A FINANCIAL EFFICIENCY MODEL

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This is to certify that the

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ABSTRACT

A FINANCIAL EFFICIENCY MODEL

By

Charles Robert Carlson

The major objective of this research was to develop a model by which a firm in a given industry would be able to obtain assistance in establishing long-range financial guidelines. The model provides a systematic approach to aid in providing a base for establishing policies for asset management and financial planning. Specifically, a financial efficiency model was developed to assist in the establishment of the appropriate level of current ratio, cash, inventory, fixed assets, long-term debt and cash dividends.

It was assumed that there were no transaction costs, no taxes and that the goal of the firm was the maximization of shareholder wealth. Financial decision making was classified into three subdivisions: the investment, the financing and the dividend decisions. Specific ratios were the independent variables specified to measure the relative efficiency of the three major decisions. Several independent variables were considered simultaneously in the

ABSTRACT

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iterative solution procedure and correlated with the dependent variable--the index of shareholder wealth appreciation.

Eighteen companies in the drug industry were selected for the study over the time period 1960 thru 1969. All data were obtained from the Standard Statistics Compustat Tape, which collected its data from annual financial statements, filings with the Securities Exchange Commission and questionnaires received directly from the firms.

In this study, the model developed an index of financial efficiency using the Spearman Rho Rank Correlation Test. A specifically designed computer program was the vehicle for determining the highest correlation between the mean values of several financial ratios and the mean value of the index of shareholder wealth.

The results were highly significant for the best computer run--achieving a rho value equal to .690 which is significant at α = .01 confidence level. In this run the seven financial ratios were the current ratio; the cash turnover; the inventory turnover; the receivables turnover; the fixed asset turnover; the debt ratio and the dividend payout ratio. The current ratio and the receivables turnover ratio assisted in increasing the final rho level even though on a univariate analysis they were

duration.

Eighteen companies in the Grand Industry were se-

of low significance. Also, the model developed weighting factors for the seven financial ratios, which indicated the relative importance of each variable. This provides management with additional information for determining areas on which to concentrate their efforts.

Several other practical applications of the model were shown to be easily applicable for practical decision making purposes--such as assisting bankers, credit managers and investors. Even if they do not have access to a computer, manual calculations on a small selected number of firms could be useful since the model's attributes are its simplicity and low cost.

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CHAPTER I

INTRODUCTION

A. Purpose

The objective of the research was to develop a technique by which a firm in a given industry can obtain assistance in establishing long range financial guidelines. Specifically, a financial efficiency model was developed to assist in the establishment of the appropriate level of current ratio, cash, inventory, fixed assets, long-term debt and cash dividends. The drug industry was selected for the study and the data obtained from the compustat tape.[1]

Establishing effective overall long-range financial guidelines requires knowledge of the prime objectives of a firm. The literature of finance[2] frequently assumes that the principal objective of a firm is to maximize shareholder wealth. This study assumed that management would try to achieve this objective. In addition it was assumed that there were no income taxes nor

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[1]Compustat Tape, Standard Statistics Company, Inc., 1971.

[2]See James C. Van Horne, Financial Management and Policy, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968, p. 8-9.

brokerage charges. Removal of the latter two assumptions would not significantly alter the technique used in this research -- it would only complicate the mathematics involved.

In this study, the goal of maximization is viewed in the same manner as it would be in a linear programming problem. In linear programming the solution is regarded as an optimal value, whereas in this study it was only considered to be the best value relative to other values generated by other firms in their respective industry. One way to measure shareholder wealth is to look at the sum of market price appreciation of a stock plus the cash dividends paid to its shareholders between points of time. An index of shareholder wealth appreciation is the dependent variable used in this study. It is the percentage change in market price over time with any cash dividends reinvested each year in its own respective stock.

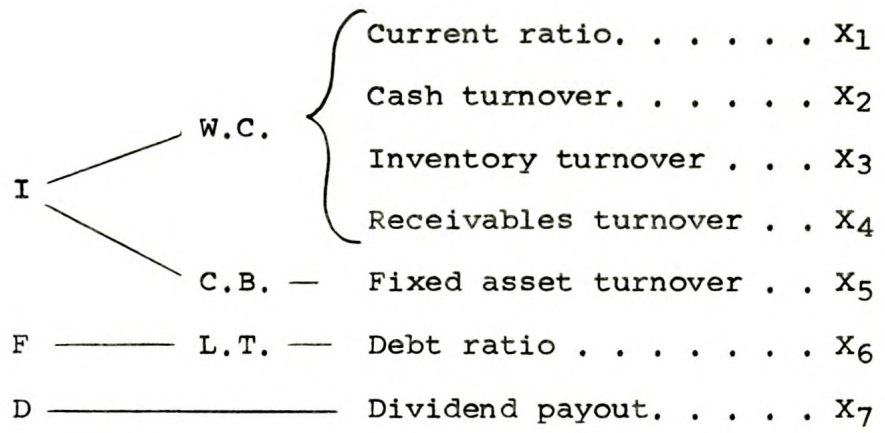
If the objective of the firm is to increase shareholder wealth through cash dividends and/or increase in the market price of its stock, decisions by the firm should reflect this objective. Financial decision making in a firm can be classified as the investment, the financing, and the dividend decision. These decisions are interrelated and should be considered simultaneously to insure the efficient operation of the firm for the shareholders. Determining an

appropriate level of cash, inventories, receivables, fixed assets, current ratio, long-term debt and cash dividends are the major components of these decisions. The financial decisions should lead to an effective utilization of the resources available to the firm by considering the degree of goal fulfillment and the efforts required to achieve this result. The focal point for the final result is dividend and share appreciation.

Several independent variables were selected to measure the efficiency of the three major decisions of a firm. Figure 1 shows the seven independent ratios chosen to reflect the efficiency of the three financial decisions made within a firm. Chapter III will discuss the reasons for the selection of these seven ratios.

Even with detailed internal data -- generally unavailable to the researcher- - the measurement of efficiency is extremely difficult. For those outside of the firm the problem is even more difficult. Since the yardstick generally used to evaluate management decisions by those outside the firm is the annual financial statement, the financial efficiency model developed here will incorporate only data from these statements. Roy A. Foulke said: "Every managerial policy, or absence of managerial policy, is reflected somewhere in the figures in the balance sheet, in the income statement, or in the reconciliation of sur-

plus."[3] The independent variables used in this research are standard financial ratios--such ratios are the means of comparing data between firms. Ratios selected were those which reflect best the results of the investment, the financing and the dividend decisions.



where I = Investment decision
F = Financing
D = Dividend decision
W.C. = Working capital
C.B. = Capital budgeting
L.T. = Long-term

Figure 1

Investment, Financing and Dividend Decisions and Their Related Independent Variables

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[3]Roy A. Foulke, Practical Financial Statement Analysis, 6th Edition, New York: McGraw-Hill, 1968, p. 4.

those which reflect best the results of the investigation.

the financing and the dynamic conditions.

Ratios and indexes are the "nuts and bolts" that make up security analysis. Ratios take two absolute numbers and allow a meaningful comparison between entities. An index takes one absolute number and again allows a meaningful comparison between entities. "The ratios are snapshots of the picture at one point in time, but there may be trends in motion that are in the process of rapidly eroding a relatively good present position. . . . Conversely, an analysis of the ratios over the past few years may suggest that a relatively weak present position is being improved at a rapid rate."[4] The number and form of ratios are numerous, however, the model will accomodate any reasonable number of independent variables--up to the specific limitation of the particular computer in use. Since it was desirable in this model to use a minimum number of independent variables, it would be extremely unlikely that any upper limit of independent variables would ever become a limitation.

Necessarily, any model should be parsimonious in its use of independent variables for easy interpretation and use. Those independent variables were selected that are relevant to the drug industry. The relevancy of these ratios for other industries was not investigated in this study. The drug industry was selected because of a large number of

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[4]J. Fred Weston and Eugene F. Brigham, Essentials of Managerial Finance, New York: Holt, Rinehart and Winston, 1968, p. 49.

firms with a comparatively homogeneous product line. Additional reasons are given in Chapter II--results of other research studies--for restricting the use of this model to a given industry.

Consequently, the model will provide the technique by which a firm in a given industry can develop guidelines for several independent variables. The development of these guidelines were attempted by an iterative solution procedure based on a previous or past interval of time considered to be the long-term. The drug industry was used to demonstrate the soundness of the technique. Naturally the question should be raised and answered about whether the future will be like the past to project future target guidelines. Also, quantitative methods established internally should be used in order to refine the specific levels of cash, inventories, etc. If conflict arises between the levels obtained by the detailed internal analysis and the overall guidelines established by the model, further investigation will be necessary.

B. Rationale for need

"Apart from the stock market, we have no objective standard of managerial efficiency. . . . A fundamental premise underlying the market for corporate control is the existence of a high positive correlation between corporate managerial efficiency and the market price of shares of that

company. . . ."[5] Given that the firm's objective is to maximize shareholder wealth and that the independent variables selected in this study reflect the efficient operation of the firm; then a model achieving a high statistical correlation between the two should be extremely useful. Manne indicates a need for an objective standard of managerial efficiency, and he also indicates that there is a high positive correlation between managerial efficiency and the market price appreciation of a firm's stock over a period of time. Therefore, a model designed to provide a standard of managerial efficiency--an index of financial efficiency --should assist corporate management in establishing long-range financial guidelines.

In reviewing the relevant literature, no research study was found concerning ratios or measures of the decision making process within a firm as to the correlation to the firm's objective. Alexander Wall[6] in 1919 pointed out that to get a complete picture, it is necessary to consider relationships in financial statements other than that of current assets to current liabilities. Many authors since have pointed out the necessity of simultaneously relating ratios to obtain a complete picture.

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[5]Henry G. Manne, "Mergers and the Market for Corporate Control," The Journal of Political Economy, LXXIII, No. 2 (April, 1965), p. 112-113.

[6]Alexander Wall, How to Evaluate Financial Statements, New York and London: Harper and Brothers Publishers, 1936, p. 70-72.

In this study a model was designed specifically to develop an index of financial efficiency. Simultaneously, the mean values of several independent variables were the input data to an iterative solution procedure with the task of correlating their values -- using nonparametric statistics --with the mean value of the index of shareholder wealth.

The highest correlation obtained produces the index of financial efficiency. Then this index can be used to assist the management of a firm in establishing long-range financial guidelines.

C. Technique

An iterative solution procedure was used to empirically investigate the relationship between several independent variables and a dependent variable. A specifically designed program (see Appendix C) was the vehicle for determining this relationship. The input data for all variables came from the compustat tape; the information or data on the tape were obtained from annual financial statements, questionnaires from companies and information filed with the Securities Exchange Commission.

The steps in the iterative solution procedure are as follows:

1) Compute a mean value for the two dependent and seven independent variables (as listed on page 4,

Figure 1) of the companies in the drug industry for 1960-1969;

2) Rank all drug companies from high to low based on the mean value of their dependent variable;
3) Normalize all values of independent variables on a scale from one to one hundred;
4) Select various combinations of weighting factors which sum to 1.00;
5) Multiply the various sets of weighting factors times each normalized value obtained in Step 3;
6) Compute a composite value by adding these component scores obtained in Step 5 for each firm;
7) Rank the composite values for each company from high to low;
8) Use each set of weighting factors as specified in Step 4 to run a Spearman Rho Rank Correlation Test between the rankings in Step 7 and Step 2;
9) Select the composite value arrived at in iterative solution procedure described above with the highest Spearman Rho coefficient -- this will be the index of financial efficiency.

A least square deletion (multiple regression) program was used in this study and proved to be an unreliable predictor. For example, the program eliminated all the independent variables but one (at α = .05 confidence level)

in trying to explain the changes in the dependent variable. Consequently, a nonparametric test was used.

According to Mendenhall: "Finally, one should note that many nonparametric methods are nearly as efficient as their parametric counterparts when the assumptions underlying the parametric procedures are true, and, as noted earlier, they could be more efficient when the assumptions are unsatisfied."[7] The data for this study were believed to violate the assumptions of normality and independence of variables for parametric tests.

By evaluating the index of financial efficiency a range of values for each independent variable can be derived. This range of values will provide assistance in establishing broad financial guidelines for a firm. With this type of model a sensitivity analysis can be accomplished -- changing the mean values of independent variables and observing the relative changes in the ranking of the composite values or ranking of the index of financial efficiency.

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[7]William Mendenhall, Introduction to Probability and Statistics, Belmont, California: Wadsworth Publishing Company, Inc., Second Edition, 1968, p. 318.

CHAPTER II

ANTECEDENTS OF THE FINANCIAL EFFICIENCY MODEL

Alexander Wall published an article in 1919 suggesting that it is necessary to consider relationships in financial statements other than that of the current ratio alone. In 1936 he developed "An Index of Related Proportions."[1] Subjective judgment was used in weighting the ratios as follows:

Current ratio.	25 %	
Net Worth-to-fixed	15 %	
Net Worth-to-debt.	25 %	
Sales-to-receivables	10 %	Managerial
Sales-to-merchandise	10 %	Capacity
Sales-to-fixed assets. . . .	10 %	
Sales-to-net worth	5 %	
	100 %	

Wall went on to explain that two years of data were necessary to develop the index. "Those ratios having

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[1]Alexander Wall, How to Evaluate Financial Statements, New York and London: Harper and Brothers Publishers, 1936, p. 70-72.

to do with profit or losses cannot be worked successfully into an index, because if we should be using a profit figure as a base and our subject should show a loss it is difficult to establish the relation between such plus and minus data."[2] This difficulty of negative profits could probably be handled by merely dropping the data for that specific period. Profit figures are not used in this study as they are the result of the financial decisions made in the firm. Adhering to the cause and effect relationship it is believed that the independent variables selected in this study are the cause or efficiency yardstick of the three financial decisions made in the firm. The profit figures then were considered to be the effect of these decisions. Efficient decision making should cause greater profitability--resulting in increased cash flows to the shareholders through cash dividend and/or share price appreciation.

Roy A. Foulke[3] looks at groups of financial ratios in evaluating overall performance; and though relationships are discussed, it appears that guidelines for selected ratios are developed individually. As an example, his guideline for the current ratio is the familiar 2:1. "The ratio

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[2]Ibid. p. 72.

[3]Roy A. Foulke, Practical Financial Statement Analysis, New York and London: Harper and Brothers Publishers, 1936, p. 10-72.

would hardly have been adopted so extensively as a standard if ordinary experience had not indicated its practical significance."[4] Foulke does look at the overall firm by making judgments based on whether the firm deviates from his guidelines. The 2:1 guideline is known to be good since a lower ratio is a characteristic of many firms that have failed. However, no experimental evidence of its relationship to other ratios is revealed in his book. Nowhere does he relate these ratios simultaneously to explain the changes in shareholder wealth appreciation. Mr. Foulkes' and Mr. Walls' emphasis is primarily on a firm's credit standing or credit worthiness.

Mr. Vance in his article, "Is your Company a Take-over Target?"[5] developed an index of vulnerability by using four financial ratios. His take-over indicators and weighting factors were as follows:

Liquidity: % of working capital to total assets	30 %
Long-term debt as a % of net worth	25 %
Annual earnings per share divided into share price	35 %
Percentage growth in earnings over the past three years	10 %
	100 %

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[4] Ibid., p. 191.

[5] Mr. Vance, "Is Your Company a Takeover Target?" Harvard Business Review, May-June 1969, p. 93-98.

All four financial ratios can be calculated from data found in the annual financial statements which is also true of the model developed in Chapter IV. Mr. Vance indicated that his Raiders Index was particularly applicable to industrial companies, not to debt-heavy financial institutions. He empirically tested his model against twenty-one companies that were approached with tender offers during a three month period--May, June, and July of 1968. By this test, seventeen of the twenty-one companies could have detected their vulnerability to take-over.

Vance continues: "Statistical research, verified by subsequent observation, suggests the possibility of combining these four signals to provide a sort of 'Raider's index' or formula for the possible take-over victim. Obviously, such an index cannot be definitive. It can, however, serve as a useful spur to management thinking for further analysis."[6] Vance uses profit figures in his index which Wall rightfully warns against because of negative profit possibilities. Also, profit figures are believed to be the effect of and not a cause of efficient financial decisions made in the firm. In addition, the article unfortunately does not explain how the weighting factors are developed.

Vance's research technique is closely related to this study--even though his objective was different--as it uses

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[6] Ibid., p. 94.

only data available on annual financial statements; uses only a minimum number (4) of independent variables for his predictive model; and combines independent variables into an index. The financial efficiency model developed in Chapter IV accomplishes these points and serves as a spur or a helping device for management to establish financial guidelines.

Robert Jess Frame, in his thesis on "Corporate Financial Policy and Growth: A Behavioral Model"[7] suggests that financial decision variables controlling retained earnings, external equity, and debt sources are rarely altered.

> The basic hypothesis advanced in this study is that the firm maintains stable financial policies which, through their influence on the source of funds available to the firm, determine the long-run growth rate it can achieve. . . . . .
> much of the empirical evidence available is based on broad aggregates, rather than the behavior of individual firms.
> Further, both the theoretical and empirical work in the literature typically focus on one financial policy, ignoring its inter-relationships with other policies and their combined influence on growth. . . .[8]

Finally, even though the basic hypothesis was substantially supported, it was pointed out that stable financial policies are not necessarily optimal. During the most

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[7]Robert Jess Frame, "Corporate Financial Policy and Growth: A Behavioral Model," (unpublished Ph.D. Dissertation, University of Colorado, 1966).

[8]Ibid.

recent three year period we have seen changes in financial policies. For example, American Telephone and Telegraph, a conservative company, has increased its debt ratio significantly over the past two years.

It is the thrust of this research effort to provide insights into previous patterns of financial guidelines that have appeared to be related to the efficient operation of the firm.

Ralph Michael Kraus' thesis concerned itself with managerial performance ratios which supplemented the traditional framework of financial ratios by encompassing physical as well as financial stocks and flows.[9]

> The managerial control ratio system he used consisted of the following:
> 1) The rate of return on total investment
> 2) unit profits
> 3) selling prices
> 4) total unit costs
> 5) physical output turnover of total investment
> 6) the rate of capacity utilization
> 7) the ratio of capacity to fixed investment
> 8) the ratio of fixed investment to total investment.
>
> Empirical findings covered twenty years experience in nine industries and sixteen companies in respect to each of ninety-two hypothesis. . . . . Perhaps the most interesting, however, from a decision-making point of view is the finding that industries seem to differ significantly in the relative influence of adjustments in the various control ratios on concomitant adjustments in their respective rates of return on total investment. This opens the possibility of developing

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[9]Ralph Michael Kraus, "Empirical Testing of New Managerial Control Ratios," (unpublished Ph.D. dissertation, University of Pittsburg, 1967).

> differentiated managerial strategies for various sectors of industry--emphasizing profit margins in some, capacity utilization in others and investment allocations in still others.[10]

The empirical findings of Kraus' thesis suggests that any financial policies derived from any set of financial ratios should be confined to a single industry.

Many of the items in Kraus' control ratio system seemed to be related to efficiency measures and were considered in the selection of the independent variables in this study. For example, the turnover ratios (cash, inventory and fixed assets) were highly significant when correlated individually to the dependent variable.

Manak Chand Gupta's thesis analyzes corporate financial structures with respect to three exogenous variables--size, growth, and industrial variations--and attempts to make a modest theoretical contribution to the construction of a theory of corporate financial structures.[11]

> The study relates to the year 1961-62 and essentially indicates the following:
> (a) accessibility to outside capital markets varies positively with the size of the corporation, because of various psychological, institutional, and cost factors;
> (b) the greater degree of integration (vertical, forward, backward) that larger corporate size favors;

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[10] Ibid.

[11] Manak Chand Gupta, "A Synchronic Study of Corporate Financial Structures 1961-1962," (unpublished Ph.D. dissertation, University of California, Los Angeles, 1967).

> (c) the volatility of earnings that varies negatively with corporate size and the associated operation and cash breakeven points consideration that it entails.
>
> Profitability ratios based on sales vary positively with size, but those based on assets show no significant differences among various sized corporations. . . . . .
>
> No significant difference between the financial ratios of the growth group and nongrowth group of industries was observed. . . . . .
>
> The profitability ratios show no significant relation to corporate growth. This is because (1) the sales concept of growth is used in this study and sales expansion need not always be associated with operational efficiency or technological progressiveness; (2) sales expansion may be in response to 'trade position motivation' rather than extra-profit opportunities, and (3) the existence of a 'speed premium function' as well as greater possibilities of production--sales mischeduling[12]

Even though Gupta's study covers only two years and treats only financial structure, some of his results indicate that the model should only cover one industry. Part (a) and (b) could possibly explain why companies in the drug industry with mean values of total assets and/or total sales have substantially lower debt ratios than the mean value of debt ratios for the industry. Gupta's comments on profitability--particularly in the last paragraph in the quote--infers that sales expansion is usually associated with operational efficiency or technological progressiveness. Thus, it lends support for the use of turnover ratios as an efficiency measure and supports the

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[12] Ibid.

interpretation that profitability ratios are the end result of efficient decision making. Technology, research and development expenditures probably should be used; however, the data are not available for all of the companies in this study.

Edward Ira Altman investigated empirically the characteristics of bankrupt corporations and attempted to develop an accurate bankruptcy predictive model.[13]

> The model contained five independent ratios which served as the predictive variables. These ratios were also investigated on an univariate basis. . . . From an original list of twenty-two ratios, the suggested model contained five variables. They represent measures of corporate liquidity, profitability, solvency and capital turnover. . . . . .
>
> Results of the study indicate that it is possible to classify successfully corporations into either bankrupt or non-bankrupt groups. . . prior to bankruptcy with the effectiveness of the model substantially deminishing after the second year.
>
> The bankruptcy predictive model was shown to be easily applicable for practical decision-making purposes with two of its attributes being simplicity and low cost. Important utilities of the model were suggested pertaining to business credit evaluation, internal and external management considerations and investment guidelines.[14]

The utilities of business credit evaluation, internal management considerations and investment guidelines are also applicable to the financial efficiency model in

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[13]Edward Ira Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," Journal of Finance, Vol. XXIII, No. 4 (Sept. 1968) p. 589-609.

[14]Ibid.

this study. The technique and the objectives are different in this study as multiple discriminant analysis and profitability ratios were not used. Success of the firm as measured by a relative ranking of a ten year mean value of shareholder wealth appreciation was the dependent variable used in the model developed in Chapter IV.

Beaver found that the ratio of cash-flow to total-debt was the best predictor of failure.[15] This ratio had a 13% error rate using data for the year prior to failure and a 22% error rate using data five years before failure.[16] Altman did not consider this ratio because of a lack of consistent appearance of precise depreciation data.[17] Cash-flow involves net income which is a profitability measure that was not used in this research.

Altman pointed out that it is essential to analyze the entire variable profile simultaneously rather than sequentially examining its individual characteristics. His X_5, Sales/Total Assets or Capital turnover ratio was the least significant ratio on a univariate or individual basis.

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[15] W.H. Beaver, "Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies 1966, Institute of Professional Accounting, University of Chicago, January, 1967, p. 71-111.

[16] Ibid.

[17] Altman, op. cit., p. 594.

However, because of its unique relationship to other variables in the model, the capital-turnover ratio ranked second in its contribution to the overall discriminating ability of his model.[18] Being able to justify the individual ratio's contribution is subject to the assumption of independence between the variables. Since Altman seems to indicate that there is a unique relationship of this ratio to other ratios, one would suspect that this assumption is violated. It appears that Altman clearly enhances the credibility of using financial ratios in predictive models, successfully uses a turnover ratio, and adds additional support for simultaneously combining ratios.

James S. Stone's thesis investigates the effect of conglomerate mergers on the performance of the economy in terms of capital allocation and suggests that the existence of the conglomerate merger movement is inconsistent with the belief in profit maximization as the primary motivation of firm managers.[19] His thesis is relevant to this study as he uses an efficiency measure which is a rate of return on assets or net earnings after taxes per dollar of asset value. Yet, no justification for using this efficiency measure is given in his thesis. Stone indicates in

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[18] Ibid., p. 596.

[19] James S. Stone, "Conglomerate Mergers: Their Implications for the Efficiency of Capital and the Theory of the Firm," (unpublished Master's Thesis, Harvard University, March, 1969).

ability of his model [illegible] Baird are to justify the indi-
vidual ratio's [illegible] in the assumption
of [illegible]

his conclusions that the questions which prompted his thesis are without definitive answers.[20] Perhaps his criteria for efficiency is not a relevant one to use for his study.

The Annual Statement Studies of 1969 says the following: "The Robert Morris Associates is the national association of bank loan and credit officers. It is actively engaged in promoting improvement in principles and practices of commercial lending, loan administration, and asset management in commercial banks."[21] Their treatment of ratios is to develop medians and quartiles by industry groupings. "For any given ratio, in any size class, these figures were calculated by, first, arranging all the numerical values of that ratio in the order of the strongest to the weakest ratio. The figure which falls in the middle of the list of ratio values is the median. The figure halfway between the median and the best of the ratio values is the upper quartile. The ratio halfway between the median and the weakest is the third quartile."[22] The emphasis in this study is clearly on credit worthiness and each individual ratio is treated separately. Obviously, a subjective overall evaluation of the firm is made by whichever institution

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[20] Ibid., p. 48, 88.

[21] The Robert Morris Associates Annual Statement Studies, The Robert Morris Associates, Philadelphia National Bank Building, 1969.

[22] Ibid., p. iii.

is doing the evaluation. This naturally can vary by whoever is making the overall subjective judgment as to the credit worthiness of the firm.

The purpose of this chapter was to look at earlier works and to show how they were related to the model developed in this thesis. Selection of a single industry for review, use of data from annual financial statements, the credibility of ratios, the use of a minimum number of independent variables, the combination of ratios into an index and background information on the use of certain ratios were some of the relevant items that earlier research substantiated. The work of Wall and Altman was extremely beneficial in the development of the financial efficiency model presented in this thesis.

The main purpose of the model is to develop a technique for assisting management in the establishment of long-term financial guidelines. Inputs for the model were mean values of financial ratios which were chosen to best represent the efficient financial decision making within the firm. In searching the literature no study was found that simultaneously combined financial ratios--designed to measure financial decision making--to correlate with performance in shareholder wealth appreciation.

CHAPTER III

THE CONCEPTUAL FRAMEWORK

A. Overview

In this chapter the conceptual framework will be discussed since it is the foundation which was used to build the model as explained in the next chapter. The major objective of a firm, the three major financial decisions, and the selection of the dependent and independent variables are the topical areas of this framework.

B. Financial objective of a firm

In this study it was assumed that the objective of a firm is to maximize its value to its shareholders--the appreciation of the market value of stock and cash dividends. It would seem that the firm utilizing its assets most efficiently (making the most efficient decisions) would also be the one to achieve the greatest increase in shareholder wealth. It is possible for a firm that is efficiently using its resources to fail. In a given industry--for instance, in a dying industry such as the railroad industry--it would appear that the most efficient firm would be the last one to fail, ceteris paribus. However, a firm in any industry should be able to generate

profitable investment opportunities by finding the best uses for scarce resources. Consequently, it should continue as a successful "going concern" and concomitantly be recognized as such in the market place.

According to Van Horne: "Because the principle of maximization of shareholder wealth provides the most rational guide for running a business and for the efficient allocation of resources in society, we shall use it as our assumed objective in considering how financial decisions should be made."[1]

The model in this study provides a systematic approach to aid in providing a base for establishing guidelines for asset management and financial planning. All resources are not included in the model, and as such suboptimal results will undoubtedly occur. On a relative basis within a given industry it will, perhaps, provide assistance or a technique to assist in increasing the present level of efficient operation.

Because there are day to day fluctuations in market price, this study is concerned with the long-term view, and except in rare cases management should be concerned with this view in the stewardship of an organization. Short-term decision making with no consideration for the impact on the long-term goals of the firm will certainly not enhance the success of a firm.

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[1]Van Horne, op. cit., p. 8-9.

How long is the long-term view? There are many factors that must be considered in answering this question. The financial efficiency model which is developed in Chapter IV will be flexible enough for any time period to be chosen to fit the particular circumstances. Crucial to the selection of this time period is the removal of day-to-day fluctuations in share price so that an average market price can be obtained. Generally, a three to five year period would seem to be a reasonable range to use in the model.

C. Selection of dependent variables

This financial efficiency model was designed to incorporate two dependent variables. The first dependent variable was an index of shareholder wealth appreciation. As explained in Chapter I, shareholder wealth consists of cash dividends and market price appreciation. Latané and Tuttle use these two components in computing holding period returns.[2] An index was used as this method takes absolute values and makes them comparable among firms. For this study the base year for the index calculation was 1959. The index of shareholder wealth was the preferred dependent variable as it considered the total return to the shareholder. Each year the cash dividends were

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[2]Henry A. Latané and Donald L. Tuttle, Security Analysis and Portfolio Management, New York: The Ronald Press Company, 1970.

assumed to be reinvested in the same dividend paying stock in order to allow comparison between both dividend and non-dividend paying firms. One of the original assumptions stated in the introduction was that there would be no transaction costs.

The second dependent variable was an index of market price appreciation. Ranking stocks using mean values of both dependent variables gave almost identical rankings in the drug industry. Therefore, the index of shareholder wealth appreciation was the only dependent variable used in the model development as explained in Chapter IV.

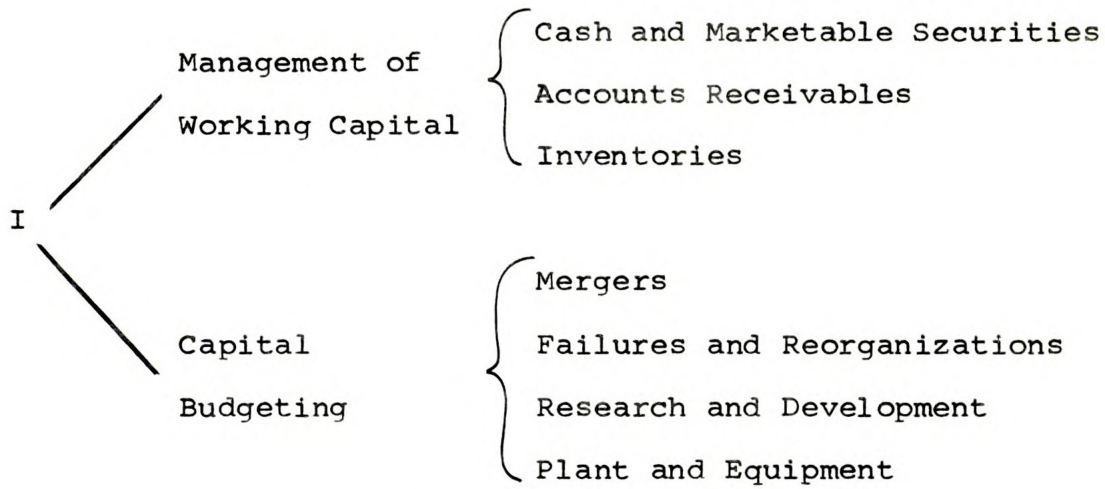
D. The three major decisions

The broad classification of decision making into the investment, the financing and the dividend decisions includes almost every financial management decision within a firm. Together they help determine the efficient operation of a firm.

The investment decision's impact is felt on the entire left-hand side of the balance sheet. Working capital management, for example, includes determining cash, inventory and receivables level. Managing these existing assets efficiently is essential to the success of the firm. In addition to working capital management, allocating capital to long-term investment proposals is a major part of the investment decision. These long-term investments,

merger considerations, failures and reorganizations, research and development expenditures are referred to as long-term capital budgeting decisions. Included also under these decisions are the reallocation of capital when an asset no longer justifies economically the capital committed to it--an abandonment decision. Again, the resultant impact is observed on the left hand-side of the balance sheet usually as fixed assets. Therefore, the investment decision determines the total asset mix of a firm.

Figure 2 shows the breakdown of the investment decision within a firm.

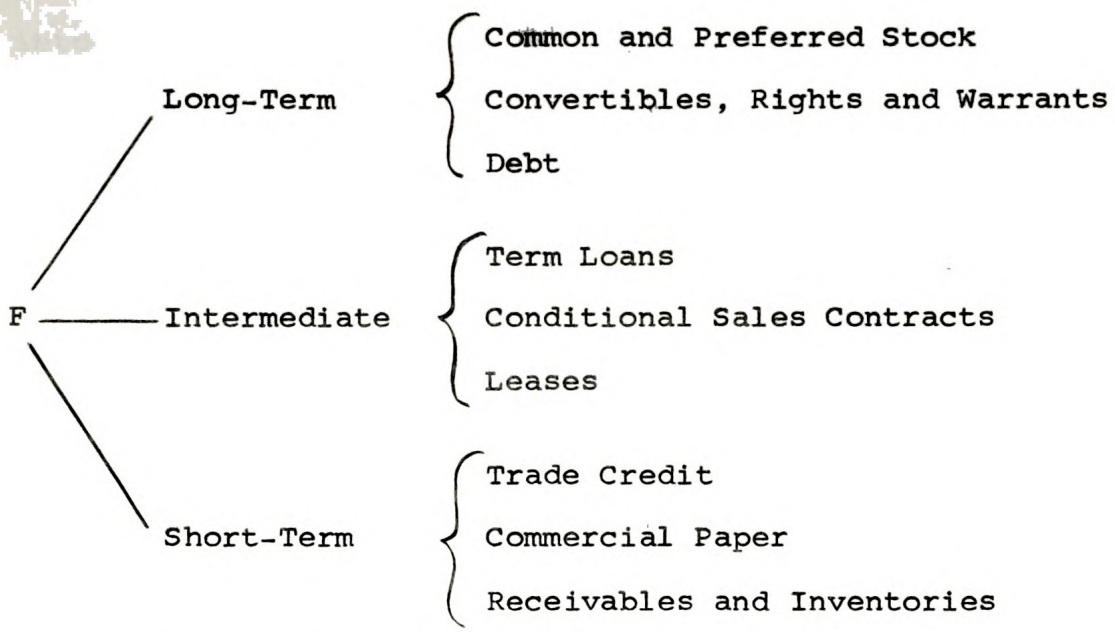


Where I = Investment decision

Figure 2

Investment Decision

The investments of a firm should be financed to maintain an optimal capital structure for a firm. Though this issue has not been solved with empirical results, firms tend to behave as if there is an optimal capital structure. In addition, when raising capital in the financial markets, they seem to act as though they believed that changing their financial mix (capital structure) may change their common stock price. The model will hopefully assist in providing guidelines or some insights for this optimal structure. Also, consideration should be given to the firm's desired asset mix; hence the financing decision cannot be made in isolation. The concern of this study is the long-term funds portion of a firm's debt and equity and not the short and intermediate term funds. Again, the attempt is to assist in the development of long-range financial guidelines and, by definition, not consider the intermediate and short-term market since it will generally fluctuate within any given years time. The impact of the financing decision makes its appearance under long-term debt and equity sections on the right hand side of the balance sheet. Figure 3 shows the breakdown of the financing decision.



Where F = Financing decision

Figure 3

Financing Decision

The dividend decision could have been included with the financing decision but because its impact on the index of shareholder wealth of a firm seemed so great it was treated separately. The dividend payout ratio (dividend policy) determines the allocation of earnings between payments to common shareholders and retained earnings. Retained earnings are one of the most significant sources of funds in the drug industry for financing the firm's investments. Cash-flows to shareholders in the form of cash dividends constitute an increment in their wealth. In the literature of finance, this variable has sometimes been divided

into two parts--either an active or a passive decision variable. Figure 4 shows the breakdown of the dividend decision. Hopefully, the model will assist in providing guidelines for what the dividend payout ratio should be for an efficiently operated firm.

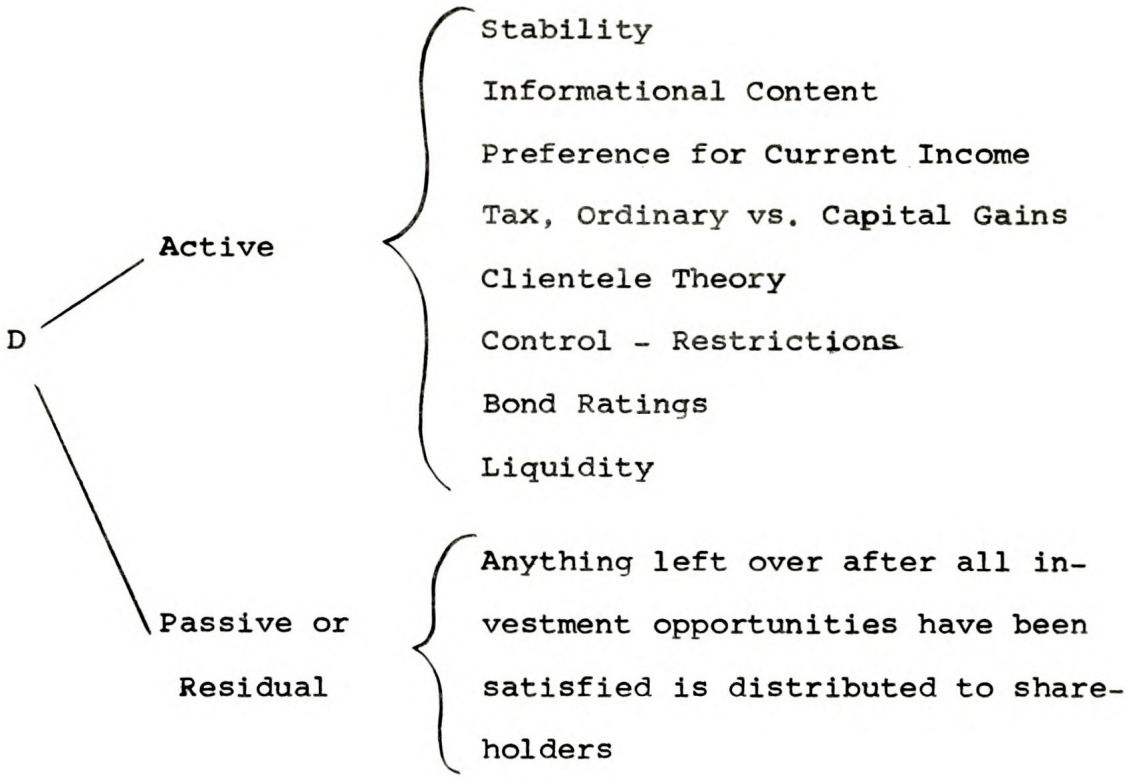


Figure 4

Dividend Decision

E. Selection of independent variables

The end result of almost every financial decision makes an impact on a firm's annual financial statements. Consequently, the model was designed to incorporate data available from annual financial statements. This data are available on compustat tape.

As indicated before, the investment decision was divided into working capital management and capital budgeting. The initial variables selected for these components were the current ratio, cash turnover, inventory turnover, accounts receivable turnover and fixed asset turnover.

When reviewing the literature it is apparent that the current ratio was used early in this century and continues to be widely used today. The current ratio is calculated by dividing total current assets by the total current liabilities. It is one measure of the firm's ability to meet its current debt.[3]

In tracing the history of the current ratio Foulke says:

> By 1908 one author had written, '. . . many good judges feel that the ratio of quick (current) assets to (current) liabilities should be about 2½ to 1.' Gradually, 2 and not 2½ dollars of

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[3]See Appendix B for definitions of Total Current Assets and Total Current Liabilities.

> current assets for each dollar of current liabilities came to be expected as a reasonable margin of protection. . . . In case of bankruptcy, falling prices, or inflated figures, the book value of the current assets could shrink 50 per cent in liquidation and current creditors, provided there were no long-term creditors, would still receive payment of their obligations in full. For many years this 'two for one' current ratio was the alpha and omega of balance sheet analysis; even today the businessmen are legion who believe this single ratio to be one infallible guide to balance sheet interpretation.[4]

Thus, a current ratio that might be suitable for A.T.& T. might not be suitable for a relatively new golf driving range. Moreover, depending on the product line, different current ratio guidelines will be different for different industries. Because this ratio is predominantly used in the market place and the data are readily available, it was used as a component of the financial efficiency model.

A cash turnover ratio should tell how efficiently a firm uses its cash to generate sales--at least relative to other firms in the industry. The cash turnover ratio was a highly significant independent variable used in the model. It is calculated by dividing net sales by cash.[5]

Foulke refers to inventories as the "graveyard of American business" because they have so frequently been

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[4]Foulke, op. cit., p. 178.

[5]See Appendix B for definitions of net sales and cash.

the prime cause of business falures.[6] Inventories require large investments of money and represent a significant percentage of a firm's total assets in the drug industry. For example, it represents about 30% of Baxter Laboratories total assets as of December 31, 1969. Quantitative tools are available to provide efficient levels of inventory. Because inventory levels are generally related to net sales, inventory turnover was selected as the independent variable to be used for this guideline. The inventory turnover ratio is calculated by dividing cost of goods sold by the average inventory--an average of beginning and ending inventories for the period.[7] Classification of inventories by product line would certainly enhance the use of this ratio, but existing data availability on annual financial statements precludes this possibility.

Sales of inventories replenish the level of receivables. Again, receivables represent a sizable portion of a firm's total assets. Management of receivables, i.e. credit and collection policies, can be crucial to the success of a firm. ". . . credit policy involves a tradeoff between the profit on sales that give rise to receivables on one hand and the cost of carrying these receivables

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[6]Foulke, op. cit., p. 310.

[7]See Appendix B for definitions of cost of goods sold and inventories.

plus bad-debt losses on the other."[8] The receivable turnover ratio is calculated by dividing annual credit sales by receivables. Annual credit sales are calculated by dividing net sales by three hundred and sixty-five,[9] which is a usual procedure in the financial community. If the credit terms granted to customers were known, the efficiency of the level of receivables could be appraised.

The receivables turnover ratio is actually the reciprocal of the collection period and should be helpful in evaluating the collectibility of receivables. Dunn & Bradstreet say the collection period should not exceed the net maturity of selling terms by more than ten to fifteen days.[10] When trying to compare collection periods between firms the variations in selling terms should be stated, but selling terms were not available on the compustat tape.

Turnover ratios allow the comparison of companies within an industry and then allow judgments to be made as to the efficiency of utilizing assets to produce sales. Wide recognition has been given in American industry to the du Pont system of financial control, and total asset

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[8]Van Horne, op. cit., p. 362.

[9]See Appendix B for definitions of net sales and receivables.

[10]Key Business Ratios in 125 Lines 1968; Retailing, Wholesaling, Mfg., Construction, Dunn & Bradstreet, Inc: New York.

turnover is one of its key variables.[11] This study uses the fixed asset turnover ratio, which relates the efficiency with which the firm utilizes its fixed assets to generate sales. It is computed by dividing net sales by fixed assets.[12] A danger exists in using a fixed asset turnover ratio; it could stimulate the use of old equipment. When equipment is almost fully depreciated and highly inefficient, it may show a high turnover but actually be unprofitable. The profitability ratios ignore the efficient utilization of assets--at least in the short run. A firm sacrificing the profitable purchase of new equipment for the sake of higher turnover ratios would experience a relative decline in profits and share price.

The current ratio, cash turnover, receivables turnover and inventory turnover were the independent variables selected to assist in measuring the efficiency of working capital management. These are the variables for which the model will establish guidelines. The fixed asset turnover ratio was the independent variable used to measure the efficiency of capital budgeting decisions. Since the drug industry was selected for research, a valid question would be the following: why not use research and development as

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[11] T.C. Davis, "How the du Pont Organization Appraises Its Performance," Financial Management Series, No. 94, New York: American Management Association Treasurer's Dept., 1950.

[12] See Appendix B for definitions of net sales and fixed assets.

a variable? One reason was that the data were only available for thirteen of the desired eighteen companies on the compustat tape. Another reason was that the rankings between the percent R & D of net sales and the index of shareholder wealth produced a Spearman Rho = -.39. The t calculated value was - 1.405 and the tabled value of $t_{\alpha} = .20$; df = 11 = 1.363. Therefore, with a negative correlation and significance at the confidence level of $\alpha = .20$ there was little reason to use this variable, particularly when the data were only available for thirteen of the desired companies.

A debt ratio was used to assist in the measurement of the efficiency of the financing decision. It is calculated by dividing long-term debt by total assets.[13] There are many debt ratios used in the market today, but preference was given to long-term debt divided by total assets. The purpose of the ratio is to appraise a firm's ability to meet its obligations as well as to help achieve greater efficiency of operation for the firm. Since this measure excludes the short-term accounts in the current liability section, it was felt to be a better measure of the long-term financial policy of a firm.

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[13]See Appendix B for definitions.

Finally, the dividend payout ratio was used as the measure or proxy for efficiency of the dividend decision. It is calculated by dividing earnings available to common shareholders into cash dividends paid to common shareholders.[14] One of the most important financial decisions made annually by the firm is to determine the allocation of profits after taxes between dividends and retained earnings; it may have a critical influence on the value of the firm. To illustrate the importance of the dividend payout policy, retained earnings financed 43 percent and new capital 57 percent of a group of firms' investments during a 12-year period.[15] The twelve year period was between 1955 and 1966 and the total uses of funds by these corporations was $705 billion.[16]

The efficient firm should be able to generate a large number of attractive investment opportunities, thereby needing a large amount of capital. This appears to be the situation for the more successful firms in the drug industry, a fact which helps to explain their lower cash dividend payout ratios. Thus, for purposes of the model in

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[14]See Appendix B for definitions.

[15]J. Fred Weston and Eugene F. Brigham, Essentials of Managerial Finance, New York: Holt, Rinehart and Winston, 1968, p. 359-360.

[16]Ibid., p. 359-361.

this study, the lower the dividend payout ratio the more efficient the dividend decision. In this sense, the dividend payout ratio is a proxy for the generation of attractive investment opportunities.

CHAPTER IV

MODEL DEVELOPMENT

A. Overview

The financial efficiency model will be developed in this chapter and accompanied by an explanatory example. Initially, the selection of industry, independent and dependent variables, data source, and time period will be discussed. The explanatory example will consider the top five and the low five of the eighteen companies chosen for the study. Finally, sensitivity analysis will be used to develop range of values as an assistance in establishing financial guidelines.

B. Selection of industry and companies

Compustat provides a reliable source of financial information covering a wide range of companies and industries. After reviewing the companies listed by industry in the Compustat Information Manual, the drug industry was selected because it comprises a large number of companies with a fairly homogeneous product line.

Under the classification of drug industry twenty-nine companies were listed (see Appendix A). Five

companies were eliminated from the study because of incomplete data for the independent variables. Several of the listed firms were small and exhibited quite different data from the larger firms, so firms having a mean value of less than $100 million in sales and/or total assets were also eliminated.[1]

It may be useful for officers of any given firm to compare their firm's policies and financial data with those of other carefully selected firms in the industry. Detailed information such as future product line direction, depreciation policies, accounting differences and differing collection periods with their associated selling terms may be available about their competition. With this additional information available as input data to the model, the output data used in establishing financial guidelines should be more meaningful and useful.

C. Data

The data base compiled on the Compustat tape covers the most widely used balance sheet and profit and loss information. It includes all the data necessary for the independent and dependent variables used in the model.

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[1]It is customary in ratio analysis to segregate firms by size, i.e., Robert Morris Associates segregate by total assets. Their lowest category is $250 M and less in total assets, however, their time period is two years.

As explained in Chapter III, the independent variables are as follows:

X_1 = Current ratio

X_2 = Cash turnover

X_3 = Inventory turnover

X_4 = Receivables turnover

X_5 = Fixed asset turnover

X_6 = Debt ratio

X_7 = Dividend payout ratio

and the dependent variables are:

Y_1 = Index of shareholder wealth appreciation

Y_2 = Index of market price appreciation

To verify the reliability of the data all of the variables were calculated for several randomly selected firms. The raw data were reviewed for reasonableness and much of it was verified with specific annual reports. Standard Statistics states:

> Extreme care has been used to investigate each item of the data for correctness and accuracy checking against many primary sources of information. Highly developed computer techniques are applied to further refine and verify all of the items which are translated to machine readable magnetic tapes.
>
> A high degree of comparability has been achieved through the use of specifically defined accounting terms which have been reviewed by

> leading accounting firms. Necessarily, some of the information has been altered from that contained in the annual reports of various companies, since all reporting methods are not similar. For this purpose additional public and confidential sources of information are used so as to insure reliability. . . .[2]

Based on manual computations done for this research the data were believed to be highly reliable.

D. Time period

The time period selected for this research was 1960-1969. The objective of the research was to develop long-term financial guidelines for the financial variables, and "long-term" was defined as five years or more. Working with mean values of market price seems to dictate at least a three to five year time interval so that year-to-year fluctuations can be ironed out. The time period selected was long enough to satisfy this condition, was long enough to contain two recessionary periods and was the most recent interval of time possible for the study. Nevertheless, the model could be used with different intervals of time.

E. Dependent variables--ranking

A mean value for the selected firms was calculated for both dependent variables--index of market price

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[2]Compustat Information Manual, April 1970, p. 1-1.

appreciation and index of shareholder wealth appreciation--over the time period 1960 thru 1969. Next, each firm was comparatively ranked against other firms on both dependent variables. For the twenty-four companies chosen, Table I shows a marked correlation between two dependent variables. Running a Spearman Rho Rank Correlation Test on these paired observations yielded a coefficient of rho = .9939, which is highly significant. A calculated t test value was 42.4 whereas the tabled value of $t_{\alpha} = .01$; df = 22 = 2.819. With this high correlation the index of shareholder wealth appreciation was used as the sole dependent variable.

Table 2 also shows a marked correlation between the two dependent variables for the eighteen companies. A Spearman Rho equal to .9918 is also highly significant. A calculated t test value was 30.5 whereas the tabled value of $t_{\alpha} = .01$, df = 16 = 2.921.

F. Independent variables--normalizing

A mean value was calculated for each independent variable for all firms for the ten year time period and each variable was normalized. The firm with the lowest mean value of cash turnover was equated to one. The firm with the highest mean value was equated to one hundred. Then, the remaining firm's mean values were interpolated

to their relative position between one and one hundred. Similarly, normalized values were calculated for the remaining mean values of the independent variables--with the exception of the dividend payout. The lowest mean value of the dividend payout ratio was equated to one hundred and the highest equated to one.

The logic for equating the highest mean value for the independent variables (and the lowest for dividend payout) was assumed to be the most efficient level obtained for that given listing of companies. Certainly it is possible that these ratios could be too high (too low for dividend payout) and in reality be inefficient. For example, an inventory turnover ratio may be so high that it causes a loss in sales due to frequent stock shortages. Detailed knowledge of the factors involved in each of the chosen independent variables would be necessary to be precise in setting the most efficient levels. The top performing companies exhibited the lowest dividend payout ratios; the highest debt ratios; and the highest cash, inventory and fixed asset turnover ratios. Consequently, it followed then that the higher the level of the independent variables (lowest in dividend payout), the more efficient the financial decision making in the firm.

TABLE 1

Rankings on Dependent Variables
Mean Values; 1960 - 1969

	Index of Shareholder Wealth		Index of Market Price Appreciation
*1.	Syntex	*1.	Syntex
*2.	Baxter	*2.	Baxter
3.	Bristol Myers	3.	Bristol Myers
4.	American Hospital	4.	American Hospital
*5.	Plough	5.	Johnson/Johnson
6.	Johnson/Johnson	*6.	Plough
*7.	Searle	*7.	Searle
8.	Gillette	8.	Gillette
9.	Kendall	9.	Merck
10.	Sterling	10.	Sterling
11.	Merck	11.	Kendall
12.	Warner Lambert	12.	Warner Lambert
13.	Eli Lilly	13.	Eli Lilly
14.	Abbott Laboratories	14.	Miles
15.	Miles	15.	Abbott Laboratories
16.	American Home Prod.	16.	American Home Prod.
17.	Pfizer	17.	Pfizer
18.	Richardson-Merrell	18.	Richardson-Merrell
19.	Schering	*19.	Cutter
*20.	Cutter	20.	Schering
21.	Smith Kline	21.	Smith Kline
22.	Upjohn	22.	Upjohn
*23.	Carter Wallace	*23.	Carter Wallace
24.	Parke Davis	24.	Parke Davis

* Companies with less than $100 Million Total Assets and/or Total Sales.

TABLE 2

Rankings on Dependent Variables
Mean Values; 1960 - 1969
Explanatory Example

	Index of Shareholder Wealth		Index of Market Price Appreciation
1.	Bristol Myers	1.	Bristol Myers
2.	American Hospital	2.	American Hospital
3.	Johnson/Johnson	3.	Johnson/Johnson
4.	Gillette	4.	Gillette
5.	Kendall	5.	Merck
6.	Sterling	6.	Sterling
7.	Merck	7.	Kendall
8.	Warner Lambert	8.	Warner Lambert
9.	Eli Lilly	9.	Eli Lilly
10.	Abbott Laboratories	10.	Abbott Laboratories
11.	Miles	11.	Miles
12.	American Home Prod.	12.	American Home Prod.
13.	Pfizer	13.	Pfizer
14.	Richardson-Merrell	14.	Richardson-Merrell
15.	Schering	15.	Schering
16.	Smith Kline	16.	Smith Kline
17.	Upjohn	17.	Upjohn
18.	Parke Davis	18.	Parke Davis

This table excludes companies from Table 1 with mean values of total assets and/or total sales of less than $100 million for 1960-1969.

G. Independent variables--rankings

Weights were developed for each independent variable which summed to one. Combinations could have been derived through an iterative or step-by-step procedure. For this study various combinations of weighting factors were read directly into the computer.

For each independent variable the weighting factors were multiplied by each normalized value. It resulted in component scores for each company which were then summed to obtain a composite value. An example of this is illustrated in Figure 5.

Independent variable	Weighting factor		Normalized value		Component score
	WF	x	NV	=	CS
Cash turnover	.25	x	21.80	=	5.45
Inventory turnover	.15	x	67.20	=	10.05
Fixed asset turnover	.20	x	6.92	=	13.84
Debt ratio	.30	x	38.80	=	11.64
Dividend payout	.10	x	55.60	=	5.56
	Composite Value (CV)			=	46.54

Figure 5

Index of Financial Efficiency
Bristol-Myers

The composite value is called the index of financial efficiency. The weighting factors which gave the best fit to the data explain the relative importance of each independent variable. They are significant in that they allow management to determine in which areas to concentrate their efforts.

The next step was to rank all the firms from highest to lowest in composite value. This ranking was then correlated by running a Spearman Rho Rank Correlation Test with the dependent variable. This ranking was continued with all combinations of weighting factors read into the computer. Each final ranking was then correlated with the ranking of the index of shareholder wealth--the dependent variable.

As an explanatory example, the top five and the low five companies of those listed in Table 2 were chosen. As indicated before, six companies were eliminated from the list of twenty-four in Table 1 because the mean value of total assets and/or total sales was less than $100 million for 1960 thru 1969.

For comparative purposes normalized values were computed for the top quartile (5) and low quartile (5) of the eighteen companies previously listed. Table 3 lists the mean values for cash turnover and shows the calculation of their respective normalized values of cash turnover ratios.

Similarly, the mean values were normalized for the remaining independent variables. The results shown in Table 4 were provided by ranking the mean value of each independent variable and running a Spearman Rho Rank Correlation Test on the shareholder wealth dependent variable. For the five top and low quartile companies the cash turnover and debt ratio correlations were significant at a confidence level $\alpha = .01$. The inventory turnover and fixed asset turnover correlations to the dependent variable were significant at $\alpha = .05$. Simultaneously, all independent variables were combined and their resultant rankings correlated using the Spearman Rho on the dependent variable.

TABLE 3

Normalizing Procedure for Cash Turnover Ratio
Top and Low Quartile Companies
Mean Values; 1960-1969

	Mean Value Cash Turnover	Rearranging High to Low			Normalized Value (NV)	
1. Bristol-Myers	13.32	50.36			100.0	
2. American Hosp.	50.36	32.40			62.1	Q*
3. Johnson/Johnson	10.08	13.32			21.8	
4. Gillette	7.25	10.08			15.0	
5. Kendall	32.40	8.08			10.8	
		Z				Y
6. Richardson-Mer.	8.08	7.25	W	X	9.2	
7. Schering	3.82	6.68			7.7	
8. Smith Kline	4.22	4.22			2.7	
9. Upjohn	6.68	3.82			1.7	
10. Parke Davis	2.96	2.96			1.0	

$$Q^* = \frac{32.4 - 2.96}{50.36 - 2.96} \times 99.0 + 1.0 = 62.1$$

$$\frac{Z}{W} = \frac{Y}{X} \quad \text{where} \quad x = \frac{WY}{Z}$$

$$Q^* = X + 1.0$$

TABLE 4

Univariate Spearman Rho Correlation Tests
Top and Low Quartile Companies
Mean Values; 1960-1969

	Cash Turnover	Inventory Turnover	Fix Asset Turnover	Debt Ratio	Dividend Payout	Current Ratio	Receivables Turnover
(ρ) rho	.855	.750	.758	.833	.590	.188	.320
t calculated	4.570	3.190	3.260	4.220	2.120	.541	.955
Significant at α =	.01	.05	.05	.01	.10	-	-

t tabled values

$t_{\alpha = .01;\ df=8} = 3.355$

$t_{\alpha = .05;\ df=8} = 2.306$

$t_{\alpha = .10;\ df=8} = 1.860$

$t_{\alpha = .20;\ df=8} = 1.397$

Experimenting with five independent variables and various combinations of weighting factors, the following in Figure 6 gave the best fit (eliminated, for illustrative purposes, the current ratio and receivables turnover ratio). As might be expected, the weighted factors were related to the Spearman Rho coefficients. Continuing the computation, multiplying the normalized value times its associated weighting factors yields all the component scores as shown in Table 5. Finally, the component scores for each independent variable were summed to obtain the composite values. These values are compiled in Table 6.

		Rho	Significant at
Cash turnover	WF = .25	.851	α = .01
Inventory turnover	WF = .15	.750	α = .05
Fixed Asset turnover	WF = .20	.758	α = .05
Debt ratio	WF = .30	.833	α = .01
Dividend payout	WF = .10	.590	α = .10
	1.00		

Where WF = Weighting factor

Figure 6

Weighting Factors and Spearman Rho Rank Correlation Test Results

TABLE 5

Mean Values, Normalized Values
and Component Scores
1960-1969

	Mean Cash Turnover	Normalized Values (NV)	*Component Score (CS) (WF_1 =.25)
Bristol-Myers	13.32	21.8	5.45
American Hospital	50.36	100.0	25.00
Johnson/Johnson	10.08	15.0	3.75
Gillette	7.25	9.2	2.30
Kendall	32.40	62.1	15.53
Richardson-Merrell	8.08	10.8	2.70
Schering	3.82	1.7	.43
Smith Kline	4.22	2.7	.68
Upjohn	6.68	7.7	1.93
Parke Davis	2.96	1.0	.25

	Mean Inventory Turnover	Normalized Values(NV)	*Component Score (CS) (WF_2 =.15)
Bristol-Myers	2.90	67.20	10.05
American Hospital	3.65	100.00	15.00
Johnson/Johnson	3.56	96.07	14.41
Gillette	2.00	27.90	4.19
Kendall	3.44	90.83	13.61
Richardson-Merrell	2.74	60.30	9.04
Schering	1.36	1.00	.15
Smith Kline	2.58	53.30	8.01
Upjohn	1.41	2.20	.33
Parke Davis	1.61	10.80	1.50

* Component Score (CS) = Normalized Value (NV) x Weighting Factor (WF)

TABLE 5--Continued

	Fixed Asset Turnover	Normalized Value	*Component Score (CS) (WF_3 =.20)
Bristol-Myers	6.84	69.2	13.84
American Hospital	8.92	100.0	20.00
Johnson/Johnson	4.42	33.3	6.66
Gillette	4.98	41.6	8.32
Kendall	3.71	22.8	4.56
Richardson-Merrell	6.48	63.8	12.76
Schering	3.79	23.9	4.78
Smith Kline	4.47	34.1	6.82
Upjohn	2.17	1.0	.20
Parke Davis	2.45	4.1	.82

	Debt Ratio	Normalized Value	*Component Score (CS) (WF_4 =.30)
Bristol-Myers	.07	38.8	11.64
American Hospital	.07	38.8	11.64
Johnson/Johnson	.02	11.1	3.33
Gillette	.04	22.2	6.66
Kendall	.18	100.0	30.00
Richardson-Merrell	.01	5.6	1.68
Schering	.00	1.0	.30
Smith Kline	.00	1.0	.30
Upjohn	.00	1.0	.30
Parke Davis	.00	1.0	.30

*Component Score (CS) = Normalized Value (NV) x Weighting Factor (WF)

TABLE 5--Continued

	Dividend Payout	Normalized Value	*Component Score (CS) (WF_5 =.10)
Bristol-Myers	.50	55.6	5.56
American Hospital	.34	91.1	9.11
Johnson/Johnson	.30	100.0	10.00
Gillette	.72	6.6	.66
Kendall	.40	77.8	7.78
Richardson-Merrell	.31	97.8	9.78
Schering	.51	53.4	5.34
Smith Kline	.67	17.7	1.77
Upjohn	.54	46.7	4.67
Parke Davis	.75	1.0	.10

* Component Score (CS) = Normalized Value (NV) x Weighting Factor (WF)

TABLE 6

Index of Financial Efficiency

	(CS) Cash Turnover	(CS) Inventory Turnover	(CS) Fix Asset Turnover	(CS) Debt Ratio	(CS) Dividend Payout	(CV) Composite Value
Bristol-Myers	5.45	10.05	13.84	11.64	5.56	46.54
American Hospital	25.00	15.00	20.00	11.64	9.11	80.75
Johnson/Johnson	3.75	14.41	6.66	3.33	10.00	38.15
Gillette	2.30	4.19	8.32	6.66	.66	22.13
Kendall	15.53	13.61	4.56	30.00	7.78	71.48
Richardson-Merrell	2.70	9.04	12.76	1.68	9.78	35.96
Schering	.43	.15	4.78	.30	5.34	11.00
Smith Kline	.68	8.01	6.82	.30	1.77	17.58
Upjohn	1.93	.33	.20	.30	4.67	7.43
Parke Davis	.25	1.50	.82	.30	.10	2.97

The composite value or index of financial efficiency for American Hospital Supply is 80.75, for Bristol-Myers is 46.54, and for Kendall is 71.48. Thus, the ranking from high to low on the index of financial efficiency was not perfectly correlated to the ranking of the index of shareholder wealth appreciation. The rankings of the two indexes are listed in Table 7. The correlation between the two rankings was highly significant with a rho = .867; t computed = 4.90 and a tabled value $t_{\alpha} = .01$; df = 8 = 3.355.

H. Financial policy guidelines

Individual variables can be analyzed for possible strategies by which assistance in establishing financial guidelines can be obtained. For example, assume that we want to look at the relative ranking of Johnson/Johnson with that of Bristol-Myers. Through sensitivity analysis we could vary any of several ratios simultaneously and observe the relative change in rankings. The index of financial efficiency or composite value for Johnson/Johnson is 38.15, whereas for Bristol-Myers it is 46.54. Therefore, the total number of index points that Johnson/Johnson would have had to gain to overtake Bristol-Myers is 8.39.

Johnson/Johnson has fewer financial efficiency index points than Kendall but Johnson/Johnson is ranked

higher on the dependent variable. Any number of factors could account for this: better advertising programs; greater future earnings expectations; an imperfect market with an overvalued issue; omission of crucial variables; etc. Whatever the reason, a rho value of .867 is highly significant at $\alpha = .01$.

Finally, how could Johnson/Johnson have achieved a higher ranking (over the past decade) on the dependent variable than Bristol-Myers? By subtracting Johnson/Johnson's index of efficiency from Bristol-Myers' index of efficiency a difference of 8.39 index points is obtained. This is the amount they needed to overtake Bristol-Myers, ceteris paribus. For example, assume that the management of Johnson/Johnson feels that they can improve the cash turnover ratio substantially. The 8.39 index points added to the existing component score for cash turnover of 3.75 yields 12.14 index points. After computing a normalized value of 48.56, a new cash turnover value of 25.98 can be obtained by interpolation. Consequently, Johnson/Johnson would have had to increase their cash turnover to 25.98 or more to overtake Bristol-Myers, see Figure 7.

TABLE 7

Rankings of Top and Low Quartile Companies

	Index of Shareholder Wealth		Index of Financial Efficiency
1.	Bristol-Myers	1.	American Hospital
2.	American Hospital	2.	Kendall
3.	Johnson/Johnson	3.	Bristol-Myers
4.	Gillette	4.	Johnson/Johnson
5.	Kendall	5.	Richardson-Merrell
6.	Richardson-Merrell	6.	Gillette
7.	Schering	7.	Smith Kline/French
8.	Smith Kline/French	8.	Schering
9.	Upjohn	9.	Upjohn
10.	Parke Davis	10.	Parke Davis

	Index of Efficiency	
Bristol-Myers	46.54	
Johnson/Johnson	38.15	
	8.39	Additional points needed
	3.75	Existing points
	12.14	Total new component score (CS)

Mean Cash Turnover		NV	x	WF	=	CS
47.40	50.36	100.00				
	51.44	48.56	x	.25	=	12.14
	10.08	15.00	x	.25	=	3.75
	2.96	1.00				

$NV \times WF_1 = CS$

$NV \times .25 = 12.14$

$NV = 48.56$ New normalized value needed

$$\frac{Z}{47.40} = \frac{51.44}{100} \qquad Z = 24.38$$

$50.36 - 24.38 = 25.98$

Figure 7

Financial Guideline Computation
For Cash Turnover Ratio

Obviously, firms must forecast what will happen in the future. If Bristol-Myers improves their cash turnover ratio, Johnson/Johnson will have to capture this amount in addition to that calculated in the preceding example.

Suppose the management of Johnson/Johnson feels that they can improve the inventory turnover ratio substantially. Again, by looking at Bristol-Myers, they would need a total of 8.39 additional index points added to their existing 14.41 component score, giving a new component score of 22.80, see Figure 8.

	Index of Efficiency	
Bristol-Myers	46.54	
Johnson/Johnson	38.15	
	8.39	Additional points needed
	14.41	Existing component score
	22.80	New component score

Figure 8

Financial Guideline Computation for Inventory Turnover Ratio

If Johnson/Johnson increases their inventory turnover to 3.65 or above, they will only obtain the maximum component score of 15.00. Thus, they will have to pick up an additional 7.80 points elsewhere (22.80 - 15.00). For example, assume they try to pick up these 7.80 additional points by increasing their fixed asset turnover ratio. They could do that in a manner shown in Figure 9.

		NV	x	WF	=	CS
6.75	w 8.92	27.70 100.0				
	4.42	72.30	x	.20	=	14.46
	2.17	33.30	x	.20	=	6.66
		1.00				

6.66 Existing points

7.80 Additional points

14.46 New component score

$NV \times .20 = 14.46$

$NV = 72.30$

$$\frac{w}{6.75} = \frac{100.00-72.30}{100.00} \qquad w = 1.81$$

New Fixed Asset Turnover = 8.92-1.81 = 7.11

Figure 9

Financial Guideline Computation for Fixed Asset Turnover Ratio

Consequently, Johnson/Johnson would have to increase their inventory turnover ratio at least to 3.65 and their fixed asset turnover ratio to 7.11. Again, the future must be forecast; these guidelines should form the base on which to make intelligent forecasts. Knowing the management of competitors and their patterns of decision making in the past is a good basis for looking into the future. Johnson/Johnson, for example, may decide to maximize all of the component scores and achieve an even greater increase in financial efficiency. Naturally, they have restraints as their competitors do, and by applying sensitivity analysis they can more confidently plan their future rather than merely let it happen. Further research is warranted when conflict arises between the guidelines determined by the model and detailed internal analysis of the same independent variable.

Another way of developing additional information for establishing financial guidelines is to compute mean and range of values for each independent variable for the top and low quartile companies used in the preceding example. See Table 8 for this compilation.

TABLE 8

Financial Guidelines
18 Companies;
1960-1969

Top Quartile

	Mean	Range High Value	Low Value
Cash turnover	22.70	50.36	7.25
Inventory turnover	3.11	3.65	2.00
Fixed Asset turn.	5.77	8.92	3.71
Debt ratio	.08	.18	.02
Dividend Payout	.45	.30	.72

Low Quartile

	Mean	Range High Value	Low Value
Cash turnover	5.20	8.08	2.96
Inventory turnover	1.94	2.74	1.36
Fixed Asset turn.	3.87	6.48	2.17
Debt ratio	.002	.01	.00
Dividend Payout	.56	.31	.75

CHAPTER V

RESULTS

A. Least square deletion program

Initially, it was decided to use parametric statistics to determine the relationships between the several independent variables and a dependent variable. Using the data from all twenty-four companies, as listed in Appendix A, the stepwise deletion of independent variables from a least square equation was run on the computer with $\alpha = .05$ confidence level. The Michigan State University Agricultural Experimental Station, Stat Series Description No. 8 LSDEL program was used on the CDC 3600 computer. As explained in previous chapters the time period was 1960 thru 1969, and in this particular run all five independent variables were dropped out in the final iteration. The five independent variables used in this run were inventory turnover, dividend payout ratio, debt ratio, receivables turnover and fixed asset turnover ratios. The dependent variable was the index of shareholder wealth appreciation. It was believed that the six small companies--with total sales and/or total assets less than $100 million--produced the "noise" causing the elimination of all the independent

variables. As would be expected, a similar run on the index of market price appreciation produced the same results. Changing only the time period--using 1960 thru 1964--and running the same program again on the two independent variables also eliminated all five independent variables in the final iteration.

It was decided to use eighteen companies as listed in Appendix A and seven independent variables (dividend payout ratio, debt ratio, current ratio, inventory turnover) for 1960 thru 1969. Running these seven independent variables on the index of shareholder wealth appreciation as the inputs to the LSDEL program at α = .05 confidence level eliminated all of the independent variables except the fixed asset turnover ratio. The R^2 = .5441 was for all seven independent variables, which means they were associated with approximately fifty-four percent of the variation in the dependent variable. The F statistic was 1.7047, which is only significant at α = .214. In the last iteration the R^2 was equal to .4284 and a F statistic was equal to 11.911, which is significant at α = .003. Making a run on the other dependent variable--the index of market price appreciation--with everything else the same produced similar results. Also, changing the time period to 1960 thru 1964 and making runs on both dependent variables caused the identical elimination of independent variables.

Since the sample size was small (n = 18), it was believed that the data violated the normality assumption of parametric statistics. Consequently, nonparametric statistics was chosen as the technique to use in the development of the model.

B. Iterative solution runs

A computer program (see Appendix C) was designed to incorporate the nine step procedure as listed in Chapter I and described in Chapter IV. Data for seven independent variables and the index of shareholder wealth appreciation were used for the eighteen companies for 1960 thru 1969. Twelve sets of weighting factors were used for individual runs of seven, six, five and four independent variables. Table 9, which follows, shows the weighting factors used in this study.

The mean value for each independent variable was ranked from high to low. Each independent variable ranking was correlated separately, on a univariate basis, to the ranking of the dependent variable by using a Spearman Rho Rank Correlation Test. The higher the rho the more weight its associated independent variable was given. For example, the rho equal to -.051 for receivables turnover was assigned values from .00 to .30 with predominantly more values nearer to .00 in the various sets of weighting factors. Table 10 shows the rho's for each

TABLE 9

Weighting Factors - 18 Companies
1960 - 1969

Current Ratio	Inventory Turn.	Receivables Turn.	Fixed Assets Turn.	Dividend Payout	Debt Ratio	Cash Turn.
.00	.25	.00	.25	.00	.25	.25
.00	.25	.00	.20	.30	.10	.15
.00	.20	.00	.20	.00	.30	.30
.00	.15	.00	.15	.00	.35	.35
.00	.15	.00	.15	.00	.30	.40
.00	.15	.00	.15	.00	.40	.30
.00	.20	.00	.30	.00	.30	.20
.00	.10	.00	.20	.00	.50	.20
.00	.20	.00	.30	.00	.20	.30
.00	.15	.00	.20	.00	.45	.20
.00	.30	.00	.25	.00	.20	.25
.00	.20	.00	.30	.00	.25	.25
.00	.20	.00	.25	.00	.30	.25
.00	.20	.05	.15	.10	.25	.25
.00	.15	.05	.20	.10	.25	.25
.00	.15	.10	.20	.10	.20	.25
.00	.15	.10	.10	.10	.25	.30
.00	.15	.10	.20	.15	.20	.20
.00	.20	.05	.30	.05	.10	.30
.00	.15	.30	.20	.25	.05	.05
.00	.15	.25	.20	.20	.10	.10
.00	.20	.15	.20	.15	.15	.15
.00	.20	.05	.20	.20	.15	.20
.00	.10	.05	.25	.10	.25	.25
.00	.15	.05	.10	.05	.30	.35
.15	.15	.10	.15	.15	.15	.15
.10	.15	.15	.15	.15	.15	.15
.05	.20	.05	.20	.10	.20	.20
.05	.20	.05	.20	.05	.25	.20
.05	.20	.05	.20	.05	.20	.25
.05	.15	.05	.20	.05	.25	.25
.05	.20	.05	.25	.10	.15	.20
.05	.10	.05	.10	.10	.30	.30
.05	.15	.05	.25	.05	.20	.25
.20	.10	.20	.10	.20	.10	.10
.10	.15	.05	.15	.10	.15	.30
.05	.20	.10	.20	.15	.15	.15

TABLE 9--Continued

Current Ratio	Inventory Turn.	Receivables Turn.	Fixed Assets Turn.	Dividend Payout	Debt Ratio	Cash Turn.
.00	.15	.00	.20	.10	.30	.25
.00	.20	.00	.20	.20	.20	.20
.00	.20	.00	.20	.10	.25	.25
.00	.10	.00	.25	.10	.25	.30
.00	.15	.00	.20	.10	.20	.35
.00	.20	.00	.15	.10	.25	.30
.00	.15	.00	.20	.10	.25	.30
.00	.15	.00	.15	.25	.30	.15
.00	.20	.00	.20	.20	.30	.20
.00	.20	.00	.20	.10	.30	.20
.00	.20	.00	.10	.20	.30	.20
.00	.20	.00	.10	.10	.40	.20

TABLE 10

Univariate Spearman Rho Correlation Tests
Mean Values; 1960-1969
18 Companies

	Cash Turnover	Inventory Turnover	Fix Asset Turnover	Debt Ratio	Dividend Payout	Current Ratio	Receiv. Turn.
(ρ) rho	.603	.575	.504	.636	.352	.343	-.051
t calculated	3.000	2.810	2.300	3.000	1.500	1.4608	-
Significant at α =	.01	.05	.05	.01	.20	.20	-

t tabled values

$t_{\alpha=.01;\ df=16} = 2.921$

$t_{\alpha=.05;\ df=16} = 2.120$

$t_{\alpha=.10;\ df=16} = 1.746$

$t_{\alpha=.20;\ df=16} = 1.337$

independent variable correlated to the dependent variable, on a univariate basis. Increments of five were determined to be an accurate gauge for developing the best rho value for the purposes of this study.

Table 11 shows the highest rho value for the seven, six, five and four independent variables. The highest rho value was .690 and is significant at α = .01 confidence level; the best rho for the six, five and four independent variable runs are also significant at α = .01 confidence level. The current ratio and the receivables turnover ratio assisted in increasing the final rho level even though on a univariate analysis they were of low significance.

C. Five year prediction

It was decided to run the model for 1960 thru 1964 and develop the best rho value for each of the seven, six, five and four independent variables. Then, assuming that firms did not appreciably change their financial policy over a five year interval, the predicted results were compared with those that were actually achieved for 1965 thru 1969. Table 12 shows the best rho and weighting factors for each of the seven, six, five and four independent variables. The best rho value was achieved by the four independent variable run. The next best rho was achieved with the seven independent variable run. It would be desirable to use the seven independent variable run (also significant

TABLE 11

Simultaneous Spearman RHO Correlation Tests
18 Companies; 1960 - 1969

No. of Independent Variables	RHO	Current Ratio	Inventory Turnover	Receiv-ables Turnover	Fixed Asset Turnover	Dividend Payout	Debt Ratio	Cash Turnover
7	.690	.05	.20	.05	.20	.05	.25	.20
6	.653	.00	.20	.05	.30	.05	.10	.30
5	.655	.00	.20	.00	.20	.10	.30	.20
4	.664	.00	.20	.00	.20	.00	.30	.20

TABLE 12

Simultaneous Spearman RHO Correlation Tests
18 Companies; 1960 - 1964

No. of Independent Variables	RHO	Current Ratio	Inventory Turnover	Receiv-ables Turnover	Fixed Asset Turnover	Dividend Payout	Debt Ratio	Cash Turnover
7	.759	.05	.20	.05	.20	.05	.25	.20
6	.734	.00	.10	.05	.25	.10	.25	.25
5	.734	.00	.10	.00	.25	.10	.25	.30
4	.761	.00	.25	.00	.25	.00	.25	.25

at α = .01 confidence level) since it would provide assistance in setting policy for a larger number of variables.

Using all these weighting factors, as listed in Table 12, and using the actual data for the same eighteen companies for 1965 thru 1969 produced the best rho values with their corresponding set of weighting factors, as shown in Table 13.

The prediction of the results for the succeeding five years produced results that were significant at α = .01 confidence level. By running all combinations of weighting factors shown in Table 9 for 1965 thru 1969 the best rho value was the same as that shown in Table 13, with the exception of the seven independent variable run. The best rho for this seven independent variable run was equal to .664, which is the highest rho value for all of the runs for this time period.

TABLE 13

Simultaneous Spearman Rho Correlation Tests
18 Companies; 1965 - 1969

No. of Independent Variables	RHO	Current Ratio	Inventory Turnover	Receiv-ables Turnover	Fixed Asset Turnover	Dividend Payout	Debt Ratio	Cash Turnover
7	.633	.05	.20	.05	.20	.05	.25	.20
6	.647	.00	.10	.05	.25	.10	.25	.25
5	.657	.00	.10	.00	.25	.10	.25	.30
4	.639	.00	.25	.00	.25	.00	.25	.25

CHAPTER VI

SUMMARY AND CONCLUSIONS

A. Summary of technique

The major objective of this research was to develop a technique by which a firm in a given industry would be able to obtain assistance in establishing long range financial guidelines. It was assumed that there were no transaction costs, no taxes and that the goal of the firm was the maximization of shareholder wealth. Financial decision making was classified into three subdivisions: the investment, the financing and the dividend decisions. Specific ratios were the independent variables specified to measure the relative efficiency of the three major decisions. The several independent variables were considered simultaneously in the iterative solution procedure and correlated with the dependent variable--the index of shareholder wealth appreciation.

The drug industry was selected for the study over the time period 1960 thru 1969. All data were obtained from the compustat tape. The steps used in the technique were as follows:

1) Compute a mean value for each dependent and each independent variable of the companies in the drug industry for 1960-1969;
2) Rank all drug companies from high to low based on the mean value of their dependent variable;
3) Normalize all values of independent variables on a scale from one to one hundred;
4) Select various combinations of weighting factors which sum to 1.00;
5) Multiply the various sets of weighting factors times each normalized value obtained in Step 3;
6) Compute a composite value by adding these component scores obtained in Step 5 for each firm;
7) Rank the composite values for each company from high to low;
8) Use each set of weighting factors as specified in Step 4 to run a Spearman Rho Rank Correlation Test between the rankings in Step 7 and Step 2;
9) Select the composite value arrived at in iterative solution procedure described above with the highest Spearman Rho coefficient--this will be the index of financial efficiency.

In this study the model developed an index of financial efficiency, using the Spearman Rho Rank Correlation Test. The results were significant at a confidence level of $\alpha = .01$. Next, it was shown how to apply sensitivity analysis in assisting the management of a firm to establish long range financial guidelines. Specifically, the model attempted to determine the levels of cash, inventories, receivables, fixed assets, long-term debt, cash dividend and current ratio that were correlated to performance of the firms in the drug industry on shareholder wealth appreciation. As explained in a previous chapter, the model was developed to assist management and not to be the sole determinant in establishing future financial guidelines.

The independent variables may not be at the optimum level but will be efficient relative to other firms in the drug industry. When considering the financial decision-makers within an enterprise--from the inside looking out--it is crucial to have some insight as to the efficient levels of cash, inventory, etc. to increase the relative efficiency of a firm's operations in their respective industry. The existing levels of cash, inventory, receivables, etc. are probably determined independently in practice with little consideration given to their combined influence on the major goal of the firm. Therefore, the

model considered several independent variables simultaneously and should provide the technique to assist in increasing the present level of efficient operation. If it accomplishes this purpose, it should be a valuable tool for internal management. On an ongoing basis, the first years data could be dropped and the most current years data could be added.

B. Limitations

The results of the study are pertinent to a specific industry for a given historical period of time. The technique can be applied, however, to any time period and to any industry. Since it covered a past interval of time, the crucial question is whether the future will be like the past. However, the study does give patterns of financial policy correlated to their success in shareholder wealth appreciation. There is evidence in the literature that long-range financial policy does not change drastically over time.[1]

The assumption that the goal of the firm is to maximize shareholder wealth could be a limitation; however, this goal is commonly recognized and agreed upon in the financial literature. "There is general agreement among economists and financial analysts that share price (stock-holder

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[1]Frame, op. cit.

wealth) maximization is the appropriate normative model for corporate behavior."[2]

Solomon says: "Even the centrally planned economies, which had earlier abolished 'profitability' and 'interest' as inventions of the capitalist devil, have begun to reintroduce these concepts in disguised form as guides to the more efficient utilization of scarce funds among competing uses. In doing so they too have wrestled with a basic issue of financial management: how should capital costs be measured and used in making optimal investment decisions?"[3]

It is believed that this assumption--maximization of shareholder wealth--is a valid objective for a business firm. The question then is: How is this achieved? Surely the efficient financial decision making of any firm should enhance this objective. To the extent that independent variables measure--at least in a relative sense within a given industry--the efficiency of these decisions the model should be an effective aid in long-range financial planning.

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[2]See Eugene M. Lerner and Willard T. Carleton, "Financing Decisions of the Firm," Journal of Finance, (May 1966), Vol. XXI, p. 202.

[3]Ezra Solomon, The Theory of Financial Management, New York: Columbia University Press, 1963, p. 7-8.

Since the compustat tape was used for the data in this study, the results are dependent upon the accuracy accomplished by Standard Statistics. By accuracy is meant the handling of accounting differences, industry classifications, and the placement of data on the tape.

The application of the statistical method in this study cannot offer proof of the existence of a causal relationship between selected variables. Statistical analysis with these methods can, however, provide valuable information concerning the possibility of a cause-and-effect relationship between the variables selected for analysis.

C. Contributions

It is hoped that this model will provide assistance to management in establishing long-range financial guidelines. The weighting factors arrived at should focus or re-focus attention to the more significant areas needing further detailed study and attention. Perhaps this study will stimulate further research and result in increased application of quantitative tools. The results of this study were encouraging.

Since this study was limited to large firms in the drug industry for which comprehensive financial data were obtainable, an area for future research would be to

extend the model to relatively smaller asset-sized firms in several different industries. It may even be desirable to extend the research across industry lines to attempt to uncover significant patterns of financial policy.

Several practical applications of the model could be extended to assist bankers, credit managers, and investors. Even if they do not have access to a computer, manual calculations on a small selected number of firms could be useful. The evaluation of business loans is an important function in our society--especially by commercial banks and other lending institutions. Obviously, the analysis of the loan applicant's financial statements is but one aspect of the entire evaluation process--but it is a very important aspect. Many of the variables used in the model are also common to business loan evaluation. Therefore, the model would seem to be useful in this business sector.

Important variables such as the purpose of the loan, its maturity, the security involved, the deposit status of the applicant, and the particular characteristics of the bank are not explicitly considered in the model; hence, the model should probably not be used as the only means of credit evaluation. The composite value or the index of financial efficiency score, however, can be used as a guide to lower the costs of investigation

of loan applicants. Less time would be spent on companies whose score is very high, i.e., above 50, while those with lower scores would signal a very thorough investigation. This points out the important advantage of the simplicity and low cost of the financial efficiency model.

An extremely important task of higher level management is to periodically assess inventory management, cash management, etc., without spending the time necessary for a detailed analysis. In addition it is somewhat awkward to ask for a detailed analysis of a specific operation in a firm without some justifiable reason. The suggestion here is that the financial efficiency model is able to predict corporate weaknesses, and thus could indicate to management the need for a thorough analysis which would possibly provide the means for a more efficient operation. Again, the simplicity and low cost of using this model makes it a valuable control device for higher level management.

The potentially useful applications of the model are not limited to credit evaluation purposes and internal control considerations only. An accurate predictor of successful firms--specifically market price appreciation--appears to be a valuable technique for screening out desirable investment opportunities. Admittedly, the analysis in this study was from only one industry, but the

potential implications for selection of firms to be held for long-term capital gains are of interest. If an individual already owns stock in a firm that has a low index of financial efficiency, a sale should prevent further loss and provide capital for alternative investments with higher index points. At least the use of this model could provide the rough screen to initiate a thorough detailed "value analysis" of fewer numbers of potentially desirable investment opportunities. Further investigation, however, is required on this subject.

BIBLIOGRAPHY

BIBLIOGRAPHY

Altman, Edward Ira. "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." Journal of Finance, Vol. XXIII, No. 4 (September, 1968), 589-609.

Beaver, W. H. "Financial Ratios as Predictors of Failure." Empirical Research in Accounting: Selected Studies 1966. Institute of Professional Accounting, University of Chicago, (January, 1967), 71-111.

Compustat Information Manual. April 1970.

Compustat Tape. Standard Statistics Company Inc., 1971.

Davis, T. C. "How the du Pont Organization Appraises Its Performance." Financial Management Series. No. 94. New York: American Management Association Treasurer's Department, 1950.

Foulke, Roy A. Practical Financial Statement Analysis. 6th ed. New York: McGraw-Hill Book Company, 1968.

Frame, Robert Jess. "Corporate Financial Policy and Growth: A Behavioral Model." Unpublished Ph.D. dissertation, University of Colorado, 1966.

Gupta, Manak Chand. "A Synchronic Study of Corporate Financial Structures, 1961-1962." Unpublished Ph.D. dissertation, University of California, Los Angelos, 1967.

Key Business Ratios in 125 Lines 1968: Retailing, Wholesaling, Mfg., Construction. Dunn and Bradstreet Inc., New York.

Kraus, Ralph Michael. "Empirical Testing of New Managerial Control Ratios." Unpublished Ph.D. dissertation, University of Pittsburg, 1967.

Latané, Henry A. and Tuttle, Donald L. Security Analysis and Portfolio Management. New York: The Ronald Press Company, 1970.

Lerner, Eugene M. and Carleton, Willard T. "Financing Decisions of the Firm," Journal of Finance, Vol. XXI (May 1966), 202.

Manne, Henry G. "Mergers and the Market for Corporate Control," The Journal of Political Economy, LXXIII, No. 2 (April, 1965), 112-113.

Mendenhall, William. Introduction to Probability and Statistics. Belmont, California: Wadsworth Publishing Company, Inc., 2nd ed. 1968.

Solomon, Ezra. The Theory of Financial Management. New York: Columbia University Press, 1963.

Stone, James S. "Conglomerate Mergers: Their Implications for the Efficiency of Capital and the Theory of the Firm." Unpublished Master's Thesis, Harvard University, 1969.

The Robert Morris Associates Annual Statement Studies. Philadelphia: Robert Morris Associates, 1958 - 1966.

Vance, Mr. "Is Your Company a Takeover Target?" Harvard Business Review, (May-June 1969), 93-98.

Van Horne, James C. Financial Management and Policy. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

Wall, Alexander. How to Evaluate Financial Statements. New York and London: Harper and Brothers Publishers, 1936.

Weston, J. Fred and Brigham, Eugene F. Essentials of Managerial Finance. New York: Holt, Rinehart and Winston, 1968.

GENERAL REFERENCES

Bock, Betty. "Mergers and Markets," The Conference Board Studies in Business Economics. No. 105, 1969, 112-114.

_____. "Emerging Questions on Efficiency, Competition, and Antitrust." The Conference Board Record, (November 1968), 37.

Bodenhorn, Diran. "A Cash Flow Concept of Profit." Journal of Finance, XIX (March, 1964).

Bogen, Jules I. Financial Handbook. 4th ed. New York: The Ronald Press Company, 1965.

Conover, W. J. Practical Nonparametric Statistics. New York: John Wiley & Sons, Inc., 1971.

Dean, Joel. Capital Budgeting. New York: Columbia University Press, 1951.

Donaldson, Gordon. "Financial Goals; Management vs. Stockholders." Harvard Business Review, (May-June, 1963).

Findaly III, M. Chapman and Williams, Edward E. An Integrated Analysis for Managerial Finance. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970.

Friedman, Milton. "The Methodology of Positive Economics." Essays in Positive Economics. Chicago: University of Chicago Press, 1953.

Gordon, Myron J. "Dividends, Earnings and Stock Prices." Review of Economics and Statistics, XLI (May, 1959).

_____. The Investment, Financing and Valuation of the Corporation. Homewood, Ill.: Richard D. Irwin, Inc., 1962.

_____. "Optimal Investment and Financing Policy." and "The Savings Investment and Valuation of a Corporation." Review of Economics and Statistics. XLIV, (February, 1962).

Grunewald, Adolph E., and Nemmers, Erwin Esser. Basic Managerial Finance. New York: Holt, Rinehart and Winston, Inc., 1970.

Helfert, Erich A. Techniques of Financial Analysis. Homewood, Illinois: Richard D. Irwin, Inc., Rev. ed. 1967.

Mason, Robert D. Statistical Techniques in Business and Economics. Homewood, Illinois: Richard D. Irwin, Inc., 1967.

Miller, Merton H., and Modigliani, Franco. "Dividend Policy, Growth, and the Valuation of Shares." Journal of Business, XXXIV (October, 1961).

Moody's Industrial Manual. New York: Moody's Investors Service, Inc., 1959 through 1969.

Myers, John N. Financial Statement Analysis, 3rd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1969.

Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill Book Company, 1956.

U.S. Department of Agriculture, "Diversification and Profitability among Large Food Processing Firms," Economic Research Service Apriculture Economic Report No. 171, Washington, D.C. (January, 1970).

Walter, James E. Dividend Policy and Enterprise Valuation. Belmont, California: Wadsworth Publishing Co., 1967.

_____, "Dividend Policy: Its Influence on the Value of the Enterprise." Journal of Finance. XVIII (May, 1963).

Various corporate annual reports.

APPENDICES

APPENDIX A

APPENDIX A

Compustat classification of drug companies

1. Abbott Laboratories
2. American Home Products Corporation
3. American Hospital Supply Corporation
4. American Sterilizer Company*
5. Ansul Company*
6. Baxter Laboratories**
7. Becton Dickinson Company*
8. Bristol-Myers Company
9. Carter Wallace Incorporated**
10. Cutter Laboratories**
11. Forest Laboratories*
12. Gillette Company
13. Johnson/Johnson
14. Kendall Company
15. Lily Eli Company
16. Merck & Company
17. Miles Laboratories Incorporated
18. Parke Davis and Company
19. Pfizer Uchasco and Company
20. Plough Incorporated**
21. Richardson-Merrell Incorporated
22. Robins (A.H.) Company*
23. Schering Corporation
24. Searle G.D. Company**
25. Smith Kline/French Laboratories Inc.
26. Sterling Drug Incorporated
27. Syntex Corporation**
28. Upjohn Company
29. Warner-Lambert Pharmaceutical Co.

* Eliminated because of insufficient data.

** Eliminated because mean value total assets and/or total sales less than $100 million.

APPENDIX B

APPENDIX B

Compustat industrial definitions

1. CASH AND EQUIVALENT

   A. "Cash and Equivalent" includes all cash, government marketable and other securities listed in the current asset section.

   B. Letters of credit are included.

   C. Margin deposits on commodity futures contracts are included.

   D. U.S. Government securities are included, regardless of whether stated by the company as a current asset or netted against tax liability in the current section on the liability side of the balance sheet.

   E. Excluded from cash and equivalent are the following:

      1. Money due from sale of debentures (treated as receivable);

      2. Commercial paper issued by unconsolidated subsidiaries to parent company (treated as receivable);

      3. Cash surrender value of life insurance (treated as non-current asset);

      4. Bullion, bullion in transit, uranium in transit, etc. (treated as an inventory item);

2. RECEIVABLES

   A. "Receivables" represent claims against others (after applicable reserves) collectible in money generally within 12 months. This includes,but is not limited to:

      1. Trade, miscellaneous and other receivables;

      2. Amounts due from unconsolidated subsidiaries;

3. Income tax refunds;

4. Money due from sales of securities;

5. Unbilled shipments;

6. Amounts due from officers and employees when listed as current asset;

7. Property to be sold under lease-back arrangement;

8. Commercial paper issued by unconsolidated subsidiaries to parent company;

B. Excluded from receivables are the following items:

1. Advances on material purchases (treated as inventory item);

2. Work in process and advances to subcontractors (treated as inventory item);

3. U.S. Government contract billings and expensed contracts (treated as inventory items);

4. Reserves for unearned charges on commercial installment and equipment lease receivables and reserves for losses for finance companies (receivables are stated after deducting these items).

3. INVENTORIES

A. "Inventories" represent merchandise bought for resale and materials and supplies purchased for use in production of revenue. Inventories include among other items:

1. Deposits and/or advances on material purchases;

2. U.S. Government contract billings and expensed contracts;

3. Work in process and advances to subcontractors (net of progress payments);

4. Advance manufacturing costs;

5. Bullion in transit, bullion, uranium in transit, etc.;

6. Revenue stamps;

7. Unbilled costs on U.S. Government contracts;

8. For motion picture companies advances to other producers;

9. Advances to planters (when classified as a current asset);

10. Merchandise in transit;

11. For real estate companies, land purchase option deposits;

12. For distillers, storage charges.

13. For motion picture companies film costs and distribution rights.

B. Excluded from inventories are the following items:

1. Tools that are listed in current asset section (treated as other current assets);

2. Supplies and prepaid expenses for companies that lump these items together (treated as other current assets);

3. Unbilled shipments (treated as receivable);

4. Growing crops (treated as non-current asset);

5. Bottles cases and kegs (treated as property item);

4. TOTAL CURRENT ASSETS

A. "Total Current Assets" represent cash and other assets which in the next 12 months are expected to be realized in cash or used up in the production of revenue.

B. Prepayments when listed separately and not as prepayments, etc., prepayments and deferred charges

or deferred charges are included in total current assets. The latter categories are considered non-current assets unless listed in the company's public reports as current assets. Prepayments for American Telephone & Telegraph are treated as non-current assets at the company's request.

C. U.S. Government securities, whether listed as current assets by the company or netted against tax liability in the current section on the liability side of the balance sheet are treated as current assets.

D. For finance companies, repossessions are included.

E. Growing crops are excluded (treated as non-current assets).

F. Cash surrender value of life insurance is excluded (treated as non-current asset).

5. TOTAL CURRENT LIABILITIES

A. "Total Current Liabilities" represent liabilities due within one year, including the current portion of long term debt.

B. U.S. Government securities are not deducted from tax liability in current liabilities (treated as current asset).

C. Customers' deposits on bottles, cases, kegs, etc., are excluded from current liabilities (treated as long-term liability).

D. For finance companies, reserves for unearned insurance premiums are excluded from current liabilities (treated as other non-current liabilities).

E. For retail companies, deferred income taxes due to installment sales are included.

6. TOTAL ASSETS

A. "Total Assets" represent current assets plus net plant plus other non-current assets (including intangible assets and deferred items).

B. Treasury stock carried by the company on the asset side of the balance sheet in its public reports is netted against preferred or common stock respectively on the liability side. Shares held specifically for officers and employees funds (incentive compensation, pension and profit sharing) are not considered treasury stock. However, shares held for officer and employees stock option plans are considered treasury stock and netted against preferred or common stock respectively on the liability side.

C. U.S. Government securities that have been netted by the company in its public reports against tax liability side of the balance sheet are considered as current assets.

7. LONG TERM DEBT

A. "Long-Term Debt" represents debt obligations due after one year.

B. Purchase obligations and payments to officers (when listed as long term liabilities) are included as long-term debt.

C. Notes payable, due within one year and to be refunded by long-term debt, when carried as a non-current liability are included in long-term debt.

D. Subsidiary preferred stock is excluded (treated as other liability).

E. The current portion of long-term debt is excluded (treated as current liability).

8. COMMON EQUITY

A. "Common Equity" represents common stock plus the following items:

1. Surplus;

2. Surplus reserves (contingencies, insurance, etc.);

3. Unamortized debt premium;

4. Capital stock premium;

5. Excess value of net assets over cost (negative intangible) less the following items:

    1. Common treasury stock;

    2. Intangibles (see Item # 33);

    3. Unamortized debt discount and expense;

    4. Capital stock expense;

    5. Accumulated unpaid preferred dividends;

    6. Excess of involuntary liquidating value of outstanding preferred stock over carrying value;

    7. For finance companies, deferred development costs.

B. Deferred taxes and investment credit (Balance Sheet) are not included in this figure.

C. Negative equity figures are shown where applicable.

9. NET SALES

Annual Data

1. "Net Sales" represent gross sales and other operating revenue less discounts, returns and allowances.

2. Royalty income is included.

3. For retail companies, sales of leased departments are included, when available.

4. For shipping companies, operating differential subsidies are included.

5. For shipping companies, income on reserve fund securities is included when shown separately.

6. For finance companies, earned insurance premiums are included.

7. For airline companies, net mutual aid assistance is included.

8. For cigar, cigarette, oil, rubber and liquor companies, net sales are after deducting excise taxes.

9. For finance companies, sales are after deducting net losses on factored receivables purchased.

10. Income derived from equipment rental is considered part of operating revenues.

10. AVAILABLE FOR COMMON

Annual Data

1. "Available for Common" represents net income less preferred dividend requirements.

2. Normally, the preferred dividend requirements used in this calculation will be the same as the preferred dividends declared.

   a. If more or less than four quarterly preferred dividends are declared in one year (where dividends are declared quarterly), then preferred dividend requirements will be used in calculating available for common;

   b. If all convertible preferred stock is converted into common during the year, no preferred dividends are deducted in calculating available for common;

   c. If common stock is issued by the company in exchange for preferred stock of another company, the dividends on the old preferred stock are disregarded in calculating available for common.

11. COMMON DIVIDENDS

A. "Common Dividends" represent the dividends (other than stock dividends) declared on the common stock of the company during the year.

B. Dividends declared by a company which is merged on a pooling of interests basis are included for the

year of the merger, including dividends on preferred stock of a merged company which was exchanged for common stock.

C. Dividends declared in stock of other corporations, excluding spin-offs, are included.

D. Dividends declared in preferred stock are included.

E. Subsidiary dividends (other than preferred, which are treated as a fixed charge) are excluded (treated as a minority interest).

12. PRICE - HIGH, LOW, AND CLOSE

Annual Data

1. "Price - High, Low and Close" represents the absolute high, low and close transactions during the year for companies on national stock exchanges and bid prices for Over-the-Counter issues.

2. Prices are reported on a calendar-year basis, regardless of the company's fiscal year-end.

3. Prices in COMPUSTAT are adjusted for all stock splits and stock dividends that occurred in the calendar year, except for fiscal year companies which have declared stock splits and dividends between the end of the fiscal year and the end of the calendar year. In those instances, the stated prices are not adjusted. This enables the user to adjust prices, shares traded and per share statistics with a single adjustment factor, as with calendar year companies.

4. Prices are indicated in eights, with the digit after the decimal designating eighths. The following table illustrates the method used:

Stock Price	Figure on Tape
20	20.0
20 1/8	20.1
20 1/4	20.2
20 3/8	20.3
20 1/2	20.4
20 5/8	20.5
20 3/4	20.6
20 7/8	20.7

5. The primary source for back price data was Bank & Quotations Record, with these figures adjusted by Standard Statistics for stock splits and stock dividends which occurred during the reporting year, except as indicated in paragraph 3 above. Beginning in 1964 prices were derived from the S & P Stock Guide, data for which is obtained directly from the Associated Press which compiles the information electronically.

6. The method of adjusting data for stock splits and stock dividends that occurred subsequent to the reporting year is explained in the adjustment factor section of these definitions.

13. NUMBER OF COMMON SHARES OUTSTANDING

Annual Data

1. "Number of Common Shares Outstanding" represents the net number of common shares outstanding at year-end, excluding treasury shares and scrip. Shares held specifically for officers and employees' funds (incentive compensation, pension and profit sharing) are not considered treasury stock. However, shares held for officer and employee stock option plans are considered treasury stock and netted against preferred or common stock respectively on the liability side.

2. Shares paid in stock dividends are included, where the stock of record date falls within the year and the payment date the next year.

14. DIVIDENDS PER SHARE

Annual Data

1. "Dividends Per Share" represents the cash dividend per share paid during the reporting year, adjusted for all stock splits and stock dividends that occurred during the year. This field, unlike the common dividends field, excludes payments in preferred stock in lieu of cash, spinoffs, and stock of other corporations.

2. The method of adjusting dividends per share for stock splits and stock dividends that occurred subsequent to the reporting year is explained in the adjustment factor section which follows.

15. ADJUSTMENT FACTOR

Annual Data

1. The "Adjustment Factor" is an annual number which enables the user to correct reported per share data, such as price, earnings per share, dividends per share, etc., for all stock splits and stock dividends that occurred subsequent to the end of the year in which the original data was reported. These factors, applied to per share data for earlier years, in effect, convert such data into terms of the current share units.

2. The adjustment factors for all years will be changed whenever a stock split or stock dividend occurs. The factors are carried to six decimal places in order that rounding errors will be minimized.

3. When no changes in capitalization have occurred because of splits and dividends, the adjustment factors are indicated as 1.000000. If for example, a 2-for-1 split occurred in 1962, the adjustment factor for 1961 would be indicated as 2.000000. If, in addition, a 2% stock dividend occurred in 1961, the adjustment factor for 1960 would be indicated by 2.040000.

4. To adjust price to a current units basis, divide the indicated price for each year by the corresponding adjustment factor. To convert shares traded to an equivalent current basis, the reported shares traded are multiplied by the corresponding adjustment factor.

5. To compute adjusted per share statistics, except dividends per share, (e.g. earnings per share, sales per share, etc.) multiply the number of shares outstanding by the corresponding adjustment factor and use this adjusted total number of shares adjustment factor.

6. Since dividends per share are indicated separately on the tape, adjustments to this figure are obtained directly by dividing the indicated dividends per share by the corresponding adjustment factor.

7. To enable the user to adjust per share statistics, price and shares traded with a single adjustment factor as with calendar year companies, the prices and the shares traded for fiscal year companies are not adjusted on the tape for stock splits and dividends that took place between the end of the fiscal year and the end of the calendar year.

8. On calendar year companies, the stock of record date is used as a guide in determining adjustment of per share data in any year.

16. COST OF GOODS SOLD

A. "Cost of Goods Sold" includes all costs directly allocated by the company to production such as material, labor and overhead, etc.

B. Total operating costs are considered cost of goods sold for non-manufacturing companies.

C. Included in this caption are:

1. Taxes other than income charged to cost of sales. When no breakdown is available, the total amount will be included.

2. Pension retirement and other employee benefits when listed separately will be included.

D. Excluded from cost of goods sold are the following items:

1. Depreciation and amortization charged to cost of sales. When no breakdown is available, the total amount will be deducted.

2. Director's fee and remunerations.

17. RESEARCH & DEVELOPMENT EXPENSES

"Research & Development Expenses" include all costs incurred, such as salaries, departmental expenses, etc., which are charged to operations as research expense. For mining, gas and oil companies, exploration expenses are included.

18. EARNINGS PER SHARE AS REPORTED (Before extraordinary items net of tax)

Annual Data

"Earnings Per Share as Reported" represents the per share earnings figure as reported by the company. Figure reported may be different from earnings per share calculated from information on the tape due to company's presentation of primary earnings per share or the weighted average number of common shares used to compute earnings per share.

APPENDIX C

```
$JOB,465871,CARLSON,3.0,APJM
$FOR,L
      PROGRAM COMPRANK
C      COMPRANK 1.3                    18 COMPANIES
C                        VARIABLES 1-9
      COMMON  X(24,9), COMP(24), WT(700),Z(24,7),
     1                                ORD1(24), ORD2(24), ORD3(24) ,
     2    ORD4(24), ORD5(24), ORD6(24),ORD7(24), ORD8(24), ORD9(24)
     3 , ORD10(24)
      DIMENSION Y(90)
C ***************************************************************
      DATA(MM=18)
C ***************************************************************
C ***************************************************************************
      DATA(NWT=49)
C ***************************************************************************
C       MARCH  1971
C       MM= NO. OF COMPANIES
C     ARRAYS ORD CONTAIN VALUES IN ORIGINAL ORDER OF COMPANIES (1-24)
C       NWT= NO. OF WT COMBINATIONS INPUT
C      5 VAR.  INV TURN  X2, FXAS TURN  X4,  PAY RATIO  X5,
C      DEBT RATIO  X8,  CASH TURN  X9 ,
      PRINT 3
    3 FORMAT(1H1)
      NCOUNT = 0
C       MM= NO. OF COS.
   10 FORMAT
     1(9(2X,F6,  3( 1X,F7), 18X, F6, 2( 1X,F9) / 14X, F6,4X,F6 / ),
     22X,F6,      3( 1X,F7), 18X, F6, 2( 1X,F9) / 14X, F6,4X,F6)
      M=1
      DO  100 N=1,24
      READ  10, Y
C      18 COMPANIES
      IF(N.EQ.4.OR.N.EQ.6.OR.N.EQ.7.OR.N.EQ.16.OR.N.EQ.19
     1 .OR.N.EQ.22) GOTO 100
C ***************************************************************************
C      MEAN FOR 10 YEARS
      K =1
      DO 50 J=1,9
C ***************************************************************************
      X(M,J) =(Y(K) + Y(K+9) + Y(K+18) + Y(K+27) +Y(K+36) + Y(K+45)
     1          +Y(K+54) +Y(K+63) +Y(K+72) + Y(K+81))/10.0
C ***************************************************************************
   50 K=K+1
      PRINT 20, (X(M,J),J=1,9)
```

```
   20 FORMAT(1H0, 9(1X,F10.4))
      M=M+1
  100 CONTINUE
C     NWT*7 = LENTH OF ARRAY WT  = NWTN
      NWTN=NWT*7
C     READ  WEIGHTS
      READ  400, (WT(I),I=1,NWTN)
  400  FORMAT (7F2.2)
      IF(EOF(60) 99,98
   98 CONTINUE
   99 CONTINUE
      CALL ORDER(MM,1)
C     RANK  THE 9 VARIABLES
      DO 200 J=1,9
      CALL RANK(J,1)
C      VAR 6 AND 7 ARE NOW RANKED MEANS
C     VAR 1-4,5,8,9ARE   RANKED MEANS IN ARRAY X
  200 CONTINUE
C ***************************************************************
      PRINT 30, ((X(I,J),J=1,9),I=1,MM)
   30 FORMAT(1H1, *    RANK MEANS * / 24(1H0,9F10.4, / ))
C ***************************************************************
      CALL NORMAL(MM)
C     VAR 1-4,5,8   ARE NORMALIZED SCORES  IN ARRAY Z (IN ORIGINAL ORDER) 1-MM
      DO 300 M=1,NWT
      CALL COMPOSIT(MM)
      CALL PRINT(MM)
  300 CONTINUE
      END
      SUBROUTINE RANK (VR,JP)
      COMMON  X(24,9), COMP(24)
      TYPE INTEGER VR
C ***************************************************************************
      DATA(MM=18)
C ***************************************************************************
      GO TO (1,2)JP
    1 DO 50  I = 1,MM
      DO 50  J=1,MM
      IF(X(I,VR) .LT.X(J,VR)) 10,20
   20 TEMP =X(I,VR)
      X(I,VR) =X(J,VR)
      X(J,VR) = TEMP
   10 CONTINUE
   50 CONTINUE
      RETURN
```

```
      2 DO 70 I =1,MM
        DO 70 J=1,NN
        IF(COMP(I).LT.COMP(J))80,90
     90 TEMP=COMP(I)
        COMP(I)= COMP(J)
        COMP(J)= TEMP
     80 CONTINUE
     70 CONTINUE
        END
        SUBROUTINE NORMAL (NN)
        COMMON  X(24,9), COMP(24), WT(700),Z(24,7),
       1                            ORD1(24), ORD2(24), ORD3(24) ,
       2     ORD4(24), ORD5(24), ORD6(24),ORD7(24), ORD8(24), ORD9(24)
       3 , ORD10(24)
        DIMENSION ZR(24,7)
C       NORMALIZE VALUES INTO ARRAY Z    KEEPING ORIGINAL ORDER 1 THRU NN
C       INDEP VAR = 1-5 AND 8,9
C       SET  MEANS  FROM 1 - 100   100 FOR HIGHEST  FOR ALL BUT PAYRATIO
        NNN=NN-1
C       VAR   1
        I=1
        DO221  K=2,NNN
        DO  21  N= 1, NN
        IF (X(K,1).EQ. ORD4(N)) 80,21
     80 Z(N,1) = (X(K,I) - X(NN,I)) *  99.0  / (X(1,I) - X(NN,I))  +1.0
        GOTO 221
     21 CONTINUE
    221 CONTINUE
C       VAR   2
        I=2
        DO  222 K=2,NNN
        DO  22   N= 1,NN
        IF(X(K,2).EQ.ORD5(N))81,22
     81 Z(N,2) = (X(K,I) - X(NN,I)) *  99.0  / (X(1,I) - X(NN,I))  +1.0
        GOTO 222
     22 CONTINUE
    222 CONTINUE
C       VAR  3
        I=3
        DO 223  K=2,NNN
        DO  23  N=1,NN
        IF(X(K,3).EQ.ORD6(N))82,23
     82 Z(N,3) = (X(K,I) - X(NN,I)) *  99.0  / (X(1,I) - X(NN,I))  +1.0
        GOTO 223
     23 CONTINUE
```

```
 293 CONTINUE
C      VAR   4
       I=4
       DO 224  K= 2*NNN
       DO  24  N =1*NN
       IF(X(K+4) .EQ.ORD7(N)) 83,24
  83 Z(N+4) = (X(K+I) - X(NN+I)) *  99.0  / (X(1+I) - X(NN+I))   +1.0
       GOTO 224
  24 CONTINUE
 224 CONTINUE
C       VAR 8
       DO 331 K=2*NNN
       DO  31  N=1* NN
       IF(X(K+8).EQ.ORD9(N)) 25,31
  25 Z(N+6) = (X(K+8) - X(NN+8)) *  99.0 / (X(1+8) - X(NN+8))  +1.0
       GOTO 331
  31 CONTINUE
 331 CONTINUE
C      VAR 9
       DO 361 K=2*NNN
       DO 61 N=1*NN
       IF(X(K+9).EQ.ORD10(N))   65,61
  65 Z(N+7)=(X(K+9)-X(NN+9))*99.0 / (X(1+9)-X(NN+9)) +1.0
       GOTO 361
  61 CONTINUE
 361 CONTINUE
C      PAY RATIO
C      VAR  5
       RANGE = X(1+5) - X(NN+5)
       D0441 K=2*NNN
       DO  41     N= 1*NN
       IF(X(K+5).EQ.ORD8(N)) 35,41
  35 Z(N+5) = (X(1+5) - X(K+5)) *  99.0 / RANGE   +1.0
       GOTO 441
  41 CONTINUE
 441 CONTINUE
C     SET HI MEAN TO 100 LO TO 1
       DO  120  N=1*NN
       IF (X(1+1).EQ.ORD4(N)) 115,116
 115 Z(N+1) = 100
 116 IF(X(NN+1).EQ.ORD4(N))141,120
 141 Z(N +1)=1
 120 CONTINUE
       DO  121  N=1*NN
       IF (X(1+2).EQ.ORD5(N)) 117,118
```

```
117 Z(N+2) = 100
118 IF(X(NN+2)+EQ+ORD5(N))142+121
142 Z(N+2)=1
121 CONTINUE
      DO  122  N=1+NN
      IF (X(1+3)+EQ+ORD6(N)) 131+132
131 Z(N+3) = 100
132 IF(X(NN+3)+EQ+ORD6(N))143+122
143 Z(N+3)=1
122 CONTINUE
      DO  123  N=1+NN
      IF (X(1+4)+EQ+ORD7(N)) 133+134
133 Z(N+4) = 100
134 IF(X(NN+4)+EQ+ORD7(N))144+123
144 Z(N+4)=1
123 CONTINUE
      DO  124  N=1+NN
      IF (X(1+8)+EQ+ORD9(N)) 135+136
135 Z(N+6) = 100
136 IF(X(NN+8)+EQ+ORD9(N))145+124
145 Z(N+6)=1
124 CONTINUE
C ***********************************************************************
C ***********************************************************************
C       SET ZERO VALUES OF VAR 8 TO 1+0      ( FOR 18 COS+)
      Z(11+8)=Z(15+8)=Z(17+8)=1+000
C ***********************************************************************
C ***********************************************************************
      DO 174 N=1+NN
      IF(X(1+9)+EQ+ORD10(N)) 175+176
175 Z(N+7)=100
176 IF(X(NN+9)+EQ+ORD10(N)) 185+174
185 Z(N+7)=1
174 CONTINUE
C     SET HI MEAN TO 1  LO TO  100
      DO  125  N=1+NN
      IF(X(1+5)+EQ+ORD8(N)) 161+162
161 Z(N+5)=1
162 IF(X(NN+5)+EQ+ORD8(N))163+125
163 Z(N+5)=100
125 CONTINUE
      PRINT 60+ ((Z(I+J)+J=1+7)+I=1+NN)
 60 FORMAT(1H1+ 2A(2X+ 7F9+3 / ))
C ***********************************************************************
C       RANK NORMALIZED SCORES IN ARRAY ZR
```

```
      DO 700 I=1,NN
      DO 700 J=1,7
  700 ZR(I,J)=Z(I,J)
      DO 702 J=1,7
      DO 701 I=1,NN
      DO 701 K=1,NN
      IF(ZR(I,J).LT.ZR(K,J)) 703,701
  703 TEMP=ZR(I,J)
      ZR(I,J)=ZR(K,J)
      ZR(K,J)=TEMP
  701 CONTINUE
  702 CONTINUE
      PRINT 704,((ZR(I,J),J=1,7),I=1,NN)
  704 FORMAT(1H1, *      ZR      * / 24(1X,7F10.3 / ) )
C *****************************************************************
      RETURN
      END
      SUBROUTINE  ORDER (NN,JP)
      COMMON  X(24,9), COMP(24), WT(700),Z(24,7),
     1                              ORD1(24), ORD2(24), ORD3(24) ,
     2    ORD4(24), ORD5(24), ORD6(24),ORD7(24), ORD8(24), ORD9(24)
     3 , ORD10(24)
C     ARRAYS ORD CONTAIN VALUES IN ORIGINAL ORDER OF COMPANIES (1-24)
C     TO KEEP TRACK  OF  COMPANIES IN  ORDER   1-NN (BEFORE RANKING)
C     ORD1= ORDER OF 1ST DEP  VAR  PRICEAPP, ORD2=ORDER OF 2ND DEP VAR
C     SHAREWEAL (VAR  NO. 6 AND 7)
C     ORD3 = ORDER OF COMPOSIT SCORE
C       ORD4 = ORDER OF 1 ST INDEP VAR (X1)
C       ORD5 = ORDER OF 2 ND INDEP VAR (X2)
C       ORD6 = ORDER OF 3 RD INDEP VAR (X3)
C       ORD7 = ORDER OF 4 TH INDEP VAR (X4)
C       ORD8 = ORDER OF 5 TH INDEP VAR (X5)
C       ORD9 = ORDER OF 6 TH INDEP VAR (X8)
C       ORD10= ORDER OF THE 7 TH INDEP VAR (X9)
      GO TO (1,2) JP
    1 DO  50  I=1,NN
      ORD1(I) = X(I,6)
      ORD2(I) = X(I,7)
      ORD4(I)=X(I,1)
      ORD5(I)=X(I,2)
      ORD6(I)=X(I,3)
      ORD7(I)=X(I,4)
      ORD8(I)=X(I,5)
      ORD9(I)=X(I,8)
      ORD10(I)=X(I,9)
```

```
   50 CONTINUE
      PRINT 51, (ORD1(I),ORD2(I),I=1,NN)
   51 FORMAT(1H1, *  ORD1        ORD2 * / 24(1X,F10.4,2X,F10.4 / ))
      PRINT 52, (ORD4(I),ORD5(I),ORD6(I),ORD7(I),ORD8(I),ORD9(I) ,
     1 ORD10(I), I=1,NN)
   52 FORMAT(1H1, *  ORD4      ORD5        ORD6          ORD7          ORD8
     1         ORD9      ORD10  * /
     2                  24(1X,F8.4,2X,F8.4,2X,F8.4,2X,F8.4,2X,F8.4,2X,
     3 F8.4,2X, F8.4 / ))
      RETURN
    2 DO  60  I=1,NN
      ORD3(I) = COMP(I)
   60 CONTINUE
      RETURN
      END
      SUBROUTINE  COMPOSIT  (NN   )
      COMMON  X(24,9), COMP(24), WT(700),Z(24,7),
     1                           ORD1(24), ORD2(24), ORD3(24) ,
     2    ORD4(24), ORD5(24), ORD6(24),ORD7(24), ORD8(24), ORD9(24)
     3 , ORD10(24)
      DATA(L=1)
C     COMPOSITE SCORE = WEIGHTS * NORMALIZED SCORES FOR THE INDEP VAR
C     SUMMED FOR THE NO. OF INDEP VAR
C     COMPOSITE SCORE =  WT1 * INDEPVAR1 + WT2*IV2 + WT3*IV3  +
C                        WT4 * IV4 + WT5 * IV5  + WT6 * IV6 + WT7*IV7
C     WTS VARY  IN  INCREMENTS OF .1, SUM = 1.0
  500 DO 250 I = 1,NN
      COMP(I)= (WT(L)*Z(I,1)) + (WT(L+1)*Z(I,2)) + (WT(L+2)*Z(I,3))
     1  +  (WT(L+3)*Z(I,4)) + (WT(L+4)*Z(I,5)) + (WT(L+5)*Z(I,6))
     2  + (WT(L+6)*Z(I,7))
      Z(I,1)=0.0  $  Z(I,3)=0.0
  250 CONTINUE
      L=L+7
      CALL ORDER(NN,2)
      CALL RANK (1,2)
C   COMPUTATIONS FOR COMPOSITE DONE
      RETURN
      END
      SUBROUTINE PRINT (NN)
      COMMON  X(24,9), COMP(24), WT(700),Z(24,7),
     1                           ORD1(24), ORD2(24), ORD3(24) ,
     2    ORD4(24), ORD5(24), ORD6(24),ORD7(24), ORD8(24), ORD9(24)
     3 , ORD10(24)
      DIMENSION IRANKX6(24),IRANKX7(24), IRANKCOM(24)
      DATA (N1=1), (N2=7)
```

```
C       INDEP VAR NAMES
        DIMENSION IWT(7)
        DATA( IWT = 8HCURRATIO,8HINV TURN,8HREC TURN,8HFXASTURN,
       1  8HPAYRATIO,8HDEBTRATE,8HCASHTURN )
C ***************************************************************************
C       NAMES FOR 18 COMPANY ANALYSIS
        DIMENSION IC018(18)
        DATA(IC018= 8H ABBOTT ,8HAMERHOME,8HAMERHOSP,8HBRISTOLM,
       1 8HGILLETTE,8H J / J  ,8HKENDALL ,8HELILILLY,8H MERCK  ,
       2 8HMILESLAB,8HPARKEDAV,8H PFIZER ,8HRICHMERL,8HSCHERING,
       3 8HSMITHKLI,8HSTERLING,8H UPJOHN ,8HWARNLAMB )
C ***************************************************************************
C       PRINTS  RANKING OF  INDEP VAR , COMPOSIT, WTS,  RHO
C       ASSIGNING  ORGINAL  CO, NO, 1-NN      AND   RANK
C       I = CO, NO,  1-NN
C      ARRAYS ORD CONTAIN VALUES IN ORIGINAL ORDER OF COMPANIES (I=24)
C        VAR 6 AND 7 ARE NOW RANKED MEANS
C      VAR 1-4,5,8,9ARE   RANKED MEANS IN ARRAY X
        PRINT 150, IWT ,
       1          (WT(I),I=N1,N2)
  150 FORMAT(1H1,*      WEIGHTS      * /
       1 7(1X,A8) / 7(2X,F4.2,3X))
        RHO=0.0
        N1=N1+7
        N2=N2+7
C       DEP  VAR X6 PRICEAPP
        DO 60  I = 1,NN
C       J  = RANKED  VALUE
        DO 50    J = 1, NN
        IF(X(J,6).EQ.ORD1(I)) 10,20
   10 IRANKX6(I) = J
        GOTO 60
   20 CONTINUE
   50 CONTINUE
   60 CONTINUE
C       DEP VAR X7 (SHARE WEALTH)
        DO 61  I=1,NN
        DO 51  J=1,NN
        IF(X(J,7).EQ.ORD2(I)) 15,25
   15 IRANKX7(I)=J
        GOTO 61
   25 CONTINUE
   51 CONTINUE
   61 CONTINUE
        DO 62 I=1,NN
```

```
      DO 52 J=1,NN
      IF(COMP(J).EQ.ORD3(I)) 30,52
   30 IRANKCOM(I) = J
      GOTO 62
   52 CONTINUE
   62 CONTINUE
      PRINT 90
   90 FORMAT (1H0, *  DEP  VAR SHARE WEAL AND  COMPOSIT SCORE - COS 1-N*
     1       / 1H0, *    X7        RANK      COMP     RANK    COMPANY *  )
      DO  200  I = 1,NN
C ***************************************************************************
      PRINT   100,I,ORD2(I),IRANKX7(I),ORD3(I),IRANKCOM(I) ,ICO18(I)
C ***************************************************************************
  200 CONTINUE
  100 FORMAT( 1X,I2,    1X,F9.4,2X,I2,3X,F8.4,2X,I2,  2X,A8)
C     COMPUTE  SPEARMAN  RANK CORRELATION (RHO)
      DO  400  I = 1,NN
  400 RHO=(IRANKX7(I)-IRANKCOM(I)) ** 2 + RHO
      RHO= 1.0-((6.0*RHO)/ (NN**3 - NN))
      PRINT  450, RHO
  450 FORMAT (5 (/), 10X, * RHO = * F5.3)
      RETURN
      END
!RUN,3,3000
```