent for firms with large patent portfolios when Japan changed to a patent system that provided more clear property rights (Kawaura and La Croix 1995). The nature of the regulatory process also has been shown to restrict the strategic response of firms in the industry. Reich (1990) shows that the nature of the regulations in Japan makes it easy for Japanese firms to ignore export market opportunities. Studies that look at the variation in the response across firms are less common. Penner-Hahn (1998) examines the differing response in foreign R&D activities across firms in Japan. Roehl (1996) shows how the nature of foreign R&D activities of Japanese pharmaceutical firms can influence their ability to build new competitive skill bases.

The present study builds on these previous attempts to understand why some firms respond differently to the challenges posed by regulatory and environmental change in Japan's pharmaceuticals industry. To test our approach, we utilize an established concept in strategy, the strategic group. This tool allows for a careful analysis of the nature of and change in industry structure, and it allows for quick identification of benchmark competitive groups and the bases of competition within those groups. Since we are to examine the response to regulatory change, we first use strategic group analysis to provide a base line from which to examine the response to regulation. Our use of the dynamic strategic group framework, coupled with a detailed environmental assessment, bridges the informational deficiencies of large-scale industry-wide analyses and the firm-specific perspectives of case studies (Doz and Prahalad 1991). We use the methodologies developed by Fiegenbaum, Sudharshan and Thomas (1990) and Sudharshan, Thomas and Fiegenbaum (1991) to analyze the data

set. Using this methodology, we can determine periods when the groupings are stable, and analyze the barriers that firms face in moving to a new strategic position as regulations and international environment change during our study period of 1970 to 1984.

The Japanese business environment for pharmaceutical firms provides a rich context in which to examine the character of the strategic groups, as well as the nature of barriers to firm mobility across group boundaries. This particular Japanese industry is of added interest, because we are not relating the usual Japanese success story. Quite to the contrary, the Japanese pharmaceutical industry has been unpopular and a relative failure from the Japanese perspective (Reich 1990). Many of the environmental changes that caused Japanese firms to refocus their operations were forced on the industry by foreign governments and foreign multinational firms. Furthermore, in this study a research methodology developed in the U.S. context is shown to be equally powerful in another business culture and in analyzing an external environmental regulatory shock.

The following section gives an overview of the environmental and regulatory considerations in the Japanese pharmaceutical industry. Then we examine methodological considerations concerning strategic group formation and group shifts. The subsequent sections present the statistical methodology, the results and our discussion.

CHANGES IN THE JAPANESE PHARMACEUTICAL INDUSTRY

The Japanese pharmaceutical industry includes firms of various sizes, but the largest firm is less than one half the size of the leading firms in the United States and Europe. The industry has long been focused on its domestic market, with exports now growing but seldom accounting for more than ten percent of sales. Research and development efforts are significant, however, with many firms having R&D-to-Sales ratios that compare favorably with those of U.S. and European firms. (Mitchell, Roehl and Slattery 1995, Mitchell, Roehl and Campbell 1996) By the end of the period being examined, firms were adding international alliances to their already significant domestic research efforts (Penner-Hahn 1998). In contrast to the commonly held image of Japanese firms, firms in this industry have always had to struggle to compete and to extend or build new competencies to enhance their competitive positions in an increasingly globalizing environment.

Like many other industries in the early post-war period, the Japanese pharmaceutical industry was the beneficiary of government policies, which created a protected and supportive domestic environment in which to operate. Two important classes of changes in the regulatory environment, however, upset this comfortable, isolated market and forced these firms to change: (1) increased pressure for cost

reduction from the government's universal medical insurance system; and (2) increased competitive pressure from foreign firms which entered the Japanese market directly as rules for foreign investment changed.

Health System Changes

In the immediate post-war period, the Japanese Ministry of Health and Welfare provided a very favorable environment for the Japanese pharmaceutical firms (Mitchell, Roehl and Campbell 1996). Japanese firms enjoyed rather high fixed prices for their drugs. They were also legally permitted (within Japan) to copy drugs developed abroad by simply using a different process to make their product identical to a drug patented outside Japan. These two policies created a rather comfortable environment, giving Japanese pharmaceutical firms both a favorable cost position in R&D (a major cost in the value chain for this product), as well as profitable sales into a controlled market.

Japanese pharmaceutical firms were obliged, however, to share the gains from this cozy system with other members of the health care system, specifically with doctors. Doctors enjoyed an effective monopoly on the sale of prescription drugs. Firms therefore competed to provide information and assistance to doctors, anticipating that the results would be increased sales of the firm's drug portfolio. Firms were free to sell drugs to doctors at a negotiated discount, which could vary, by doctor and by product. The result was that pharmaceutical firms felt it necessary to maintain large staffs of medical representatives to promote drugs to doctors, which certainly reduced somewhat the net value of the regulatory protection. Because they wanted to sell as many drugs as possible to each doctor with which they established a relationship, the firms also felt compelled to have a full set of drugs in their portfolio, meaning that they would always try to match the portfolios of other drug firms, even when drugs had to be obtained via licensing from abroad. There was also an incentive to make a stream of incremental changes to drugs to continually provide the marketing department with "new" drugs (so called "me-too" drugs) to gain doctor attention and maintain customer loyalty.

The first significant change in the regulatory environment occurred in 1975, when Japan adjusted its patent system to match those of other developed countries. This change made the chemical composition of a drug, rather than the process used in making the drug, the source of pharmaceutical product protection under Japanese law. Japanese pharmaceutical firms could no longer copy drugs discovered outside Japan by just devising a different production process.

The second important environmental change occurred when Japanese medical costs skyrocketed in the 1970's, at the same time that Japanese government budget deficits put the government under severe pressure to eliminate budget increases for

existing programs. The government response was a change in policies that meant that firms could no longer expect to maintain prices which allowed for comfortable margins. Government rules were changed in the early 1980's so that both the initial price the government approved, and the rates of price changes it approved, were now less attractive to firms. Under the tougher regulations, the initial price approved by the government is based on the level of increase in benefits of the new drug rather than its costs of development. An innovative drug, defined as one which has "significantly" greater efficacy than existing drugs, gets favorable pricing treatment, while "me-too" drugs similar to other existing products can expect only a modest price. Further, rather than ministry actions which support the drug price, firms can now expect periodic reevaluations from the Ministry of Health and Welfare, which continuously and more rapidly ratchet down the prices of existing drugs. Moreover, the rate of decrease in the approved price for a drug is likely to increase if competitors have started to introduce "me-too" drugs. Thus the actions of competitors could greatly influence the total returns a firm might receive from its prior investment in drug R&D.

Foreign Investment Rule Changes

Initial post-war rules effectively encouraged foreign firms to license their drugs to Japanese firms for clinical testing and distribution in the local market (Mitchell, Roehl and Campbell 1996). In addition to Japanese patent rules, which made it easy for Japanese firms to copy new foreign drugs, foreign firms were not allowed to present their drugs for ministry approval in their own name. They had to have a Japanese "partner" make the formal application. Other rules that made it difficult for all foreign firms to invest in Japan of course applied to foreign pharmaceutical firms as well. The predictable result of these restrictions was marketing alliances, which matched the foreign firms with domestic partners.

By the middle of the 1980's, these restrictions had all been dropped (Maurer 1989). After the change in patent laws in the mid 1970's, and the adoption of a more liberal Foreign Exchange Control Law in 1980, there were essentially no formal regulatory barriers to investment. Further, regulatory changes in the early 1980's enabled foreign firms to apply for their own drug approvals**.** The results of the relaxation of these restrictions were predictable, if somewhat slow to develop. Since 1980, foreign firms have introduced independent marketing units into Japan and have begun to set up or expand R&D facilities in Japan. The weak competence of Japanese firms in drug creation relative to foreign firms was exposed by these environmental changes. Foreign firms could even consider taking over a poor performer in the Japanese industry (e.g. Merck's purchase of a lagging Banyu in 1983).

For Japanese firms, these environmental changes had several implications for R&D and marketing strategies. Increasing numbers of competitors could only drive

down the returns available from the Japanese domestic market. Even more worrisome was that the availability of new pharmaceutical products from abroad for licensing into Japan was likely to diminish, since foreign firms, like any other firms operating in the domestic market, would want to have a full and (if possible) an exclusive line of drugs to offer to doctors.

In the last two decades, all the world's pharmaceutical firms have faced the pressures of escalating research and development expenses. Japanese firms are no different. Yet the two foregoing trends in the domestic environment exacerbated the pressures on Japanese pharmaceutical firms. These firms now faced reduced access to their (previously) low-cost foreign source of new drugs, i.e., the drug-creation competence of foreign firms willing to license to Japanese firms. Moreover, they also faced a reduced payoff from profits made by developing incrementally effective drugs in which their existing R&D operations had strong competencies. Following these momentous environmental changes, Japanese pharmaceutical firms clearly needed to develop new R&D competencies to survive in their new competitive environment (Mitchell, Roehl, and Slattery 1995).

These changes also reduced the effectiveness of the firms' other strong competence, their marketing capability. With more sophisticated products increasingly available in the Japanese market, medical representatives needed to become more sophisticated. Large numbers of representatives alone would no longer be as effective. In addition, while it would take foreign firms some time to develop a marketing network of their own, Japanese firms would surely find that increased competition in marketing progressively eroded the value of their existing marketing system. It seems inevitable that Japanese pharmaceutical firms would have had to develop competencies which were capable of creating and marketing new, truly innovative pharmaceuticals.

These changes did not affect all firms in the industry equally. The changes in environment had, at least for some firms, a positive effect, as they searched for opportunities to improve their existing competitive positions. If a firm had, or could build more quickly or more effectively, the R&D skills needed to succeed in the new environment, it could reasonably expect to change its relative position within the Japanese (and perhaps even the worldwide) pharmaceutical industry (Mitchell, Roehl, and Slattery 1995, Kneller 1999).

On a relative basis, marketing competence had become less critical, since superior competence in new drug development also should have enabled a firm either to license drugs or to form an alliance with another firm to market the products developed (Roehl 1996). Thus one can argue that the Japanese pharmaceutical firms most likely to have benefited from these changes would be those which had longer experience in doing research, those firms with technologies useful in creating

innovative drugs (e.g. fermentation technology), and those with a currently profitable drug portfolio from which to fund an increase in R&D.

We use dynamic strategic group analysis to help us identify and interpret the results of these regulatory and environmental shifts. By comparing the positions of firms in the groups, and by identifying changes in the competitive groups within the industry, we show the differential impact on the firms in the industry. We predict that the groups should show more instability as first the patent changes of 1975 had their impact, and then the governmental rules and the foreign firm strategic flexibility increased in the early 1980's. We predict that on an individual firm level, firms that were best adapted to the tightly regulated and protected environment of the earlier period will have had the most difficulties competing in the new environment. Firms that were most isomorphic, or had committed to a certain strategy should display different movement patterns than firms that remained flexible (possibly due to later entry into the industry). Huff, Huff and Thomas (1992, 56) describe such organizational inertia and define it as the level of commitment to the current strategy, reflecting individual support for a given way of operating, institutional mechanisms for implementation, and monetary and social investments.

STRATEGIC GROUP FORMATION AND GROUP SHIFTS

Strategic groups refer to collections of firms or segments within an industry. They are usually defined as sets of firms with similar strategies or groups of firms facing common mobility barriers (Porter 1979). Lately, strategic group research has come under criticism concerning its statistical rigor (Barney and Hoskisson 1990, Hatten and Hatten 1987) and a lack of theoretical fundamentals (Barney and Hoskisson 1990). Yet a wealth of studies continues to use the concepts and techniques developed in the mid-1980s (see McGee and Thomas 1986 for a review). While a purely statistical approach to strategic group formation, using financial and strategic variables, is clearly insufficient, it has been shown that dynamic strategic group analysis, supplemented by a qualitative historical analysis of industry evolution, provides an insightful view of competitive activity (Bogner, Thomas, and McGee 1996).

Within the context of the business environment in the United States, dynamic strategic group studies have shown how competitive environments change over time (Cool and Schendel 1987, Mascarenhas 1989, Fiegenbaum, Sudharshan, and Thomas 1990, Bogner, Thomas, and McGee 1996). Here, examining stable strategic time periods and mobility barriers that mark off one strategic group of competitors from another, together with a qualitative historical analysis of industry conditions, provides an in-depth view of competitive activity in the Japanese pharmaceutical industry. Although this methodology has been used to examine globalization in an industry where patterns of competition are substantially influenced by North American

business practices (Bogner, Thomas, and McGee 1996), it has to our knowledge not been applied in a context where patterns of competition are heavily influenced by regulation and government policy, as is the case in Japan during the time period under study.

In this analysis of the Japanese pharmaceutical industry we follow the methodology proposed and applied by Fiegenbaum et al (1990) and Sudharshan, Thomas, and Fiegenbaum (1991). Fiegenbaum et al (1990) proposed a five-step process for determining and analyzing strategic groups in an industry. In step one, researchers need to map the strategic space of the competitive environment. Three dimensions determine the broad characteristics of that space: the levels of organizational strategy (e.g., corporate, business and functional), the components of strategic decisions (e.g., scope, resource deployment), and the time period. In step two the researchers determine the strategic sub-space, such as which level of strategy to examine. In the third step, variables must be identified which best capture the firm's scope and resource deployment decisions in the competitive context under study. Fourth, time periods of homogeneity and similarity in competitive strategic behavior are identified. Fiegenbaum, Sudharshan and Thomas (1987) proposed two criteria for periods to be considered stable, namely: (1) that the variance-covariance matrix formed from the strategic variables should remain relatively unchanged, and (2) that the average (mean) behavior of the firms in terms of the strategic variables should remain relatively unchanged over the time period examined. Once the time periods have been identified, step five clusters the firms in the industry into strategic groups. Subsequently, mobility barriers to strategic group shifts (Sudharshan et al 1991) are identified and interpreted, using a rich database of market share and regulatory data in the case of the Japanese pharmaceutical firms.

METHOD AND DATA ANALYSIS

The Yukashoken Hokokusho, consisting of the firms' "10-K" reports to the Japanese Ministry of Finance, is the primary source of our financial data. The time period of 1970 to 1985 allows for a stable starting period and for enough time to observe in the data the attempts by firms to search out new competitive strategies consistent with a significantly new regulatory and competitive environment. During that time period the Japanese pharmaceutical industry consisted of up to 41 publicly listed firms. Our sample excludes firms that entered or exited the industry during that period in terms of their listing status. Further, we exclude two firms that lack sufficient data to construct all the strategic variables. In total, 8 firms were excluded. The 33 companies remaining in our sample represent more than 95 percent of the sales in this industry.

Table 1 summarizes the strategic variables used in this study. These variables were originally chosen by Fiegenbaum, Sudharshan, and Thomas (1990) to describe scope

of operations and resource deployment activities of firms in the U.S. pharmaceutical industry. Resource deployment activities consist of finance, marketing, and production elements.

Strategic Time Periods And Strategic Groups

As the first step in our analysis we identified time periods of homogeneity with regard to the strategic behavior of the firms in our sample. According to Fiegenbaum et al. (1987) two criteria are used to identify such stable periods:

(1) the variance-covariance matrix formed from these strategic variables should remain relatively unchanged; and
(2) the average (mean) behavior of the firms in terms of the strategic variables should remain relatively unchanged over the time period examined.

Stability in the variance-covariance matrix between adjacent time periods indicates that no strategic change has taken place. If a firm's commitment along the strategic variables has changed, this must be reflected in the covariances between the variables. Thus, according to Cool (1985), a stable strategic time period is a period in which the variance-covariance matrix formed from the strategic variables within the considered time period is more stable than that which exists across periods. Two statistical tests are applied for the two criteria of change. The first test, Bartlett's Chi-square (Green 1978, 169-171), is used to test the equivalence of two sets of variance-covariance matrices. The matrices consist of the 17 variables for each of the 33 firms. The second criterion of change, the equivalence of the sets of mean vectors, is examined using Hotelling's T2 test (Green 1978, 166-167).

Table 2 presents the first part of the research findings for the stable strategic time periods. Using Bartlett's test, the variance-covariance matrices for adjacent years are compared. A significant difference observed using this test indicates that the interrelationships between the strategic variables have changed from one year to the next. Five changes are observed that are significant at the $\alpha = 0.01$ level. These changes took place from 1972 to 1973, 1976 to 1977, 1981 to 1982, 1983 to 1984, and 1984 to 1985. The first and last stable strategic time periods are identified with open-ended dates (i.e., -1972; 1985-) indicating that, although the data began in 1970 and ended in 1985, there is no evidence that those dates represent the beginning and the end of the respective stable strategic time periods as well.

In summary, we infer from Tables 2 and 3 that there exist 6 stable time periods for the Japanese pharmaceutical industry between 1970 and 1985. The latter part of the period shows evidence of frequent strategic realignment, indicating that the

periods are only "quasi-stable" and the final pattern of strategic choice has not yet been established. Given the two major environmental shocks which the industry experienced in the late 1970's and early 1980's, this pattern matches our expectations very well. The exact timing of the first major strategic realignments can be debated, but it stands to reason that although the firms could have anticipated some of the changes, a lagged reaction is very plausible.

TABLE 1 Strategic variables and measures

Variable		Abbreviation	Measurement Units
(1) SCOPE*			
(V1)	Assets	ASS	Book value of fixed assets
(V2)	Sales	SLS	Firm's total sales
(V3)	Advertising	ADV	Firm's total advertising expenditure
(V4)	R&D	RD	Firm's total R&D expenditure
(V5)	Inventory	INV	Firm's total inventory level
(2) RESOURCE DEPLOYMENT			
a) Finance			
(V6)	Current ratio	CR	Current assets over current liabilities
(V7)	Quick ratio	QR	Cash and short-term receivables over current liabilities
(V8)	Dividend payout ratio	DP	Preferred and common dividends over income before extraordinary items and discontinued operations
(V9)	Times interest earned	TIE	Operating income before depreciation over interest expense
(V10)	Debt-equity ratio	DE	Debt over equity
b) Production			
(V11)	Capital intensity	CI	Invested capital yen over sales yen
(V12)	R&D intensity	PRDI	20% of R&D yen over sales yen
(V13)	Inventory intensity	INVI	Inventory yen over sales yen
(V14)	Cost efficiency	CE	Cost of goods over sales
c) Marketing			
(V15)	Receivables intensity	RSI	Receivable yen over sales yen
(V16)	Advertising intensity	ASI	Advertising yen over sales yen
(V17)	R&D intensity	MRDI	80% of R&D yen over sales yen

Scope Variables are deflated for inflation. As a deflator we used the producer price index for chemicals from the *Statistical Yearbook for Asia and the Pacific, 1990, 1983, 1980, 1978, and 1975.*

TABLE 2

	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79
Chi^2	122.04	175.34	198.58**	181.35	185.27*	182.08	218.56**	115.77	85.53

	79-80	80-81	81-82	82-83	83-84	84-85
	137.60	148.57	252.77**	196.20*	208.45**	362.22**

* Significant at $\alpha = 0.05$ ** Significant at $\alpha = 0.01$

Bartlett Chi-square without companies with missing data for 1970 to 1985, D.F. 153

Table 3 presents the summary of the multivariate test results for Hotelling's T2 statistic. None of the differences in the two adjacent sets of means are significant at the 0.01 level.

TABLE 3

Year	70-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79
T^2 (F)	0.2978	1.1032	0.3309	2.2735*	0.8312	1.1284	0.3541	0.3208	0.2840

	79-80	80-81	81-82	82-83	83-84	84-85
	0.3366	0.7128	0.2073	0.3441	0.5603	0.373

Significant at $\alpha = 0.05$

Hotelling T-square without companies with missing data for 1970 to 1985, F (17,48)

Within each strategic time period, meaningful strategic grouping can now be undertaken. Strategic grouping was performed for each year separately, which enables us to cross check the results against the time periods established earlier. We used cluster analysis (Harrigan 1985) as the grouping procedure. Clustering was performed with Ward's (1963) hierarchical method, as implemented in SAS. The stopping rule used was based on the R^2 criterion.

There are no perfectly satisfactory methods for determining the number of population clusters for any type of cluster analysis. A commonly used rule of thumb involves examining the 'tightness' of the clusters as the algorithm progressively combines groups (e.g. Cool 1985, Harrigan 1985). The tightness of the group structure is usually measured in terms of the contribution that an additional group would make to the overall fit of the clusters (measured in terms of the R^2 coefficient;

for computational details, see SAS/STAT User's Guide (1990)). Following Fiegenbaum (1987), we use two criteria for determining the structure of the clusters: (1) an additional cluster increases the overall fit by less than 5 percent; and (2) the clusters obtained explain at least X percent of the overall variance. The level of *X* can be determined empirically for any given data set. We stopped clustering when an additional group caused a change of less than 5 percent in R^2 and total R^2 was above 0.65. Figure 1 to Figure 4 represent summaries of the strategic groups that were identified.

FIGURE 1: Period 1 to period 2 (1972/73)

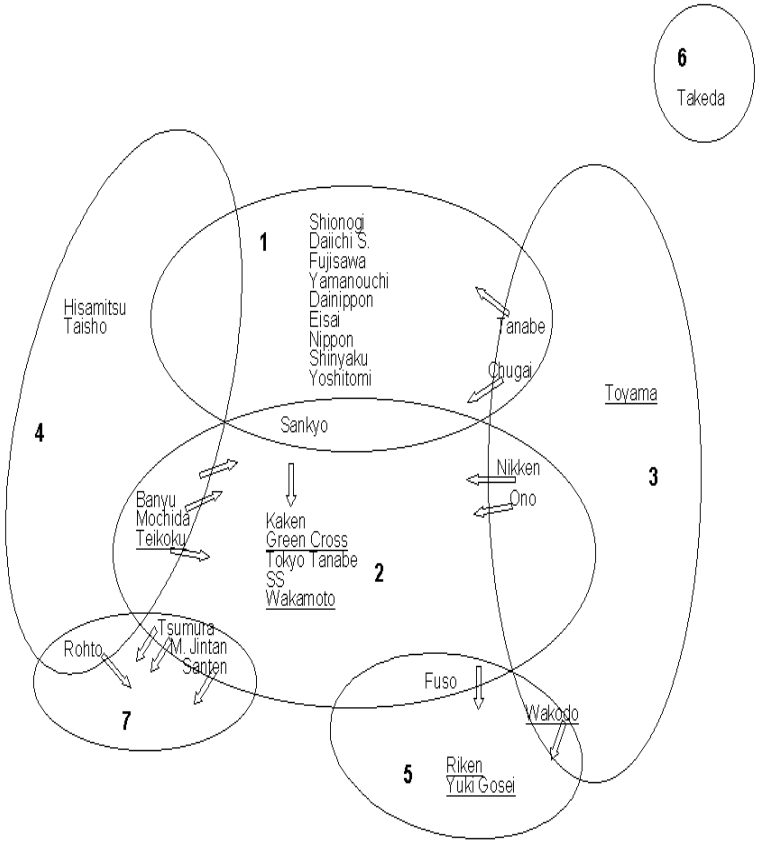


FIGURE 2: Period 2 to period 3 (1976/77)

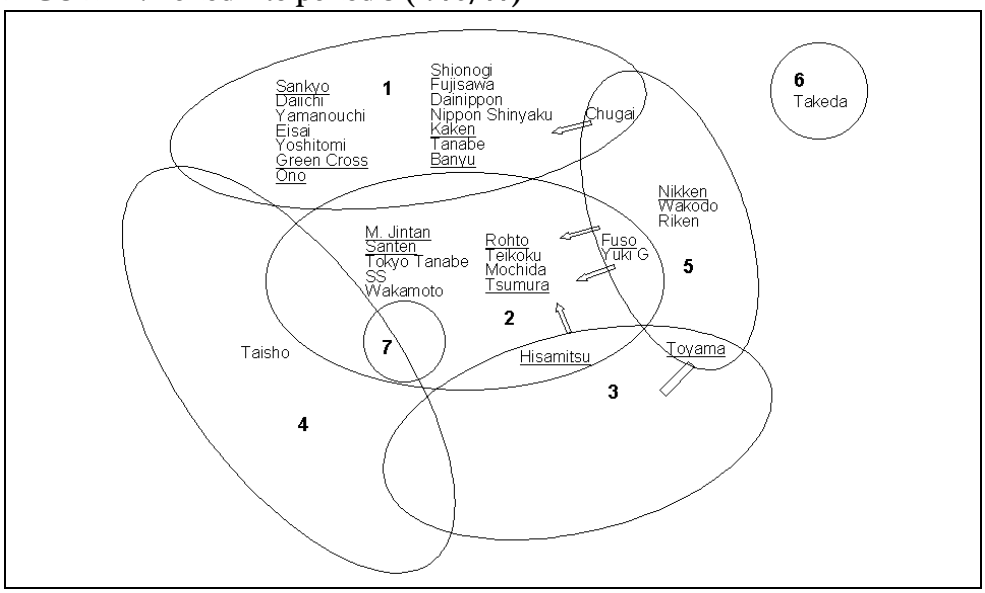


FIGURE 3: **Period 3 to period 4 (1981/1982**)

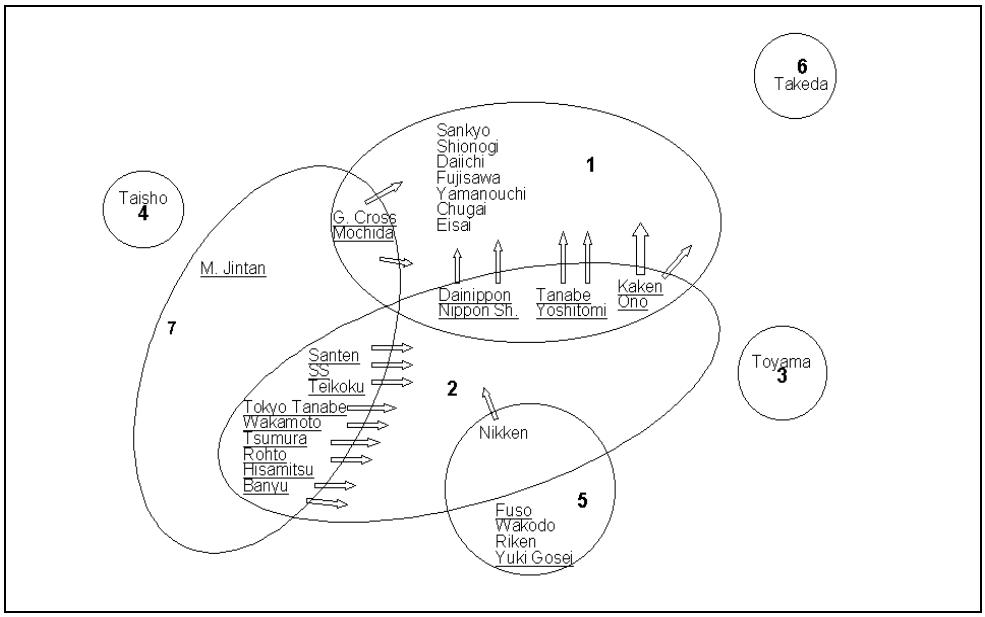
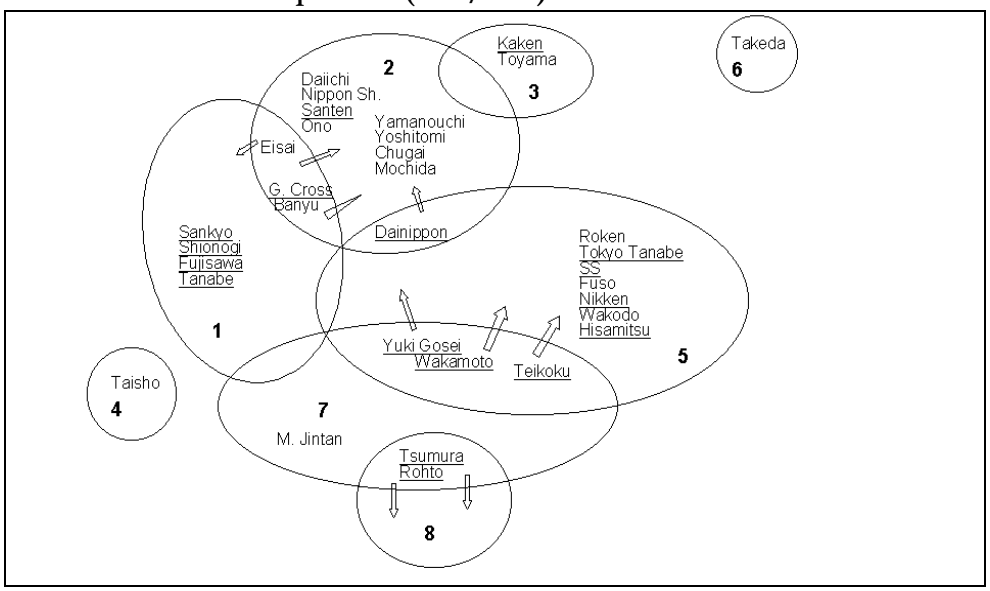


FIGURE 4: Period 4 to period 5 (1984/1985)



The four figures show the constituents of each group at the end of one stable period and the beginning of the next one. They also indicate the companies that changed groups and their new affiliation at the beginning of the new stable time period. These Venn-type diagrams use the two-dimensional space for expository purposes only. The group numbers have been chosen for convenience. For example, the stable time period 1 ended in 1972 and a new stable period started in 1973. Between the years 1972 and 1973, Santen changed its group affiliation from strategic group one to strategic group two. Arrows indicate the direction of movement during the transition phase.

Group proximity is shown by the overlapping areas of the circles that delimit the group boundaries. Companies that change affiliation are located in these overlapping areas. Empty overlapping areas indicate that company movements have taken place during the previous stable period. The companies that moved within the previous stable period are indicated by an underscore. For example, during stable period 1, Teikoku moved from strategic group one to strategic group four. During the transition from stable period 1 to stable period 2, Teikoku moved again, this time to group two.

It is interesting to note that despite the significant movements of firms between the groups, the total number of groups identified remains relatively stable over time. Overall, we identified 6 to 8 different groups, of which one group was always formed by Takeda Chemical Industries alone. Although Ward's method has a bias for outliers (Ketchen and Shook 1996), in the cases of Takeda, Taisho and Toyama, the qualitative analysis of firm strategy shows this to be a legitimate classification. Takeda is by far

the largest and most diversified competitor in the Japanese pharmaceutical industry. Taisho, the second outlier that emerges by 1976, is a diversified producer of almost exclusively over-the-counter products. The firm's most important product is "drink medicine", a mix of vitamins and sugar, of which Taisho holds about 50 percent of the total market. This product has no western equivalent, but is very profitable in Japan. Toyama is a maker of Chinese medicines, and thus legitimately occupies a different strategic space than the more conventional drug companies.

Mobility Barriers

Since we observe that firms change their group affiliation considerably from one stable strategic time period to another, we also need to more closely examine the mobility barriers presented to firms. Mobility barriers are the key factors (or variables) that can be identified when no movement between strategic groups in adjacent time periods occurs. If certain key decision variables form a mobility barrier, then there should be very little shift in the structure (group membership and number of groups) of strategic groups characterized by these variables over time. For variables that do not represent a mobility barrier, considerable shifting in strategic group structure over time (relative to these variables) is a likely occurrence.

In the following we will identify the key variables that define mobility barriers using the MOBIUS (Mobility Barriers Identification Using Strategic Grouping) procedure (Sudharshan, Thomas, and Fiegenbaum 1991). The MOBIUS procedure specifies a measure of structural change, which uses the output of strategic grouping analyses undertaken for different time periods. An index called "Match Ratio" (MR) captures structural change.

MR is computed by comparing two adjacent time periods. If there are m strategic groups in period T_1 and n strategic groups in period T_2 and the same companies belong to the same groups in both time periods (and therefore $m=n$), then there is no mobility between these to time periods, and MR is high. There is no change in group structure or membership. If either m is very different from n, or if there are considerable differences in group membership between the two time periods, then there is relatively high mobility between the two time periods, and the corresponding MR is low. Equation 1 shows the computation of MR where:

C_{ij} = number of companies that belong to group i in period T_1 and group j in T_2

N_{1i} = total number of companies belonging to group i in period T_1

N_{2j} = total number of companies belonging to group j in period T_2 .

$$\sum_{i=1}^{m} N_{1i} = \sum_{j=1}^{n} N_{2j} = N \qquad (1)$$

means that no companies have entered or exited the industry between T_1 and T_2 .

$$\sum_{i=1}^{m} N_{1i} \neq \sum_{j=1}^{n} N_{2j} \qquad (2)$$

means that at least one new company has entered or exited the industry.

$$MR = \frac{\sum_{i=1}^{\min(m,n)} C_{i,i}}{1/2(\sum_{i=1}^{M} N_{1i} + \sum_{j=1}^{N} N_{2j})} \quad \text{(when m≥n)} \qquad (3)$$

The *m* groups in T_1 are assigned numbers 1,2,...,*m* in the order in which the groups were developed. Each group in T_2 was compared to the groups in T_1 and assigned the identification number of that group in T_1 with which it had the highest degree of overlap. Ties were resolved arbitrarily as the MR is not changed by such a procedure. The MR corresponding to a perfect match between groupings between the periods is 1. If no group retains the same members, MR is 0. All other combinations will result in an MR value between 0 and 1. Note, that MR is sensitive to a change in the number of clusters as well as cluster membership. However, in our analysis the number of clusters proved relatively stable.

For each variable type, scope, finance, production, and marketing, as shown in Table 1, strategic groups were identified using cluster analysis. Using each set of variables separately, the number of clusters was determined for each year. Separate clustering gives an indication of the type of structural barriers that might prevent firms from changing group affiliations. The stopping rule used was again based on the R^2 criterion. We stopped clustering when an additional group caused a change of less than 5 percent in R^2. However the total R^2 achieved varied between 70 percent for the production variables, and 95 percent for the scope variables. Finally, the firms in the clusters were identified, and all firm movements between clusters were counted.

For each variable type and every pair of adjacent years, match ratios (MRs) were computed between strategic groups. These match ratios are shown in Table 4. The table demonstrates that there is considerable stability in the strategic grouping structure in terms of scope, with an average MR of 0.87 for the entire period. This was also demonstrated for the U.S. pharmaceutical industry by Sudharshan, Thomas, and Fiegenbaum (1991), who found an MR of 0.92 for the scope variables. Marketing, finance, and production variables do not clearly stand out as barriers. Their MR averages range from 0.73 for Finance to 0.78 for Marketing. Table 4 shows that the key decision variables that form strategic barriers vary across time. The graphical representation in Figure 5 further clarifies this notion.

Table 4 Match ratio by strategic variable type

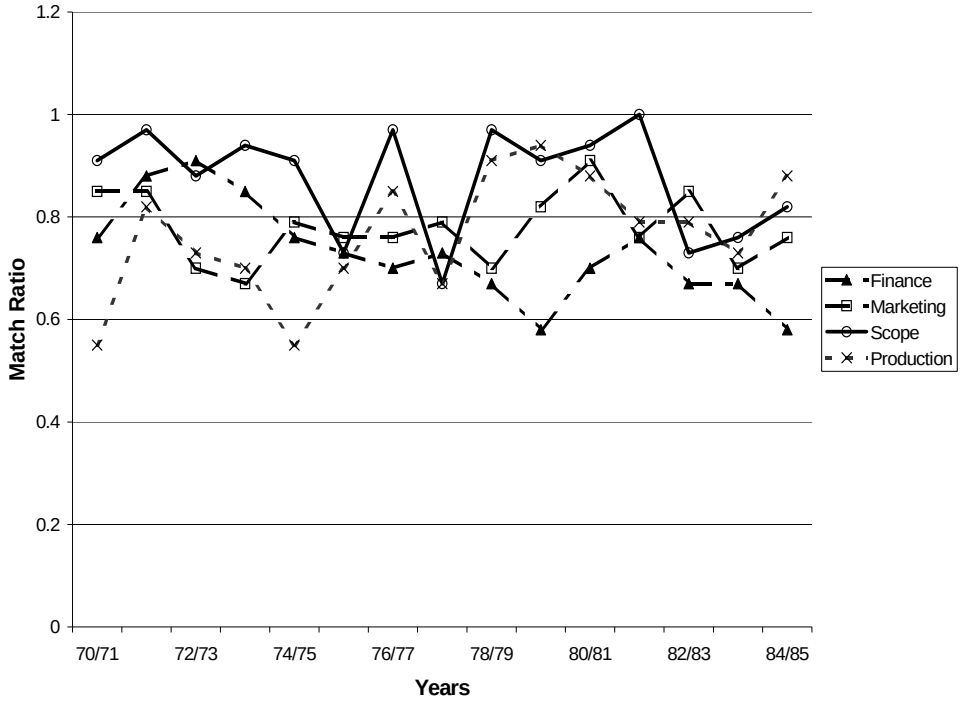
MR	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78
Finance	0.76	0.88	0.91	0.85	0.76	0.73	0.70	0.73
Marketing	0.85	0.85	0.70	0.67	0.79	0.76	0.76	0.79
Scope	0.91	0.97	0.88	0.94	0.91	0.73	0.97	0.67
Production	0.55	0.82	0.73	0.70	0.55	0.70	0.85	0.67
All	0.82	0.88	0.70	0.67	0.91	0.73	0.85	0.79
	Period 1			Period 2				Period 3

MR	79/80	80/81	81/82	82/83	83/84	84/85	Avg	Min
Finance	0.58	0.70	0.76	0.67	0.67	0.58	0.73	0.58
Marketing	0.82	0.91	0.76	0.85	0.70	0.76	0.78	0.67
Scope	0.91	0.94	1.00	0.73	0.76	0.82	0.87	0.67
Production	0.94	0.88	0.79	0.79	0.73	0.88	0.76	0.55
All	0.64	0.79	0.45	0.45	0.76	0.91	0.75	0.45
	Period 3			Period 4		Period 5		

For example, the cluster analysis with the production variables displays unusually high MRs from 1978/79 to 1980/81, and then again for 1984/85. Earlier in the period, production variables are clearly not impediments to mobility. The significant increase of the importance of the production measures clearly reflects the firms' reactions to the environmental changes in patent law in 1975 and the increasing entry of foreign firms by the early 1980's. Firms needed to invest capital and ramp up product development in new areas, as it was no longer permissible to rely on "me-too" drugs. The marketing match ratios also show higher peaks toward the latter part of the period. Although the product palette was an important tool in the earlier part

of the period, increased product development efforts are also reflected in our marketing variables, especially (V17), after 1979. Again, the match ratio indicates to us that firms with product development resources are separated from firms without such means.

FIGURE 5: **Mobility Barriers**



DISCUSSION

Product Mix And Market Share Data

Following statistical analysis, it is essential to put the findings into context. Although we have already provided some context by linking our findings with the environmental changes, further detail on products and market shares is highly desirable. We have obtained such information for almost all of our sample firms from *Market Share in Japan* (in Japanese) for the years 1973 to 1985. This database contains sales revenues by product for the firms with the top 10 market shares. (Product examples are: broad-spectrum antibiotics, middle spectrum antibiotics, vitamin B, vitamin compound). The products are further distinguished as ethical or over-the-counter drugs. Total market size is also shown.

Using the market share data, we analyzed each group at the beginning and the end of each stable strategic time period with respect to the dominant product or product type in that group and the product mix and level of diversification for each firm in that group. Group one clearly emerges as the antibiotics group. Using their profitable antibiotics as a base, these group one firms were also able to develop a complete line of products to sell to doctors, reaping the full benefits under the old regulatory system. Thus, these antibiotics manufacturers had the most commitment to that system. Being so isomorphic to their environment, they were not able to adjust quickly from their well-established position and consequently did not move around

much. When examining their product portfolio and their market shares we found that typically each of the firms produced a number of closely related variations of different antibiotic products in addition to a wide variety of other drugs and vitamins. These firms also tended to be fairly large and diversified, thus meeting the marketing requirement for a complete product portfolio that could be sold to the doctors.

The regulatory shock is reflected by a radical shift in group one memberships in the early part of the 1980's. At the end of the time under consideration, only Sankyo, Shionogi, and Fujisawa remain as permanent members of group one. All three of them are major producers of antibiotics, while having added a number of other products to their portfolio over time. Other early members of group one, such as Daiichi and Dainippon have refocused their activities away from antibiotics ("me-too" products). Table 5 provides the respective market shares of the top five antibiotics makers over time.

TABLE 5 Top five antibiotics makers at the beginning of each stable time period

73	Market Share (%)	77	Market Share (%)	82	Market Share (%)	84	Market Share (%)
Shionogi	12.8	Shionogi	8.6	Shionogi	10.1	Shionogi	14.0
Fujisawa	8.4	Fujisawa	7.5	Fujisawa	6.8	Fujisawa	6.8
Takeda	6.8	Takeda	4.7	Takeda	2.9	Takeda	6.2
Banyu	5.6	Banyu	2.3	Sankyo	2.6	Sankyo	4.2
Dainippon	2.3	Yamanouchi	1.5	Yamanouchi	1.5	Banyu	2.7

It is striking that the top five producers of antibiotics in our sample account for only about one quarter to one third of the entire antibiotics market in Japan, with Shionogi in a clear leadership position with only about 10 percent market share for most of the period. This indicates that the Japanese antibiotics market is highly fragmented, but also that foreign makers, not counted in our database, play a considerable role. Given that foreign competition in the latter part of our time period increased, we would have expected the total market share in antibiotics of the top five Japanese producers to fall significantly. However, this did not occur. We only observe a slight decrease in market share from 35.9 percent in 1973 to 33.9 percent in 1984. The reason for this surprising result is that Shionogi attempted to entrench itself in its antibiotics strategy, which is reflected in the firm's considerable increase in market share toward the end of the period to 14 percent.

Firms in group one are typically also more highly diversified than members of other groups. Employing a raw product count, we found that at the beginning of period two, in 1973, group one had an average product count of 12.6, compared to an

average count of 5.6 for group two. Product counts for groups one and two during the other periods show an even more clear distinction.

Our market share data, in addition to showing newly emerging groups, show that firms take substantial time to search out their new competitive positions, moving from group to group over a series of periods in our sample. Two groups, two and seven, show substantial change in membership. Apparently no clear identification of a stable strategic pattern had yet emerged. This demonstrates the difficulty that firms face when their fundamental competitive positions are challenged by regulatory and competitive changes in the environment.

IMPLICATIONS

We combine the power of statistical grouping procedures and an analysis of product and market share changes to provide an in depth view of the response of Japanese pharmaceutical firms to regulatory and environmental change. This combination of techniques permits us to examine the pattern of change in competitive positions within an industry, allowing for a firm level analysis of change to supplement the more conventional industry level analysis. We found that while some firms undertook substantial changes in competitive position, others remained in their same competitive space.

Interestingly, the firms that did not move included two quite different types. One group, whose antibiotics portfolio fit the earlier regulatory structure well, found it hard to move away from that base. In addition, three firms that had a clear competitive advantage found less need to move, since their firm-specific skills could not be easily duplicated, even in a more open and less regulated market. Takeda, with its size and concomitantly larger R&D budget, saw less need to change strategy. The two very specialized firms in the sample, Toyama in Chinese medicines, and Taisho in over-the-counter health drinks, also were already appropriately positioned for the new environment. This suggests that the conventional analysis of regulation, that all firms must change, ignores the possibility that firms might have competitive positions that are appropriate for several types of regulatory structure. Foreign firms might find those firms harder to displace as markets become more open.

Most of the other firms move from group to group as they search for appropriate positions in the new environment. This is especially common in pharmaceuticals, as the R&D plans of firms generate unexpected changes in the drug portfolios of the firms. Product development in this industry is much less predictable than in more conventional industries, leading to a longer period of adjustment. Japanese firms that rapidly expand their R&D activities are even less able to forecast the output, and this helps to explain the longer period of adjustment and greater number of changes in competitive direction which we observe.

The mobility barriers changed substantially for firms in this industry as a result of the regulatory change. The costly development of radically new drugs, with the associated capital investments in research facilities and more complex production systems, became more important for competitiveness. Some firms lacked the resources to make these moves. Other firms may have mismanaged their initial moves and become immobile.

Ideally, our analysis of product mix adjustments would have generated a stable end period for comparison. This shows the desirability of even longer term longitudinal studies when examining major changes in the competitive environment. It may also signal, however, that in industries like pharmaceuticals, with very uncertain returns to investment, that such stable periods may be hard to identify and use for scholarly analysis. Another obvious extension would involve comparative work in other countries that have gone through significant changes in the competitive environment as well. Doz and Prahalad (1991) suggested that such research should bridge industry and firm level analysis. Our in-depth approach to studying the regulatory environment and the product strategies of the firms in the context of dynamic strategic groups bridges that gap. Further studies that combine these two levels will improve our understanding of the impact of environmental change on the dynamics of competition among firms in an industry.

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