# AN INVESTIGATION INTO THE EFFECT OF SELECTED VARIABLES UPON BARRIERS TO ENTRY IN MANUFACTURING INDUSTRIES

by

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# CHAPTER I

## STATEMENT OF THE PROBLEM

### Introduction

A basic premise of microeconomic theory and business behavior is that the policies and actions of a firm are strongly influenced by the market structure within which it operates. In turn, the market structure of an industry is at least partially determined by the number of competitors which can profitably operate in the industry. In a perfectly competitive market the number of competitors is always large because of freedom of entry into the marketplace. Any firm desiring to compete as a seller in a perfectly competitive market may do so. Profits or losses will be determined solely by cost structure and the market forces of supply and demand.

The perfectly competitive market model, however, is less than descriptive of the real world situation. In an effort to alleviate this limitation, three additional types of market models have been identified. These are the models normally referred to as monopolistic competition,[1]

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[1]Monopolistic competition occurs when a relatively large number of sellers are offering only slightly differentiated products.

oligopoly,[2] and pure monopoly.[3] These models are characterized by successively fewer competitors. As the number of competitors decreases, businesses become more dependent upon the actions of the remaining competitors and less dependent upon the natural forces of supply and demand operating in the marketplace.

Through this interdependence, certain firms in an imperfectly competitive industry[4] are often able to obtain a differential advantage which allows them to function in such a manner as to restrict the number of competitors entering the market. The lack of entry of effective competitors is often explained in terms of barriers to entry into the market. A large number of factors (or variables) which can create barriers to entry have been identified over the years. Among these variables are (1) absolute cost advantages of established firms, (2) necessity and level of advertising, (3) control of essential raw materials,

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[2]Oligopoly is a market situation which is characterized by a limited number of interdependent sellers of differentiated products.

[3]A monopoly model depicts the situation of one seller who offers a product with no substitutes.

[4]An imperfectly competitive market structure is one in which firms within the market have some degree of control over price because of a downward sloping demand curve, as opposed to perfect competition in which no individual firm has any control over price or any advantage in terms of market share or production costs. In this presentation, an imperfectly competitive industry refers to either monopolistic competition, oligopoly, or monopoly.

(4) economies of being established, (5) economies of scale, (6) industry growth rate, (7) use of market franchises, (8) control over patent rights, (9) product differentiation by established firms, and (10) research rights.[5] This is neither an exhaustive nor a mutually exclusive list of barriers. For example, product differentiation and absolute cost advantages may be considered as sub-parts of the more general "economies of being established." Likewise, research rights may be obtained by a firm because of economies of scale, especially if the research rights are granted based upon competitive bidding by various companies.

Likewise, certain of the variables have greater applicability than others. The following six variables are ordinarily identified as having the greatest general applicability: (1) advertising, (2) company age, (3) product durability, (4) price level of the industry product,

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[5]Although additional factors which can create barriers to entry exist, those mentioned are the ones most frequently found in relevant literature. See Campbell S. McConnell, Economics (4th ed.; New York: McGraw-Hill, Inc., 1969), pp. 492-495; Joe S. Bain, Barriers to New Competition (2nd ed.; Cambridge, Mass: Harvard University Press, 1962); Nocholas Kaldor, "The Economic Aspects of Advertising," The Review of Economic Studies, XVIII (1950), p. 13; Ralph L. Nelson, "Market Growth, Company Diversification, and Product Concentration," Journal of the American Statistical Association (December, 1960), pp. 640-649; and Federal Trade Commission, Staff Report to the Commission, Economic Report on the Influence of Market Structure on the Profit Performance of Food Manufacturing Companies (Washington, D. C.: U. S. Government Printing Office, September, 1969), pp. 11-12.

(5) short-run industry growth rate, and (6) long-run industry growth rate.[6]

## Entry Barriers of General Applicability

### Advertising

Much research has been devoted to advertising as a major factor in the creation of barriers to entry. Former Assistant Attorney General Donald F. Turner, in a speech before the Briefing Conference on Federal Controls of Advertising and Promotion, stated as follows:

> . . . when heavy advertising and other promotional expenditures create durable preferences going beyond the relative superority of the product, resistant to anything but major countervailing promotional campaigns, we may well question whether the price has become too high. If heavy advertising expenditures thus serve to raise the barriers to entry, the adverse competitive consequences are important not only because new firms are kept out, but also because frequently it is the prospect of new entry which

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[6]Certain variables may by definition create barriers to entry into an industry. Control of essential raw materials, for instance, may function as a major barrier to entry in all industries where only one firm or a few firms have access to a vital raw material. There is no necessity of testing this variable in the industries where it exists because manufacturing firms cannot enter an industry if they do not have access to all of the materials necessary for the production of the industry product. Likewise, patent rights, research rights, and market franchises necessarily create barriers to entry wherever these variables exist. Therefore, these variables are not included in the list of independent variables.

> serves as a major competitive restraint upon the actions of existing firms . . .[7]

Turner further stated that, in cases where consumers have considerable difficulty in making accurate product comparisons, the advantage rests with the established, well-known companies. It is his contention that advertising accentuates this advantage.[8]

A similar proposition is set forth in a Federal Trade Commission study published in September, 1969. This study relates industry concentration, advertising expenditures, and profitability in an effort to determine whether price and profitability vary with the level of advertising expenditures.[9] Stanley Cohen of Advertising Age has stated that the study is important because it suggests "advertising expenditures are decisive advantages for dominant companies in highly concentrated industries."[10]

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[7]Donald F. Turner, "Advertising and Competition," an address before the Briefing Conference on Federal Controls of Advertising and Promotion sponsored by the Federal Bar Association, Washington, D. C., June 2, 1966, p. 203.

[8]Ibid.

[9]Federal Trade Commission, Staff Report to the Commission, Economic Report on the Influence of Market Structure on the Performance of Food Manufacturing Companies (Washington, D. C.: U. S. Government Printing Office, September, 1969).

[10]Stanley E. Cohen, "FTC Study Finds Ads Boost Profits, but Also Foster Monopoly," Advertising Age, May 11, 1970, pp. 1, 8.

The above studies suggest that advertising may create barriers to entry by insuring the entrenchment of large, established businesses by reinforcing the market shares held by them in the industry. In partial support of these results, Professor Joe S. Bain, in his widely publicized study on barriers to entry published in 1962, concludes that advertising aids in the creation of barriers to entry through the process of product differentiation. Bain contends that, although many products may be similar, the advertisements which extol the various virtues of these products are a major cause of product differentiation.[11] Other studies have also supported the Turner hypothesis. William Comanor and Thomas Wilson, for example, concluded that advertising greatly affects market structure.[12]

Advertising may also create entry barriers by artificially raising capital expenditure requirements.[13] Leading companies in the dry cereal industry, for instance, spend millions of dollars annually on advertising.[14] If a

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[11]Bain, Barriers to New Competition, p. 115.

[12]William S. Comanor and Thomas A. Wilson, "Advertising, Market Structure, and Performance," The Review of Economics and Statistics, XLIX (November, 1967), p. 440.

[13]Preben Munthe, Freedom of Entry into Industry and Trade (London: European Productivity Agency of the Organization for European Economic Coopertion, 1953), p. 25.

[14]"Big Three Cereal Makers Being Probed by FTC," Tuscaloosa News, April 22, 1970, p. 26. According to this article, General Foods, Kellogg, and General Mills have an estimated combined annual advertising expenditure of $91 million.

new company must spend similar amounts in order to compete successfully, this means that a greater initial amount of capital must be invested by the entering company.

Company Age

Traditionally, academicians have also considered economies of being established as a major cause of barriers to entry into various industries.[15] Economies of being established has reference to the reputation that a business has created for itself in the eyes of the consuming public and the business community over the years. A manufacturing firm of long standing often develops a loyal core of customers who are aware of the product quality, the distribution network, and customer services offered by the company of its marketing intermediaries. These customers are not likely to patronize new firms about which they have little knowledge. Well-established firms not only can maintain a loyal group of customers who are likely to reject the products of new companies, but also are better able to attract customers coming into the market for the first time. These potential new buyers necessarily depend to some extent upon the reputation of sellers in making purchase decisions.

Established firms, merely through longevity of operation, often demonstrate a superior ability to survive in the

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[15]See, for example, Campbell S. McConnell, Economics (4th ed.; New York: McGraw-Hill, Inc., 1969), p. 495.

marketplace. Survival may result partly from ridding a business of initial inefficiences.[16] Since creditors are often of the opinion that success breeds success, established firms often enjoy certain economies because of easier credit terms than would be available to newly created companies. Established businesses also realize advantages when seeking new outlets for their products. Distributors are ordinarily more receptive to handling the products of a well-known company than those of a business struggling to get started.[17]

Durability of the Industry Product

The durability of a product may create barriers to entry into a particular industry in two ways. First, a direct relationship appears to exist between product durability and product differentiation as perceived by the consumer. As Professor Bain and subsequent writers have stated, product differentiation can be a major cause of the existence of imperfect competition.[18] Second, the durability

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[16]Frederick D. Sturdivant, et al., Managerial Analysis in Marketing (Glenview, Illinois: Scott, Foresman and Company, 1970), p. 59.

[17]Ibid., p. 58.

[18]Bain, Barriers to New Competition; also H. Michael Mann, "Seller Concentration, Barriers to Entry, and Rates of Return in Thirty Industries, 1950-1960," The Review of Economics and Statistics, XLVII (August, 1966), pp. 296-307; and Munthe, Freedom of Entry into Industry and Trade.

of a product varies inversely with its replacement rate.[19] Consumers are more likely to experiment with new products which are frequently replaced than with those products which will be used for an extended period of time before they are replaced.[20] A cigarette smoker, for example, may readily experiment with different brands. After smoking a new brand for a day or two, he may revert to his original brand or he may switch brands. In deciding which automobile to purchase, however, the individual is less likely to "experiment" with a newly introduced brand of automobile about which he has very little knowledge. The reluctance of many consumers to purchase new brands of durable goods may thus function to create at least a partial barrier to the entry of new firms into an industry.[21]

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[19]Leo V. Aspinwall has defined the replacement rate of a good as "the rate at which a good is purchased and consumed by users in order to provide the satisfaction a consumer expects from the product" in his article entitled "The Characteristics of Goods Theory," in Managerial Marketing: Perspectives and Viewpoints, rev. ed., eds. William Lazer and Eugene J. Kelley (Homewood, Ill.: Richard D. Irwin, Inc., 1962), pp. 633-643.

[20]This is why marketing strategists conclude that heavy promotional expenditures should be used for non-durable goods in an effort to create brand loyalty which will keep the consumer from switching brands frequently.

[21]The area of durable goods demand has largely been ignored in the past by researchers trying to identify variables affecting demand, according to Arnold C. Harberger, ed., The Demand for Durable Goods (Chicago: The University of Chicago Press, 1960), p. 3.

Product Price Level

Although only limited research has been performed on the effects of product price level as a barrier to the entry of new firms into the marketplace, evidence indicates that this variable may be important as a possible cause of entry barriers. One reason is that the amount of prepurchase shopping activity of a consumer depends upon the type of good which is sought. Melvin T. Copeland first developed a product classification scheme based upon the amount of consumer search in 1923.[22] All consumer goods, based on his framework, can be classified in one of three groups: convenience goods (soap, newspapers, chewing gum, small packaged confections, and many food products); shopping goods (millinery, dress goods, furniture, women's ready-to-wear and shoes, used automobiles, and major appliances); and specialty goods (specific brands and types of fancy goods, high fidelity components, certain types of sporting equipment, photographic equipment, and men's shoes).[23]

Purchasers of convenience goods (normally low-priced) exert very little effort in comparing product characteristics because the small amount of money which would be saved

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[22]Melvin T. Copeland, "Relation of Consumers' Buying Habits to Marketing Methods," Harvard Business Review, April, 1923, pp. 282-289.

[23]Examples for each of the categories are taken from Marketing Definitions: A Glossary of Marketing Terms, compiled by the Committee on Definitions of the American Marketing Association, Ralph S. Alexander, Chairman (Chicago: American Marketing Association, 1960).

would not justify an extensive process of search. Buyers of shopping goods and specialty goods, however, expend much more effort in search before making a purchase.[24] Thus, for shopping and specialty goods, consumers are likely to be hesitant about purchasing products about which they have little knowledge. This would be the case for products of firms new to a given industry.

Although durability and price are often related, exceptions to the relationship exist which may make it necessary to consider durability and price as separate variables. For example, a durable item such as a piece of costume jewelry (see Appendix E, page 121) sells at an average price of about $10. A nondurable item such as a rare vintage wine, however, would be much higher priced.

Short-run and Long-run Industry Growth Rate

When a firm endeavors to enter an industry, the likelihood of success is at least partially dependent upon the sales trend of the industry. All products depict a similar sales curve when sales are plotted over time. This is commonly referred to as the product life cycle[25] which is depicted in Figure 1. In further support of this point,

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[24] Ibid.

[25] Philip Kotler, Marketing Management (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967), p. 291.

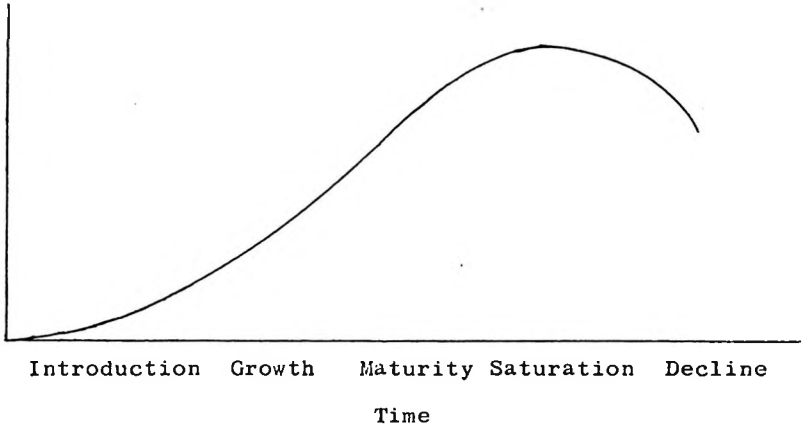


Figure 1.--Stages in the Product Life Cycle

Joel Dean said that a definite relationship exists between the length of a product's life cycle and the ease of competitive entry into the industry.[26]

Both short-run and long-run growth must be considered. Short-run growth may be the result of brief flourishes because of a sharp economic upturn, for example, which, although appearing to indicate industry growth, may not be sufficient to support new firms. Likewise, long-run growth potential may initially appear sufficient to indicate a high probability of success for new entrants. However, further investigation may reveal that the product is in the

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[26]Joel Dean, "Pricing Policies for New Products," Harvard Business Review, November-December, 1950, p. 28.

latter stages of its life cycle and that sales have already "peaked out" or will do so in the near future.

## Objective of the Dissertation

The objective of this dissertation is to measure the effects of the six previously mentioned variables (advertising, company age, industry product durability, industry product price level, short-run industry growth rate, and long-run industry growth rate) on barriers to entry in a broad range of manufacturing industries producing durable, semi-durable, and nondurable consumer goods.

The results of the study will indicate whether generalizations can be made relative to the effect of these variables on barriers to entry in certain industries. The study does not focus on the level of entry barriers, but instead attempts to clarify the influence of various suggested causes of these barriers.[27] Another point of departure from previous studies is that no effort is made to relate profitability, return on investment, or other measures of industry or company performance to the market structure of various industries. This dissertation has as

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[27]Since the purpose of this dissertation is not to determine the level of barriers to entry which exist in many industries, this study differs significantly from the study by Joe S. Bain, Barriers to New Competition, and subsequent studies such as that of Mann, "Seller Concentration, Barriers to Entry, and Rates of Return in Thirty Industries, 1950-1960."

its objective a determination of factors associated with market structure and not the nature of market structure for given industries.

## The Model

The model which is utilized in this study to accomplish the stated objective is a multiple linear regression model. The dependent variable is a measure of the extent of barriers to entry in an industry. The independent variables (advertising, age, durability, price, short-run growth, long-run growth, advertising times age, and price times durability) reflect possible reasons for the existence of barriers to entry.

### The Dependent Variable

The extent of entry barriers can be expressed in several ways. The dependent variable may be expressed as a ratio of new business failures (or successes) to new business entries in the industry being studied. The primary weakness of this alternative is that the elements of the ratio would have to be arbitrarily determined by the researcher. The ratio would depend, for example, on how the researcher defined a business failure. Also, the time period would have to be arbitrarily specified.

Another disadvantage of this approach is the problem of collecting the necessary data for industries comprised of

a large number of firms. Difficulty would be encountered in determining the number of firms which entered the industry for a given period of years. It would be difficult not only to obtain an accurate sample, but also to define an "entry" into the industry.[23]

Finally, this ratio would give no indication of the number of potential competitors who did not attempt to enter the industry because of the existence of barriers to entry.

A second alternative is to express the extent of entry barriers in terms of the number of firms in the industry. This alternative is not viable, however, because the number of firms in an industry does not necessarily reflect the competitive situation.

Realistically, the market structure of an industry does reflect the degree to which barriers to entry are present.[29] Thus, a concentration ratio showing the combined

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[28]An entry into a market is the initiation or extension of a firm's activities into a field in which it has not previously operated, according to Preben Munthe, Freedom of Entry into Industry and Trade, p. 9. This refers not only to the establishment of new businesses, but also to the expansion or diversification of firms already established in other fields. Munthe further states that a new market entry can also be classified as either a product entry or a spatial entry. A product entry occurs when a new product brand is introduced into the market. A spatial entry occurs when a company has been producing a product for some time and decides to market its product in a new geographic area.

[29]Sturdivant, et al., Managerial Analysis in Marketing, p. 83. Justification of the use of concentration ratios as indicators of barriers to entry in various industries is presented in the following chapter.

market share of the eight largest firms in an industry is used as the dependent variable.[30] Although other concentration ratios could be used (such as the smallest possible percentage of the firms controlling 50 percent of the market), the selected ratio is most applicable in the model proposed in this research.

Marshall Hall and Nicholaus Tideman suggest that a concentration ratio should meet the following criteria: (1) one dimensional ratio, (2) independent of industry size, (3) representative of some order, (4) relative (ratio scale), (5) fractional (a value between zero and one).[31] The proposed ratio for this study meets the above criteria with the possible exception of criterion four. Because of the nature of the multiple linear regression model to be used, however, this does not present a problem.[32]

## Techniques Utilized in the Study

Several two- and three-way cross-classifications are performed in order to generate hypotheses concerning the

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[30]The usual number of firms included in a concentration ratio of this nature is four, eight, or twenty, according to Marshall Hall and Nicolaus Tideman, "Measures of Concentration," Journal of the American Statistical Association, LXII (March, 1967), p. 165.

[31]Ibid., pp. 163-164.

[32]The fact that the 1966 eight-firm concentration was 100% in the cigarette industry and 50% in the rayon industry does not warrant the assumption that the cigarette industry was twice as concentrated as rayon. This does not invalidate the use of industry concentration as the dependent variable in the model because the researcher makes no such assumption.

interrelationships that possibly exist among the variables. The multiple linear regression analysis is then used to determine the aggregate effect of the independent variables upon the dependent variable. Finally, the stepwise regression technique is utilized as an aid in determining the individual effects of the independent variables.

## Plan of Presentation

The following chapter discusses the methodology of the study. It includes a detailed explanation of the multiple linear regression technique, the methods used in defining and measuring the dependent and independent variables, the hypotheses to be constructed and tested, and the method of sample selection.

Chapter III justifies the choice of industries included in the sample. It also contains a presentation of data generated, the statistical results of the analysis, and a discussion of the marketing implications of the findings.

Chapter IV is a summary of the study and of the conclusions. This chapter also offers suggestions for future research in the area of barriers to entry.

## CHAPTER II

## METHODOLOGY OF THE STUDY

Multiple linear regression is a method for predicting the value of a specified dependent variable given the values of a set of independent variables relative to the same subject of interest. Since the derived equation is based upon data obtained through sampling, the subject of the prediction equation must be assumed to be a member of the same population from which the sample is taken.[1]

If $y_i$ is the specified (dependent) variable, it is said to be a linear function of the independent variables $x_1, x_2, \ldots, x_{i-1}$. The constant proportional relationship implied between the dependent and independent variables does not necessarily place severe restrictions on the

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[1]A. P. Dempster, Continuous Multivariate Analysis (Reading, Mass.: Addison Wesley Publishing Company, 1969), p. 144. For a more detailed discussion of multiple regression analysis, the reader is referred to the above-cited text along with the following: T. W. Anderson, An Introduction to Multivariate Statistical Analysis (New York: John Wiley and Sons, Inc., 1958); Robert E. Bechhofer, Jack Kiefer, and Milton Sobel, Sequential Identification and Ranking Procedures (Chicago: The University of Chicago Press, 1955); Arthur S. Goldberger, Topics in Regression Analysis (New York: The Macmillan Company, 1968); and William Mendenhall, Introduction to Linear Models and the Design and Analysis of Experiments (Belmont, California: Wadsworth Publishing Company, Inc., 1968).

analysis since the set of variables $x_1, x_2, \ldots x_{i-1}$ may be arbitrary functions of any set of directly observable values.[2]

## Definition and Measurement of the Variables

### The Dependent Variable

As previously stated, industry concentration ratios are to be used as a measure of the extent of barriers to entry in the industries studied. The justification of the use of concentration ratios as an expression of entry barriers necessitates evidence that a relation exists between these two variables. Correlation will be used to provide a measure of this linear relationship.

To test the above association for this purpose, a cardinal ranking of barriers to entry associated with a number of industries was performed. The most thorough attempt at measuring entry barriers is the work of Professor Joe S. Bain. Dr. Bain did not, however, assign cardinal values to the barriers to entry associated with the twenty industries included in this study. He did succeed in grouping the industries into three major groups: Group A, those industries with very high barriers to entry; Group B, those industries with substantial barriers to entry, and; Group C, those

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[2]Dempster, Continuous Multivariate Analysis, p. 144.

industries with moderate to low barriers to entry.[3] The industries in each group developed by Bain are listed in Table 1. The placement of each industry into a given group was based upon four criteria: absolute cost advantages, product differentiation, capital requirements, and economies of scale.[4] The relative barriers to entry created by each of these factors in each industry are shown in Table 2.

Bain pointed out that assigning numerical values to the barriers found in each industry based upon the four criteria is a difficult task. He also stated that it is difficult to obtain a single accurate numerical measure of entry barriers in each industry by aggregation or averaging of the barriers to entry resulting from each of the four criteria.[5] With these limitations in mind, Dr. Bain, however, was able to group industries as described earlier.

The study by Bain is the most reliable source from which a cardinal ranking of entry barriers can be developed. The method employed for this study was to sum the four

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[3]Although Dr. Bain classified the industries under three major headings, the third group (industries with moderate to low barriers to entry) can actually be subdivided into two headings because Dr. Bain indicates which industries have moderate barriers and which have low barriers. This researcher thus utilized four groups to develop the scalar values which are necessary for a meaningful correlation analysis. (Joe S. Bain, Barriers to New Competition 2nd ed.; Cambridge: Harvard University Press, 1962 .)

[4]Ibid., pp. 167-172.

[5]Ibid., p. 169.

TABLE 1

RANKING OF TWENTY MANUFACTURING INDUSTRIES ACCORDING TO THE ESTIMATED HEIGHT OF THE AGGREGATE BARRIER TO ENTRY BY PROFESSOR BAIN

| | | |
|---|---|---|
| A. | Industries with very high entry barriers: | |
| | Automobiles | Liquor |
| | Cigarettes | Tractors |
| | Fountain Pens ("quality"grade) | Typewriters |
| B. | Industries with substantial entry barriers: | |
| | Copper | Shoes (high-priced men's and specialties) |
| | Farm machines (large, complex) | Soap |
| | Petroleum refining | Steel |
| C. | Industries with moderate to low entry barriers: | |
| | Canned fruits and vegetables[a] | Meat packing[a] |
| | Cement | Metal containers[b] |
| | Farm machinery (small, simple) | Rayon |
| | Flour[a] | Shoes (women's and low-priced men's) |
| | Fountain pens (low-priced) | Tires and tubes |
| | Gypsum products[b] | |

[a]The barriers to entry for meat packing generally and for major segments of the flour and canned goods industries lie at the "low" extreme.

[b]The metal container industry is placed in Group C only in years after 1950. Prior to 1950, metal containers would have been placed in Group B.

Source: Joe S. Bain, Barriers to New Competition (2nd ed.; Cambridge: Harvard University Press, 1962), p. 170.

TABLE 2

SUMMARY OF RELATIVE HEIGHTS OF SPECIFIC ENTRY BARRIERS IN TWENTY INDUSTRIES (HIGHER NUMBERS DENOTE HIGHER ENTRY BARRIERS)

| Industry | Scale-Economy | Product-Differentiation | Absolute-Cost | Capital-Requirement |
|---|---|---|---|---|
| Automobiles | III | III | I | III |
| Canned goods | I | I to II | I | I |
| Cement | II | I | I | II |
| Cigarettes | I | III | I | III |
| Copper | n.a.[c] | I | III | n.a. |
| Farm machinery | II | I to III | I | n.a. |
| Flour | I | I to II | I | Ø[d] |
| Fountain pens | n.a. | I to III | I | I |
| Gypsum products[b] | n.a. | I | III | I |
| Liquor | I | III | I | II |
| Meat packing | I | I | I | Ø or I |
| Metal containers[b] | n.a. | II | I | I |
| Petroleum ref. | II | II | I | III |
| Rayon | II | I | I | II |
| Shoes | II | I to II | I | Ø |
| Soap | II | II | I | II |
| Steel | II | I | III | III |
| Tires and tubes | I | II | I | II |
| Tractors | III | III | I | III |
| Typewriters | III | III | I | n.a. |

[a]Alternative ratings refer generally to different product lines within an industry.

[b]Product-differentiation rating refers to the period subsequent to 1950. A rating of three is probably indicated for earlier periods.

[c]Not available. [d]Negligible.

Source: Joe S. Bain, Barriers to New Competition, (2nd ed.; Cambridge: Harvard University Press, 1962), p. 169.

criterion barriers associated with each industry and weigh this sum by the final group classification in which the industry was placed.[6] For example, referring to Table 1 and 2, the passenger automobile industry, which is placed in the very high barrier group, had criterion ratings of III, III, I, and III, respectively, where III indicates the highest barriers. The total criterion rating of ten was then multiplied by four, since the very highest group was given a score of four. The scalar value for passenger automobiles is thus forty as shown in Table 3. Petroleum refining, on the other hand, shown in Group B in Table 2, has a four-criterion aggregate rating of eight which was developed from the ratins shown in Table 2. Thus the scalar value for the barriers to entry in the petroleum refining industry is eight multiplied by its group rating of three, for a total score of twenty-four. This procedure was conducted for each of the twenty industries in Dr. Bain's study. (This scale is hereafter referred to as the "weighted aggregate scale.") The final scalar values assigned to the entry barriers in each of the twenty industries are presented in Table 3.

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[6]Although Bain divided the industries into only three groups, he noted that the third group (moderate to low barriers) could be subdivided into two groups (moderate barriers and low barriers), thus making a total of four groups. In determining the scalar values, this researcher assigned a value of four to the highest group, three to the next, and so on.

TABLE 3

WEIGHTED AGGREGATE SCALE VALUES FOR THE TWENTY MANUFACTURING INDUSTRIES[a]

| Industry | Scale Value |
|---|---|
| A. High Barriers | |
| Automobiles | 40 |
| Tractors | 40 |
| Typewriters[b] | 36 |
| Cigarettes | 32 |
| Fountain pens ("quality grade")[b,c] | 28 |
| Liquor | 28 |
| B. Substantial Barriers | |
| Steel | 27 |
| Gypsum products[b,d] | 27 |
| Copper[b] | 24 |
| Petroleum refining | 24 |
| Farm machines (large, complex)[b,c] | 21 |
| Soap | 21 |
| Shoes (high-priced men's, specialties)[e,f] | 16.5 |
| C. Moderate Barriers | |
| Metal containers[b] | 14 |
| Cement | 12 |
| Farm machines (small, simple)[b,c] | 12 |
| Rayon | 12 |
| Tires and tubes | 12 |
| Fountain pens (low-priced)[b,c] | 10 |
| Shoes (women's, low-priced men's)[e,f] | 9 |
| D. Low Barriers | |
| Canned fruits and vegetables | 4.5 |
| Flour[f] | 4 |
| Meat packing | 3.75 |

[a]Although twenty-three industries appear in the table, the shoe, fountain pen, and farm machinery industries are broken down into two sub-categories. The industries are ranked in order of the height of barriers, but are placed in the same groups in which Dr. Bain originally placed them.

TABLE 3--continued

[b]In Table 2, n.a. is treated as II in the derivation of the weighted aggregate scale.

[c]In the fountain pen and farm machinery industries, the product differentiation barrier is depicted by Bain (see Table 2) as being I to III. A product differentiation barrier of I is assigned to the low-priced fountain pen and small, simple farm machinery industries. A product differentiation barrier of III is assigned to the "quality grade" fountain pen and large, complex farm machinery industries. This is in accordance with Bain's explanation of the product differentiation barriers of these industries.

[d]Gypsum products is placed in the higher group because Dr. Bain indicates that for periods subsequent to 1950 only have the barriers to entry in this industry declined, and much of his research is based on data prior to 1950.

[e]The product differentiation barrier of I (see Table 2) applies to women's and low-priced men's shoes. The high-priced men's and specialties shoes have a product differentiation barrier of II. These are the values used in the calculation of the weighted aggregate scale.

[f]Since Dr. Bain implies less difference between negligible barriers and low barriers than between the three major classifications, Ø (Table 2) is treated as .5 in these cases.

The Thurstone Paired Comparisons Test was used to verify the reliability of the cardinal scale developed in the above manner.[7] This test substantiated the validity of the weighted aggregate scale. Greater than 90 percent correlation was found between the values assigned to barriers to entry by both scales. (See Appendix A, page 111, for the data relevent to the Paired Comparisons Test.) Figure 2 is a graphic comparison of the agreement between the two scales.

Next a test was conducted to determine whether a reliable correlation existed between industry concentration and barriers to entry.[8] The industry concentration data

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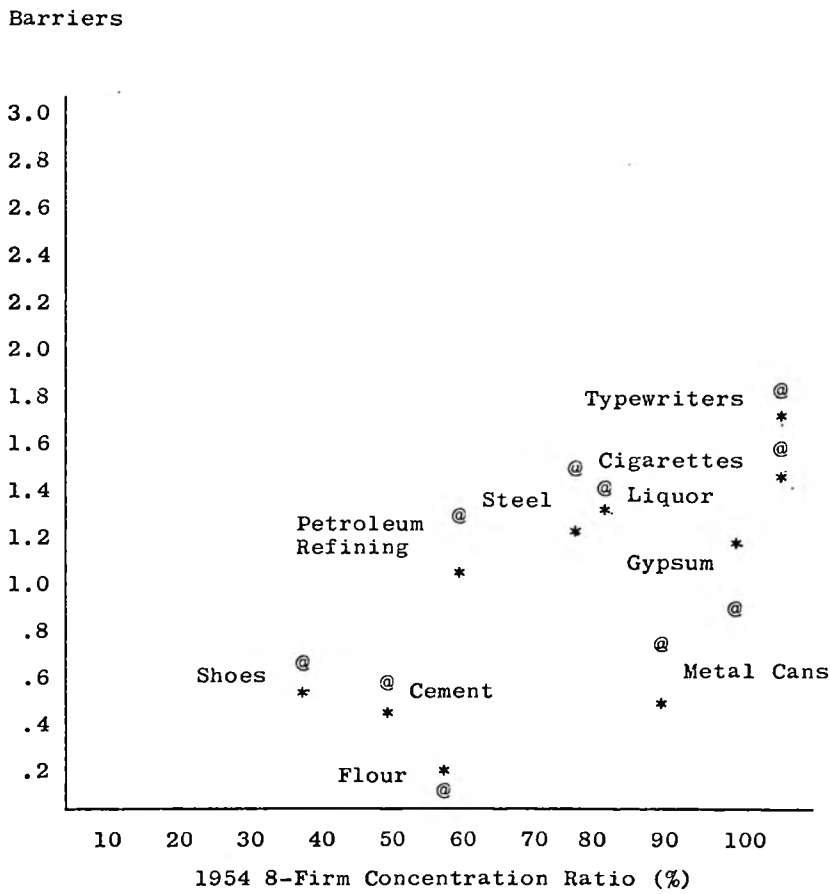
[7]A detailed description of the use of this technique is found in L. L. Thurstone, The Measurement of Values (Chicago: The University of Chicago Press, 1959). Chapter 7, "The Measurement of Paired Comparisons for Social Values," offers the reader an opportunity to determine exactly how the technique is applied. See also, Herbert Aron David, The Method of Paired Comparisons (New York: Hafner Publishing Company, 1963). The researcher should point out that, although Thurstone's method was carried out in every other detail, there was one modification necessary for this application. The Thurstone technique calls for several judges to make comparisons between pairs of objects being ranked. In ranking Bain's twenty industries according to the respective barriers to entry, five criteria were used for comparison purposes in lieu of judges. These were: scale-economy barriers, product-differentiation barriers, absolute-cost barriers, capital-requirement barriers, and Bain's "overall" barriers.

[8]The reader may wonder at this point why, if the weighted aggregate scale proved to be so accurate, values pertaining to this scale are not suitable for use as the dependent variable in the model. These values would be suitable if the only industries to be included in the study were from the sample of industries used in Dr. Bain's study. The model which this researcher has attempted to develope, however, is applicable to all industries and is not limited to the twenty industries used in developing the scale.




* Weighted aggregate scale values
@ Paired Comparisons scale values

Figure 2.--A Graphic Analysis of the Weighted Aggregate Scale and the Paired Comparisons Scale in Terms of their Comparability

Note: In the above graph, the values for the weighted aggregate scale were divided by twenty for ease of analysis. The absolute difference between the scale values is not of importance. As long as the difference for each industry is approximately the same in terms of percentages, the paired comparison scale has justified the use of the weighted aggregate scale.

were gathered from the Annual Survey of Manufactures[9] and are shown in Table 4. The table shows, for example, that in 1966 eight firms in the meat packing industry accounted for 39 percent of industry sales.

Initially, a test was made to determine the correlation between entry barriers and four-firm concentration ratios for 1954. This analysis for ten industries resulted in a simple correlation coefficient of .65. The analysis is shown in Appendix B, page 115. A second test was conducted using eight-firm concentration ratios for 1954 for the same ten industries. (Only ten of the industries studied by Bain were used as explained in the notes to Table 4.) This correlation analysis yielded a simple correlation coefficient of .76. (See Appendix C, page 117, for the details.)[10]

Based on the above tests, the conclusion was that concentration ratios do reflect the extent of barriers to entry into the marketplace. The data also revealed that the eight-firm concentration ratio is optimal for this study.

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[9]U. S. Bureau of the Census, Annual Survey of Manufactures: 1966 (Washington, D. C.: U. S. Government Printing Office, 1969), Chapter 9.

[10]A visual examination of the concentration data revealed that an analysis based on twenty-firm concentration ratios would result in a lower level of correlation because several of the industries involved in the analysis were controlled by fewer than twenty firms.

TABLE 4

CONCENTRATION DATA (%)[a]

| Industry | 4-Digit SIC Code | 4-Firm Concentration 1947 | 1954 | 1958 | 1966 |
|---|---|---|---|---|---|
| Meat packing plants[b] | 2011 | 41 | 39 | 34 | 27 |
| Canned goods[c] | 2033 | n.a. | n.a. | n.a. | 24 |
| Flour | 2041 | 29 | 40 | 38 | 31 |
| Liquor | 2085 | 75 | 64 | 60 | 55 |
| Cigarettes | 2111 | 90 | 82 | 79 | 81 |
| Rayon[d] | 2221 | 31 | 30 | 34 | 40 |
| Soap[c] | 2841 | n.a. | n.a. | n.a. | 72 |
| Petroleum refining | 2911 | 37 | 33 | 32 | 32 |
| Tires & inner tubes[c] | 3011 | n.a. | n.a. | n.a. | 71 |
| Shoes | 2141 | 28 | 30 | 27 | 26 |
| Cement | 3241 | 30 | 31 | 32 | 30 |
| Gypsum products | 3275 | 85 | 90 | 88 | 80 |
| Steel | 3312 | 50 | 55 | 53 | 49 |
| Copper[c,e] | 3362 | n.a. | n.a. | n.a. | 20 |
| Metal containers | 3411 | 78 | 80 | 80 | 71 |
| Farm machinery & equip.[c,f] | 3522 | n.a. | n.a. | n.a. | 45 |
| Typewriters | 3572 | 79 | 83 | 79 | 79 |
| Motor vehicles[g] | 3717 | 56 | 75 | 75 | 79 |
| Pens, pencils, etc.[g,h] | 3951 | n.a. | n.a. | n.a. | 46 |

Source: U. S. Bureau of the Census, Annual Survey of Manufactures: 1966 (Washington, D. C.: U. S. Government Printing Office, 1969).

[a]The analysis for determining the correlation between the barriers to entry in the various industries according to the weighted aggregate scale and the concentration ratios for those industries included only ten of the twenty industries in Dr. Bain's study. Those industries footnoted in this table were not included in the correlation analysis for reasons which are given in the following footnotes.

[b]Dr. Bain calculated the barriers to entry in the meat packing industry based on data referring to wholesale fresh meat packing only. Concentration data include all barriers and concentration data are not based on the same premise for this industry.

[c]Concentration data for these industries are not available for 8-firm concentration in 1954 or 1958, so these industries were eliminated from the correlation.

TABLE 4--continued

| 8-Firm Concentration | | | | 20-Firm Concentration | | | |
|---|---|---|---|---|---|---|---|
| 1947 | 1954 | 1958 | 1966 | 1947 | 1954 | 1958 | 1966 |
| 54 | 51 | 46 | 39 | 63 | 60 | 57 | n.a. |
| n.a. | n.a. | n.a. | 35 | n.a. | n.a. | n.a. | n.a. |
| 41 | 52 | 51 | 47 | n.a. | n.a. | 85 | n.a. |
| 86 | 79 | 77 | 72 | 95 | 93 | 94 | n.a. |
| 99 | 99 | 99 | 100 | 100 | 100 | 100 | n.a. |
| 39 | 39 | 44 | 50 | 56 | 55 | 62 | n.a. |
| n.a. | n.a. | n.a. | 80 | n.a. | n.a. | n.a. | n.a. |
| 59 | 56 | 55 | 57 | 83 | 84 | 82 | n.a. |
| n.a. | n.a. | n.a. | 90 | n.a. | n.a. | n.a. | n.a. |
| 35 | 36 | 34 | 34 | 45 | 45 | 43 | n.a. |
| 45 | 48 | 50 | 51 | 70 | 73 | 78 | n.a. |
| 94 | 97 | 96 | 95 | 99 | 99 | 98 | n.a. |
| 66 | 71 | 70 | 66 | 81 | 86 | 84 | n.a. |
| n.a. | n.a. | n.a. | 28 | n.a. | n.a. | n.a. | n.a. |
| 86 | 88 | 89 | 83 | 94 | 96 | 97 | n.a. |
| n.a. | n.a. | n.a. | 59 | n.a. | n.a. | n.a. | n.a. |
| 96 | 99 | 99 | 99 | 100 | 100 | 100 | n.a. |
| 64 | 80 | 81 | 83 | 78 | 87 | 89 | n.a. |
| n.a. | n.a. | n.a. | 60 | n.a. | n.a. | n.a. | n.a. |

[d]Dr. Bain classified the extent of barriers to entry in this industry by an analysis of the rayon industry alone. Concentration data, however, include all synthetic fibers.

[e]The scale values for barriers to entry are based solely on control of copper refining capacity whereas the concentration ratio is based on the structure of the industries producing brass, bronze, copper, and similar metals.

[f]Although Dr. Bain separated farm machinery and tractors into two separate industries, they are both included under the same industry classification (4-digit) in the Annual Survey of Manufactures, from which the concentration data were obtained.

[g]Industry concentration ratios are given for the motor vehicle industry, but the scale values for entry barriers are based only on the passenger car industry which in fact has a much higher concentration ratio.

[h]Dr. Bain studied the fountain pen industry, but the available concentration data apply to the broader industry of pens, pencils, desk sets, etc.

## The Independent Variables

Advertising.--In this dissertation advertising is defined as any expense incurred by a firm in its efforts to inform existing and potential customers as to the availability of its product and to persuade them regarding its desirability and/or usefulness. This definition includes not only expenditures for advertisements in the traditional media (e.g., radio, television, billboards, magazines, newspapers, and trade journals), but also expenditures for promotional purposes such as exhibits, demonstrations, catalogues, and pamphlets.

Advertising expenditures in this study are expressed as a ratio of advertising expenditures to sales revenue. This definition is necessary because the model is applied to many industries which contain firms of varying sizes and differ in the dollar amount of advertising expenditure.

Company age.--Company age is defined as the number of years a company has been in operation. This definition purposefully does not restrict the measurement of years of operation by a firm to the number of years which that firm has been operating in the particular industry in question. This variable, as defined, is to be used as an indicator of economies of being established which is a rather intangible and qualitative asset. Economies of being established may be transferred when a well-established firm in one industry

expands its product line so that it, in effect, is entering a new industry.

In determining the average age of the companies in each industry included in this study, the researcher calculated an average age on the basis of these firms which accounted for a predominance of sales in a given industry.[11] The reasoning behind this process is that a priori firms with insignificant market shares, regardless of age, have not benefited from economies of being established. On the other hand, if a new firm has obtained a substantial share of the market in its industry, then its age should be considered in determining the average age variable.

After calculating an average age for the leading firms in each industry included in the sample, this average was then converted to a ratio relative to the age of the industry as a whole. This was necessary because in inter-industry comparisons an absolute value of average age of leading firms lacks sensitivity due to the varying ages of manufacturing industries. For example, a firm with sixty years of operation would be an "old" firm in the automobile industry, but a "young" firm in the newspaper industry because of the vast difference in the ages of the two industries.

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[11]Names of the leading firms in each industry were obtained from Standard and Poor's Industry Surveys. (New York: McGraw-Hill, Inc.) Industry surveys pertaining to the appropriate industries were used. Also, Moody's Industrial Manual, June, 1966 (New York: Moody's Investors Service, Inc., 1966).

Durability of the industry product.--Product durability is used as a relative measure of the useful life of a product. An ordinal ranking of this variable was performed to reflect three levels of durability. The values of 1, 2, or 3 were assigned depending on whether the product was classified as a nondurable, semi-durable, or durable good, respectively. A nondurable item is one which is purchased for immediate consumption or disposal. Examples of nondurable consumer goods are most food and toiletry items. A durable good is an article whose use is extended over a longer period of time, usually more than two years. Examples of durable consumer goods include automobiles, furniture, appliances, and major sporting equipment such as golf clubs and boats.[12] Semi-durable goods are those which are used over an intermediate period of time. As the terminology indicates, the useful life of a semi-durable good is longer than the life of a nondurable good but not as long as that of a durable good. Examples of semi-durable goods are shoes, clothing, automobile tires, and fountain pens.[13]

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[12]Major sporting equipment is included as an explicit example indicating that price is not necessarily a function of durability. Although golf clubs and boats are both considered as durable consumer goods, a major differential exists in the price levels of these items.

[13]An item classified as a nondurable good ordinarily has a useful life which is measured in hours, days, or weeks. A semi-durable good usually lasts the user no longer than two years. A durable good ordinarily has a lifetime of more than two years.

Price level of the industry product.--The industry product price level is defined as the price at which the product is sold to the consumer. The amount of money spent on a given type of good in a time period by a consumer is a function of the absolute price level of one unit of the good and the number of units of the good purchased during that time period. Thus, the price level of the industry product is expressed as the total dollar expenditures for the industry product per year per consuming unit.[14] For example, in calculating this variable for the passenger car industry, it was determined that $22,608,000,000 was spent in 1965 by families who purchased 7.2 million passenger cars. Of 58.4 million families in the United States in 1965, 79 percent owned one or more automobiles. Thus, the number of potential consuming units in 1965 was 79 percent of the total number of families in the United States, or 46,136,000 families. Dividing the total expenditures for the industry product ($22,608,000,000) by the number of consuming units (46,136,000 families) yielded a value of $490.05, which is the amount of money spent in 1965 per consuming unit for automobiles.[15]

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[14]Since a separate calculation of the ratio is necessary for the equation corresponding to each industry being studied, there is no problem of heterogeneity of units of the various industry products. The consuming units which are applicable for the respective industries in the study are presented in the following chapter.

[15]The data for these calculations were obtained from the U. S. Bureau of the Census, Statistical Abstract of the United States: 1968 (89th ed.) Washington, D. C., 1968.

The use of this ratio is helpful in three ways. First, if the absolute price level of an industry product were not adjusted, the conclusions forthcoming from the results of the multiple regression model would be rather spurious and would therefore weaken the explanatory power of the model. This is necessarily true because the absolute price level of a product is a poor measure of the real periodic cost to the purchaser. Secondly, this ratio does not require an arbitrary decision by the researcher as to the unit of a good adopted for the research. Quantity can be expressed in pounds or tons, cartons or carloads, pints or gallons. This tends to create ambiguities in both analysis and conclusions. The use of this ratio allows the researcher to circumvent this problem, thereby increasing the validity and explanatory power of the variable. Finally, the use of this ratio does not require a typical selling price to be designated for the products of every industry included in the study.

Short-run industry growth rate.--Short-run industry growth rate is defined as the annual compound rate of change in the value of the annual industry shipments from 1963 to 1966, according to data obtained from the Census of Manufactures.[16] This variable is used as an indicator of the most recent potential for expansion of industry sales.

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[16]U. S. Bureau of the Census, 1967 Census of Manufactures, INDUSTRY SERIES: Sugar and Confectionary Products, MC67(2)-20F; Beverages, MC67(2)-20G; Newspapers, Periodicals, Books, and Miscellaneous Publishing, MC67

Long-run industry growth rate.--Long-run industry growth rate is defined as the annual compound rate of change in the value of the annual industry shipments from 1958 to 1966 for the chosen industries. Data for the calculation of this variable were also obtained from the Census of Manufactures.

## The Multiple Linear Regression Model Used in this Study

An equation for each industry included in the study is set up as follows:

$$y_i = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + B_4x_4 + B_5x_5 + B_6x_6 + B_7x_7 + B_8x_8.$$

This is a linear equation where

$y_i$ = the eight-firm concentration ratio for industry i

$B_0$ = the model parameter representing the intercept value

$B_1,\ldots,B_8$ = the model parameters representing the regression coefficients of the independent variables $x_1, \ldots, x_8$

(2)-27A; Drugs, MC67(2)-28C; Soap, Cleaners, and Toilet Goods, MC67(2)-28D; Petroleum and Coal Products, MC67(2)-29A; Rubber and Miscellaneous Plastic Products, MC67(2)-30A; Tanning, Industrial Leather Goods, and Shoes, MC67(2)-31A; Engines and Turbines and Farm Machinery and Equipment, MC67(2)-35A; Communications Equipment, Including Radio and TV, and Electronic Components and Accessories, MC67(2)-36D; Motor Vehicles and Equipment, MC67(2)-37A; Photographic Equipment, Clocks, Watches, and Watchcases, MC67(2)-38B; Office Supplies, Costume Jewelry, and Notions, MC67(2)-39C (Washington, D. C.: U. S. Government Printing Office, 1969).

$x_1$ = average annual advertising expenditure/average annual sales revenue for leading firms in industry i

$x_2$ = the average age of the leading firms in industry i/the age of industry i

$x_3$ = the durability of the industry product (coded)

$x_4$ = the total dollar expenditure for the product of industry i in 1966/total number of consuming units

$x_5$ = the compounded average rate of growth of the value of shipments of industry i from 1963 to 1966

$x_6$ = the compounded average rate of growth of the value of shipments of industry i from 1958 to 1966

$x_7$ = $x_3x_4$ (an interaction term measuring the combined effects of durability and expenditure on the market structure of industry i)

$x_8$ = $x_1x_2$ (an interaction term measuring the combined effects of advertising and company age on the market structure of industry i).

The statistical linear model to be fitted to the set of data points is

$$y = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + B_4x_4 + B_5x_5 + B_6x_6 + B_7x_7 + B_8x_8 + \epsilon .$$

The expected value of y is the equation of a straight line,

$$E(y) = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + B_4x_4 + B_5x_5 + B_6x_6 + B_7x_7 + B_8x_8$$

and the prediction equation is

$$y = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + B_4x_4 + B_5x_5 + B_6x_6 + B_7x_7 + B_8x_8$$

where the estimates $B_0,\ldots,B_8$ are found by the method of least squares.

The null hypothesis, $H_0$, states that the six individual independent variables and the two interaction terms have no aggregate effect upon industry eight-firm concentration ratios. This null hypothesis will be tested using the standard F-test derived from an analysis of variance.

## The Sample

### Criteria for Choosing Industries to be Included in the Sample

Four criteria were established for choosing the industries to be included in the sample. First, all the industries in the sample had to be manufacturing industries. This restriction was necessary because of the manner in which the measurement of barriers to entry by industry concentration was explained previously in this chapter. The correlation analysis between concentration ratios and barriers to entry could be conducted only after cardinal values were assigned to entry barriers of the industries utilized in Dr. Bain's study, which reflected only manufacturing industries.

The second criterion was that the sample should reflect the distribution of the total value of shipments of the twenty major two-digit manufacturing industry groups[17] listed in the Survey of Manufactures: 1966.[18] The number

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[17]According to the U. S. Bureau of the Budget, Office of Statistical Standards, Standard Industrial Classification Manual (Washington, D. C.: U. S. Government Printing Office, 1967), pp. ix-xi, the Standard Industrial Classification was developed by the Technical Committee on Standard Industrial Classification under the auspices of the Office of Statistical Standards of the Bureau of the Budget to facilitate the "collection, tabulation, presentation, and analysis of data" concerning all economic establishments. Every manufacturing establishment falls into one of twenty major industry groups according to its primary activity. Each of the twenty major industry groups is assigned a two-digit number. More explicit characterization of economic establishments is accomplished by sub-dividing each two-digit industry group. For example, Major Group 28, Chemicals and Allied Products, is divided into the following groups:

281 Industrial Inorganic and Organic Chemicals
282 Plastics, Metals, and Synthetic Resins, Synthetic Rubber, Synthetic and Other Manmade Fibers, Except Glass
283 Drugs
284 Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations
285 Paints, Varnishes, Lacquers, Enamels, and Allied Products
286 Gum and Wood Products
287 Agricultural Chemicals
289 Miscellaneous Chemical Products

Furthermore, Group 287, Agricultural Chemicals, is composed of the following industries:

2871 Fertilizers
2872 Fertilizers, Mixing Only
2879 Agricultural Pesticides, and Other Agricultural Chemicals, Not Elsewhere Classified

Based upon its primary activity, every economic establishment falls into one of the four-digit industries. All establishments within one particular four-digit industry form a more homogeneous group than all establishments in a major two-digit industry group.

[18]U. S. Bureau of the Census, Annual Survey of Manufactures: 1966 (Washington, D. C.: U. S. Government Printing Office, 1969), p. 12.

of four-digit industries chosen from each major two-digit industry group was based upon the percentage of the total value of manufacturing shipments made by industries in each two-digit group. Appendix D, page 119, contains a listing of the major manufacturing industry groups, the shipment value attributable to each group, and the percentage of the total value of all manufacturing shipments attributable to each group in 1966.

The third criterion was that the distribution of industry concentration ratios for the sample should approximate the distribution of the same ratios in the universe. Of 159 four-digit consumer goods manufacturing industries listed in the Survey of Manufactures: 1966, approximately 26 percent had eight-firm concentration ratios of less than .34, 42 percent had concentration ratios from .34 to .66, and 32 percent had concentration ratios which were greater than .66.[19]

A final criterion or limiting factor was the availability of data. Concentration ratios and value of shipments for some of the manufacturing industries were not available for years prior to 1963. These industries, therefore, were not included in the sample.

## Sample Size

The minimum number of industries which can be included in a study of this nature, is dependent upon the number

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[19] Ibid., Chapter 9.

of variables to be included in the model. A stipulation of the multiple linear regression technique is that the number of observations must be at least equal to the number of variables in the model. Thus, the minimum number of industries for the sample is ten (one observation for each industry in the sample and a total of nine variables in the model--one dependent variable, six autonomous independent variables, and two interaction independent variables).

The sample in this study contains at least one four-digit industry from every major two-digit industry groups whose value of shipments is five percent or more of the total value of shipments for all manufacturing industries and whose primary industry products are purchased by consumers. Since there are twenty major two-digit industry groups, five percent is the average percentage value of shipments for each industry group. The sample for the study contains sixteen industries.[20]

Before the various analyses are presented in the following chapter, certain points should be noted concerning the method of selecting the sixteen industries which were

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[20]This is not a time series study, but a cross-sectional study made for one point in time, namely, the year 1966. This particular year was chosen for the study as it is the most recent year for which data are available for all of the variables in the model. Although the data which are used in the model are, for the most part, applicable to only one year, the researcher is hopeful that the conclusions are more generally applicable.

included in the study. The initial choice of industries could not be based on a perfectly random sample due to the restrictive criteria discussed earlier in this chapter. The industry selection was consequently based on two separate samples. The first sample was used in selecting consumer goods manufacturing industries which could meet the restrictive criteria. From this list of industries, a random sample was drawn. This should be noted because the basic assumptions underlying the general linear model state that the sample should be randomly collected. By limiting the universe of this study to that group of consumer goods manufacturing industries which meet the established criteria, the assumptions of the general linear model were not loosened.

# CHAPTER III

## ANALYSIS OF DATA

The results of the analysis are divided into four parts. First, cross-classifications of the variables are presented along with interpretations of their results. Second, the results of the multiple linear regression model are presented and statistical and economic interpretations of the model are discussed. Third, the results of the stepwise regression technique for the primary model and the sub-models stemming from the use of alternative variables for expressing expenditure and durability are presented. Fourth, an analysis of the effects of the independent variables based on the combined results of the cross-classifications and the regression techniques concludes the presentation in this chapter.

The data for these analyses relate to the sixteen industries listed in Table 5.[1] This table also shows the percentage of the total value of shipments of all consumer goods manufacturing industries accounted for by each industry in 1966. Although these sixteen comprised only

[1]Appendix E contains the eight-firm concentration ratio for each industry and the values of the independent variables used in the analysis. The procedure used in obtaining measures for these variables was discussed in Chapter II, pages 32-36.

TABLE 5

THE SIXTEEN SAMPLE INDUSTRIES, THE 1966 VALUE OF SHIPMENTS FOR EACH INDUSTRY, AND THE PERCENTAGE OF THE TOTAL VALUE OF SHIPMENTS FOR CONSUMER GOODS MANUFACTURING INDUSTRIES

| SIC Code | Industry | Value of Shipments (Billions of dollars) | Percentage of Total Value of Shipments for Consumer Goods Industries |
|---|---|---|---|
| 2071 | Confectionary products | 1.7 | .8 |
| 2085 | Distilled spirits, except brandy | 1.3 | .6 |
| 2086 | Soft drinks | 2.7 | 1.3 |
| 2711 | Newspapers | 5.5 | 2.7 |
| 2841 | Soap and other detergents | 2.4 | 1.2 |
| 2844 | Toilet preparations | 2.4 | 1.2 |
| 2911 | Petroleum refining | 18.8 | 9.1 |
| 3011 | Tires and inner tubes | 3.7 | 1.8 |
| 3141 | Shoes, except rubber | 2.6 | 1.3 |
| 3522 | Farm machinery and equipment | 4.3 | 2.1 |
| 3651 | Radio and TV receiving sets | 4.1 | 2.0 |
| 3717 | Passenger cars | 17.6 | 8.5 |
| 2834 | Drugs | 4.4 | 2.2 |
| 3861 | Photographic equipment | 3.2 | 1.6 |
| 3871 | Watches and clocks | .7 | .3 |
| 3961 | Costume jewelry | .3 | .2 |
| | Total | 75.7 | 36.9 |

Source: U. S. Bureau of the Census, Annual Survey of Manufactures: 1966, U. S. Government Printing Office, Washington, D. C., 1969, Chapter 9.

10 percent of the 159 four-digit consumer goods manufacturing industries, they accounted for over one-third of the total value of shipments by all consumer goods manufacturing industries in 1966. Therefore the sample represents a large portion of the consumer goods manufacturing segment of the economy.

## The Cross-classification Analyses

The first approach to the analysis of the data was the use of selected cross-classifications of the variables. Because of the small number of observations and the method of sampling employed, statistical tests of significance could not be applied to the tables. However, the cross-classifications enabled the researcher to formulate those hypotheses concerning relationships between the variables which could then be tested via the regression models. Furthermore, the cross-classifications are indicative of certain common characteristics and trends in the variable relationships which might be overlooked by the regression analyses because of the averaging process inherent in the regression techniques.

### Basic Two-way Cross-classifications of Industry Eight-firm Concentration and Each of the Independent Variables

In each of the two-way cross-classifications presented on the following pages, the relative magnitude of each variable for every industry studied was classified as high, medium, or low. The high and low classifications

contained five industries each and the middle classification contained six industries. Appendix I, page 140, presents the classification of each variable for every observation of the study. These classifications were derived from Appendix E, page 121. For example, the high industry eight-firm concentration classification included the five most concentrated industries of the sixteen industries studied (soft drinks, soap, tires and tubes, passenger cars, and photographic equipment). The low industry eight-firm concentration classification contained the five least concentrated industries (confectionary products, newspapers, shoes, drugs, and costume jewelry). The remaining six industries were placed in the medium industry eight-firm concentration classification.

Each of the basic two-way cross-classifications was investigated for two reasons. First, they were studied to see if any trends existed between the dependent variable and any of the independent variables. Second, the industry groupings in each cross-classification were investigated for commonality based on three criteria: (1) absolute size of companies in each industry as reflected by sales revenues, (2) price level of the industry product, and (3) whether the industry product is normally considered a luxury or a necessity. Table 6 presents a listing of the sixteen industries and their respective classifications as to size, price level, and whether each industry product is a luxury or a necessity.

TABLE 6

CLASSIFICATION OF THE SIXTEEN INDUSTRIES BY SIZE OF FIRMS IN EACH INDUSTRY, PRICE LEVEL OF THE INDUSTRY PRODUCT, AND WHETHER THE INDUSTRY PRODUCT IS A LUXURY OR A NECESSITY

| Industry | Size of Firms in the Industry | Price Level of Industry Product | Necessity or Luxury |
|---|---|---|---|
| Confectionary products | Small | Low | Luxury |
| Distilled spirits, except brandy | Medium | Low | Luxury |
| Soft drinks | Medium | Low | Luxury |
| Newspapers | Small | Low | Necessity |
| Soap and other detergents | Large | Low | Necessity |
| Toilet preparations | Medium | Low | Luxury |
| Petroleum refining | Large | Low | Necessity |
| Tires and inner tubes | Large | High | Necessity |
| Shoes, except rubber | Medium | Low | Necessity |
| Farm machinery and equipment | Large | High | Necessity |
| Radio and TV receiving sets | Medium | High | Luxury |
| Passenger cars | Large | High | Luxury |
| Drugs | Small | Low | Necessity |
| Photographic equipment | Medium | Medium | Luxury |
| Watches and clocks | Small | Medium | Luxury |
| Costume jewelry | Small | Medium | Luxury |

Industry eight-firm concentration versus advertising expenditure per dollar of sales revenue.--As shown in Table 7, this cross-classification failed to reveal any basic relationships between industry concentration and advertising since the sixteen industries seemed to be rather

TABLE 7

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND ADVERTISING EXPENDITURE PER DOLLAR OF SALES REVENUE

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Advertising Expenditure Per Dollar of Sales Revenue | High | Soft drinks<br>Soap | Cosmetics<br>Watches and clocks | Drugs |
| | Medium | Tires and tubes<br>Photographic equipment | Liquor<br>Radio and TV sets | Confectionary<br>Shoes |
| | Low | Passenger cars | Petroleum refining<br>Farm machinery | Newspapers<br>Costume jewelry |

evenly distributed throughout the cells of the matrix. For example, the three industries in the sample which had the heaviest investments in advertising per sales dollar in 1966 (cosmetics, soap, and drugs) were in three separate concentration classifications.

Table 7 also failed to reveal any apparent relationships between advertising and either firm size, price of the industry product, or whether the industry product was a luxury or a necessity.

Industry eight-firm concentration versus price level of the industry product.--This cross-classification (Table 8) indicated a possible positive curvilinear relationship between the two variables studied, with concentration

TABLE 8

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND AVERAGE PRICE LEVEL OF THE INDUSTRY PRODUCT

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Average Unit Price of the Industry Product | Low | Tires and tubes<br>Autos | Farm machinery<br>Radio and TV sets<br>Watches and clocks | |
| | Medium | Photographic equipment | Liquor<br>Cosmetics | Shoes<br>Drugs<br>Costume jewelry |
| | High | Soft drinks<br>Soap | Petroleum refining | Confectionary<br>Newspapers |

increasing at an increasing rate as the price level of the industry product rises.

Table 8 did not indicate any apparent relationships between the average price of the industry product and either the absolute size of firms operating in the industry or whether the industry product is a luxury or a necessity.

Industry eight-firm concentration versus annual expenditure per consuming unit.--Table 9 seemed to imply a positive relationship between annual expenditure per consuming unit and industry eight-firm concentration.

TABLE 9

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND ANNUAL EXPENDITURE PER CONSUMING UNIT

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Annual Expenditure Per Consuming unit | High | Soap<br>Autos | Petroleum refining<br>Farm machinery<br>Radio and TV sets | |
| | Medium | Soft drinks<br>Tires and tubes<br>Photographic equipment | Liquor<br>Cosmetics | Newspapers |
| | Low | | Watches and clocks | Confectionary<br>Shoes<br>Drugs<br>Costume jewelry |

Four of the five least concentrated industries were in the low annual expenditure per consuming unit category. No industries were in either the low expenditure-high

concentration cell of the high expenditure-low concentration cell.

The annual expenditure per consuming unit appeared to be positively related to the absolute size of the firms in an industry, according to Table 9. The firms which comprised the passenger car, petroleum refining, farm machinery, and soap industries in 1966 were among the largest businesses represented by the sixteen sample industries. These four industries were in the high expenditure category in Table 9. Furthermore, of the five industries in the low expenditure category, four (watches and clocks, confectionary products, drugs, and costume jewelry) were composed of relatively small firms. These firms might be considered periphery firms whose activities have little effect on the economy as a whole, while the larger firms composing the passenger car, petroleum refining, farm machinery, and soap industries might be considered center firms whose activities can significantly affect the economy.[2] A valid conclusion forthcoming from this relationship may be that center firms have high annual sales revenues per consuming unit and periphery firms have low annual sales revenues per consuming unit. The products whose purchases require a large portion of the consumer's income and on which the consumer spends a large amount annually were all produced by center firms,

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[2]For a detailed discussion of the terms "center firms" and "periphery firms" see Robert T. Averitt, The Dual Economy (New York: W. W. Norton and Co., 1968).

and these firms were in the high and medium concentration classifications. This indicated that barriers to entry are greater in industries producing large items than in industries producing small items which do not account for a large portion of the consumer's income in a given time period.

Industry eight-firm concentration versus durability of the industry product.-- As shown in Table 10, ten of the sixteen industries were in cells representing high concentration-high durability, medium concentration-high durability, low concentration-medium durability, and low concentration- low durability. This appeared to indicate a positive

TABLE 10

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND DURABILITY OF THE INDUSTRY PRODUCT

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Durability of the Industry Product | High | Autos<br>Photographic equipment | Farm machinery<br>Radio and TV sets<br>Watches and clocks | |
| | Medium | Soap<br>Tires and tubes | Cosmetics | Shoes<br>Drugs<br>Costume jewelry |
| | Low | Soft drinks | Liquor<br>Petroleum refining | Confectionary<br>Newspapers |

curvilinear relationship between industry concentration and product durability. Those industries producing goods of the greatest durability (passenger cars, photographic equipment, farm machinery, radio and television sets, and watches and clocks) were in the high and medium concentration ranges, while the five least concentrated industries (shoes, drugs, costume jewelry, confectionary products, and newspapers) were in the medium and low durability classifications.

Table 10 suggested no apparent relationship between durability of the industry product and either the size of companies in the industry or whether the industry product was a necessity or a luxury. Table 10 did indicate an apparent positive relationship between durability and price of the industry product, which suggests that these variables may have a synergistic effect on industry eight-firm concentration.

Industry eight-firm concentration versus average age of the leading companies in each industry relative to the industry age.--The cross-classification of industry eight-firm concentration levels and the average age of the leading companies in an industry relative to the industry age (Table 11) suggested a positive relationship between the two variables. This trend was the strongest thus far revealed in the cross-classifications.

Eight of the sixteen industries were in either the high age-high concentration, medium age-medium concentration, or low age-low concentration category. None of the

remaining eight industries were in the low age-high concentration or high age-low concentration cells of Table 11. In other words, high concentration was associated with high and medium age, while low age was associated with medium and low concentration.

TABLE 11

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND THE AVERAGE AGE OF LEADING COMPANIES IN AN INDUSTRY RELATIVE TO THE INDUSTRY AGE

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Average Age of the Leading Firms in an Industry Relative to the Industry Age | High | Soft drinks<br>Tires and tubes<br>Autos | Farm machinery<br>Radio and TV sets | |
| | Medium | Soap<br>Photographic equipment | Petroleum refining<br>Watches and clocks | Drugs<br>Costume jewelry |
| | Low | | Liquor<br>Cosmetics | Confectionary<br>Newspapers<br>Shoes |

Table 11 did not reveal any apparent relationships between the age variable and whether the industry product is a luxury or a necessity. It did, however, appear to indicate a positive relationship between the age variable and the size of firms in an industry. The farm machinery,

passenger car, and tire and inner tube industries were among the five industries in the sample with the largest firms in 1966. All three of these were in the high age classification along with soft drinks and radio and television sets, both of which were composed of medium- to large-size firms. This may indicate that relatively large firms enjoy more economies of being established than do relatively small firms.

Four of the five industries with the smallest firms were also in the low industry eight-firm concentration classification. Tires and inner tubes, soap, and passenger cars--three industries composed of relatively large firms--were in the high concentration classification. Based upon the assumption that sales revenue is an indicator of the initial capital requirement to enter an industry, this supports the usual contention that high capital requirements act as barriers to entry.

Table 11 also implied that there may be a positive relationship between the price of an industry product and the average age of leading companies in the industry relative to the industry age. The four industries producing the highest priced items (tires and inner tubes, passenger cars, farm machinery, and radio and television sets) were in the high age classification. This apparent relationship suggested that older firms dominate industries producing high-priced consumer goods, which in turn implies that consumers faced with a purchasing decision concerning high

priced items tend to favor the products of well-established businesses. This is a reflection of economies of being established.

Industry eight-firm concentration versus long-run industry growth rate.--An apparent positive relationship also exists between concentration and long-run growth, as depicted in Table 12. Although this association does not

TABLE 12

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND LONG-RUN GROWTH OF THE INDUSTRY VALUE OF SHIPMENTS

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Long-run Growth | High | Autos<br>Photographic equipment | Cosmetics<br>Radio and TV sets<br>Watches and clocks | |
| | Medium | Soft drinks<br>Soap<br>Tires and tubes | Farm machinery | Newspapers<br>Drugs |
| | Low | | Liquor<br>Petroleum refining | Confectionary<br>Shoes<br>Costume jewelry |

appear to be as strong as that found between concentration and age, the same basic pattern prevails. Only four of the sixteen industries studied had long-run average compounded rates of growth of less than 4 percent. These were

petroleum refining, confectionary products, shoes, and costume jewelry. Three of these four industries were in the low concentration range. The exception, petroleum refining, was in the middle concentration range. On the other hand, photographic equipment, the industry with the greatest long-run growth rate, was in the high concentration category.

Table 12 did not reveal any apparent relationships between the long-run growth of an industry's value of shipments with the size of companies in the industry. Apparently, companies of all sizes had comparable growth rates from 1958 to 1966.

A positive relationship did appear to exist between long-run growth and both the price of the industry product and whether the industry product was a luxury or a necessity. The five industries with the highest long-run growth rates were passenger cars, photographic equipment, cosmetics, radio and television sets, and watches and clocks. This indicates that consumers may have had an increasing propensity to consume high-priced luxury items in the years 1958 through 1966.

Industry eight-firm concentration versus short-run industry growth rate.--No trend was apparent in this cross-classification (Table 13). The industries appeared to be rather evenly distributed throughout the cells of the matrix with none of the extreme categories dominant.

TABLE 13

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND SHORT-RUN GROWTH OF THE INDUSTRY VALUE OF SHIPMENTS

| | | Industry Eight-firm Concentration | | |
|---|---|---|---|---|
| | | High | Medium | Low |
| Short-run Growth | High | Photographic equipment | Cosmetics<br>Farm machinery<br>Radio and TV sets | Drugs |
| | Medium | Soft drinks<br>Tires and tubes<br>Autos | Liquor<br>Watches and clocks | Costume jewelry |
| | Low | Soap | Petroleum refining | Confectionary<br>Newspapers<br>Shoes |

Table 13 did not reveal any apparent relationships between the short-run growth of an industry's value of shipments with either the size of companies in an industry, the price level of the industry product, or whether the industry was a necessity or a luxury.

Three-way Cross-classification of Industry Eight-firm Concentration, Advertising Expenditure per Dollar of Sales Revenue, and Durability of the Industry Product

A three-way cross-classification was performed to study possible interrelationships of industry concentration, advertising, and durability. For this analysis, the industries were classified as having high or low concentration

ratios with an equal number in each category. Second, the industries were divided into two equal groups according to the amount of advertising per sales dollar. The industry products were then classified as being either durable or nondurable goods. This three-way classification is presented in Table 14. The most notable feature of Table 14 is that six of the eight nondurable goods were heavily advertised. Further, all of the heavily advertised nondurable goods were either food or personal care items. Newspapers and gasoline were the two nondurable items which were not heavily advertised. The two durable goods industries which were placed in the heavy advertising classification were photographic equipment and watches and clocks, both of which are normally classified as luxury items.

The three industries which produced personal care items (soap and other detergents, toilet preparations, and drugs) invested 11 percent, 11.2 percent, and 9.7 percent respectively of sales revenue in advertising. These percentages are larger than those for any of the other industries.

The respective eight-firm concentration ratios of these three industries in 1966 were .80, .54, and .41. The three industries producing food and related items (confectionary products, distilled spirits, and soft drinks) also had a rather large variation in concentration ratios, which were .34, .72, and .81 respectively.

The remaining two nondurable goods industries,

TABLE 14

THREE-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION, DURABILITY OF THE INDUSTRY PRODUCT, AND ADVERTISING EXPENDITURE PER DOLLAR OF SALES REVENUE

| | | | | Concentration | |
|---|---|---|---|---|---|
| | | | | High | Low |
| Durability of the Industry Product | Durable goods | Advertising/sales Revenue | High | Photographic equipment<br>Watches and clocks | |
| | | | Low | Tires and inner tubes<br>Radio and TV sets<br>Passenger cars | Costume jewelry<br>Shoes, except rubber<br>Farm machinery and equipment |
| | Nondurable goods | Advertising/sales Revenue | High | Distilled spirits, except brandy<br>Soft drinks<br>Soap and other detergents | Confectionary products<br>Cosmetics<br>Drugs |
| | | | Low | | Newspapers<br>Petroleum refining |

newspapers and petroleum refining (motor fuel), had the two lowest advertising expenditure-sales revenue ratios of the sixteen industries. This suggests that little correlation exists between durability of the industry product and advertising expenditure by firms in the industry in question.

Two-way Cross-classification of Industry Eight-firm Concentration and the Percentage Difference Between Long-run and Short-run Growth

In a further effort to investigate the relationship between industry concentration and industry growth, the two-way cross-classification shown in Table 15 was performed. The industries were divided into four equal groups according to the magnitudes of their concentration ratios. The variable with which concentration was classified was derived from the long-run and short-run growth rates of the industries as shown in Appendix E, page 124. The percentage difference between the short-run and long-run growth rates was calculated for each of the sixteen industries included in the sample.[3] The industries were then ranked and also placed in four groups of four industries each. Table 15 shows that a negative relationship apparently exists between industry concentration and the percentage differences between short-run and long-run industry growth rates. The industries representing departures from this

[3]Table 16 presents the results of these calculations. Only three of the industries had a greater compounded average rate of growth in the period from 1958 to 1966 than from 1963 to 1966.

TABLE 15

TWO-WAY CROSS-CLASSIFICATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND THE PERCENTAGE DIFFERENCE IN LONG-RUN AND SHORT-RUN INDUSTRY GROWTH RATES

| Percentage Difference in Growth Rates (Low ← → High) | ← Low — Industry Eight-firm Concentration — High → | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| IV | Shoes<br>Costume jewelry | Farm machinery | | Tires |
| III | | Drugs | Liquor<br>Radio and TV<br>Photographic equipment | |
| II | Confectionary products<br>Newspapers | Petroleum refining | Watches and clocks | |
| I | | Cosmetics | | Soft drinks<br>Soap<br>Passenger cars |

TABLE 16

PERCENTAGE DIFFERENCES BETWEEN LONG-RUN AND SHORT-RUN GROWTH FOR THE SIXTEEN SAMPLE INDUSTRIES

| Industry | Long-run growth rate (Percentage) | Short-run growth rate (Percentage) | Percentage Difference |
|---|---|---|---|
| Farm machinery and equipment | 7.54 | 15.08 | 100.00 |
| Costume jewelry | 3.53 | 6.10 | 72.30 |
| Shoes, except rubber | 3.27 | 5.62 | 71.87 |
| Tires and inner tubes | 4.68 | 8.00 | 70.94 |
| Radio and TV receiving sets | 13.01 | 22.23 | 70.87 |
| Photographic equipment | 13.36 | 21.08 | 57.78 |
| Distilled spirits, except brandy | 4.43 | 6.88 | 55.30 |
| Drugs | 7.24 | 10.17 | 40.47 |
| Petroleum refining | 3.24 | 4.37 | 34.88 |
| Confectionary products | 3.99 | 4.95 | 24.06 |
| Newspapers | 4.74 | 5.44 | 14.77 |
| Watches and clocks | 9.04 | 9.40 | 3.98 |
| Soft drinks | 7.28 | 7.35 | .96 |
| Cosmetics | 10.94 | 10.68 | -2.38 |
| Soap and other detergents | 5.13 | 4.03 | -21.04 |
| Passenger cars | 10.34 | 6.85 | -33.75 |

from this trend were tires and tubes, confectionary products, toiletries, and newspapers. The apparent trend generated by the remaining twelve industries in the sample indicates that constant increases in industry value of shipments are absorbed by existing companies in an industry but, when the industry value of shipments begins to increase at an increasing rate (which indicates that an industry's product is in the growth stage), new firms are able to enter the industry.

Summary of the Results of the Cross-classification Analyses and Tests for Curvilinearity

The cross-classification analyses seemed to imply a positive relationship between industry eight-firm concentration and five of the independent variables: (1) average price per unit of the industry product, (2) annual expenditure on the industry product per consuming unit, (3) durability of the industry product, (4) average age of the leading companies in each industry relative to the industry age, and (5) long-run growth of the industry value of shipments. Furthermore, the two variables expressing the average unit price and durability of the industry product appeared to have a curvilinear relationship with industry eight-firm concentration. To test these implied relationships and to investigate the possibility of a curvilinear relationship between industry concentration and any of the other independent variables, each independent variable was plotted against the dependent variable. This approach did

not suggest the existence of any curvilinear relationships. This indicated that there was little possibility of improving the predictive power of the model to be used by introducing higher powers of the independent variables.

Although the cross-classification of short-run growth and industry eight-firm concentration did not imply any relationship between the two variables, the cross-classification presented in Table 15 did indicate that short-run growth may have an effect upon industry concentration. Therefore, this variable was also retained in the initial regression analysis. Advertising expenditure per dollar of sales revenue was retained because of the large amount of attention that has been given to this variable in recent years concerning its effects upon barriers to entry.

In addition to the primary null hypothesis stating that the eight independent variables do not have a statistically significant relationship with industry eight-firm concentration when considered in the aggregate, six hypotheses were formulated concerning the individual effects of the variables. These were as follows:

1. A statistically significant positive linear relationship exists between average advertising expenditure per dollar of sales revenue and industry eight-firm concentration.
2. A statistically significant positive linear relationship exists between annual expenditure

on the industry product per consuming unit and industry eight-firm concentration.

3. A statistically significant positive linear relationship exists between durability of the industry product and industry eight-firm concentration.
4. A statistically significant positive linear relationship exists between the average age of the leading companies in an industry relative to the industry age and industry eight-firm concentration.
5. A statistically significant positive linear relationship exists between the compounded long-run average rate of growth of industry value of shipments and industry eight-firm concentration.
6. A statistically significant negative linear relationship exists between the compounded short-run average rate of growth of industry value of shipments and industry eight-firm concentration.

## The Multiple Linear Regression Model

Based upon the results of the cross-classification analyses and the discussion of the proposed independent variables which was presented in Chapter I, pages 4-13, a multiple linear regression analysis was performed to investigate the aggregate effect of the independent variables on industry eight-firm concentration.

The equation which was derived from the multiple linear regression model using the method of least squares is

$$y = 22.93 - 2.07x_1 + 0.06x_2 - 2.85x_3 + 34.98x_4 + 5.64x_5 - 0.02x_6 + 5.19x_7 - 2.31x_3$$

where

$y$ = the industry eight-firm concentration ratio expressed as a percentage

$x_1$ = the average advertising expenditure-sales revenue ratio for companies in the industry

$x_2$ = the expenditure per consuming unit per year for the industry product

$x_3$ = the durability of the industry product where $x_3 = 1$ for nondurable goods, $x_3 = 2$ for semi-durable goods, and $x_3 = 3$ for durable goods

$x_4$ = the average age of the leading companies in the industry divided by the industry age

$x_5 = x_1x_4$ = the advertising-sales ratio multiplied by the company age-industry age ratio (as discussed in Chapter I, pages 4-7, some writers have hypothesized that advertising is most beneficial to those firms which are well-established in their respective industries, and therefore this interaction term was included in the model.)

$x_6 = x_2x_3$ = the expenditure per consuming unit per year multiplied by the coded durability

of the product of the industry (as the cross-classification presented in Table 10, page 52, indicated, the durability and price of the products produced by the industries in this study appear to be positively related, and therefore this interaction term was also used in the initial regression model)

$x_7$ = the compounded average rate of growth of the dollar value of shipments for the industry from 1958 to 1966

$x_8$ = the compounded average rate of growth of the dollar value of shipments of the industry from 1963 to 1966.

The coefficient of multiple correlation (R) resulting from the analysis was .73 and the coefficient of determination ($R^2$) was .54. The F-value of 1.01 was not significant at the .10 level of significance. Therefore, the results of this regression model indicate that the regression coefficients of the prediction equation do not differ significantly from zero and that, although correlation may exist between industry eight-firm concentration ratios and some of the independent variables included in the model equation, the null hypothesis that the variables included in the analysis do not have a statistically significant combined effect upon the degree of concentration in consumer goods manufacturing industries cannot be rejected.

The standard error of the estimate which resulted from the analysis was 22.8 which, when compared to a mean value for the dependent variable of 60.4, indicates that the predictive accuracy of the resulting equation is extremely weak. This further substantiates the conclusion that use of the selected variables as expressed in the initial model for accurately predicting the eight-firm concentration of any consumer goods manufacturing industry is not warranted.

The correlation matrix presented in Table 17 shows the simple correlation between all possible pairs of variables included in the multiple regression model. Only six of the twenty-eight coefficients expressing correlation between independent variables exceeded .5. These pairs of variables were (1) advertising and advertising times age (.88), (2) expenditure and expenditure times durability (.93), (3) durability and age (.61), (4) durability and long-run growth (.60), (5) durability and short-run growth (.67), and (6) long-run and short-run growth (.82).

No economic significance can be attached to the two simple correlation coefficients involving the interaction terms, which were directly derived from values of other independent variables. This does indicate, however, that the interaction terms themselves may not have had significant individual effects upon the dependent variable that were not measured by the variables from which they were derived.

TABLE 17

CORRELATION MATRIX SHOWING MULTICOLLINEARITY AMONG THE VARIABLES

| | Concen-tration | Adver-tising | Expen-diture | Dura-bility | Age | Long-run growth | Short-run growth | Adv. x age | Exp. x Durab. |
|---|---|---|---|---|---|---|---|---|---|
| Concen-tration | 1.000 | .081 | .199 | .296 | .561 | .435 | .230 | .301 | .196 |
| Adver-tising | | 1.000 | - .301 | - .303 | - .300 | .207 | - .050 | .896 | - .292 |
| Expen-diture | | | 1.000 | .371 | .322 | .078 | .160 | - .285 | .932 |
| Dura-bility | | | | 1.000 | .612 | .602 | .666 | - .085 | .458 |
| Age | | | | | 1.000 | .415 | .489 | .097 | .348 |
| Long-run growth | | | | | | 1.000 | .822 | .292 | .152 |
| Short-run growth | | | | | | | 1.000 | .079 | .230 |
| Adv. x age | | | | | | | | 1.000 | - .264 |
| Exp. x durability | | | | | | | | | 1.000 |

The relatively high simple correlation which existed between the durability and age variables suggests that economies of being established resulting from longevity of operation may be realized to a greater extent by companies producing durable goods than by those producing nondurable goods. Further evidence on this point is offered by the data in Appendix E, page 123, which indicates that the lowest value of a variable expressing the average age of leading companies in an industry relative to the industry age for durable goods industries was .59 (costume jewelry). The remaining five durable goods industries had values of .60 and above. Only one of the seven nondurable goods industries in the study had a value for the age variable over .59. That industry was soft drinks with a value of .80. The remaining six nondurable goods industries had values for the age variable ranging from .29 (distilled spirits) to .58 (petroleum refining).

## The Primary Stepwise Regression Analysis

Although the results of the multiple linear regression analysis indicated that the primary null hypothesis could not be rejected since the aggregate effect of the selected independent variables upon the dependent variable was not significantly different from zero, this does not necessarily imply that none of the independent vari- had a significant individual effect upon industry eight-firm

concentration. To obtain further information about the effect of each independent variable on the dependent variable and, more specifically, to test the six hypotheses concerning the individual effects of the independent variables, a stepwise regression was applied to the industry data.[4]

## Results of the Primary Model

Step one.--The first variable to enter the equation in the stepwise analysis was $x_4$, the age of leading companies in an industry expressed as a percentage of the industry age. The prediction equation resulting from step one was

$$y = 31.26 + 47.68x_4.$$

The coefficient of determination ($R^2$) was .31 and the standard error of the estimate was 19.60. Table 18 presents the results of the first step of the primary stepwise regression model.

The coefficient of determination indicated that the variation in the age variable accounted for 31 percent

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[4]Although the stepwise regression technique arrives at a final prediction equation in the same way as the multiple linear regression technique, it allows one to study the effects of the independent variables individually by entering one variable at a time into the equation. The variable reducing the sum of squares by the greatest amount is entered first, and the remaining variables are then also entered in order of their contribution toward accounting for the unexplained variation in the dependent variable.

of the total variation in industry eight-firm concentration. The F-value of 6.43 indicates that the age variable did have a statistically significant effect upon the dependent variable at the .10 level of significance. The standard error of the estimate (19.60), however, was quite

TABLE 18

PRIMARY STEPWISE REGRESSION: STEP 1

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$ (age) | 1 | 6.43 | .31 | .31 |
| Residual | 14 | | | |

large in view of the mean value of the dependent variable (60.44). This, along with the .31 coefficient of determination, implied that, although the age variable was statistically significant, the predictive power of the model at this stage was rather weak. Thus, more variables had to be considered if industry concentration was to be predicted with greater accuracy.

Step two.--The second variable which entered the equation was $x_1$, advertising expenditure per dollar of sales revenue. The resulting prediction equation was

$$y = 20.63 + 1.70x_1 + 54.67x_4.$$

The coefficient of determination was .38 and the standard error of the estimate was 19.30. Table 19 presents the results of the second step of the primary stepwise regression.

TABLE 19

PRIMARY STEPWISE REGRESSION: STEP 2

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$ | 2 | 4.03 | | .38 |
| $x_4$ (age) | 1 | 7.92 | .31 | |
| $x_1$ (advertising) | 1 | 1.44 | .07 | |
| Residual | 13 | | | |

The results indicated that the total regression ($x_4$, $x_1$) at this point was still significant at the .10 level. Advertising acting with age did therefore increase the predictive ability of the equation. The standard error of the estimate is only slightly smaller after the second step. This implied very little improvement in the predictive power.

The advertising variable when considered alone had an F-value of 1.44 which was not statistically significant at the .10 level. Thus, when other causal variables were

excluded, no real relationship existed between advertising expenditure per dollar of sales revenue and industry eight-firm concentration.

Step three.--The third variable entering the regression equation was $x_7$, the average compounded rate of growth of industry value of shipments from 1958 to 1966. The prediction equation which resulted from the entry of the long-run growth variable was

$$y = 18.93 + 1.34x_1 + 47.62x_4 + 1.05x_7.$$

The coefficient of determination was .40 and the standard error of the estimate was 19.30. Table 20 presents the results of step three of the analysis.

TABLE 20

PRIMARY STEPWISE REGRESSION: STEP 3

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$ | 3 | 2.67 | | .40 |
| $x_4$ (age) | 1 | 4.22 | .31 | |
| $x_1$ (advertising) | 1 | .73 | .07 | |
| $x_7$ (long-run growth) | 1 | .35 | .02 | |
| Residual | 12 | | | |

After the third variable was entered into the

equation, the total regression of the three independent variables on the dependent variable remained significant at the .10 level. The $R^2$ value was increased slightly to .40. The entrance of the long-run growth variable was therefore considered necessary. (Although the standard error of the estimate increased after the third step, it again went down following the fourth step due to the multicollinearity of the third and fourth variables which entered the equation.)

The age variable remained the only individual causal variable which had a significant independent effect upon the dependent variable (F-value = 4.22). Neither the advertising variable nor the long-run growth variable, when regressed individually against the dependent variable, revealed a significant relationship with industry eight-firm concentration.

Step four.--The fourth variable to enter the regression equation was $x_8$, the average compounded rate of growth of industry value of shipments from 1963 to 1966. The predictive equation which resulted from the entry of the short-run growth variable was

$$y = 18.63 + 0.61x_1 + 52.17x_4 + 4.37x_7 - 2.48x_8.$$

The coefficient of determination was .50 and the standard error of the estimate decreased to 18.90. Table 21 presents the results of the fourth step of the primary stepwise regression analysis.

TABLE 21

PRIMARY STEPWISE REGRESSION: STEP 4

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$, $x_8$ | 4 | 2.74 | | .50 |
| $x_4$ (age) | 1 | 5.45 | .31 | |
| $x_1$ (advertising) | 1 | .15 | .07 | |
| $x_7$ (long-run growth) | 1 | 2.41 | .02 | |
| $x_8$ (short-run growth) | 1 | 2.17 | .10 | |
| Residual | 11 | | | |

The total regression of the four independent variables entered thus far upon the dependent variable was statistically significant at the .10 level. The age variable, $x_4$, had an F-value of 5.45 and remained the only variable which exhibited a real "independent" relationship with industry eight-firm concentration at the above stated level of significance.

After the entrance of the short-run growth variable, however, the F-value of $x_7$, the long-run growth variable, increased from 0.35 in step three to 2.41, which indicates that the long-run growth variable would be significant at a lower alpha level than in the previous step.

This was a reflection of the multicollinearity between the two growth variables which had a simple correlation coefficient of .82 as shown in Table 17, page 70.

Although the long-run growth was the first of the two growth variables to enter the equation, the short-run growth variable actually accounted for a larger proportional reduction in the residual sum of squares. This was also due to the high correlation between the two variables. This result was expected because, as the cross-classification presented in Table 15, page 62, indicated, long-run and short-run growth, acting together, appeared to have a more than proportional effect upon industry eight-firm concentration than did either of the variables acting separately.

Final four steps of the primary stepwise regression model.--The results of the final four steps in the analysis are presented in tabular form in Appendix J, page 142. The inclusion of additional variables in the equation not only reduced the level of significance since the regression was not significant at the .10 level after they entered, but also caused an increase in the standard error of the estimate. The combined proportional reduction in the residual sum of squares by the variables entering after step four was only .037. There are several possible explanations for the lack of significance of the

regression when additional variables were added. First, no statistical relationship may have existed between any of the remaining variables and the dependent variable. Second, the data may not have possessed the necessary sensitivity to reveal the significance. Finally, the variables already in the equation may have obscured the real effect of the final four variables.

Conclusions Forthcoming from the Primary Stepwise Regression

The final estimated prediction equation chosen is

$$y = 18.63 + .61x_1 + 52.17x_4 + 4.37x_7 - 2.43x_3,$$

with a coefficient of determination of .50 and a standard error of the estimate of 13.90. The four variables that together exhibited significance (at the .10 level) in their aggregate effect upon industry eight-firm concentration could therefore account for only one-half of the total variation in the dependent variable. The low coefficient of determination and the large standard error of the estimate indicated that, although some relationship may have existed, the selected group of independent variables could not be used reliably to predict industry eight-firm concentration.

The primary stepwise regression analysis did reveal some independent relationships between the variables, however. Economies of being established, as expressed by the

age variable, appear to have a definite impact upon industry concentration. As an independent variable acting alone and in conjunction with the other variables, age exhibited a significant relationship with the dependent variable. The other three variables included in the prediction equation, advertising, long-run growth, and short-run growth, did not have "independent" causal relationships with the industry eight-firm concentration ratios at the stated level of significance. It appears that they do, however, interact in such a way as to improve the predictive power of the model. The long-run and short-run growth variables appeared to have a synergistic effect upon industry concentration. The positive regression coefficient of the long-run growth variable and the negative regression coefficient of the short-run growth variable implied that industry concentration can be explained in part by the difference between these two variables. The absolute value of the regression coefficient of the long-run growth variable (4.37) was larger than that of the short-run growth variable (2.48), indicating that the industry value of shipments must be increasing at an increasing rate if the industry is susceptible to the entry of new competitors. This fact was indicated by the previous cross-classification of concentration and the percentage difference between long-run and short-run growth rates of the sixteen industries included in the sample (Table 15, page 62).

Sub-models Resulting from Alternative Variables

In addition to the two interaction terms used in the analysis, the only other variables which did not enter the primary stepwise regression equation at the .10 level of significance were those variables expressing durability of the industry product and expenditure on the industry product per consuming unit per year. The investigation of the correlation matrix discussed previously revealed the existence of multicollinearity between the durability variable as initially coded and several of the other causal variables. The three highest correlation coefficients concerning the durability variable were durability and age, durability and long-run growth, and durability and short-run growth. Each of the three variables with which durability had the highest correlation were included in the final primary stepwise regression equation. It was thus concluded that there may have been a real relationship between durability and concentration but its effect was obscured by these three variables. An alternative method of coding the durability variable was therefore employed. This technique employed the use of two dummy variables, $x_{3a}$ and $x_{3b}$. For industries producing nondurable items, a value of 0 was assigned to both dummy variables. For the semi-durable goods industries, a value of 0 was assigned to the first dummy variable and a value of 1 was assigned to the second dummy variable. For the durable

goods industries, a value of 1 was assigned to the first dummy variable and a value of 0 was assigned to the second dummy variable. The equation thus established was

$$y = B_0 + B_1x_1 + B_2x_2 + B_{3a}x_{3a} + B_{3b}x_{3b} + B_4x_4 \quad . \; . \; . \quad B_8x_8$$

where

$x_{3a}$ = 1 if the industry was a producer of durable goods,
0 if the industry was not a producer of durable goods;

$x_{3b}$ = 1 if the industry was a producer of semi-durable goods,
0 if the industry was not a producer of semi-durable goods.

It was also concluded that the way in which the expenditure variable was measured may have obscured its true relationship with industry eight-firm concentration since annual expenditure per consuming unit does not in all cases reflect the price of a product. For example, the data in Appendix E, page 122, indicate that, although the average price of radio and television sets in 1966 was much greater than the price of a gallon of gasoline, more money per year was spent per consuming unit on gasoline than on radio and television sets.

Sub-model Number 1

In this sub-model the annual expenditure per consuming unit was retained but the durability variable originally coded as 1, 2, and 3 was replaced with the two dummy variables $x_{3a}$ and $x_{3b}$.

Step one.--The first step of the first sub-model using the stepwise regression technique was identical to the first step of the primary model. The results of the first step are presented in Table 22.

TABLE 22

SUB-MODEL NUMBER 1: STEP 1

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$ (age) | 1 | 6.43 | .31 | .31 |
| Residual | 14 | | | |

The estimated prediction equation after the first step remained the same,

$$y = 31.26 + 47.68x_4$$

as did the coefficient of determination (.31) and the standard error of the estimate (19.60).

Step two.--The second variable to enter the equation in the first sub-model was $x_{3b}$, the dummy variable which was assigned a value of 1 for industries producing

semi-durable goods and a value of 0 for industries producing either nondurable or durable goods. The prediction equation which resulted from this step was

$$y = 34.75 - 15.13x_{3b} + 48.15x_4.$$

The coefficient of determination was .40 and the standard error of the estimate was 19.00. The results of the second step are presented in Table 23.

TABLE 23

SUB-MODEL NUMBER 1: STEP 2

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$ | 2 | 4.37 | | .40 |
| $x_4$ (age) | 1 | 6.97 | .31 | |
| $x_{3b}$ (2nd dummy variable) | 1 | 1.90 | .04 | |
| Residual | 13 | | | |

The inclusion of the second variable improved the predictive power of the model somewhat by reducing the residual sum of squares by 8.7 percent and the standard error of the estimate from 19.6 to 19.0. The regression of the two variables on the dependent variable was significant at the .10 level of significance. Thus the inclusion of the second variable was warranted.

Although the age variable still exhibited a real relationship with industry concentration independent of the durability variable, the durability variable itself only increased the reliability of the model when combined with the age variable since the F-value of the durability variable was only 1.90, which is not significant at the .10 level.

Step three.--The third variable entering the equation was $x_1$, advertising expenditure per dollar of sales revenue. The resulting prediction equation was

$$y = 24.29 + 1.67x_1 - 14.87x_{3b} + 54.98x_4.$$

The coefficient of determination was .47 and the standard error of the estimate was 18.67. The results of the third step are presented in Table 24.

TABLE 24

SUB-MODEL NUMBER 1: STEP 3

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_1$ | 3 | 3.51 | | .47 |
| $x_4$ (age) | 1 | 8.57 | .31 | |
| $x_{3b}$ (2nd dummy variable) | 1 | 1.90 | .09 | |
| $x_1$ (advertising) | 1 | 1.47 | .07 | |
| Residual | 12 | | | |

The F-value of 3.51 for the regression of the three variables remained significant at the .10 level. Thus the inclusion of the advertising variable was warranted (as an individual independent variable it was not significant) because of the increase in the explained variation and the decrease in the standard error of the estimate.

Step four.--The last variable to enter the equation while the stated level of significance was maintained was $x_8$, the short-run growth variable. The prediction equation then became

$$y = 26.25 + 1.78x_1 - 16.71x_{3b} + 63.02x_4 - 0.74x_8.$$

The coefficient of determination at this stage was .49 and the standard error of the estimate increased to 19.07. The results of the fourth step are presented in Table 25.

TABLE 25

SUB-MODEL NUMBER 1: STEP 4

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_1$, $x_8$ | 4 | 2.65 | | .49 |
| $x_4$ (age) | 1 | 7.99 | .31 | |
| $x_{3b}$ (2nd dummy variable) | 1 | 2.18 | .09 | |
| $x_1$ (advertising) | 1 | 1.59 | .07 | |
| $x_8$ (short-run growth) | 1 | .50 | .02 | |
| Residual | 11 | | | |

Step four was the final step of this sub-model for which the total regression of the included variables was significant at the alpha = .10 level. The addition of the short-run growth variable only reduced the residual sum of squares by 2.3 percent. At this point the standard error of the estimate began to increase.[5]

The final estimated prediction equation,

$$y = 26.25 + 1.73x_1 - 16.71x_{3b} + 63.02x_4 - 0.74x_8,$$

had a coefficient of determination of .49 and a standard error of the estimate of 19.07. The results of this sub-model indicated that the substitution of a different method for measuring durability of the industry product did not improve the predictive power of the model. The final $R^2$ value was slightly lower (.49 as compared to .50 of the primary model) and the standard error of the estimate was slightly higher (19.07 as compared to 18.90 of the primary model.) There is another possible reason for the inferior results of the first sub-model. Durability was expressed in this sub-model through the use of two dummy variables. Only one of these, however, entered the equation. As

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[5]After the fourth step, the combined proportional reduction in the sum of squares by the remaining variables was only .04. The total regression was not significant at the .10 level, and the standard error of the estimate began to increase significantly. Therefore, the "effects" of the remaining variables were relegated to the error term. The results of the final four steps of this sub-model are presented in Appendix K, page 147.

Appendix K, page 147, indicates, $x_{3a}$, the dummy variable assigned a value of one for a durable goods industry, did not enter the equation even at a low level of significance. The results thus imply a relationship between industry concentration and durability such as that depicted in Figure 3.

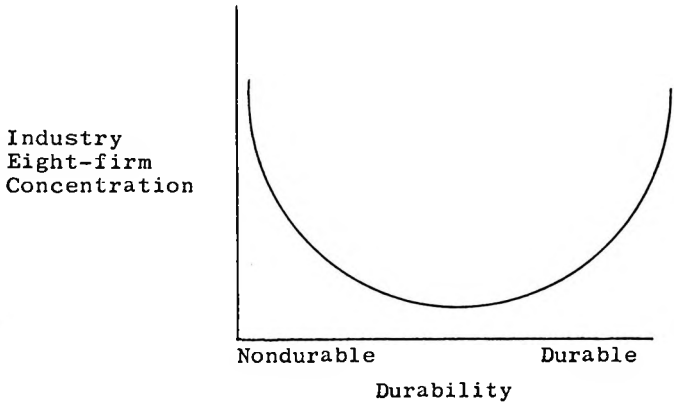


Figure 3.--Implied Relationship Between Industry Eight-firm Concentration and Durability of the Industry Product

This suggests that semi-durable goods industries are less concentrated than either nondurable goods industries or durable goods industries.

Sub-model Number 2

In this sub-model, the durability variable was expressed as in the primary model, but the expenditure variable in that model was replaced by a variable expressing average price per unit of the industry product. The first

and second steps of this sub-model were identical to the first two steps of the primary model presented in Tables 18 and 19, pages 73and 74.

Step three.--After the entrance of age and advertising into the equation, the average price per unit variable ($x_9$) entered in the third step. The resulting prediction equation was

$$y = 21.30 + 1.93x_1 + 49.45x_4 + 0.004x_9.$$

The coefficient of determination was .41 and the standard error of the estimate was 19.64. The results of the third step of this sub-model are presented in Table 26.

TABLE 26

SUB-MODEL NUMBER 2: STEP 3

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_9$ | 3 | 2.78 | | .41 |
| $x_4$ (age) | 1 | 5.56 | .31 | |
| $x_1$ (advertising) | 1 | 1.71 | .07 | |
| $x_9$ (price) | 1 | .55 | .03 | |
| Residual | 12 | | | |

The low F-values for the advertising and price variables indicate that, unlike the age variable, these

variables did not have a real "independent" relationship with industry eight-firm concentration at the .10 level of significance. The total regression of the three variables taken together, however, was statistically significant.

Step four.--The last entered variable which increased the accuracy of this sub-model was $x_{10}$, the price-durability interaction term. The estimated prediction equation which resulted from the fourth step was

$$y = 21.35 + 1.94x_1 + 43.93x_4 + 0.07x_9 - 0.02x_{10}.$$

The coefficient of determination was .53 and the standard error of the estimate was 18.29. The results of step four of the second sub-model are presented in Table 27.

TABLE 27

SUB-MODEL NUMBER 2: STEP 4

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_9$, $x_{10}$ | 4 | 3.12 | | .53 |
| $x_4$ (age) | 1 | 6.29 | .31 | |
| $x_1$ (advertising) | 1 | 1.98 | .07 | |
| $x_9$ (price) | 1 | 2.85 | .12 | |
| $x_{10}$ (price durability) | 1 | 2.85 | .12 | |
| Residual | 11 | | | |

The inclusion of the price-durability interaction term increased the explained sum of squares by 12.14 percent which is a larger increase than that which resulted from the price variable (2.72 percent). The F-value of the price variable when considered independently of the other causal variables was significant at at the .10 level in this step. The cause of these results was found by investigating the simple correlation coefficient between the price and price-durability variables. These two variables were almost perfectly correlated ($r = .995$). This high degree of multicollinearity tended to obscure the true individual relationships of these variables with the dependent variable in the third step of this sub-model. When both variables were included in the fourth step, the stepwise technique was then able to determine more accurately the relative degrees of significance (as indicated by the F-values) of the two variables.[6]

Conclusions forthcoming from sub-model number 2.--The entrance of the price and price-durability variables into the equation and the level of significance of the price

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[6]After the fourth step, the combined proportional reduction in the sum of squares by the remaining variables was only .05. The total regression was not significant at the .10 level, and the standard error of the estimate began to increase significantly. Therefore, the "effects" of the remaining variables were relegated to the error term. The results of the final steps of this submodel are presented in Appendix L, page 152.

variable imply that price is apparently a greater determinant of industry eight-firm concentration than is annual expenditure per consuming unit, which failed to enter the primary equation at .10 level of significance.

The final equation resulting from this sub-model was

$$y = 21.35 + 1.94x_1 + 48.93x_4 + 0.07x_9 - 0.02x_{10}$$

where

$y$ = industry eight-firm concentration

$x_1$ = advertising expenditure per dollar of sales revenue

$x_4$ = average age of the leading companies in an industry divided by the industry age

$x_9$ = average unit price of the industry product

$x_{10}$ = average unit price of the industry product times the coded durability of the industry product.

This equation possessed the greatest ability to predict industry eight-firm concentration of all the prediction equations derived. This includes not only the prediction equations derived by the primary stepwise regression and the two sub-models, but also the equation resulting from the multiple linear regression. The coefficient of determination of .53 for this sub-model was the highest obtained through the use of stepwise regression, and the 18.29 standard error of the estimate was the lowest obtained in any of the regression analyses.

## Analysis of the Individual Effects of the Independent Variables Based Upon the Results of the Three Analytical Tools Utilized in This Study

### Advertising

The variable which expressed advertising expenditure per dollar of sales revenue was entered into the primary model and both sub-models when the total regression of the independent variables included at that point was significant at the .10 level. Therefore, the advertising variable, in conjunction with the other causal variables, did improve the predictive ability of the model.

At no point in any of the regression analyses, however, did advertising exhibit a truly "independent" relationship with the dependent variable. This raises a question as to whether extensive advertising by the leading companies in an industry necessarily creates high industry eight-firm concentration.

### Company Age

A rather strong relationship appears to exist between industry eight-firm concentration and the ratio of the average age of the leading companies in the industry to the industry age. This variable was found to be the most effective of all the independent variables in all models of the stepwise regression analysis. The residual sum of squares was reduced after the first step in the stepwise regression technique by 31 percent when age was the only variable in the

equation. The cross-classification of the age variable and industry eight-firm concentration exhibited a much stronger relationship than did any of the other cross-classifications. This further substantiates the existence of an apparent causal relationship. This is quite possibly a two-way relationship between the two variables. It could be argued that the sizeable ages of leading firms in an industry are the results of considerable barriers to entry into that industry. Based not only upon the results of this study but also upon statements found throughout much of the literature, however, it is more logical to conclude that the economies of being established have helped to create barriers to entry which have, in turn, aided in the longevity of operation of these firms.

Industry Growth Rates

In the primary stepwise regression, long-run and short-run industry growth rates were the third and fourth most effective variables, respectively, with a combined reduction of the residual sum of squares of 12 percent. The regression coefficients of these variables, however, were of opposite signs--long-run growth had a positive coefficient and short-run growth had a negative coefficient. This result indicates that existing firms in an industry apparently are able to absorb increases in demand which develop slowly over a period of years. Those industries

which realize large increases over a short period of time, however, are likely to be more susceptible to new firms entering the marketplace. This hypothesis is strengthened by the cross-classification analysis presented in Table 15, page 62, which suggests that, as the rate of growth of the demand for an industry product increases (when the industry product is in the growth stage), the industry is likely to become less concentrated.

Annual Expenditure per Consuming Unit

The variable expressing expenditure on the industry product per consuming unit per year did not have a significant relationship with industry eight-firm concentration either by itself or in conjunction with the other variables. It must therefore be concluded that this variable does not have any effect upon the eight-firm concentration of consumer goods manufacturing industries.

Average Unit Price of the Industry Product

As indicated by the results of the second sub-model, the price level of an industry product exhibited a greater degree of statistical significance in its relationship with industry eight-firm concentration than did the expenditure variable. At the .10 level, the price variable had a significant "independent" effect upon the dependent variable. Therefore, there appears to be a direct causal relationship between these two variables.

Durability of the Industry Product

The durability of the industry product does not appear to be related to the eight-firm concentration of a consumer goods manufacturing industry. Although in the first sub-model, one of the dummy variables expressing durability entered the equation, it did not have a significant individual effect upon industry concentration.

# CHAPTER IV

# FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

## Background of the Study

A review of the literature suggests that the existence of barriers to entry into manufacturing industries typically stems from such factors as absolute cost advantages of established firms, control of essential raw matrials, economies of being established, economies of scale, market franchises, patent rights, product differentiation, and research rights. However, virtually no empirical investigation has been conducted to determine if these or other factors are causally related to entry barriers. The most notable study concerning barriers to entry was performed by Professor Joe S. Bain in 1955. Professor Bain classified a diverse group of industries according to the magnitude of barriers to entry which he found to exist. He did not, however, attempt to quantify precisely the barriers to entry into the industries in his study.

The objective of this dissertation, because of the lack of empirical evidence on the incidence of barriers to entry, was to determine the effects of selected variables on barriers to entry into a broad range of manufacturing

industries producing durable, semi-durable, and nondurable consumer goods. The independent variables selected included those which traditionally have been viewed as constituting barriers to entry into a broad range of industries. More specifically, the variables studied were (1) average advertising expenditure per dollar of sales revenue, (2) annual expenditure on the industry product per consuming unit, (3) durability of the industry product, (4) average age of the leading companies in an industry relative to the industry age, (5) compounded long-run average rate of growth of the industry value of shipments, and (6) compounded short-run average rate of growth of the industry value of shipments.

Two interaction terms were also included in the analysis. The first was an interaction term derived by multiplying the advertising variable by the age variable. This variable was included because it has been suggested in the literature that advertising is most beneficial to those firms which are well-established in their respective industries. The second was a term derived by multiplying annual expenditure per consuming unit by the coded durability of the industry product. This variable was included because it was hypothesized that durability and price are highly correlated and therefore an interaction term might best measure their combined effect upon barriers to entry.

The measure chosen to reflect the extent of barriers

to entry into an industry was the percentage of the value of shipments of the industry attributable to its eight largest firms. Both the eight-firm concentration ratio and the four-firm concentration ratio were tested, and the former was found to be the best reflection of entry barriers.

The sample for the study consisted of sixteen industries. The selection of the sample was based on (1) the type of industry since only consumer goods manufacturing industries could be included, (2) the distribution of the total value of shipments of manufacturing industries among the twenty major two-digit SIC code manufacturing industry groups, (3) the distribution of the industry eight-firm concentration ratios, and (4) the availability of data. The sixteen industries comprised only ten percent of the total number of four-digit SIC code consumer goods manufacturing industries in 1966, but they accounted for approximately one-third of the total consumer goods value of shipments.

Three techniques were applied to the data to measure the effects of the chosen variables upon concentration in the sixteen manufacturing industries. These were (1) selected two- and three-variable cross-classifications, (2) multiple linear regression analysis, and (3) stepwise regression analysis. The cross-classification analyses were

used to study the existence of possible trends between the dependent variable and each of the independent variables as the basis for hypotheses to be investigated by the application of the regression techniques. The multiple linear regression analysis was applied to determine the aggregate effect of the eight independent variables on industry eight-firm concentration. The stepwise regression technique was used to investigate the relative effect of each independent variable on the dependent variable and to determine the best prediction equation based on variables included in this study.

## Findings and Conclusions

### The Cross-classification Analyses

An apparent positive curvilinear relationship was found between industry eight-firm concentration ratios and the average unit price of the industry product. Concentration increased at an increasing rate as the average unit price of the industry product increased.

Likewise, a positive relationship was found between annual expenditure per consuming unit and industry eight-firm concentration. This apparent relationship was further strengthened by the finding of a positive relationship between annual expenditure per consuming unit and the absolute size of firms operating within an industry.

An additional positive curvilinear relationship

was found between industry eight-firm concentration and durability of the industry product. Concentration increased at an increasing rate as the durability of the industry product increased.

The age variable also seemed to depict a strong positive relationship to industry concentration, as revealed by initially cross-classifying industry eight-firm concentration and the average age of the leading companies in each industry relative to the industry age. This was strengthened by a positive relationship between the age variable and the absolute size of the firms in each industry. Lastly, a positive relationship was also found between the price of an industry product and the average age of leading companies in the industry relative to the industry age.

The short-run and long-run growth variables also seemed to be related to entry barriers into the sixteen industries. An apparent positive relationship was found between industry eight-firm concentration and the long-run growth of the value of shipments of each industry. In a further effort to determine the influence of this factor upon barriers to entry, a two-way cross-classification between industry eight-firm concentration and the percentage difference between the long-run and short-run industry growth rates was performed. This analysis revealed a negative relationship between the two variables. A rapidly

increasing rate of growth is apparently associated with decreasing industry concentration.

A final analysis involved a three-way cross-classification of industry concentration, advertising expenditure per dollar of sales revenue, and durability of the industry product. It was found that six of the eight industries whose products were classified as nondurable goods invested more heavily in advertising per dollar of sales revenue in 1966 than did the industries producing durable goods. These six industries were all producers of either food and related items or personal care items. The three industries producing personal care items (soap, toiletries, and drugs) were the heaviest investors in advertising of the sixteen sample industries.

To test the implied curvilinear relationships and to investigate other possible curvilinear relationships, each independent variable was plotted against the dependent variable. This approach did not suggest the existence of any curvilinear relationships. Furthermore, it indicated that there was little possibility of improving the predictive power of the regression models by introducing higher powers of the independent variables.

Based upon the results of the cross-classification analyses, the test for curvilinearity, and the findings in the literature, the following hypotheses were formulated:

1. A statistically significant positive relationship exists between average advertising expenditure per dollar of sales revenue and industry eight-firm concentration.
2. A statistically significant positive relationship exists between annual expenditure per consuming unit and industry eight-firm concentration.
3. A statistically significant positive relationship exists between durability of the industry product and industry eight-firm concentration.
4. A statistically significant positive relationship exists between the average age of the leading companies in an industry relative to the industry age and industry eight-firm concentration.
5. A statistically significant positive relationship exists between the compounded long-run average rate of growth of industry value of shipments and industry eight-firm concentration.
6. A statistically significant negative relationship exists between the compounded short-run average rate of growth of industry value

of shipments and industry eight-firm concentration.

## The Multiple Linear Regression Analysis

The results of the multiple linear regression model indicated that the total regression of the eight independent variables on the dependent variable was not significant at the .10 level of significance. In other words, the regression coefficients, $B_1$ through $B_8$, did not differ significantly from zero, and therefore the null hypothesis that no real causal relationship exists cannot be rejected. Apparently, barriers to entry are unique to each industry, which precludes the development of broad generalizations relative to a given group of variables in their aggregate ability to cause high barriers to entry into all consumer goods manufacturing industries.

## The Stepwise Regression Analyses

Because of the above findings, an investigation was conducted concerning the relationships between industry eight-firm concentration and each of the independent variables when these were considered on an individual basis. The application of the primary stepwise regression model, which included the eight initial independent variables, revealed that the most reliable equation (based on the size of the standard error of the estimate and the F-value for the total regression) included only four of the variables.

These were (1) the average age of leading companies in an industry relative to the industry age, (2) advertising expenditure per dollar of sales revenue, (3) compounded average long-run growth of the industry value of shipments, and (4) compounded average short-run growth of the industry value of shipments. The inclusion of the additional variables resulted in a higher standard error of the estimate and a statistically insignificant regression. These four variables together accounted for 50 percent of the variation in the dependent variable, while all variables accounted for 51 percent.

The findings of the stepwise regression technique indicated that extensive advertising is not necessarily associated with high industry concentration. Firms which manufacture nondurable food and personal care items, however, invest more heavily in advertising expenditures per dollar of sales revenue than do other nondurable consumer goods manufacturing firms. Therefore if advertising does act as a barrier to entry into any particular type of industry, it is likely that it may act to increase the capital requirements in industries similar to those producing food and personal care items.

Neither the annual expenditure per consuming unit nor the durability of the industry product revealed an independent relationship with industry eight-firm concentration. These were the only two variables which did not enter

the primary stepwise regression equation while the regression was still significant at the .10 level.

The age variable was the only independent variable which exhibited a truly "independent" relationship with the dependent variable at the alpha .10 level of significance. The hypothesis stating that a positive relationship exists between the average age of leading firms in an industry relative to the industry age and industry eight-firm concentration therefore could not be rejected. Economies of being established which arise through longevity of operation apparently are associated with high concentration in consumer goods manufacturing industries, especially those industries comprised of companies which produce high-price durable goods. This implies that consumers faced wtih purchasing decisions concerning these types of goods tend to favor the products of well-established businesses which maintain a sizeable share of the total market demand.

Although it cannot be said that the long-run and short-run growth variables had significant "independent" effects on industry eight-firm concentration, the results of the stepwise model indicated that the two variables acting together may affect concentration. This result was substantiated by the findings in the two-way cross-classification between industry eight-firm concentration and the percentage difference between long-run and short-run growth, which, acting together, appeared to have a more than proportional

effect upon industry concentration than did either of the variables acting separately. Increases in the demand for an industry product which occur gradually over a long period of time are therefore apparently absorbed by those companies already in operation within the industry. However, increases in the demand for an industry product which occur rapidly over a short period of time may lead to reduced industry concentration. New competitors are thus more likely to enter these types of industries.

In an effort to improve the predictive power of the model, two alternative variables were used in two sub-models of the primary stepwise regression. Sub-model number 1 incorporated the use of two dummy variables in place of the original durability variable which was assigned a code of 1, 2, or 3 for nondurable goods industries, semi-durable goods industries, and durable goods industries, respectively. In sub-model number 2 a variable expressing average unit price of the industry product was used in place of the expenditure variable.

Neither of the dummy variables used in the first sub-model was statistically significant in its relationship with the dependent variable. It was therefore concluded that the hypothesis stating that a positive relationship exists between durability of the industry product and industry eight-firm concentration must be rejected.

Sub-model number 2, which incorporated the use of a variable expressing average unit price of the industry product in place of the expenditure variable, indicated that a real relationship exists between industry eight-firm concentration and both the age and price variables at the .10 level of significance. The second sub-model yielded the equation with the greatest predictive power of all the regression analyses. This equation was

$$y = 21.35 + 1.94x_1 + 48.98x_4 + 0.07x_9 + 0.02x_{10}$$

where

$y$ = industry eight-firm concentration expressed as a percentage

$x_1$ = advertising expenditure per dollar of sales revenue

$x_4$ = average age of the leading companies in an industry expressed as a percentage of the industry age

$x_9$ = average unit price of the industry product

$x_{10}$ = the interaction term derived by multiplying the average unit price of the industry product by its coded durability.

The coefficient of determination was .53 and the standard error of the estimate was 18.3. This regression equation was significant at the alpha = .10 level with an F-value of 3.12.

## Recommendations

The results of this study apply only to consumer goods manufacturing industries. No conclusions can be drawn as to whether a selected group of variables has a significant effect on industries in other segments of the economy. Studies should therefore be performed which would apply to all manufacturing industries and to the retailing and wholesaling of goods and services. These studies should be applicable to local, regional, and national markets. Conclusions from these studies would enable students of market structure to gain greater knowledge of the barriers to entry into many kinds of industries.

Both the findings and conclusions of this study indicated the difficulty of determining the effects of a selected group of variables on a broad range of industries. Therefore, studies should be performed on a single industry basis. By employing time series data, the effects of selected variables on a particular type of industry could be studied. Although studies of this type would be limited in scope, more in-depth knowledge would be gained concerning the individual and aggregate effects of the variables incorporated into the study.

# APPENDIX A

## THE PAIRED COMPARISONS TEST

TABLE 28

TABLE OF PROPORTIONS, $\rho_{k>r} / X_{kr}$

| | Automobiles | Canned Goods | Cement | Cigarettes | Copper | Farm Machinery | Flour | Fountain Pens | Gypsum Products | Liquor | Meat Packing | Metal Containers | Petroleum Refin. | Rayon | Shoes | Soap | Steel | Tires & Tubes | Tractors | Typewriters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Automobiles | | 1 -1.28 | 1 -1.28 | .4 .25 | .4 .25 | .2 .85 | .1 -1.28 | .3 .53 | .3 .53 | .3 .53 | .1 -1.28 | .2 .85 | .2 .85 | .1 -1.28 | .1 -1.28 | .1 -1.28 | .3 .53 | .1 -1.28 | .5 0 | .5 0 |
| Canned Goods | .9 1.28 | | .7 .53 | .6 .85 | .6 .25 | .8 .85 | .4 -.25 | .7 .53 | .6 .25 | .8 .85 | .5 0 | .7 .53 | .9 1.28 | .7 .53 | .6 .25 | .9 1.28 | .8 .85 | .8 .85 | .9 1.28 | .8 .85 |
| Cement | .9 1.28 | .3 -.53 | | .7 .53 | .7 .53 | .7 .53 | .3 -.53 | .6 .25 | .5 0 | .6 .25 | .2 -.85 | .5 0 | .8 .85 | .5 0 | .6 .25 | .8 .85 | .8 .85 | .5 0 | .9 1.28 | .8 .85 |
| Cigarettes | .6 .25 | .2 -.85 | .3 -.53 | | .5 0 | .4 -.25 | .2 -.85 | .2 -.85 | .2 -.85 | .4 -.25 | .2 -.85 | .2 -.85 | .4 -.25 | .3 -.53 | .3 -.53 | .3 -.53 | .5 0 | .2 -.85 | .6 -.25 | .6 -.25 |
| Copper | .6 .25 | .4 -.25 | .3 -.53 | .5 0 | | .4 -.25 | .3 -.53 | .5 .25 | .4 -.25 | .5 .25 | .4 -.25 | .4 -.25 | .5 0 | .3 -.53 | .4 -.25 | .5 0 | .6 .25 | .4 -.25 | .6 .25 | .6 .25 |
| Farm Machinery | .8 .85 | .2 -.85 | .3 -.53 | .6 .25 | .5 .25 | | .1 -1.28 | .4 -.25 | .4 -.25 | .5 0 | .1 -1.28 | .3 -.53 | .3 -.53 | .3 -.53 | .2 -.85 | .3 -.53 | .4 -.25 | .3 -.53 | .7 .53 | .7 .53 |
| Flour | .9 1.28 | .6 .25 | .7 .53 | .8 .85 | .7 .53 | .9 1.28 | | .8 .85 | .7 .53 | .8 .85 | .5 0 | .8 .85 | .9 1.28 | .7 .53 | .7 .53 | .9 1.28 | .8 .85 | .8 .85 | .9 1.28 | .8 .85 |
| Fountain Pens | .7 .53 | .3 -.53 | .4 -.25 | .8 .85 | .4 -.25 | .6 .25 | .2 -.85 | | .4 -.25 | .7 .53 | .2 -.85 | .4 -.25 | .6 .25 | .4 -.25 | .4 -.25 | .6 .25 | .6 .25 | .5 0 | .8 .85 | .8 .85 |
| Gypsum Products | .7 .53 | .4 -.25 | .5 0 | .8 .85 | .5 .25 | .6 .25 | .3 -.53 | .6 .25 | | .7 .53 | .2 -.85 | .5 0 | .7 .53 | .5 0 | .5 0 | .7 .53 | .7 .53 | .6 .25 | .7 .53 | .6 .25 |
| Liquor | .7 .53 | .2 -.85 | .4 -.25 | .6 .25 | .4 -.25 | .5 0 | .2 -.85 | .3 -.53 | .3 -.53 | | .2 -.85 | .2 -.85 | .5 0 | .4 -.25 | .3 -.53 | .4 -.25 | .6 .25 | .3 -.53 | .7 .53 | .6 .25 |
| Meat Packing | .9 1.28 | .5 0 | .8 .85 | .8 .85 | .6 .25 | .9 1.28 | .5 0 | .8 .85 | .8 .85 | .8 .85 | | .8 .85 | .9 1.28 | .8 .85 | .7 .53 | .9 1.28 | .9 1.28 | .8 .85 | .9 1.28 | .9 1.28 |
| Metal Containers | .8 .85 | .3 -.53 | .5 0 | .8 .85 | .6 .25 | .7 .53 | .2 -.85 | .6 .25 | .5 0 | .6 .25 | .2 -.85 | | .7 .53 | .5 0 | .4 -.25 | .7 .53 | .7 .53 | .6 .25 | .8 .85 | .7 .53 |
| Petroleum Refining | .8 .85 | .1 -1.28 | .2 -.85 | .6 .25 | .5 0 | .7 .53 | .1 -1.28 | .4 -.25 | .3 -.53 | .5 0 | .1 -1.28 | .3 -.53 | | .2 -.85 | .2 -.85 | .3 -.53 | .6 .25 | .2 -.85 | .8 .85 | .8 .85 |
| Rayon | .9 1.28 | .3 -.53 | .5 0 | .7 .53 | .7 .53 | .7 .53 | .3 -.53 | .6 .25 | .5 0 | .6 .25 | .2 -.85 | .5 0 | .8 .85 | | .6 .25 | .8 .85 | .8 .85 | .5 0 | .9 1.28 | .8 .85 |
| Shoes | .9 1.28 | .4 -.25 | .4 -.25 | .7 .53 | .6 .25 | .8 .85 | .3 -.53 | .6 .25 | .5 0 | .7 .53 | .3 -.53 | .6 .25 | .8 .85 | .4 -.25 | | .7 .53 | .7 .53 | .5 0 | .9 1.28 | .8 .85 |
| Soap | .9 1.28 | .1 -1.28 | .2 -.85 | .7 .53 | .5 0 | .7 .53 | .1 -1.28 | .4 -.25 | .3 -.53 | .6 .25 | .1 -1.28 | .3 -.53 | .6 .25 | .2 -.85 | .3 -.53 | | .6 .25 | .1 -1.28 | .9 1.28 | .8 .85 |
| Steel | .7 .53 | .2 -.85 | .2 -.85 | .5 0 | .4 -.25 | .6 .25 | .2 -.85 | .4 -.25 | .3 -.53 | .4 -.25 | .1 -1.28 | .3 -.53 | .4 -.25 | .2 -.85 | .3 -.53 | .4 -.25 | | .2 -.85 | .8 .85 | .7 .53 |
| Tires & Tubes | .9 1.28 | .2 -.85 | .5 0 | .8 .85 | .6 .25 | .7 .53 | .2 -.85 | .5 0 | .4 -.25 | .7 .53 | .2 -.85 | .4 -.25 | .8 .85 | .5 0 | .5 0 | .7 .53 | .8 .85 | | .9 1.28 | .8 .85 |
| Tractors | .5 0 | .1 -1.28 | .1 -1.28 | .4 -.25 | .4 -.25 | .3 -.53 | .1 -1.28 | .2 -.85 | .3 -.53 | .3 -.53 | .1 -1.28 | .2 -.85 | .7 .85 | .1 -1.28 | .1 -1.28 | .1 -1.28 | .2 -.85 | .1 -1.28 | | .5 0 |
| Typewriters | .5 0 | .2 -.85 | .2 -.85 | .4 -.25 | .4 -.25 | .3 -.53 | .2 -.85 | .2 -.85 | .4 -.25 | .4 -.25 | .1 -1.28 | .3 -.53 | .2 -.85 | .2 -.85 | .2 -.85 | .2 -.85 | .3 -.53 | .2 -.85 | .5 0 | |
| $\Sigma X_{kr}$ | 15.41 | -12.84 | -6.39 | 8.07 | 1.84 | 5.25 | -15.25 | -.88 | -3.65 | 4.71 | -16.54 | -4.32 | 5.22 | -6.54 | -6.17 | 2.41 | 6.21 | -4.75 | 15.73 | 11.52 |
| $[\Sigma X_{kr} \cdot \sqrt{2}]/20$ | 1.09 | -.91 | -.45 | 1.57 | .13 | .37 | -1.08 | -.06 | -.26 | .33 | -1.17 | -.31 | .37 | -.39 | -.44 | .17 | .44 | -.34 | 1.09 | .81 |
| $[(\Sigma X_{kr} \cdot \sqrt{2})/20] + 1.17$ | 2.26 | .26 | .72 | 1.74 | 1.30 | 1.54 | .09 | 1.11 | .91 | 1.50 | 0 | .86 | 1.54 | .78 | .73 | 1.34 | 1.61 | .83 | 2.26 | 1.98 |

In the upper left-hand corner of each cell rk in the matrix, where r equals the row and k equals the column, is given the computed percentage of time that industry k was deemed superior to industry r when comparisons between the two industries were made on the basis of each of the five criteria discussed on page 20.

The lower right-hand corner of each cell contains the value $x_{kr}$ which is taken directly from a standard Z table. These values are summed at the bottom of each column. The summations are then multiplied by the square root of two and divided by twenty, which is the number of industries. The largest negative value (-1.17 for the meat packing industry) is then added to the values for all the industries in order to arrive at an interval scale with a minimum value of zero.

Using the comparison of the automobile industry and the canned goods industry as an example, note that the value $_{k\ r}$ in the upper left-hand corner of this cell is .9, which means that when comparisons between these two industries were made based on each of the five criteria, the automobile industry was deemed to have higher entry barriers 90 percent of the time. This percentage was calculated from Tables 1 and 2 (of Chapter II), pages 21 and 22. According to four of the five criteria (over-all barriers, scale-economy barriers, product-differentiation

barriers, and capital-requirement barriers), the automobile industry has higher entry barriers than does the canned goods industry. Since each criterion accounts for 20 percent of the comparison, the automobile industry was definitely favored 30 percent of the time. The absolute-cost barriers of the two industries are rated even. Since there can be no "ties" in the Paired Comparisons Technique, a value of 10 percent (or one-half the total percentage value for the absolute-cost criterion) is assigned to the percentage of time the automobile industry is deemed superior.

Thus the total value of $\rho_{k>r}$ where k is the automobile industry and r is the canned goods industry is .9. Referring to the matrix cell where the canned goods industry is industry k and the automobile industry is industry r, $\rho_{k>r}$ equals 1., or the complement of .9.

The values $x_{kr}$ are obtained by subtracting .5 from the value of $\rho_{k>r}$ and finding the appropriate Z value. If $(\rho_{k>r} - .5)$ is a positive number, $x_{kr}$ is assigned a positive value. If $(\rho_{k>r} - .5)$ is negative, $x_{kr}$ is assigned a negative value. Thus the value $x_{kr}$ in any cell kr plus $x_{rk}$ in its complementary cell always equals zero.

In comparing two industries, the industry deemed superior more than 50 percent of the time will have a positive value of $x_{kr}$, and the industry with smaller entry

barriers will have a negative value of $x_{kr}$.

If a comparison of two industries results in the conclusion that the two have equal barriers, ($\rho_{k>r} = .5$), a value of zero is assigned to the corresponding $x_{kr}$.

# APPENDIX B

## SIMPLE CORRELATION OF INDUSTRY FOUR-FIRM CONCENTRATION AND ENTRY BARRIERS

TABLE 29

SIMPLE CORRELATION OF INDUSTRY FOUR-FIRM CONCENTRATION AND ENTRY BARRIERS

| Industry | 1954 Four-firm Concentration (X) | Entry Barriers (Y) | $X^2$ | $Y^2$ | XY |
|---|---|---|---|---|---|
| Steel | 55 | 27 | 3025 | 729 | 1485 |
| Petroleum refining | 33 | 24 | 1089 | 576 | 792 |
| Flour | 40 | 4 | 1600 | 16 | 160 |
| Shoes | 30 | 9 | 900 | 81 | 270 |
| Cigarettes | 82 | 32 | 6724 | 1024 | 2624 |
| Liquor | 64 | 28 | 4096 | 784 | 1792 |
| Metal cans | 80 | 14 | 6400 | 196 | 1120 |
| Cement | 31 | 12 | 961 | 144 | 372 |
| Typewriters | 83 | 36 | 6889 | 1296 | 2988 |
| Gypsum products | 90 | 27 | 8100 | 729 | 2430 |
| | $\Sigma X=583$ | $\Sigma Y=213$ | $\Sigma X^2= 39,784$ | $\Sigma Y^2= 5575$ | $\Sigma XY = 14,033$ |

$(\Sigma X)^2 = 345,744$ $\quad (\Sigma Y)^2 = 45,369$ $\quad n = 10$

$$r = \frac{n(\Sigma XY) - \Sigma X \Sigma Y}{\sqrt{(n\Sigma X^2 - (\Sigma X)^2)(n\Sigma Y^2 - (\Sigma Y)^2)}}$$

$$= \frac{10(14,033) - 125,244}{\sqrt{(10(39,784) - 345,744)(10(5575) - 45,369)}}$$

$$= .6439$$

# APPENDIX C

## SIMPLE CORRELATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND ENTRY BARRIERS

TABLE 30

SIMPLE CORRELATION OF INDUSTRY EIGHT-FIRM CONCENTRATION AND ENTRY BARRIERS

| Industry | 1954 Eight-firm Concentration (X) | Entry Barriers (Y) | $X^2$ | $Y^2$ | XY |
|---|---|---|---|---|---|
| Steel | 71 | 27 | 5041 | 729 | 1917 |
| Petroleum refining | 56 | 24 | 3136 | 576 | 1344 |
| Flour | 52 | 4 | 2704 | 16 | 208 |
| Shoes | 36 | 9 | 1296 | 81 | 324 |
| Cigarettes | 99 | 32 | 9801 | 1024 | 3168 |
| Liquor | 79 | 28 | 6241 | 784 | 2212 |
| Metal cans | 88 | 14 | 7744 | 196 | 1232 |
| Cement | 48 | 12 | 2304 | 144 | 576 |
| Typewriters | 99 | 36 | 9801 | 1296 | 3564 |
| Gypsum products | 97 | 27 | 9409 | 729 | 2619 |
| | $\Sigma X=725$ | $\Sigma Y=213$ | $\Sigma X^2 = 57,477$ | $\Sigma Y^2 = 5575$ | $\Sigma XY = 17,164$ |

$(\Sigma X)^2 = 525,625$ $\quad (\Sigma Y)^2 = 45,369$ $\quad n = 10$

$$r = \frac{n(\Sigma XY) - \Sigma X \Sigma Y}{\sqrt{(n\Sigma X^2 - (\Sigma X)^2)(n\Sigma Y^2 - (\Sigma Y)^2)}}$$

$$= \frac{10(17,164) - 154,425}{\sqrt{(10(57,477) - 525,625)(10(5575) - 45,369)}}$$

$$= .7623$$

# APPENDIX D

## VALUE OF SHIPMENTS BY MAJOR INDUSTRY GROUPS, 1966

TABLE 31

VALUE OF SHIPMENTS BY MAJOR INDUSTRY GROUPS, 1966

| SIC 2-Digit Code | Industry Group | Value of Shipments (thousands of dollars) | Percentage of Total Value of Shipments |
|---|---|---|---|
| 20 | Food and kindred products | 71,597,482 | 15.98 |
| 21 | Tobacco manufactures | 4,651,742 | 1.03 |
| 22 | Textile mill products | 16,998,969 | 3.79 |
| 23 | Apparel and related products | 17,901,120 | 4.01 |
| 24 | Lumber and wood products | 9,881,766 | 2.20 |
| 25 | Furniture and fixtures | 6,309,352 | 1.41 |
| 26 | Paper and allied products | 17,194,513 | 3.84 |
| 27 | Printing and publishing | 17,337,056 | 2.87 |
| 28 | Chemicals and allied products | 34,268,090 | 7.64 |
| 29 | Petroleum and coal products | 18,357,499 | 4.09 |
| 30 | Rubber and plastics products, not elsewhere classified | 9,723,152 | 2.17 |
| 31 | Leather and leather products | 4,414,381 | 0.98 |
| 32 | Stone, clay, and glass products | 12,950,207 | 2.88 |
| 33 | Primary metal industries | 40,032,406 | 8.92 |
| 34 | Fabricated metal products | 24,859,599 | 5.55 |
| 35 | Machinery, except electrical | 35,060,068 | 7.82 |
| 36 | Electrical machinery | 30,784,679 | 6.87 |
| 37 | Transportation equipment | 57,691,997 | 12.87 |
| 38 | Instruments and related products | 6,603,160 | 1.47 |
| 39 | Miscellaneous manufacturing | 6,888,983 | 1.53 |

Source: U. S. Bureau of the Census, Annual Survey of Manufactures:1966 (Washington, D. C.: U. S. Government Printing Office, 1969), p. 13.

# APPENDIX E

## INDUSTRY DATA USED IN THE MULTIPLE LINEAR AND STEPWISE REGRESSION ANALYSES

TABLE 32

INDUSTRY DATA USED IN THE MULTIPLE LINEAR AND STEPWISE REGRESSION ANALYSES

| Industry | Eight-firm Concentration (Percentage) | Advertising/ Sales Revenue (Percentage) | Avg. Price per Unit (Dollars) |
|---|---|---|---|
| Confectionary products | 34 | 2.90 | .105 |
| Distilled spirits, except brandy | 72 | 2.54 | 4.750 |
| Soft drinks | 31 | 4.94 | .094 |
| Newspapers | 22 | .61 | .076 |
| Soap and other detergents | 80 | 10.97 | .500 |
| Toilet preparations | 54 | 11.25 | 1.500 |
| Petroleum refining | 57 | .57 | .321 |
| Tires and inner tubes | 90 | 2.14 | 81.080 |
| Shoes, except rubber | 34 | 1.36 | 6.240 |
| Farm machinery and equipment | 59 | .91 | 36.77 |
| Radio and TV receiving sets | 68 | 1.99 | 398.12 |
| Passenger cars | 100 | 1.15 | 32.60 |
| Drugs | 41 | 9.72 | 3.41 |
| Photographic equipment supplies | 79 | 2.75 | 25.00 |
| Watches and clocks | 63 | 4.74 | 30.00 |
| Costume jewelry | 33 | 1.10 | 10.00 |

Sources: The concentration data (except for the soft drink and passenger car industries) were obtained from U. S. Bureau of the Census,

TABLE 32--continued

| Industry | Annual Expenditure/ Consuming Unit (Dollars) | Durability | Avg. Leading Co. Age/ Industry Age |
|---|---|---|---|
| Confectionary products | 7.84 | N | .297 |
| Distilled spirits, except brandy | 44.84 | N | .288 |
| Soft drinks | 23.70 | N | .804 |
| Newspapers | 33.11 | N | .421 |
| Soap and other detergents | 114.32 | N | .435 |
| Toilet preparations | 30.66 | N | .300 |
| Petroleum refining | 358.55 | N | .579 |
| Tires and inner tubes | 44.23 | S | 1.049 |
| Shoes, except rubber | 20.28 | S | .342 |
| Farm machinery and equipment | 1186.94 | D | .839 |
| Radio and TV receiving sets | 84.05 | D | 1.162 |
| Passenger cars | 534.44 | D | .855 |
| Drugs | 11.07 | S | .505 |
| Photographic equipment supplies | 21.69 | D | .601 |
| Watches and clocks | 6.00 | D | .680 |
| Costume jewelry | 10.00 | D | .536 |

Annual Survey of Manufactures: 1966 (Washington, D. C.: U. S. Government Printing Office, 1970), Chapter 9. Concentration ratios for the soft drink and passenger car industries were obtained from

TABLE 32--continued

| Industry | Long-run Growth Rate (Percentage) | Short-run Growth Rate (Percentage) | Adv. x Age |
|---|---|---|---|
| Confectionary products | 3.99 | 4.95 | .8613 |
| Distilled spirits, except brandy | 4.43 | 6.88 | .73152 |
| Soft drinks | 7.28 | 7.35 | 3.97176 |
| Newspapers | 4.74 | 5.44 | .25681 |
| Soap and other detergents | 5.13 | 4.43 | 5.32095 |
| Toilet preparations | 10.94 | 10.68 | 3.375 |
| Petroleum refining | 3.24 | 4.37 | .33003 |
| Tires and inner tubes | 4.68 | 8.00 | 2.24486 |
| Shoes, except rubber | 3.27 | 5.62 | .46512 |
| Farm machinery and equipment | 7.54 | 15.08 | .76349 |
| Radio and TV receiving sets | 13.01 | 22.23 | 2.31238 |
| Passenger cars | 10.34 | 6.85 | .98325 |
| Drugs | 7.24 | 10.17 | 4.9086 |
| Photographic equipment supplies | 13.36 | 21.08 | 1.65275 |
| Watches and clocks | 9.04 | 9.40 | 3.2232 |
| Costume jewelry | 3.53 | 6.10 | .6446 |

Standard & Poor's Industry Surveys, "Autos" and "Soft Drinks and Confectionary Items" (New York: McGraw-Hill, Inc.).

The advertising expenditure-sales revenue

TABLE 32--continued

| Industry | Price x Durability | Expend. x Durability |
|---|---|---|
| Confectionary products | .105 | 7.84 |
| Distilled spirits, except brandy | 4.750 | 44.84 |
| Soft drinks | .094 | 28.70 |
| Newspapers | .076 | 33.11 |
| Soap and other detergents | .500 | 114.32 |
| Toilet preparations | 1.500 | 30.66 |
| Petroleum refining | .321 | 358.55 |
| Tires and inner tubes | 162.160 | 88.56 |
| Shoes, except rubber | 12.480 | 40.56 |
| Farm machinery and equipment | 11031.000 | 3560.82 |
| Radio and TV receiving sets | 1194.360 | 252.15 |
| Passenger cars | 8100.000 | 1603.32 |
| Drugs | 7.360 | 22.14 |
| Photographic equipment supplies | 75.000 | 65.07 |
| Watches and clocks | 90.000 | 18.00 |
| Costume jewelry | 20.000 | 10.00 |

ratios were obtained from "Percentage of Sales Invested in Advertising in 1966-'67 for 231 Separate Product Classifications," Advertising Age (December 29, 1969), p. 73.

TABLE 32--continued

For the references used in obtaining the data necessary for calculating the expenditure, price, and age variables, see Appendix F.

For the leading companies in each industry and their ages, see Appendix G.

Long-run and short-run industry growth rates were derived from data found in the Annual Survey of Manufactures: 1966. The value of shipments from 1953 to 1966 for each of the sample industries is presented in Appendix H.

# APPENDIX F

## REFERENCES USED IN THE COLLECTION OF DATA FOR THE EXPENDITURE, PRICE, AND AGE VARIABLES

TABLE 33

REFERENCES USED IN THE COLLECTION OF DATA FOR THE EXPENDITURE, PRICE, AND AGE VARIABLES

| Industry | Expenditure | Price | Age[a] |
|---|---|---|---|
| Confectionary products | Standard & Poor[b] | Standard & Poor(d)[c] | BFDD[d]<br>Standard & Poor<br>Moody's[e] |
| Distilled spirits, ex. brandy | LBI Facts Book, 1969[f] | LBI Facts Book, 1969 | BFDD<br>Standard & Poor<br>Moody's |
| Soft drinks | Standard & Poor(d) | Standard & Poor(d) | Standard & Poor<br>Moody's |
| Newspapers | Statistical Abstract(d)[g] | Statistical Abstract(d) | BFDD<br>Moody's |
| Soap and other detergents | Census of Business(d)[h]<br>Standard & Poor(d) | Standard & Poor(e)[i] | Standard & Poor<br>Moody's<br>Encyclopedia[j] Britannica |
| Toilet preparations | Census of Business(d)<br>Standard & Poor(d)<br>Statistical Abstract(d) | Census of Business(e) | BFDD<br>Standard & Poor<br>Moody's |
| Petroleum refining | Statistical Abstract(d) | Statistical Abstract | Petroleum Facts & Figures, 1967[k]<br>Standard & Poor<br>BFDD<br>Moody's |
| Tires and inner tubes | Standard & Poor(d) | Standard & Poor(d) | BFDD<br>Standard & Poor<br>Moody's |

TABLE 33--continued

| Industry | Expenditure | Price | Age[a] |
|---|---|---|---|
| Shoes, except rubber | Standard & Poor(d) | Standard & Poor(d) | The Story of Footwear[l]<br>BFDD<br>Standard & Poor<br>Moody's |
| Farm machinery and equipment | Standard & Poor(d) | Standard & Poor | Standard & Poor<br>Moody's |
| Radio and TV receiving sets | Statistical Abstract(d) | Statistical Abstract(d) | BFDD<br>Moody's<br>Encyclopedia[m] Britannica |
| Passenger cars | Statistical Abstract(d) | Statistical Abstract | BFDD<br>Standard & Poor<br>Moody's |
| Drugs | Census of Business(d)<br>Statistical Abstract(d)<br>Standard & Poor(d) | Key Facts About the U.S. Prescription Drug Industry(d)[n] | BFDD<br>Standard & Poor<br>Moody's |
| Photographic equipment and supplies | Standard & Poor(d)<br>Business in Brief(d)[o] | Standard & Poor(e) | Standard & Poor<br>Moody's |
| Watches and clocks | Standard & Poor(e) | Standard & Poor(e) | Moody's |
| Costume jewelry | Standard & Poor(e) | Standard & Poor(e) | Moody's |

[a]All ratios were derived from these sources.

[b]Standard & Poor's Industry Surveys (New York: McGraw-Hill, Inc.). Industry surveys pertaining to the appropriate industries included in the sample and to the year 1966 were used.

APPENDIX F--continued

[c]The letter "(d)" indicates that the data was derived from the source noted.

[d]Etna M. Kelley, The Business Founding Date Directory (New York: Morgan & Morgan Publishers, 1954).

[e]Moody's Industrial Manual, June, 1966 (New York: Moody's Investors Service, Inc., 1966).

[f]Licensed Beverage Industries, Inc., The Alcoholic Beverage Industry: Transition to a New Era (New York: Licensed Beverage Industries, Inc., 1970).

[g]U. S. Bureau of the Census, Statistical Abstract of the United States: 1967 [also 1963 - 1970] (Washington, D. C.: U. S. Government Printing Office, 1967).

[h]U. S. Bureau of the Census, Census of Business, 1967, Retail Trade: United States Summary, BC67-RA1 (Washington, D. C.: U. S. Government Printing Office, 1970).

[i]The letter "(e)" indicates that the data was estimated as accurately as possible from the source noted. Most of the estimates were made concerning the price variable, which was not used in the primary model.

[j]"Soap," Encyclopedia Britannica (1967), Volume XX.

[k]American Petroleum Institute, Petroleum Facts and Figures, 1967 ed. (New York: American Petroleum Institute, 1967), Foreword.

[l]National Shoe Manufacturers Association, The Story of Footwear (New York: National Shoe Manufacturers Association, 1945), p. 21

[m]"Television," Encyclopaedia Britannica (1967), Volume XXI.

[n]Pharmaceutical Manufacturers Association, Key Facts About the U. S. Prescription Drug Industry (Washington, D. C.: Pharmaceutical Manufacturers Association, 1970).

[o]"Photography in Perspective," Business in Brief, No. 98, June, 1971, p. 4.

# APPENDIX G

## THE AGES OF THE SIXTEEN INDUSTRIES, THEIR LEADING FIRMS, AND THE FIRMS' AGES IN 1966

TABLE 34

THE AGES OF THE SIXTEEN INDUSTRIES, THEIR LEADING FIRMS, AND THE FIRMS' AGES IN 1966

| | |
|---|---|
| Confectionary products--176 years | |
| Hershey | 73 years |
| Peter-Paul | 47 years |
| Tootsie Roll | 37 years |
| Distilled spirits, except brandy--226 years | |
| Hiram Walker-Gooderham & Worts | 134 years |
| Schenley Industries | 46 years |
| Mohawk Liqueur Company | 42 years |
| Distillers Corp.-Seagrams | 38 years |
| Soft drinks--74 years | |
| Coca Cola | 72 years |
| Pepsi Cola | 47 years |
| Newspapers--202 years | |
| Southeastern Newspapers | 181 years |
| Boston Herald-Traveler Corp. | 141 years |
| Cincinnati Enquirer | 124 years |
| Richmond Newspapers | 116 years |
| New York Times | 115 years |
| Southam Press | 89 years |
| Dow Jones | 84 years |
| Times-Mirror Company | 82 years |
| Maclean-Hunter Publishers Co. | 75 years |
| Sun Publishing Company | 51 years |
| Federated Publications | 38 years |
| Stauffer Publications | 33 years |
| Thomson Newspapers | 32 years |
| Cowles Communications | 30 years |
| Soap and other detergents--141 years | |
| The Proctor & Gamble Company | 129 years |
| Armour and Company | 103 years |
| Colgate-Palmolive Company | 102 years |

TABLE 34--continued

| | |
|---|---|
| Babbitt, Inc. | 96 years |
| Unilever Limited | 72 years |
| Oakite Products | 57 years |
| Purex Corp. | 39 years |
| Standard International Corp. | 11 years |
| Harrell Corp. | 7 years |
| **Toilet preparations--207 years** | |
| The Proctor & Gamble Company | 129 years |
| Colgate-Palmolive Company | 102 years |
| Cheesebrough-Pond's | 86 years |
| Avon Products | 80 years |
| Unilever Limited | 72 years |
| Rexall Drug & Chemical | 63 years |
| Max Factor | 57 years |
| Helene Curtis | 39 years |
| Lanvin-Charles of the Ritz | 39 years |
| Revlon | 39 years |
| Rayette-Faberge | 27 years |
| Alberto-Culver | 11 years |
| **Petroleum refining--106 years** | |
| Standard Oil of Ohio | 96 years |
| Atlantic Richfield | 96 years |
| Standard Oil of California | 87 years |
| Mobil Oil | 84 years |
| Standard Oil of New Jersey | 84 years |
| Sun Oil | 80 years |
| Marathon Oil | 79 years |
| Standard Oil of Indiana | 77 years |
| Union Oil | 76 years |
| Texaco | 64 years |
| Gulf Oil | 59 years |
| Cities Service | 56 years |
| Shell Oil | 54 years |
| Phillips Oil | 49 years |
| Ashland Oil | 48 years |
| Sinclair Oil | 47 years |
| Continental Oil | 46 years |
| Sunray DX | 46 years |
| Getty Oil | 38 years |
| Signal Oil | 38 years |
| Hess Oil | 37 years |
| American Pertofina | 10 years |

TABLE 34--continued

| | |
|---|---|
| **Tires and inner tubes--71 years** | |
| Goodrich | 96 years |
| Uniroyal | 74 years |
| Goodyear | 68 years |
| Firestone | 60 years |
| **Shoes, except rubber--203 years** | |
| Interco | 130 years |
| Brown Shoe Company | 88 years |
| Melville Shoe Company | 74 years |
| Endicott Johnson | 72 years |
| Shoe Corporation of America | 46 years |
| Genesco | 41 years |
| U. S. Shoe Corporation | 35 years |
| **Farm machinery and equipment--126 years** | |
| John Deere | 129 years |
| Massey-Ferguson | 121 years |
| Allis-Chalmers | 119 years |
| International Harvester | 64 years |
| **Radio and TV receiving sets--46 years** | |
| RCA | 124 years |
| Sylvania | 65 years |
| Zenith | 51 years |
| Motorola | 38 years |
| Magnavox | 36 years |
| Admiral | 32 years |
| Warwick | 28 years |
| **Passenger cars--69 years** | |
| General Motors | 69 years |
| Ford Motor Company | 63 years |
| Chrysler Motors | 45 years |
| **Drugs--170 years** | |
| Richardson-Merrell | 138 years |

TABLE 34--continued

| | |
|---|---|
| Warner-Lambert | 110 years |
| Carter-Wallace | 98 years |
| Norwich Pharmacal | 81 years |
| Bristol-Myers | 79 years |
| Sterling Drugs | 66 years |
| Plough | 58 years |
| American Home Products | 57 years |
| Photographic equipment and supplies--124 years | |
| GAF Corporation | 124 years |
| Eastman Kodak | 86 years |
| Bell and Howell | 59 years |
| Polaroid | 29 years |
| Watches and clocks--153 years | |
| General Time | 153 years |
| Elgin | 102 years |
| Longines | 100 years |
| Bulova | 91 years |
| Hamilton | 74 years |
| Costume jewelry--129 years | |
| Tiffany and Company | 129 years |
| Jostens, Inc. | 69 years |
| Swank, Inc. | 69 years |
| Coro, Inc. | 65 years |
| Herff Jones Company | 46 years |

Note: The leading companies in each of the sixteen industries were found by referring to Standard & Poor's Industry Surveys and Moody's Industrial Almanac: 1966.

# APPENDIX H

## ANNUAL VALUE OF SHIPMENTS OF THE SIXTEEN INDUSTRIES--1958-1966

TABLE 35

ANNUAL VALUE OF SHIPMENTS OF THE SIXTEEN INDUSTRIES--1958-1966
(Millions of Dollars)

| Industry | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 |
|---|---|---|---|---|---|---|---|---|---|
| Confectionary products | 1229.3 | 1268.2 | 1318.0 | 1362.0 | 1395.1 | 1454.5 | 1552.6 | 1583.1 | 1681.5 |
| Distilled spirits | 941.3 | 959.2 | 927.1 | 937.9 | 946.0 | 1090.5 | 1133.8 | 1288.2 | 1331.6 |
| Soft drinks | 1558.3 | 1714.4 | 1806.1 | 1911.4 | 2032.9 | 2210.9 | 2408.8 | 2505.4 | 2734.9 |
| Newspapers | 3628.0 | 3946.7 | 4136.7 | 4183.0 | 4319.5 | 4483.6 | 4620.4 | 4886.1 | 5256.0 |
| Soap and other detergents | 1605.9 | 1827.9 | 1815.4 | 1900.7 | 1996.2 | 2127.8 | 2227.8 | 2235.7 | 2395.9 |
| Toilet preparations | 1059.2 | 1229.5 | 1261.4 | 1363.5 | 1501.0 | 1792.7 | 2003.8 | 2201.2 | 2430.6 |
| Petroleum refining | 14539.1 | 15090.1 | 15505.1 | 15618.6 | 15914.1 | 16497.5 | 16802.4 | 17500.9 | 18758.7 |
| Tires and inner tubes | 2577.8 | 2947.1 | 2844.3 | 2723.0 | 2883.7 | 2949.7 | 3048.3 | 3381.2 | 3715.8 |
| Shoes, except rubber | 2048.9 | 2279.6 | 2212.7 | 2233.1 | 2312.3 | 2249.2 | 2365.9 | 2461.3 | 2650.1 |
| Farm machinery and equipment | 2421.9 | 2559.5 | 2162.6 | 2339.5 | 2482.0 | 2842.2 | 3204.1 | 3532.6 | 4332.0 |
| Radio and TV receiving sets | 1548.0 | 1781.1 | 1719.3 | 1849.2 | 2128.9 | 2254.9 | 2509.7 | 3207.5 | 4117.4 |
| Passenger cars | 20830.1 | 26712.2 | 30110.1 | 25847.7 | 32673.8 | 36181.0 | 36504.6 | 45185.0 | 44579.4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Drugs | 2591.8 | 2692.2 | 2772.1 | 2926.6 | 3142.2 | 3314.3 | 3571.1 | 4049.7 | 4432.4 |
| Photographic equipment and supplies | 1204.9 | 1318.0 | 1467.0 | 1517.8 | 1635.9 | 1851.2 | 2091.2 | 2552.8 | 3285.7 |
| Watches and clocks | 334.9 | 406.7 | 408.5 | 403.1 | 427.3 | 511.2 | 553.2 | 611.8 | 669.4 |
| Costume jewelry | 253.8 | 245.1 | 245.2 | 253.2 | 253.2 | 280.5 | 294.3 | 313.0 | 335.0 |

Source: U. S. Bureau of the Census, 1967 Census of Manufactures (Washington, D. C.: U. S. Government Printing Office, 1969).

# APPENDIX I

## CLASSIFICATION OF THE VARIABLES FOR THE CROSS-CLASSIFICATION ANALYSES

TABLE 36

CLASSIFICATION OF THE VARIABLES FOR THE CROSS-CLASSIFICATION ANALYSES[a]

| Industry | Concentration | Advertising/ Sales Revenue | Average Price Per Unit | $Expenditure Per Consuming Unit | Durability | Avg. Co. Age/ Industry Age | Long-Run Growth | Short-Run Growth | Advertising x Age | Price x Durability | Expenditure x Durability |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Confectionary products | L | M | L | L | L | L | L | L | M | L | L |
| Distilled spirits, except brandy | M | M | M | M | L | L | L | M | L | M | M |
| Soft drinks | H | H | L | M | L | H | M | M | H | L | L |
| Newspapers | L | L | L | M | L | L | M | L | L | L | M |
| Soap and other detergents | H | H | L | H | M | M | M | L | H | L | H |
| Toiletries | M | H | M | M | M | L | H | H | H | M | M |
| Petroleum refining | M | L | L | H | L | M | L | L | L | L | H |
| Tires and inner tubes | H | M | H | M | M | H | M | M | M | H | M |
| Shoes, except rubber | L | M | M | L | M | L | L | L | L | M | M |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm machinery and equipment | M | L | H | H | H | H | M | H | M | H | H |
| Radio and TV receiving sets | M | M | H | H | H | H | H | H | M | H | H |
| Passenger cars | H | L | H | H | H | H | H | M | M | H | H |
| Drugs | L | H | M | L | M | M | M | H | H | M | L |
| Photographic equipment and supplies | H | M | M | M | H | M | H | H | M | M | M |
| Watches and clocks | M | H | H | L | H | M | H | M | H | H | L |
| Costume jewelry | L | L | M | L | M | M | L | M | L | M | L |

[a]L - Low Classification

M - Medium Classification

H - High Classification

# APPENDIX J

## RESULTS OF THE FINAL FOUR STEPS OF THE PRIMARY STEPWISE REGRESSION ANALYSIS

TABLE 37

PRIMARY STEPWISE REGRESSION: STEP 5

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$ $x_8$, $x_2$ | 5 | 2.05 | | .51 |
| $x_4$ | 1 | 4.43 | .31 | |
| $x_1$ | 1 | .19 | .07 | |
| $x_7$ | 1 | 2.22 | .02 | |
| $x_8$ | 1 | 2.01 | .10 | |
| $x_2$ | 1 | .14 | .01 | |
| Residual | 10 | | | |

Notes: The fifth variable to enter the equation was expenditure per year per consuming unit ($x_2$). The resulting prediction equation was

$$y = 18.33 + .74x_1 + .01x_2 + 50.35x_4 + 4.37x_7 - 2.49x_8$$

and the standard error of the estimate was 19.7.

TABLE 38

PRIMARY STEPWISE REGRESSION: STEP 6

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$, $x_8$, $x_2$, $x_6$ | 6 | 1.65 | | .53 |
| $x_4$ | 1 | 4.11 | .31 | |
| $x_1$ | 1 | .16 | .07 | |
| $x_7$ | 1 | 2.23 | .02 | |
| $x_8$ | 1 | 1.70 | .10 | |
| $x_2$ | 1 | .40 | .01 | |
| $x_6$ | 1 | .33 | .02 | |
| Residual | 9 | | | |

Notes: The sixth variable to enter the equation was $x_6$, the interaction term derived by multiplying the expenditure variable by the coded value of the durability variable. The resulting prediction equation was

$$y = 14.65 + .69x_1 + .06x_2 + 49.94x_4 - .02x_6 + 4.64x_7 - 2.38x_8$$

and the standard error of the estimate was 20.4.

TABLE 39

PRIMARY STEPWISE REGRESSION: STEP 7

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$, $x_8$, $x_2$, $x_6$, $x_5$ | 7 | 1.30 | | .54 |
| $x_4$ | 1 | 0.55 | .31 | |
| $x_1$ | 1 | 0.07 | .07 | |
| $x_7$ | 1 | 2.21 | .02 | |
| $x_8$ | 1 | 1.54 | .10 | |
| $x_2$ | 1 | 0.44 | .01 | |
| $x_6$ | 1 | 0.34 | .02 | |
| $x_5$ | 1 | 0.16 | .01 | |
| Residual | 8 | | | |

Notes: The seventh variable to enter the equation was $x_5$, the interaction term derived by multiplying the advertising variable by the age variable. The resulting prediction equation was

$$y = 19.86 - 1.62x_1 + .07x_2 + 34.67x_4 + 5.02x_5 - .02x_6 + 4.93x_7 - 2.38x_8$$

and the standard error of the estimate was 21.4.

TABLE 40

PRIMARY STEPWISE REGRESSION: STEP 8

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_7$, $x_8$, $x_2$, $x_6$, $x_5$, $x_3$ | 8 | 1.01 | | .54 |
| $x_4$ | 1 | 0.50 | .31 | |
| $x_1$ | 1 | 0.09 | .07 | |
| $x_7$ | 1 | 1.96 | .01 | |
| $x_8$ | 1 | 1.25 | .10 | |
| $x_2$ | 1 | 0.26 | .01 | |
| $x_6$ | 1 | 0.16 | .02 | |
| $x_5$ | 1 | 0.17 | .01 | |
| $x_3$ | 1 | 0.05 | .00 | |
| Residual | 7 | | | |

Notes: The eighth variable to enter the equation was $x_3$, the durability variable. The resulting prediction equation was

$$y = 22.98 - 2.07x_1 + .06x_2 - 2.85x_3 + 34.98x_4 + 5.64x_5 - .02x_6 + 5.19x_7 - 2.31x_8$$

and the standard error of the estimate was 22.8.

# APPENDIX K

## RESULTS OF THE FINAL FOUR STEPS OF SUB-MODEL NUMBER 1

TABLE 41

SUB-MODEL NUMBER 1: STEP 5

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_1$ $x_8$, $x_7$ | 5 | 2.25 | | .53 |
| $x_4$ | 1 | 5.89 | .31 | |
| $x_{3b}$ | 1 | .65 | .09 | |
| $x_1$ | 1 | .34 | .07 | |
| $x_8$ | 1 | 1.33 | .02 | |
| $x_7$ | 1 | .84 | .04 | |
| Residual | 10 | | | |

Notes: The fifth variable to enter the equation was $x_7$, the long-run growth variable. The resulting prediction equation was

$$y = 22.57 + .98x_1 - 10.65x_{3b} + 56.88x_4 + 3.03x_7 - 2.06x_8$$

and the standard error of the estimate was 19.2.

TABLE 42

SUB-MODEL NUMBER 1: STEP 6

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_1$ $x_8$, $x_7$, $x_5$ | 6 | 1.70 | | .53 |
| $x_4$ | 1 | 1.73 | .31 | |
| $x_{3b}$ | 1 | .58 | .09 | |
| $x_1$ | 1 | .00 | .07 | |
| $x_8$ | 1 | 1.20 | .02 | |
| $x_7$ | 1 | .78 | .04 | |
| $x_5$ | 1 | .02 | .00 | |
| Residual | 9 | | | |

Notes: The sixth variable to enter the equation was $x_5$, the interaction term derived by multiplying the advertising variable by the age variable. The resulting prediction equation was

$$y = 24.40 + .20x_1 - 10.59x_{3b} + 52.18x_4 + 1.65x_5 + 3.12x_7 - 2.06x_8$$

and the standard error of the estimate was 20.2.

TABLE 43

SUB-MODEL NUMBER 1: STEP 7

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_8$ $x_7$, $x_5$ | 5 | 2.26 | | .53 |
| $x_4$ | 1 | 5.69 | .31 | |
| $x_{3b}$ | 1 | .65 | .09 | |
| $x_8$ | 1 | 1.37 | .02 | |
| $x_7$ | 1 | .94 | .04 | |
| $x_5$ | 1 | .37 | .00 | |
| Residual | 10 | | | |

Notes: In the seventh step of the first sub-model, the advertising variable ($x_1$) was forced out of the equation because of its low F-value. The computer program which was used in this stepwise regression analysis called for the removal of any variable which had an F-value less than 0.005. After the completion of step 6 of this sub-model, the advertising variable had an F-value of 0.001 as indicated on the previous page. The resulting prediction equation was

$$y = 24.87 - 10.54x_{3b} + 51.01x_4 + 2.01x_5 + 3.17 - 2.07x_8$$

and the standard error of the estimate was 19.2.

TABLE 44

SUB-MODEL NUMBER 1: STEP 8

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_{3b}$, $x_8$, $x_7$, $x_5$, $x_2$ | 6 | 1.71 | | .53 |
| $x_4$ | 1 | 4.12 | .31 | |
| $x_{3b}$ | 1 | .44 | .09 | |
| $x_8$ | 1 | 1.26 | .02 | |
| $x_7$ | 1 | .94 | .04 | |
| $x_5$ | 1 | .37 | .00 | |
| $x_2$ | 1 | .04 | .00 | |
| Residual | 9 | | | |

Notes: In the eighth step $x_2$, the expenditure variable entered the equation. The resulting prediction equation was

$$y = 24.38 + .004x_2 - 9.62x_{3b} + 49.24x_4 + 2.19x_5 + 3.26x_7 - 2.10x_8$$

and the standard error of the estimate was 20.2.

# APPENDIX L

## RESULTS OF THE FINAL THREE STEPS OF SUB-MODEL NUMBER 2

TABLE 45

SUB-MODEL NUMBER 2: STEP 5

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_9$, $x_{10}$, $x_3$ | 5 | 2.34 | | .54 |
| $x_4$ | 1 | 5.28 | .31 | |
| $x_1$ | 1 | 1.73 | .07 | |
| $x_9$ | 1 | 2.94 | .03 | |
| $x_{10}$ | 1 | 2.64 | .12 | |
| $x_3$ | 1 | .17 | .01 | |
| Residual | 10 | | | |

Notes: The fifth variable to enter the equation in the second sub-model was $x_3$, the durability variable. The resulting prediction equation was

$$y = 24.16 + 1.89x_1 - 3.18x_3 + 53.82x_4 + .07x_9 - .02x_{10}$$

and the standard error of the estimate was 19.0.

TABLE 46

SUB-MODEL NUMBER 2: STEP 6

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_9$, $x_{10}$, $x_3$, $x_8$ | 6 | 1.89 | | .56 |
| $x_4$ | 1 | 4.10 | .31 | |
| $x_1$ | 1 | 1.21 | .07 | |
| $x_9$ | 1 | 3.04 | .03 | |
| $x_{10}$ | 1 | 2.79 | .12 | |
| $x_3$ | 1 | .48 | .01 | |
| $x_8$ | 1 | .36 | .02 | |
| Residual | 9 | | | |

Notes: The sixth variable to enter the equation in this sub-model was $x_8$, the short-run growth variable. The resulting prediction equation was

$$y = 25.89 + 1.68x_1 - 7.16x_3 + 50.40x_4 + .88x_8 + .09x_9 - .03x_{10}$$

and the standard error of the estimate was 19.7.

TABLE 47

SUB-MODEL NUMBER 2: STEP 7

| Source of Variation | Degrees of Freedom | F-value | Proportional Sum of Squares Reduction by Each Variable | Multiple $R^2$ |
|---|---|---|---|---|
| Total | 15 | | | |
| $x_4$, $x_1$, $x_9$, $x_{10}$, $x_3$, $x_8$, $x_5$ | 7 | 1.57 | | .58 |
| $x_4$ | 1 | .34 | .31 | |
| $x_1$ | 1 | .12 | .07 | |
| $x_9$ | 1 | 3.23 | .03 | |
| $x_{10}$ | 1 | 2.94 | .12 | |
| $x_3$ | 1 | .71 | .01 | |
| $x_8$ | 1 | .64 | .02 | |
| $x_5$ | 1 | .42 | .02 | |
| Residual | 8 | | | |

Notes: The seventh variable to enter the equation in this sub-model was the interaction term derived by multiplying the advertising variable by the age variable ($x_5$). The resulting prediction equation was

$$y = 37.39 - 2.07x_1 - 9.59x_3 + 26.30x_4 + 8.22x_5 + 1.34x_8 + .10x_9 - .03x_{10}$$

and the standard error of the estimate was 20.3.

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