An Empirical Test of Financial Theory Relating to Utilities in the Capital Market

Gary Owen Glenn
MANUSCRIPT THESSES

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MASTER OF BUSINESS ADMINISTRATION

AN EMPIRICAL TEST OF FINANCIAL THEORY RELATING TO UTILITIES IN THE CAPITAL MARKET

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AN EMPIRICAL TEST OF FINANCIAL THEORY
RELATING TO UTILITIES IN THE CAPITAL MARKET

BY

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B.S., University of New Mexico, 1964

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of
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AN EMPIRICAL TEST OF FINANCIAL THEORY
RELATING TO UTILITIES IN THE CAPITAL MARKET

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Gary O. Glenn

ABSTRACT OF THESIS
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ABSTRACT.

By observation of the average cost of new debt capital, average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios, it is apparent that utilities are facing a deteriorating competitive situation in the capital market in relation to industrials. It was the purpose of this study to determine if these deteriorating characteristics were statistically significant or whether they were strictly attributable to chance. It was also to be determined if the movements in the utilities' average cost of new debt capital were significantly related in a statistical sense to the movements in utilities' average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. The comparison of the utility characteristics and industrial characteristics was accomplished by analysis of their regression coefficients (slopes of the least squares fit) over the time period 1950-1966. Through the use of t-test analysis it was then determined if these regression coefficients were statistically different or if the difference was strictly due to chance. Multiple regression analysis was used in order to determine if the movements in average cost of new debt capital were significantly explained in a statistical sense by
the movements in average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. The t-test analysis was again used in order to determine if the multiple correlation coefficient was statistically different than zero. It was found that utilities were in a deteriorating competitive position with respect to average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. The difference in regression coefficients of the average cost of new debt capital was found to be strictly attributable to chance. In addition, it was found that the changes in the utilities' average cost of new debt capital were not significantly explained by the changes in average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios.
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CHAPTER 1

INTRODUCTION

I. TOPIC

The hypotheses explored in this thesis, test several predictions of financial theory relating to utilities in the capital market. These predictions are concerned with the movements in average earnings per share of common equity, average market price per share of common equity, average price-earnings ratios, and average cost of new debt capital for utilities under higher risk conditions.

II. PURPOSE OF THE STUDY

By observation of the average cost of new debt capital, it is apparent that this cost for utilities is increasing at a faster rate than that for industrials.\(^1,2,3\) In addition, it is apparent that utilities are also facing deteriorating competitive situations in relation to industrials as evident in average earnings per share of common equity, average

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market price per share of common equity, and average price-
earnings ratios. It is the purpose of this study to deter-
mine if these deteriorating characteristics really exist in a statistically significant sense, or whether they are
strictly attributable to chance. Also, it will be deter-
mined if movements in the average cost of new debt capital
for utilities are significantly related in a statistical sense to the movements in average earnings per share of common equity, average market price per share of common
equity and average price-earnings ratios.

In addition to furnishing relevant information about the competitive situation of utilities in the capital market, this study will also serve as a test for those aspects of financial theory dealing with the capital market.

In general, there are two ways to evaluate a theory. One way is to investigate the underlying structure and assumptions, while the second method is to test its predictions through the use of empirical data. In this line of thought, the essence of this study is the testing of that part of financial theory that concerns itself with the

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4 Butsler, loc. cit.
5 Benjamin, loc. cit.
capital market. In particular, do the increasing debt/equity ratios of utilities have the effect on their cost of capital, average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios that financial theory predicts?

It is believed that the testing of financial theory in the empirical world will provide an important and much needed contribution to financial knowledge. The reasons for this are that there seems to be a general refusal to acknowledge the possibility of generalizations in finance, yet many commonly used explanations and techniques stem from a framework of theoretical background. In an effort to make these generalizations less ambiguous, it is necessary to test these implicit theories that are copiously spread throughout financial practices and writings. The most important test of propositions or theories is in

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their success at prediction. For if they can provide adequate prediction, then they have passed the only relevant test required of them.
CHAPTER 2

PROBLEM ANALYSIS

I. REVIEW OF EXISTING KNOWLEDGE

Classical financial theory hypothesizes that the cost of capital depends directly, but not solely, on the financial 1,2,3 structure of the firm. It explains that the amount of debt capital that a firm uses can have a derogatory effect on the cost of capital if too much debt financing is used. It is further reasoned that this trading on the equity tends to improve earnings per share as long as the probable earnings on total assets exceeds the interest rate of the debt capital.6 But, this increase in earnings per share is


4Ibid.


somewhat offset by the increased debt/equity ratio. By increasing their debt/equity ratios, companies tend to place themselves in a higher risk class, i.e. higher debt/equity ratios are generally related to higher risk companies within a given risk class. This raising of risk class for companies has, therefore, been related to increased cost of capital.

This discussion of effects of financial structure on the cost of capital is relevant to this study because of the increased reliance of utilities on debt financing. Utilities have proceeded to this type of financing in order to assure that their earnings per share of common equity remains competitive with the increasing rates of return of industrials.

If the capital market behaves as classical financial theory predicts, then it could be expected that the increased reliance on debt financing (and its inherent raising of the debt/equity ratio) would tend to increase the cost of


9 Ibid.
this capital loaned to utilities. That is, utilities with higher debt/equity ratios would appear more risky to investors than utilities with lower debt/equity ratios. The investors would therefore charge more for the capital that is loaned to the utilities.\textsuperscript{10}

This generally pessimistic attitude toward utilities would then be expected to be transferred to the stock market. In the stock market, this decline could be expected to show itself with relative deteriorations in average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios.\textsuperscript{11,12}

It can therefore be deduced that a direct relationship exists between long-term changes in cost of capital and long-term changes in average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios. It is important to note that


\textsuperscript{11}\textit{Ibid.}

the last three variables are not necessarily indicating the same phenomenon. Market price per share is an after-the-fact indicator of how certain stocks are evaluated in the stock market. Earnings per share is a before-the-fact determinant of stock market evaluation. This is to say that earnings per share is a figure available before the evaluation of the stock by the investors, whereas market price per share is an indication of how the stock has been evaluated. The price-earnings ratio is a function of both (1) market price per share and (2) earnings per share. It is therefore a hybrid as fas as before- or after-the-fact is concerned, since it is a ratio of both types of factors.

From the above discussion, it is apparent that the deteriorating situation of utilities in the capital market (with respect to market price, earnings per share, and price-earnings ratios) is supported on theoretical basis. In addition, it is not without theoretical support that it is hypothesized that variations in the average cost of new debt capital can be explained to a significant extent by the changes in average earnings per share of common equity.

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and average price-earnings ratios.

II. EVALUATION OF CURRENT KNOWLEDGE

There have been many studies in the general area of cost of capital and its interrelationships with market price per share, earnings per share, and the price-earnings ratio. For the most part, these studies have been inconclusive. This has been partly due to the fact that most of them rendered conclusions that were the result of subjective analysis. What is missing from the literature are conclusions reached through the use of objective measures. An example of this type of measure is the use of statistical analysis used to either accept or reject a hypothesis.

Some examples of these subjective types of studies are readily available concerning the cost of capital. A study by Modigliani and Miller was concerned with the development of a link between cost of capital and market valuation. This study cannot be criticized for its lack of objective tools, but no objective empirical test was used for the acceptance or rejecting of a hypothesis. Of

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interest in this study were a few of the findings. Using their methods, it was found that none of the effects assumed by traditional financial theory in relation to financial structure and market valuation existed. It is quite possible that the short term over which these variations were studied (four years) had a large effect on the conclusion.

Studies by Weston and Wippern concluded that traditional financial theory was valid in an empirical analysis.\textsuperscript{15,16} Wippern found two important relationships: (1) the use of debt financing by a firm can improve the shareholders position, (2) the value of the corporation is maximized by prudent use of debt financing. Weston's findings were that the predictions of traditional financial theory concerned with the influence of leverage on cost of capital agreed with the empirical evidence. But, the use of strict objective statistical tests, in order to accept or reject a hypothesis, were not used.

Conclusions by Christy contributed some information


\textsuperscript{16} Wippern, \textit{loc. cit.}
about the utilities position in the stock market. Through the use of inconclusive subjective judgment, it was found that over the time period in question, utility stocks outperformed industrials. He also concluded that utilities experienced greater stability and growth in earnings.

Using data that were somewhat fragmentary, Sharpe concluded that traditional financial theory did in fact agree with empirical evidence. In particular, he found that there was a somewhat direct relationship between risk and rate of return. It was concluded that securities that had substantial variations in returns, provided larger average returns than those with less variable returns. Apparently, no effort was made to find out if this difference in returns was statistically significant. The lack of reliable data also added to the opinion that these results were inconclusive.

In a study that parallels the subjects of this thesis quite closely, Hoover found that existing financial theory


18 Sharpe, op. cit.
came close to reality in its predictions. The study was mainly concerned with the relationship between the rate of profit that a given type of industry requires for a given rate of interest on debt capital, but the results tie in with the subjects of this thesis. This finding was that the earnings-price ratio will tend to approach the market rate of interest of debt capital. Since the price-earnings ratio is simply the inverse of the earnings-price ratio, it is obvious that the price-earnings ratio also has a close relationship with the rate of interest (i.e. the cost of capital).

A study by Benishay was somewhat along the lines of Hoover's, but it was concerned with more of the variables under study in this paper. Benishay was interested in how the rate of return on corporate equities was related to: (1) trend in earnings, (2) trend in market price, (3) pay-out ratio, (4) stability of future income, (5) stability of equity value, (6) market price of the equity, and (7) debt/equity ratio. As such, his study is more relevant to

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19 Hoover, *op. cit.*

the subjects of this thesis, than any of the other studies reviewed. It is significant to note that he found that the changes in market price of the equity had a closer relationship to changes in rate of return than to any of the other variables. The other variables for the most part showed inconclusive results. The inconclusiveness of the results was also somewhat adversely affected by the fact that no objective criterion was used for the hypothesis evaluation.

There has been some work done in model building in this area. The importance of many of these models lies in the fact that they have been used in recent rate cases. This fact is somewhat superfluous since Sparrow showed that there exists no unique model of growth allowances and financial ratios for utilities. 21 Of course, his conclusion about financial ratios will be objectively tested in this study. Again, the data are quite inconclusive.

In summary, there have been many studies of the variables under examination in this study. The one fact that stands out about these studies is their inconclusiveness.

Many of them contradict each other on relevant topics of this study. For instance, it was not generally agreed on what, if any, effect financial structure had on the cost of capital. Very little could be concluded from these studies, about the relevant interrelationships between changes in cost of capital, earnings per share, market price per share, and the price-earnings ratio. But this aura of uncertainty pervades many of the existing financial writings and teachings.  

Through the use of objective tests and methods, such as will be used in this study, it is believed that much of this uncertainty can be eliminated.

III. STATEMENT OF HYPOTHESIS

The basic hypothesis to be tested is that utilities are facing a relatively deteriorating competitive situation in the capital market. This situation is deduced from several apparent facts: (1) their average cost of new debt capital is increasing at a faster rate than that of industrials, (2) they are experiencing a relative deterioration in average earnings per share of common equity.


23 Eutsler, loc. cit.
with respect to industrials, (3) they are experiencing a relative deterioration in average market price per share of common equity, and (4) they are experiencing a relative deterioration in their average price-earnings ratios. The hypothesized relative increase in average cost of new debt capital is being backed up by the apparent decline in their earnings per share of common equity, market price per share of common equity, and price-earnings ratios. It then follows that an inferred hypothesis is that variations in the average cost of new debt capital are significantly explained by movements in the earnings per share of common equity, market price per share of common equity, and price-earnings ratios.

In order to clearly define the hypotheses, the following statements of them along with the appropriate measure and accept-reject criterion are given:

1. Utilities are experiencing a relative deteriorating competitive situation in the capital market.
   a. Accept if the least squares fit of the utilities' average cost of new debt capital has a statistically significant greater slope (regression coefficient) than that of industrials.
   b. If the slopes are not significantly different
then reject the hypothesis.

2. Utilities are experiencing a relative deterioration in average earnings per share of common equity with respect to industrials.
   a. Accept if the least squares fit of the utilities' average earnings per share of common equity has a statistically significant smaller slope than that of industrials.
   b. If the slopes are not significantly different then reject the hypothesis.

3. Utilities are experiencing a relative deterioration in the average market price per share of common equity.
   a. Accept if the least squares fit of the utilities' average market price per share of common equity has a statistically significant smaller slope than that of industrials.
   b. If the slopes are not significantly different then reject the hypothesis.

4. Utilities are experiencing a relative deterioration in price-earnings ratios.
   a. Accept if the least squares fit of the utilities average price-earnings ratios has a
statistically significant smaller slope than that of industrials.

b. If the trends are not significantly different then reject the hypothesis.

5. The variations in the utilities average cost of new debt capital are significantly explained by movements in utilities average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios.

a. Accept if the variations in utilities average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios explain a statistically significant part of the variations in the average cost of new debt capital for utilities.

b. If the movements in the average cost of new debt capital are not explained significantly by the movements in average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios, then reject the hypothesis.
CHAPTER 3

RESEARCH DESIGN

I. RESEARCH INSTRUMENT

A commonly used tool to determine what part of the variation in one variable is explained by the movements in another variable is regression analysis. Multiple regression analysis can be used if more than one independent variable is being studied (in this study three independent variables will be studied). The regression coefficient of two curves can be compared through the use of a t-test. The proper statistical table can be used in order to decide if the difference in slope is statistically significant for a given alpha level (significance level). In this case the proper table to be used is the t-distribution table. The t-test and the t-distribution table can also be used to determine if a correlation coefficient is statistically

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2 Ibid., pp. 715-732
3 Ibid., pp. 760-769
significant. These will be the tools used to determine statistical significance in this study.

In general, regression analysis in economic and business statistics is approached by inference from a small sample to its parent population. The sample that is analyzed represents at best only a fraction of the values that could be expected from the population in question. Through the application of statistical inference to regression analysis, many important relationships between variables can be found.

All the data in this study are time series data. As such, they present a major problem. This results from the fact that regression analysis assumes a distribution of $x_1$ values (dependent variable) on the $x_2$ values (independent variable). Typically, time series data do not satisfy this basic requirement. However, by dealing only with the differences between values, this problem can be overcome. In

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6 Ibid.
this manner, the data are randomized, i.e. the serial correlation of the data to time is eliminated. By eliminating this serial correlation, the basic requirement for regression analysis is satisfied. This also results in the required distribution of $x_1$ values on the $x_2$ values.

II. ASSUMPTIONS

Before inferences are made from the use of regression techniques, it is necessary to understand the assumptions that underly the use of them as a tool. The following are these assumptions:

1. Assumption of linearity—If a straight line is fit to sample data, in order to estimate the population characteristic, the data in the sample must themselves be of a linear nature.

2. Assumption of homoscedasticity—This assumption is concerned with the fact that the standard deviations of the $x_1$ values on the $x_2$ values are the same for all values of $x_2$. Stated in simpler terms, there is a uniform scatter or dispersion of the points about the particular regression line.

3. Assumption of independence—Of relevance in this

[Ibid.]

-20-
case is that the deviation of a given point about the line is not related in any way to the deviation of any other point.

4. Assumption of normal distribution—This assumption is that the distribution of points above and below the regression line follows an approximately normal curve.

It can not be expected that all of the above assumptions would be fully satisfied in any case. In this study they are not fully satisfied. But, to the extent that useful conclusions can be drawn through regression techniques without any large or significant error, this study does satisfy these assumptions.

The question of linearity is not a large problem. The reason for this is that curvilinear data can be converted quite easily to linear data simply by taking the log (typically to the base 10) of the data (if necessary). In this study it was concluded that this step was unnecessary.

As concerns the assumptions of homoscedascity, it is also believed that no great violation occurs. There seems to be a sufficient amount of data so that no problem related to the outcome is likely to occur. If the data does turn out to be biased in an adverse way, then any conclusions
drawn from them must be qualified as such.

Probably the hardest assumption to satisfy in this study will be the assumption of independence. The reason for this is that the data from which the conclusions will be drawn are strictly time series data. The problem is that all values are not independent. A given high value will tend to bias the data due to the fact that surrounding values will most likely be high. But here again, first differences will for the most part eliminate this problem.

The assumption of normal distribution, both above and below the regression line is not strictly satisfied. But, as in the case of the linearity assumption, it most probably will not present any serious problem.

III. RELIABILITY OF A STATISTICAL TEST

In any test where a hypothesis is accepted or rejected on the basis of relevant data, it is possible that an error has been committed. Table I shows the possible outcomes. Two types of errors are possible: (1) if a false hypothesis is accepted and (2) if a true hypothesis is rejected. For a given instance of testing, it will not be known whether the results of the test are true or false, since the test would be irrelevant if this was known. Most important to the reliability of a test will be its record over the long run.
TABLE I

THE VARIOUS POSSIBLE OUTCOMES OF TESTS

<table>
<thead>
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<th>Kind of Inference</th>
<th>State of the World</th>
<th>Outcome of Test</th>
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<td>Reject hypothesis</td>
<td>Hypothesis is true</td>
<td>Incorrect rejection</td>
</tr>
<tr>
<td>Reject hypothesis</td>
<td>Hypothesis is false</td>
<td>Correct rejection</td>
</tr>
<tr>
<td>Accept hypothesis</td>
<td>Hypothesis is true</td>
<td>Correct acceptance</td>
</tr>
<tr>
<td>Accept hypothesis</td>
<td>Hypothesis is false</td>
<td>Incorrect Acceptance</td>
</tr>
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</table>

The question of whether a sample leads to rejecting or acceptance of the hypothesis, is a matter of chance. That is, it depends solely on the result of the process of random sampling.

The alpha level of a test gives the reliability of the test as related to true null hypotheses. If, for example, alpha is .01 then .01 is the chance of rejecting a true null hypothesis, whereas .99 (1.00-.01) gives the chance of making a correct inference.

This discussion is essentially involved with the theory of decisions. There is no best method for selecting the best
test for a given situation. This discussion is relevant to this study in order to more clearly show the various aspects of a certain technique. More important is that the limitations should be considered in interpreting the factual evidence.

IV. PROCEDURE

The problems involved in showing whether or not utilities are facing a deteriorating competitive situation in the capital market have been set down in general terms. It is now appropriate to indicate in exact terms how these tests will be carried out, what the tests will be, and what part of the population will comprise the sample to be worked with.

The first four hypotheses that were stated earlier that related to whether the slopes in utility characteristics are significantly different than the slopes in the industrial characteristics, will all be tested using the same method. This method is comprised of estimating the regression coefficient of both the characteristic of the utilities and the industrials. By using the t-test, the two regression coefficients can be compared. Reference to the applicable statistical table (t-distribution), will then result in the accept-reject decision, given the appropriate level of significance (alpha level).
The last of the five hypotheses that were stated earlier presents a different problem than that involved in the first four. In this case it must be determined if the variations in the average cost of new debt capital of utilities can be explained by the movements in utilities average market price per share of common equity, average earnings per share of common equity, and average price-earnings. The appropriate tool in this case is multiple regression analysis. By obtaining the distribution of $x_1$ values (average cost of new debt capital) on $x_2$, $x_3$, and $x_4$ values (average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios), it can be determined if any or all of these variables explain the movements in average cost of new debt capital, on a statistically significant level. The t-test and t-distribution will also be used in this case.

The tests of the hypotheses will be evaluated in the following manner:

1. State the null hypothesis:
   a. For the first four hypotheses it would be that $b_u = b_1$, where $b$ is the regression coefficient of the respective curves.
   b. For the last hypothesis, it would be that
\[ R_{1.234} = 0, \text{ where } R \text{ is the correlation coefficient between the independent variable } x_2 \]
and dependent variable \( x_1 \).

2. Establish an alpha level. (In this case alpha is 0.05).

3. Determine the appropriate characteristic from the data:
   a. For the first four hypotheses, \( b \)-the regression coefficient would be determined.
   b. For the last hypothesis, \( R \)-the correlation coefficient would be determined.

4. Accept or reject decision determined from the selected alpha level and characteristic that has been determined. If the null hypothesis is rejected, it infers the following (alternate hypothesis):
   a. In the case of the first four hypotheses:
      \[ b_u \neq b_1 \]
   b. In the case of the last hypothesis:
      \[ R_{1.234} \neq 0 \]
V. STRATEGY

The sample to be worked with will be comprised of Moody's 125 industrials and Moody's 24 utilities. Over the time period under study (1950-1966), Moody's gives yearly values for average cost of new debt capital, average earnings per share of common equity, average market price per share of common equity, and average price-earnings ratios for both industrials and utilities.

Since the sample has already been drawn by Moody's, the inherent sampling error and any problems associated with it will be ignored. This is permitted since it is a random sample over time. The reason that it is a random sample over time is due to the fact that the same companies are evaluated over the time period in question.

It is important to note that the acceptance of the hypotheses in this study will be based strictly on statistical significance. No attention will be paid to the fact that the difference may seem relatively large if it is insignificant on a statistical basis. This essentially means that no concern will be given any difference that is attributed to chance only. If the data under examination do not offer conclusive evidence, then no attempt will be made at its analysis.
It is appropriate at this point to put forth the possible general conclusions that could be drawn in the accepting of rejecting of these hypotheses. This strictly will not be an attempt to prove anything per se. The hypotheses under question will either be disproved or they will not be disproved. Essentially what this means is that if an hypothesis is rejected, then this part of the theory will be rejected. In the case of acceptance of a particular hypothesis, the related part of the theory will continue to be accepted.

The level of significance for all tests will be the same. This level will be .05. It is generally accepted that this is quite a high level of certainty for economic research.

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10 Ibid.
CHAPTER 4

RESULTS, DISCUSSION, AND CONCLUSION

I. RESULTS AND DISCUSSION

For the first four hypotheses, the regression coefficients (slopes) of the least squares fits were subjected to comparison through t-analysis. In reference to the fifth hypothesis, the multiple correlation coefficient was subjected to a slightly different type of t-analysis in order to determine if it was statistically different from zero.

Comparison of the Average Cost of New Debt Capital

The first hypothesis states that utilities are experiencing a relative deteriorating situation in the debt capital market. The relevant data were subjected to the appropriate t-analysis with an alpha of .05 (See Appendix C for formula).

The results of this analysis are presented in Table II. As can be seen, the cutoff t-value for the regression coefficients to be declared equal is 2.05. Since the computed t-value is $t = 1.14$, it is deduced that $b_u = b_1$. This is to say that the difference between the two regression coefficients is strictly due to chance at the .95
### TABLE II

**RESULTS OF COMPARISON OF AVERAGE COST OF NEW DEBT CAPITAL**

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<td>Conclusion</td>
<td>$b_u=b_1$</td>
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1, 2, 3 confidence level.

It can be further concluded that this leads to the rejection of the original hypothesis concerning the rate


of the average cost of new debt capital increases of uti-

lities relative to that for industrials. For the data under

examination, this hypothesis cannot be accepted. Therefore,

in this case, financial theory leading to the development

of this hypothesis cannot be validated. In more practical

terms, the differences between the regression coefficients

are strictly due to chance at a confidence level of .95.

It is also appropriate to note that this hypothesis

could have been rejected on inspection of the values of

the regression coefficients, without determining the appro-

priate t-value. This is possible since it can be seen

that the slope of the utilities line of regression is a

small negative number, whereas the slope of the line of

regression for the industrials is a small positive number.

Therefore, the slope of the industrial's regression line

is greater than that for utilities (even though the dif-

ference in slope is not statistically significant).

Comparison of Average Earnings Per Share of Common Equity

The second hypothesis states that utilities are

experiencing a relative deterioration in average earnings

per share of common equity with respect to industrials. The

relevant data were subjected to the appropriate t-analysis

with an alpha of .05 (See Appendix C for formula).
The results of this analysis are presented in Table III. The cutoff t-value for the regression coefficients to be declared equal is 2.05. Since the computed t-value for the data is 4.46, the conclusion that $b_u = b_i$ must be rejected. This results in the acceptance of the alternate conclusion that $b_u \neq b_i$. By inspection, the regression coefficient for the industrials is greater than that for the utilities. It is therefore concluded at the .95 confidence level that $b_u < b_i$ and that this difference is not

**TABLE III**

**RESULTS OF**

**COMPARISON OF AVERAGE EARNINGS PER SHARE OF COMMON EQUITY**

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<td>$b_u \neq b_i$, $b_u &lt; b_i$</td>
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due solely to chance.

The fact that the average earnings per share of industrials is increasing at a faster rate than that for utilities, substantiates the hypothesis that utilities are experiencing a deteriorating competitive situation with respect to industrials in this important indicator of success to stockholders. This finding also substantiates the financial theory leading to this hypothesis.

Comparison of Average Market Price Per Share of Common Equity

The third hypothesis states that utilities are experiencing a relative deterioration in average market price per share of common equity with respect to industrials. The relevant data were subjected to the appropriate t-analysis with an alpha of .05 (See Appendix C for formula).

The results of this analysis are presented in Table IV. The cutoff t-value for the regression coefficients to be declared equal in this case is t=2.04. Since the computed t value is 5.10, it is concluded that $b_u \neq b_i$. It is also of consequence to note by inspection that the regression

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4 Fisher, loc. cit.
5 Duncan, loc. cit.
6 Lewis, loc. cit.
coefficient for utilities is less than that for industrials. It can thus be concluded that the regression coefficient for utilities is less than that for industrials. In addition, at the .95 confidence level, this difference is statistically significant, i.e. not due to chance.

The essence of this finding is that the average market price per share of common equity for utilities is not increasing at a rate as fast as that for industrials. This infers that utilities are in fact facing a deteriorating

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**RESULTS OF**

**COMPARISON OF AVERAGE MARKET PRICE PER SHARE OF COMMON EQUITY**

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competitive situation in the stock market. In addition, this results in the substantiation of the financial theory leading to the hypothesis.

**Comparison of Average Price-Earnings Ratios**

The fourth hypothesis states that utilities are experiencing a relative deterioration in price-earnings ratios with respect to industrials. The relevant data were subjected to the appropriate t-analysis with an alpha of .05 (See Appendix C for formula).

The results of this analysis are presented in Table V. The cutoff t-value for the regression coefficients to be declared equal in this case is \( t = 2.05 \). Since the computed t-value is 2.41, it is deduced that \( b_u \neq b_i \). In addition, by inspection it can be seen that the slope of the least squares fit for utilities is less than that for industrials and that this difference is significant (statistically) at the .95 confidence level.

This finding substantiates the hypothesis relating to these variables, since it was hypothesized that utilities were deteriorating with respect to industrials. It can also be stated that the financial theory leading to this hypothesis was substantiated.
TABLE V

RESULTS OF COMPARISON OF AVERAGE PRICE- EARNINGS RATIOS

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**Significance of the Multiple Correlation Coefficient**

The fifth hypothesis states that the variations in the utilities' average cost of new debt capital are significantly explained by movements in the utilities' average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. The relevant data were subjected to the appropriate \( t \)-analysis with an alpha of .05 (See Appendix C for formula).

The results of this analysis are presented in Table VI. The cutoff \( t \)-value for the multiple regression coefficient
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to be declared equal to zero is 2.18. Since the computed t-value is 1.55, it can be deduced that \( R_{1.234} = 0 \). In more practical terms, the variations in the utilities' average cost of new debt capital are significantly determined by the combined variations in average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. It is also important to note that this correlation is statistically significant at the .95 confidence level, i.e. at this
level of confidence it is not attributable to chance.

The importance of this finding is that it supports the original hypothesis that this correlation would be significant. Since the original hypothesis was deduced in line with financial theory, than it follows that this finding supports this part of financial theory.

II. CONCLUSION

As mentioned above, all the tests performed related to the validity of financial theory. This stems from the fact that all five hypotheses were rationally deduced from financial theory. It thus follows that the results should give accurate reflections of the empirical validity of financial theory.

Of the five hypotheses deduced, only one was rejected. It is significant to note that this hypothesis was concerned with probably the most important aspect of this study. This aspect being whether or not utilities are facing a deteriorating competitive position in the capital market as indicated by their increases in average cost of new debt capital as compared to industrials. Possibly the competitive position of utilities in the capital market is not as bad as financial theory might indicate.  

It is also possible that the tool used to test the hypothesis was invalid or inaccurate. However, this position is tenuous in that the other four hypotheses which were logically deduced from financial theory were supported. Further, the significance level was extremely exacting, so that any errors due to chance were essentially eliminated. ⁸

One tenuous area that influenced the statement of the hypotheses was the element of risk. It was assumed that the increased debt/equity ratios for utilities would automatically make them a riskier class of investments. It was deduced that this increase in risk would increase their cost of capital. Possibly the increase in debt/equity ratios was not deemed great enough to investors to warrant a significant increase in this cost over that for industrials. Essentially, the problem is that risk is not easily quantifiable, rather it is open to many and varied interpretations. ⁹

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Another possibility is that the regulation of utilities somehow assures them of a reasonably good performance in the debt capital market. Whether in actuality this is true is problematical, but if investors believe it then the empirical evidence will show it.

Probably of more significance than the rejecting of the cost of capital hypothesis, is the acceptance of those hypotheses dealing with average market price per share of common equity, average earnings per share of common equity, and average price-earnings ratios. The indicated deterioration of utilities over this long period is a result of considerable consequence. Since it was a comparison of utilities against industrials, it would seem most important for the proper regulatory agencies to probe further into these areas.

---

REFERENCES

BOOKS


ARTICLES


APPENDIX A
## Average Cost of New Debt Capital

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APPENDIX B
The following is from the IBM System/360 Scientific subroutine package. It is the multiple linear regression with slight modifications.

```
DIMENSION XBAR(40), STD(40), D(40), RY(40), ISAVE(40), E(40),
               1 SB(40), T(40), W(40)
DIMENSION RX(1600)
DIMENSION R(220)
DIMENSION ANS(1C)
1 FORMAT(A4,A2,15,212)
2 FORMAT(25H1MULTIPLE REGRESSION....A4,A2//6X,14HSELECTION....12//
3 HREGRESSION,4X,1CHSTD, ERRCR,5X,9HCOMPUTED/6H, NG,18X,5HDEVIATION
2N,7X,6HVS Y,7X,11HCEFFICIENT,3X,12HCF REG. CCF...3X,7HT VALUE)
4 FORMAT(1H,14,6F14.5)
5 FORMAT(10H DEPENDENT)
6 FORMAT(1H0/10H INTERCEPT,13X,F13.5//23H MULTIPLE CCRELATION ,F12
1.5//23H STD. ERRPR OF ESTIMATE,F13.5//)
7 FORMAT(1H0,21X,3SHANALYSIS OF VARIANCE FOR THE REGRESSION//5X,15H
SOURCE OF VARIATION,7X,7HDGREES,7X,6HSUM OF,10X,4HMEAN,12X,7HF VAL
2U,8/3X,10HCF FREEDOM,4X,7HSQUARES,9X,7HSQUARES)
8 FORMAT(30H ATTRIBUTABLE TO REGRESSION ,16,3F16.5/30H DEVIATION F
FROM REGRESSION ,16,2F16.5)
9 FORMAT(1H,6X,EHTOTAL,19X,16,16,F16.5)
10 FORMAT(2E12)
11 FORMAT(1H,15X,EHTABLE OF RESIDUALS//9H CASE NEC...5X,7HY VALUE,5X,
110H ESTIMATE,6X,8HRESIDUAL)
12 FORMAT(1H,16,F15.5,2F14.5)
13 FORMAT(53H1NUMBER OF SELECTIONS NOT SPECIFIED. JOE TERMINATED.)
14 FORMAT(52H THE MATRIX IS SINGULAR. THIS SELECTION IS SKIPPED.)
100 READ (5,1) PR, PRI, N, W, NS
10=6
X=0.0
CALL CORRE (N,M,IO,X,XBAR,STD,RX,R,D,E,T)
IF(NS) 108, 10B, 10S
108 WRITE (6,13)
GO TO 300
109 DO 200 I=1,NS
WRITE (6,2) PP, PRI, I
READ (5,10) NRESI, NDEP, K, (ISAVE(J), J=1, K)
CALL ORDER (M,P,NDEP,K, ISAVE,RX,RY)
CALL MINV (RX,K,DET,E,T)
IF(DET) 112, 110, 112
110 WRITE (6,14)
GO TO 200
112 CALL MULTR (N,K,XBAR,STD,D,RX,RY,ISAVE,B,SB,T,ANS)
MM=K+1
WRITE (6,3)
DO 115 J=1,K
L=ISAVE(J)
115 WRITE (6,4) L,XBAR(L),STD(L),RY(J),B(J),SB(J),T(J)
WRITE (6,5)
L=ISAVE(MM)
WRITE (6,4) L,XBAR(L),STD(L)
```

-50-
WRITE (6,6) ANS(1), ANS(2), ANS(3)
WRITE (6,7)
L=ANS(8)
WRITE (6,8) K, ANS(4), ANS(6), ANS(10), L, ANS(7), ANS(9)
L=N-1
SUM=ANS(4) & ANS(7)
WRITE (6,9) L, SUM
IF(NRESI) 200, 200, 120
120 WRITE (6,2) PR, PRI, I
WRITE (6,11)
MM=ISAVE(K+I)
DO 140 II=1,N
READ (4) (W(J), J=1,N)
SUM=ANS(I)
DO 130 J=1,K
L=ISAVE(J)
130 SUM=SUM+W(L)*B(J)
RESI=W(MM)-SUM
140 WRITE (6,12) II, W(MM), SUM, RESI
200 CONTINUE
GO TO 100
300 CONTINUE
END
SIZE OF COMMON CC0000 PROGRAM 13700

SUBROUTINE DATA (W,D)
DIMENSION D(1)
1 FORMAT(12F6.0)
READ (5,1) (D(I), I=1,N)
WRITE (4) (D(I), I=1,N)
RETURN
END
SIZE OF COMMON CC0000 PROGRAM 00308

SUBROUTINE CORRE (N,N,IC,X,XBAR,STD,RX,R,E,C,T)
DIMENSION X(1), XBAR(1), STD(1), RX(1), R(1), E(1), C(1), T(1)
DO 100 J=1,N
B(J)=C*C
100 T(J)=C*C
K=(N+N+M)/2
DO 102 I=1,K
102 R(I)=C*C
FN=N
L=0
IF(IC) 105, 127, 105
105 DO 106 J=1,M
106 DO 107 I=1,N
L=L+1
107 T(J)=T(J)+X(L)
XBAR(J)=T(J)
108 T(J)=T(J)/FN
DO 115 I=1,N
JK=C
L=I-N
220 \text{ \\quad STD(J) = SORT(ABS(R(JK)))} \\
230 \text{ \quad DO 230 J=1,M} \\
230 \quad \text{ \quad DO 230 K=J,M} \\
\text{ \quad JK=J+(K*K-K)/2} \\
\text{ \quad L=M*(J-1)+K} \\
\text{ \quad RX(L)=R(JK)} \\
\text{ \quad L=M*(K-1)+J} \\
\text{ \quad RX(L)=R(JK)} \\
230 \quad \text{ \quad R(JK)=R(JK)/(STD(J)*STD(K))} \\
\text{ \quad FN=SQRT(FN-1.C)} \\
\text{ \quad DO 240 J=1,N} \\
240 \text{ \quad STD(J)=STD(J)/FN} \\
\text{ \quad L=-M} \\
\text{ \quad DO 250 I=1,M} \\
\text{ \quad L=L+M+1} \\
250 \quad \text{ \quad B(I)=RX(L)} \\
\text{ \quad RETURN} \\
\text{ \quad END} \\
\text{ SIZE OF COMMON CO000 PROGRAM 02852} \\

\text{ SUBROUTINE ORDER(M,R,NDEF,K,ISAVE,RX,RY)} \\
\text{ DIMENSION P(1),ISAVE(1),RX(1),RY(1)} \\
\text{ MM=C} \\
\text{ DO 130 J=1,K} \\
\text{ L2=ISAVE(J)} \\
\text{ IF(NDEF-L2) 122, 123, 123} \\
\text{ 122 L=NDEF+(L2+L2-L2)/2} \\
\text{ GO TO 126} \\
\text{ 123 L=L2+(NDEF-NDEF-NDEF)/2} \\
\text{ 125 RY(J)=R(L)} \\
\text{ DO 130 I=1,K} \\
\text{ L1=ISAVE(I)} \\
\text{ IF(L1-L2) 127, 128, 128} \\
\text{ 127 L=L1+(L2-L2-L2)/2} \\
\text{ GO TO 129} \\
\text{ 128 L=L2+(L1-L1-L1)/2} \\
\text{ 129 MM=MM+1} \\
\text{ 130 RX(MM)=R(L)} \\
\text{ ISAVE(K+1)=NDEF} \\
\text{ RETURN} \\
\text{ END} \\
\text{ SIZE OF COMMON CO000 PROGRAM 00682} \\

\text{ SUBROUTINE MINV(A,N,D,L,M)} \\
\text{ DIMENSION A(1),L(1),M(1)} \\
\text{ D=1.C} \\
\text{ NK=-N} \\
\text{ DO E0 K=1,N} \\
\text{ NK=NK+N} \\
\text{ L(K)=K} \\
\text{ M(K)=K} \\
\text{ KK=NK+K} \\
\text{ BIGA=A(KK)} \\
\text{ DO E0 J=K,N}
IZ = N * (J - 1)
DO 20 I = K, N
  J = IZ + I
10 IF (ABS(BIGA) - ABS(A(IJ))) 15, 20, 20
15 BIGA = A(IJ)
   L(K) = I
   M(K) = J
20 CONTINUE
   J = L(K)
   IF (J - K) 35, 35, 25
25 KI = K - N
DO 30 I = 1, N
   KI = KI + N
   HOLD = -A(KI)
   JI = KI - K + J
   A(KI) = A(JI)
30   A(JI) = HOLD
35 I = M(K)
   IF (I - K) 45, 45, 36
36 JP = N * (I - 1)
   DO 40 J = 1, N
      JK = NK + J
      JI = JP + J
      HOLD = -A(JK)
      A(JK) = A(JI)
40   A(JI) = HOLD
45 IF (BIGA) 46, 46, 46
46 D = 0.0
RETURN
42 DO 55 I = 1, N
   IF (I - K) 50, 55, 50
50 IK = NK + I
   A(IK) = A(IK) / (-BIGA)
55 CONTINUE
   DO 65 I = 1, N
      IK = NK + I
      HOLD = A(IK)
50   IJ = I - N
   DO 65 J = 1, N
      IJ = IJ + N
   IF (I - K) 60, 65, 60
60 IF (J - K) 62, 65, 62
62 KJ = IJ - I + K
   A(IJ) = HOLD + A(KJ) + A(IJ)
65 CONTINUE
   KJ = K - N
   DO 75 J = 1, N
      KJ = KJ + N
   IF (J - K) 70, 75, 70
70 A(KJ) = A(KJ) / BIGA
75 CONTINUE
   D = D * BIGA
   A(KK) = 1.0 / EIGA
80 CONTINUE
   K = N
100 K = (K - 1)
IF(K) 150,150,1C5
105 I=L(K)
106 IF(I-K) 120,120,108
108 JQ=N*(K-1)
JR=N*(I-1)
DO 110 J=1,N
JK=JQ+J
HOLD=A(JK)
JI=JR+J
A(JK)=-A(JI)
110 A(JI)=HOLD
120 J=M(K)
IF(J-K) 100,100,125
125 KI=K-N
DO 130 I=1,N
KI=KI+N
HOLD=A(KI)
JI=KI-K+J
A(KI)=-A(JI)
130 A(JI)=HOLD
GO TO 100
150 RETURN

SIZE OF COMMON 1CC00C PROGRAM 018744

SUBROUTINE MLTRTR (N,K,XBAR,STD,D,RX,RY,ISAVE,E,SB,T,ANS)
DIMENSION XBAR(1),STD(1),D(1),RX(1),RY(1),ISAVE(1),E(1),SB(1),
1
T(1),ANS(1)
M=M+1
DO 100 J=1,K
100 B(J)=C*C
DO 110 J=1,K
L1=K*(J-1)
DO 110 I=1,K
L=L+I
110 B(J)=B(J)+RY(I)*RX(L)
RM=C*C
BD=C*C
L1=ISAVE(MN)
DO 120 I=1,K
RM=RM+D(I)*RY(I)
L=ISAVE(I)
B(I)=B(I)*(STD(L1)/STD(L))
120 BD=BD+B(I)*XBAR(L)
BD=XBAR(L)-BD
SSAR=RM*STD(L)
122 RM=SCRT(ABS(RM))
SSDR=STD(L)-SSAR
FN=N-K-1
SY=SSDR/FN
DO 130 J=1,K
L1=K*(J-1)+J
L=ISAVE(J)
125 SQ(J)=SCRT((ABS((RX(L1)/C(L))+SY))
130 T(J)=B(J)/SQ(J)

-55-
135 \[ SY = \text{SQR}T(\text{ABS}(SY)) \]
FK=K
SSARM=SSAR/FK
SSDRM=SSDR/FN
F=SSARM/SSDRM
\[ \text{ANS}(1)=30 \]
\[ \text{ANS}(2)=RN \]
\[ \text{ANS}(3)=SY \]
\[ \text{ANS}(4)=SSAR \]
\[ \text{ANS}(5)=FK \]
\[ \text{ANS}(6)=SSARM \]
\[ \text{ANS}(7)=SSDR \]
\[ \text{ANS}(8)=FN \]
\[ \text{ANS}(9)=SSDRM \]
\[ \text{ANS}(10)=F \]
RETURN
END

SIZE OF COMMON CCC00 PROGRAM 01356
MULTR
## Utilities' Average Cost of New Debt Capital

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MULTIPLE REGRESSION

SELECTION

Industrials' Average Cost of New Debt Capital

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DEPENDENT

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INTERCEPT

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MULTIPLE CORRELATION

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STD. ERROR OF ESTIMATE

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ANALYSIS OF VARIANCE FOR THE REGRESSION

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Utilities' Average Earnings Per Share of Common Equity

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MULTIPLE REGRESSION

Industrials' Average Earnings Per Share of Common Equity

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DEPENDENT

4 0.52375 1.14702

INTERCEPT

-0.32850

MULTIPLE CORRELATION

0.41617

STD. ERROR OF ESTIMATE

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ANALYSIS OF VARIANCE FOR THE REGRESSION

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Utilities' Average Price-Earnings Ratios

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ANALYSIS OF VARIANCE FOR THE REGRESSION

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MULTIPLE REGRESSION

**SELECTION**

Industrials' Average Price-Earnings Ratios

<table>
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<tr>
<th>VARIABLE</th>
<th>MEAN NO.</th>
<th>STANDARD DEVIATION</th>
<th>CORRELATION X VS Y</th>
<th>REGRESSION COEFFICIENT</th>
<th>STD. ERROR OF REG. COEFF.</th>
<th>COMPUTED T VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPENDENT</td>
<td>0.069562</td>
<td>4.766625</td>
<td>-0.16728</td>
<td>-0.07699</td>
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**ANALYSIS OF VARIANCE FOR THE REGRESSION**

<table>
<thead>
<tr>
<th>SOURCE OF VARIATION</th>
<th>DEGREES OF FREEDOM</th>
<th>SUM OF SQUARES</th>
<th>MEAN SQUARES</th>
<th>F VALUE</th>
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</thead>
<tbody>
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MULTIPLE REGRESSION

Utilities' Average Market Price Per Share of Common Equity

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<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>CORRELATION X VS Y</th>
<th>REGRESSION COEFFICIENT</th>
<th>STD. ERROR OF REG. COEFF.</th>
<th>T VALUE</th>
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<tr>
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<td>4.76055</td>
<td>-0.00435</td>
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<td>0.40965</td>
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<td>DEPENDENT</td>
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<td>7.29746</td>
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ANALYSIS OF VARIANCE FOR THE REGRESSION

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<th>SUM OF SQUARES</th>
<th>MEAN SQUARES</th>
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GO

SELECTION: 7
**Industrials' Average Market Price Per Share of Common Equity**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>CORRELATION X VS Y</th>
<th>REGRESSION COEFFICIENT</th>
<th>STD. ERROR OF REG. COEFF.</th>
<th>T VALUE</th>
<th>COMPLETION</th>
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**ANALYSIS OF VARIANCE FOR THE REGRESSION**

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<th>SOURCE OF VARIATION</th>
<th>DEGREES OF FREEDOM</th>
<th>SUM OF SQUARES</th>
<th>MEAN SQUARES</th>
<th>F VALUE</th>
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</thead>
<tbody>
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<td>ATTRIBUTABLE TO REGRESSION</td>
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### Multiple Regression

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<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Correlation</th>
<th>Regression Coefficient</th>
<th>Std. Error of Coef.</th>
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<td>NO. 5</td>
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<td>1.66496</td>
<td>-0.34311</td>
<td>-0.01471</td>
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<td>NO. 7</td>
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<td>7.29746</td>
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<td>-0.02572</td>
<td>0.04207</td>
<td>-0.6314</td>
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#### Dependent
- NO. 1: 0.24427 0.41865
- INTERCEPT: 0.55122
- MULTIPLE CORRELATION: 0.55788
- STD. ERROR OF ESTIMATE: 0.37817

#### Analysis of Variance for the Regression

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Value</th>
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</tbody>
</table>
APPENDIX C
Formulas for Calculation of t-values Pertaining to Comparison of Regression Coefficients.\(^1\) (when \(\sigma_{x_1}\) is not known to be equal to \(\sigma_{x_2}\))

Degrees of Freedom = \[1 \]
\[
\frac{c^2}{n_1-2} + \frac{(1-c^2)}{n_2-2}
\]

where \(c = \frac{s_{y_1 \cdot x_1}^2}{s_{y_1 \cdot x_1}^2 + s_{y_2 \cdot x_2}^2}
\]
\[
\frac{n_1 \sigma_{x_1}^2}{n_1 \sigma_{x_1}^2 + n_2 \sigma_{x_2}^2}
\]

\(n\) is the number of cases

\(s_{y_1 \cdot x_1}\) is the standard error of estimate of the regression of \(y_1\) on \(x_1\)

\(\sigma_{x_1}\) is the standard deviation of \(x_1\)

\[t = \frac{b_1 - b_2}{s_{y_1 \cdot x_1}^2 + s_{y_2 \cdot x_2}^2}
\]
\[
\frac{n_1 \sigma_{x_1}^2}{n_1 \sigma_{x_1}^2 + n_2 \sigma_{x_2}^2}
\]

\(^1\)Acheson J. Duncan, Quality Control and Industrial Statistics (Homewood: Richard D. Irwin, Inc., 1965), p. 757.
Formula for Calculation of t-value Pertaining to Multiple Correlation Significance

\[ t = \frac{R_{1.234}}{s_{R_{1.234}}} \]

Where \( R_{1.234} \) is the multiple correlation coefficient

\( s_{R_{1.234}} \) is the standard error of estimate of \( R_{1.234} \)