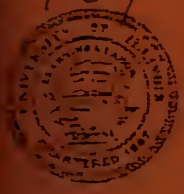

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Strategic Groups and Mobility Barriers: The Level of Struggle in an Industry

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Strategic Groups and Mobility Barriers: The Level of Struggle in an Industry

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Abstract

The level of aggregation in the industrial organization field is generally the industry. However, several researchers have recently suggested that the appropriate level of aggregation is the strategic groups which exist within each industry. Mobility barriers affect firm movements among strategic groups in an industry. They are responsible for protecting groups from intrusion by firms outside the groups.

This research examines strategic groupings within nine different industries. Markov processes are used to develop several indexes to determine the degree of mobility and struggle within the individual industries studied.

STRATEGIC GROUPS AND MOBILITY BARRIERS: THE LEVEL OF STRUGGLE IN AN INDUSTRY

By: Avi Fiegenbaum and Walter J. Primeaux, Jr.

I. INTRODUCTION

Among the many tasks of the field of industrial organization economics, is the study of market processes as they direct activities of producers in meeting consumer demand.[1]

The market structure concept is highly developed in the economic literature; different market structures lead to different performance levels among participants. This difference occurs because of the relative power of firms in the economic environment in which they operate.

The level of aggregation in the industrial organization field is generally the industry. An industry is broadly viewed as a collection of firms selling very similar or homogeneous products. Firms within an industry are similar in many respects. Hunt (1972) argues, however, that firms should be grouped into strategic groups and that type of aggregation provides the appropriate unit for examination. Firms within a strategic group are homogeneous to some extent and they undertake similar strategies in the conduct of their business. Mobility barriers affect firm movements among strategic groups in an industry and they are responsible for protecting groups from intrusion by firm outside the groups.

The main purpose of this study is to examine the nature and extent of struggling and mobility barriers within several different types of industries in a rigorous way using data and statistical analyses.

II. NATURE OF THIS STUDY

Even though mobility barriers are very important, they have been virtually ignored by previous empirical research. This research adapts Markov's[2] probabilistic method to the analysis of firm data to provide some new insights into the strategic group and mobility barriers concepts.

Results of this research provides researchers and decision makers very important information at both the corporate and business strategy levels,[3] such as:

1. The probability that a firm's strategic group will be invaded by a firm from another strategic group.

2. The probability that any firm in a particular strategic group will remain in the same strategic group in the following period.

Answers to these two questions also provide direct and indirect information about the level of competition and the efficiency of mobility barriers in protecting members of a given strategic group.

In any nonmonopoly business, a firm is affected by the behavior of rivals. Knowledge of offensive and defensive probabilities of changes in strategic group membership, can assist policy makers of a firm facing competition in determining the extent to which it must defend itself and strengthen the frontier which protects it from undesirable offensive moves. As McGee (1982) suggests, an understanding of oligopolistic interdependence among firms is important. This paper shows that the application of Markov Chain Theory to strategic group analysis provides insights and understandings of characteristics of competitive patterns within an industry which have not been previously developed.

The plan of this study is as follows: Section I is the introduction; section II discusses the nature of the study; section III discusses the strategic group and mobility barrier concepts and some previous studies; section IV briefly presents the theory of Markov Chains; section V presents the method for estimating the transition probabilities and some of their properties. Section VI develops four indixes and three sub-indixes for the struggling level in an industry. Section VII presents the empirical part of the research. Section VIII presents the conclusions and suggestions for further research. Appendices are at the end of the paper.

III. PREVIOUS STUDIES

Primeaux (1983a) presents a rather complete review of the strategic group concept; consequently, only those studies which are more relevant and germane to this research will be discussed here.

Porter (1980 p. 132) discussed one of the more valuable uses of the strategic group concept.

> The strategic group concept is an analytical device designed to aid in structural analysis.

Each firm is somewhat unique, and, differences which exist among firms, make it essential that researchers carefully proceed as they classify firms within an industry into strategic groups. As suggested by Primeaux (1983b), each industry is different and it is highly probable that appropriate strategic group designations for one industry (upon whatever dimension is used) will probably be inappropriate for classifying firms in another industry. The researcher must treat each industry individually and determine the important strategic dimensions for each industry.

Hunt (1972, pp. 8-16) originally coined the strategic group concept in his doctoral thesis. According to Hunt, a strategic group would be reflected in the following:

> A group of firms within the industry that are highly symmetric...With respect to cost structures, degree of product differentiation, degree of vertical integration, and the degree of product diversification... formal organization, control system, and management rewards and punishments...(and) the personal views and preferences for various possible outcomes.

Porter (1980, p. 129) modified Hunt's definition of a strategic group. According to Porter a strategic group is a group of firms "...in an industry following the same or a similar strategy along strategic dimensions." Firms within a strategic group may be said to be homogeneous while firms outside that strategic group may be said to be heterogeneous.

Newman (1978) used a similar approach to that used by Hunt. Newman, however, examined the relationship between the industry and the way firms acted outside the industry. Therefore, according to Neuman, strategic groups:

> Turn out to be defined by their differing degrees of vertical integration with the market in question. Newman (1978 p. 419).

Porter (1979) used the relative size of firms within an industry to determine strategic group membership. Porter divided all industries he examined into two strategic groups. Leaders are those firms accounting for thirty percent of industry sales while followers are firms within the same industry accounting for the remaining seventy percent of sales.

Primeaux (1983b) examined investment behavior of firms in two industries and concludes that Porter's strategic group designation generated superior results for the petroleum industry but that an alternative

designation of three strategic groups was superior for the textile industry. The three strategic group designation used by Primeaux was twenty percent, thirty percent and fifty percent of industry sales.

Barriers which tend to prevent a firm within an industry from changing the strategic group to which it belongs are called mobility barriers (Porter 1980, p. 134).

> Mobility barriers provide the first major reason why some firms in an industry will be persistently more profitable than others. Different strategic groups carry with them different levels of mobility barriers, which provide some firms with persistent advantages over others. The firms in strategic groups with high mobility barriers will have greater profit potential than those in groups with lower mobility barriers.

Oster (1982) actually attempted to examine mobility barriers based on advertising strategy and identified strategic groups and mobility barriers in certain industries.

McGee discussed the importance of mobility barriers to strategic management research.

> Classification of groups by their mobility barriers is an appealing idea which stresses the cost advantages enjoyed by group members and emphasizes the elapsed time as well as the investment expenditures required of would be entrants to overcome the barriers. (McGee 1982 p. 6).

McGee further says:

> The generalization of entry barriers into mobility barriers allows a richer and more realistic portrayal of the process of entry and the motives for diversification...the nature of oligopolistic interdependencies is illuminated by the pattern of group memberships and the change in membership over time. (McGee 1982 p. 9).

In the empirical section of this study, market share is used as the basis for determining strategic group membership. The business litera-

ture generally shows a strong relationship between market share and profitability;[4] consequently, we assume that the market share boundaries of the strategic groups reflect mobility barriers which prevent all firms in an industry from being equally profitable. This designation is consistent with Porter (1980, p. 134) who explained that mobility barriers provide the first major reason why some firms in an industry will be persistently more profitable than others.

IV. THE MARKOV PROCESS

One important objective of positive economics is to describe how economic data are generated. If one can understand the process which generates changes in the observed data, they are in a better position to predict the future time path of data and to control the economic variables. Marschak (1953) explained that "economic data are generated by systems of relations that are in general stochastic, dynamic and simultaneous." Markov processes are useful applications in dynamic analyses which use lagged variables to illustrate the relationship and dependence between economic variables across time. In this type of analysis "Current values of economic variables are assumed to depend on earlier values of the same variables." (Telser 1963).

The Markov theory of stochastic processes is concerned with the probabilities of moving from one state to another. In the analysis presented here, we observe and study firms moving from one strategic group to another, as will be discussed in a later section of this paper. Markov Chains are well suited to this type of analysis. The reader who is unfamiliar with Markov Chains will find a brief review

in an appendix of this paper; an even more thorough treatment is presented in Horowitz (1970).

V. THE ESTIMATION OF THE TRANSITION PROBABILITIES FROM FIRM DATA

As explained in the previous section and in the appendix, a Markov chain specification is a probability model for analyzing time series data. In this investigation, we are interested in determining whether any firms, starting within a given strategic group, have changed group membership through time.

The simplest model can be characterized as one with a finite number of possible outcomes, Si (i=1,2,...r); and the outcome (in this study of strategic group membership) of a given trial, at all stages, depends only on the outcome of the immediately preceding trial.

$$P\left(S_{j,t+1}/S_{i,t}\right) = P_{ij}$$

This probability has the following properties:

(1) $P_{ij} \geq 0$

(2) $\sum_{i=1}^{r} P_{ij} = 1$

There are several ways of estimating the transition probability, P_{ij}. One way is by the method of Maximum Likelihood (ML) presented by Anderson and Goodman (1957) and Goodman (1953) as:

$$P = [P_{ij}] = \frac{n_{ij}}{\sum_{j=1}^{r} n_{ij}}$$

when $$n_{ij} = \sum_{t} n_{ij,t}$$

where n_{ij} represents the number of firms moving from state i to state j for t years. State i is equivalent to strategic group i. The idea behind this estimate is that we can count the number of times firms move from strategic group i to strategic group j and divide that number by the number of occurrences of strategic group i.

The ML estimator is consistent but is not generally unbiased (Kendall and Stuart 1961, pp. 39-40). However, Kendall and Stuart show that by increasing the sample size, the bias moves toward zero. They also show that the estimates are asymptotically normally distributed.

VI. THE INDUSTRY STRUGGLING INDEXES

In this section we develop seven indexes to characterize the level of struggling within an industry. We call these struggling indexes because they give an indication of the overall movement or struggle which takes place within an industry.

For example, we have the following transition probabilities matrix P:

from i \ to j	1	2	3
1	1,1	1,2	1,3
2	2,1	2,2	2,3
3	3,1	3,2	3,3

In this example we have three strategic groups. Strategic group 1 includes firms with the higher market share while strategic group 3 includes firms with lower market share, while strategic group 2 includes firms with market shares between these two extremes.

P_{ij} indicates the firm transition probability of moving from strategic group i to strategic group j. The left diagonal elements indicate the probabilities of a firm moving from strategic group 3 to strategic group 2 or 1 and from strategic group 2 to strategic group 1. The right diagonal elements indicate the probabilities of firms moving from strategic group 1 to strategic groups 2 or 3, and from strategic groups 2 to strategic groups 3.

We develop four main industry indexes and three additional sub-indexes. The sub-indexes are derived from the main indexes; they provide important additional information.

a. The industry struggling indexes

(1) The industry stability index - P_s

$$P_s = \frac{\sum_{i,j} P_{i,j}}{i} \qquad \text{for } i=j$$

The sum of the diagonal elements (elements 1.1, 2.2, 3.3) is in the numerator. The sum of these elements indicate the probability that firms in the industry being studied will remain in the same strategic group in the next year. The number of strategic groups in this industry is presented in the denominator.

The industry stability index indicates the average probability that a firm in any one of the three strategic groups in this example will remain in the same strategic group in adjacent years.

(2) The industry climbing index - P_c

$$P_c = \frac{\sum_{i,j} P_{ij}}{(i^2-i)/2} \qquad \text{for } i > j$$

The left diagonal elements (elements 2.1, 3.1, 3.2) are in the numerator. The sum of these elements gives the probability of moving from a lower strategic group to a higher strategic group. The climbing index gives the average probability that a firm in a lower strategic group will move to a higher strategic group in an adjacent year. The number of events is in the denominator.

(3) The declining industry index - P_D

$$P_D = \frac{\sum_{i,j} P_{i,j}}{(i^2-i)/2} \qquad \text{for } i < j$$

The idea behind this index is basically the same as in the previous index; here, however, we are looking at the right side diagonals' elements. The declining index represents the average probability that a firm moves from a higher strategic group to a lower strategic group in an adjacent year. The number of events is in the denominator.

(4) The industry struggling index - P_{st}

$$P_{st} = \frac{\sum_{i,j} P_{ij}}{(i^2-i)} \qquad \text{for } i \neq j$$

The sum of the matrix elements, excluding the Diagonal elements, is in the numerator and the number of events involved in these transitions is in the denominator.

The struggling index gives the average probability that a firm in a given industry will move outside his current strategic group; this movement, of course, could be to either a higher or a lower strategic group.

This is called an industry struggling index because it gives an indication of the overall movement or struggling taking place within an industry.

A high struggling index means that the relative position of firms in the industry, with respect to market shares, is not very well established. In this case, most of the firms are trying to improve their positions and if some succeed other firms in the industry suffer from their improvements. The firms losing market share, however, may still enjoy high profits because of the profit potential which may exist in the industry. A high struggling index indicates low mobility barriers and vice-versa.

A high level of struggling will occur most frequently in industries that are in the introductory stage of the industry life cycle, as firms attempt to take advantage of emerging opportunities as the industry develops.

b. The sub-industries indexes

From the previous four indexes, three sub-indexes were developed. These additional indexes are important because the most probable outcome, excluding remaining in the same strategic group, is that firms will either move up or down by only one step at a time. That is, a firm may move to the next highest or lowest strategic group within its industry, but it is not likely to move up or down by more than one step at a time.

The above information is taken into consideration in the development of the following indexes.

(5) The sub-climbing index - Psub-c

$$\text{Psub-c} = \frac{\sum_{i,j} P_{i,j}}{(i-1)} \qquad \begin{array}{l}\text{for } i > j \\ \text{and } i-j = 1\end{array}$$

The numerator presents the sum of the probabilities of moving to a strategic group that is located only one level higher. For example, moving from strategic group 2 to strategic group 1, but not from strategic group 3 to strategic group 1.

The number of events is in the denominator. For example in an industry with three strategic groups we have a 3x3 transition probabilities matrix; so i-1 = 3-1 = 2 element (2.1, 3.2). Therefore, the sub climbing index (Psub-c) gives the average effective probability of a firm moving to a strategic group one level higher.

(6) The industry sub-declining index - (Psub-d)

$$\text{Psub-d} = \frac{\sum_{i,j} P_{ij}}{(i-1)} \qquad \begin{array}{l}\text{for } i < j \\ \text{and } j-i = 1\end{array}$$

This index is calculated in the same manner as the sub-climbing index; the difference is that in this case we use the right side elements of the diagonal. This index gives the average effective probability of a firm moving down only one level to a lower strategic group.

(7) The sub-struggling index - (Psub-st)

$$\text{Psub-st} = \frac{\sum_{i,j} P_{ij}}{(i-1)+(i-1)} \qquad \begin{array}{l}\text{for } i \neq j \\ \text{and } i-j = \pm 1\end{array}$$

This index is actually a combination of the previous two, and it gives the average effective probability that a firm in a given industry will move toward a different strategic group either one level higher or lower.

The next section presents the empirical analysis based on the models presented here.

VII. EMPIRICAL RESULTS

Data from the textile, computer, chemical, drug, lumber, perfume, petroleum, newspaper, and metal industries were selected for examination.

The years selected for study were 1969-1979 because complete data are available on compustat tapes for the selected industries during that time interval.[5] Table I-A in the appendix presents the number of firms included from each industry, as well as the number of years of data for each industry studied. This table also presents the results of a statistical test which is discussed later.

The first step in the research procedure was to decide what variable or set of variables would be used for the strategic group classifications. As we know from the literature, there is no prescribed basis or bases of strategic group designation which is acceptable to all researchers. In this study, as mentioned earlier, firm market share was used as the criterion of strategic group membership. While using alternative variables to establish strategic group membership may be useful, in practice other strategic variables are highly correlated with market share. As Porter (1980 p. 130) says:

> ... firms in the same strategic group generally resemble one another closely in many ways besides their broad strategies. They tend to have similar market shares and also to be affected by and respond similarly to external events or competitive moves in the industry because of their similar strategies. (italics added).

The above quote supports the selection of market share as an appropriate variable for determining strategic group membership; as explained below, however, the basic approach used here is really independent of the variable used to establish strategic groups. In other words, the method presented here could be adapted to any method of strategic group determination.

The second step in the research process was to determine the appropriate intervals for each strategic group; in other words, it was necessary to establish the range of market shares, for each strategic group, in each industry. This step determined the number of strategic groups in each industry as well as the groupings within each industry. Obviously each industry is unique and differs both on the basis of the number of strategic groups as well as the market share range of its strategic groups.

To determine the intervals of the strategic groups within each industry, we began by examining the data for the first period, 1969. For each industry, we plotted each firm's market share on a scale ranging from zero percent to one hundred percent. Then, by inspection we determined that a strategic group existed where the market shares clustered; consequently, the variance of market shares among members of a given strategic group would be smaller than it would be if any other firm in an adjoining strategic group or any firm in any other

strategic group within the industry were included within that strategic group. This procedure established five strategic group for some industries and six strategic groups for other industries being examined. However, this was determined by the groupings observed in the data and not predetermined by the procedure. Indeed, if an industry not included in this study were examined, it is possible that four or perhaps even seven strategic groups would be observed in that industry.

The intervals established in the beginning period for strategic groups within a given industry were also used for that industry for the ending period. Then, we traced the year to year growth pattern of each firm in terms of its movement (or lack of movement) from one strategic group to another in its industry, using the Markov procedure discussed earlier.

Results

a. Transition probabilities

Tables 1 through 9 present the transition probability matrices for each industry. These probabilities give some useful insights into the dynamic aspects of the strategic groups, and mobility barriers within each industry studied.

Tables 1 through 9 are read in the following manner. The number on the vertical stub of the table indicated as i represents the strategic groups that the firm moves from at the beginning year and the number on the horizontal stub indicated as j represents the strategic group that the firm goes to in the adjacent year. The market share interval of each strategic group within the industry is also given in the table.

The following discussion explains how the numbers in Table 1 should be interpreted; this information will also be useful in helping the reader understand the tables for the other industries included in the sample.

The diagonal element gives the probability of a firm within a given strategic group at the beginning of the year remaining in that group at the end of the year. For example, Table 1 shows that the probability is 88% that a firm in strategic group I at the beginning of the year would remain in strategic group I at the end of the year. The table also shows that the probability is 0 that a firm in strategic group III at the beginning of the year would move to strategic group V at the end of the year. The table also shows that any firm with a market share ranging from 20% to 26.99%, in the textile mill products industries would be categorized as being in strategic group I; a firm with a market share ranging from 0% to .99% would be designated to be in strategic group V, etc. This procedure should also be followed in interpreting data in other tables.

The elements on the diagonal indicate, for all industries studied here, a strong tendency for firms to remain within a given strategic group from year to year. For all industries studied, the probability that a given firm would remain in the same strategic group from one year to the next was higher than the probability that it would move to another strategic group. This tendency is indicated by the fact that the values of the main diagonal are higher than the off diagonal elements.

The fact that a number of elements reflect a zero probability is not surprising. This condition is partially caused by the fact that a

zero probability exists of a firm moving up or down by more than one strategic group; that is, the probability of a firm moving from strategic group III to I or IV to II, or moves of this nature.

Of the nine industries studied here, only in the textile mill products industry (Table 1) and the drug industry (Table 4) did all firms have a probability of moving from one strategic group to another. That is, in these two industries, all firms were able to move from the strategic group in which they operated to another during a given year because an absorbing state did not exist (see appendix). For the remaining seven industries, however, conditions were somewhat different. At least one absorbing state existed in each of those industries; meaning that once a firm entered a certain strategic group mobility barriers were too high for them to move to another group.

A chi square test was used to test the hypothesis of stationary conditions for the industries studied. The calculations are presented on Table I-A in the appendix, along with some additional discussion. The results are statistically significant at better than the .5 percent level for all industries. These results mean that the assumption of stationary conditions for all industries studied cannot be rejected. A more complete discussion of the test is presented in the appendix.

b. The struggling industry indexes and sub-indexes

The struggling index, which is around one percent for most industries, reveals that there is a rather low probability of a firm changing strategic groups in adjacent years.

The sub-indexes examines the same relationships as the basic indexes. The only difference is that the sub-indexes do not consider two stage moves or transitions over more than one strategic group; the earlier analysis and discussion, however, have shown such moves to be nonexistent.

Tables 10 and 11 present the 4 struggling indexes and the 3 struggling sub-indexes developed for all firms in each industry in the sample.

The stability index in Table 10 shows that in 8 out of the 9 industries in the sample, the probability of a firm remaining in the same strategic group during the next period is very high (more than 90%). Only in the metal mining industry, is the probability substantially lower; however, even in this case the probability remains quite high at 80.86. These overall results are not surprising. The high stability index value means that the movement among strategic group membership is not fluid; that is, firms do not easily move back and forth from one strategic group to another. This condition reflects the existence of mobility barriers which tend to prevent a firm from moving to a more profitable or favorable strategic group, at will.

In six of the nine industries examined, the declining index is higher than the climbing index. This condition reveals that firms in more favorable strategic groups (higher market share and thus higher profits) are protected by high mobility barriers from entry by firms outside their strategic groups. The stability index supports this result.

C. Industry results

The statistical results for the individual industries examined in this study are presented in the following discussion.

Textile Mill Products (Table 1)

This is one of the two industries that does not have an absorbing state. This means that more flexibility exists for firms to move in this industry; that is, mobility barriers are lower than in the seven other industries with absorbing states. For this industry, strategic groups III, IV, and V constitute a closed set. This means that firms can move among these three strategic groups; however, mobility barriers absolutely prevent them from moving to the preferred I or II groups. Movement from strategic groups I or II to a lower strategic group is possible but this would constitute a move to an inferior state or smaller market share and, thus, lower profits. The results show that mobility barriers protect members of strategic group II from firms in groups III, IV, and V but group II is not protected from group I.

The stability index is 92.2% and the sub-declining index is 5%, while the sub-climbing index is 4.57%. The overall sub-struggling index for this industry is 4.78%.

Electronic Computing Equipment (Table 2)

In this industry two of the six strategic groups are in absorbing states. Strategic group V and VI are a closed set; that means that firms in group V and VI can move between these two groups but cannot go to a higher (more favorable) strategic group. Firms in group I, on the otherhand, with high market shares face a high probability of losing their leadership positions in the industry.

The two absorbing state situations and the closed set reveal that in this industry the mobility barriers are high; this condition can be explained by the nature of the industry, which requires high investments by a firm in both capital equipment and R&D to improve its competitive position.

The large difference between the sub-declining index and the sub-climbing index (6.25 and 1.81 respectively, see Table 11), shows that high mobility barriers protect firms in the more favorable strategic groups from other firms which are trying to improve their position in the industry; at the same time, the results show that firms in any strategic group (except the lowest) can readily move to a lower strategic group. The results show that firms in the leading strategic group have a twenty percent probability of losing their leadership position. The rapidly changing technology and the importance of new breakthroughs in computer hardware partially explain firm movements among strategic groups.

The results also show that the overall sub-struggling index is 4.03%.

Chemical and Allied Products (Table 3)

This industry has only one absorbing state; this is strategic group I. Firms in this group are leaders; they cannot leave the group they are in. Since all other groups represent an inferior state, a firm would not be inclined to willingly leave group I for another position in the industry. The high mobility barriers which exist can be partially explained by the high level of R&D which exists in this industry.

Firms in the lower level strategic groups are able to sustain sufficient R&D expenditures to maintain their positions and sometimes move into a higher strategic group. However, they are unable to generate R&D results which will push them into the very highest group. Strategic groups IV and V constitute a closed set in this industry. Firms in these groups are able to move between these two groups but they are unable to move to a higher level, such as group III. Moreover, conditions in this industry are such that firms in strategic group III cannot move to a lower strategic group.

This is one of three industries in which the climbing index is higher than the declining index (3.60 and .50 respectively). This result occurs largely because of the high probability of firms moving from strategic group V to IV. The overall sub-struggling index is 2.05%.

Drugs (Table 4)

This is the second industry which does not have an absorbing state. Two closed sets exist in the industry; strategic groups I, II, and III constitute one closed set and strategic groups IV and V constitute the second set. This kind of situation means that firms with low market share (strategic groups IV and V) face very high mobility barriers preventing them from moving to a higher strategic groups. Consequently, they must struggle among themselves to gain higher market share. On the otherhand, firms in higher strategic groups face lower mobility barriers and they have a better opportunity to move to the top strategic group. These results show that R&D activity, which is significant in this industry, can generate a product which can catapult a firm into a

higher strategic group. The results also show that this type of results is most likely to occur in firms in higher strategic groups.

The sub-declining index is higher than the sub-climbing index (3.75% and 1.87% respectively). The value of the index in this industry can be explained by the relatively high probability of a firm in strategic group I and IV to fall to a lower strategic group (5% and 8.6% respectively). The overall sub-struggling index is 2.77%.

Lumber and Wood Products (Table 5)

Two of the five strategic groups in this industry are in absorbing states; also, groups I and II constitute a closed set. Moreover, group V may also be considered an absorbing state for any reasonable purpose, because the probability of the main diagonal is 99.1%. This structure is very interesting; the results mean that stability exists among firms in the low market share strategic groups and there is struggling among firms in the high market share strategic groups.

The sub-declining index is higher than the sub-climbing index (2.11% and 4.44% respectively). The explanation for this outcome is the high probability for firms in strategic group I to lose their leading position and to move (or fall) to strategic group II. The overall struggling sub-index is 3.26%.

Perfumes (Table 6)

Two absorbing states exist in this industry; these are for strategic groups I and II. These results mean that firms in the two highest strategic groups tended to keep their same relative positions in the industry. The results also mean that a firm in either strategic group I or II would

not tend to leave the strategic group with which is associated. Consequently, mobility barriers, preventing firms in lower strategic groups from moving into group I or II, were extremely high. Indeed, "perfect" mobility barriers exist for group I, meaning that mobility into that group is impossible. At the same time, firms in strategic groups III, IV, and V faced relatively lower mobility barriers and changes in strategic group membership was more likely to occur in those groups.

The high mobility barriers in this industry originate from formulae developed by the stronger firms, which create strong brand preference on the part of consumers. This strong brand preference is not present for products of firms in the lower strategic groups; consequently, mobility barriers are lower among those groups.

The sub-climbing (2.45%) and sub-declining indexes (2.02%) are similar in magnitude for this industry; the overall sub-struggling index is 2.23%.

Petroleum Refining (Table 7)

There is one absorbing state in this industry--strategic group I. Strategic groups II, III, IV, V, and VI are a closed set; there is no way for a firm to move from this set to strategic group I. This result means that firms in strategic group I are well protected from firms in other strategic groups, because of high mobility barriers. One possible cause of the high mobility barriers could be the large fixed asset requirements necessary to become one of the larger firms in this industry. Another possible source of mobility barriers is the ownership of large crude oil reserves and petroleum production which distinguishes the very

large from the smaller firms in this industry. Other factors, such as the ability to undertake large capital expenditures to adopt the most recent efficiency inducing technology, as well as the ability to exploit economies of scale in production (causing operating costs to be lower), give the larger firms advantages over the smaller companies in this industry. All-in-all, the mobility barriers are at least partially caused by the financial strength of the large firms compared with smaller firms; also, mobility barriers are erected by the sheer size of production plants of the larger firms which smaller firms are unable to achieve. Perhaps other factors are involved but the items discussed above are certainly important in preventing smaller firms from migrating into strategic group II. Firms in lower level strategic groups, how-ever, are not totally protected by mobility barriers. The sub-declining index (2.84%) is very similar to the climbing sub-index (2.64%). The struggling index is 2.74%.

Newspapers (Table 8)

Strategic groups I, II, and IV are absorbing states in this industry. Firms in strategic group I are protected by high mobility barriers because it is impossible for a firm to move to that group from strategic group II. Part of the explanation for these results rests in the fact that market size limits the ability of a newspaper to grow; that is, a newspaper in a city the size of New York City is able to grow to a level which is impossible in Houston, Texas, for example. The nature of the industry is the limiting factor. National newspapers, which have relatively unlimited markets, are not common in this country. Firms may

move from strategic group VI to V, V to IV, and III to II because of relatively low mobility barriers.

The sub-climbing index is higher than the sub-declining index (3.87% and 1.66% respectively). The overall struggling sub-index is 2.76%.

Metal Mining (Table 9)

There are two closed sets in this industry but there are no absorbing states. One closed set is composed of groups I, II and III and the second closed set consists of strategic groups IV, V and VI. Firms belonging to groups IV, V and VI are able to move among those strategic groups (which are the lower market share groups) but they are unable to move into groups I, II and III. This means that mobility barriers are relatively low within this closed set but they are high among the sets.

These results mean that in this industry a small market share firm cannot become a large market share firm and vice versa. The results partially reflect the necessity for firms in this industry to have access to mineral ores either by leases or through ownership. Mobility is partially impared by the financial resources necessary to acquire the mining rights necessary for growth. This is the only industry in which the stability index is lower than 90%; the 80.86%, which represents relatively low stability, is explained by the high probability of firms moving only within the closed set to which they belonged. The sub-declining index is higher than the sub-climbing index (14.96% and 10.40% respectively). The struggling sub-index is 12.68%.

VIII. CONCLUSIONS

The main purpose of this study is to examine the nature of struggling and mobility barriers within several different types of industries. The results provide some additional perspectives on market structure and reveal some important aspects of dynamics within an industry.

The results show that firms within a given industry tended to remain within the same strategic group through adjacent years. The analyses also show that, generally, in adjacent years the probability is higher that a firm will move from a higher strategic group (with a larger market share) to a lower strategic group (with a smaller market share) than is the probability of moving in the opposite direction. Consequently, it is the "upward mobility" which is most difficult.

Care must be taken in applying and interpreting the seven indexes which characterize the level of struggling within an industry. It is only valid to make inferences from the indexes for firms within the same industry. Comparisons across industries lead to bias conclusions.

The results of this research add further empirical support to the theory of strategic groups and provides some empirical results showing the existence of mobility barriers between strategic group. As one might have expected, the nature of mobility barriers differs from industry to industry and among strategic groups within an industry.

Industry economists presently speak broadly about market structure in terms of monopoly, oligopoly and perfectly competitive models. They speak more specifically about market structure in terms of advertising expenditure, product differentiation, barriers to entry and exit,

economies of scale and other structural dimensions. Use of a level of a struggling index would add a dynamic aspect to industry analysis which should be useful and meaningful to observers of an industry. Such an index would provide important additional information about competitive structure.

APPENDIX

THE MARKOV PROCESS

The purpose of this appendix is to present a brief review of Markov processes which are essential to the analysis presented in the text of this paper. One who is interested in more detail may benefit from reviewing the literature of management science such as Horowitz (1970).

Markov processes or chains can be described in the following discussion:

If we have r "states" (state = strategic group),

designated $S_i (i=1,2,3,\ldots,r)$

The probability that a firm belongs to state i, in time t (t is for time), is given by:

(1) $$P(S_{i,t}) = m_{i,t}$$

If the states occur independently on the successive trials, then the probability of alternative states is the product of the probabilities' states. For example, the probability of the sequence S_i on trial t and S_j on trial t+1 is:

(2) $$P(S_{i,t}, S_{j,t+1}) = m_{i,t} \cdot m_{j,t+1}$$

A zero order Markov process assumes that states occur independently on successive trials. The process is also known as a Bernouli process.

In a first order Markov chain, the probability of a given state on any one trial is conditional on the trial which preceded it.

For example, if the probability of state j on trial t+1 is conditional on state i on trial t this is denoted $P_{i,j}$; we then have:

$$(3) \qquad P(S_{j,t+1}/S_{i,t}) = P_{i,j}$$

The absence of t subscripts on $P_{i,j}$ is not an accident. It indicates that the probability of a transition from i to j is the same for all trials (stationary); it does not depend on time. The transition probabilities $P_{i,j}$ can be represented in the form of transition matrix P

$$P = \begin{array}{c} \\ S_1 \\ S_2 \\ \vdots \\ S_n \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \cdots & S_n \end{array} \\ \begin{bmatrix} P_{11} & P_{12} & \cdots & P_{1n} \\ P_{21} & P_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ P_{n1} & & & P_{nn} \end{bmatrix} \end{array}$$

where $\sum_{j=1}^{r} P_{i,j} = 1$

and $P_{i,j} \geq 0$ for all i,j

For example, $P_{i,j}$ denotes the probability of firm moving from strategic group i to strategic group j, and it is given for every pair of states.

In the case of the first order Markov chain, the probability of the sequence Si on trial t and Sj on trial t+1 is

$$(4) \qquad P(S_{i,t},S_{j,t+1}) = m_{i,t} \cdot P_{i,j}$$

As we can see from equation (4), knowledge of the state which occurred on trial t affects the expectation of the state which will occur on trial t+1.

Second or higher order processes allow the transition probabilities to vary according to the outcomes of two or more preceding trials. In other words, we can say that a process is h order if the occurrence of a state on trial t+1 depends on the r states which occurred on the h preceding trials.

There are a variety of Markov processes that may be grouped according to:

1. Whether the order is zero, first or higher order
2. Whether the Markov states are finite or infinite
3. Whether the transition probabilities are stationary or non-stationary
4. Whether the time variable is continuous or discrete

The most common used Markov model in the marketing,[6] economic,[7] and psychology[8] literature is called the "Markov chain" and it involves first order, finite states, stationary transition probabilities and discrete time.

The assumptions of the first order Markov chain are quite realistic and consistent with the study of strategic management and business policy. Those assumptions include: the position of a firm today is affected by its position in the previous period. A second assumption is also quite realistic; that is, we can usually divide an economic variable into a finite number of categories. An assumption relating to discrete time is also valid since economic data are often available in the form of annual data. However, the validity of the stationary assumption, relative to the parameters of the probability system, may not be clear in many cases.

A more reasonable assumption may be that the transition probabilities vary over time and are functions of certain explanatory variables; the probabilities change as these variables change. Telser (1962), in research of cigarette brand consumption, assumed that the transition probabilities, relating to the switching from one cigarette brand to another, depended on the relative prices of the brands and the relative advertising expenditures of the companies.

In the research presented in this paper, we assume that the transition probabilities of firm switching from one strategic group to another are stationary. We tested this hypothesis by a Chi square (X^2) test,[9] and we could not reject the null hypothesis of stationarity.

In first order Markov processes, there are several ways of classifying Markov chains. Two important classifications used in the text of this paper are (1) absorbing state and (2) closed set.

An absorbing state occurs when a firm, in a given strategic group, is unable to move to another group. This condition is seen to exist on some of the transition probability tables in the text of this study. The following discussion presents an example of an absorbing state. If the first row of the matrix is the vector (1,0,0,0,0). Because $P_{11} = 1$ and $P_{1j} = 0$ (j=2,3,4,5), this indicates that a firm in strategic group I will not leave that group. In this case S1 is called an absorbing state.

A closed state exists if no set outside of the set can be reached from any state within the set.

For example:

$$\begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & S_3 & S_4 \end{array} \\ \begin{bmatrix} .7 & .3 & 0 & 0 \\ .6 & .4 & 0 & 0 \\ .2 & .1 & .6 & .1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \end{array}$$

S_1 and S_2 combine to form a closed set S_{12}. This is a closed set since neither S_3 nor S_4 can be reached from S_{12}.

$$(P_{s1,s3} = P_{s1,s4} = P_{s2,s3} = P_{s2,s4} = 0)$$

In this example, S_4 is both a closed set and an absorbing state.

This appendix does not intend to explain all possibilities or versions of Markov chains. We merely describe the most important points to explain the basic concepts to the reader who may not be familiar with these models.[10] These models give us a good explanation of the link between strategic groups and mobility barriers. These two elements are essential to this study.

FOOTNOTES

[1]For discussions of the industrial organization field see Bain 1968 and Scherer 1980.

[2]For complete statements of the theory of finite Markov chains see Kemeny and Snell (1960), Bailey (1964) and Cox and Miller (1965).

[3]For complete statements of corporate strategy and business strategy see Schendal and Hofer (1979).

[4]See for example Buzzel, Gale and Sultan (1975).

[5]For two industries, computer and newspaper, the selected years were 1973-1979 and 1974-1979 respectively. This difference exists because we did not have complete data.

[6]In the marketing literature, Ehrenberg (1965) applied Markov theory to brand-switching data. Lipstein (1965) presented a mathematical model of consumer behavior, related advertising effort to attitude changes and consumer purchases, using a nonstationary Markov process. Thompson and McNeal (1967) applied a Markov process to measure changes in customer propensities to buy.

[7]The concepts of Markov chains was introduced around 1907. Solow (1951) applied this concept to the analysis of income and wage distributions. Hart and Prais (1956) employed the technique in an investigation of business concentration. Adelman (1958) used the same approach in analyzing the size distribution of firms within the steel industry. Telster (1962) measured brand-switching of consumers in the cigarette industry. Thorburn (1981) used a Markov chain for forecasting the agriculture structure.

[8]Goodman (1953), Miller (1952) and Madansky (1959) used Markov chains to measure change of attitude and other psychological variables.

[9]See Lee, Judge and Zellner (1970) p. 51 for an application of the identical test.

[10]See also Horowitz 1970, chapter 14, section 3 (14.3).

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Table I-A

χ^2 Test

Industry	n(# of firms)	t(# of years)	calculated χ^2	$\chi^2_{.5}$ book
1. Textile	29	11	32.11	168.77
2. Computer	37	7	31.75	160.01
3. Chemicals	18	11	26.72	168.77
4. Drugs	26	11	46.25	168.77
5. Lumber	13	11	23.12	168.77
6. Perfume	16	11	28.96	168.77
7. Petroleum	46	11	61.63	266.59
8. Newspaper	13	6	17.62	133.94
9. Metal	20	11	30.51	266.59

See some additional discussion on preceding page.

*χ^2 is significant at the .5% level for all industries.

Table 1

IND. 2200 (SIC CODE)

TEXTILE MILL PRODUCTS - transition probabilities*

FROM	S·Gi \ S·Gj	j=I	II	III	IV	V	Market Share Intervals (%)
	i=I	88	12	0	0	0	20 - 26.99
	II	10.5	84	5.5	0	0	10 - 19.99
	III	0	0	98	2	0	3 - 9.99
	IV	0	0	.8	98.4	.8	1 - 2.99
	V	0	0	0	7	93	0 - .99

TO

*All probabilities are given in percentage.

Table 2

IND. 3573 (SIC CODE)

ELECTRONIC COMPUTING EQUIPMENT - transition probabilities*

		TO						
	S·Gi \ S·Gj	j=I	II	III	IV	V	VI	Market Share Intervals (%)
FROM	i=I	80	20	0	0	0	0	28 - 40
	II	0	100	0	0	0	0	16 - 28
	III	0	0	100	0	0	0	6 - 16
	IV	0	0	6.25	87.5	6.25	0	2 - 6
	V	0	0	0	0	95	5	.5 - 2
	VI	0	0	0	0	2.8	97.2	0 - .5

*All probabilities are given in percentage.

Table 3

IND. 2800 (SIC CODE)

CHEMICALS AND ALLIED PRODUCTS - transition probabilities*

		TO					
	S·Gj / S·Gi	j=I	II	III	IV	V	Market Share Intervals (%)
FROM	i=I	100	0	0	0	0	11 - 17.99
	II	4	96	0	0	0	7 - 10.99
	III	0	1.8	98.2	0	0	4 - 6.99
	IV	0	0	0	98	2	2 - 3.99
	V	0	0	0	8.6	91.4	0 - 1.99

*All probabilities are given in percentage.

Table 4

IND. 2830 (SIC CODE)

DRUGS - transition probabilities*

FROM \ TO	j=I	II	III	IV	V	Market Share Intervals (%)
i=I	95	5	0	0	0	10 - 14.99
II	1.5	97	1.5	0	0	5 - 9.99
III	0	3.7	96.3	0	0	2 - 4.99
IV	0	0	0	91.4	8.6	1 - 1.99
V	0	0	0	2.4	97.6	0 - .99

*All probabilities are given in percentage.

Table 5

IND. 2400 (SIC CODE)

LUMBER AND WOOD PRODUCTS - transition probabilities*

		TO					
	S·Gi \ S·Gj	j=I	II	III	IV	V	Market Share Intervals (%)
	i=I	82.3	17.7	0	0	0	26 - 34.99
	II	7.6	92.4	0	0	0	18 - 25.99
FROM	III	0	0	100	0	0	10 - 17.99
	IV	0	0	0	100	0	4 - 9.99
	V	0	0	0	.9	99.1	0 - 3.99

*All probabilities are given in percentage.

Table 6

IND. 2844 (SIC CODE)

PERFUMES - transition probabilities*

		TO					
	S·Gi \ S·Gj	j=I	II	III	IV	V	Market Share Intervals (%)
FROM	i=I	100	0	0	0	0	22 - 29.99
	II	0	100	0	0	0	14 - 21.99
	III	0	5.8	88.2	5.8	0	6 - 13.99
	IV	0	0	2.3	95.4	2.3	2 - 5.99
	V	0	0	0	1.6	98.4	0 - 1.99

*All probabilities are given in percentage.

Table 7

IND. 2911 (SIC CODE)

PETROLEUM REFINING - transition probabilities*

		TO						
	S·Gi \ S·Gj	j=I	II	III	IV	V	VI	Market Share Intervals (%)
FROM	i=I	100	0	0	0	0	0	10 - 24.99
	II	0	97.8	2.2	0	0	0	6 - 9.99
	III	0	6	88	6	0	0	4 - 5.99
	IV	0	0	2	98	0	0	1 - 3.99
	V	0	0	0	2.9	91.1	6	0.5 - .99
	VI	0	0	0	0	2.3	97.7	0 - .49

*All probabilities are given in percentage.

Table 8

IND. 2711 (SIC CODE)

NEWSPAPER: PUBLISHING - PRINT - transition probabilities*

		TO						
	S·Gi \ S·Gj	j=I	II	III	IV	V	VI	Market Share Intervals (%)
FROM	i=I	100	0	0	0	0	0	23 - 34.99
	II	0	100	0	0	0	0	15 - 22.99
	III	0	8.3	83.4	8.3	0	0	10 - 14.99
	IV	0	0	0	100	0	0	5 - 9.99
	V	0	0	0	4.3	95.6	0	2 - 4.99
	VI	0	0	0	0	6.7	93.3	0 - 1.99

*All probabilities are given in percentage.

Table 9

IND. 1000 (SIC CODE)

METAL MINING - transition probabilities*

		TO						
	S·Gi \ S·Gj	j=I	II	III	IV	V	VI	Market Share Intervals (%)
FROM	i=I	78.5	21.5	0	0	0	0	21 - 30.99
	II	19	76	5	0	0	0	16 - 20.99
	III	0	17	83	0	0	0	10 - 15.99
	IV	0	0	0	66.7	33.3	0	5 - 9.99
	V	0	0	0	4	81	15	1 - 4.99
	VI	0	0	0	0	12	88	0 - .99

*All probabilities are given in percentage.

Table 10

THE STRUGGLING INDUSTRY INDEXES*

INDUSTRY	$\overline{P}$ STABILITY	$\overline{P}$ CLIMBING		$\overline{P}$ DECLINING	$\overline{P}$ STRUGGLING
2200 (TEXTILE)	92.20	1.83	<	2	1.91
3573 (COMPUTER)	93.27	.60	<	2.08	1.34
2800 (CHEMICAS)	96.72	1.44	>	.20	.82
2830 (DRUGS)	95.42	.75	<	1.50	1.12
2400 (LUMBER)	94.77	.85	<	1.76	1.30
2844 (PERFUME)	96.40	.98	>	.81	.89
2911 (PETROLEUM)	95.41	.88	<	.94	.91
2711 (NEWSPAPER)	95.38	1.29	>	.55	.91
1000 (METAL MINING)	80.86	3.46	<	4.99	4.22

*All the indexes are given in percentage.

Table 11

THE STRUGGLING INDUSTRY SUB-INDEXES*

INDUSTRY	$\hat{P}$ SUB-CLIMBING		$\hat{P}$ SUB-DECLINING	$\hat{P}$ SUB-STRUGGLING
2200 (TEXTILE)	4.57	<	5	4.78
3573 (COMPUTER)	1.81	<	6.25	4.03
2800 (CHEMICALS)	3.60	>	.50	2.05
2830 (DRUGS)	1.87	<	3.75	2.77
2400 (LUMBER)	2.11	<	4.44	3.26
2844 (PERFUME)	2.45	>	2.02	2.23
2911 (PETROLEUM)	2.64	<	2.84	2.74
2711 (NEWSPAPER)	3.87	>	1.66	2.76
1000 (METAL)	10.40	<	14.96	12.68

*All the indexes are given in percentage.