AN EMPIRICAL EVALUATION OF THE RELATIONSHIP BETWEEN ERRORS IN ANALYSTS' FORECASTS OF EARNINGS PER SHARE AND STOCK PRICES

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ABSTRACT

AN EMPIRICAL EVALUATION OF THE RELATIONSHIP BETWEEN ERRORS IN ANALYSTS' FORECASTS OF EARNINGS PER SHARE AND STOCK PRICES

By

Paul Andrew Janell

The purpose of this research was to examine the relationship between errors in analysts' forecasts of earnings per share and subsequent stock price changes and, thereby, provide empirical evidence as to the utility of these forecasts. A second area for consideration was an assessment of the effectiveness of revisions in these forecasts made over a period of time.

It has been established, both theoretically and empirically, that a strong association exists between earnings and stock prices. Previous empirical work demonstrates that an appropriate methodology for the assessment of the utility of an event is the observation of subsequent stock price reactions to that event.

This study examined the relationship between errors in analysts' forecasts and subsequent stock price returns,

adjusted for market effects. Analysts' forecasts were obtained from the Standard and Poor's Earnings Forecaster. Fifty firms in 1970 and fifty firms in 1971 were randomly selected from the relevant population.

In establishing the utility of analysts' forecasts it must be shown that the relationship between errors in analysts' projections of earnings and subsequent stock price returns is statistically greater than can be found between forecasts made by other models and stock price returns. Thus, six naive forecast models were selected to provide projections which would serve as a control group.

The results of this study are reported in two sections. The first section presents the results of two preliminary test statistics which describe the predictive accuracy of the forecast models included in the study. Several conclusions were drawn from this aspect of the study. First, it was shown that as the forecast horizon was reduced, the mean prediction errors decreased for both the analysts' forecasts and the projections made by the naive models. Secondly, it was noted that analysts tended to be overoptimistic since approximately 70% of their forecasts were overpredictions. The Wilcoxon signed-rank test was then employed to test whether differences in accuracy of the forecast models were statistically significant. The best naive model yielded lower forecast errors than analysts in 1970 but greater errors in 1971, although neither difference was statistically significant.

The second part of the study presents the results concerning the utility of the forecasts as perceived by investors. The Spearman rank correlation coefficient was utilized to measure the relationship between errors in the forecasts and subsequent cumulative stock return residuals. At the .05 level of significance it was found that two of the three annual naive models did not differ significantly in their association with stock price returns than did errors in the analysts' estimates. The conclusion drawn, therefore, was that analysts' projections do not have greater utility for investors than do forecasts generated by simple naive forecast models.

It was also found at the .05 level of significance that there was no statistical difference in the association between errors in the analysts' annual forecasts and subsequent stock price returns than existed between errors in the analysts' revisions and the cumulative stock price returns. The conclusion drawn was that the analysts' revisions were not perceived to possess greater utility

than the analysts' annual forecasts.

These conclusions imply that the cost incurred by analysts in the preparation and dissemination of their forecasts is not justified in terms of the utility derived by the market.

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CHAPTER I

INTRODUCTION

Purpose of the Research

It has been fairly well-established in the financial literature that a strong relationship exists between earnings and stock prices.[1] Because of this relationship, a considerable amount of effort in the investment community has been devoted to the prediction of earnings per share. This can be evidenced by the many publications which recommend various stocks to buy-and-sell. These recommendations are substantially supported by projections of the firm's earnings.[2]

Recently, academic researchers have begun to examine the accuracy of analysts' projections of earnings per share and have raised several questions. How accurate are these forecasts of earnings? Does the accuracy of these forecasts influence investor decisions? Is the accuracy of these forecasts such that it justifies the

---

[1]Footnotes appear at the end of each chapter.

cost of their preparation and dissemination? Will inaccurate forecasts be ignored by investors, or will they mislead investors and increase the volatility of stock prices and disrupt the allocative efficiency of the stock market?

The present research was directed primarily at determining whether an association exists between analysts' forcasts of earnings per share and stock prices. If investors do utilize analysts' projections then their reactions to the forecasts can be ascertained by an examination of subsequent stock price movements. Specifically, stock price changes were related to forecast errors over a period of time.

However, it is not sufficient to merely determine that an association between analysts' forecasts of EPS and stock prices exists. Since analysts devote a significant amount of time in preparation of these forecasts there is a substantial cost attached to them. To justify this cost, there should be a significantly greater association between analysts' forecasts and stock prices than between alternative forecast models, which are obtainable at a lesser cost, and stock prices. One method of examining this "cost-benefit" question is to compare the analysts' predictions with naive forecast models to determine which is more highly associated with stock prices, since forecasts from naive models can be obtained at a relatively negligible cost. This "cost-benefit" analysis represents a second primary area of this research.

A third, but no less important, area for consideration in this research was an investigation of the improvement of the forecasting accuracy of analysts and any increased association between analysts' estimates and stock prices as the forecasting horizon is reduced. The purpose was to ascertain how effective the analysts' revisions are over time.

Significance of Earnings in Investor Expectation Models

Cohen and Zinbarg, authors of a well-known investment text have stated that:

> Common stock has value for only three possible reasons. First, the ownership of common stock confers a claim to a corporations' net income. This claim bears fruit when the corporation's board of directors declares dividends. Second, if the corporation enjoys growing success, earnings and dividends will rise, and the price of the stock may rise also. The third, and least significant, source of common stock value is that if a corporation is liquidated, the common stock owner has a pro rata claim to any asset value that may remain after all creditors and preferred stockholders have been paid.[3]

The third reason is only of significance when a corporation is about to be liquidated. Since most investors are concerned with investing in corporations that are going concerns, they will be most interested in dividend payments and price appreciation of their stock. Thus, according to Cohen and Zinbarg the two factors that give stock value are earnings and dividends.

Latane' and Tuttle offer a similar explanation.

> A stock's value is thought of as based on the present value of the future stream of payments to be received either by the company (earnings) or from the company's earnings stream by the stockholder (cash dividends).[4]

Theoretically, it is the cash payment (cash dividends) that give stock value. However, without earnings there would be no dividends. Since dividends are a function of earnings, authors of investment texts have suggested the use of earnings rather than dividends in various investment models.

Bolten points out:

> ...dividends tend to lag earnings, in many cases, by relatively long and unpredictable lengths of time, and the direct forecasting of dividends over the infinite time horizon of a stock is often very difficult and inaccurate. Nearer term earnings estimates, however, imply an expected dividend stream;....[5]

Latane' and Tuttle state:

> ...Since dividend payout rate is so variable and non-comparable, and since dividends seem to be related to the more

> comparable earnings figures, we shall concentrate on earnings, because a growing earnings trend must eventually result in an increased stream of dividend payments to the investor.[6]

An even stronger case for the use of earnings in investor models has been made by Modigliani and Miller.

> They assert that, given the investment decision of the firm, the dividend payout ratio is a mere detail. It does not affect the wealth of shareholders. M.M. argue that the value of the firm is determined solely by the earning power on the firm's assets or its investment policy and that the manner in which the earnings stream is split between dividends and retained earnings does not affect this value.[7]

The above excerpts from financial literature confirm the importance of earnings in investor expectation models. To come to firm conclusions regarding the outlook for a particular security, investors must employ estimates of future earnings as inputs to their models. One obvious source of these inputs are projections of earnings per share provided by professional security analysts. A priori, one could, therefore, expect that analysts' estimates of earnings per share are a potential source of valuable information to investors.[8]

Associations of Earnings and Stock Prices

To assess whether analysts' projections do in fact furnish information to investors, an operational definition of information must be provided. Beaver[9] has shown that the information content of an event can be ascertained by observing the stock price adjustment to the announcement of that event. In the context of the present study, if an event (i.e. analysts' projections) changes the expectations of investors such that it leads to a change in the equilibrium price of the stock, that event is said to possess information content.

In the previous section of this chapter the theoretical importance of earnings in investor expectation models was established. It remains to be demonstrated that in the real world earnings themselves possess information content. Beaver examined this issue by observing stock price and volume reaction to 506 earnings announcements. He concluded:

> ...The behavior of the price changes uniformly supports the contention that earnings reports possess information content. Observing a price reaction as well as a volume reaction indicates that not only are expectations of individual investors altered by the earnings report but also the expectations of the market as a whole, as reflected in the changes in equilibrium prices.[10]

Ball and Brown have also investigated the markets' reaction to accounting income numbers and concluded:

> Of all the information about an individual firm which becomes available during a year, one-half or more is captured in that year's income number. Its content is therefore considerable.[11]

Both of the above studies indicate that earnings do have information content in the sense that the market reacts (as measured by price changes) to the income numbers.

Further evidence between the association of earnings and stock prices, although in a more indirect way, has been provided in several studies by Latane' and Tuttle. In one of their research efforts they computed growth rates for several variables during the period 1956-66 for 68 industries and then calculated intercorrelations among the variables. Commenting on the results they state:

> Perhaps the most significant (relationship) is the high correlation of growth in prices with earnings and operating profits growth as well as the high correlation between these latter two measures of earnings. This relationship between price growth and earnings growth is at the heart of security analysis and explains why security analysts spend such a large part of their time trying to forecast earnings.[12]

The above excerpt not only gives support to the contention that stock prices and earnings are contemporaneously related but also some credence as to why analysts' forecasts of earnings and stock prices should also be related. Such a relationship is the underlying foundation for the present research.

Additional support has also been provided by Ball and Brown, who were earlier quoted as saying that the current income number has considerable content. They further state:

> However, the annual income report does not rate highly as a timely medium, since most of its content (about 85 to 90 percent) is captured by more prompt media which perhaps include interim reports. Since the efficiency of the capital market is largely determined by the adequacy of its data sources, we do not find it disconcerting that the market has turned to other sources which can be acted upon more promptly than annual net income.......
>
> This study raises several issues for further investigation. For example, there remains the task of identifying the media by which the market is able to anticipate net income.....[13]

It seems plausible to hypothesize that one possible medium by which the market is able to anticipate earnings would be analysts' projections of net income.

Approach and Organization of the Study

The approach of this study was to first obtain analysts' predictions of earnings per share from the Standard and Poor's "Earnings Forecaster." For each firm included in the study, monthly abnormal returns were computed from the forecast date through the month that actual earnings were announced. Then the association between the analysts' forecast errors and stock return residuals was established. The study also included a comparison of naive models with the analysts' forecasts and assessed the cost and benefits of each. Finally, an investigation of the effect of revisions in the analysts' forecasts was performed.

Chapter II contains a review of the literature dealing with analysts' projections of earnings per share. This review is concerned with the available empirical evidence on the accuracy of analysts' forecasts and their association with stock prices.

Chapter III contains a detailed discussion of the hypotheses to be tested, the data used, and the methodology employed. A theoretical discussion of the methodology utilized is also presented.

Chapter IV contains a discussion of the findings of the study. The hypotheses are restated and the evidence with which to accept or reject these hypotheses is also presented.

Finally, Chapter V contains a brief summary of the study, lists the major conclusions, and presents several recommendations for future areas of study.

FOOTNOTES

[1]The empirical evidence demonstrating that a strong relationship exists between earnings and stock prices is discussed in the third section of this chapter.

[2]Many investment research firms and research divisions of brokerage firms (e.g., Shearson, Hammil & Co., Inc., Merrill Lynch, Pierce, Fenner and Smith, Bache & Co., to name a few) publish lists of stocks to buy, hold, or sell. Often, their recommendations are supported by their estimates of future earnings per share for the firm in question.

[3]Cohen, Jerome B., and Zinbarg, Edward D., Investment Analysis and Portfolio Management, Homewood, Illinois: Richard D. Irwin, Inc., 1968, p. 260.

[4]Latane', Henry A., and Tuttle, Donald L., Security Analysis and Portfolio Management, New York, New York: The Ronald Press Company, 1970, p. 270.

[5]Bolten, Steven E., Security Analysis and Portfolio Management, New York, N.Y.: Holt, Rinehart and Winston, Inc., 1972.

[6]Latane' and Tuttle, op. cit., pp. 277-8.

[7]Van Horne, James C., Financial Management and Policy, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1971, p. 245.

[8]This statement, of course, is a primary issue underlying this research project.

[9]Beaver, William H. "The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, a supplement to Volume VI of The Journal of Accounting Research, p. 68.

[10]Ibid., p. 82.

[11]Ball, Ray and Brown, Philip, "An Empirical Evaluation of Accounting Income Numbers," Journal of Accounting Research, VI (Autumn, 1968), p. 176.

[12]Latane' and Tuttle, _op. cit._, p. 385.

[13]Ball and Brown, _op. cit._, pp. 176-7.

CHAPTER II

REVIEW OF EXISTING LITERATURE CONCERNING ANALYSTS' FORECASTS OF EARNINGS PER SHARE

Introduction

The literature pertaining to analysts' projections of earnings per share can be classified into two principal categories:

1. Research focusing on the accuracy of analysts' estimates of earnings. For the most part this research is concerned with the comparison of analysts' projections with estimates computed using various naive or mechanical forecasting models.

2. Research concerned with the accuracy of analysts' forecasts of earnings and the relationship of the forecasts with stock prices.

The studies to be reviewed and falling under the above categories are of an empirical rather than a theoretical nature. Since these works possess varying degrees of similarity to the present study, they will be explicated in considerable detail.

Survey of the Literature Concerning the Reliability and Accuracy of Analysts' Forecasts of Earnings

One of the first studies dealing with the analysis of earnings predictions was conducted by Cragg and Malkiel.[1] Their research examined the expected growth of earnings per share for 185 corporations as of the end of 1962 and 1963. The data for these corporations were collected from five investment firms and consisted of an average annual rate of growth expected to occur for each of the 185 sample firms.[2] Cragg and Malkiel indicated that each of the five participating firms was trying to predict the same growth rate, specifically "the long-run average ("normalized") earnings level, abstracting from cyclical or special circumstances."[3] Although each participating firm may have a somewhat different perception of growth and how it should be calculated, Cragg and Malkiel contended that any such differences among the participating firms did not appear to show up in the predicted growth rates.[4] Furthermore, the growth rates provided by the investment firms were given as point estimates and no confidence intervals surrounding these estimates were provided.

Cragg and Malkiel were primarily interested in determining the degree of agreement among the five investment firms in their predictions of expected growth rates as well as determining the accuracy of these predictions. A review of the results of the relevant aspects of their study will be presented below.

By use of an intercorrelation matrix, Cragg and Malkiel demonstrated that considerable agreement existed among the investment firms in their growth-rate predictions. Kendall's coefficient of concordance for ranks of companies by different predictors was .79 for 1963. However, Cragg and Malkiel recommend some caution in interpreting the statistic by stating that "...the lack of agreement it also reveals can hardly be considered negligible."[5]

Decomposition of the correlation coefficients into two components indicated that agreement concerning industry growth was not the major factor in accounting for the agreement in predictions among the participating firms. Further testing provided some evidence that certain industry groups (oil and cyclicals) were more difficult to forecast than other groups (electric utilities) in the ex ante sense.

The extent of agreement among the predicting firms was also examined by a comparison of the predicted growth rates of earnings. This analysis revealed that the predictions of 1963 were highly correlated with those of 1962.

Finally, Cragg and Malkiel correlated the forecasted growth rates with P/E ratios. Actually, they used the inverse of the P/E ratios as surrogates for market-expected growth rates. Although the correlations presented were generally high, they also demonstrated a degree of disparity among the forecasting firms.

The second aspect of their study was concerned with the accuracy of the predictions made by the five investment firms. However, in assessing the abilities of the forecasters, Cragg and Malkiel encountered a major difficulty in that the five years for which the projections were made had not yet elapsed. Thus, they used the realized growth of actual and normalized earnings (as estimated by firms 1 and 2) through 1965.[6]

The methods of evaluation utilized by the authors were "simple correlations and the inequality coefficient,

$$U^2 = \frac{(P_i - R_i)^2}{R_i^{\,2}} \qquad (1)$$

where P_i is the predicted and R_i the realized growth rates for the i^{th} company. It will be noticed that the inequality coefficient, in effect, gives a comparison between perfect prediction (U^2=0) and a naive prediction of zero growth for all corporations (U^2=1)."[7]

Note, however, that an underprediction would appear to be superior to an overprediction of the same magnitude. This can be illustrated by the use of the following example:

	P	R
Case 1	6%	4%
Case 2	4%	6%

Both cases have an absolute forecast error of 2%. Using equation (1) and solving for U^2, case 1 would have a U^2=.25 whereas, case 2 would have a U^2=.11. Thus, the use of the inequality coefficient leads to a bias, which is impossible to assess without an indication of the number of over-and-under-predictions.

Commenting on the results of the over-all accuracy of the forecasts, Cragg and Malkiel state:

> First, the forecasts based on perceived past growth rates, including even growth over the most recent year, do not perform much differently from the predictions. There seems to be no clear-cut forecasting advantage to the careful and involved procedures our predictors employed over their perceptions of past growth rates either in terms of correlation or of the inequality coefficient.[8]

By reference to "their perceptions of past growth rates" Cragg and Malkiel are referring to historic growth rates provided by the participating firms themselves.

As a final step of their study, Cragg and Malkiel examined the forecasting ability of several naive models based on historic data. The findings indicated that the investment firms did not have significantly superior ability in forecasting.

In concluding, the authors state that:

> ...the careful estimates of the security analysts participating in our survey, the bases of which are not limited to public information perform little better than these past growth rates.
>
> We must be cautious, however, in overgeneralizing these results. We did not have data to investigate directly whether the performance of the predictions of growth in the period considered were atypical of the usual forecasting abilities of such forecasts. The question is important, however, since it can be argued that the peculiarities of the expansion that occurred after the date of the forecasts made the period especially difficult to forecast. Moreover, our work is hampered by the fact that only a few firms were able to participate in our survey. It may also be that shorter-term earnings predictions are considerably more successful relative to naive forecasting methods.[9]

In evaluating and comparing Cragg and Malkiel's work to the present study several points should be emphasized. First, they dealt with predicted growth rates of earnings over a five year period, whereas the present study employed forecasts of earnings per share for a one-year period. This eliminated the difficulties of dealing with growth rates and the problem that the period had not entirely elapsed when comparisons were made. Secondly, the effect of revisions in the forecasts was examined. A final distinction is that Cragg and Malkiel did not directly relate the forecasts to stock price changes, a procedure which is of central importance to the present study.

A second empirical research effort dealing with the accuracy of analysts' estimates was conducted by Edwin J. Elton and Martin J. Gruber.[10] The purpose of this research was to test the performance of alternative mechanical forecasting techniques in predicting earnings per share and to compare the results of these models with predictions made by security analysts. Nine mechanical techniques, which were variations of exponentially weighted moving averages, naive models, simple moving averages, and regressions, were employed in their project. Analysts' estimates were obtained from a large pension fund, an investment advisory service, and a large brokerage house.

The mechanical forecasting techniques were "used to estimate earnings for the period 1962-67 on a stratified random sample of 180 firms selected from the Standard and Poor's Compustat Tape."[11] One, two, and three-year forecasts were made.

The majority of the article was devoted to a discussion of these mechanical forecasting techniques in terms of their properties and predictive accuracy. To evaluate the accuracy of the forecasts two methods were employed: (1) The square of the forecast error (i.e. $(\text{actual} - \text{forecast})^2$)[12] and (2) a variation of the standard error of estimate in the form:

$$U = \frac{\Sigma_i\ (\text{actual}_i - \text{forecast}_i)^2}{\Sigma_i\ (\text{actual}_i)^2}$$ [13]

First, the accuracy of the nine mechanical forecasting techniques for a one-year period was examined. The results indicated that the additive exponential with no trend in trend[14] out performed every other technique at a statistically significant level. The naive model[15] was outperformed by only three of the four exponential models, but even for these only the additive exponential with no trend in trend exhibited a statistically significant difference and this was at the 10% level of significance.

In comparing the performance of the mechanical techniques to the analysts' forecasts, the performance was measured for only those firms common to the participating firms and the random sample, and covered the period 1964-66. Actually, only the additive exponential model was used in the comparison.

Commenting on their results, Elton and Gruber state:

> The average data show that the best mechanical technique outperforms the security analysts at one financial institution, but is outperformed by the analysts at two others. However, none of the three differences is significant at even the 20% level.... In short, there is no statistically significant evidence to indicate that the forecasts made by analysts are different from those made by an exponentially weighted moving average employing an additive trend. Insofar, as better forecasts lead to better valuation models, the lack of such evidence would seem to indicate that mechanical techniques exist which can provide valid inputs to financial models and that these techniques (given their low cost) should be employed at least as a bench mark against which to judge analysts' performance.[16]

Although the results of Elton and Grubers' study appear to somewhat discredit analysts' performance, three points should be noted. First, two of the firms did perform better than the mechanical model. Next, one must question whether the method of evaluation utilized was appropriate (see footnote 12). Finally, in a footnote, the authors, themselves, issue the following caveat:

> One must exercise care in generalizing these results, since, to the extent that the superior performance of the additive exponential was peculiar to our sample, the results may be biased against the analysts' performance.[17]

Elton and Grubers' study is somewhat more comparable to the present study in that analysts' projections of earnings were compared to a mechanical forecasting technique. The results are interesting and were useful in selecting mechanical forecasting techniques utilized for comparative purposes in the present study. However, there are some notable differences between Elton and Gruber's research and the present research effort. First, a broader group of analysts' estimates was utilized. Secondly, revisions in forecasts were examined. Lastly, forecast errors were related to stock prices.

Both of the above studies discuss the accuracy of analysts' estimates but fail to relate these predictions to subsequent stock price changes. The next section of this chapter reviews several studies that relate analysts' forecasts and stock prices.

Survey of the Literature Concerning the Accuracy of Analysts' Estimates of Earnings Per Share and Stock Prices

Richard W. McEnally[18] employed a sample of 100 companies to evaluate the usefulness of earnings estimates in selecting common stocks. Earnings estimates for the year ended 12/31/66 were obtained from the three leading investment advisory services.

McEnally examined several investment strategies that could be used as models for testing the usefulness of the earnings estimates. The first strategy examined was one that advocates buying stocks that sell for a low price-earnings ratio.

To test the validity of this P/E model, the author divided the 100 firms into 5 portfolios of 20 stocks each on the basis of the ratio of April 1 prices to e.p.s. for the same year. This was done for the five year period 1961-1965. The results indicate that purchase of the lowest P/E stocks, Portfolio 1, would have yielded the highest returns, 38% before commissions, while the purchase of the highest P/E stocks, Portfolio 5, would have yielded the lowest returns.

To insure that the results were not due to the fact that low P/E stocks perform better, McEnally repeated the study using historical rather than future earnings per share. Few meaningful differences were found between the portfolios.[19]

The second investment strategy organized the 100 stocks into five portfolios on the basis of the magnitude of current years' earnings appreciation (i.e. Portfolio 1 consists of the 20 stocks having the highest ratio of Current Year's Earnings/Prior Year's Earnings). The results of this experiment indicated that Portfolio 1 would have had an average annual compounded rate of return of approximately 43% while Portfolio 5 would have declined about 7%

in value.

The above tests manifest the importance of the potential use of earnings estimates as well as demonstrating the strong relationship between earnings and stock prices.

In order to examine the usefulness of earnings estimates the above tests were repeated substituting the mean of the investment advisory firms' estimates for actual earnings for the April 1, 1966-March 1, 1967 period. The results showed an absence of any pattern in the returns among the different portfolios.

The author presents and discusses several reasons why the earnings estimates did not prove meaningful. First, the investment strategies may have been inappropriate. However, this was quickly dismissed since it was demonstrated that the two strategies could differentiate between the weak and strong performing stocks. Secondly, the earnings estimates may not have been useful since they were poor approximations of actual earnings. McEnally states, however, that the earnings estimates were quite close to actual earnings. Finally, the estimates of 1966 could have been representative of investor expectations and, thus, the stock prices on April 1, 1966 fully discounted the expected earnings changes.

Although McEnally's results may seem to conclusively demonstrate the uselessness of earnings estimates, caution must be exercised in evaluating and generalizing these results. It was not stated whether the sample was selected randomly or not. Thus, the results may be peculiar to these particular companies. Also, the study investigated earnings estimates for one year only, 1966, which may again limit the generalizations of McEnally's results. McEnally did not employ any statistical tests, thus, it is possible that some of the differences he found could have occurred by chance. This fact is somewhat substantiated by the fact that in one of the tests Portfolio 2 performed better than Portfolio 1, which McEnally rationalized by examining the performance of two of the companies contained in Portfolio 1. But perhaps, the results he did achieve could have been explained by a similar rationalization. Another notable deficiency in his study was a lack of adequate control. No attempt was made to control for general market effects, or control the level of risk among the different portfolios. Finally, the use of price-earnings ratios may be justifiably questioned since P/E ratios are affected by several variables.[20]

There are also notable differences between McEnally's study and the present research. The present study examined the relationship of stock prices and forecast errors over time. In investigating this issue general market effects were removed from the stock prices. Secondly, analysts' estimates were compared to estimates provided by naive models. A final important distinction was that the present study also examined the effect of revisions in the forecasts on subsequent stock price changes.

A second study relating earnings forecasts and stock prices was done by Victor Niederhoffer and Patrick J. Regan.[21] The purpose of this research was to provide some empirical evidence to support the hypothesis that stock price fluctuations are closely associated with changes in earnings. For their study, Niederhoffer and Regan selected the 50 best and 50 worst price performers on the NYSE for 1970. A random sample of 100 firms also selected from the NYSE served as a control group.

Earnings projections were obtained from the 3/31/70 edition of Standard and Poor's "Earnings Forecaster." In the cases where more than one prediction was provided for a company the authors arbitrarily chose the estimate of the institution with the largest number of forecasts in the "Earnings Forecaster."[22] Eight stocks were rejected from the original top 50 and 17 from the bottom 50 because the authors limited the study to only those firms with fiscal years ending between September and February.[23]

To evaluate the earnings changes and forecasting errors the authors normalized the data by price. This was primarily done because of the many companies which had small or negative earnings making the use of percentage changes misleading. The following three variables were computed for each company:

(1) $\frac{F - A_1}{P}$ = estimated earnings change per dollar of price

(2) $\frac{A_2 - A_1}{P}$ = actual earnings change per dollar of price

(3) $\frac{A_2 - F}{P}$ = error in forecast per dollar of price

where A_1 = 1969 actual earnings per share

A_2 = 1970 actual earnings per share

F = 1970 forecasted earnings per share

P = 1969 year-end stock price[24]

A non-parametric discriminant analysis was utilized to contrast the top 50, random 100, and bottom 50. Reporting on the results of the distribution of actual earnings changes per dollar of price (equation 2) Neiderhoffer and Regan state:

> ...for all companies with actual earnings gains of four cents or more per dollar of price, the odds were 14 to one that the company would finish in the top 50 rather than in the random 100, with virtually no

> chance of ending up in the bottom 50. But for earnings losses of eight cents or more,[25] the odds were 20 to one that the stock would land in the bottom 50 rather than in the random 100. In this case, there was no chance of finishing in the top 50.
>
> A similar phenomenon emerged in the distribution of forecasting errors, ... we can see that when the forecast was overestimated by eight cents or more per dollar of price, the odds were nearly 17 to one that the stock would finish in the bottom 50 rather than in the random 100. At the other extreme, an underestimate of one cent or more per dollar of price almost guaranteed that the stock would finish in the top 50 rather than in the random 100, since the chances were 24 out of 25.[26] But the table does seem to vindicate the analysts' position as seers, since half of the estimates for the 100 random stocks were within one cent (normalized) of actual earnings and two-thirds were within two cents.[27,28]

Considerable caution should also be exercised in assessing and generalizing the results of this study. Only forecasts for 1970 were subjected to analysis, which limits the generalizations of the study to that particular year. Many will agree that 1970 was an atypical year, one in which the stock market suffered a dramatic drop as evidenced by the dip in the Dow Jones Industrial Average to 631.16.[29] In such a year as 1970 corporations also have the tendency to increase expenses since net income will probably be below expectations at any rate. In this way corporations shift expenses into one year so future years' reported incomes will be increased.

These deficiencies could have been partially alleviated by removing general market effects from the stock prices and associating the estimates with these residual returns, a procedure that was utilized in the present study. Nevertheless, Niederhoffer and Regan do confirm the fact that a strong relationship exists between earnings changes and stock prices.

The final work to be reviewed in this chapter is an unpublished paper completed at Portland State University by Richard H. Gassner and Roger D. Williams.[30] They selected 100 firms, not on a random basis, and examined the relationship of stock returns to changes in analysts' weekly estimates. The source for these forecasts was the 1967 edition of the Standard and Poor's "Earnings Forecaster".

Two separate models were use to detect significant changes in analysts' estimates. The first model was designated the mean relative change model (MR), since it was based upon a change in the mean of the analysts' projections of earnings per share. For their analysis, only changes considered as significant, arbitrarily set at 5% or more, were utilized. Using the MR model, returns, or price relatives, were computed for various holding periods. For example, if there was a mean change in the analysts' estimate of e.p.s.$\geq$5% the stock was "purchased and held" for a given holding period (e.g. one week, 2 weeks, 3 weeks, or 6 months). Then a return was computed by dividing the initial price of the stock into the price at the end of the holding period.

The second model utilized in the analysis was called the cluster model. A cluster was defined as a group of estimates which had a boundary of plus or minus one standard deviation around the mean. In order for a signal to be produced for this model an analyst's estimate first had to be within the cluster and then move out of the cluster.

To evaluate the results of these models two measures were utilized (1) the standard deviation of returns, employed as a surrogate for risk and (2) a control index of performance. This control index was similar to an index developed by Fisher and, in fact, employed the same weighting factors as did Fisher. However, the index was not a market index since it was constructed only for the stocks employed in the study.[31]

The authors summarize the overall results of their study as follows:

> In general, the results of the study were not as significant as was hoped, although the results could be generally classed as encouraging and warranting further research. The central problem is one of a lack of consistency in the results. Although both models produced impressive returns for selected conditions, few patterns of returns or consistency of upward and downward signals were produced.[32]

The mean relative change model produced annualized percentage returns after commissions for most of the weekly holding periods in excess of the returns for the control index. The returns on the 100 stock sample for the 6-month holding period were slightly below the control index. In general the standard deviations were of the same magnitude for both the up and down signals over the shorter holding periods. However, for the 6 month holding period the standard deviation was significantly greater.

With regard to the mean relative change model Gassner and Williams state:

> Although certain specific results of the mean relative change model as discussed above seem promising, it should be carefully noted that the model as applied here does not clearly distinguish between upward and downward signals, i.e., positive results were indicated by both upward and downward changes. This factor does not necessarily mean that the model has no value, but it should point out that these results should be carefully interpreted and considered at best as promising results and thus indicative of a need for further research.[33]

In general, the cluster model did not perform as well as the mean relative change model. There were no particular patterns of results and "there was little distinction between upward and downward signals as predictors of price movement."[34]

There are several limitations of this study that the authors acknowledged. Since the data base was not randomly selected and the study covered only one time period, the generalizations of this study are limited. The methodology is also limited in that only week by week changes were examined, "whereas, the changes that may be significant may occur slowly over a long period of time".[35] Another limitation is that the control index and the results of the model are not strictly comparable because they were not compared at the same level of risk.

There are some other limitations that the authors failed to acknowledge. Since no statistical tests were employed it is difficult to assess whether any of the results would have been significant in a statistical sense. Secondly, the price relatives did not include any dividend payments. This may not be too serious since dividends were also absent in the control index. Finally, the methodology utilized did not adequately control for general market effects since the control index was not a

market index.

In spite of these limitations, this research effort indicates that analysts' estimates of earnings per share may be useful in some investor valuation models and the relationship between analysts' projections and stock price changes warrants further research. In the present study this relationship was examined from a different perspective and with a different methodology.

Summary

This chapter has reviewed previous works dealing with the accuracy of analysts' estimates and the attempts made to relate them to stock price changes. These studies do confirm that there is a strong relationship between earnings and stock prices.

However, there is some contradictory evidence regarding the usefulness and accuracy of analysts' estimates. On one hand, Gassner and William's project and Niederhoffer and Regan's study provide some evidence that analysts' forecasts of earnings per share are meaningful data for investors. On the other hand, it was also demonstrated that certain mechanical forecasting techniques may be as good at predicting earnings as are security analysts. Because of certain deficiencies and limitations of these studies, such evidence is not conclusive. In the present study an attempt was made to remove these weaknesses, and, thereby establish conclusively the relationship that exists between analysts' forecasts and stock prices.

The present research effort (1) examined the association between analysts' estimates and stock prices from a different perspective and with a different methodology (2) incorporated several aspects of the previous studies into one study (3) improved upon the previous works by removing some of their deficiencies and limitations and (4) investigated some areas that have previously been unexplored.

FOOTNOTES

[1]Cragg, J. G. and Malkiel, Burton G., "The Consensus and Accuracy of Some Predictions of the Growth of Corporate Earnings," Journal of Finance (March, 1968), pp. 67-84.

[2]Actually only two of the five participating firms could provide data for all of the 185 sample corporations.

[3]Ibid., p. 68.

[4]It should be noted that any bias introduced by the way the participating firms calculated expected growth rates is indeed difficult to assess. Thus, one can not say how such differences in calculations would affect the results of their study.

[5]Cragg and Malkiel, op. cit., p. 71.

[6]Although the authors logically argue that since the firms are predicting normalized earnings, the use of an estimate of normalized earnings may be a valid standard of comparison, such a procedure certainly detracts from the conclusions of the study.

[7]Cragg and Malkiel, op. cit., p. 76.

[8]Ibid., p. 77.

[9]Ibid., pp. 83-84.

[10]Elton, Edwin J. and Gruber, Martin J., "Earnings Estimates and the Accuracy of Expectational Data," Management Science, Vol. 18, No. 8 (April, 1972) Application Series, pp. B409-B429.

[11]Ibid., p. B-414.

[12]Note that this method weights differences of the same magnitude equally. Thus, an error of 20¢ per share would be given equal weight regardless of whether the difference originated from actual e.p.s. of $2.00 and a forecast of $1.80 or from actual e.p.s. of $.40 and a forecast of $.20. However, there could be a wide disparity in terms of percentage error as the foregoing

example illustrates. Because of such a disparity the results of the study must be interpreted with a great deal of caution.

[13]Note that this equation is the same as Cragg and Malkiel's inequality coefficient, which was discussed earlier, and is, thus, subject to the same bias. Because of these biases, the conclusions of this study are suspect.

[14]An additive trend effect means that earnings per share are expected to grow at a constant amount per year. The term "no trend in trend" indicates that there is no trend in this growth rate for this model.

[15]The naive model utilized in this study was of the following form:

$$E_{t}, T = E_t + (E_t - E_{t-1}).$$

This equation states that estimated earnings are equal to earnings of the prior period plus the prior change that had occurred in earnings.

[16]Elton and Gruber, op. cit., p. B-419.

[17] Ibid., p. B-419, footnote 26.

[18]McEnally, Richard W., "Using Earnings Estimates in Selecting Common Stocks," Trusts and Estates, Volume 109 (January, 1970), pp. 35-38.

[19]It should be noted that there is some evidence to support the fact that low P/E stocks perform better than high P/E stocks. The reader is referred to Nicholson, S. Francis, "Price Ratios in Relation to Investment Results," Financial Analysts Journal, Volume 24, No. 1 (January-February 1968), pp. 105-109.

[20]The price-earnings ratio is a shorthand formulation of the present discount valuation (PDV) model. The PDV model discounts dividends (or earnings) at a particular discount rate r. Theoretically, the PDV model considers dividends (or earnings), their expected growth, and the discount factor r, which is composed of interest rate risk, purchasing power risk, business risk, and financial risk. For a further discussion see Bolten, Steven E., op. cit., Chapter III, pp. 39-48.

[21]Niederhoffer, Victor and Regan, Patrick J., "Earning Changes, Analysts' Forecasts and Stock Prices," Financial Analysts Journal, Volume 28, No. 3 (May-June 1972), pp. 65-71.

[22]Upon review of the "Earnings Forecaster" for a period of some 26 months (including 1970) it is this writer's opinion that the institution providing the greatest number of forecasts is, in fact, Standard and Poor's. If this observation is correct then Niederhoffer and Regan are testing Standard and Poor's Forecasts rather than a representative sample of security analysts.

[23]It is possible that the elimination of these 25 firms could have biased the results of this study. Furthermore, since the companies were limited to those with fiscal year ends between September and February and the authors did not separately disclose the results by length of forecast (i.e., 6 months, 7 months, etc.), an additional bias of unknown dimension detracts from the results of this study.

[24]Another potential bias in this study relates to the use of the 1969 year-end stock price for two reasons. First, the price could have been unusually high or low at that time. Secondly, since the forecasts were selected from the March 31, 1970 "Earnings Forecaster" it would seem that a more current price or a recent months' average should be used so as to reflect the events transpiring up to that time.

[25]It is interesting to note that 86% of the top 50, 98% of the random 100, and 80% of the bottom 50 had earnings changes within + $.04 and -$.08 limits discussed by the authors.

[26]It is also interesting to note that 100% of the bottom 50 companies, 79% of the random 100 companies and only 11.4% of the top 50 companies were characterized by overestimates.

[27]These percentages are difficult to assess because of the method of computation, as well as, the potential bias that exists in this methodology. See footnote 24.

[28]Niederhoffer and Regan, op. cit., pp. 70-71.

[29]This was the lowest point since 1962.

[30]Gassner, Richard H., and Williams, Roger D., "The Relationship Between Changes in Analysts' Earnings Per Share Estimates and Ensuing Price Movements for Individual Stocks." Unpublished paper, Portland State University, 1969.

[31]The use of the same weighting factors as Fisher may be somewhat inappropriate in this case since Fisher developed a market index to be used as a standard of comparison for long periods of time. Fisher states that over shorter periods of time the results of his index are somewhat erratic and have a downward bias. See Fisher, Lawrence. "Some New Stock Market Indices," Journal of Business, Volume 34 (Supplement, January, 1966), pp. 226-41, especially page 201.

[32]Gassner and Williams, op. cit, p. 21.

[33]Ibid., p. 21 and 25.

[34]Ibid., p. 25.

[35]Ibid., p. 34.

CHAPTER III

HYPOTHESES AND METHODOLOGY

Introduction

Chapter III is concerned with three major topics. First, the theoretical considerations that provide the foundation for the research hypotheses tested and the methodology utilized are presented. Second, the general research hypotheses concerning the association of forecasts and stock prices are set forth. Finally, the methodological structure of the research is presented. This structure included an identification of the population of firms under study, a description of the sample selection criteria and procedures, a discussion of the selection of the naive forecasting models, and a development of the model utilized to abstract market-wide effects from stock returns. This section also included a discussion of some preliminary descriptive test statistics as well as the statistical hypotheses and statistical tests utilized in this study. The chapter concludes with a discussion of the limitations of this methodological structure.

Theoretical Considerations

In Chapter I the theoretical importance of earnings in investor expectation models was established. That chapter also contained a brief discussion of empirical studies made by Beaver[1] and Ball and Brown[2] which substantiated the contemporaneous association of stock prices and earnings data. Because these two studies were instrumental in establishing a theoretical construct and a valid research methodology for investigating investor adjustment to new information, this section of Chapter III will present a more detailed discussion of these research efforts.

Beaver examined both price changes and the physical volume of securities traded associated with the announcement of annual earnings for 143 firms during the period 1961–1965. With respect to these earnings announcements, he stated that:

> a firm's earnings report is said to have information content if it leads to a change in investors' assessments of the probability distribution of future returns (or prices), such that there is a change in equilibrium value of the current market price.[3]

Beaver has, thereby, operationalized the concept of information by defining the information content of a event to be a stock price adjustment to that particular event.

Beaver hypothesized that if the earnings report had information content then the stock price adjustment during the week of the earnings announcement would be larger than in other weeks. To test this hypothesis some method was required to abstract out effects which were not related to the earnings announcement but, nevertheless, might cause a change in stock prices. To abstract from market-wide events that tend to affect all stock prices, Beaver employed the following linear regression model:

$$R_{jt} = \hat{a}_{jt} + \hat{b}_{jt} R_{mt} + \hat{e}_{jt}$$ [4]

where: R_{jt} = the return of security j for week t

$\hat{a}_{jt}$, $\hat{b}_{jt}$ = regression parameters that vary from security to security and relate past security returns to market returns.

R_{mt} = the return on a market index for week t.

$\hat{e}_{jt}$ = the residual return for firm j in week t.

Since the residual return ($\hat{e}_{jt}$) reflects events unique to a particular firm, Beaver analyzed the behavior of the $\hat{e}_{jt}$ during the week of the earnings announcement as well as the behavior of these $\hat{e}_{jt}$ for several weeks both before and after the earnings announcement. Beaver predicted that the $\hat{e}_{jt}$ during the week of the earnings announcement would be greater than for non-report weeks.

Based on the results obtained from this test, he concluded that "the behavior of price changes uniformly supports the contention that earnings reports possess information content."[5]

With respect to the present study, Beaver's research effort is very significant. First, he has demonstrated that earnings reports possess information which leads to a change in the equilibrium value of the current market price of the securities. This result confirms the fact that a strong contemporaneous relationship exists between earnings and stock prices. Furthermore, his research provides support for the utilization of the market model as a means of abstracting market-wide effects from a security's total return.

A second study that also investigated the information content of annual earnings reports, but from a different perspective than Beaver, was the pioneering effort of Ball and Brown. In their study they were concerned with both the content and the timing of earnings reports. They contend that:

> An empirical evaluation of accounting income numbers requires agreement as to what real-world outcomes constitute an appropriate test of usefulness. Because net income is a number of particular interest to investors, the outcome we use as a predictive criterion is the investment

> decision as it is reflected in security prices. Both the content and timing of existing annual net income numbers will be evaluated since usefulness could be impaired by deficiencies in either.[6]

The authors examined a total of 261 firms over the period 1957-1965 and constructed "two alternative models of what the market expects income to be and then investigate(d) the market's reactions when its expectations prove(d) false".[7] The first model was constructed by regressing each firm's income on the average of all firms' income in the market. The expected income change for a particular firm was "then given by the regression prediction using the change in the average income for the market..."[8] The difference between the actual and expected income change was defined as the forecast error. It was this forecast error, or unexpected income change, which the authors assumed to represent the information to be conveyed by the income number. The second model constructed was a simple naive model which predicted that income for the current year would be the same as that of the previous year.

Ball and Brown elected to use the investment decision as it is reflected in security prices as their predictive criterion. Their choice was justified by both theory and empirical evidence as they indicated in their study:

> Recent developments in capital theory provide justification for selecting the behavior of security prices as an operational test of usefulness. An impressive body of theory supports the proposition that capital markets are both efficient and unbiased in that if information is useful in forming capital asset prices, then the market will adjust asset prices to that information quickly and without leaving any opportunity for further abnormal gain. If, as the evidence indicates security prices do in fact adjust rapidly to new information as it becomes available, then changes in security prices will reflect the flow of information to the market. An observed revision of stock prices associated with the release of the income report would thus provide evidence that the information reflected in income numbers is useful.[9]

To examine the stock price adjustments to the information conveyed by the income forecast errors, Ball and Brown had to first abstract the market-wide effects from each security's overall return. Like Beaver, they employed the market model to abstract from these effects and to obtain a measure of the return attributable to each specific security. These stock return residuals were computed for each firm and for each month for a period of 11 months prior to the month of the earnings announcement. The importance of these residual returns is conveyed by the following statement:

> ...since the market has been found to adjust quickly and efficiently to new information, the residual must represent the impact of new information, about firm j alone, on the return from holding common stock in firm j.[10]

Next the authors separated their sample of firms into two categories according to the sign of the forecast error. Firms that had positive forecast errors (i.e. actual earnings > predicted earnings) were designated as good news firms and those with negative forecast errors (i.e. actual earnings < predicted earnings) were designated as bad news firms.

Ball and Brown hypothesized that the firms with positive forecast errors should have positive stock return residuals and the firms with negative forecast errors should have negative stock return residuals. The rationale supporting this hypothesis assumes that investors utilize the authors' models to form expectations about earnings and also act according to these expectations in establishing an equilibrium price for each security. For the good news firms investors will gradually realize that their predictions of earnings were underestimated and, thus, will act to bid the price of these stocks up[11] (more precisely it is the residual return that should increase). A similar reaction but in the opposite direction should occur for the firm conveying bad news.

To test this hypothesis a chi-square statistic for a two-by-two classification by sign of forecast error and sign of stock residual was computed. The results of their study indicate not only that earnings numbers possess information content but also that most of this information was anticipated prior to the earnings announcement date. However, the authors did not investigate what media the market was utilizing to anticipate the information contained in the annual income number.

The significance of Ball and Brown's study is threefold. First, it confirms Beaver's results by also demonstrating that earnings reports do possess information content. Secondly, it provides additional support for the utilization of the market model as a valid method of abstracting market-wide effects from the overall return of a security. Finally, it suggests the existence of other media by which investors are able to anticipate the information conveyed by the annual earnings report.

General Research Hypotheses

Research Hypothesis-1

The previous section of this chapter has demonstrated that a valid predictive criterion for examining the usefulness of an event (e.g. the announcement of earnings reports) is the investment decision as it is reflected in security prices. Beaver has utilized this criterion to show that annual earnings reports cause significant changes in stock prices in the week of their announcement relative to stock price adjustments in other weeks. Ball and Brown's research also utilized this criterion to confirm Beaver's results. They further demonstrated that much of the information content of these earnings reports is anticipated by the market prior to their actual release. However, the media utilized by the market to anticipate the annual income numbers were not established.

As stated in Chapter I it seems plausible to hypothesize that one possible medium by which the market is able to anticipate earnings would be analysts' projections of net income. Since professional security analysts devote a considerable amount of time in developing their projections, it is reasonable to assume that these forecasts are worthwhile.

If analysts' forecasts of earnings per share do possess information content (in the operational sense as utilized by Beaver and by Ball and Brown), then stock price adjustments should be associated with errors in these forecasts. Furthermore, since there is a substantial cost in preparing these forecasts, a priori, it is expected that there would be a greater degree of association between analysts' forecasts and stock prices than between forecasts made by some naive model (with a relatively negligible cost) and stock prices.

A comparison of projections provided by security analysts and predictions generated from naive models was made in the present study. This comparison was somewhat akin to a cost-benefit analysis. However, since the costs and benefits of each prediction method were not fully assessed, a complete cost-benefit analysis was not made. In this study benefits were assessed by the association between forecasts (more specifically, forecast errors) and stock return residuals. Thus, it was assumed the greater the association, the greater the benefits. Also, no attempt was made to determine the exact cost of the earnings projections. Rather, it was assumed that forecasts generated from the naive models examined in this study were obtained at a lesser cost than forecasts provided by the analysts. Because of these restrictions on the cost-benefit analysis, conclusive results are forthcoming only if the forecasts generated by the naive models have the greatest association with the stock return residuals.

The first hypothesis of this study dealt with the issue of cost-benefit analysis in the limited sense as described above. The hypothesis concerned with the association between stock price returns and errors in forecasts is:

Null Hypothesis, H_o^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected naive models and stock price returns.

Alternative Hypothesis, H_a^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns is greater than the association that exists between forecast errors generated by selected naive models and stock price returns.

Research Hypothesis-2

The first research hypothesis was concerned with the association between stock price returns and errors in forecasts of earnings per share which were made at a time when only the previous year's earnings data were available. Generally, this meant that at the time the forecasts were made there were nine to ten months remaining in a firm's fiscal year. However, as the year progresses many events may occur that cause such forecasts to become outdated and unrealistic. One such event is the issuance of the corporations' quarterly earnings reports.

If any of these events (including the quarterly earnings reports) possess information content, then investors will revise the inputs to their expectation models and act accordingly, which will result in stock price adjustments. Analysts will also react to these events by revising their forecasts. It is, therefore, reasonable to expect that errors in such revisions should have a greater association with stock price returns than errors in the analysts' original forecasts made at a time when only the previous years earnings were known. Specifically, errors in annual analysts' forecasts were compared to errors in analysts' predictions made after the quarterly earnings reports were published. The statement of the hypothesis contrasting annual analysts' forecasts and analysts' revised forecasts is:

Null Hypothesis, H_o^2: The association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns <u>does not differ</u> from the association that exists between errors in analysts' quarterly revised forecasts and stock price returns.

Alternative Hypothesis, H_a^2: The association that exists between errors in analysts' quarterly revised forecasts and stock price returns <u>is greater than</u> the association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns.

<u>Research Hypothesis-3</u>

As mentioned above, one primary event that may provide additional information about expected earnings per share is the issuance of quarterly earnings reports. These interim reports not only allow analysts the opportunity to revise their forecasts but also furnish additional data that could be used in various naive models. The final research hypothesis of this study is concerned with a comparison of errors in analysts' forecasts revised on a quarterly basis to naive models employing quarterly earnings data. This final hypothesis is:

Null Hypothesis, H_o^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected quarterly naive models and stock price returns.

Alternative Hypothesis, H_a^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns is greater than the association that exists between forecast errors generated by selected quarterly naive models and stock price returns.

Methodology

Population Criteria

The population of firms considered in this research met the following criteria:

1. The firms appear in the 1970 and 1971 editions of Standard and Poor's *Earnings Forecaster*.

2. The firms are listed on the New York Stock Exchange (NYSE), except for firms leaving the NYSE because of delisting, merging, or listing on other exchanges.

3. The firms have a fiscal year-end on December 31.

4. The firms meeting the first three criteria have a minimum of three analysts' estimates per month for at least ten months prior to the announcement of the annual earnings by the corporation in the *Earnings Forecaster*.

The Standard and Poor's Earnings Forecaster[12] was selected as a data base because it provides a broad compilation of analysts' forecasts made by leading Wall Street researchers on over 1800 leading corporations. Over sixty investment, research, and/or brokerage firms contribute their forecasts to this publication.

Criteria two and three were imposed to put the firms on a comparable basis with regard to the time horizon of the forecasts, to facilitate the data collection procedures, and to facilitate the hypotheses testing.

Criterion four was imposed to give added validity to the analysts' forecasts. A mean of the analysts' estimates was computed and it was assumed in the present study that this mean estimate was a valid representation of the analysts' expectations regarding the earnings. The utilization of the above criteria limited the population of firms to 296 in 1970 and to 251 in 1971.

Sample Selection Criteria and Procedures

From the relevant population described above, fifty firms in 1970 and fifty firms in 1971 were randomly selected using a table of random numbers.[13] For each firm selected the following additional criterion had to be met.

1. At a minimum, sixty months of price data prior to the month of forecast must have been available.

This criterion was imposed to assure that sufficient observations were available for the market model, which was employed to abstract the general market effects from a security's overall return.

Selection of Naive Forecasting Models

The primary criteria utilized in the selection of naive forecasting models were (1) their ability to generate accurate forecasts according to previous testing, (2) ease of computation, and (3) ease of data collection. All of the models selected are capable of generating forecasts at a minimum of cost, thus, insuring that they could be widely used by any investor.

After a review of the pertinent literature the following models were selected for inclusion in the present study.

Model 1. The current year's earnings per share (EPS) is equal to the prior year's earnings per share. Mathematically, this forecast is computed as follows:

$EPS_t = EPS_{t-1}$ where t = the current year

Model 2. The current year's earnings per share is equal to the previous year's earnings per share plus any change that occurred from the year before. Mathematically, this forecast is computed as follows:

$$EPS_t = EPS_{t-1} + (EPS_{t-1} - EPS_{t-2})$$

or

$EPS_t = 2(EPS_{t-1}) - EPS_{t-2}$ where t = the current year

Model 3. The current year's earnings per share is equal to the previous year's earnings times the percentage change in earnings per share from the year before. Mathematically, this forecast is computed as follows:

$$EPS_t = EPS_{t-1} \times (EPS_{t-1}/EPS_{t-2})$$

or

$$EPS_t = (EPS_{t-1})^2/EPS_{t-2}$$ where t = the current year

The association of forecast errors from these models and stock price returns was compared in this study with the association between errors in analysts' forecasts of earnings per share and stock price returns.

All three of the annual naive forecast models were used by Copeland and Marioni[14] who tested them against forecasts made by corporate executives. Of these three models, model 1 exhibited the best predictive accuracy in terms of the lowest total relative and absolute errors, summed and averaged, over the sample of firms employed in their study. However, as these models were only tested for the prediction of 1968 earnings per share, the results of Copeland and Marioni's study may well be peculiar to this particular year. There appears to be some indirect evidence that this might be the case.

Elton and Gruber[15] conducted a study, which was reviewed in Chapter II, that evaluated the predictive accuracy of several mechanical forecasting techniques. Their results demonstrate that their naive model was outperformed by only three of the four exponential models evaluated; but even for these exponential models only the additive exponential with no trend in trend was superior to the naive model in terms of a statistically significant difference, and this was at the 10% level of significance. The naive model employed by Elton and Gruber was equivalent to model 2 of the present study. Since Copeland and Marioni found that model 1 was superior to model 2, one can infer that either the results of the two works are peculiar to the years observed, or that the difference between model 1 and the more sophisticated exponential models may be minor.[16]

The association between forecast errors derived from three additional naive forecast models was compared with the association between errors in analysts' quarterly revised forecasts and stock price returns. These models were designated as the quarterly naive forecast models, since they utilized quarterly earnings per share data.

These quarterly naive forecast models are listed below:

Model 4. Earnings per share of the current year equals four times the first quarter earnings per share of the current year.

Mathematically, this forecast is computed as follows:

$$EPS_t = 4(EPS_{tq1})$$

where: t = the current year
q1 = the first quarter

Model 5. Earnings per share of the current year equals two times the combined earnings per share of the first two quarters of the current year. Mathematically, this forecast is computed as follows:

$$EPS_t = 2(EPS_{tq1}) + EPS_{tq2})$$

where: t = the current year
q1 = the first quarter
q2 = the second quarter

Model 6. Earnings per share of the current year equals four-thirds times the sum of the first three quarters of earnings per share of tle current year. Mathematically, this forecast is computed as follows:

$$EPS_t = 4/3\ (EPS_{tq1} + EPS_{tq2} + EPS_{tq3})$$

where: t = the current year
q1 = the first quarter
q2 = the second quarter
q3 = the third quarter

Of the above three quarterly naive forecast models, only model 4 was evaluated by Copeland and Marioni. They concluded that of the six naive models they evaluated, model 4 was the superior predictor in terms of the lowest total relative and absolute errors. Models 5 and 6 were formulated so that comparisons could also be made with analysts' revisions made when second and third quarter earnings reports were available.

Identification of Actual Earnings Per Share and Their Announcement Dates

Actual annual and quarterly earnings per share data and their announcement dates were obtained from the Wall Street Journal Index. The annual earnings per share were also verified against the actual earnings reported in the Standard and Poor's Earnings Forecaster. On the rare occasions when either the annual or quarterly earnings per share data were not reported in the Wall Street Journal Index, these data were obtained from either the Standard and Poor's Earnings Forecaster or the Standard and Poor's Stock Market Reports.[17] Where necessary appropriate adjustments were made in the earnings data to reflect stock splits and stock dividends.

It was necessary to obtain the earnings announcement dates to assure that the analysts could have had access to the actual reported earnings of the previous year prior to forming their estimates of current year's earnings per share. Analysts' estimates made at the end of the month of the earnings announcement were selected for inclusion in this study. In this way the analysts' predictions and the forecasts generated by the naive models comprised the same time horizon. Consider the following example:

	1969 EPS		1970 EPS	
	Date	Amount	Date	Amount
Firm A	2/12/70	2.00	1/28/71	2.30
Firm B	3/ 5/70	4.00	3/ 8/71	3.80

For firm A actual 1969 EPS was reported in February 1970, whereas the actual 1969 EPS for firm B was reported in March of 1970. Thus, the analysts' projections made at the end of February 1970 for firm A and the analysts' projections made at the end of March 1970 for firm B would be utilized in the present study. The purpose of this procedure was to put the naive forecast models and the analysts' forecasts on a comparable time-period basis so that investors would have had the opportunity to apply either the naive models or the analysts' forecasts in obtaining inputs for their particular stock price models.

The earnings announcement dates also dictated the period over which the stock return residuals were computed. For firm A, stock return residuals would be computed for each month beginning with March 1970 and terminating with January 1971. On the other hand, the stock return residuals for firm B would be computed for each month beginning with April 1970 and terminating with March 1971.

The Market Model

In the first section of this chapter the theoretical considerations underlying the information content of an event were discussed. It was asserted that an appropriate predictive criterion for establishing the usefulness of an event was the investment decision as it is reflected in security prices, since they adjust rapidly to new information as it becomes available. Thus, an observed revision in stock prices to the release of some event suggests the utility of that particular event.

It was also stated that the market model was an appropriate specification of the process generating individual security returns. This model asserts that security returns are a linear function of a general market factor. Empirical support of this model was established in a study by King[18] who demonstrated that stock prices and, thus, rates of returns of holding stocks tend to move together. He established that over the period from March 1944 through December 1960 that approximately 30 to 40 per cent of the variability in a stock's monthly rate of return could be related to market-wide effects. He also demonstrated that for the same period approximately 10 per cent of the variability in a stock's monthly rate of return could be accounted for by industry effects.

Thus, a security's overall return is a result of three main factors: The first is common to all securities and is known as the market effect; the second is common to particular industries and is called the industry effect; and the third factor is unique to each specific security and is designated as the residual effect (or residual return). It is this residual return that is of special significance in establishing the information content of an event. The significance of this residual return is substantiated by Ball and Brown who state that:

> Since the market has been found to adjust quickly and efficiently to new information, the residual must represent the impact of new information, about firm j alone, on the return from holding common stock in firm j.[19]

Thus, to ascertain whether an event possesses information content, it was necessary to abstract from the market-wide effects and concentrate on the effects unique to the firm. The industry effect was not removed from a security's overall return because the amount of variability accounted for by the industry effect relative to the market effect was believed to be minor. Specifically, the increase in precision by removal of the industry effect does not outweigh the cost of data-gathering and computational problems. Furthermore, Ball and Brown refer to a study by Blume[20] which suggests that the industry effects could be somewhat less than the 10%

found by King.

The market model was the method utilized in the present study to abstract the market-wide effects from the individual security's return. This model is of the form:

$$R_{jt} = \hat{a}_{jt} + \hat{b}_{jt} R_{mt} + \hat{e}_{jt} \tag{1}$$

where:

R_{jt} = the return of firm j in month t and is equal to $\left(\frac{P_{jt} + D_{jt}}{P_{j,\ t-1}}\right) -1$[21]

where:

P_{jt} = the closing price per share of firm j at the end of month t,

D_{jt} = the cash dividend paid per share of firm j in month t that the share went ex-dividend,

$P_{j,t-1}$ = the closing price at the end of month t-1, adjusted for stock splits and stock dividends,[22]

$\hat{a}_{jt}, \hat{b}_{jt}$ = the regression parameters that vary from security to security which relate past changes in a security's price to past changes in the market index. $\hat{b}_{jt}$ has a special meaning since it measures the response of a security's return to the overall market's return and "it serves as a relative measure of the risk of holding the i^{th} security."[23]

R_{mt} = the return of the market index in month t and is equal to: $\frac{(SP)_t}{(SP)_{t-1}} -1$[24]

where:

SP_t = the closing value of Standard and Poor's Price Index at the end of month t,

SP_{t-1} = the closing value of Standard and Poor's Price Index at the end of month t-1,

$\hat{e}_{jt}$ = the residual return in month t and incorporates the effects unique to the firm.

The error term (e_{jt}) is assumed to satisfy the assumptions of a linear regression model. That is,

1. $\hat{e}_{jt}$ has zero expectation.
2. The variance of $\hat{e}_{jt}$ is constant over time.
3. The $\hat{e}_{jt}$ are serially independent.

The residual return ($\hat{e}_{jt}$) is equal to the overall return of a security less the return attributable to market-wide events, which can be represented in equation form as follows:

$$\hat{e}_{jt} = R_{jt} - \hat{a}_{jt} - \hat{b}_{jt} R_{mt} \qquad (2)$$

Equation (2) is not a strict transformation of equation (1) since the regression coefficients ($\hat{a}_{jt}$, $\hat{b}_{jt}$) are estimated from time periods that differ from the period in which the effect of the unique factor ($\hat{e}_{jt}$) is being studied. For example, in computing the residual term ($\hat{e}_{jt}$) for each month in 1970, five years of monthly price data terminating with December 1969 were used in the linear regression model to obtain estimates of $\hat{a}_{jt}$ and $\hat{b}_{jt}$. Then these estimates were substituted in equation (2) along with the actual monthly returns (R_{jt}) and the actual market return (R_{mt}) to obtain each $\hat{e}_{jt}$. The reason for deleting 1970 monthly price data from the computation of the regression parameters ($\hat{a}_{jt}$, $\hat{b}_{jt}$) was that otherwise the first assumption (i.e., E $(\hat{e}_{jt})=0$) of the regression model would have been violated if the forecasts possessed information content.

In the present study the estimates of the regression parameters were provided by the Securities Research Division of Merrill Lynch, Pierce, Fenner and Smith, Inc.[25] An explanation of the methodology utilized by Merrill, Lynch to compute these regression parameters is warranted since its procedures differ somewhat from that discussed above. Merrill, Lynch used simple linear regression analysis to relate monthly price returns on an individual security to monthly price returns on the Standard and Poor's 500 Stock Index[26] for a period of sixty months. Standard regression analysis was selected over other methods (e.g. curvilinear regression or exponential smoothing) because there is no empirical evidence to demonstrate that any other method is statistically superior. Monthly price returns were chosen rather than

weekly or daily returns, because this interval has been the most thoroughly tested and there is some evidence to indicate that weekly and daily intervals contain some bias. The actual price data used to compute the security and market price relatives was obtained from the ISL Daily Stock Price Index.[27]

A major difference in the procedure used by Merrill, Lynch from that discussed previously is that it excludes dividends from the calculations of both the individual and the S & P 500 returns. It states that:

> In the calculations, returns on the stocks and on the S&P 500 are represented by percentage price changes, excluding dividends. Studies have shown that betas based on simple price returns are almost identical to those based on total returns (prices and dividends). A study by Sharpe and Cooper at Stanford University showed that the r^2 on regressions of total-returns beta against price-return betas is above .99. Because dividends are usually stable, it can also be shown that the two methods yield statistically as well as empirically, an almost identical beta.[28]

To be useful for estimation purposes the regression parameters (a_{jt}, b_{jt}) should be stable from period to period. Several researchers[29] have examined the stability of the beta coefficient by measuring and comparing betas on individual stocks from one period to another. Although a relation was found between betas for successive time periods, the betas for some stocks did vary from one period to the next. The variations in the betas can be caused by statistical or sampling error, or by changes in the actual value of a security's beta. Such variations suggest that some type of adjustment to the beta is warranted. Merrill, Lynch makes such an adjustment in its calculation of the betas to allow for the statistical phenomenon called regression bias.[30] It states that this:

> ...adjustment makes use of an empirical Bayesian approach to determine the amount of measurement error in the population of betas. One makes an a priori assumption that all betas are equal to one. Using the statistical error information (standard error of beta) provided by the regression, it is possible to gauge the over-all accuracy of the betas vis-a-vis the prior estimates. Adjusted betas are obtained by taking an appropriately weighted average of the unadjusted and the a priori estimates of beta. Because the degree of adjustment depends on the estimated reliability of a priori assumptions, no change is made in the betas if the a priori estimates prove to be useless.
>
> Statistical theory indicates that under certain conditions these modifications can never result in worse predictions than those indicated by the unadjusted betas.[31]

It is these adjusted betas that were substituted in equation (2) to obtain estimates of the residual returns (e_{jt}).

Evidence Supporting the Use of the Market Model

Fama, et.al, in their study which investigated the information effect of stock splits examined the validity of the market model (which they refer to as equation (1)) as a means of removing the general market effects from a security's return. They contend that:

> ...the estimates of equation (1) for the different securities conform fairly well to the assumptions of the linear regression model. For example, the first order auto-correlation coefficient of the estimated residuals from (1) has been computed for every twentieth split in the sample (ordered alphabetically by security). The mean (and median) value of the forty-seven coefficients is - 0.10, which suggests that serial dependence in the residuals is not a serious problem.....
>
> In sum we find that regressions of security returns on market returns over time are a satisfactory method for abstracting from the effects of general market conditions on the monthly rates of return on individual securities...[32]

Further support for the market model may be inferred from the many studies[33] that have utilized this model to abstract from general market effects.

Preliminary Descriptive Test Statistics

For each forecasting model examined in this study two descriptive statistics were computed to present a preliminary evaluation of each model's predictive ability. These two statistics are also presented since they are somewhat comparable to statistics utilized in previous studies. However, they are still deficient since they do not relate the forecasts to stock price adjustments, which is the predictive criterion employed in the present study.

The first measure of predictive accuracy was of the form:

$$\frac{|A-F|}{F}$$

where:

F = Forecasted earnings per share

A = Actual earnings per share

This measure relates absolute forecast errors ($|A-F|$) to the forecasted earnings rather than to the actual earnings per share because they will be easier to use by investors in this form. Since actual earnings are not known when the prediction is made, any adjustments that an investor desires to make to adjust for past tendencies to over-or-underpredict will be easier, if the prediction errors are expressed relative to predicted earnings.[34]

It was previously demonstrated that expressing prediction errors relative to actual earnings results in a bias favoring underpredictions.[35] In a similar fashion the measure ($|A-F|/F$) results in a bias favoring overpredictions. This bias can be illustrated by the following example:

	Forecast	Actual	$(\lvert A-F \rvert)/F$
Firm A	1.80	2.00	11%
Firm B	2.20	2.00	9%

In this example the absolute earnings forecast error for both firms is $.20. Note, however, that the error rate is 11% for the underprediction while it is only 9% for the overprediction.

The second measure of predictive accuracy used in this study was of the form:

$$\frac{\lvert A-F \rvert}{P}$$

where:

F = Forecasted earnings per share
A = Actual earnings per share
P = Average closing price of the most recent three months prior to the forecast.

Since this model normalizes the errors by price, it provides a more meaningful measure when earnings are small or negative. An average closing price of the most recent three months was used to alleviate any undue influence of extreme prices in any particular month. This measure also is void of any differential bias of under-or-over-estimates and thus serves as a control on the first measure.

These two measures provide only preliminary evidence of the predictive accuracy of the forecast models investigated in this study. What is more important is the association that exists between the forecasts and stock prices.

Statistical Hypotheses and Tests

Research Hypothesis-1

The first hypothesis of this research was:

Null Hypothesis, H_o^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected naive models and stock price returns.

Alternative Hypothesis, H_a^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns is greater than the association that exists between forecast errors generated by selected naive models and stock price returns.

To operationalize this hypothesis, a statistical hypothesis which tests for the degree of correlation between errors in the forecasts of earnings per share and the stock price returns was required. The measure of correlation utilized in the present study was the Spearman rank correlation coefficient (sometimes designated as Spearman's Rho). This test is a measure of association which requires only that both variables be measured in at least an ordinal scale so that the observations under consideration can be ranked. In the present study the forecasts were ranked according to the size of the forecast errors. This was accomplished by first computing the forecast errors according to the model (A-F)/F [i.e. (actual earnings per share minus forecasted earnings per share) / forecasted earnings per share] and then ranking the forecasts by the size of the forecast errors. The largest forecast error received the lowest rank (i.e. a rank of 1). Then the monthly stock return residuals ($\hat{e}_{jt}$) were cumulated over time for each firm and ranked in a similar fashion (i.e. the largest negative cumulative stock return residual received a rank of 1).

The justification for expecting a correlation to exist between the forecast errors and stock price returns was similar to that offered by Ball and Brown. If investors perceive that the forecasts offer valuable information, they will utilize them in forming their expectations of future stock returns. When actual earnings per share are announced and they are greater than forecasted (i.e. there is a positive forecast error) then it is expected that the stock return residuals would increase. However, as Ball and Brown have demonstrated this increase will occur gradually over time. Thus, large positive stock return residuals cumulated over time should be associated with large positive forecast errors. The converse should hold for negative forecast errors.

The formula used to compute the Spearman rank correlation coefficient was:

$$r_s = 1 - \frac{6 \sum_{i=1}^{N} d_i^2}{N^3 - N}$$

where:

d = the difference between the rankings of the two sets of data

N = the number of firms for which observations were made (i.e. 100)

A separate r_s was computed to measure the association between each forecast model and stock price returns. Thus, four separate correlation coefficients were computed and designated as r_s^1, r_s^2, r_s^3 for the three annual naive forecast models, respectively, and r_s^4 for the analysts' forecasts.

The following statistical hypotheses were then tested to determine which forecast model had the greatest association with stock price returns:

$H_o^{1a} : r_s^4 = r_s^1$

$H_a^{1a} : r_s^4 > r_s^1$

$H_o^{1b} : r_s^4 = r_s^2$

$H_a^{1b} : r_s^4 > r_s^2$

$H_o^{1c} : r_s^4 = r_s^3$

$H_a^{1c} : r_s^4 > r_s^3$

The statistic used to test for differences in the population correlation coefficients ($\rho_{01} - \rho_{02}$) is stated as:

$$\frac{\sqrt{n}\,[(r_{01}-r_{02}) - (\rho_{01}-\rho_{02})]}{\sqrt{(1-r_{01}^2)^2 + (1-r_{02}^2)^2 - 2r_{12}^2 + (2r_{12}-r_{01}-r_{02})(1-r_{01}^2-r_{02}^2-r_{12}^2)}}$$

where:

ρ_{01} = the population correlation of variables 0 and 1

ρ_{02} = the population correlation of variables 0 and 2

r_{01} = the sample estimate for the population correlation of variables 0 and 1

r_{02} = the sample estimate for the population correlation for variables 0 and 2

r_{12} = the sample estimate for the population correlation of variables 1 and 2

n = the size of the sample

It was shown by Olkin and Siotani[36] that the approximate distribution of the above statistic is standard normal.

Because of the large sample size (n=100) employed in the present study, the Spearman rank correlation coefficients could be utilized in this statistic to test for differences in the relationships between the various forecast models and stock price returns.

Research Hypothesis-2

The second research hypothesis was:

Null Hypothesis, H_o^2: The association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns does not differ from the association that exists between errors in analysts' quarterly revised forecasts and stock price returns.

Alternative Hypothesis, H_a^2: The association that exists between errors in analysts' quarterly revised forecasts and stock price returns is greater than the association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns.

This hypothesis was also tested with the Spearman rank correlation coefficient. Forecast errors for the quarterly revised analysts' forecasts were computed using the same model, (A-F)/F, as was utilized for the first

hypothesis. The analysts' quarterly revised forecasts were obtained in a manner similar to that of the analysts' annual forecasts. The principal difference between the two models is that the annual forecasts were obtained at a time when only the previous years annual earnings per share data were available whereas the analysts' revisions were obtained when quarterly earnings per share data were also available. To clarify this point consider the following example:

	1960 EPS		1970 1^{st}q EPS		1970 2^{nd}q EPS		1970 3^{rd}q EPS	
	Date	Amount	Date	Amount	Date	Amount	Date	Amount
Firm A	2/5/70	3.00	4/11	.73	7/11	.80	10/2	.90

Thus, the mean estimate of the analysts' forecasts for firm A at the end of February was computed to determine the analysts' <u>annual</u> forecast; for the three quarterly revisions, respectively, the mean estimates would be computed using the analysts' forecasts at the end of April, July, and October. The announcement dates of the quarterly earnings per share data also dictated the period over which the stock return residuals were cumulated. In the above example for the second quarterly revision the residuals would have been computed and cumulated from the month of August through the month that 1970 earnings per share were announced.

The rankings were achieved in the same way as for the first hypothesis. Three separate correlation coefficients, designated as r_s^{q1}, r_s^{q2}, r_s^{q3} for each of the three quarterly revisions, were then calculated. The following statistical hypotheses were then tested to determine which forecast model had the greatest association with stock price returns:

$$H_o^{2a} : r_s^{q1} = r_s^4$$

$$H_a^{2a} : r_s^{q1} > r_s^4$$

$$H_o^{2b} : r_s^{q2} = r_s^4$$

$$H_a^{2b} : r_s^{q2} > r_s^4$$

$$H_o^{2c} : r_s^{q3} = r_s^4$$

$$H_a^{2c} : r_s^{q3} > r_s^4$$

Research Hypothesis-3

The third research hypothesis of this study was:

Null Hypothesis, H_o^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected quarterly naive forecast models and stock price returns.

Alternative Hypothesis, H_a^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns <u>is greater than</u> the association that exists between forecast errors generated by selected quarterly naive forecast models and stock price returns.

Forecast errors were computed using the same model as for research hypotheses one and two. Cumulative stock return residuals were obtained for each naive quarterly model in the same manner as they were obtained for the analysts' quarterly revised forecasts. Again, the Spearman rank correlation coefficient was computed to measure the association between each forecast model and the stock price returns. For the quarterly naive models these correlation coefficients were designated as r_s^{Nq1}, r_s^{Nq2}, and r_s^{Nq3} to represent naive models 4, 5, and 6, respectively.

The following statistical hypotheses were then tested to ascertain which forecast model had the greatest association with stock price returns:

$$H_o^{3a}: r_s^{q1} = r_s^{Nq1}$$

$$H_a^{3a}: r_s^{q1} > r_s^{Nq1}$$

$$H_o^{3b}: r_s^{q2} = r_s^{Nq2}$$

$$H_a^{3b}: r_s^{q2} > r_s^{Nq2}$$

$$H_o^{3c}: r_s^{q3} = r_s^{Nq3}$$

$$H_a^{3c}: r_s^{q3} > r_s^{Nq3}$$

Fama, et.al. have stated that the distributions of returns are better approximated by the non-Gaussian members of the stable Paretian family than the normal distribution.[37] Thus, the Spearman rank correlation coefficient was chosen as the appropriate test statistic for this study since it makes no assumptions regarding the distributions of the forecast errors nor the stock return residuals. The efficiency of this statistic is described below:

> The efficiency of the Spearman rank correlation when compared with the most powerful parametric correlation, the Pearson r, is about 91 per cent. (Hotelling and Pabst, 1936). That is, when r_s is used with a sample to test for the existence of an association in the population, and when the assumptions and requirements underlying the proper use of the Pearson r are met, that is, when the population has a bivariate normal

> distribution and measurement is in the sense of at least an interval scale, then r_s is 91 per cent as efficient as r in rejecting H_o. If a correlation between X and Y exists in that population, with 100 cases r_s will reveal that correlation at the same level of significance which r attains with 91 cases.[38]

This means that the probability of showing no correlation when one in fact does exist in a bivariate normal population is somewhat less when utilizing the Spearman rank correlation coefficient than when using the Pearson's product moment correlation. The probability of showing that a correlation does exist when in fact none exists depends upon the level of significance chosen (i.e. the alpha level).

The Level of Significance

The level of significance chosen for which to reject or not reject the null hypotheses in the present study was equal to .05. This means that the probability of a Type I error, rejecting the null hypothesis when in fact it is true, is .05. The significance level was set at .05 to conform to conventional standards. However, the actual significance levels are also reported to allow the reader to draw his own conclusions.

The second type of error which can occur in hypothesis testing is known as the Type II error, not rejecting the null hypothesis when in fact it is false. To determine the probability of a Type II error, several alternative distributions of the possible correlations would first have to be formulated. This procedure is beyond the scope of this research. However, it is believed that a sample size of 100 and an alpha level of .05 are large enough to limit the probability of a Type II error to a reasonably low level.[39]

Limitations of the Methodology

The most obvious limitations of the proposed study relate to the criteria used to specify the population. The first limitation is that the results of this study are strictly applicable to only the population of firms included in the study. This population was restricted to New York Stock Exchange firms with December 31 fiscal year-ends that appeared in the 1970 and 1971 editions of the Standard and Poor's Earnings Forecaster. A further restriction was that a minimum of three analysts' estimates per month for at least ten months prior to the annual earnings announcement had to be available for the firm to be included in the study. Although it was assumed that the mean of the analysts' estimates was a representative forecast for all analysts, this may not be the case.

However, there are no *a priori* reasons to believe that these limitations are critical. The definition of the population criteria and sample selection procedures provides an opportunity for the reader to judge for himself whether or not he can safely infer the results of this study to forecasts made by analysts in general.

Summary

This chapter was concerned with three major topics. The first topical area dealt with the theoretical considerations that provided the necessary foundation for the formulation of the research hypotheses and the methodology that was utilized in this study. Two major empirical research efforts that examined the information content of the annual earnings report were reviewed. The first article, by Beaver,[40] demonstrated that the information content of an event could be assessed by observing the market's response in terms of stock price adjustments to the announcement of that event. The second study conducted by Ball and Brown,[41] also employed as a predictive criterion the investment decision as it is reflected by security prices. In these studies the authors utilized the market model which asserts that a security's return is a linear function of a market factor. The use of

this model was necessary to remove the market-wide effects so that the residual returns, which represent the impact of new information about those firms alone, could be obtained. Both works indicated that the annual earnings report possesses information content. However, Ball and Brown further demonstrated that much of the information content was anticipated prior to the release of the earnings report. The significance of these two studies for the present research was three-fold. First, they demonstrated that there exists a strong relation between earnings and stock prices. Second, they provided a valid criterion and methodology for examining the information content of an event. Finally, it was suggested that the media which allow the market to anticipate the information content of the earnings report deserve investigation.

The second section of this chapter sets forth the general research hypotheses. These hypotheses are concerned with whether there exists a greater association between analysts' forecasts of earnings per share and stock price returns than exists between forecasts generated by selected naive models and stock price returns. They are also concerned with any improvement that may be obtained in this association as the forecast horizon is reduced.

The final topical area of the chapter presents the methodological structure of the research. This structure includes an identification of the population of firms studied, a description of the sample selection criteria and procedures, and a discussion of the selection of naive forecast models. Also included in this section was a detailed discussion of the market model and the manner in which it was utilized in this research. Evidence supporting the use of this model was also cited. Furthermore, there was a discussion of some preliminary descriptive statistics as well as the statistical hypotheses and statistical tests employed in the study. The statistical model used to measure the association between each model's forecast errors and the cumulative stock return residuals was the Spearman's rank correlation coefficient. The chapter concludes with a discussion of the limitations of the methodological structure.

FOOTNOTES

[1]Beaver, William H. "The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, a supplement to Volume VI of The Journal of Accounting Research, pp. 67-92.

[2]Ball, Ray and Brown, Philip, "An Empirical Evaluation of Accounting Income Numbers," Journal of Accounting Research, Volume VI (Autumn, 1968), pp. 159-178.

[3]Beaver, *op. cit.*, p. 68.

[4]Since the market model is also employed in the present study to abstract from market-wide effects, a detailed discussion of it is deferred to a subsequent section of this chapter.

[5]Beaver, *op. cit.*, p. 82.

[6]Ball and Brown, *op. cit.*, p. 160.

[7]*Ibid.*, p. 161.

[8]*Ibid.*, p. 162.

[9]*Ibid.*, pp. 160-1. For a discussion of the theory and empirical evidence referred to see Fama, Eugene "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, Vol. 25 (May, 1970), pp. 383-420.

[10]*Ibid.*, p. 163.

[11]There are other events that could cause stock prices to go up or down. However, the market model was employed to remove the confounding effects of such events.

[12]The importance of this data source is further manifested by Standard and Poor's assertion that the estimates of earnings per share "represent the best estimates of leading analysts at the moment and therefore have a significant bearing on current stock values."

[13]This table of random numbers was obtained from the

following source: Clark, Charles E., Random Numbers in Uniform and Normal Distributions, San Francisco, California: Chandler Publishing Company, 1966.

[14]Copeland, Ronald M. and Marioni, Robert J., "Executives' Forecasts of Earnings Per Share Versus Forecasts of Naive Models," Journal of Business, Volume 45, No. 4 (October, 1972), pp. 497-512.

[15]Elton, Edwin J. and Gruber, Martin J., "Earnings Estimates and the Accuracy of Expectational Data," Management Science, Vol. 18, No. 8 (April, 1972) Application Series, pp. B409-429.

[16]The primary purpose of this research is not a comparison of the predictive accuracy of various mechanical forecasting techniques. Thus, the exponential models were not included in this study. They were also omitted since they require computer computation which means they would not be readily accessible to all investors. Furthermore, some naive models (e.g. model #1) may be capable of producing forecasts equivalent in accuracy to the more sophisticated exponential models.

[17]A few discrepancies in reported earnings per share data were noted between The Wall Street Journal Index and the Standard and Poor's sources. These discrepancies were eliminated by utilizing the data in the corporations annual report.

[18]King, Benjamin F. "Market and Industry Factors in Stock Price Behavior," Journal of Business, Volume 34 (Supplement, January, 1966), pp. 139-90.

[19]Ball and Brown, op. cit., p. 163.

[20]Blume, Marshall E. "The Assessment of Portfolio Performance" (unpublished Ph.D. dissertation, University of Chicago, 1968).

[21]Subtracting one from the monthly price relatives yields the discrete monthly rate of return. Discrete rather than continuous compounding was chosen because this was the method utilized to compute the alpha and beta estimates which were supplied by Merrill, Lynch, Fenner and Smith Inc. Ball and Brown, who also utilized discrete compounding, performed tests on the continuous

compounding model and noted that the results of both compounding models corresponded closely. See Ball and Brown, op. cit., p. 162.

[22]For the method of adjustment see Fisher, Lawrence, "Outcomes for Random Investments in Common Stocks Listed on the New York Stock Exchange," Journal of Business, XXVIII (April, 1965), pp. 149-161.

[23]Pettit, Richardson R., "Dividend Announcements, Security Performance and Capital Market Efficiency," The Journal of Finance, Volume XXVII, No. 5 (December, 1972), pp. 993-1007.

[24]See footnote 21.

[25]The author expresses his gratitude to Merrill, Lynch and especially to Mr. Gilbert Hammer and Mr. Lawrence Tint for providing the data necessary to complete this dissertation.

[26]Fama, et.al., found that the results using Standard and Poor's Composite Price Index as a measure of market conditions in the linear regression model were in agreement with those obtained by using Fisher's "Combination Investment Performance Index." See Fama, et.al. "The Adjustment of Stock Prices to New Information," International Economic Review, Vol. 10, No. 1 (February, 1969), p. 4.

[27]Investment Statistics Laboratory, Inc., ISL Daily Stock Price Index: New York Stock Exchange (Palo Alto, California: Investment Statistics Laboratory, Inc.), volumes for the years 1969-1972.

[28]Merrill, Lynch, Fenner and Smith Inc., Securities Research Division, "Security Risk-Evaluation Service," Technical Addendum, March, 1972, p. 3.

[29]The issue concerning the stationarity of beta remains unresolved. On the one hand, Sharpe and Cooper have concluded "there is substantial stability over time even at the level of individual securities." On the other hand, Myers indicated that "the beta coefficient was stationary for no more than about 75 per cent and possibly as few as 50 per cent of the stocks on the NYSE between 1950 and 1967." Sharpe and Cooper's conclusions

were based on the ability of betas calculated over a five-year period using monthly data to predict betas for the next year (a method similar to the one utilized in the present study) whereas Myers conclusions were based on the ability of betas calculated over one 7-year period to predict betas over the next 7-year period. Furthermore, Blume had indicated that the usefulness of beta can be improved by correcting for regression toward the mean.

It has been assumed that the stationarity assumption has not been violated for the purposes of the present study, since the methodology utilized in computing betas was similar to Sharpe's and the betas were corrected for regression toward the mean. For further discussion concerning the issue of stationary betas see Blume, Marshall E. "On the Assessment of Risk," The Journal of Finance (March 1971), pp. 1-10. Myers, Stephen L. "The Stationarity Problem in the Use of the Market Model of Security Price Behavior," The Accounting Review (April 1973), Vol. XLVIII, No. 2, pp. 318-322. Sharpe, W. F. and Cooper, G. M., "Risk-Return Classes of New York Stock Exchange Common Stocks, 1931-67," Financial Analysts Journal (March-April 1972), pp. 46-54.

[30]Regression toward the mean is a function of errors in measurement and the degree of correlation. Generally, the more deviant the estimate is from the mean the greater is the measurement error contained in the estimate. Also, the lower the degree of correlation, the greater the regression toward the mean. Thus, a stock with an observed beta of 2.0 (assuming that the observed beta for all stocks was between 0 and 2.0 with a mean of 1) is mostly likely overestimated and its beta will tend to move toward one. The reverse will apply to stocks with beta estimates less than one.

[31]Merrill, Lynch, op. cit., p. 4.

[32]Fama, et.al., op. cit., pp. 5-7.

[33]For example, See Beaver, op. cit., pp. 67-92; Ball and Brown, op. cit., pp. 159-178; Pettit, op. cit., pp. 993-1007; and Brown, Philip and Kennelly, John W., "The Information Content of Quarterly Earnings: An Extension and Some Further Evidence," The Journal of Business, Vol. 45, No. 3 (July, 1972), pp. 403-15.

[34]This point was made by Charles L. McDonald. See McDonald, Charles L., "An Empirical Examination of Published Predictions of Future Earnings." Unpublished Ph.D. dissertation, Michigan State University, 1972, p. 55.

[35]See Chapter II, p. 13.

[36]Olkin, Ingram and Siotani, M. "Asymptotic Distribution Functions of a Correlation Matrix." Stanford, California: Stanford University Laboratory for Quantitative Research in Education, Report No. 6, 1964.

[37]Fama, et.al., op. cit., p. 7.

[38]Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences, New York, New York: McGraw-Hill Book Company, Inc., 1956, p. 213.

[39]For a given value of the parameter being tested, the power of a test increases as the sample size, and the significance level increases. Since the power of a test is equal to one minus the Type II error, this means that under the above conditions the probability of a Type II error would decrease.

[40]Beaver, William H., op. cit., p. 67-92.

[41]Ball and Brown, op. cit., p. 159-178.

CHAPTER IV

RESULTS OF THE STATISTICAL TESTS

Introduction

Chapter IV is concerned with the findings of this research study. First, the results of the preliminary test statistics which describe the predictive accuracy of the forecast models are presented and then subjected to a brief statistical analysis. This section also contains a comparison of these results with the findings of some of the empirical works reviewed in Chapter II. In the last section of this chapter the research hypotheses are restated and the evidence obtained to reject or not reject these hypotheses is presented.

Results of the Preliminary Descriptive Test Statistics

As discussed in Chapter III, two descriptive test statistics were computed for each forecasting model to privide a preliminary evaluation of each model's predictive ability. The first measure of predictive accuracy was of the form:

$$\frac{|A-F|}{F}$$

where:

F = Forecasted earnings per share

A = Actual earnings per share

The results for this measure are given for each forecast model in Tables 1 through 10. Each table includes a range of relative prediction errors, the mean relative prediction error, and the distribution of over-and-under-predictions for each year and the period under study. In addition, an adjusted mean relative error is also included in the tables. The adjustment was made by excluding the largest deviate from the observations and then recalculating the mean. This adjusted mean error appears to be a better representation of the average error rate since the deviate tended to have an unusually large influence on the results. The deviates that were removed (one from 1970 and one from 1971) were two firms that had reported positive earnings for the first three quarters of their fiscal years but reported large negative earnings for their entire fiscal year.

A summary of the data contained in Tables 1 through 10 is presented in Table 11 to facilitate comparisons between the forecast models. In addition the models have been grouped by forecast horizon. Thus, naive models 1,

2, and 3 were classified with the analysts' annual forecasts since each of these models provides forecasts that cover the same time period.

Several general observations should be made about the predictive power of the forecast models using the first measure of predictive accuracy (i.e., $|A-F|/F$). Reference to Table 11 reveals that of the three annual naive forecast models, model 1 was the superior predictor for the period under study. Model 1 had an adjusted mean prediction error of 19.14% for the period under study as compared to adjusted mean errors of 24.70% and 25.31% for models 2 and 3 respectively. Furthermore, 40% of the forecasts produced by model 1 yielded errors of less than 10% and 68% of the forecasts yielded errors of less than 20%. In fact, model 1 also proved to be superior to model 4 which utilized first quarter earnings. This latter model had an adjusted mean error of 26.75%.

The success of model 1 appears to be somewhat attributable to the period under study. It was noted previously that the economy was somewhat depressed in 1970 which means that earnings were also depressed. Since model 1 predicts that current year earnings will be the same as prior year earnings, this model produced earnings estimates that were smaller in magnitude relative to models 2

TABLE 1

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 1 ($EPS_t = EPS_{t-1}$)

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	17	23	40
10.00% to 19.99%	17	11	28
20.00% to 29.99%	7	5	12
30.00% to 39.99%	4	3	7
40.00% to 49.99%	2	3	5
Over 50.00%	3	5	8
Totals	50	50	100
Mean Error (all observations)	20.46%	21.30%*	20.88%
Mean Error (largest deviate excluded)	16.98%	21.30%	19.14%
Underpredictions	20	35	55
Overpredictions	30	15	45
Totals	50	50	100

*One prediction was omitted from this computation since the forecast was a negative amount.

TABLE 2

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 2 ($EPS_t = EPS_{t-1} + (EPS_{t-1} - EPS_{t-2})$)

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	13	22	35
10.00% to 19.99%	14	5	19
20.00% to 29.99%	11	7	18
30.00% to 39.99%	6	6	12
40.00% to 49.99%	2	1	3
Over 50.00%	4	9	13
Totals	50	50	100
Mean Error (all observations)	24.15%	35.67%	29.91%
Mean Error (largest deviate excluded)	20.76%	28.64%	24.70%
Underpredictions	11	26	37
Overpredictions	39	24	63
Totals	50	50	100

TABLE 3

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 3 ($EPS_t = EPS_{t-1} \times EPS_{t-1}/EPS_{t-2}$)

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	13	20	33
10.00% to 19.99%	12	7	19
20.00% to 29.99%	12	9	21
30.00% to 39.99%	6	4	10
40.00% to 49.99%	2	3	5
Over 50.00%	5	7	12
Totals	50	50	100
Mean Error (all observations)	25.57%	48.10%	36.84%
Mean Error (largest deviate excluded)	22.21%	28.41%	25.31%
Underpredictions	11	27	38
Overpredictions	39	23	62
Totals	50	50	100

TABLE 4

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 4 ($EPS_t = 4(EPS_{tql})$)

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	19	20	39
10.00% to 19.99%	6	8	14
20.00% yo 29.99%	14	5	19
30.00% to 39.99%	3	6	9
40.00% to 49.99%	4	4	8
Over 50.00%	4	7	11
Totals	50	50	100
Mean Error (all observations)	31.64%	34.48%	33.06%
Mean Error (largest deviate excluded)	24.63%	28.86%	26.75%
Underpredictions	26	29	55
Overpredictions	24	20	44
Exact Predictions	0	1	1
Totals	50	50	100

TABLE 5

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 5 ($EPS_t = 2(EPS_{tq1} + EPS_{tq2})$

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	21	29	50
10.00% to 19.99%	13	9	22
20.00% to 29.99%	9	5	14
30.00% to 39.99%	4	3	7
Over 40.00%	3	4	7
Totals	50	50	100
Mean Error (all observations)	24.83%	18.73%	21.78%
Mean Error (largest deviate excluded)	18.72%	14.18%	16.45%
Underpredictions	23	28	51
Overpredictions	26	21	47
Exact Predictions	1	1	2
Totals	50	50	100

TABLE 6

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

Model 6 ($EPS_t = 4/3(EPS_{tq1} + EPS_{tq2} + EPS_{tq3})$)

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	33	32	65
10.00% to 19.99%	11	10	21
20.00% to 29.99%	3	5	8
30.00% to 39.99%	1	0	1
40.00% to 49.99%	1	2	3
Over 50.00%	1	1	2
Totals	50	50	100
Mean Error (all observations)	17.22%	13.84%	15.53%
Mean Error (largest deviate excluded)	9.63%	8.97%	9.30%
Underpredictions	22	26	48
Overpredictions	28	22	50
Exact Predictions	0	2	2
Totals	50	50	100

TABLE 7

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

	ANALYSTS' ANNUAL PREDICTIONS		
Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	16	30	46
10.00% to 19.99%	15	7	22
20.00% to 29.99%	8	5	13
30.00% to 39.99%	6	4	10
40.00% to 49.99%	0	1	1
Over 50.00%	5	3	8
Totals	50	50	100
Mean Error (all observations)	22.10%	16.46%	19.28%
Mean Error (largest deviate excluded)	18.78%	12.76%	15.77%
Underpredictions	11	15	26
Overpredictions	39	34	73
Exact Predictions	0	2	1
Totals	50	50	100

TABLE 8

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

ANALYSTS' FIRST QUARTERLY REVISION

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	17	30	47
10.00% to 19.99%	15	11	26
20.00% to 29.99%	8	1	9
30.00% to 39.99%	5	5	10
40.00% to 49.99%	1	0	1
Over 50.00%	4	3	7
Totals	50	50	100
Mean Error (all observations)	20.84%	15.31%	18.08%
Mean Error (largest deviate excluded)	17.47%	11.55%	14.51%
Underpredictions	11	16	27
Overpredictions	37	32	69
Exact Predictions	2	2	4
Totals	50	50	100

TABLE 9

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

ANALYSTS' SECOND QUARTERLY REVISION

Range of Errors	1970	1971	Period 1970-1971
0.00% to 9.99%	26	35	61
10.00% to 19.99%	13	7	20
20.00% to 29.99%	6	2	8
30.00% to 39.99%	0	3	3
40.00% to 49.99%	1	1	2
Over 50.00%	4	2	6
Totals	50	50	100
Mean Error (all observations)	17.27%	13.60%	15.44%
Mean Error (largest deviate excluded)	13.55%	9.74%	11.65%
Underpredictions	14	19	33
Overpredictions	35	29	64
Exact Predictions	1	2	3
Totals	50	50	100

TABLE 10

RELATIVE PREDICTION ERRORS ($\frac{|A-F|}{F}$) CLASSIFIED BY RANGE OF RELATIVE ERRORS, MEAN RELATIVE ERROR, AND DISTRIBUTION OF OVER-AND-UNDERPREDICTIONS BY YEARS

ANALYSTS' THIRD QUARTERLY REVISION

Range of Errors	1970	1971	Period 1970-1971
0.00 % to 9.99%	34	37	71
10.00% to 19.99%	7	6	13
20.00% to 29.99%	5	4	9
30.00% to 39.99%	2	2	4
40.00% to 49.99%	1	0	1
Over 50.00%	1	1	2
Totals	50	50	100
Mean Error (all observations)	15.80%	11.49%	13.65%
Mean Error (largest deviate excluded)	9.83%	7.43%	8.63%
Underpredictions	12	17	29
Overpredictions	38	32	70
Exact Predictions	0	1	1
Totals	50	50	100

TABLE 11

SUMMARY OF THE RELATIVE PREDICTIVE ACCURACY OF THE NAIVE FORECAST MODELS AND ANALYSTS' FORECASTS FOR THE PERIOD 1970-1971

Model	Mean Error	Mean Error Adjusted	# of Errors Less than 10%	# of Errors Less than 20%	# of Under-Predictions	# of Over-Predictions	# of Exact Predictions
M1	20.88%	19.14%	40	68	55	45	0
M2	29.91%	24.70%	35	54	38	62	0
M3	36.84%	25.31%	33	52	39	61	0
A1	19.28%	15.77%	46	68	26	73	1
M4	33.06%	26.75%	39	53	55	44	1
AQ1	18.08%	14.51%	47	73	27	69	4
M5	21.78%	16.45%	50	72	51	47	2
AQ2	15.44%	11.65%	61	81	33	64	3
M6	15.53%	9.30%	65	86	48	50	2
AQ3	13.65%	8.63%	71	84	29	70	1

where:

M1 = Model 1
M2 = Model 2
M3 = Model 3
M4 = Model 4
M5 = Model 5
M6 = Model 6
A1 = Analysts' Annual Predictions
AQ1 = Analysts' First Quarterly Revised Forecasts
AQ2 = Analysts' Second Quarterly Revised Forecasts
AQ3 = Analysts' Third Quarterly Revised Forecasts

and 3 and, thus, was superior in terms of predictive accuracy.

As expected, models 5 and 6, which used second and third quarter earnings data, were superior to the annual naive forecast models. Model 6 showed the largest improvement in forecasting with an adjusted mean error of 9.3%. Also, 65% of the forecasts produced by model 6 had errors of less than 10% and 86% had errors less than 20%.

Another important observation to be made from Table 11 pertains to the superiority of the analysts' projections over the forecasts of the naive models for each of the relevant comparisons. The mean adjusted error for the analysts' annual projections was 15.77% compared to 19.14% for the best annual naive forecast model (model 1). Forty-six per cent of the analysts' projections had an error rate of less than 10% as compared to 40% for model 1.

Both the analysts' forecasts and the naive forecast models exhibited improvement in accuracy (with the exception of model 4) as the forecast horizon was reduced. Model 6 had a mean adjusted error rate of 9.3% as compared to 8.63% for the analysts' third quarterly revisions.

A third important observation to be gleaned from Table 11 relates to the number of under-and-overpredictions.

Naive forecast models 1, 4 and 5 yielded more underpredictions than overpredictions. On the other hand, the analysts, relative to the naive models, tended to overpredict earnings. Approximately 70% of the analysts' forecasts were overpredictions. The effect of the number of under-and-overpredictions made will be discussed in conjunction with the second measure of predictive accuracy.

Two final points should be noted about the accuracy of the forecasts as summarized in Table 11. First, it is not surprising that the analysts' projections are more accurate, since the analysts could utilize the naive models as well as other facts in forming their expectations. Second, the improvement in accuracy as the forecasting horizon was reduced is also to be expected since more knowledge is acquired as corporations issue their quarterly earnings reports. However, the question of the usefulness of the forecasts is not resolved. Whether or not a particular forecast is useful to an investor depends upon his assessment of the reliability of that particular forecast, which in turn depends upon his materiality function.

Before examining the usefulness of the forecasts, as measured by the association of the markets' reaction to the forecasts, the accuracy of the forecasts will be assessed in terms of the second measure of predictive accuracy. This second measure of predictive accuracy was employed for two primary reasons, as discussed in Chapter III.

First, it furnished more reasonable and interpretable results for companies whose actual earnings per share are small or negative in amount. Secondly, the bias of differential weighting of under-and-overestimates is absent from this particular measure. This second measure of predictive accuracy utilized in this study was of the form:

$$\frac{|A-F|}{P}$$

where:

F = forecasted earnings per share
A = actual earnings per share
P = average closing price of the most recent three months prior to the month of forecast.

The results for the normalized price measure are summarized in Table 12. Relevant groupings by forecast horizon were also made in this table and both the mean forecast error normalized by price and an adjusted mean forecast error are presented. The adjusted mean error was computed by excluding the largest deviate and recalculating the mean from the remaining observations.

TABLE 12

MEAN AND ADJUSTED MEAN PREDICTION ERRORS NORMALIZED BY PRICE ($\frac{|A-F|}{P}$) FOR THE YEARS 1970 and 1971

Model	Mean Error (All Observations) 1970	1971	Period 1970-71	Adjusted Mean Error (Largest Deviate Excluded) 1970	1971	Period 1970-71
M1	.0173	.0154	.0164	.0134	.0113	.0124
M2	.0225	.0195	.0210	.0187	.0159	.0173
M3	.0246	.0165	.0206	.0209	.0128	.0169
A-1	.0198	.0135	.0167	.0158	.0094	.0126
M4	.0184	.0158	.0171	.0152	.0129	.0141
AQ1	.0196	.0112	.0154	.0154	.0076	.0115
M5	.0183	.0124	.0154	.0146	.0092	.0119
AQ2	.0188	.0103	.0146	.0135	.0064	.0100
M6	.0111	.0097	.0104	.0073	.0059	.0066
AQ3	.0122	.0093	.0108	.0080	.0048	.0064

where:

M1 = Model
M2 = Model 2
M3 = Model 3
M4 = Model 4
M5 = Model 5
M6 = Model 6
A1 = Analysts' Annual Predictions
AQ1 = Analysts' First Quarterly Revised Forecasts
AQ2 = Analysts' Second Quarterly Revised Forecasts
AQ3 = Analysts' Third Quarterly Revised Forecasts

Table 12 confirms that model 1 is superior in forecasting to the other annual naive forecast models and to model 4 which utilizes first quarter earnings, both in terms of the mean error and the adjusted mean error. This measure also verifies that an improvement in accuracy occurs as the forecast horizon is reduced.

In the comparison of the naive forecast models to the analysts' projections note that this measure $(\frac{|A-F|}{P})$ indicates that the naive forecast model 1 is slightly superior to the analysts' annual projections in terms of both the mean error and the adjusted mean error. This result contradicts the results of the first measure (see Table 11) which indicated that the analysts' projections were somewhat more accurate than the naive models. This inconsistency is caused by the bias inherent in the measure, $|A-F|/F$. As explained in Chapter III, this measure gives less weight to overpredictions than to underpredictions. Reference to Tables 1 and 7 reveals that the analysts made 39 overpredictions in 1970 and 34 in 1971, while model 1 yielded 30 overpredictions in 1970 and only 15 in 1971. Since the analysts' had a greater number of overpredictions than model 1, the measure $|A-F|/F$ would tend to yield a lower predictive error for the analysts' forecasts than for model 1. A review of the raw data

confirmed this finding.

Results of the Wilcoxon-Signed Rank Tests

The first section of this chapter presented some preliminary observations regarding the predictive accuracy of the forecast models as well as some observations pertaining to the improvement in accuracy as the forecast horizon is reduced. These observations were derived from comparisons of the forecast models based on mean and adjusted mean forecast error rates. In this section these forecast models are subjected to a brief statistical analysis to determine whether any of the differences in the forecasting accuracy of the models was statistically significant.

The Wilcoxon signed-rank test was utilized as the appropriate test statistic for comparing the accuracy of the forecast models since it does not require any assumptions concerning the underlying distributions of the parameters. The tests were computed separately for 1970 and 1971 since these years represent periods of different economic conditions. As previously noted, 1970 was a period of economic recession whereas 1971 was a period of economic recovery. It is possible that some forecast models (e.g., a "no-growth" model) are more accurate in a

recessionary period than in an expansionary period. Thus, conducting the tests for each period individually will allow one to ascertain whether the periods involved had a significant influence on the accuracy of the forecasting models. The results of the Wilcoxon signed-rank tests are reported in Tables 13 through 16.

Table 13 presents the Z scores computed from the Wilcoxon signed-rank test for a comparison of the predictive accuracy of model 1 with the other naive models. As can be seen from this table, model 1 yielded a lower error rate than either of the other two annual models (2 or 3) at a statistically significant level in 1970. Such a result is not unusual since model 1 is a no-growth model and 1970 was a year in which the economy experienced a recession. In 1971 model 1 also had a lower mean error rate than the other annual naive models but this was not statistically significant at either the .05 or .10 level.

Table 13 also reflects comparisons between model 1 and the models utilizing quarterly earnings data (models 4, 5, and 6). Although model 1 had a lower mean error rate than model 4 in both 1970 and 1971, this difference was not statistically significant for either year at the .05 level. Only model 6 which employed the first three quarters of earnings data was statistically superior to

TABLE 13

RESULTS OF THE WILCOXON SIGNED-RANK TEST COMPARING NAIVE FORECAST MODELS FOR 1970 AND 1971 UTILIZING |A-F|/F AND |A-F|/P AS MEASURES OF PREDICTIVE ACCURACY

Comparison*	Z Scores**	
	1970	
	|A-F|/F	|A-F|/P
M1 < M2	-2.59	-2.83
M1 < M3	-3.15	-2.98
M1 < M4	-1.57	-2.43
M5 < M1	- .79	+ .14
M6 < M1	-3.67	-3.98
	1971	
M1 < M2	- .52	-1.27
M1 < M3	- .88	- .48
M1 < M4	-1.43	- .30
M5 < M1	-1.61	-2.02
M6 < M1	-3.14	-3.71

Where: M1 = Model 1, M2 = Model 2, M3 = Model 3, M4 = Model 4, M5 = Model 5, M6 = Model 6

*The comparison is between the relative error rates of the two models, e.g. M1 < M2 is testing whether model 1 had a smaller error rate than model 2.

**Z $\leq$ -1.282 indicates significance at the .10 level.

Z $\leq$ -1.645 indicates significance at the .05 level.

model 1 for both 1970 and 1971.

One further observation should be noted regarding the results as presented in Table 13. The two measures utilized in computing the relative prediction errors did not consistently yield comparable results. This inconsistency was partially explained in the preceding section of this chapter where it was noted that the first measure ($|A-F|/F$) assigns less weight to overpredictions than to underpredictions. However there is also a bias inherent in the second measure ($|A-F|/P$). Since the denominator is equal to the average of the closing prices for the three months prior to the forecasts, higher price stocks will tend to yield a lower error rate. Furthermore, the denominator of this measure does not remain the same when comparisons are made between models of different forecasting horizons (e.g., between M1 and M4, M5, or M6).

Table 14 presents the results of the Wilcoxon signed-rank test comparing the analysts' annual forecast model with the analysts' subsequent quarterly revised forecasts. As indicated in the table the analysts' quarterly revisions are statistically superior to the analysts' annual forecasts in terms of their predictive accuracy at a significant level of .05. The only exception noted was the comparison of the analysts' annual forecast errors

TABLE 14

RESULTS OF THE WILCOXON SIGNED-RANK TEST COMPARING ANALYSTS' ANNUAL FORECASTS WITH ANALYSTS' QUARTERLY REVISED FORECASTS FOR 1970 AND 1971 UTILIZING $|A-F|/F$ AND $|A-F|/P$ AS MEASURES OF PREDICTIVE ACCURACY

Comparison*	Z Scores**	
	1970	
	$\|A-F\|/F$	$\|A-F\|/P$
AQ1 < A1	-3.15	-1.05
AQ2 < A1	-4.12	-2.28
AQ3 < A1	-4.46	-4.47
	1971	
AQ1 < A1	-3.06	-3.91
AQ2 < A1	-3.08	-4.22
AQ3 < A1	-4.68	-4.57

Where: A1 = Analysts' Annual Forecasts
AQ1 = Analysts' First Quarterly Revised Forecasts
AQ2 = Analysts' Second Quarterly Revised Forecasts
AQ3 = Analysts' Third Quarterly Revised Forecasts

*The comparison is between the relative error rates of the two models, e.g. AQ1 < A1 is testing whether the analysts' first quarterly revised forecasts yielded a lower forecast error rate than did the analysts' annual forecasts.

**$Z \leq -1.282$ indicates significance at the .10 level.

$Z \leq -1.645$ indicates significance at the .05 level.

with the first quarterly revised forecast for 1970 utilizing $|A-F|/P$ as a measure of predictive accuracy. As explained above this measure is influenced by both a change in the numerator and denominator and can thus lead to inconsistent results.

Table 15 reports the results of the comparison's between the analysts' annual forecasts and the annual naive forecast models. Model 1 had a lower mean error rate than the analysts' annual forecasts but this was not statistically significant at the .05 level using either measure of predictive accuracy. However, the analysts' did achieve a lower error rate than either models 2 or 3 for 1971 utilizing both measures of predictive accuracy at the .10 level of significance. Furthermore some of the comparisons were significant at the .05 level.

Finally, in Table 16 the comparisons between the analysts' quarterly revised forecasts and the quarterly naive forecast models are made. It was found that only the first quarterly revised analysts' forecasts (AQ1) was statistically superior to model 4 in 1971 at the .05 level. None of the other comparisons yielded statistically significant results. The positive Z-scores obtained in comparing AQ3 with M6 indicate that M6 yielded lower error rates but again this was not statistically

TABLE 15

RESULTS OF THE WILCOXON SIGNED-RANK TEST COMPARING ANALYSTS' ANNUAL FORECAST MODELS WITH THE ANNUAL NAIVE FORECAST MODELS FOR 1970 AND 1971 UTILIZING |A-F|/F AND |A-F|/P AS MEASURES OF PREDICTIVE ACCURACY

Comparison*	Z Scores**	
	1970	
	|A-F|/F	|A-F|/P
M1 < A1	-1.53	-1.37
A1 < M2	-1.54	-1.88
A1 < M3	-3.00	-2.26
	1971	
A1 < M1	-1.68	- .44
A1 < M2	-2.81	-1.72
A1 < M3	-2.64	-1.56

Where: M1 = Model 1
M2 = Model 2
M3 = Model 3
A1 = Analysts' Annual Forecast Model

*The comparison is between the relative error rates of the two models, e.g. M1 < A1 is testing whether model 1 yielded a lower forecast error rate than did the analysts' annual forecasts.

**Z $\leq$ -1.282 indicates significance at the .10 level.

Z $\leq$ -1.645 indicates significance at the .05 level.

TABLE 16

RESULTS OF THE WILCOXON SIGNED-RANK TEST COMPARING ANALYSTS' QUARTERLY REVISED FORECASTS WITH THE NAIVE QUARTERLY FORECAST MODELS FOR 1970 AND 1971 UTILIZING |A-F|/F AND |A-F|/P AS MEASURES OF PREDICTIVE ACCURACY

Comparison*	Z Scores**	
	1970	
	|A-F|/F	|A-F|/P
AQ1 < M4	- .77	- .58
AQ2 < M5	-1.18	- .53
AQ3 < M6	+ .46	+1.50
	1971	
AQ1 < M4	-2.44	-1.73
AQ2 < M5	-1.15	- .57
AQ3 < M6	- .16	- .73

Where: AQ1 = Analysts' First Quarterly Revised Forecasts
AQ2 = Analysts' Second Quarterly Revised Forecasts
AQ3 = Analysts' Third Quarterly Revised Forecasts
M4 = Model 4
M5 = Model 5
M6 = Model 6

*The comparison is between the relative error rates of the two models, e.g. AQ1 < M4 is testing whether AQ1 yielded a smaller forecast error rate than did M4.

**$Z \leq -1.282$ indicates significance at the .10 level.

$Z \leq -1.645$ indicates significance at the .05 level.

significant.

Since the two measures of predictive accuracy did not yield consistent results for all comparisons, caution must be exercised in making generalizations. However, the following general conclusions can be drawn. First, model 1 yielded lower error rates than did the other annual forecast models (M2 and M3) for the year 1970. In 1970 model 1 was also superior to model 4. However, the results were not statistically significant for the same comparisons in 1971. Some improvement was noted in forecasting accuracy as the forecast horizon was reduced. Model 6 was found to be superior to model 1 in both 1970 and 1971. Model 5 was superior to model 1 only in 1971. With regard to the analysts' forecast models, a definite improvement was obtained in terms of predictive accuracy by the analysts as the forecast horizon was reduced.

In general, the analysts' annual forecasts yielded statistically lower forecast errors than either naive forecast model 2 or 3 for both years under study. Although model 1 yielded lower forecast errors than the analysts in 1970 and the analysts yielded lower errors than model 1 in 1971, these differences were not statistically significant. Furthermore, analysts' quarterly revised forecasts were not statistically different from the forecasts generated by the naive quarterly models.

The findings for some of the works evaluated in Chapter II are briefly summarized below so that a comparison can be made with the results of the preliminary test statistics computed in this study. Cragg and Malkiel[1] examined the accuracy of predicted growth rates of earnings. Their findings indicated that past earnings growth was not a useful predictor of future earnings growth. Furthermore, they asserted that the estimates of the security analysts participating in their study performed little better than these past growth rates.

Elton and Gruber[2] tested the performance of several mechanical forecasting techniques in predicting earnings per share. They compared the results of their best mechanical model (the additive exponential) with predictions made by security analysts. Although two of the three groups of security analysts produced forecasts with a smaller squared error than the additive exponential model, no statistically significant differences were observed.

The final work, comparable to the results of the first section of this chapter, was done by Niederhoffer and Regan.[3] As one of their measures of predictive accuracy they employed the following model:

$$\frac{A_2 - F}{P}$$

where:

A_2 = 1970 actual earnings per share.

F = 1970 forecasted earnings per share.

P = 1969 year-end stock price.

This model was similar to the second measure of predictive accuracy utilized in this study except that an absolute predictive error was computed and an average price was utilized to normalize the error.

Niederhoffer and Regan reported that the <u>median</u> error in forecasts during 1970 was an overestimate of approximately one cent per dollar of price. Reference to Table 12 indicates that the best naive model had a mean error of 1.73 cents per dollar of price, whereas, the analysts achieved a mean forecast error of about 1.98 cents per dollar. Considering the differences in the computation of the errors, the results of this study are similar to the findings obtained by Niederhoffer and Regan.

In summary, Cragg and Malkiel's and Elton and Gruber's studies indicate that analysts' forecasts were not superior in terms of predictive accuracy to naive forecasts. Reference to Table 15 indicates that the forecasting accuracy of the best naive model (model 1) and the analysts' annual forecasts are not statistically different at the .05 level for both measures of predictive accuracy and in this respect confirm both Cragg and Malkiel's and Elton and Gruber's findings. However, note that the best naive model (model 1) yielded a lower error rate than the analysts' annual forecasts for 1970. Although this comparison was not statistically significant at the .05 level, it was significant at the .10 level.

The first section of this chapter presented some statistics regarding the accuracy of analysts' forecasts and forecasts generated by selected naive models as well as some conclusions reached by other authors regarding the accuracy of forecasts. However, the utility of earnings forecasts to investors depends upon the market's perception of their reliability and timeliness. To evaluate the utility of earnings forecasts the association between stock prices and forecast errors was examined. The next section of this chapter presents the results of testing the hypotheses that examined this association.

It was demonstrated in the previous section that under certain economic conditions the analysts' forecasts were more accurate than the best annual naive model (i.e. in 1971, a period of economic recovery) whereas under other economic conditions the naive model yielded lower forecast errors than the analysts (i.e. in 1970, a period of economic recession) although neither difference was statistically significant. However, the hypotheses of this study are tested for the combined period, because in this writer's opinion the utility of analysts' forecasts should not be measured by specific periods. In fact, the utility of analysts' forecasts should be greater than naive models at turning points in the economy, since at these points many naive models would tend to yield very inaccurate forecasts. However, the data are analyzed separately for each year under study and the results are presented in Appendix A for those readers who do not agree with the foregoing opinion.

Results of the Statistical Test Concerning the First Research Hypothesis

The first research hypothesis of this study was concerned with the association of stock price returns with earnings forecasts. The forecasts are provided by analysts as well as generated by selected naive models. This hypothesis is stated as:

Null Hypothesis, H_o^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected naive models and stock price returns.

Alternative Hypothesis, H_a^1: The association that exists between errors in analysts' forecasts of earnings per share and stock price returns is greater than the association that exists between forecast errors generated by selected naive models and stock price returns.

To test this hypothesis Spearman rank correlation coefficients were first computed to measure the association between each model's forecast errors and the cumulative stock price residuals. Thus, four separate correlation coefficients were computed and designated as r_s^1, r_s^2, r_s^3, for the three annual naive forecast models, respectively, and r_s^4 for the analysts' annual forecasts. These coefficients appear in Table 17. Then the coefficient for the analysts' annual model was compared to each of the other coefficients to determine if the association between the analysts' model and stock price returns was statistically greater at a .05 significance level than the association that existed between the naive forecast models and the cumulative stock price residuals.

The specific statistical hypotheses tested were:

$$H_o^{1a} : r_s^4 = r_s^1$$

$$H_a^{1a} : r_s^4 > r_s^1$$

$$H_o^{1b} : r_s^4 = r_s^2$$

$$H_a^{1b} : r_s^4 > r_s^2$$

$$H_o^{1c} : r_s^4 = r_s^3$$

$$H_a^{1c} : r_s^4 > r_s^3$$

At the .05 level of significance the null hypothesis, H_o^{1a} was rejected in favor of H_a^{1a}. This indicates that the association that exists between errors in annual analysts' forecasts and stock returns is greater than the association that exists between the forecast errors generated by model 1 and stock returns. However, the null hypotheses, H_o^{1b} and H_o^{1c}, could not be rejected at the .05 level of significance. Thus, there is no statistical difference between the association that exists between the annual analysts' forecasts and stock returns and the association that exists between the forecast errors generated by model 2 and 3 and stock returns. The actual p values at which the null hypotheses could be rejected are reported in Table 18.

TABLE 17

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR THE ANNUAL FORECAST MODELS

Model 1 $(EPS_t = EPS_{t-1})$	$r_s^1 = .207494$*
Model 2 $(EPS_t = 2EPS_{t-1} - EPS_{t-2})$	$r_s^2 = .200068$**
Model 3 $(EPS_t = (EPS_{t-1})^2 / EPS_{t-2})$	$r_s^3 = .183691$***
Analysts Annual Forecasts	$r_s^4 = .319957$****

*Significantly different from zero at the p = .02 level
**Significantly different from zero at the p = .025 level
***Significantly different from zero at the p = .04 level
****Significantly different from zero at the p = .001 level

TABLE 18

SIGNIFICANCE LEVELS FOR REJECTION
OF THE FIRST RESEARCH HYPOTHESIS

	Null hypothesis would be rejected at
$H_o^{1a} : r_s^4 = r_s^1$ $H_a^{1a} : r_s^4 > r_s^1$	p = .045
$H_o^{1b} : r_s^4 = r_s^2$ $H_a^{1b} : r_s^4 > r_s^2$	p = .135
$H_o^{1c} : r_s^4 = r_s^3$ $H_a^{1c} : r_s^4 > r_s^3$	p = .115

It is not obvious from Tables 17 and 18 why the null hypotheses, H_o^{1b} and H_o^{1c}, were not rejected when the difference between the correlation coefficients for the analysts' annual model and model 1 (i.e., r_s^4 and r_s^1) was actually less than the difference between the correlation coefficients for the analysts' annual forecasts and model 2 and 3 (i.e., between r_s^4 and r_s^2, r_s^3). The explanation is found in the correlation of each naive forecast model with the analysts' annual model. The association of the forecast errors of model 1 were more highly correlated with the forecast errors of the analysts ($r_s^1 = .849$) than the correlations that existed between the analysts' model and naive models 2 and 3 ($r_s^2 = .679$, $r_s^3 = .675$, respectively). Because of the strong association of the analysts' model and model 1, a smaller difference between the correlation coefficients measuring the association of forecast errors and stock returns (i.e., r_s^4 and r_s^1) was needed to reject H_o^{1a} than was required to reject H_o^{1b} and H_o^{1c}.

The outcome of the statistical tests of the first research hypothesis implies that the market does not perceive analysts' forecasts to have greater utility than forecasts generated by simple naive models. Furthermore, since the results indicate that the forecasts do not differ in regard to benefits, as measured by the association of forecast errors and stock price returns, this implies that the additional cost of preparation of forecasts by security analysts is not warranted.

One final point should be made about the association of the forecast errors with stock prices. Table 17 demonstrates that a statistically significant relationship exists between the forecast errors of all the models and the cumulative stock return residuals. Although these associations were all in the predicted direction and statistically greater than zero at the .05 significance level, the magnitude of the Spearman rank correlation coefficients suggest that the strength of the relationships was fairly weak. This implies that the market does not rely heavily on these forecasts when forming its expectations about future earnings.

Results of the Statistical Test Concerning The Second Research Hypothesis

The second research hypothesis of this study states:

Null Hypothesis, H_O^2: The association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns does not differ from the association that exists between errors in analysts' quarterly revised forecasts and stock price returns.

Alternative Hypothesis, H_a^2: The association that exists between errors in analysts' quarterly revised forecasts and stock price returns <u>is greater than</u> the association that exists between errors in annual analysts' forecasts of earnings per share and stock price returns.

Three separate Spearman rank correlation coefficients, designated as r_s^{q1}, r_s^{q2}, and r_s^{q3}, were computed for each of the analysts' quarterly revised forecasts to measure their association with the cumulative stock price residuals. Table 19 presents the Spearman rank correlation coefficients for the quarterly forecasts and the analysts' annual forecasts. The following statistical hypotheses were then tested to determine whether any of the errors in analysts' quarterly revised forecasts had a greater association with the stock price residuals than the errors in analysts' annual forecasts:

$$H_o^{2a} : r_s^{q1} = r_s^4$$

$$H_a^{2a} : r_s^{q1} > r_s^4$$

$$H_o^{2b} : r_s^{q2} = r_s^4$$

$$H_a^{2b} : r_s^{q2} > r_s^4$$

$$H_o^{2c} : r_s^{q3} = r_s^4$$

$$H_a^{2c} : r_s^{q3} > r_s^4$$

At the .05 level of significance none of the null hypotheses, H_o^{2a}, H_o^{2b}, and H_o^{2c}, could be rejected. This indicates that the association that exists between errors in analysts' forecasts and the cumulative stock return residuals does not improve as the forecast horizon is reduced. Actually, it can be observed from Table 19 that the Spearman rank correlation coefficient for the analysts' annual forecasts is greater than the correlation coefficients for the analysts' quarterly revised forecasts. Rather than the association between the forecast errors and the stock returns increasing as the forecasts horizon is reduced the relationship actually decreases. In fact, it was found that no relationship exists between the analysts' third quarterly revised forecasts and the subsequent cumulative stock return residuals. The results obtained from testing the second research hypothesis imply that investors do not perceive the quarterly

TABLE 19

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR ANALYSTS' FORECASTS

Analysts' Annual Forecasts	r_s^4 = .319957*
Analysts' First Quarterly Revised Forecasts	r_s^{q1} = .310431**
Analysts' Second Quarterly Revised Forecasts	r_s^{q2} = .303349**
Analysts' Third Quarterly Revised Forecasts	r^{q3} = .0307223

revised forecasts to possess greater utility than the analysts' annual forecasts. Furthermore, the lack of any correlation between errors in the third quarterly revised forecasts and the cumulative stock return residuals seems to indicate that the market has already discounted the final quarter's earnings.

Results of the Statistical Test Concerning The Third Research Hypothesis

The third and final research hypothesis of this study states:

Null Hypothesis, H_o^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns does not differ from the association that exists between forecast errors generated by selected quarterly naive forecast models and stock price returns.

Alternative Hypothesis, H_a^3: The association that exists between errors in analysts' quarterly revised forecasts of earnings per share and stock price returns is greater than the association that exists between forecast errors generated by selected quarterly naive forecast models and stock price returns.

Again, Spearman rank correlation coefficients were computed and designated as r_s^{Nq1}, r_s^{Nq2}, and r_s^{Nq3} to represent the naive quarterly models 4, 5, and 6, respectively. These coefficients along with the correlation coefficients for the analysts' quarterly revised forecasts appear in Table 20. The statistical hypotheses that were tested are stated as:

$$H_o^{3a} : r_s^{q1} = r_s^{Nq1}$$

$$H_a^{3a} : r_s^{q1} > r_s^{Nq1}$$

$$H_o^{3b} : r_s^{q2} = r_s^{Nq2}$$

$$H_a^{3b} : r_s^{q2} > r_s^{Nq2}$$

$$H_o^{3c} : r_s^{q3} = r_s^{Nq3}$$

$$H_a^{3c} : r_s^{q3} > r_s^{Nq3}$$

As can be seen from Table 21 none of the three null hypotheses could be rejected at the conventional .05 significance level. Thus, the conclusion must be that there is no statistically significant difference in the association between the stock price returns and the forecast errors generated by the naive quarterly models or the errors in analysts' quarterly revised forecasts.

TABLE 20

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR THE INTERIM FORECAST MODELS

Model 4 ($EPS_t = 4\ EPS_{tq1}$)	r^{Nq1} =	.119198*
Analysts First Quarterly Revised Forecasts	r_s^{q1} =	.310431**
Model 5 ($EPS_t = 2(EPS_{tq1}+EPS_{tq2})$)	r_s^{Nq2} =	.151501***
Analysts Second Quarterly Revised Forecasts	r_s^{q2} =	.303349**
Model 6 ($EPS_t = 4/3(EPS_{tq1}+EPS_{tq2}+EPS_{tq3})$)	r_s^{Nq3} =	-.161865****
Analysts Third Quarterly Revised Forecasts	r_s^{q3} =	.0307223

*Significantly different from zero at p = .12
**Significantly different from zero at p = .005
***Significantly different from zero at p = .07
****Significantly different from zero at p = .06

TABLE 21

SIGNIFICANCE LEVELS FOR REJECTION
OF THE THIRD RESEARCH HYPOTHESIS

	Null hypothesis would be rejected at
H_o^{3a} H_a^{3a}	p = .075
H_o^{3b} H_a^{3b}	p = .115
H_o^{3c} H_a^{3c}	p = .11

It is interesting to note that there is no statistical relationship between the forecast errors made from model 6 and subsequent stock price returns. This result was also observed regarding the third quarterly analyst model. Apparently any information forthcoming from the third quarter earnings is rapidly consumed and discounted by the market.

Summary

This chapter was concerned with the findings of this research study. First, the results of two preliminary test statistics, which described the predictive accuracy of the forecast models, were presented. Tables 1 through 12 report the mean errors, adjusted mean errors, and the number of over-and underpredictions for each of the forecast models. Some preliminary observations were made based on the adjusted mean errors of the forecast models. The Wilcoxon signed-rank test was then employed to test whether the differences in accuracy of the forecast models were statistically significant.

It was demonstrated that of the three annual naive forecast models, model 1 had the lowest mean adjusted error rate for both years under study. However, it was found that model 1 was statistically superior in terms of

forecast accuracy to models 2 and 3 for 1970, but not for 1971. Model 1 also yielded a lower adjusted mean error rate than model 4, which utilized first quarter earnings. However, it was shown that the difference between these two models was statistically significant only in 1970 utilizing $|A-F|/P$ as a measure of predictive accuracy.

With regard to improvement in the predictive accuracy of the naive models as the forecasting horizon was reduced, only model 6 was statistically superior to model 1 for both 1970 and 1971. On the other hand, the analysts' quarterly revised forecasts produced statistically lower error rates than did the analysts' annual forecasts.

Table 15 presented comparisons between the forecast error for the analysts' annual forecasts and the annual naive models. In general, the analysts achieved lower forecast error rates than models 2 or 3 at a statistically significant level. The best annual naive model (model 1) produced lower forecast errors than the analysts' annual forecasts in 1970 but higher error rates in 1971. However, these differences were not statistically significant.

Table 16 indicated that the analysts' quarterly revised forecasts were not, in general, statistically different from the quarterly naive forecast models. An exception was that the analysts' first quarterly revised forecast was statistically superior to model 4 in 1971.

It is also important to note that there was a distinct tendency for the analysts to overpredict. Approximately 70% of their forecasts were overpredictions.

The second section of this chapter presented the outcome of the hypotheses testing. The first research hypothesis of this study was concerned with whether annual analysts' forecasts or forecasts generated by selected naive models had a greater association with subsequent stock price changes. The analysts' projections of earnings were compared to three naive models. At the .05 level of significance it was found that two of the three naive models did not differ significantly from the analysts' estimates in their association with stock price returns. The conclusion drawn, therefore, was that analysts' projections do not have greater utility for investors than do forecasts generated by simple naive forecast models.

The second research hypothesis was concerned with whether any improvement in the association of forecasts and stock returns was forthcoming as the forecast horizon was reduced. Since none of the null hypotheses was rejected at the .05 level of significance, the conclusion

was that the market did not perceive these forecasts as possessing greater utility than the analysts' annual forecasts.

The third and final research hypothesis of this study compared the association of the analysts' quarterly forecasts and stock price returns with the association obtained by selected naive models utilizing quarterly data. Again none of the null hypotheses was rejected. This implied that the analysts' quarterly forecasts did not differ from these selected naive models as to their utility.

One final conclusion pertains to the strength of the relationship observed between the various forecast models and the cumulative stock price residuals. Although many of the models were found to be positively associated with stock price returns, the magnitudes of the Spearman rank correlation coefficients were fairly small indicating a rather weak relationship.

APPENDIX A

SPEARMAN RANK CORRELATION COEFFICIENTS FOR THE FORECAST MODELS FOR 1970 AND 1971

This appendix is presented to report the Spearman rank correlation coefficients, which measure the association between errors in forecasts and stock price returns, computed for each forecast model separately for the years 1970 and 1971. The research hypotheses of Chapter 4 are not restated in this appendix, although they were retested for each year (i.e., 1970 and 1971 were treated separately). Thus, the purpose of this appendix is to present the results of retesting the research hypotheses by individual years and, thereby, ascertain whether the results are significantly influenced by the periods involved.

Table A-1 presents the Spearman rank correlation coefficients classified by years for the annual forecast models. The first research hypothesis of this study was concerned with whether the association between errors in analysts' annual forecasts and stock price returns was greater than the association between forecast errors generated by annual naive models and stock price returns. It was found that even at a .20 level of significance the first null research hypothesis was not rejected for either 1970 or 1971. This indicates that there was no

TABLE A-1

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR THE ANNUAL FORECAST MODELS
FOR 1970 AND 1971

	r_s	
	1970	1971
Model 1 $(EPS_t = EPS_{t-1})$	.264454	.326506
Model 2 $(EPS_t = 2EPS_{t-1} - EPS_{t-2})$	.300511	.374856
Model 3 $(EPS_t = (EPS_{t-1})^2/EPS_{t-2})$	.309491	.320920
Analyst Annual Forecasts	.317415	.418085

TABLE A-2

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR THE ANALYSTS' FORECASTS FOR
1970 AND 1971

	1970	1971
Analysts' Annual Forecasts	.317415	.418085
Analysts' First Quarterly Revised Forecasts	.314979	.415616
Analysts' Second Quarterly Revised Forecasts	.302776	.382048
Analysts' Third Quarterly Revised Forecasts	.078131	-.0918718

statistical difference between the association of errors in forecasts and stock price returns for any of the annual forecast models for either 1970 or 1971. This conclusion is in agreement with that reached when the data were analyzed for the combined period of 1970 and 1971.

The Spearman rank correlation coefficients for the analysts' annual and interim forecasts are presented in Table A-2. The second research hypothesis was concerned with the improvement in the association between forecast errors and cumulative stock price returns as the forecast horizon was reduced. As can be seen from Table A-2 the association between forecast errors and stock price returns decreases over time. Thus, the second null research hypothesis could not be rejected for either 1970 or 1971, a conclusion which conforms to that obtained when the hypothesis was tested for the combined period.

The third and final research hypothesis of this study was concerned with whether the association between forecast errors and stock price returns was greater for the analysts' interim models than for the naive quarterly forecast models. Table A-3 presents the Spearman rank correlation coefficients for these interim forecast models. There was a statistically greater association between forecast errors and stock price returns for the analysts'

TABLE A-3

SPEARMAN RANK CORRELATION COEFFICIENTS
FOR THE INTERIM FORECAST MODELS
FOR 1970 AND 1971

	r_s 1970	r_s 1971
Model 4 ($EPS_t = 4\ EPS_{tq1}$)	.148146	.140796
Analysts' First Quarterly Revised Forecasts	.314979	.415616
Model 5 ($EPS_t = 2(EPS_{tq1}+EPS_{tq2})$)	.133545	.211828
Analysts' Second Quarterly Revised Forecasts	.302776	.382048
Model 6 ($EPS_t = 4/3(EPS_{tq1}+EPS_{tq2}+EPS_{tq3})$)	-.0231469	-.278003
Analysts' Third Quarterly Revised Forecasts	.078131	-.0918718

first quarterly revised forecasts than for model 4 in 1971 at a .05 level of significance. The association for the analysts' third quarterly revised forecasts was also statistically greater than for model 6 in 1971. However, there was no statistical difference between the association of forecast errors and stock price returns for the analysts second quarterly revised forecasts and Model 5 for 1971. No statistical differences were noted for any of the comparisons for 1970. Thus, the third null research hypothesis could not be rejected for either 1970 or 1971. Again, this result agrees with that obtained when testing

the hypothesis for the combined period.

Thus, the same general conclusions were reached by testing the research hypotheses individually by year as were obtained when the data for each year were combined into a single period. None of the three null research hypotheses could be rejected at the .05 level of significance.

FOOTNOTES

[1] Cragg, J. G. and Malkiel, Burton G., "The Consensus and Accuracy of Some Predictions of the Growth of Corporate Earnings," Journal of Finance (March, 1968), pp. 67-84.

[2] Elton, Edwin J. and Gruber, Martin J., "Earnings Estimates and the Accuracy of Expectational Data," Management Science, Vol. 18, No. 8 (April, 1972) Application Series, pp. B409-B429.

[3] Niederhoffer, Victor and Regan, Patrick J., "Earnings Changes Analysts' Forecasts and Stock Prices," Financial Analysts Journal, Volume 28, No. 3 (May-June 1972), pp. 65-71.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary

The purpose of this research was to provide empirical evidence regarding the utility of analysts' projections of earnings. A secondary area for consideration was an assessment of the effectiveness of revisions in these forecasts made over a period of time.

It has been established in the financial literature, both theoretically and empirically, that a strong bond exists between earnings and stock prices. Theoretically, it is the payment of dividends that give stock value. However, dividends are a function of earnings. Furthermore, dividends tend to lag earnings and direct forecasting of dividends is often very difficult. Thus, most academicians have recommended utilizing earnings estimates as inputs to stock price models. Empirically, it has been demonstrated that there are significant stock price reactions to the release of earnings reports. It was further shown that much of this reaction occurs over time as investors anticipate earnings.

Given these theoretical and empirical considerations there are two primary reasons why analysts' estimates of earnings per share should possess considerable utility for investors. First, the analysts devote a considerable amount of time and effort in preparing these estimates which could easily be utilized by investors in their security price models. Secondly, it seems reasonable to argue that one possible medium by which the market is able to anticipate earnings would be analysts' projections of net income. The previous empirical research also indicates that an appropriate methodology for the assessment of the utility of an event is the observation of subsequent stock price reaction to that event. This study examined the association of analysts' forecasts and subsequent stock price returns. Analysts' forecasts were obtained from the Standard and Poor's Earnings Forecaster, Fifty firms in 1970 and fifty firms in 1971 were randomly selected from the relevant population.

In establishing the utility of the analysts' forecasts it was deemed insufficient merely to determine that an association between analysts' forecasts and stock prices existed. Rather, it must be demonstrated that such an association is statistically greater than can be

found between forecasts made by other models and stock price returns. Thus, six naive forecast models were selected to provide forecasts which would serve as a control group.

The results of the study are reported in two sections. The first section presents the results of two preliminary test statistics which describe the predictive accuracy of the forecast models included in the study. The second section presents the outcome of the tests of the various hypotheses. These hypotheses are concerned with the strength of the relationship that exists between each of the forecast models and cumulative stock price residuals, and how this association changes as the forecast horizon is reduced.

Conclusions

The results of this research study consist of three basic parts: the preliminary test statistics that describe the predictive accuracy of the forecast models, a statistical test employed to evaluate the differences in the forecasting accuracy of the models, and the statistical hypotheses that test the association between the various forecasts and subsequent stock price returns.

The first section described the predictive accuracy

of the forecast models in terms of mean errors, adjusted mean errors, and the number of over-and-underpredictions. Several conclusions were drawn from this aspect of the study. Model 1 had the lowest error rate of the three annual naive models. Secondly, it was concluded that as the forecast horizon was reduced, accuracy improved. This second conclusion pertained to both the naive and analysts' forecasts. A final conclusion drawn was that analysts' tend to be overoptimistic in their predictions since approximately 70% of their forecasts were greater than actual earnings.

The Wilcoxon signed-rank test was then employed to test whether differences in accuracy of the forecast models were statistically significant. Several conclusions were also drawn from this aspect of the study: First, it was found that model 1 had a lower forecast error rate than either model 2, 3, or 4 in 1970 at a statistically significant level. The differences noted in 1971 were not statistically significant. Secondly, some improvement in accuracy was noted as the forecasting horizon was reduced. Model 6 was statistically superior to model 1 in both 1970 and 1971. With regard to the analysts' forecasts, a statistically significant improvement was obtained as the forecasting horizon was reduced.

It was observed that generally the analysts' annual forecasts yielded lower error rates than either model 2 or 3 at a statistically significant level. Model 1 yielded lower forecast errors than analysts in 1970 and the analysts yielded lower errors than model 1 in 1971, although these differences were not statistically significant. Finally, it was observed that analysts' quarterly revised forecasts were not statistically different from the forecasts generated by the naive quarterly models.

The second part of the study dealt with the question of the utility of the forecasts as perceived by investors. Several research hypotheses were set forth and then tested. At the .05 level of significance none of these major research hypotheses could be rejected. (This was also true when the hypotheses were tested for each year separately. See Appendix to Chapter 4.) Several conclusions were reached from these statistical tests. The first conclusion was that the analysts' annual forecasts apparently possess no more utility for investors than forecasts generated by simple naive models. This further implied that the cost incurred by analysts in the preparation and dissemination of their forecasts is not justified in terms of the utility derived by the market.

Although analysts' achieved considerable improvement in their predictive ability over the subsequent quarters of the fiscal year, no statistical difference was found in the association that existed between their annual forecasts and stock price returns and the relationship that existed between their revised forecasts and stock price returns. This led to the conclusion that investors do not perceive these revisions as possessing greater utility than the original forecasts. From the test of the final research hypothesis it was further concluded that the utility as perceived by the market did not differ between these revised projections and forecasts derived from the naive quarterly models.

At this point several caveats should be issued. First, the results of this study are strictly applicable only to the population of firms included in this study. This population was defined by the following criteria:

1. The firms appear in the 1970 and 1971 editions of the Standard and Poor's Earnings Forecaster.

2. The firms are listed on the New York Stock Exchange (NYSE), except for firms leaving the NYSE because of delisting, merging or listing on other exchanges.

3. The firms have a fiscal year end on December 31.

4. The firms meeting the first three criteria have a minimum of three analysts' estimates per month for at least ten months prior to the announcement of the annual earnings by the corporation in the Earnings Forecaster.

Secondly, as with all research employing statistical tests, this study is subject to the limitation of statistical error. This error is referred to as a Type II error, i.e., accepting the null hypothesis when the alternative hypothesis is true. In this study control over this error was achieved by a relatively large sample size and by formulating directional alternative hypotheses.

The final warning pertains to the presumed validity of the forecast error model. It was assumed that a mean estimate of the analysts' forecasts for a particular firm provided an adequate surrogate of the true analysts' forecasts. This may in fact not be the case as is explained in the next section. Also, the expression of relative prediction errors as a percentage of predicted earnings may result in some bias. That is, other measures may result in a better definition of forecast errors.

Implications of the Empirical Results

Several plausible explanations can be formulated to account for the fact that the analysts' forecasts did not possess greater utility for investors than did the forecasts of the selected naive models. First, the projections provided by the analysts' may not have been sufficiently more accurate than those of the naive models to

prove useful for investors. This is substantiated by the fact that no statistical difference was found between model 1 and the analysts' annual forecasts.

A second possibility is that the market forms its expectations according to some alternative forecast model, which was not included in this research study. This would also explain why the quarterly forecasts did not exhibit an improvement in their association with stock price returns.

Another explanation pertains to the use of mean estimates as a surrogate for the analysts' "true" forecast. Some other value may actually prove to be a better surrogate. This can be illustrated by the following hypothetical example:

		Case 1	Case 2
Forecast A		2.00	2.00
Forecast B		2.10	2.00
Forecast C		1.90	3.00
	Mean Estimate	2.00	2.33

In case 1 an estimate of $2.00 is probably a reasonable estimation of what analysts expect the corporation to actually earn. Whereas, in the second case the mean estimate is likely a poor surrogate for the analysts' "true" expectations of actual earnings. Rather, a modal

value or some value which considers the variance of the forecasts should probably be utilized.

Even though the analysts' forecasts did not manifest greater utility than the forecasts of the simple naive models it is important to note that the relationship between the analysts' forecasts and stock prices was in the predicted direction and was statistically different from zero. This could imply that the errors in forecast model utilized in this study actually provided a poor measurement of the forecast errors. Thus, additional investigation into the utility of these forecasts appears warranted. The next section of this chapter presents several recommendations for further research.

Recommendations for Further Research

Based upon the findings of this research effort, there are several areas that seem to warrant further investigation. First, the study could be extended to a broader population of firms. Specifically, the population could be expanded by inclusion of firms listed on exchanges other than the New York Stock Exchange and by including firms with other than calendar year-ends.

The fact that a positive relationship, albeit fairly weak, was observed between analysts' forecasts and

cumulative stock price residuals suggests that a further decomposition of the data might prove useful. Such a refinement and reclassification of the data might assume many facets. For example, the data could be classified as to particular industry or risk classes to ascertain whether any improvement in the association would be forthcoming.

Another possible alternative would be an examination of alternative forecast models. This could include other various naive models as well as a redefinition of the analysts' forecast models. The present study utilized mean estimates. However, it is possible that some other measure that also considers the variance of the forecasts might offer additional insights into the reaction of the market to earnings forecasts.

It is also recommended that further research be undertaken to learn more about the process underlying the forecasts made, e.g., what factors do analysts' consider and how do these factors affect the accuracy of the predictions.

On a broader spectrum, additional research in the area of investor expectation models and into the decision making processes of investors should receive additional attention.

BIBLIOGRAPHY

American Accounting Association. Report of the Committee on Research Methodology in Accounting. A supplement to the _Accounting Review_, Vol. XLVII, 1972, 401-37.

Ball, Ray and Brown, Philip. "An Empirical Evaluation of Accounting Income Numbers," _Journal of Accounting Research_, VI (Autumn, 1968), 159-178.

Baskin, Elba F. _An Empirical Evaluation of the Communicative Effectiveness of Consistency Exceptions in Auditor' Opinions_. Unpublished Ph.D. dissertation, Michigan State University, 1972.

Beaver, William H. "The Information Content of Annual Earnings Announcements," _Empirical Research in Accounting: Selected Studies, 1968_, a supplement to Volume VI of the _Journal of Accounting Research_, 67-92.

Beaver, William H., and Dukes, Roland E., "Interperiod Tax Allocation, Earnings Expectations, and the Behavior of Security Prices," _The Accounting Review_, Volume XLVII, No. 2 (April, 1972), 320-32.

Beaver, William, Kettler, Paul, Scholes, Myron, "The Association Between Market Determined and Accounting Determined Risk Measures," _The Accounting Review_, Volume XLV, No. 4 (October, 1970), 654-682.

Blume, Marshal E., II. "On the Assessment of Risk," _Journal of Finance_, Volume 26 (March, 1971), 1-10.

Bolten, Steven E., _Security Analysis and Portfolio Management_, New York, New York: The Holt, Rinehart and Winston, Inc. 1972.

Brown, Philip and Kennelly, John W. "The Informational Content of Quarterly Earnings: An Extension and

Some Further Evidence," The Journal of Business, Volume 45, No. 3 (July, 1972) 403-15.

Campbell, Donald T. and Stanley, Julian C. Experimental and Quasi-Experimental Designs for Research, Chicago, Illinois: Rand McNally and Company, 1966.

Clark, Charles E. Random Numbers in Uniform and Normal Distribution, San Francisco, California: Chandler Publishing Company, 1966.

Cohen, Jerome B., and Zinbarg, Edward D. Investment Analysis and Portfolio Management, Homewood, Illinois: Richard D. Irwin, Inc., Fourth Printing, 1968.

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

Copeland, Ronald M. and Marioni, Robert J. "Executives' Forecasts of Earnings Per Share Versus Forecasts of Naive Models," Journal of Business, Volume 45, No. 4 (October, 1972), 497-512.

Cragg, J. G. and Malkiel, Burton G. "The Consensus and Accuracy of Some Predictions of the Growth of Corporate Earnings," Journal of Finance (March, 1968), 67-84.

Dow Jones and Company, Inc. The Wall Street Journal Index, various Volumes 1969-1972.

Elton, Edwin J. and Gruber Martin J. "Earnings Estimates and the Accuracy of Expectational Data," Management Science, Vol. 18, No. 8 (April, 1972) Application Series, B409-B429.

Elton, Edwin J. and Gruber, Martin J. "Improved Forecasting Through the Design of Homogeneous Groups," The Journal of Business, Volume 44, No. 4 (October, 1971), 432-450.

Fama, Eugene F., Fisher, Lawrence, Jensen, Michael C. and Roll, Richard. "The Adjustment of Stock Prices to New Information," International Economic Review, Vol. 10, No. 1 (February, 1969), 1-21.

Fama, Eugene. "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance Volume 25 (May, 1970), 383-420.

Fisher, Lawrence. "Some New Stock Market Indices, " Journal of Business, Volume 34 (Supplement, January, 1966), 226-41.

Gassner, Richard H. and Williams, Roger D. "The Relationship Between Changes in Analysts' Earnings Per Share Estimates and Ensuing Price Movements for Individual Stocks," Unpublished paper, Portland State University, 1969.

Gray III, William S. "Proposal for Systematic Disclosure of Corporate Forecasts," Financial Analysts Journal, Vol. 29, No. 1 (January/February 1973), 64-71, 85.

King, Benjamin F. "Market and Industry Factors in Stock Price Behavior," Journal of Business, Volume 34 (Supplement, January, 1966), 139-90.

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

Levy, Robert A. "On the Short-term Stationarity of Beta Coefficients," Financial Analysts Journal, November-December 1971, Volume 27, 55-62.

McDonald, Charles L. An Empirical Examination of Published Predictions of Future Earnings. Unpublished Ph.D. dissertation, Michigan State University, 1972.

McEnally, Richard W., "Using Earning Estimates in Selecting Common Stocks," Trust and Estates, Vol. 109 (January, 1970), pp. 35-38.

Merrill, Lynch, Fenner and Smith Inc., Securities Research Division, "Security Risk-Evaluation Service, Technical Addendum," March, 1972.

Moody's Investors Service Inc., Moody's Dividend Record, Annual Cumulative Issues Volumes 39-43, 1969-1972.

Myers, Stephen L. "The Stationarity Problem in the Use of the Market Model of Security Price Behavior," The Accounting Review, Vol. XLVIII, No. 2 (April, 1973), 318-322.

Nicholson, S. Francis, "Price Ratios in Relation to Investment Results," Financial Analysts Journal, Volume 24, No. 1 (January-February 1968), 105-109.

Niederhoffer, Victor and Regan, Patrick J., "Earning Changes, Analysts' Forecasts and Stock Prices," Financial Analysts Journal, Vol. 28, No. 3 (May-June 1972), 65-71.

Pettit, Richardson R., "Dividend Announcements, Security Performance, and Capital Market Efficiency," The Journal of Finance, Volume XXVII, No. 5 (December, 1972), 993-1007.

Prestbo, John A. ". . .And an Expert Who Says They Won't Work," The Wall Street Journal, Vol. LIII, No. 40, (December 11, 1972), 8.

Schellhardt, Timothy D. "The Argument for Profit Forecasts...." The Wall Street Journal, Vol. LIII, No. 40 (December 11, 1972), 8.

Sharpe, William F. "Risk, Market Sensitivity and Diversification," Financial Analysts Journal, January-February, 1972, Vol. 28, 74-9.

Sharpe, W. F. and Cooper, G. M., "Risk-Return Classes of New York Stock Exchange Common Stocks, 1931-67," Financial Analysts Journal (March-April 1972), pp. 46-54.

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

Standard and Poor's, Earnings Forecaster, various cumulative master-lists, 1969-1971, Ephrata, Pennsylvania.

Stewart, Jr., Samuel S. "Research Report on Corporate Forecasts," Financial Analysts Journal, Vol. 29, No. 1 (January/February 1973), 77-85.

Van Horne, James C. Financial Management and Policy, Englewood Cliffs, N.J.: Prentice-Hall, Inc., Second Edition, 1971, Chapter 9.

Zweig, Martin E. "Clouded Crystal Ball," Barron's (December 18, 1972), 9, 19.