AN EMPIRICIAL EVALUATION OF THE STOCK PRICE REACTION TO ERRORS IN MANAGEMENT FORECASTS OF EARNINGS PER SHARE

Thesis for the Degree of D. B. A.
MICHIGAN STATE UNIVERSITY
RUSSELL THEODORE GINGRAS
1974

This is to certify that the

thesis entitled

AN EMPIRICAL EVALUATION OF THE STOCK PRICE REACTION
TO ERRORS IN MANAGEMENT FORECASTS
OF EARNINGS PER SHARE

presented by

Russell Theodore Gingras

has been accepted towards fulfillment
of the requirements for

DBA degree in Business - Accounting

R Salmonson
Major professor

Date 8/8/74

O-7639

ABSTRACT

AN EMPIRICAL EVALUATION OF THE STOCK PRICE REACTION TO ERRORS IN MANAGEMENT FORECASTS OF EARNINGS PER SHARE

by

Russell Theodore Gingras

The purpose of this research effort was to examine the stock price reaction to errors in management forecasts of earnings per share. It was expected that the study would provide evidence as to whether such forecasts were used by investors. If such forecasts were not used by investors, then perhaps the other difficult problems associated with the publication of such forecasts could be avoided.

Since questions were directed toward the usefulness of management forecasts to investors, it was important to examine the theoretical basis for expecting such forecasts to be useful to investors. It was found that many security valuation models depend on expected earnings. This, coupled with research studies which found that there was a relationship between reported earnings and stock prices, strongly indicated that there might be a relationship between management forecasts of earnings per share and stock prices.

Russell Theodore Gingras

If management earnings forecasts had influenced investor expectations and reported earnings were different from the earnings which had been forecast, a reaction in the price of the stock would be expected. Thus, the stock price reaction to forecast errors was used as a measure of the usefulness of management forecasts to investors. In order to be meaningful, the study went beyond an analysis of stock price reactions to management earnings forecasts. It was possible that similar results could have been obtained using forecasts generated by naive or mechanical models. Therefore, the study included an analysis of possible stock price reaction to several naive model forecasts as well as to management earnings forecasts.

The firms making management forecasts were selected from The Wall Street Journal. In total, there were 123 usable management forecasts.

The computation of forecast errors in an attempt to relate forecasts to stock price changes made it possible to examine the accuracy of such forecasts. It was found using the chi-square one sample test that there was no tendency for management to overpredict or underpredict earnings. The Wilcoxon Signed-Ranks test was then applied to determine the comparative accuracy of the forecasts. This test confirmed that management forecasts were more accurate than those of the naive model.

The first tests of the association between forecast errors and stock prices dealt with the question of whether the direction of the price response was associated with the direction of the forecast error. The chi-square test was used in determining that there was no significant association between the sign of the forecast error and the sign of the price response for either management or naive model forecasts. Cases were then found where the management forecast and the naive model forecast were on opposite sides of actual earnings. The Fisher Exact Probability Test was used to determine, in these cases, that there was no tendency for the sign of the price response to follow the sign of the management forecast error.

In order to include magnitudes of forecast errors and price responses in the analysis, rank order correlations were obtained between forecast errors and price responses. It was found that low but positive correlations existed between all forecast errors and price responses. However, management forecast errors were not in all cases more highly associated with price responses than naive model forecast errors.

Since the correlations did not conclusively answer the question of whether there was a greater association between management forecast errors and price responses

than existed for the naive models, additional tests were conducted. Cases were found where there were large differences between management forecast errors and naive models forecast errors. Then both the management forecast errors and the naive model forecast errors were correlated with the price responses. The results were again inconclusive. For some methods of computing forecast errors and in comparison with some of the naive model forecasts, management forecast errors appeared to be more closely associated with price responses than did the naive model forecasts.

A nonstatistical matrix analysis was then used to further examine whether the size of the price response seemed to be associated with the size of the forecast error. This analysis confirmed that there did seem to be an association between the size of the price response and the size of the forecast error. However, this pattern was not unique to management forecast errors.

The results of the study taken together indicate no pattern of consistent superiority in the associations between management forecasts and stock prices over the associations between naive model forecast errors and stock prices. The results of the study do not then clearly indicate that management forecasts of earnings per share have informational content.

AN EMPIRICIAL EVALUATION OF THE STOCK PRICE REACTION TO ERRORS IN MANAGEMENT FORECASTS OF EARNINGS PER SHARE

By

Russell Theodore Gingras

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF BUSINESS ADMINISTRATION

Department of Accounting and Financial Administration

1974

ACKNOWLEDGMENTS

I would like to express my appreciation to the many people who contributed to the completion of this research effort and the doctoral program, the members of my dissertation committee. Dr. Roland F. Salmonson (Chairman), Dr. Melvin C. O'Connor, and Dr. Gilbert D. Harrell provided many useful suggestions as well as continuous encouragement.

Dr. Daniel W. Collins also made many helpful suggestions. In addition, he was instrumental in arranging for the use of the CRSP tapes at the University of Iowa.

I also express my sincere thanks to Dr. Gardner M. Jones, Chairman of the Department of Accounting and Financial Administration, for his support in completing the doctoral program.

Finally, I am most indebted to my wife, Carol, for her support and encouragement in the completion of the doctoral program. And to my daughter, Rochelle, and my son, Paul, without whom the effort would have lacked purpose.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

This chapter includes a statement of the purpose of the research, an examination of the motivation for undertaking the research effort, the arguments for and against the publication of earnings forecasts, and a presentation of the organization of the dissertation.

Purpose

Accountants are concerned that information presented in accounting reports be useful to the readers of such reports. The American Accounting Association has indicated for example. that:

> ...from the viewpoint of the external user it is essential that accounting information be relevant to his needs.[1]

The American Accounting Association has further indicated that the:

> ...accounting discipline could be expanded either by absorbing additional measurement methods into the discipline or by broadening the concept of activities on which it reports.[2]

One area that has been proposed as an additional area of reporting, which might be useful to statement users, is that of forecast earnings.[3]

The possible usefulness of earnings forecasts has been considered sufficiently important that the Securities

and Exchange Commission recently dealt with this issue. Its decision was to allow, but not require, the inclusion of management forecasts of earnings in reports filed with the Commission.[4] This process intensified consideration of the problems and prospects associated with published forecasts of earnings. Many issues were raised, one of the most basic being whether or not such reports were useful to investors. This question must be strongly considered because a number of problems have been raised concerning the publication of forecast earnings. Questions have been raised concerning:

(1) the legal liability of those involved in forecasting earnings;

(2) the effect of forecast earnings on stock prices;

(3) the role of the auditor in the forecasting process.

Since serious questions of this nature have been raised, it seemed sensible to this researcher to first examine whether management forecasts seem to be used by investors. If such forecasts are not used by investors, it would seem unnecessary to resolve the other difficult problems associated with publication of earnings forecasts.

The Relationship Between Earnings and Stock Prices

Lorie & Brealey make the point that in almost all securities valuation models the most important variable

is the expected growth in earnings.[5] Many valuation models assume that investors determine the price of a security by discounting the future expected stream of dividends. One form of such a valuation model is stated below.[6]

(1) $P_o = \frac{D_o}{k-g}$ (assuming $k > g$)

P_o = the price of the security at time o.

D_o = dividends per share at time o.

k = the rate of return that investors anticipate.

g = the rate at which the dividend stream grows.

(1a) $k = \frac{D_o}{P_o} + g$

The rate of return on equity investment is then defined in terms of the current dividend yield and the growth rate in this yield. But dividends are normally viewed as being based on earnings. It should be possible, then, to rewrite these equations in terms of current earnings. Rewriting equation (1) in terms of current earnings results in the following equations.

(2) $P_o = \frac{(1-b)\ r\ A_o}{k-rb}$

Where:

A_o = firms total assets;

b = retention rate;

$1-b$ = payment rate;

r = rate of return;

g = br

$$(2a)\quad k = \frac{rA\ (1-b)}{P} + rb$$

The definition of return on equity investment is then stated in terms of current earnings adjusted for growth in earnings. The important point here is that many security valuation models depend on expected earnings.

This theoretical research seems to be supported by several empirical studies. Two studies, one by Ball and Brown, and the other by Beaver, strongly indicate that there is a relationship between earnings and stock prices.[7] Since these studies had both theoretical and methodological implications for this research effort, they are reviewed in some detail in later chapters.

Baker and Haslem recently conducted a study of common-stock investors in metropolitan Washington, D.C. They used a questionnaire to determine which 33 factors used in investment analysis were considered most important by the investors questioned. In total they received 851 complete responses. The results showed that:

> The factors ranked most highly by the investors explicitly show that investors are primarily concerned with expectations about the future.[8]

More specifically, the factor of greatest importance was the future economic outlook of the company. Expected

future percentage growth in earnings per share was the sixth ranked factor.[9]

The importance of expected earnings in the determination of stock prices, then, has a solid basis in theory and has been empirically validated to some extent. Since earnings forecasts provide information to investors about earnings expectations, they should have an influence on stock prices.

The Research Question

Earnings forecasts are available to investors from a number of sources. The investor could develop forecasts himself, he could obtain them from financial analysts, or he could obtain management forecasts. There have been previous studies concerned with the apparent usefulness to investors of both naive model forecasts and analysts' forecasts. There has not, however, been any empirical work designed to evaluate the usefulness of management forecasts to investors. This is the subject of this research project.

Arguments for Publication of Management Forecasts of Earnings

The strongest argument for making management earnings forecasts public information is that such information is useful in making investment decisions. Numerous authors have indicated that such information is considered useful

to investors. The following quotation, taken from the Financial Analysts Journal, is illustrative of the argument made for the publication of management earnings forecasts:

> One would expect the impact of forecasts to be greater than the impact of current earnings, because the former are more directly relevant to determinations of investment value; after all, the primary relevance of current earnings is their usefulness in forecasting the future. A significant change in the earnings forecast of the leading research firms sometimes has as much impact on market prices as a comparable change in reported earnings. The only thing that could give forecasts more impact would be to make them official.[10]

It is further indicated that management earnings forecasts may have some special usefulness. In another article in the Financial Analysts Journal it was indicated that:

> The analyst can bring to his forecasts objectivity and comparative information. Management has special knowledge of internal factors and a greater sensitivity to its own particular environment, thus, both types, of forecasts are useful to the investor.[11]

Another argument for publishing earnings forecasts is that such forecasts are presently being made but are unevenly disseminated; and that publication of corporate forecasts of earnings would help to remedy this inequity. The FAF Proposal for Systematic Disclosure of Corporate Forecasts noted in this connection:

> Equity in dissemination of corporate information to all investors will be enhanced. Disclosure of forecast information is merely another step foreward in the continuing effort to improve

> corporate reporting to investors. The ultimate benefit to the corporation is a more efficient capital market in which to raise funds.[12]

Arguments Against Publication of Management Forecasts of Earnings

The argument is made, that in order for forecast information to be useful to investors, it must be reasonably accurate.[13] There have been studies made concerning management forecasting, three of which are summarized later in this paper, which cast doubt on the ability of professionals to forecast accurately.

Management's lack of ability to accurately predict earnings leads to another argument against the publication of earnings forecasts. There are some who feel that inaccurate forecasts may have an undesirable influence on stock price behavior. For example, an article in Business Week stated:

> Another worry is how the stock market would behave if a forecast missed its mark badly. Wall Street's emphasis on short term results and its obsession with forecasts was vividly illustrated last week when Digital Equipment Corp., the Massachusetts mini-computer manufacturer reported its results for the July-September, 1972 quarter. Analysts had predicted per-share earnings of 40¢ for this first quarter of DEC's fiscal year, compared with 29¢ in 1971. When DEC reported 33¢, its stock plumented 17 points to 84 in one day.[14]

Others have amplified this argument. It has been indicated that publication of near term earnings forecasts would do the investing public a disservice because it would benefit only the in-and-out speculator.[15]

In addition, it has been charged by some that publication of earnings forecasts may lead management to either overpredict earnings or underpredict earnings. Management might overpredict earnings to impress the shareholders at the time the forecast was published. On the other hand it could be argued that there might be a tendency to underpredict earnings in order to be conservative. A conservative forecast would make it easier to meet or exceed the earnings which had been forecast.[16] Further, it has been suggested that publication of earnings forecasts may lead management to manipulate income in order to meet or exceed the income it had forecast.[17]

Finally, there is the possibility of legal actions if forecasts are inaccurate. There is, however, some indication that legal actions may not be a problem because the SEC may provide a "safe harbor" rule, stating what constitutes a forecast and the steps to be taken subsequent to the forecast.[18] In contrast to this position, one author has contended that "Financial performance significantly better or worse than that projected seems clearly to be a basis for action for damages."[19]

The Approach of the Research

The research question was examined by associating management forecast errors with stock price reactions. If management forecasts were being used by investors, it would seem that there should be a consistent relationship between the direction and size of the forecast error and

the direction and size of the price response. Further, if management forecasts were being used, the same results should not be obtained using naive forecasts. Several statistical tests were used in examining these questions.

Organization of the Research

Chapter II contains a review of the literature concerning:

(1) the ability of management to forecast accurately;

(2) the relationship between naive forecasts and stock price behavior;

(3) the relationship between analysts' forecasts and stock price behavior.

Chapter III discusses the general methodology of the study, including data selection, measurement of forecast errors, and measurement of price response.

Chapter IV presents an analysis of the sample which was obtained in terms of the number of forecasts and the nature of the companies making such forecasts. In addition, there is an analysis of the forecast errors using management and naive forecasts.

Chapter V contains a presentation and analysis of the test results concerned with establishing the stock price reaction to management earnings forecasts.

Chapter VI presents a summary of the study, conclusions, implications, and recommendations for further research.

FOOTNOTES

CHAPTER I

[1]American Accounting Association, A Statement of Basic Accounting Theory (Evanston: American Accounting Association, 1966), p. 27.

[2]Ibid., p. 71.

[3]E. G. W. W. Cooper, N. Dopuch and T. F. Keller, "Budgeting Disclosure and Other Suggestions for Improving Accounting Reports," The Accounting Review, October, 1968, XLIII, pp. 640-647, and Rudy Schattke, "Expected Income--A Reporting Challenge," The Accounting Review, October, 1962, XXXVII, pp. 670-676.

[4]Les Gapay, "SEC Plans to Let Concerns Forecast Profit in Filings." The Wall Street Journal, February 2, 1973, LIII(75), p. 3.

[5]James Lorie and Richard Brealey, Modern Development in Investment Management, (New York, Praeger Publishers, 1972), p. 597.

[6]George C. Philippatos, Financial Management Theory and Techniques (San Francisco, Holden-Day, Inc., 1973) pp. 374-375.

[7]William H. Beaver, 'The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, A supplement to Volume 6 of the Journal of Accounting Research, pp. 67-101., and Ray Ball and Phillip Brown, "An Empirical Evaluation of Accounting Income Numbers." Journal of Accounting Research, Autumn, 1968, VI, p. 170.

[8]J. Kent Baker and John A. Haslem, "Information Needs of Individual Investors," The Journal of Accountancy, November, 1973, 136(15), p. 65.

[9]Ibid., p. 67.

[10]"Corporate Earnings Forecasts," Financial Analysts Journal, March/April, 1972, 28(2), p. 17.

[11]William S. Gray, III, "Proposal for Systematic Disclosures of Corporate Forecasts," Financial Analysts Journal, January/February, 1973, 29(1), p. 65.

[12]Ibid., p. 71.

[13]Charles LeRoy McDonald, An Empirical Examination of Published Prediction of Future Earnings (Unpublished Ph. D. dissertation. Michigan State University, 1972), pp. 23-24.

[14]"Business Fears Profit Forecasting," Business Week November 4, 1972, p. 44.

[15]John A. Prestbo, "...And an Expert Who Says They Won't Work," The Wall Street Journal, December 11, 1972, LIII (40), p. 8.

[16]For a discussion of arguments why management might overpredict or underpredict earnings see: McDonald, pp. 22 and 24.

[17]Business Fears Profit Forecasting, p. 44.

[18]"Full Disclosure and the Changing Business Environment," Haskins & Sells, The Week in Review, April 27, 1973, p. 9.

[19]R. Gene Brown, "Ethical and Other Problems in Publishing Financial Forecasts," Financial Analysts Journal, March/April, 1972, 28(2), p. 44.

CHAPTER II

REVIEW OF THE LITERATURE CONCERNED WITH MANAGEMENT FORECASTS OF EARNINGS PER SHARE

Introduction

The literature in the area of management forecasts of earnings per share has been primarily oriented toward analyzing the accuracy of these forecasts. Accuracy of management forecasts relates strongly to this research effort which attempts to associate stock price reactions to management forecast errors. Therefore, the empirical studies concerned with the accuracy of management earnings forecasts will be carefully reviewed.

Since this research effort relates errors in management forecasts of earnings per share to stock price reactions, it would be desirable to review studies dealing with this specific question. Unfortunately, no such studies are available. But there are studies relating analysts' forecasts of earnings per share to stock price reactions. Since these studies relate forecasts of earnings per share to stock price reactions they will be reviewed in this chapter.

Review of the Literature Concerned With the Accuracy of Management Forecasts of Earnings Per Share

Green and Segall in two articles have dealt with the question of the accuracy of management forecasts of earnings.[1] Answering this question was not, however, the authors' primary purpose. Their primary purpose was to examine the predictive power of first quarter earnings reports. This they did by generating forecasts using several naive models, then comparing the accuracy of forecasts generated using first quarter earnings reports with forecasts not using first quarter earnings reports.

The naive forecasting models used included three annual models and three interim models.[2]

Annual 1: Next year's EPS equals this year's.

Annual 2: Next year's EPS equals this year's EPS plus the difference between this year's EPS and last year's.

Annual 3: Next year's EPS will differ from this year's by the same percentage that this year's EPS differs from last year's.

Interim 1: Next year's EPS equals four times the first quarter's EPS.

Interim 2: Next year's EPS will differ from this year's by the same percentage that next year's first-quarter EPS differs from this year's first-quarter.

Interim 3: Next year's EPS was derived by linearly regressing annual against first-quarter EPS for the five years preceeding the year for which the forecast is desired and applying the regression estimates to first quarter earnings of that year.

As a part of this study the authors looked at twelve management earnings forecasts. This was done to evaluate the forecasts made using the naive forecasting models. The authors point out that interim forecasts used in simple ways may yield poor forecasts, but when combined with other information, may contribute to forecasting accuracy.[3] Presumably management has access to a great deal of "other" information including information available only to those inside the firm.

The twelve forecasts represented the only firms from the original sample of fifty firms which made management earnings forecasts. The original fifty firms had been randomly selected from the January, 1964, issue of The Bank and Quotation Record.

The management forecasts were not necessarily point forecasts of earnings per share. In fact, only five of the forecasts could be construed as point estimates of earnings per share. The remaining forecasts were concerned with the direction of the earnings change. Further, six of the forecasts were made after 50% of the year had passed.

The authors reported that:

> Of the twelve forecasts, five were made before the first quarter report was available; of these, four erred in direction, and only two specified the amount of the earnings forecast for the year; of the two which gave specific forecasts, one had an error greater than any of the annual models. That is, actual forecasts made without first-quarter earnings reports do not appear to be more helpful than forecasts of the naive models. Of the remaining seven forecasts--made after first quarter reports were available--one erred in direction, and only four quantified the earnings forecast for the year; of the four which were specific, one was superior to any naive model, and three were superior to five of the naive models. That is, where comparison was possible, most actual forecasts are better than those of the naive models, but, of course, they were made later in the year.[4]

A replication of the first study was made by Green & Segall using forecasts made during 1965.[5] Fifteen management forecasts were obtained and analyzed. The results obtained were so similar to the initial results that the replication is not reviewed in detail.

The studies by Green and Segall, in terms of management forecast errors, leave much to be desired. The primary problem was the small number of forecasts which were obtained. The small number probably resulted from the selection technique used. First a random sample of firms was obtained, then they were analyzed to see whether management forecasts were available for these firms. Had there first been a search for firms making management forecasts, perhaps the sample would have been larger.

Another criticism of the study is that comparisons of the accuracy of management forecasts and naive forecasts were not made statistically. The combination of a small sample and nonstatistical comparisons leaves the authors' conclusions open to suspicion.

Further, it could be argued that the sample was nonrepresentative and that the years selected were not representative. The years 1964 and 1965 were both good years in terms of corporate profits, with profits rising sharply throughout both years.[6] Perhaps the same results would not have been obtained had the authors selected years with poor or variable economic conditions.

The small number of firms again probably contributed to the lack of representation evidenced by the firms in the sample. Even where an industry was included in the sample, it was represented by a small number of firms. It is, then, questionable whether forecasts by the firms in the sample are representative of their industry.

Finally, the usefulness of naive and management forecasts is evaluated solely on the basis of forecast accuracy. Another measure of usefulness might be the association between the various types of forecast errors (naive and management) and stock price movements. The present study evaluates both forecast accuracy and the relation between forecast errors and stock prices. It

does follow Green and Segall in that comparisons are made between naive model forecasts and management forecasts.

A second empirical study analyzing the accuracy of management forecasts of earnings per share was made by McDonald.[7] His study approximates, in part, the methodology used in the research reported in this dissertation.

McDonald's study specifically focuses on the usefulness of published management forecasts of earnings per share. The point is made that in order for these forecasts to be useful to investors they must be sufficiently reliable for investors to include them in their decision making processes.[8] Thus the accuracy of management forecasts was examined.

The author selected his sample from management earnings forecasts published in The Wall Street Journal. The forecasts to be included in the sample must have been point forecasts of earnings per share made during the first 120 days of the firm's fiscal year. The Wall Street Journal was examined for the 120 days beginning with January 1 for each year included in the study. It was felt that forecasts made in the first 120 days of a firm's year could have been included in the annual report to stockholders.[9]

The years 1966 through 1970 were included in the study. The analysis of forecast accuracy was made on an overall basis, as well as by year. In addition, an

analysis of forecast accuracy was made by industry groups.

The reliability of the management forecast was determined by comparing predicted earnings to actual earnings. The errors were computed relative to predicted earnings. This procedure allowed the predictions to be compared. In addition, this method of computing error might be particularly useful to investors.[10]

The author found that:

> ...For the five year period the Relative Prediction Errors ranged from an overprediction of 395.6 percent to an underprediction of 108.5 percent. The mean prediction error was a 13.6 percent overprediction. Of the 201 predictions, 35.3 percent had an error of 5 percent or less, and 48.5 percent had an error of 10 percent of less.[11]

It was statistically determined using the chi-square one sample test, that there was a tendency to overpredict earnings. When the errors were evaluated by industry groupings it was found that utilities had the lowest mean Relative Prediction Error.

As a final step in the research effort, McDonald examined the association between the Relative Prediction Errors and several variables. The variables were classified as endogenous and exogenous to the firm. No attempt was made, however, to associate Relative Prediction Errors with stock price changes.

As a result of the analysis it was determined that only the endogenous variables were significantly associated with Relative Prediction Errors at the .05 level.[12]

The associations between Relative Prediction Errors and the other variables were determined on both a univariate and multivariate basis. The univariate associations were established using simple correlation analysis, while the multivariate associations were established using the multiple regression technique.

The highest association was found to be between Relative Prediction Errors and Relative Extraordinary Gains and Loses.[13] The second highest association was between Relative Prediction Errors and Change in Operating Earnings.[14] With regard to the association between Relative Prediction Errors and Change in Operating Earnings it was noted that:

> This suggested that, in general, the earnings predictions of firms consist of small adjustments to the previous year's actual earnings.[15]

McDonald's study was superior to Green and Segall's in many respects. The sample of firms obtained using McDonald's selection technique was far larger than Green and Segall's. Green and Segall analyzed a total of 27 forecasts which were published during 1964 and 1965. McDonald analyzed 201 forecasts published during the years 1966 through 1970.

The years included in McDonald's study represented a wide variety of economic conditions while the years from which Green and Segall selected forecasts, as previously indicated, were very good years in terms of

corporate profits.[16] Further, McDonald Makes a strong case for his sample being more widely representative of various industries.[17]

The major weaknesses of McDonald's study were first, that it focused on forecast errors as a criterion for evaluating the usefulness of management earnings forecasts; and second, that no comparison was made between management forecasts and naive forecasts. As the author pointed out, current management forecasts seem to be small adjustments to the previous year's actual earnings. It might have been anticipated, then, that forecasts made using past years' earnings in a mechanical, or naive, model might have produced results similar to those obtained using management forecasts.

In another study, Copeland and Marioni analyzed the accuracy of management forecasts of earnings per share.[18] These authors closely followed the Green and Segall methodology. Management forecasts were compared with forecasts generated by the use of six naive models. The naive models used were the same models used by Green and Segall, presented earlier in this chapter, with one exception. The regression model indicated by Green and Segall as Interim 3 was replaced by the following model:

> Model 6: EPS of the current year will equal the EPS of the last three quarters of the previous year plus the EPS of the first quarter of the current year.[19]

The calculation of forecast errors was made using both relative errors and absolute errors. The absolute error was calculated by subtracting forecast earnings per share from actual earnings per share. Relative errors were calculated by dividing the absolute error by actual earnings per share.

The authors initially selected 50 management forecasts from The Wall Street Journal. They began with the January 2, 1968 issue, scanning each subsequent issue until they had obtained fifty management forecasts. The selection criteria used were:

> (1) The forecast consisted of a specific point or range estimate and (2) quarterly EPS data of the prediction were available. In cases where an executives forecast stated that EPS "approximate," that they "exceed," or that they will be "at least" a specific figure, the amount declared was used as that firm's prediction.[20]

The forecasts were not necessarily taken from the first part of a firm's year. One forecast made after 92 percent of the firm's year had elapsed was included in the sample. The management forecasts were found to be accurate in terms of direction. Only 14 percent of the firms failed to predict the correct direction that the change in earnings per share would take.[21]

There were two more overestimates of EPS than there were underestimates. But the firms overestimating earnings did so with greater inaccuracy than did firms underestimating earnings.[22] When the naive model forecasts

were compared with management forecasts it was found that management forecasts had the lowest average absolute error and the lowest average relative error.[23]

As an additional test the forecasts were ranked in terms of the absolute amount of the error for each firm. The most accurate prediction receiving the rank, 7, and the least accurate prediction receiving the rank, 1. The forecast errors were then compared using the chi-square and Kolmogrov-Smirnov tests. The authors note:

> Executive forecasts achieved a higher rank than that expected due to chance (14 percent) on a significant number of occasions when evaluated by the x^2 test with six degrees of freedom and the Kolmogrov-Smirnov test with N=50, with significance set at the .05 level.[24]

This indicates that the management forecasts are the most accurate of the forecasts tested. The authors, however, properly qualify the interpretation of the results by noting that in regard to the naive models:

> ...The predictions of the models are available earlier and our decision may be too dependent on the year chosen.[25]

In order to see whether the results depended on the year chosen (1968), the authors replicated the last test with 25 firms from each of the years 1964 and 1965. The results, using the Kolmogrov-Smirnov test, again showed the management forecasts to be significantly more accurate at the .05 level.

The study by Copeland and Marioni had some desirable features. The authors did compare the accuracy of management forecasts to the accuracy of forecasts generated by several naive models. In addition, the comparisons were made on a statistical basis. Further, the number of forecasts analyzed was large. In total, 100 management forecasts were analyzed. As a result of these strengths in the study, the authors' conclusion that management forecasts are more accurate than forecasts of naive models, rests on a reasonably solid foundation. This is not to say, however, that the study had no weaknesses.

One weak point was that the forecasts were not point forecasts of earnings per share. Where a range forecast was made, the authors used the midpoint of the range as the management forecast of earnings per share. As McDonald has pointed out, this procedure requires one to assume that the probability distribution associated with range predictions is symetrical.[26]

In addition, the authors include forecasts which might be termed "open ended." Forecasts in this category include those stated as "approximate," or "will exceed," or be "at least" a specific amount. Forecasts of this nature made it very difficult to measure the forecast error. For example, if a forecast stated that "at least" $1.00 per share would be earned, and earnings of $1.25

per share were reported, technically there would be no forecast error.

Another problem with Copeland's and Marioni's research effort was that the management forecasts were often made after a considerable portion of the year, for which the forecasts were being made, had elapsed. This would give management forecasts a considerable advantage.

The naive forecasts had the benefit of, at best, the first quarter earnings during the year for which the forecast was made. In contrast some of the management forecasts were made with the benefit of as many as three quarterly earnings reports during the year for which the forecast was made. Thus, typically, the naive forecasts were available earlier in the year and used less current information than management forecasts.

Finally, Copeland and Marioni focus exclusively on forecast accuracy in evaluating the usefulness of management forecasts of earnings per share. As previously indicated, another test of the usefulness of management forecasts of earnings per share might be to associate the forecast errors with stock price reactions.

Review of the Literature Relating Analysts' Forecasts to Stock Price Reactions

The research relating analysts' forecasts to stock price reactions was pertinent to this research effort in

that forecasts made by professional investors were related to stock prices. It was previously indicated that the relation between forecast errors and stock price changes might be a measure of the usefulness of forecasts to investors. Since both analyst and management forecasts are made by professionals, the result might be similar.

Niederhoffer and Regan, in a study published in 1972, evaluated the relationship between professionally generated forecasts and stock price reactions.[27] In this study, the authors examined the percentage gains and losses in price of the 1253 common stocks on the New York Stock Exchange for the year 1970. They also examined the percentage gains and losses in price for 650 stocks for a five year period ending in 1970. The 650 stocks were those of the nation's 650 largest corporations as presented in Forbes' "23rd Annual Report on American Industry" in the January 1, 1971, issue.

From these stocks they selected in each year the 50 worst performers, the 50 best performers, and 100 random stocks. The 50 best performers and the 50 worst performers were compared with each other and with the 100 random stocks on the basis of several variables.

The authors compared:

(1) median change in forecasted earnings per share;

(2) median change in actual earnings per share;

(3) median change in stock price during 1970.

The forecasts were taken from the March 31, 1970, edition of the Standard and Poor's Earnings Forecaster. The Earnings Forecaster is a compilation of analysts' forecasts made by several financial institutions. The particular forecast used was the forecast made by the financial institution with the largest number of forecasts in the booklet.

The authors concluded, based on a visual analysis, that:

> The median estimated percentage changes in earnings for the top 50 and the random 100 were comparable at 7.7% and 5.8% respectively, but neither approached the predicted 15.3% gain for the bottom 50. Such results suggest that professional investors would be wise to cast a suspicious eye on unusually optimistic estimates, since failure on the part of the firm to realize such expectations will most certainly result in a stock price decline.[28]

It was further demonstrated that the top 50 stocks had a considerably greater median change in actual 1970 earnings per share than did the random 100 stocks. The bottom 50 stocks had a much lower median change in earnings per share than did the random 100 stocks.[29]

The authors then normalized the same data by price. The following variables were computed for each company:

$$\text{Estimated earning change per dollar of price} = \frac{F,\ 1970\text{-}E,1969}{P,1969}$$

$$\text{Actual earning change per dollar of price} = \frac{E,\ 1970\text{-}E,\ 1969}{P,1969}$$

Forecast errors per dollar of price $= \frac{E, 1970 - F, 1970}{P, 1969}$

Where:

E = earnings per share;

F = forecast earnings;

P = the closing price for 1969.

The authors note that:

> The major reason for using earnings changes normalized by price rather than percentage earnings changes was that the latter became statistically cumbersome whenever the base becomes small or negative.[30]

The top 50 stocks, bottom 50 stocks, and the random 100 stocks were then compared using a non-parametric discriminant analysis.[31]

The authors conclude, based on this analysis, that:

> ...We can see that when the forecast was overestimated by eight cents or more per dollar of price, the odds were nearly 17 to 1 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 was almost a guarantee that the stock would finish in the top 50 rather than in the random 100, since the chances were 24 out of 25.[32]

The discriminant analysis was also conducted with actual earnings changes per dollar of price. The authors concluded:

> ...For all companies with actual earnings gains of four cents or more per dollar of price, the odds were 14 to 1 that the company would finish in the top 50 rather than in the random 100, with virtually no chance of ending up on the bottom 50. But for earnings losses of eight cents or more, the odds were 20 to 1 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.[33]

TABLE 1[34]

DISTRIBUTION OF FORECAST ERRORS PER DOLLAR OF PRICE

(Niederhoffer and Regan)

Forecast Errors	Top 50	Random 100	Bottom 50
6.0 & over	4.5		
5.5 to 6.0			
5.0 to 5.5	2.3		
4.5 to 5.0			
4.0 to 4.5			
3.5 to 4.0	2.3		
3.0 to 3.5			
2.5 to 3.0	4.5		
2.0 to 2.5	15.9		
1.5 to 2.0	4.5	1	
1.0 to 1.5	13.6	1	
0.5 to 1.0	13.6	7	
0.0 to 0.5	27.2	12	
-0.0 to -0.5		18	
-0.5 to -1.0	6.8	15	
-1.0 to -1.5	2.3	6	12
-1.5 to -2.0		9	3
-2.0 to -2.5	2.3	7	3
-2.5 to -3.0		5	6
-3.0 to -3.5		2	18
-3.5 to -4.0		3	6
-4.0 to -4.5		3	
-4.5 to -5.0		5	
-5.0 to -5.5		1	3
-5.5 to -6.0			9
-6.0 to -6.5		1	
-6.5 to -7.0			6
-7.0 to -7.5		1	
-7.5 to -8.0		1	3
-8.0 to -8.5			12
-8.5 to -9.0			
-9.0 to -9.5			6
-9.5 to-10.0			6
-10.0 & over			9
	99.8	100	102

The authors' results would seem to indicate that stock price changes are closely related to changes in actual earnings and to forecast errors. Their results must, however, be viewed with some caution.

The stocks which were analyzed had extremely large stock price changes. The authors purposely selected these stocks because it was expected that any relationship would be magnified in this sample.

The results, then, may be dependent on the nature of the firms selected. This seems to be born out in part by looking at the random 100 stocks selected from the Forbes' 650 largest corporations. The random 100 stocks over the five year period had a median earnings change of +18.3% but the median stock price change was -4.9%.[35] This would not be the expected result given the authors' conclusion.

Another problem is that the stock price changes are not adjusted for general market effects. The price of a stock can be viewed as being made up of three parts. The first part resulting from factors affecting the market as a whole. The second part being made up of factors affecting the entire industry of which the firm is a part. The final part resulting from factors unique to the firm. The factors affecting the industry as a whole have been found to be relatively insignificant. But factors affecting the entire market have been found

to have a relatively large effect on stock prices.[36] It would seem, therefore, that the stock prices should have been adjusted for general market effects. Further, there is no indication by the authors that prices had been adjusted for capital changes.

Another problem may have occurred because the measurement of forecast error and earnings changes, were normalized by price. The data was normalized by price in order to avoid the problems associated with calculating percentage changes in earnings or percentage forecast errors. This technique, however, also has a problem. The higher the price of the stock the lower would be earnings change or forecast error, normalized by price. Further, the price used to normalize the 1970 variables was the year-end closing price for 1969. The closing price at the end of year 1969 may have been unusual for some reason, thus distorting the error measurement.

A second study relating analysts' forecasts to stock prices was conducted by Janell.[37] This study overcomes many of the problems present in the study by Niederhoffer and Reagan.

Janell computed 50 analysts' forecasts for each of the years 1970 and 1971. The forecasts he computed were the average of several analysts' forecasts presented in Standard and Poor's Earnings Forecaster.

The population from which the sample was selected met the following selection criteria:

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

(2) The firms had a fiscal year ending on December 31.

(3) The firms which met the other criteria had to 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.[38]

A random sample of 50 firms was taken from the firms remaining after application of the selection criteria for each of the years 1970 and 1971.

The forecast errors were determined using the following formulas:[39]

(1) $\frac{A-F}{F}$

(2) $\frac{A-F}{P}$

Where:

A = actual earnings per share for the year;

F = forecast earnings per share for the year;

P = the average of the month end closing prices of the stock for the three months immediately prior to the forecast of earnings.

The author computed forecasts based on analysts' forecasts and in addition used six naive models to generate forecasts. The forecasts were then analyzed to see how accurate they were.

It was found that the forecasts generated using analysts' predictions were overforecasts in 70% of the cases.[40] When the analysts' forecasts were compared with forecasts generated by the best naive model, no significant difference in forecast accuracy was found.[41]

Several of the forecasts were then associated with stock price changes. The methodology utilized was to associate cumulative stock price residuals with forecast errors, using the Spearman rank correlation coefficient.

Previously, it was noted that the stock price changes should be computed by eliminating general market effects. This was accomplished by Janell through the use of the market model. This is a technique which through regression procedures eliminates the market effect from the stock price by utilizing a general index of market prices. This technique was essentially the same as that used in the present study and is thoroughly explained in the next chapter. The stock prices were then continuously compounded over the period from the forecast announcement to the date of the announcement of actual earnings. The result was the cumulative stock return residual.

After associations between forecast errors and cumulative stock return residuals had been determined, the associations were compared. The associations compared were those of the analysts' forecasts and those of the three annual naive models. The author stated that:

> 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.[42]

The author also had available quarterly revisions of the analysts' forecasts. When the revisions were analyzed, it was found that as the forecast horizon was reduced, there was a reduction in the mean prediction errors for both the analysts' forecasts and for forecasts generated using naive models.[43]

When the association between the analysts' annual forecast errors and the cumulative stock price returns was compared with the association between the analysts' quarterly revisions and the cumulative stock price returns, no statistical differences were found.[44]

Janell's study had a number of desirable features. The stock prices were adjusted for general market effects. A relatively large sample (100 firms) was obtained. Statistical procedures were used to compare analysts'

forecasts to those of naive models. These positive features are all included in the present study.

There is, however, the question as to whether the forecast errors were properly measured. The formula (A-F)/F can lead to different specifications of relative error among the various forecasts (naive and analysts'), even if the absolute error is the same for each of the forecasts. The formula (A-F)/P, might lead to lower relative errors for higher priced securities.

These error computations, however, also have advantages. The measurement of forecast error relative to the forecast may be particularly useful to investors. If the investor has a forecast available for the current year, he may desire to adjust this forecast for past experience with forecast errors. The past error measurement most useful to him might, then, be compared relative to the forecast.

The error normalized by price (A-F)/P would not have the problems associated with a small or negative base. This advantage was discussed previously in this chapter in the review of Niederhoffer and Regan.

The most significant problem with Janell's study was the specification of the analysts' forecasts. The author averaged several analysts' forecast for each firm and used the result as the analysts' forecast. Since there is really no one analyst forecast for each firm,

this was a necessary procedure. But it is questionable whether the results can be attributed to analysts' forecasts since the forecasts used were not actual analysts' forecasts but were rather forecasts derived from analysts' forecasts.

Summary

This chapter has reviewed previous empirical studies dealing with the accuracy of management forecasts. In addition, it contains a review of two studies relating analysts' forecasts to stock prices. The works relating analysts' forecasts to stock prices were reviewed because no studies were available which related management forecasts to stock prices.

The studies of the accuracy of management forecasts yielded contradictory evidence. Green and Segall were not impressed with the accuracy of management forecasts when such forecasts were compared with forecasts generated by naive models. But Copeland and Marioni found management forecasts to be more accurate than those of naive models. McDonald found that management forecasts were accurate enough to be useful to investors, but no comparison was made between management forecasts and forecasts of naive models.

Neiderhoffer and Regan and Janell disagree as to the association between analysts' forecasts and stock prices.

Niederhoffer and Regan found a strong association to exist between stock prices and forecast errors. Janell found relatively weak associations between stock prices and forecast errors. In addition, he determined that there was no greater association between forecast errors and stock prices for analysts' forecasts than there was for two of the three annual naive models.

The present study attempted to eliminate some of the weaknesses present in the studies examining the accuracy of management forecasts. In addition, there was an extension of the analysis of the association between forecast errors and stock prices to the area of management forecasts. Again there was an attempt to overcome any weaknesses present in the previous studies as well as to capitalize on their strengths.

FOOTNOTES

CHAPTER II

[1]David Green and Joel Segall, "The Predictive Power of First-Quarter Earnings Reports," The Journal of Business, January, 1967, XXXX, pp. 44-55. And David Green and Joel Segall, "The Predictive Power of First-Quarter Earnings Reports: A Replication," Empirical Research in Accounting Selected Studies, 1966, A Supplement to Vol. 4 of The Journal of Accounting Research, pp. 21-36.

[2]David Green and Joel Segall, "The Predictive Power of First-Quarter Earnings Reports," The Journal of Business, January, 1967, XXXX, pp. 44-55.

[3]Ibid., p. 52.

[4]Ibid., p. 54.

[5]David Green and Joel Segall, "The Predictive Power of First-Quarter Earnings Reports: A Replication," Empirical Research in Accounting: Selected Studies, 1966, A Supplement to Vol. 4 of The Journal of Accounting Research, pp. 21-36.

[6]See Figure 1.

[7]Charles LeRoy McDonald, An Empirical Examination of Published Predictions of Future Earnings (Unpublished Ph.D. dissertation. Michigan State University, 1972.)

[8]Ibid., p. 41.

[9]Ibid., p. 44.

[10]The computation of forecast errors relative to the forecast would be useful to the investor in that such an error rate could be directly used to adjust subsequent forecasts.

[11]Ibid., page two of the abstract.

[12]Ibid., p. 111.

[13]Ibid., pp. 112-113.

[14]Ibid., p. 112.

[15]Ibid., page three of the abstract.

[16]See Figure 1.

[17]McDonald, p. 52.

[18]Ronald M. Copeland and Robert J. Marioni, "Executives Forecasts of Earnings Per Share Versus Forecasts of Naive Models," Journal of Business, October, 1972, 45(4), pp. 497-512.

[19]Ibid., p. 499.

[20]Ibid., p. 498.

[21]Ibid., p. 499.

[22]Ibid., p. 502.

[23]Ibid., p. 505.

[24]Ibid., p. 506.

[25]Ibid., p. 506.

[26]McDonald, p. 46.

[27]Victor Niederhoffer and Patrick J. Regan, "Earnings Changes, Analysts Forecasts, and Stock Prices," in Modern Developments in Investment Management, A Book of Readings. New York: Praeger Publishers, 1972, pp. 599-609.

[28]Ibid., p. 602.

[29]Ibid., p. 602.

[30]Ibid., p. 605.

[31]Ibid., p. 605.

[32]Ibid., p. 606.

[33]Ibid., p. 605.

[34]Ibid., p. 607.

[35]Ibid., p. 608.

[36]Benjamin F. King, "Market and Industry Factors in Stock Price Behavior," Journal of Business, January, 1966, 34, pp. 139-190.

[37]Paul Andrew Janell, An Empirical Evaluation of the Relationship Between Errors in Analysts' Forecasts of Earnings Per Share and Stock Prices, (Unpublished Ph.D. dissertation. Michigan State University, 1974).

[38]Ibid., p. 146.

[39]Ibid., pp. 67-68.

[40]Ibid., p. 103.

[41]Ibid., p. 115.

[42]Ibid., page three of the abstract.

[43]Ibid., p. 144.

[44]Ibid., p. 146.

CHAPTER III

GENERAL METHODOLOGY

Introduction

The research studies reviewed in the second chapter indicate that management does not always forecast accurately. This lack of forecasting accuracy provided a means for analyzing the influence of management earnings forecasts.

If management earnings forecasts had an influence on investors, it would seem that such forecasts might have influenced investor expectations about future reported earnings. If management earnings forecasts had influenced investor expectations and reported earnings were different from forecasted earnings, a reaction in the price of the stock would be expected. More specifically, if reported earnings exceed forecasted earnings, this should be "good news" to the investor and an increase in the price of the stock should occur. If, however, reported earnings were less than the forecast earnings, this would be "bad news" to the investor and a stock price decline would be expected.

In order to be meaningful, the study could not conclude with an analysis of stock price reactions to management earnings forecasts. It was possible that similar

results could have been obtained using forecasts generated by naive or mechanical models. Therefore the analysis included the stock price reaction to forecasts generated by several naive models as well as to management forecasts of earnings. In this chapter the theoretical basis for the use of this method will be examined and in the process the general method for determining stock price reactions will be developed.

The method used required that results obtained using management forecasts be compared to results obtained using forecasts generated by naive models. The second section of this chapter discusses the criteria used in selecting management forecasts. The naive models used are then delineated and discussed. The final topic of the chapter is the measurement of forecast errors.

Theoretical Basis

This research effort has benefitted from the pioneering works of three accounting scholars, Ball, Brown and Beaver. The latter was instrumental in establishing the justification for using stock price movements as a measure of the usefulness of information to investors.

Beaver indicated that:

> Within the context of this study, a firm's earnings report is said to have informational 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.[1]

He thus posited a relationship to exist between earnings and stock prices.

Ball and Brown argue along much the same lines:

> An empirical evaluation of accounting income numbers requires agreement as to what constitutes 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.[2]

They support the use of security prices as a measure of usefulness in the following manner:

> Recent developments in capital market theory provide justification for selecting 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.[3]

Both Beaver, and Ball and Brown attempt to empirically validate their suppositions about the relationship between earnings and stock prices. In doing so, both make use of the market model. The market model was also used to measure price response in this research effort.

The model can be stated as follows:

$$R_i = A_i + B_i I + C_i$$

Where R_i was the return on a security, A_i and B_i are parameters, I is the level of some index, and C_i is a random variable with an expected value of zero. In a graphical presentation A_i and B_i locate the line relating the expected value of R_i to I.[4] A_i represents the intercept of the line and B_i is the slope of the line.

The market model has been used in a number of studies.[5] In these studies the index (I) has been a market price index such as the Standard and Poor's Price Index. The market model when using a market price index for (I), allows one to abstract market effects and thus to concentrate on factors affecting the return on a security which are unique to the firm.[6]

This can be shown by manipulating the model. If

$$R_i = A_i + B_i I + C_i$$

then

$$C_i = R_i - A_i - B_i I$$

C_i, then, is a measure of that part of the return on a security after removing the influence of the market $(A_i + B_i I)$.

The market model using notation appropriate to this study can be stated as:

$$R_{im} = a_i + b_i R_{sm} + C_{im}$$

R_{im} is the rate of return assuming continuous compounding on security i, for month m. It is computed as follows:

$$R_{im} = \log e \frac{D_{im} + P_{im}}{P_{im-1}}$$

where:

$\log e$ = the natural logarithm;

D_{im} = the cash dividend paid on a share of firm i, in a month m;

P_{im} = the closing price for a share of firm i, at the end of month m;

P_{im-1} = the closing price for a share of firm i at the close of month $m-1$, adjusted for capital changes.

The price relatives adjusted for dividends and capital changes (R_{im}) were taken from the CRSP tapes (Center for Research in Security Prices). The tapes include completely adjusted price relatives for virtually all New York Stock Exchange (NYSE) firms and are prepared by Standard and Poors.

The market price index used in this study was Fisher's Arithmetic Investment Performance Index. The index is the mean of the price relatives (R_{im}), completely adjusted

for dividends and capital changes, for all NYSE securities on the CRSP tapes.

R_{sm} is the rate of return assuming continuous compounding of the market price index for month m. It is computed as follows:

$$R_{sm} = \log e(FAIPI_m)$$

$FAIPI_m$ = Fisher's Arithmetic Investment Performance Index for month m.

Estimation of Parameters

The parameters of the market model, a_i and b_i must be estimated from months other than those being studied. Least squared regressions of R_{im} (the rate of return on an individual security) against R_{sm} (the market rate of return) were used to estimate a_i and b_i. The estimates of a_i and b_i must be made in the periods not under study, because it is assumed that for the periods studied, the expected value of C_i is other than zero. The use of the study period in estimating the parameters would then be inconsistent with the market model which assumes the expected value of C_i to be zero.

Fama, et.al., have found that the distribution of the return residuals (C_i) is well approximated by the infinite variance stable Paretian family.[7] The authors indicate that although least squares regressions are not efficient for these distributions, they provide estimates

which are unbiased and consistent.[8] They conclude by saying:

> 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.[9]

While the authors agree as to the appropriateness of measuring price response through use of the market model, they relate net income to price response in different ways. Beaver examines investor reaction to earnings announcements by looking at price movements in the weeks surrounding the announcement date. More specifically, Beaver measured price response, (C_{im}), over a number of weeks surrounding the announcement of earnings. The weeks closest to the announcement date were called the "report period." Other weeks were designated the "non-report period."

The procedure was then to: 1) compute the average of the $|C_{im}|$ for each firm in the nonreport period, $|\bar{C}_{im}|$; 2) to compute the ratio for each report $(|C_{im}| \div |\bar{C}_{im}|)$ for each week in the report period; and 3) determine the average of the individual report ratios for each week in the report period. The average of the $|C_{im}| \div |\bar{C}_{im}|$ for the nonreport period would be one.

In performing the procedures above, the comparison between the residual price responses in the report period and such responses in the nonreport period was

built into the measure. The following hypotheses were tested.

H_o: the mean of the price response ratio for a week in the report period is less than or equal to one.

H_1: the mean of the price response ratio for a week in the report period is greater than one.

Beaver found that the price responses in the announcement week of the report period were indeed larger than in the nonreport period, indicating that earnings announcements do have informational content.

The methodology used by Beaver does have one significant problem, that problem being that information about the earnings number becomes available prior to the announcement of annual earnings. For example, quarterly earnings reports would certainly give some indication of what the annual earnings would be. Beaver does deal with this problem to some extent by using a 17 week report period, eight weeks before and eight weeks after the announcement week. However, this period was not long enough to include quarterly earnings announcements.

Ball and Brown dealt with this problem by compounding the price responses over a 12 month period, including the month in which the announcement of earnings was made. This procedure allowed the inclusion of information about the annual earnings coming to the market prior to the announcement period.

The specific methods used by Ball and Brown included 1) the generation of earnings expectations (forecasts) using two models; 2) comparing actual earnings with the forecast of earnings to determine forecast errors; and 3) compounding the price responses (C_{im}) and averaging them for firms having positive forecast errors and for firms having negative forecast errors. The authors state:

> If the income forecast error is negative (that is if the actual change in income is less than its conditional expectation), we define it as bad news and predict that if there is some association between accounting income numbers and stock prices, then the release of the accounting income number would result in the return on the firm's securities being less than would otherwise be expected... the converse should hold for a positive forecast error.[10]

The notion of expected versus unexpected returns relates to the operation of the market model previously explained in this chapter. The return residuals (C_{im}) can be viewed as unexpected or abnormal returns. The market model asserts that the expected return on a security conditional on the ex post value of the market price index is a linear function of the market price index. That is, the amount by which the return on the security (R_{im}) differs from the expected return given a value of the market price index ($a_i + b_i R_{sm}$) can be viewed as unexpected or abnormal return (C_{im}).

The authors' results support their hypotheses. The average price response for firms having negative forecast errors is less than expected while the average price

response for firms having positive forecast errors is greater than expected. It was statistically determined using the chi-square statistic that there was a significant relationship between the sign of the forecast error and the sign of the rate of return residual.

Further, the authors found that:

> ...most of the information contained in reported income is anticipated by the market before the annual report is released.[11]

The use of stock prices as a measure of the usefulness of information to investors, then, has a solid basis in previous research efforts. Further the market model used in the current research effort was successfully used in these previous research projects. It does appear, however, that the price response does occur over time. Therefore the present study uses the basic approach set forth by Ball and Brown.

Management Forecasts and Naive Forecasts

As was pointed out in the first chapter, the SEC has now allowed the publication of management earnings forecasts in reports filed with it.[12] At one time it was considered possible that the SEC might require the publication of such forecasts, perhaps in the annual report (SEC 10-K). The collection of management forecasts to be used in this research effort was specifically designed to deal with the question of what would have been the result of including management forecasts of earnings per

share in the published financial statements of the firm.

Occasionally, such forecasts are included in the annual report to stockholders, for example, in the president's letter. However, it was not felt that there would have been a sufficient number of such forecasts to enable a meaningful study to be conducted. Therefore, a surrogate for forecasts published in annual reports was used.

The surrogate used was to obtain management forecasts published in the Wall Street Journal. The forecasts had the advantage of being widely distributed to investors in much the same manner as would have been forecasts published in the annual report to stockholders.

In order that the forecasts obtained be as similar as possible to forecasts published in annual reports, the timing of the publication of the forecasts was important. What was of interest in this study were forecasts that could have been published as a part of the annual report or in SEC filings. Therefore, it was considered desirable to select forecasts published early enough to be included in the annual report or SEC 10-K report.

The period from which forecasts were selected was the period before the required submission of the annual report (10-K) for firms listed on the major stock exchanges. This period was 120 days after a firm's year end throughout the test period.[13] Forecasts published

within a 120 day period following a firm's year end probably could have been included in the annual report. However, whether such forecasts are similar to those which would have been included in the annual report must ultimately be evaluated by the reader.

There were, in addition, other criteria applied in the selection of management forecasts of earnings per share:

1) the forecast must have been made in the first 120 days of the calendar year;
2) the firm's stock must have been traded on the New York Stock Exchange (NYSE) for the entire study period;
3) the forecast must have been a point forecast of earnings per share.

The criteria were applied to ease somewhat the problems of data collection and analysis.

The requirement that the forecast be published in the first 120 days of the calendar year eased data collection in that only January-April Wall Street Journals were analyzed. For the most part, this led to the selection of firms with years ending on December 31. However, it was also possible for firms with fiscal years ending in September, October, or November to be included.

The requirement that the firm's stock be listed on the NYSE again was partially utilized to ease data collection problems. It was desired that the stock price

information be available on the CRSP (Center for Research in Security Prices) tapes. These computer tapes are available only for NYSE firms. It was not felt that the use of NYSE firms overly restricted the research because such firms represent a major portion of the publicly owned corporations in the economy.

The criterion that forecasts be point estimates of earnings per share was included to allow precise determinations of forecast errors. In the second chapter, the review of Copeland and Marioni's article dealt with this problem. It was noted there that open ended or range forecasts lead to difficulties in the determination of forecast errors. The reader is referred to that discussion.[14]

The forecasts used were forecasts of net income per share. This type of forecast was used primarily because most of the published forecasts appeared in this form.

Naive Forecasts

In the opening remarks of this chapter it was indicated that the primary purpose of the dissertation was to assess the usefulness of management forecasts of earnings per share to investors. This was to be accomplished by relating forecast errors to stock price reactions. However, a finding that management forecasts were related to stock prices does not in itself establish the usefulness of such forecasts. Perhaps similar results would have been obtained using forecasts from other sources.

The investor certainly could generate his own forecasts (perhaps using some naive model) or could obtain them from analysts. In order to deal with this problem, naive forecasts were generated and the results obtained using management forecasts were compared with results obtained using these naive forecasts.

The naive models used in this study were as follows:

Naive 1: Pure random walk--no drift:

The current year's earnings per share is equal to the prior year's earnings per share. In mathematical terms this forecast would be stated as follows:

$$E(X_{it}) = X_{it-1}$$

Naive 2: Random walk with drift:

The current year's earnings is equal to the prior year's earnings plus the average of the changes in earnings from year to year in the past five years. In mathematical terms this forecast would be stated as follows:

$$E(X_{it}) = X_{it-1} + \frac{1}{n} \sum_{j=1}^{n} (X_{it-j} - X_{it-j-1})$$

Naive 3: Moving average of a pure mean reverting process:

The earnings process is assumed to follow a moving average process. A moving average is used to smooth out fluctuations in time series

data. In mathematical terms this forecast would be stated as follows:

$$E(X_{it}) = X_{it-1} - \frac{1}{n} \sum_{j=1}^{n} (X_{it-j} - X_{it-j-1})$$

Naive 4: Pure mean reversion:

Next year's earnings are assumed to revert to the mean of the earnings for the prior five years. Mathematically this forecast would be stated as follows:

$$E(X_{it}) = \frac{1}{n} \sum_{j=1}^{n} (X_{it-j})$$

Where:

$E(X_{it})$ = the expected value of the earnings variable for firm i in period t;

X_{it} = the actual value of the earnings variable for firm i in period t;

n = the number of periods used to estimate the parameters of the model, five years.

These four models were used by Beaver and Dukes in a research effort requiring the use of earnings expectations.[15] It was noted by the authors that these models appear to be consistent with the underlying processes generating the earnings variables.[16]

Ball and Watts have suggested that levels of earnings are well approximated by a random walk process.[17] One rationale

for this result might be that in the absence of further information no change is expected. Thus, the earnings expected are last year's earnings. Drift is introduced in the second random walk model as a measure of unexpected earnings changes. The mean reverting models assume that normal or expected earnings are based on the mean of earnings for some prior period. The moving average of the mean reverting process assumes that last year's earnings represent a moving average of earnings. An adjustment is then made for unexpected earnings to arrive at expected earnings.

The use of the mean reverting models is supported partially in that they represent processes clearly distinguishable from random walk processes. While the evidence seems to support the idea that random walk processes best approximate levels of earnings per share, it would be desirable to include other processes to expand the generality of the study. Further, Beaver has found that:

> Much of the behavior of accounting rates of return is consistent with these measurements coming from a moving average model where this underlying process is pure mean reverting.[18]

Beaver's conclusions are based on rates of return and not on levels of earnings. However, it was felt that these processes might be useful in predicting levels of earnings as well as rates of return.

Forecast Errors

The general approach of the study required that forecasts be compared with actual earnings in order to

compute errors. The forecast errors vary widely in terms of absolute amount. Therefore, in order to put such errors on a comparable basis, it was desirable to compute relative prediction errors. There are a number of approaches to the computation of relative prediction errors which have been suggested. Errors have been computed relative to: 1) actual earnings; 2) forecast earnings; and 3) stock prices.

The computation of error relative to actual earnings has the advantage of not being biased against over or under predictions. For example:

	Actual Earnings (A)	Forecast Earnings (F)	$\lvert A-F \rvert / A$
Firm 1	$3	$4	.33
Firm 2	3	2	.33

Both overpredictions and underpredictions lead to the same relative error. However, meaningful errors cannot be computed when the variables have different signs, and this method would assign a great weight to small absolute errors when actual earnings are close to zero.

The use of errors computed relative to forecasts has the advantage of being useful to investors.[19] An investor might desire to make adjustments for a tendency of a firm to either underpredict or overpredict earnings. This would be easier for him to do if errors were expressed relative to forecast earnings. However,

this method of computing relative error is biased in favor of overpredictions. For example:

Actual Earnings (A)	Forecast Earnings (F)	|A-F|/F
$3	$4	.25
3	2	.50

In this case equal absolute errors result in a lower relative error being attached to the overforecast. Again this method could be affected by small or negative forecasts.

Errors computed relative to price would provide a more meaningful measure of error when earnings are small or negative. In addition, there is no bias favoring either underpredictions or overpredictions. However, there might be a bias depending on the size of price used to compute the relative error.

Each measure of error has advantages and disadvantages. Therefore, for most of the tests conducted in the study all three error measures were used.

Summary

The first part of this chapter dealt with the theoretical basis for the conduct of the current research effort. It was indicated that if management earnings forecasts had an influence on investors, such forecasts might have influenced investor expectations about future

reported earnings. If reported earnings were different from forecasted earnings, a reaction in the price of the stock was expected. However, it was also indicated that if the same result could be obtained using naive forecasts, the results could not be attributed solely to management earnings forecasts.

Both Beaver and Ball and Brown supported the use of stock price changes as a measure of the usefulness of information to investors. In addition, these authors both use the market model as the method for measuring stock price changes. These studies taken together provide the theoretical basis for measuring the impact of earnings forecasts on investors. Further they indicated an operational method of measuring the stock price reactions which are unique to the individual firms.

Both Beaver and Ball and Brown found that income was a useful concept to investors in that it led to stock price changes. However, Ball and Brown found that the stock price changes occured over time. This led to the conclusion that in this research effort the price response should be measured over time in a manner similar to that used by Ball and Brown.

The second major topic of the chapter was to set forth the selection criteria used in selecting management earnings forecasts. Next, the naive models were set forth and the reasons for their use were explained. Finally, the measurement of forecast errors was discussed.

FOOTNOTES

CHAPTER III

[1]William H. Beaver, "The Informational Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, A supplement to Volume 6 of the Journal of Accounting Research, p. 68.

[2]Ray Ball and Phillip Brown, "An Empirical Evaluation of Accounting Income Numbers," Journal of Accounting Research, Autumn, 1968, 1, p. 160.

[3]Ibid., pp. 160-161.

[4]William F. Sharpe, "A Simplified Model for Portfolio Analysis," in Modern Developments in Investment Management, A Book of Readings (New York: Praeger Publishers, 1972), p. 192.

[5]e.g., Eugene F. Fama, Lawrence Fisher, Michael C. Jensen, and Richard Roll, "The Adjustment of Stock Prices to New Information," in Modern Developments in Investment Management, A Book of Readings (New York: Praeger Publishers, 1972), pp. 186-206.

[6]It has been shown by King that about 10% of the variability in a stock's monthly rate of return could be accounted for by industry effects. Thus, the price response is not entirely unique to the firm but in part may be the result of industry effects. The industry effect does, however, appear to be relatively small. Benjamin F. King, "Market and Industry Factors in Stock Price Behavior," Journal of Business, January, 1966, 34, pp. 139-190.

[7]Fama, et.al., p. 192.

[8]Ibid., p. 192.

[9]Ibid., p. 192.

[10]Ball and Brown, p. 164.

[11]Ibid., p. 170.

[12]Les Gapay, "SEC Plans to Let Concerns Profit in Filings," The Wall Street Journal, February 2, 1973, LIII(75), p. 3.

[13]New York Stock Exchange Guide,--Related Laws and Regulations, (Commerce Clearing House, Inc., 1962), III, p. 6183.

[14]See Chapter Two, p. 22.

[15]William H. Beaver and Roland E. Dukes, "Interperiod Tax Allocation, Earnings Expectations, and the Behavior of Security Prices," The Accounting Review, April, 1972, XLVII, pp. 320-332.

[16]Ibid., pp. 323-324.

[17]Ray Ball and Russ Watts, "Some Time Series Properties of Accounting Income," Unpublished manuscript, University of Chicago, 1970.

[18]Willaim H. Beaver, "The Time Series Behavior of Earnings," Empirical Research in Accounting: Selected Studies, 1972, A supplement to Volume 8 of the Journal of Accounting Research, p. 86.

[19]Charles Leroy McDonald, An Empirical Examination of Published Predictions of Future Earnings, Unpublished Ph.D. dissertation, Michigan State University, 1972, p. 55.

CHAPTER IV

DESCRIPTION OF THE SAMPLE AND FORECAST ERRORS

Introduction

This chapter will first discuss the sample of firms making management forecasts. The sample was obtained by applying the selection criteria presented in the previous chapter. The years from which such forecasts were selected will be examined in terms of the condition of corporate profits during those years.

The question of forecast accuracy will then be addressed. The basic question of the study was not to examine the accuracy of forecasts. But, the computation of forecast errors in an attempt to relate forecasts to stock price changes made it possible to examine the accuracy of such forecasts. This has the advantage of allowing the present research effort to be related to others which had as their primary purpose the analysis of forecasting accuracy.[1]

As a first step in the analysis of forecast accuracy, management forecasts and naive forecasts were examined to see whether there appeared to be any tendency to either underpredict or overpredict earnings per share. Following this, evidence will be presented and analyzed bearing on the question of whether management forecasts appear to be

more accurate than those of the naive models used in this study.

Description of the Sample

The selection of forecasts from the Wall Street Journal resulted in the accumulation of 123 usable forecasts. The forecasts were made by a total of 90 firms. The number of forecasts classified by year is presented in Table 2

TABLE 2

NUMBER OF USABLE MANAGEMENT FORECASTS

Year	Number of Usable Forecasts
1965	19
1966	22
1967	10
1968	22
1969	16
1970	13
1971	21
Total	123

The years 1965-1971 were selected for two reasons. First, because the selection criteria were reasonably stringent it was desired to include several years in order that a sample of reasonable size would be obtained. Second, it was desired to include these years because

they represented a wide variety of situations with regard to corporate profits. It was thought that selecting forecasts from such a wide variety of profit conditions would make the study more general because it could not be said that the results depended on the existence of a particular economic situation. Whether the results are more generalizable as a result of this process is, of course, the opinion of the reader.

The reader is referred to Figure 1 which graphically presents corporate profits for the years included in the study. It should be noted that two years, 1965 and 1971, represent climbing corporate profits throughout the year. The year 1969 was a year in which corporate profits declined throughout the year. The remaining years included in the study could be characterized as being of a mixed nature. These years were mixed in the sense that profits both increased and decreased during each of the years. The selection of these years, then, in the opinion of the researcher included a wide variety of economic conditions. But, again the ultimate opinion must be that of the reader.

It is interesting to note that those years which had a strong economic start had more usable forecasts than did years beginning with weak economic performance. This could conceivably introduce some bias into the study if firms failing to forecast in weak years were different from those which did forecast in these years.

FIGURE 1

CORPORATE PROFITS, TAXES, AND DIVIDENDS [2]

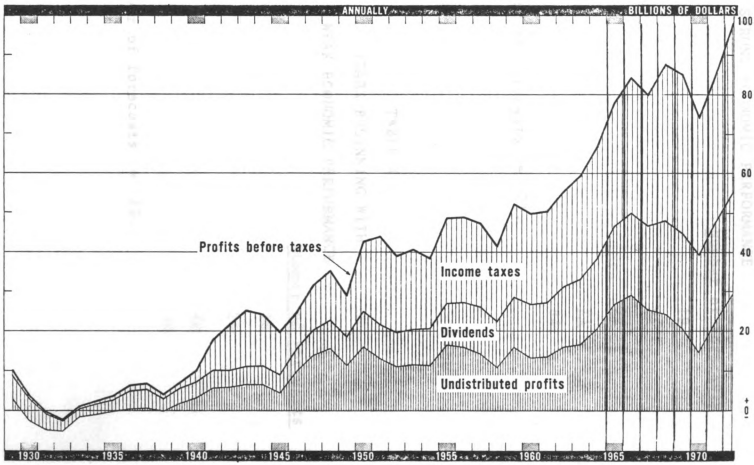


TABLE 3

YEARS BEGINNING WITH

STRONG ECONOMIC PERFORMANCE

Years	Number of Forecasts
1965	19
1966	22
1968	22
1971	21
Total	84

Average number of forecasts = 21.

TABLE 4

YEARS BEGINNING WITH

WEAK ECONOMIC PERFORMANCE

Years	Number of Forecasts
1967	10
1969	16
1970	13
Total	39

Average number of forecasts = 13.

McDonald had noted that there tended to be more forecasts in good years than there were in bad years.[3] His observations seem to be confirmed by the results of the current analysis. The forecasts which were included in the current sample had been published in the first 120 days of the firm's year. In those years where the early part of the year was good there were more forecasts than when the reverse was true.

The sample which was selected included, in the researcher's opinion, firms from a wide variety of industries. Included are many manufacturing industries such as machine tools, steel, copper, petroleum and chemicals. In addition, there were firms from the wholesale trade, utilities, financial institutions, transportation and communications. The reader is referred to Appendix A which contains a complete list of the firms in the sample and their industries.

Forecast Accuracy

It is possible to test statistically whether there was any tendency to either underpredict earnings per share or overpredict earnings per share. The chi-square one sample test is an appropriate test to use in this situation. If there were no differences between the number of firms underpredicting earnings and the number of firms overpredicting earnings, it would be expected that 50 per cent of the firms would fall in each category. The chi-square

one sample test can be used to test this proposition.

Specifically, the hypotheses are:

H_0: the frequency of underpredictions and overpredictions are equal with 50 per cent of the firms falling in each category;

H_A: the frequency of underpredictions and overpredictions are not equal.

The chi-square one sample test statistic was computed as follows:

$$\chi^2 = \sum_{i=1}^{K} \frac{(O_i - E_i)^2}{E_i} \quad [4]$$

where:

O_i = observed number of cases in the i-th category;

E_i = expected number of cases in the i-th category under H_0;

$\sum_{i=1}^{K}$ = directs one to sum over all (K) categories.

Siegel indicates:

> "If the agreement between the observed and expected frequencies are close, the differences $(O_i - E_i)$ will be small and consequently χ^2 will be small. If the difference is large, however, the value of χ^2... will also be large. Roughly speaking, the larger χ^2 is, the more likely it is that the observed frequencies did not come from the population on which the null hypothesis is based."[5]

H_0 will be rejected if the observed value of χ^2 is such that the probability associated with its occurrence under H_0 is equal to or less than $\alpha = .05$.

In conducting the test a decision had to be made about the nature of the exact forecasts. Were they underpredictions or overpredictions or should they be omitted from the analysis? The decision was made to add the exact forecasts in each case to the smaller number of either underpredictions or overpredictions. The result of this process was a conservative test of the tendency to underpredict or overpredict earnings per share.

The results of the chi-squared one sample test are displayed in Table 10-14. Tables 5-9 present the actual number of overpredictions, exact predictions, and underpredictions for management forecasts and naive model forecasts.

TABLE 5

FORECAST ERRORS

(MANAGEMENT)

	Overpredictions	Exact	Underpredictions
1965-1971	59	4	60
1965	5	0	14
1966	9	1	12
1967	4	1	3
1968	14	0	8
1969	10	1	5
1970	8	0	5
1971	7	1	13

TABLE 6

FORECAST ERRORS

NAIVE 1

(PURE RANDOM WALK)

	Overpredictions	Exact	Underpredictions
1965-1971	40	7	76
1965	4	0	15
1966	8	1	13
1967	3	0	7
1968	8	0	14
1969	4	5	7
1970	8	0	5
1971	5	1	15

TABLE 7

FORECAST ERRORS

NAIVE 2

(RANDOM WALK WITH DRIFT)

	Overpredictions	Exact	Underpredictions
1965-1971	60	3	60
1965	5	0	14
1966	11	0	11
1967	5	0	5
1968	14	0	7
1969	12	0	4
1970	8	0	4
1971	5	0	15

TABLE 8

FORECAST ERRORS

NAIVE 3

(MOVING AVERAGE OF A PURE MEAN REVERTING PROCESS)

	Overpredictions	Exact	Underpredictions
1965-1971	38	0	85
1965	3	0	16
1966	7	0	15
1967	3	0	7
1968	8	0	14
1969	4	0	12
1970	6	0	7
1971	7	0	14

TABLE 9

FORECAST ERRORS

NAIVE 4

PURE MEAN REVERSION - NO DRIFT

	Overpredictions	Exact	Underpredictions
1965-1971	32	0	91
1965	1	0	18
1966	3	0	19
1967	2	0	8
1968	8	0	14
1969	5	0	11
1970	5	0	8
1971	8	0	13

TABLE 10

MANAGEMENT FORECASTS--TENDENCY TO OVERPREDICT OR UNDERPREDICT

	Overpredictions	Underpredictions	χ^2 Computed	χ^2 Critical	
1965-1971	63	60	.073	3.84	Do not reject H_0
1965	5	14	4.260	3.84	Reject H_0, Accept H_A-U*
1966	10	12	.182	3.84	Do not reject H_0
1967	6	4	.400	3.84	Do not reject H_0
1968	14	8	1.636	3.84	Do not reject H_0
1969	10	6	1.000	3.84	Do not reject H_0
1970	8	5	.692	3.84	Do not reject H_0
1971	8	13	1.191	3.84	Do not reject H_0

*U = underpredictions

TABLE 11

NAIVE 1 FORECASTS--TENDENCY TO OVERPREDICT OR UNDERPREDICT

PURE RANDOM WALK

	Overpredictions	Underpredictions	χ^2 Computed	χ^2 Critical	
1965-1971	47	76	6.837	3.84	Reject H_0, Accept H_A-U*
1965	4	15	6.368	3.84	Reject H_0, Accept H_A-U*
1966	9	13	.727	3.84	Do not reject H_0
1967	3	7	1.600	3.84	Do not reject H_0
1968	8	14	1.636	3.84	Do not reject H_0
1969	9	7	.250	3.84	Do not reject H_0
1970	8	5	.692	3.84	Do not reject H_0
1971	6	15	3.857	3.84	Reject H_0, Accept H_A-U*

*U = underpredictions

TABLE 12

NAIVE 2 FORECASTS--TENDENCY TO OVERPREDICT OR UNDERPREDICT

RANDOM WALK WITH DRIFT

	Overpredictions	Underpredictions	X^2 Computed	X^2 Critical	
1965-1971	63	60	.073	3.84	Do not reject H_0
1965	5	14	4.260	3.84	Reject H_0, Accept H_A-U*
1966	11	11	0.000	3.84	Do not reject H_0
1967	5	5	0.000	3.84	Do not reject H_0
1968	14	8	1.636	3.84	Do not reject H_0
1969	12	4	4.000	3.84	Reject H_0, Accept H_A-O**
1970	8	5	.692	3.84	Do not reject H_0
1971	6	15	3.857	3.84	Reject H_0, Accept H_A-U*

*U = underpredictions

**O = overpredictions

TABLE 13

NAIVE 3 FORECASTS--TENDENCY TO OVERPREDICT OR UNDERPREDICT
MOVING AVERAGE OF A PURE MEAN REVERTING PROCESS

	Overpredictions	Underpredictions	χ^2 Computed	χ^2 Critical	
1965-1971	38	85	17.959	3.84	Reject H_0, Accept H_A-U*
1965	3	16	8.895	3.84	Reject H_0, Accept H_A-U*
1966	7	15	2.910	3.84	Do not reject H_0
1967	3	7	1.600	3.84	Do not reject H_0
1968	8	14	1.636	3.84	Do not reject H_0
1969	4	12	4.000	3.84	Reject H_0, Accept H_A-U*
1970	6	7	.077	3.84	Do not reject H_0
1971	7	14	2.333	3.84	Do not reject H_0

*U = underpredictions

TABLE 14

NAIVE 4 FORECASTS--TENDENCY TO OVERPREDICT OR UNDERPREDICT

PURE MEAN REVERSION - NO DRIFT

	Overpredictions	Underpredictions	χ^2 Computed	χ^2 Critical	
1965-1971	32	91	28.301	3.84	Reject H_0, Accept H_A-U*
1965	1	18	15.211	3.84	Reject H_0, Accept H_A-U*
1966	3	19	11.636	3.84	Reject H_0, Accept H_A-U*
1967	2	8	3.600	3.84	Do not reject H_0
1968	8	14	1.636	3.84	Do not reject H_0
1969	5	11	2.250	3.84	Do not reject H_0
1970	5	8	.692	3.84	Do not reject H_0
1971	8	13	1.191	3.84	Do not reject H_0

*U = underpredictions

When the results of this test are analyzed on an overall basis (for all years in the study) three of the four naive models tended to produce underpredictions. This might be expected in an inflationary period. The only Naive model which did not produce underpredictions was Naive 2, the random walk with drift model. This would not be entirely inconsistent with expectations. Ball and Watts had found that random walk processes seemed to produce the best estimates of levels of earnings.[6] The introduction of trend into the random walk process appears from these results to be important as the pure random walk model (Naive 1) does lead to underforecasts.

Management forecasts of earnings per share did not exhibit either a tendency to underpredict earnings per share or to overpredict earnings per share. This result is not consistent with McDonald's study where he found that there was a significant tendency for management to overpredict earnings per share.[7] McDonald indicated that arguments could be developed to support contentions that management would either overpredict or underpredict earnings.[8] For example, the desire to be conservative might lead to underpredictions. On the other hand a desire to have an immediate increase in the price of a firm's stock might lead to overpredictions. Neither position is supported by the current results when analyzed on an overall basis.

The year 1965 when analyzed shows that all naive models and management tended to underpredict earnings per share. However, the underpredictions were less significant for pure random walk with drift forecasts and for management forecasts. That the naive model forecasts should lead to underpredictions is not surprising since they were computed on the basis of the past five years' data. The year 1965 was but a continuation of the strong upward movement in corporate profits that had endured since 1962. The naive model predictions based on thesepast data would tend to be low. The mean reverting models did poorer than the random walk models which utilize more current information.

The results did not hold for 1971 which was again a year of strong performance in corporate profits. However, of the five years preceeding 1971, four had mixed economic performance with one year having declines throughout. The profits in some of these years were nearly as high as those in 1971. It would thus be expected that the random walk models would perform more poorly than the mean reverting models which made more use of the previous five years' data.

The only year with continuously poor results in corporate profits (1969) led to the only occasion where any model tended to overforecast earnings. In this year the random walk with drift model followed this pattern.

The years with mixed economic performance (1966, 1967, 1968, and 1970) led to the result that with but one exception no model tended to either underpredict or overpredict earnings. This result may have occurred because of the very unsettled nature of corporate profitability during those years. The only exception was that the pure mean reversion--no drift model led to underpredictions in 1966. That result was not overly surprising since this model makes more use of past information than any of the other models.

The distribution of forecast errors for each type of forecast is graphically presented in Figures 2 - 6. The analysis of the comparative accuracy of forecasts was limited to errors computed relative to forecasts. Errors computed relative to forecasts were used because, as previously indicated, this sort of error computation seems particularly useful to investors. In addition, this process allowed some comparison to be made between the present research effort and McDonald's work.[9] However, the discussion in Chapter III indicated that errors computed in this manner are biased in favor of overpredictions. In addition, such errors might be adversely affected by small or negative forecasts.

FIGURE 2
HISTOGRAM/FREQUENCIES (A-F)/F MGT

LEFT-END	HIST%	TOT%	COUNT FOR (A-F)/F MGT (EACH X = 1)
-.35000	1.8	1.6	2 +XX
-.30000	2.8	2.4	3 +XXX
-.25000	3.7	3.3	4 +XXXX
-.20000	7.3	6.5	8 +XXXXXXXX
-.15000	6.4	5.7	7 +XXXXXXX
-.10000	12.8	11.4	14 +XXXXXXXXXXXXXX
-.50000 -1	11.0	9.8	12 +XXXXXXXXXXXX
.20817-16	32.1	28.5	35 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
.50000 -1	8.3	7.3	9 +XXXXXXXXX
.10000	4.6	4.1	5 +XXXXX
.15000	2.8	2.4	3 +XXX
.20000	1.8	1.6	2 +XX
.25000	2.8	2.4	3 +XXX
.30000	1.8	1.6	2 +XX
MISSING		.8	1
		8.9	11 < -.35000
		1.6	2 > .35000
TOTAL		100.0	123 (.5000 -1 = INTERVAL WIDTH)

FIGURE 3
HISTOGRAM/FREQUENCIES (A-F)/F N1

LEFT-END	HIST%	TOT%	COUNT FOR (A-F)/F N1 (EACH X = 1)
-.35000	1.1	.8	1 +X
-.30000	2.2	1.6	2 +XX
-.25000	3.3	2.4	3 +XXX
-.20000	3.3	2.4	3 +XXX
-.15000	5.6	4.1	5 +XXXXX
-.10000	4.4	3.3	4 +XXXX
-.50000 -1	6.7	4.9	6 +XXXXXX
.20814-16	21.1	15.4	19 +XXXXXXXXXXXXXXXXXXX
.50000 -1	13.3	9.8	12 +XXXXXXXXXXXX
.10000	16.7	12.2	15 +XXXXXXXXXXXXXXX
.15000	6.7	4.9	6 +XXXXXX
.20000	6.7	4.9	6 +XXXXXX
.25000	5.6	4.1	5 +XXXXX
.30000	3.3	2.4	3 +XXX
		15.4	19 < -.35000
		11.4	14 > .35000
TOTAL		100.0	123 (.50000 -1 = INTERVAL WIDTH)

FIGURE 4
HISTOGRAM/FREQUENCIES (A-F)/F N2

LEFT-END	HIST%	TOT%	COUNT FOR (A-F)/F N2 (EACH X = 1)
-.35000	2.2	1.6	2 +XX
-.30000	2.2	1.6	2 +XX
-.25000	5.4	4.1	5 +XXXXX
-.15000	3.3	2.4	3 +XXX
-.10000	13.0	9.8	12 +XXXXXXXXXXXX
-.50000 -1	14.1	10.6	13 +XXXXXXXXXXXXX
.20817-16	21.7	16.3	20 +XXXXXXXXXXXXXXXXXXX
.50000 -1	7.6	5.7	7 +XXXXXXX
.10000	6.5	4.9	6 +XXXXXX
.15000	5.4	4.1	5 +XXXXX
.20000	4.3	3.3	4 +XXXX
.25000	4.3	3.3	4 +XXXX
.30000	3.3	2.4	3 +XXX
		17.9	22 < -.35000
		7.3	9 > .35000
TOTAL		100.0	123 (.5000 -1 = INTERVAL WIDTH)

FIGURE 5
HISTOGRAM/FREQUENCIES (A-F)/F N3

LEFT-END	HIST%	TOT%	COUNT FOR (A-F)/F N3 (EACH X = 1)
-.35000	3.5	2.4	3 +XXX
. . .			
-.25000	2.4	1.6	2 +XX
-.20000	3.4	2.4	3 +XXX
-.15000	5.9	4.1	5 +XXXXX
-.10000	7.1	4.9	6 +XXXXXX
-.50000 -1	5.9	4.1	5 +XXXXX
.20814-16	8.2	5.7	7 +XXXXXXX
.50000 -1	11.8	8.1	10 +XXXXXXXXXX
.10000	16.5	11.4	14 +XXXXXXXXXXXXX
.15000	10.6	7.3	9 +XXXXXXXXX
.20000	11.8	8.1	10 +XXXXXXXXXX
.25000	7.1	4.9	6 +XXXXXX
.30000	5.9	4.1	5 +XXXXX
		13.8	17 < -.35000
		17.1	21 > .35000
TOTAL		100.0	123 (.50000 -1 = INTERVAL WIDTH)

FIGURE 6
HISTOGRAM/FREQUENCIES (A-F)/F N4

LEFT-END	HIST%	TOT%	COUNT FOR (A-F)/F N4 (EACH X = 1)
-.35000	2.6	1.6	2 +XX
-.30000	1.3	.8	1 +X
-.25000	5.1	3.3	4 +XXXX
-.20000	9.0	5.7	7 +XXXXXXX
-.15000	5.1	3.3	4 +XXXX
-.10000	2.6	1.6	2 +XX
-.50000 - 1	5.1	3.3	4 +XXXX
.20817-16	10.3	6.5	8 +XXXXXXXX
.50000 -1	3.8	2.4	3 +XXX
.10000	11.5	7.3	9 +XXXXXXXXX
.15000	16.7	10.6	13 +XXXXXXXXXXXXX
.20000	16.7	10.6	13 +XXXXXXXXXXXXX
.25000	5.1	3.3	4 +XXXX
.30000	5.1	3.3	4 +XXXX
		8.9	11 < -.35000
		27.6	34 > .35000
TOTAL		100.0	123 (.50000 -1 = INTERVAL WIDTH)

The graphical presentation strongly indicates that management forecasts of earnings per share are indeed quite accurate and seem to be more accurate than forecasts generated by the use of the naive models. In addition, it would appear that the random walk models are more accurate than the mean reverting models. Table 15 summarizes some of the information presented in the graphical analysis.

TABLE 15

PERCENTAGES OF ERRORS WITHIN

SPECIFIED ERROR CATEGORIES

1965 - 1971

(A-F)/F

	Percentages of Errors Within the Error Category				
Error Category	Management	Naive 1	Naive 2	Naive 3	Naive 4
-.05 to .05	38.3	20.3	26.9	9.8	9.8
-.10 to .10	57.0	33.9	42.4	22.8	13.8
-.15 to .15	66.8	49.7	49.7	38.3	24.4

This summary indicates that for management forecasts the actual earnings per share were within 10 per cent of that forecast in 57 per cent of the cases and were within 15 per cent in 66.8 per cent of the cases. This performance appears to be much better than any of the naive models.

The analysis of the graphical presentation of forecast errors does provide some evidence on the accuracy of the various forecasts. However, it is also possible to analyze the comparative accuracy of the various types of forecasts on a statistical basis. In this research effort the Wilcoxon Signed-Ranks test was utilized to test whether management forecasts were more accurate than those of the naive models. In addition, it was used to determine which of the naive models seemed to do the best job of predicting levels of earnings per share.

The Wilcoxon Signed-Ranks test is a nonparametric test. It was used to avoid the distributional assumptions of equivalent parametric tests, such as the T test. This test has the advantage of considering not only the direction of the differences between forecast errors but their magnitude as well. The test statistic as computed for large samples (greater than 20) is as follows:

$$Z = \frac{T - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}} \qquad 10$$

where:

N = the number of matched pairs minus the number of pairs where the differences are zero;

T = either the sum of the positive ranks or the negative ranks, whichever sum is smaller.

The specific hypotheses to be tested are:

$H1_0$: the accuracy of management forecasts and forecasts of each of the naive models do not differ;

$H1_A$: management forecasts are more accurate than naive forecasts;

$H2_0$: the accuracy of Naive 1 forecasts and forecasts of each of the other naive models do not differ;

$H2_A$: Naive 1 forecasts are more accurate than the other naive forecasts;

$H3_0$: the accuracy of Naive 2 forecasts does not differ from that of Naive 3 and Naive 4 forecasts;

$H3_A$: Naive 2 forecasts are more accurate than either Naive 3 or Naive 4 forecasts;

$H4_0$: the accuracy of Naive 3 forecasts does not differ from that of Naive 4 forecasts;

$H4_A$: Naive 3 forecasts are more accurate than Naive 4 forecasts.

The region of rejection consists of all Z's which are so extreme that the probability of their occurrence under H_0 is equal to or less than $\alpha = .05$. The results of the tests of these hypotheses are presented in Tables 16-19.

The results of testing management forecasts against those of the naive models yield clear and consistent

results. Management forecasts are more accurate than those of any of the naive models at extremely high levels of significance.

The comparisons of the naive models provide results which are less clear. When the test was conducted using errors computed relative to price and actual earnings, the Naive 1 model (pure random walk) was more accurate than two of the three remaining naive models. However, it was not more accurate than the Naive 3 model. The third naive model was the moving average of a pure mean reverting process. This then does not entirely confirm Ball and Watt's results which indicate that random walk processes are the best predictors of levels of earnings. Further the second,model, which was a random walk procedure, does not generate forecasts which are more accurate than either of the mean reverting models. The moving average mean reverting model is, however, more accurage than the pure mean reverting model. This would not be unexpected since the pure mean reverting model does use older information. If one looks at only the number of times one model was more accurate than the other, the results are consistent with expectations. The first naive model is more accurate than any of the other naive models. Naive 2 is more accurate than any of the mean reverting models and the moving average of the mean reverting process is the more accurate of the mean reverting models.

TABLE 16

WILCOXON SIGNED-RANKS TEST

COMPARISON OF RELATIVE ERRORS

MANAGEMENT vs. NAIVE MODELS

$|A-F|/P^{*}$

Variable	Variable	Diff < 0**	Diff > 0	Rank Sum	Significance
Management	Naive 1	77	32	1549.0	.0000
Management	Naive 2	82	40	1747.0	.0000
Management	Naive 3	87	34	1825.0	.0000
Management	Naive 4	93	28	1607.0	.0000

*The price used to compute relative errors was obtained by averaging the price of the firm's shares for three months prior to the month in which the forecast was published.

**A difference of less than zero indicates the management forecast was more accurate.

TABLE 17

WILCOXON SIGNED-RANKS TEST

COMPARISON OF RELATIVE ERRORS

NAIVE MODELS

$|A-F|/P$**

Variable*	Variable	Diff < 0	Diff > 0	Rank Sum	Significance
Naive 1	Naive 2	67	54	2886.0	.0374
Naive 1	Naive 3	73	48	3096.0	.1241
Naive 1	Naive 4	82	41	2739.0	.0067
Naive 2	Naive 3	63	56	3474.0	.7991
Naive 2	Naive 4	71	51	3150.0	.1243
Naive 3	Naive 4	81	42	2658.0	.0036

*A difference of less than zero means the forecasts generated by the model in this column are more accurate than those generated by the model in the second column.

**The price used to compute relative errors was obtained by averaging the price of the firm's shares for three months prior to the month in which the forecast was published.

TABLE 18

WILCOXON SIGNED-RANKS TEST

COMPARISONS OF RELATIVE ERRORS

MANAGEMENT vs. NAIVE MODELS

|A-F|/F

Variable	Variable	Diff < 0**	Diff > 0	Rank Sum	Significance
Management*	Naive 1	78	30	1266.5	.0000
Management	Naive 2	80	41	1851.0	.0000
Management	Naive 3	88	33	1448.0	.0000
Management	Naive 4	97	24	1103.0	.0000

*There was one forecast of zero EPS.

**A difference of less than zero indicates the management forecast was more accurate.

TABLE 19

WILCOXON SIGNED-RANKS TEST

COMPARISON OF RELATIVE ERRORS

NAIVE MODELS

|A-F|/F

Variable*	Variable	Diff < 0	Diff > 0	Rank Sum	Significance
Naive 1	Naive 2	63	59	3647.0	.7895
Naive 1	Naive 3	77	45	2473.0	.0011
Naive 1	Naive 4	86	37	2102.0	.0000
Naive 2	Naive 3	72	50	3044.0	.0707
Naive 2	Naive 4	74	49	2453.0	.0006
Naive 3	Naive 4	85	38	2063.0	.0000

*A difference of less than zero indicates that the forecasts generated by the model in this column are more accurate than those generated by the model in the second column.

TABLE 20

WILCOXON SIGNED-RANKS TEST

COMPARISON OF RELATIVE ERRORS

MANAGEMENT vs. NAIVE MODELS

|A-F|/A

Variable	Variable	Diff < 0*	Diff > 0	Rank Sum	Significance
Management	Naive 1	77	31	1638.5	.0001
Management	Naive 2	82	40	1825.5	.0000
Management	Naive 3	87	34	2006.0	.0000
Management	Naive 4	93	28	1826.0	.0000

*A difference of less than zero indicates the management forecast was more accurate.

TABLE 21

WILCOXON SIGNED-RANKS TEST

COMPARISON OF RELATIVE ERRORS

NAIVE MODELS

|A-F|/A

Variable*	Variable	Diff < 0	Diff > 0	Rank Sum	Significance
Naive 1	Naive 2	67	54	2720.5	.0121
Naive 1	Naive 3	73	48	3393.5	.4424
Naive 1	Naive 4	82	41	2972.0	.0338
Naive 2	Naive 3	61	54	2038.0	.3916
Naive 2	Naive 4	71	51	3325.0	.2758
Naive 3	Naive 4	81	42	2843.0	.0144

* A difference of less than zero means the forecasts generated by the model in this column are more accurate than those generated by the model in the second column.

The latter analysis also holds for errors computed relative to the forecasts. However it is again the case that the statistical results are not entirely consistent. In this case Naive 1 is more accurate than any model except Naive 2. Naive 2 is more accurate than Naive 4 but not more accurate than Naive 3. So again it cannot be definitely said that the random walk models do a better job of predicting earnings per share than do the mean reverting models. However the second test does confirm that the moving average mean reverting model does do a better job of predicting earnings per share than does the pure mean reverting model.

Summary

This chapter was concerned with two major topics. First, there was a discussion of the sample of management forecasts which was selected and the years from which such forecasts were taken. Second, the sample was analyzed in terms of the accuracy of both management forecasts and forecasts generated by the naive models.

The sample which was selected included 123 forecasts made by 90 firms. The firms appear to be widely representative of industries within the economy. In addition, the years from which the forecasts were selected appeared to represent several different conditions with regard to corporate profitability. An

analysis of the forecasts taken from each of the years indicated that there appeared to be more usable forecasts in years beginning with strong economic performance than there were in years beginning with weak economic performance.

The first area in the exploration of forecast accuracy was whether there was a tendency to either underpredict or overpredict earnings. It was found on an overall basis that there was no tendency for management to either underpredict or overpredict earnings. This was also the case with the Naive 2 (random walk with drift) model. The remaining naive models tended to underpredict earnings.

A graphical analysis gave some preliminary evidence that management forecasts were more accurate than those of the naive models. In addition it appeared that the random walk naive models were more accurate than the mean reverting naive models.

When statistical tests were made to determine the comparative accuracy of the forecasts, it was confirmed that management forecasts were indeed more accurate than those of the naive models. However, there was not confirmation on a statistical basis that the random walk models were in all cases more accurate than the mean reverting models. As a part of the information provided by the statistical tests it was possible to conclude

that the random walk models had a greater number of accurate forecasts than did the mean reverting models. As a final note it was possible to conclude that the moving average of pure mean reverting process model was more accurate than the pure mean reverting model.

FOOTNOTES

CHAPTER IV

[1]E.g., Charles Leroy McDonald, An Empirical Examination of Published Predictions of Future Earnings. (Unpublished Ph.D.dissertation. Michigan State University, 1972).

[2]Board of Governors, Federal Reserve System, 1973 Historical Chart Book (Washington D.C. Board of Governors, Federal Reserve System, 1973) p. 50.

[3]McDonald, pp. 49-50.

[4]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York, McGraw-Hill Book Company, Inc., 1956) p. 43.

[5]Ibid., p. 43.

[6]Ray Ball and Ross Watts, "Some Time Series Properties of Accounting Income," unpublished manuscript, University of Chicago, January, 1970.

[7]McDonald, p. 68.

[8]Ibid., p. 22.

[9]See McDonald, pp. 59-67.

[10]Siegel, p. 79.

CHAPTER V

THE PRICE RESPONSE TO MANAGEMENT FORECASTS OF EARNINGS PER SHARE

Introduction

Chapter V is concerned with two major topics. The first topic is the presentation of the specific method which was used to compute the price responses to the forecasts of earnings per share. The second topic is the presentation of hypotheses and the analysis of test results concerned with the price response to management earnings forecasts.

Measurement of Price Response

In the second chapter it was noted that the market model would be used to obtain stock price changes which were unique to the firm. In addition it was indicated that as a result of the findings of Ball and Brown the price response would be measured over time.[1] The specific method used to measure price responses over time was to compound the price responses (C_{im}) obtained by applying the market model over a test period. The test period which was used began with the month in which the management forecast was published in The Wall Street Journal and ended with the month in which the actual earnings were announced. It was assumed that any price response prior

to the month of the publication of the forecast would not be related to the forecast. The price response during the test period was deemed relevant because price responses during this period could be the result of comparisons between the forecast and revised expectations of actual earnings. Revisions of expectations could occur for example as quarterly earnings reports indicate the progress already made in reaching the earnings which had been forecast. The month in which the actual earnings were announced should be included in the test period because the actual earnings figure would allow a final comparison to be made between forecast earnings and actual reported earnings.

As was previously indicated the price relatives were taken from the CRSP (Center for Research in Security Prices) tapes. These tapes contain monthly closing price relatives for NYSE firms. This data base necessitated the compounding of the price response for the entire month in which the forecast was published and the entire month in which the actual earnings were announced. This lack of precision is probably not a serious limitation. Ball and Brown have found that most of the price response to earnings occurs over a lengthy period before the announcement of annual earnings. A small addition or deletion of time, then, probably would not seriously distort the measurement of price response.

The price responses were compounded over this test period using the method of continuous compounding suggested by Beaver and Dukes.[2] The formula for this calculation of the compound price response (PR) is as follows:

$$PR_i = \prod_{t=1}^{m} e^{R_{im}} - \prod_{t=1}^{m} e^{E(R_{im}|R_{sm})}$$

i = the firm;

m = the number of months in the test period;

R_{im} = the completely adjusted price relative for firm i in month m. If log $e(y) = R_{im}$, then $y = e^{R_{im}}$

$e^{E(R_{im}|R_{sm})} = e^{R_{im}} - C_{im}$

This method of compounding is difficult to illustrate. However, Ball and Brown used and tested a method of discrete compounding which can be illustrated more easily.[3] For an example of the calculation of the PR using Ball and Brown's technique, the reader is referred to Appendix B.

The Relationship Between Forecast Errors and Price Responses

It will be recalled from the discussion in the third chapter that if actual earnings were in excess of forecast earnings, this should be "good news" to the investor and an increase in the price of the firm's stock would be expected. The reverse was also indicated as being an expected result. In terms of the compound price response after eliminating market effects an underforecast should lead

to a price response greater than zero while an overforecast should lead to a price response of less than zero.

In order to present a general picture of the relationship between forecast errors and price responses, scatter plots were obtained which allow a visual analysis to be made. The scatter plots are presented in Figures 7 through 21. The following notation was used in the preparation of the scatter plots.

Figures 7 through 11 (A-F)/A

C2 = continuously compounded price response;

E-M = management forecast errors;

$E\text{-}N_1$ = Naive 1 forecast errors;

$E\text{-}N_2$ = Naive 2 forecast errors;

$E\text{-}N_3$ = Naive 3 forecast errors;

$E\text{-}N_4$ = Naive 4 forecast errors.

Figures 12 through 16 (A-F)/F

C2 = continuously compounded price responses;

A-F/FMGT = management forecast errors;

A-F/F N_1 = Naive 1 forecast errors;

A-F/F N_2 = Naive 2 forecast errors;

A-F/F N_3 = Naive 3 forecast errors;

A-F/F N_4 = Naive 4 forecast errors;

Figures 17 through 21 (A-F)/P

C2 = continuously compounded price response;

EM/P = management forecast errors;

EN_1/P = Naive 1 forecast errors;

EN_2/P = Naive 2 forecast errors;

EN_3/P = Naive 3 forecast errors;

EN_4/P = Naive 4 forecast errors.

It had been anticipated at the outset of the study that there should be a consistent relationship between the sign of the forecast error and the sign of the price response. In addition, it had been expected that the size of the forecast error would be related to the size of the price response. The relationships depicted in the scatter plots do not seem to confirm either of these expectations. It would appear that negative forecast errors are associated with positive price responses about as often as with negative price responses. Further, the largest price responses do not seem to be consistently associated with the largest errors. However, any conclusions based on such a visual analysis must be tentative until they are confirmed by statistical tests.

The first statistical test applied to measure the association between forecast errors and price responses was the chi-square test for 2x2 contingency tables. This test was used to examine the question of whether the sign of the price response followed the sign of the forecast error. The specific hypotheses tested were:

H_0: There is no difference between positive and negative forecast errors in the proportion of price responses greater or less than zero.

H_A: A greater proportion of positive forecast errors have positive price responses than is the case

FIGURE 7

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

MANAGEMENT FORECASTS (A-F)/A

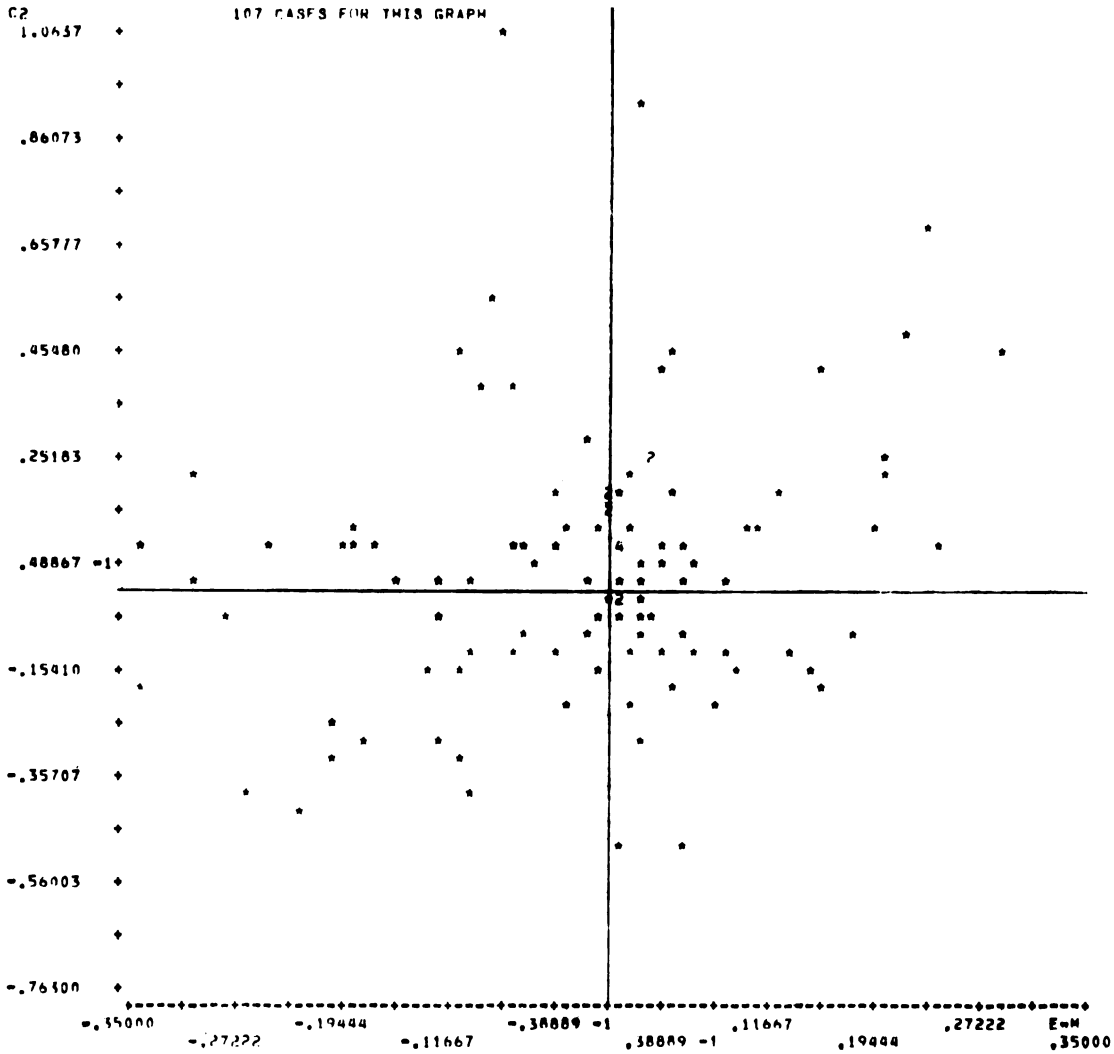


FIGURE 8

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 1 FORECASTS (A-F)/A

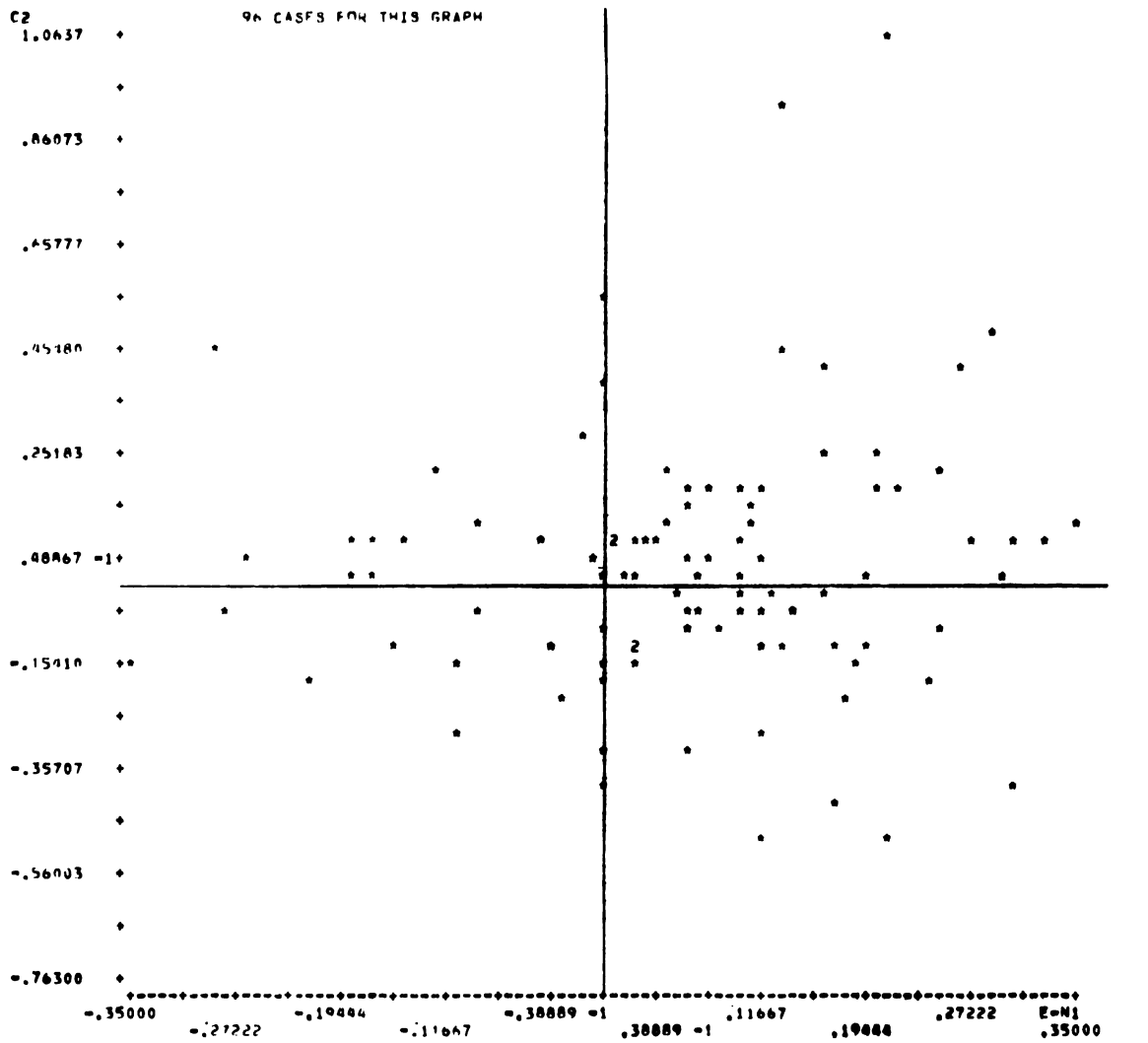


FIGURE 9

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 2 FORECASTS (A-F)/A

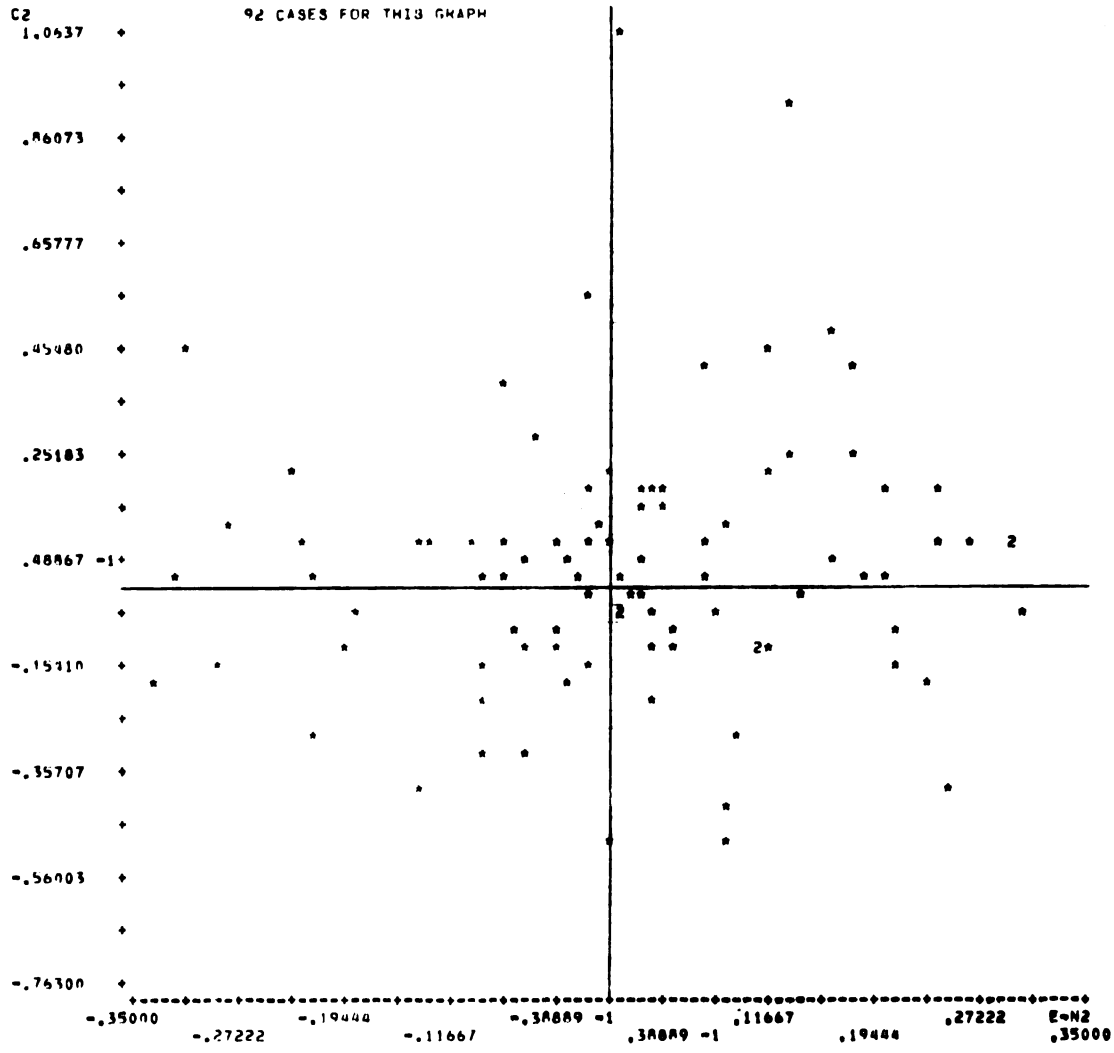


FIGURE 10

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 3 FORECASTS (A-F)/A

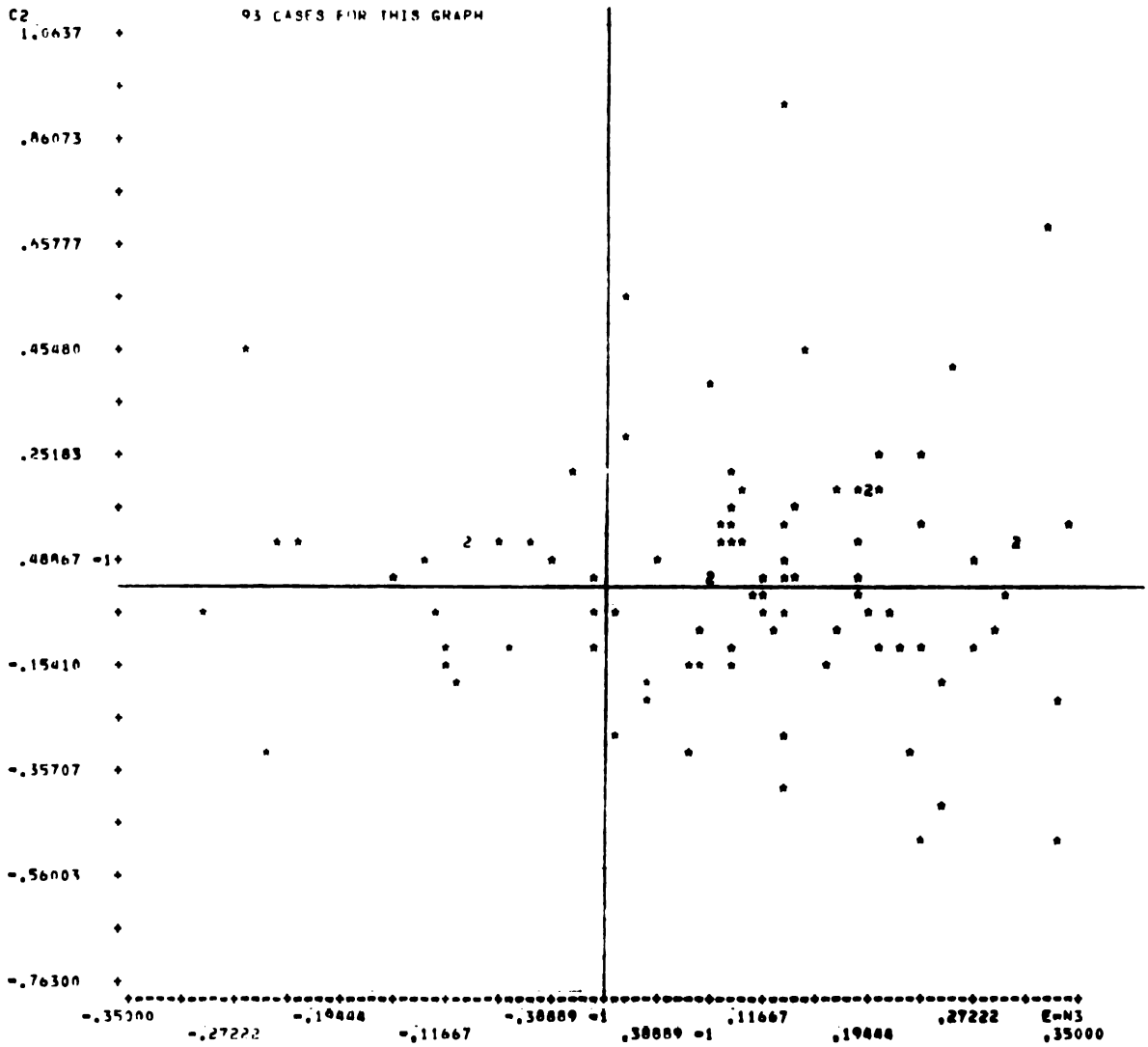


FIGURE 11

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 4 FORECASTS (A-F)/A

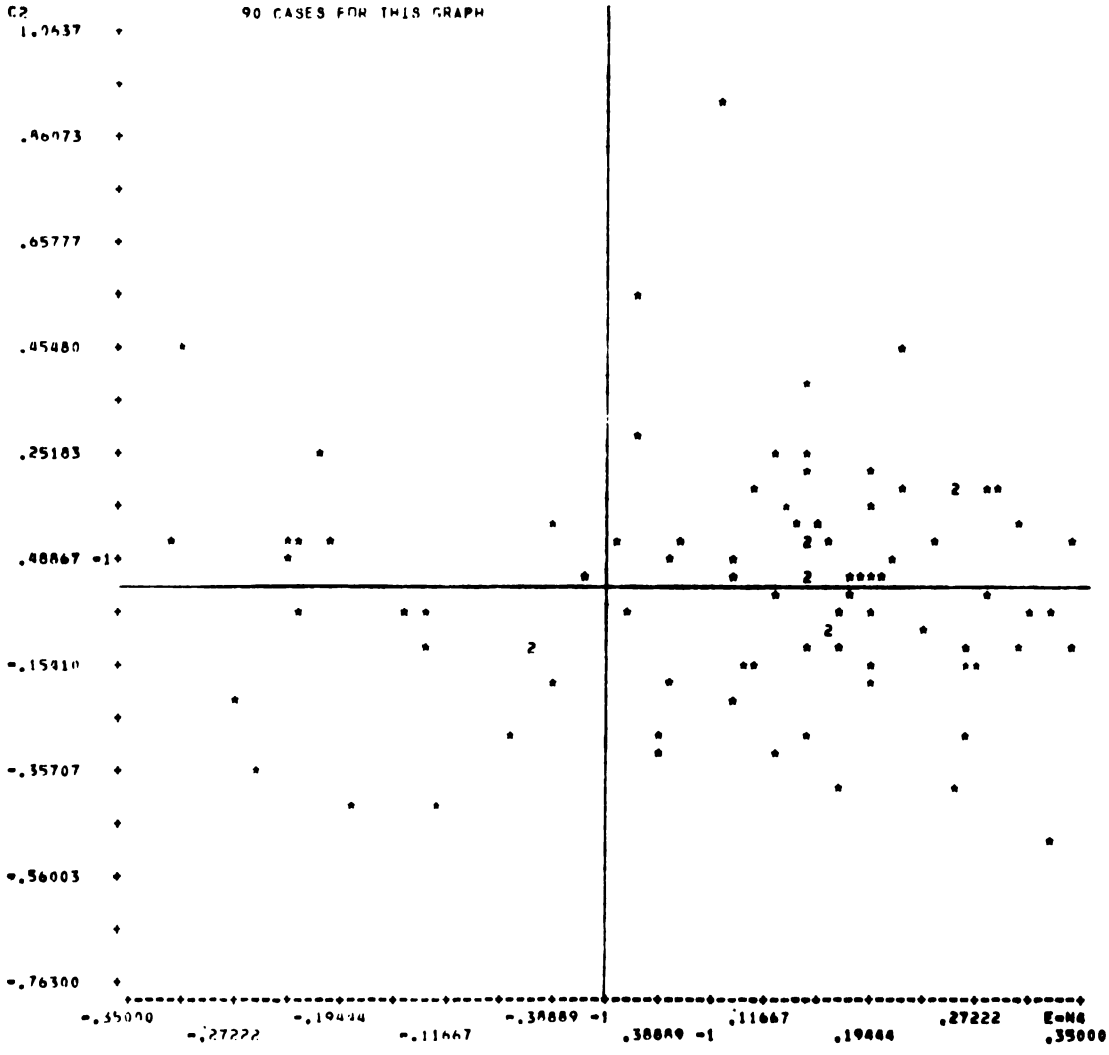


FIGURE 12

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

MANAGEMENT FORECASTS (A-F)/F

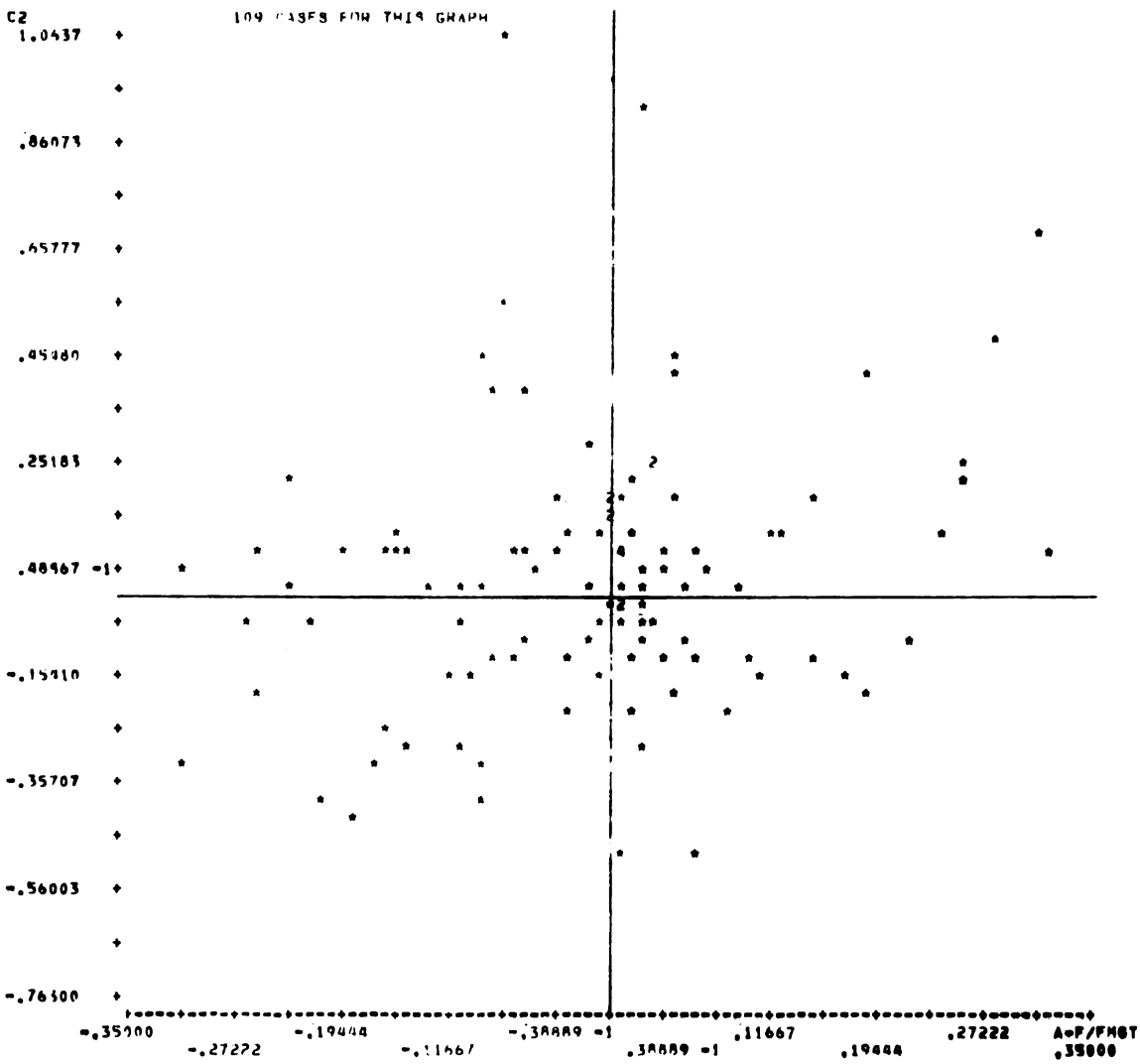


FIGURE 13

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 1 FORECASTS (A-F)/F

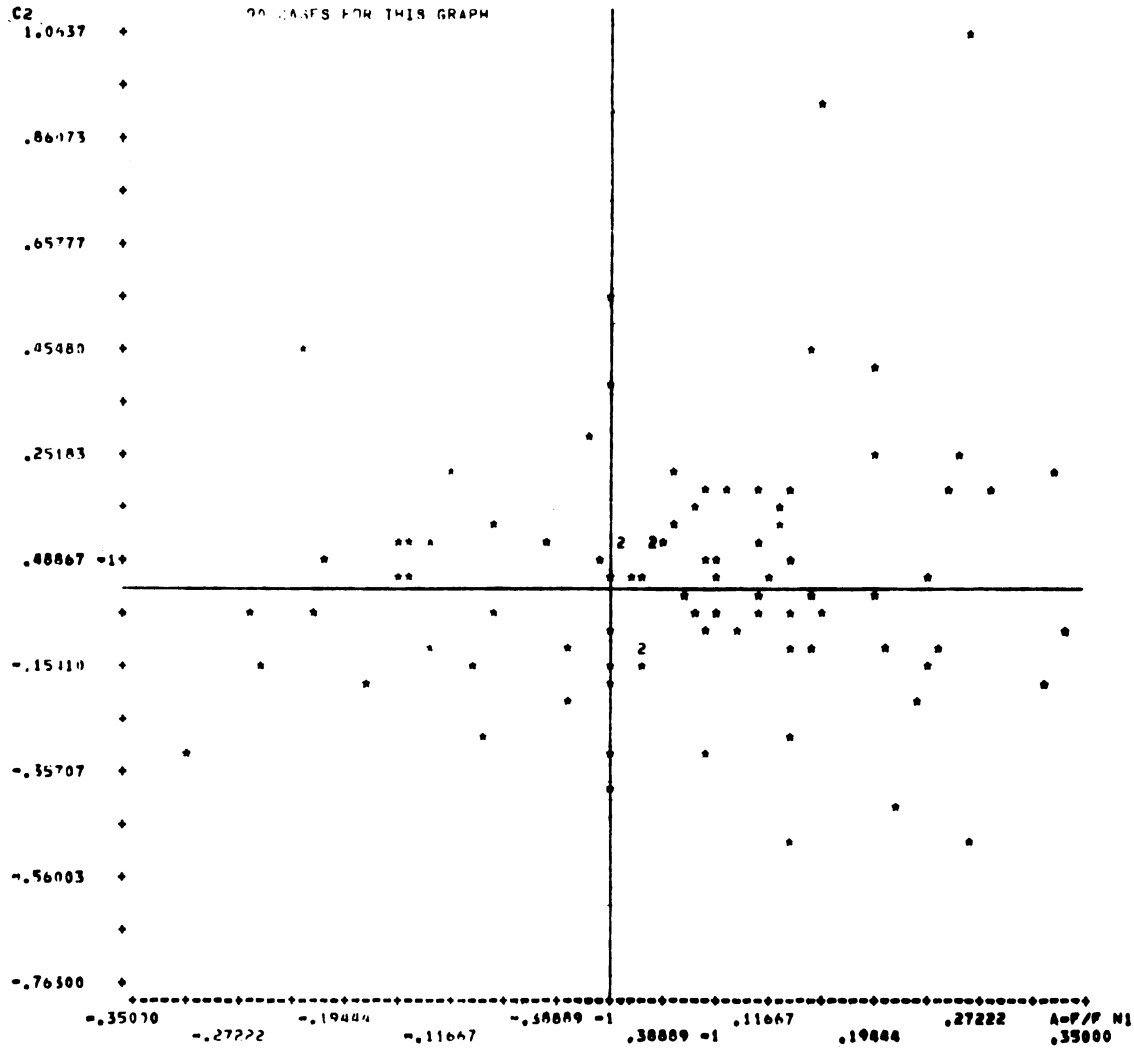


FIGURE 14

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 2 FORECASTS (A-F)/F

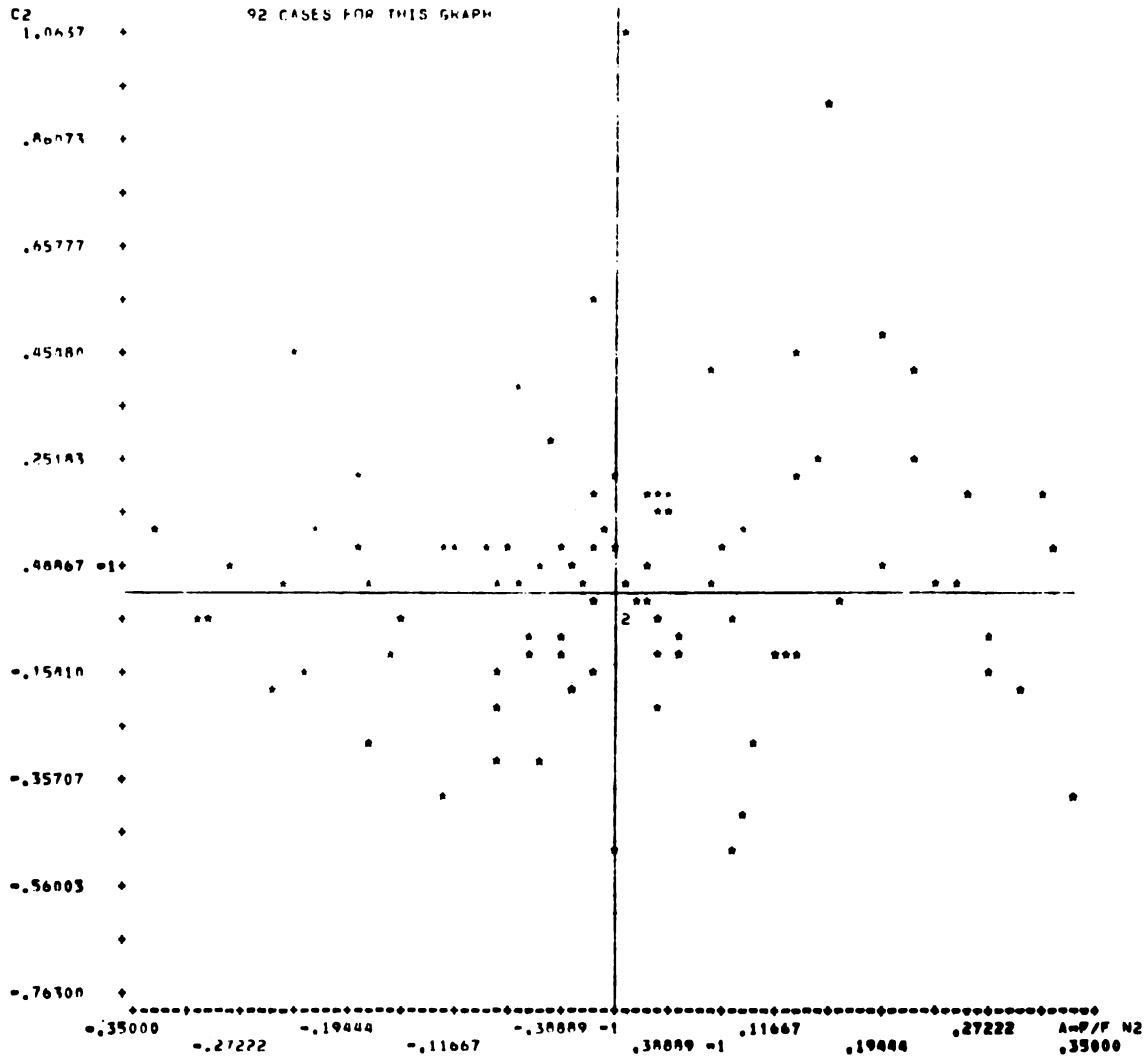


FIGURE 15

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 3 FORECASTS (A-F)/F

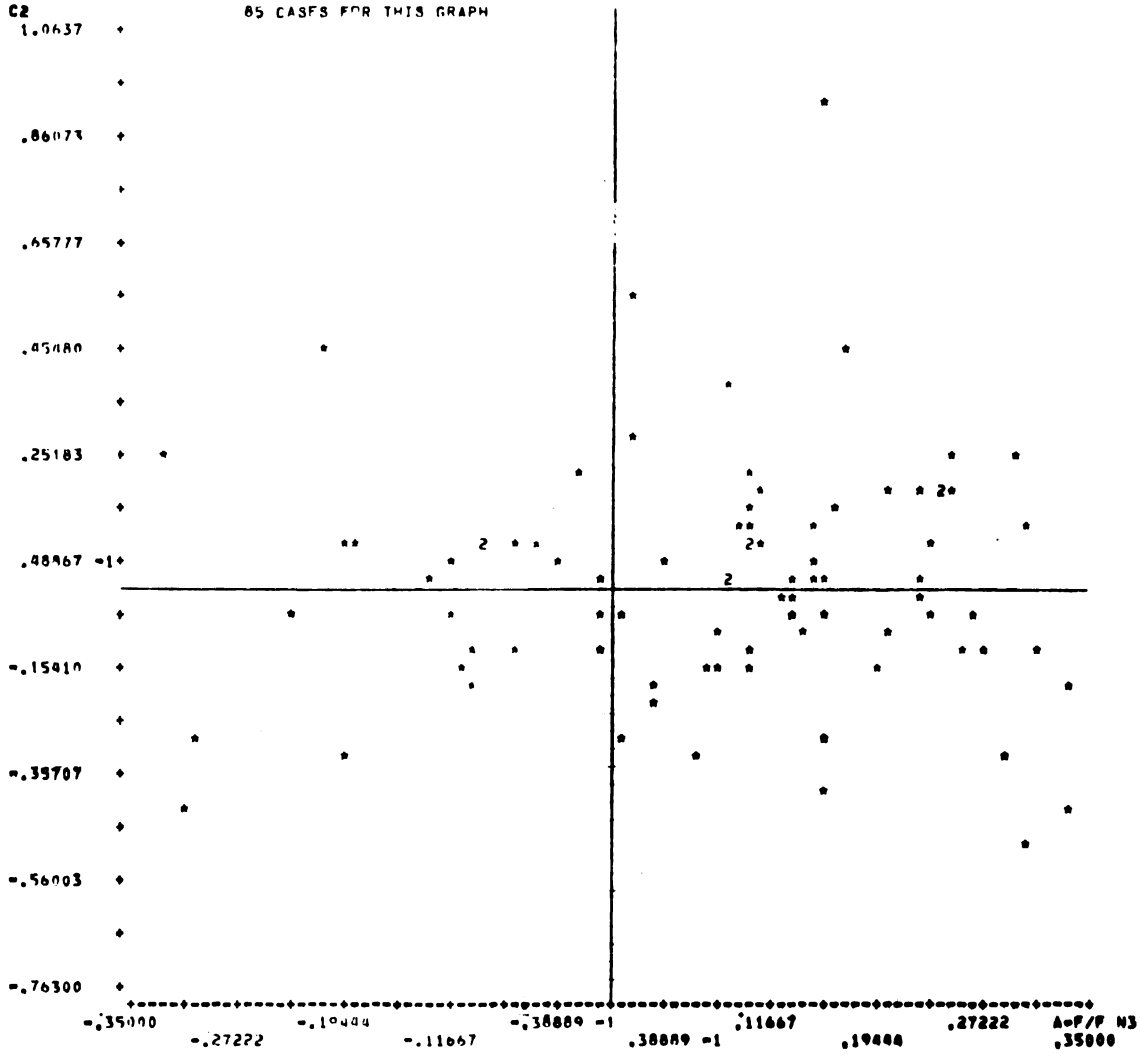


FIGURE 16

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 4 FORECASTS (A-F)/F

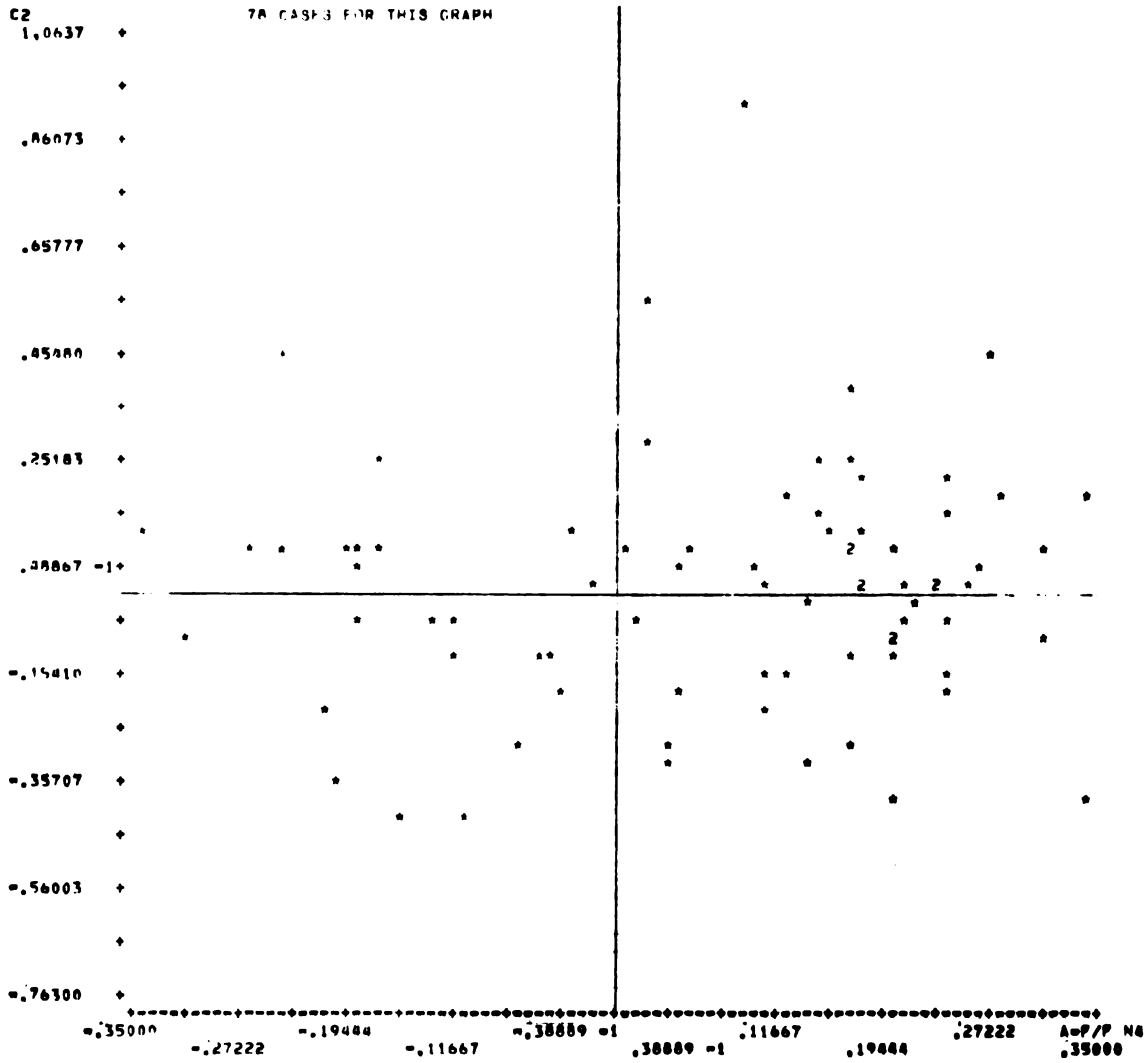


FIGURE 17

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

MANAGEMENT FORECASTS (A-F)/P

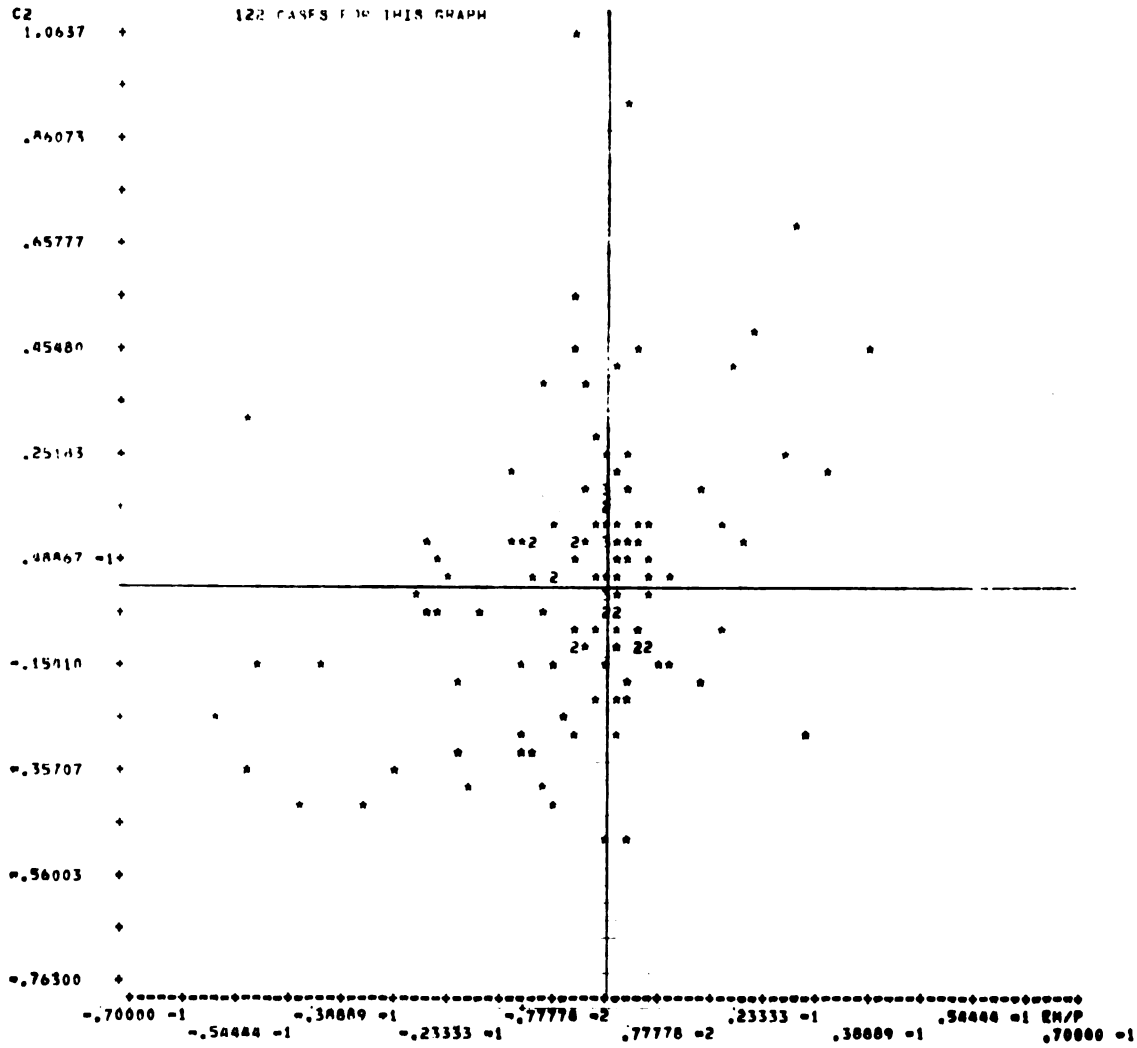


FIGURE 18

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 1 FORECASTS (A-F)/P

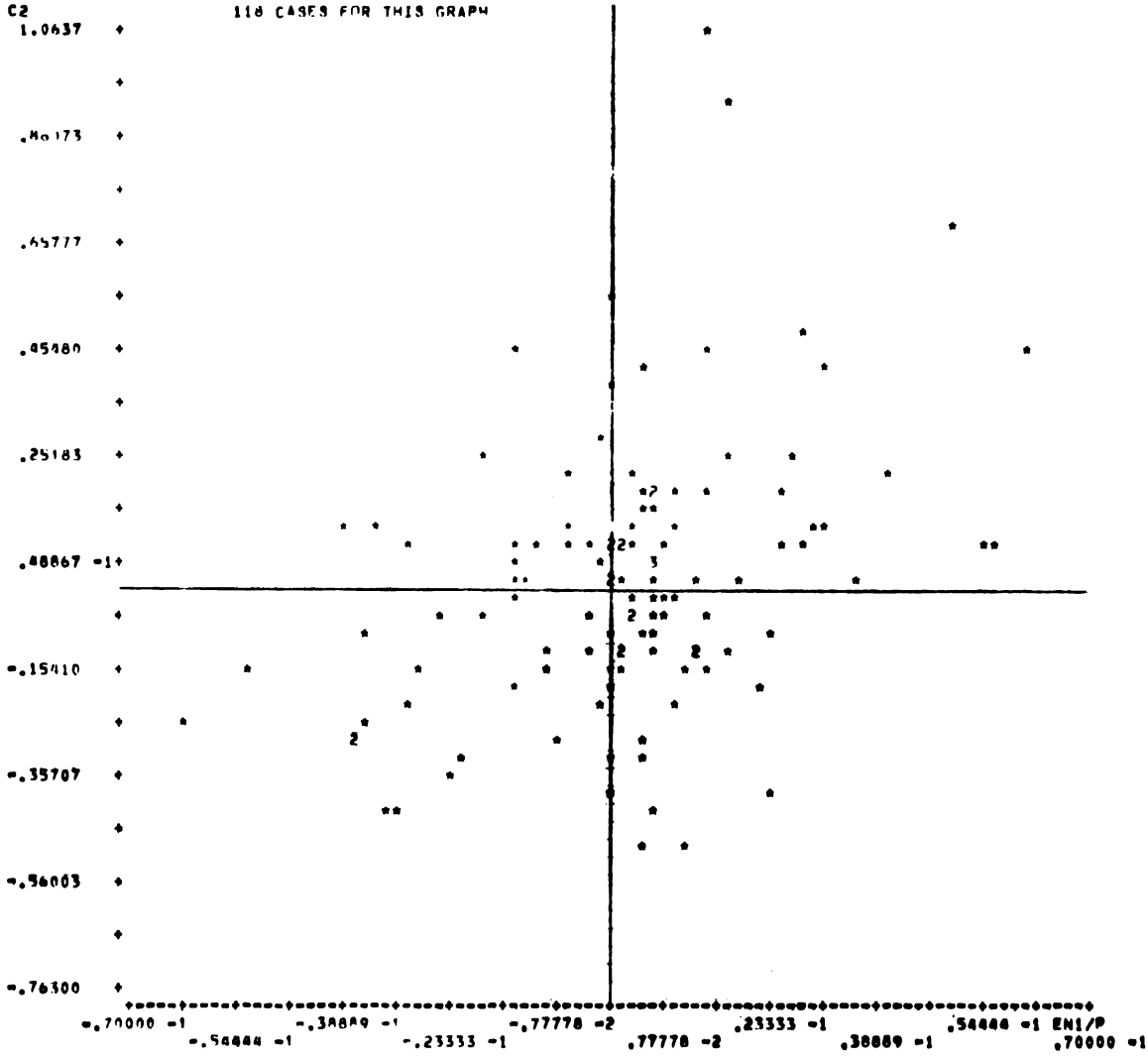


FIGURE 19

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 2 FORECASTS (A-F)/P

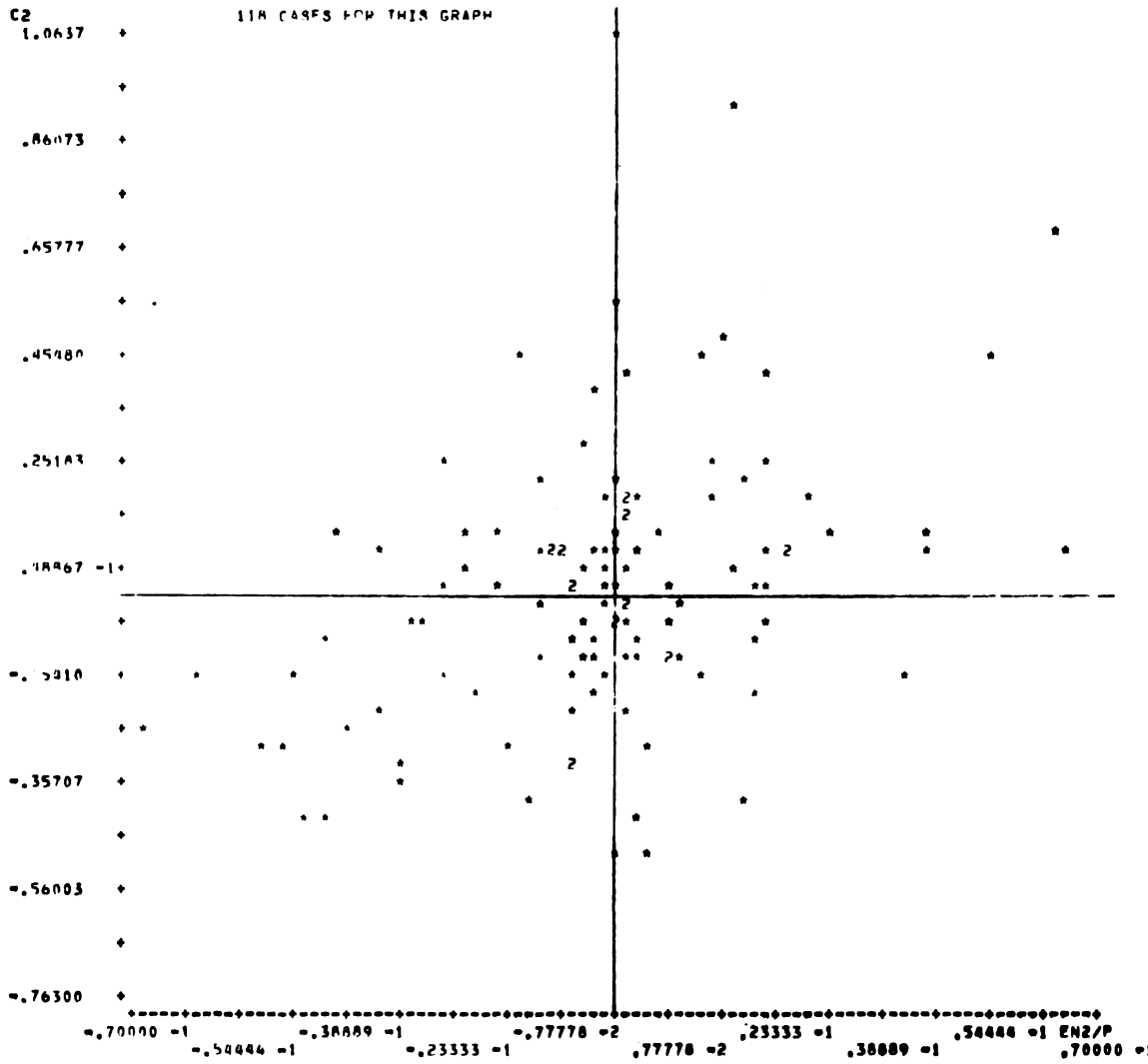


FIGURE 20

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 3 FORECASTS (A-F)/P

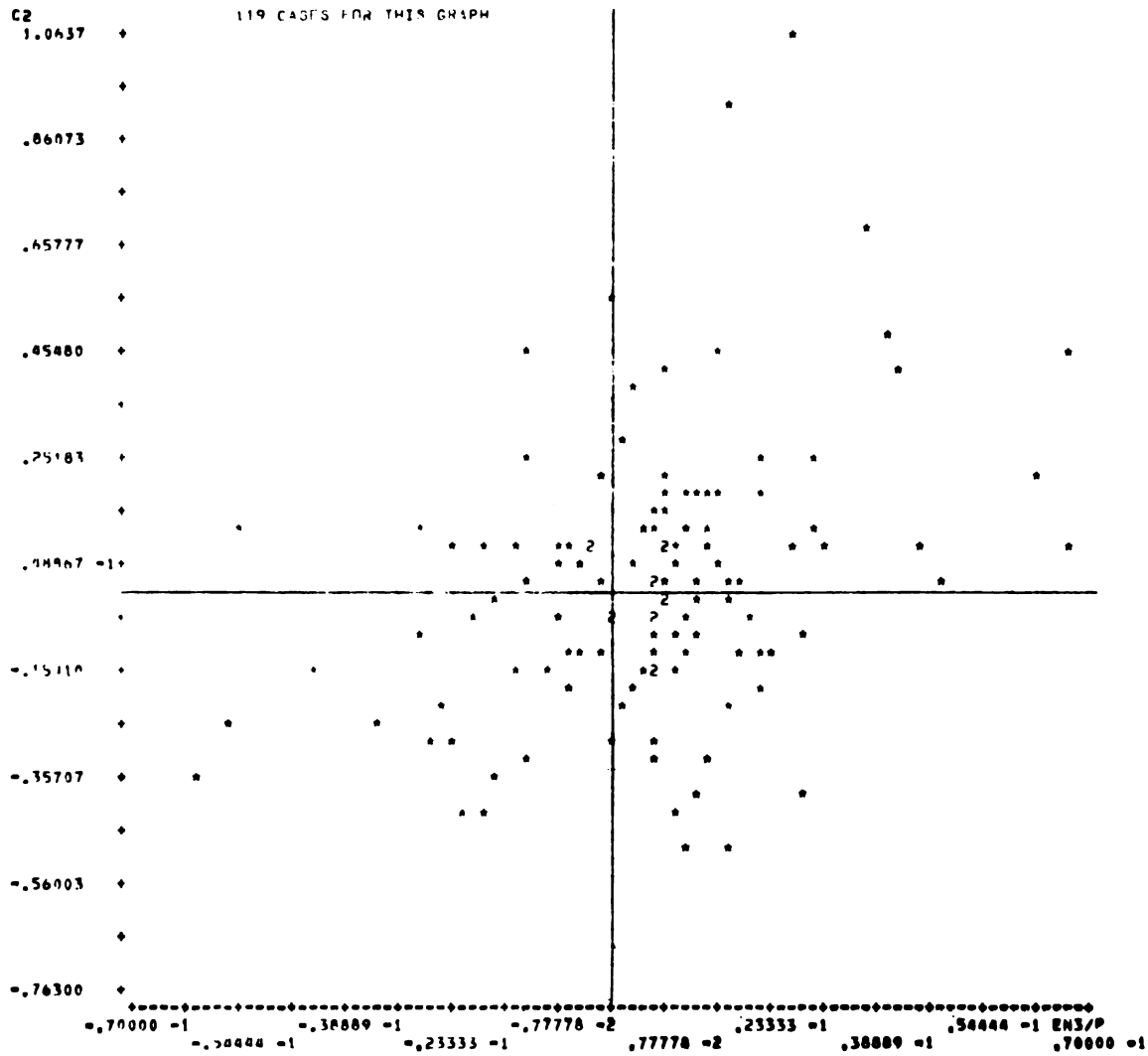
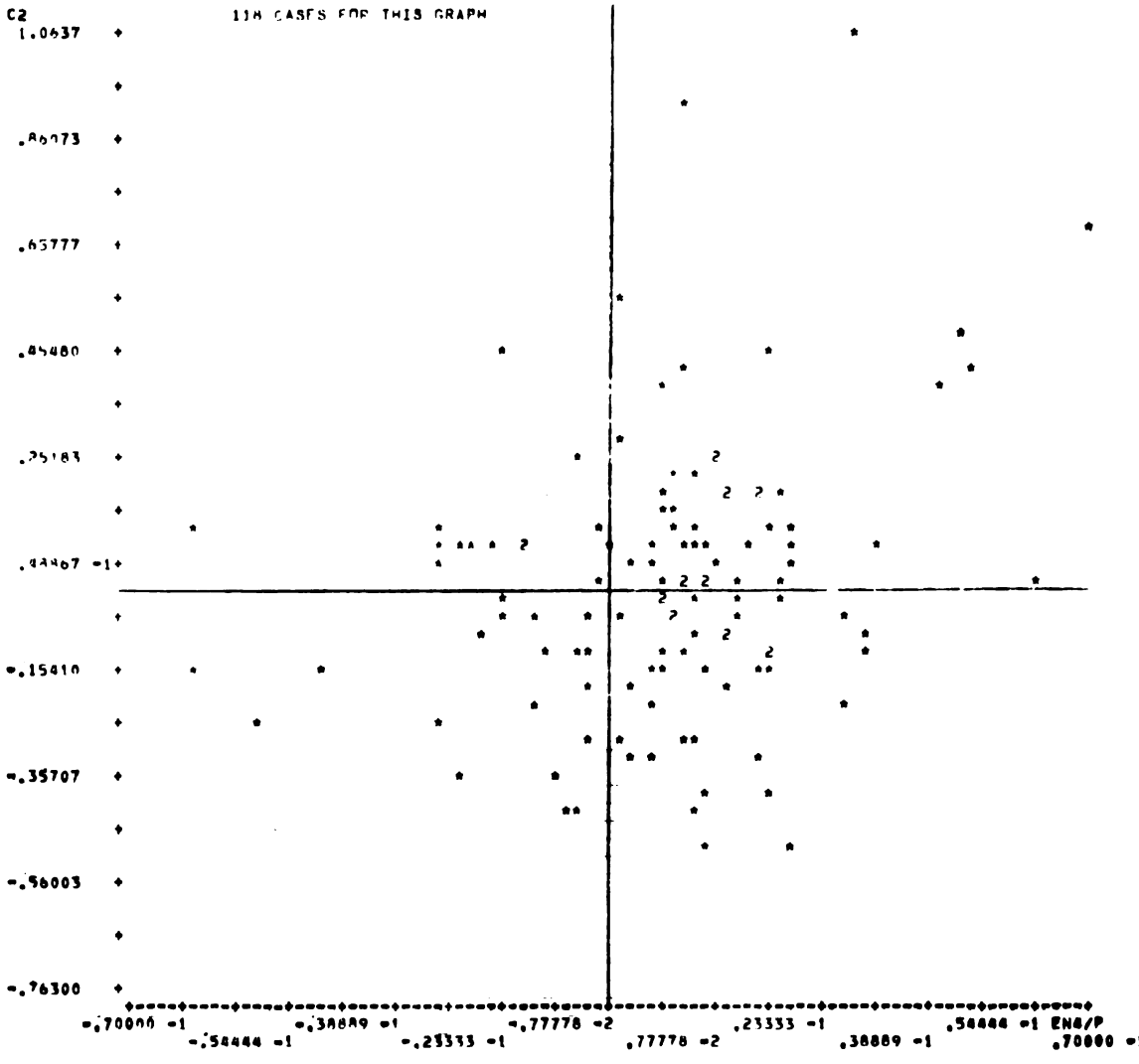


FIGURE 21

SCATTER PLOT FORECAST ERRORS AGAINST

PRICE RESPONSE

NAIVE 4 FORECASTS (A-F)/P



with negative forecast errors.

The area of rejection of the null hypothesis was all values of χ^2 which were so large that the probability associated with their occurrence is equal to or less than $\alpha = .05$.

The computational formula for the χ^2 statistic for a two by two contingency table is as follows:[4]

CONTINGENCY TABLE

A*	B*
C*	D*

$$\chi^2 = \frac{N(|AD-BC| - \frac{N}{2})^2}{(A+B)(C+D)(A+C)(B+D)}$$

Where:

N = the number of cases in the sample;

* = the frequency of occurrences in cells A,B,C, and D.

The results of this test are presented in Tables 22 through 26. These statistical results tend to confirm the visual analysis. With the exception of Naive 1 forecasts there was no significant association between the

direction of the forecast errors and the direction of the price responses. In the case of Naive 1 forecast errors there was an association which was significant at the .05 level, but it was the opposite of that which had been expected.

If Tables 22 through 26 are analyzed on a nonstatistical basis, the results for all methods of forecasting, show that more negative price responses are associated with positive forecast errors than with negative forecast errors. In addition, more positive price responses are associated with negative forecast errors than with positive forecast errors. This is not the expected result. However, many of the forecast errors are small and small deviations of the price response from the anticipated direction might be expected. This indicated the need for a test or tests which included the magnitudes of the forecast errors and price responses.

A second test of the association between forecast errors and price responses tested whether the size of the forecast error was associated with the size of the price response. Rank order correlations between the forecast errors and the price responses were computed in order to test this question. Rank order correlations were used because the use of such tests does not require assumptions about the distributions of either

TABLE 22

X^2 DIRECTION OF PRICE

RESPONSE WITH THE DIRECTION OF ERROR

MANAGEMENT FORECASTS

ERROR	PR > 0	PR < 0	
+	25	33	58
-	33	28	61
	58	61	119

Computed X^2 = 1.032

Critical X^2 = 2.71

TABLE 23

X^2 DIRECTION OF PRICE

RESPONSE WITH THE DIRECTION OF ERROR

NAIVE 1 FORECASTS

ERROR	PR > 0	PR < 0	
+	30	44	74
-	25	17	42
	55	61	116

Computed X^2 = 3.148529

Critical X^2 = 2.71

TABLE 24

X^2 DIRECTION OF PRICE

RESPONSE WITH THE DIRECTION OF ERROR

NAIVE 2 FORECASTS

ERROR	PR > 0	PR < 0	
+	24	34	58
-	34	28	62
	58	62	120

Computed X^2 = 1.668

Critical X^2 = 2.71

TABLE 25

X^2 DIRECTION OF PRICE

RESPONSE WITH THE DIRECTION OF ERROR

NAIVE 3 FORECASTS

ERROR	PR > 0	PR < 0	
+	36	47	83
-	23	17	40
	59	64	123

Computed X^2 = 1.626

Critical X^2 = 2.71

TABLE 26

X^2 DIRECTION OF PRICE

RESPONSE WITH THE DIRECTION OF ERROR

NAIVE 4 FORECASTS

ERROR	PR > 0	PR < 0	
+	39	50	89
-	20	14	34
	59	64	123

Computed X^2 = 1.658

Critical X^2 = 2.71

the forecast errors or the price responses. As was previously noted, Fama, et.al., have found that the price responses (C_{im}) are better approximated by distributions of the stable Paretian family than by the normal distribution.[5]

The particular correlation technique used was the Spearman rank correlation coefficient. In order to compute the Spearman rank correlation between forecast errors and price responses it was necessary to rank them in two series. Then the difference is found between the ranks of the two items for each firm in the sample. The Spearman rank correlation is then computed. The specific form for the computation of the correlation coefficient is as follows:[6]

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

Where:

N = the number of firms in the sample;

d_i = the difference for a firm between the rank of the forecast error and the rank of the price response.

If there were perfect correlation between forecast errors and price responses the rank of the forecast error for each firm should be the same as the rank of the price response. The d_i's would be zero.

The correlation coefficients which were obtained are presented in Table 27. The correlations which were obtained give one overall impression. They appear to be rather low. If there were perfect correlations, the coefficients would be one. The coefficients which were obtained yield only one case where there was even a .3 level of correlation. These results suggest that there is a positive but low association between the size of the forecast error and the size of the price response. In addition, the results of this procedure show that for two of the three methods of measuring error, A-F/A and A-F/F, management forecast errors are not more closely associated with price responses than are two of the naive models. Both of the random walk naive models yielded forecast errors more closely associated with price responses than management forecast errors. In fact, the associationswere stronger for the random walk models than for any of the other forecasts.

When errors are computed relative to price, the same conclusions cannot be drawn. In this case errors computed using management forecasts are more closely associated with price responses than are errors using

TABLE 27

SPEARMAN RANK-ORDER CORRELATION COEFFICIENTS

FORECAST ERRORS WITH PRICE RESPONSE

Forecast Error	(A-F)/A	(A-F)/F	(A-F)/P
Management	.1941	.2905	.2990
Naive 1	.2023	.2982	.2360
Naive 2	.2314	.3146	.2429
Naive 3	.1710	.2662	.2107
Naive 4	.0762	.1706	.1432

any of the naive modles. It is the case that errors computed using the random walk models are the next most closely associated with price responses.

Whether management forecasts appear to be more useful to investors is then not clear. The association between forecast errors and price responses for both management and the random walk naive models are very similar for all methods of computing errors. Since this lack of clarity existed, other tests were utilized to examine the question of whether management forecast errors seemed to be more related to price responses than were errors computed with forecasts generated by the naive models.

In order to specifically examine this question, comparisons were made between management forecasts and naive forecasts to determine cases where they were on opposite sides of actual results. If there were price response to management earnings forecasts, the sign of the price response should follow the sign of the management forecast error rather than the sign of the naive forecast error. Comparisons of this type were made using management forecasts and each of the naive model forecasts.

It was originally intended to test this question by using a chi-square test for a 2x2 contingency table. However, it turned out that the cell frequencies were too small to justify the use of this test. Siegel indicates that for a 2x2 contingency table where the total number is between 20 and 40, the chi-square test should not be used if the expected frequency of any cell is less than

five. He suggests the use of the Fisher test in cases where this criterion is not met.[7]

The Fisher test allows the computation of the exact probability of observing the set of frequencies obtained or results even more extreme, when the marginal totals are regarded as fixed. The exact probability is given by the hypergeometric distribution. Where:

$$P = \frac{(A+B)!\ (C+D)!\ (A+C)!\ (B+D)!}{N!\quad A!\quad B!\quad D!}$$ [8]

The contingency table would be as follows:

A	B	A + B
C	D	C + D
A+C	B+D	N

For example, if the following frequencies had been observed:

1	6	7
4	1	5
5	7	12

The formula would be applied to that contingency table and to the more extreme contingency table with the same marginal totals.

0	7	7
5	0	5
5	7	12

The results would then be summed to find the exact probability of such an occurrence of frequencies or of possibilities even more extreme.

The specific hypotheses to be tested are:

H_0: Positive management forecast errors and negative management forecast errors show equal proportions in the sign of the price response associated with such errors.

H_A: A greater proportion of positive management forecast errors have positive price responses than is the case with negative forecast errors.

The 2x2 contingency tables for this test are presented in Tables 28-31. If the exact probability is less than α, then H_0 could be rejected and it could be concluded that there was an association between the direction of forecast error and the direction of price response. However, in no case was the exact probability less than α.

The conclusion of this test is that there is no significant tendency for the sign of the price response to follow the sign of the management forecast error. However, neither is there a tendency for the sign of the price response to follow the sign of the forecast error for any of the naive models.

TABLE 28

MANAGEMENT vs. NAIVE 1

(PURE RANDOM WALK)

	ERRORS		
	MGT- N1+	MGT+ N1-	
PR > 0	10	4	14
PR < 0	11	3	14
	21	7	28

Fisher exacted probability = .5

α = .05

TABLE 29

MANAGEMENT vs. NAIVE 2

(RANDOM WALK WITH DRIFT)

	ERRORS		
	MGT- N2+	MGT+ N2-	
PR > 0	7	7	14
PR < 0	6	7	13
	13	14	27

Fisher exacted probability = .5735

α = .05

TABLE 30

MANAGEMENT vs. NAIVE 3

(MOVING AVERAGE OF A PURE MEAN REVERTING PROCESS)

ERRORS

	MGT- N3+	MGT+ N3-	
PR > 0	14	4	18
PR < 0	16	5	21
	30	9	39

Fisher exacted probability = .6107

α = .05

TABLE 31

MANAGEMENT vs. NAIVE 4

(PURE MEAN REVERSION - NO DRIFT)

ERRORS

	MGT- N4+	MGT+ N4-	
PR > 0	16	3	19
PR < 0	21	7	28
	37	10	47

Fisher exacted probability = .3497

α = .05

The above test does give an indication of whether the price responses are more closely associated with management forecast errors than with errors of the naive models. However, in some cases the management forecast and a naive forecast might be on opposite sides of actual earnings but the difference between them might be very small. Therefore the results might be expected to be similar for the two forecasts. In order to avoid this problem another test was utilized. Cases were found where differences between management forecast errors and naive forecast errors were large. Then, for these cases, both the management forecast errors and the naive forecast errors were correlated with the price responses. The correlation technique used was the Spearman rank correlation coefficient previously described. If there were a price response to management earnings forecasts, the association between such forecasts and the price responses should be greater than for the naive models.

The results of this test are presented in Table 32. The results are inconsistent. When errors are measured relative to actual earnings in all cases the management forecast errors are more closely associated with price responses than forecast errors of the naive models. However, the differences between the correlation coefficients for management and the first two naive models are not large. When errors are measured relative to the forecasts, management forecast errors are more closely associated with price responses in only two of the four comparisons.

TABLE 32

SPEARMAN RANK-ORDER CORRELATION COEFFICIENTS

FORECASTS WITH PRICE RESPONSES

41 LARGEST DIFFERENCES BETWEEN

MANAGEMENT FORECASTS AND

NAIVE FORECASTS

	(A-F)/A	(A-F)/F	(A-F)/P
Management	.2490	.3212	.4235
Naive 1	.2402	.3441	.4476
Management	.1916	.3769	.3995
Naive 2	.1709	.3251	.5850
Management	.0096	.3623	.3791
Naive 3	-.0463	.3698	.4549
Management	.1307	.3520	.4014
Naive 4	.0904	.3229	.4443

If errors are measured relative to price in no case are management errors more closely related to price responses than those of the naive models. These results certainly cannot be construed as strong support for a case of price response specifically related to management earnings forecasts.

Since the results were still inconsistent it was felt that perhaps some unrecognized bias in the statistics was obscuring the relationships. The solution adopted was to utilize a nonstatistical approach similar to that used by Niederhoffer and Regan.[9] This involved the preparation of a matrix which has sometimes been termed a confusions matrix. This simply involves indicating in how many cases the largest errors are associated with the largest price responses, middle price responses, and low price responses. The same procedure would then be followed for medium and small forecast errors.

The results of this analysis are presented in Tables 33 through 47. Again there seems to be some small relationship between the size of the error and the size of the price response. However, again there seems to be little difference between management forecast errors and forecast errors of the naive models.

TABLE 33

CONFUSIONS MATRIX

MANAGEMENT

(A-F)/A

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	17	10	14
Middle 1/3	15	18	8
Low 1/3	9	13	19

TABLE 34

CONFUSIONS MATRIX

NAIVE 1

(A-F)/A

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	19	9	13
Middle 1/3	11	20	10
Low 1/3	11	12	18

TABLE 35

CONFUSIONS MATRIX

NAIVE 2

(A-F)/A

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	18	11	12
Middle 1/3	14	17	10
Low 1/3	9	13	19

TABLE 36

CONFUSIONS MATRIX

NAIVE 3

(A-F)/A

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	17	11	13
Middle 1/3	14	16	11
Low 1/3	10	14	17

TABLE 37

CONFUSIONS MATRIX

NAIVE 4

(A-F)/A

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	15	12	14
Middle 1/3	15	15	11
Low 1/3	11	14	16

TABLE 38

CONFUSIONS MATRIX

MANAGEMENT

(A-F)/F

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	18	10	12
Middle 1/3	16	17	8
Low 1/3	7	13	21

TABLE 39

CONFUSIONS MATRIX

NAIVE 1

(A-F)/F

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	19	10	12
Middle 1/3	12	19	10
Low 1/3	10	12	19

TABLE 40

CONFUSIONS MATRIX

NAIVE 2

(A-F)/F

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	19	12	10
Middle 1/3	12	17	12
Low 1/3	10	12	19

TABLE 41

CONFUSIONS MATRIX

NAIVE 3

(A-F)/F

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	13	11	12
Middle 1/3	4	16	11
Low 1/3	9	14	18

TABLE 42

CONFUSIONS MATRIX

NAIVE 4

(A-F)/F

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	17	12	12
Middle 1/3	13	16	12
Low 1/3	11	13	17

TABLE 43

CONFUSIONS MATRIX

MANAGEMENT

(A-F)/P

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	18	12	11
Middle 1/3	16	16	9
Low 1/3	7	13	21

TABLE 44

CONFUSIONS MATRIX

NAIVE 1

(A-F)/P

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	19	13	9
Middle 1/3	12	16	13
Low 1/3	10	12	19

TABLE 45

CONFUSIONS MATRIX

NAIVE 2

(A-F)/P

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	18	13	10
Middle 1/3	14	16	11
Low 1/3	9	12	20

TABLE 46

CONFUSIONS MATRIX

NAIVE 3

(A-F)/P

Price Response

Error

	Top 1/3	Middle 1/3	Low 1/3
Top 1/3	19	12	10
Middle 1/3	13	15	13
Low 1/3	9	14	18

TABLE 47

CONFUSIONS MATRIX

NAIVE 4

(A-F)/P

Error	Price Response: Top 1/3	Middle 1/3	Low 1/3
Top 1/3	17	14	10
Middle 1/3	13	14	14
Low 1/3	11	13	17

Summary

This chapter was concerned with the presentation of hypotheses and the analysis of test results concerned with the stock price reaction to management earnings forecasts. As was indicated in Chapter III this required the comparison of price reactions to management earnings forecasts to the price reactions to forecasts generated by several naive models.

The first indication of the relationship between forecasts of earnings per share and price responses was given by scatter plots of the price responses against the forecast errors. It appeared from a visual analysis that there was little if any relationship between the direction and size of the forecast errors and the direction and size of the price responses.

These visual analyses were then extended by the use of statistical hypotheses testing. It was confirmed using a chi-square test for 2x2 contingency tables that there was no tendency for the direction of the price response to follow the direction of the forecast error for any of the forecast errors.

Rank order correlations were then computed relating the size of the price response to the size of the forecast error. Positive but low correlations were found to exist between forecast errors and price responses. However, only when errors were computed relative to stock prices were management forecast errors more closely related to price responses than errors of the naive model forecasts.

Since it was not clear that the price responses were more closely related to management forecast errors than to naive forecast errors additional tests were conducted to examine this question. It was found using the Fisher test that when management forecasts and naive forecasts were on opposite sides of actual earnings there was no tendency for the direction of the price responses to follow either type of forecast. Further, when there were large differences between management forecasts and naive forecasts there was not a consistent tendency for management forecasts to be more highly correlated with price responses than naive model forecasts.

Since the results were not consistent it was thought that perhaps some unrecognized bias existed in the statistical tests. Therefore a non-statistical matrix analysis was performed. This analysis indicated that there did seem to be a weak association between the size of the forecast error and the size of the price response. However, there was no clear evidence that price responses were more closely associated with management forecast errors than with naive model forecast errors.

FOOTNOTES

CHAPTER V

[1]Ray Ball and Phillip Brown, "An Empricial Evaluation of Accounting Income Numbers," Journal of Accounting Research, Autumn, 1968, 1, p. 170.

[2]William H. Beaver and Roland E. Dukes, "Interperiod Tax Allocation, Earnings Expectations, and the Behavior of Security Prices," The Accounting Review, April, 1972, XLVII, p. 324.

[3]Ball and Brown, p. 168. Beaver and Dukes, and Ball and Brown obtained similar results using both continuous compounding and discrete compounding.

[4]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences, (New York: McGraw-Hill Book Company, Inc., 1956) p. 107.

[5]Eugene F. Fama, Lawrence Fisher, Michael D. Jensen and Richard Roll, "The Adjustment of Stock Prices to New Information," in Modern Developments in Investment Management, A Book of Readings, (New York: Praeger Publishers, 1972), p. 192.

[6]Siegel, p. 204.

[7]Ibid., p. 110.

[8]Ibid., p. 97.

[9]Victor Niederhoffer and Patrick J. Regan, "Earnings Changes, Analysts Forecasts, and Stock Prices," in Modern Developments in Investment Management, A Book of Readings (New York: Praeger Publishers, 1972), p. 607.

CHAPTER VI

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The question of the effects of publication of management forecasts of earnings per share had recently become of concern because of the actions of the Securities and Exchange Commission. This body considered whether such forecasts might be a useful addition to published financial statements. Its conclusion was that management forecasts of earnings would be allowed as a part of statements filed with the "Commission."

The process of considering the merits of publishing forecasts of earnings raised a flurry of discussion in the financial community. Many questions were raised, one of the most prevalent being whether management forecasts would, in fact, be useful to investors. Another question which was brought forth was whether forecasts which were in error would have an undesirable influence on investors. Other questions were raised, but these two provided the incentive for this research effort.

Since questions were directed toward the usefulness of management forecasts to investors, it was important to examine the theoretical basis for expecting such forecasts to be useful to investors. It was found that many

security valuation models depend on expected earnings. This coupled with research studies which found that there indeed was a relationship between reported earnings and stock prices reinforced the researcher's feeling that there might be a relationship between management earnings forecasts and stock prices.

The research studies which were reviewed indicated that management does not always forecast accurately. The lack of forecasting accuracy provided a means for analyzing the influence of management earnings forecasts on stock prices. If management earnings forecasts had influenced investor expectations and reported earnings were different from the earnings which had been forecast, a reaction in the price of the stock would be expected. Thus, the stock price reaction to forecast errors was used as a measure of the usefulness of management forecasts to investors. In order to be meaningful, the study went beyond an analysis of stock price reactions to management earnings forecasts. It was possible that similar results could have been obtained using forecasts generated by naive or mechanical models. Therefore the study included an analysis of possible stock price reaction to several naive models as well as to management earnings forecasts.

The use of stock price changes as a measure of usefulness of information to investors is strongly supported by previous research efforts. These studies also indicated

an operational basis for the measurement of price responses. They suggest the use of the market model as an appropriate method of measuring price changes. The market model allows one to remove the influence of general stock market conditions.

In the application of the general method the problem of how best to measure forecast error had to be confronted. Since forecast errors vary widely in terms of absolute amount, it was considered desirable to compute relative prediction errors. Several methods of computing relative errors have been suggested. Errors have been computed relative to: 1) actual earnings; 2) forecast earnings; and 3) stock prices. Each of these error computations was found to have advantages and disadvantages. Therefore for most of the tests conducted in the study all three error measures were used.

The sample of firms used in this research effort was selected from those publishing forecasts in The Wall Street Journal. In total, 123 forecasts were obtained made by 90 firms. The years during which the forecasts were published included the years 1965 through 1971. The firms appeared to be widely representative of industries within the economy. In addition, the years from which the forecasts were obtained appeared to represent several different conditions with regard to general corporate profitability. It was felt by the researcher

that the heterogeneity of the sample of firms and the years from which they were obtained benefitted the study by making it more general.

Conclusions

Forecast Errors. The basic question of the study was not to examine forecast errors. However, the computation of forecast errors in an attempt to relate forecasts to stock price changes made it possible to examine the accuracy of such forecasts.

The chi-square one sample test was applied to ascertain whether there was a tendency on the part of management or the naive models to underpredict or overpredict earnings per share. It was found when all of the forecasts were used that there was no tendency for management to either underpredict or overpredict earnings. This was also the case with the Naive 2 (random walk with drift) model. The remaining naive models tended to underpredict earnings. This was not unexpected because these models rely heavily on past earnings data.

The Wilcoxon Signed-Ranks Test was then applied to determine the comparative accuracy of the forecasts. This test confirmed, using all methods of computing errors, that management forecasts were more accurate than those generated by the naive models. However, there was not confirmation on a statistical basis that the random walk naive models were in all cases more accurate than the

mean reverting models. It was found on a nonstatistical basis that the random walk naive models had a greater number of accurate forecasts than did the mean reverting naive models. When the two mean reverting models were analyzed statistically it was found that the moving average of a pure mean reverting process model was more accurate than the pure mean reverting model.

Forecast Errors Related to Stock Price Changes. The first tests of the association between forecast errors and stock prices dealt with the question of whether the direction of the price response was associated with the direction of the forecast error. The chi-square test for two by two contingency tables was utilized to examine this question. As a result of this test it was concluded that there was no significant association between the sign of the forecast error and the sign of the price response for either management forecasts or forecasts generated by the naive models.

In order to find whether there was an association between the direction of management forecast errors and the direction of the stock price response which was not present for the naive models the above analysis was extended. Cases were found where the management forecast and a naive forecast for the same firm were on opposite sides of actual earnings. The test was used to see if in these situations the sign of the price response tended

to follow the sign of management forecast error rather than the sign of the naive model forecast error. The technique utilized to examine this question was the Fisher Exact Probability Test. It was found that in cases where management forecasts and naive forecasts were on opposite sides of actual earnings there was no tendency for the sign of the price response to follow the sign of the management forecast error. However, neither was there a tendency for the sign of price response to follow the sign of the naive model forecast error.

The analysis was then expanded to include not only the direction of the forecast error and the direction of the price response but to include their magnitudes as well. The approach taken was to obtain rank order correlations between forecast errors and price responses. It was found that there were low but positive correlations between the size of the forecast errors and the size of the price responses. This was true for all forecast models and all measures of forecast error. Examination of the correlations revealed that when errors were computed relative to stock prices management forecasting errors were more closely associated with the price responses than were forecast errors obtained from any of the naive models, although differences between the models were small. However, when errors were computed relative to actual earnings and to forecast earnings, the management forecast errors were not the errors most

closely associated with the price responses.

Since the correlations did not conclusively answer the question of whether there was a greater association between management forecast errors and price responses than existed for the naive models, additional tests were conducted. Cases were found where there were large differences between management forecast errors and naive model forecast errors. Then both the management forecast errors and the naive model forecast errors were correlated with the price responses. The question was whether there was a greater correlation between management forecast errors and the price responses than there was between the naive model forecast errors and the price responses. It was found that when errors were computed relative to actual earnings management forecast errors were more closely associated with price responses than any of the naive model errors. However, the differences in the associations were small. When errors were computed relative to forecasts, management forecast errors were more closely associated with price responses in only two of the four comparisons with the naive models. When errors were computed relative to price in no case were management forecast errors more closely associated with the price responses than were the naive model forecast errors. The results were again inconclusive. For some methods of computing forecast errors and in comparison with some of the naive model forecasts, management forecasts appeared

to be more closely associated with price responses than did the naive model forecasts.

In an attempt to remove tne ambiguity in the interpretation of these test results a final approach was utilized. This involved a nonstatistical matrix analysis. Matrices were prepared to examine whether high forecast errors seemed to be associated with high price responses, medium errors with medium price responses, and low errors with low price responses. The analysis of this matrix data, although nonstatistical, seemed to confirm that there was an association between the size of the forecast error and the size of the price responses. However this pattern was not unique to management forecast errors.

Limitations of the Study

Before examining the implications of the conclusions obtained from the study the limitations of the study should be reemphasized. The first limiting factor is that the management forecasts which were utilized in the study were not actually a part of published financial reports. It is possible then that forecasts published in financial reports could differ from those used in the present study. However, since the forecasts used were published in The Wall Street Journal which allowed considerable exposure to the investing public this may not be a serious limitation.

Another limitation of the study is that the subject firms do not represent a random sample of New York Stock Exchange firms. Thus, the results of the study cannot be statistically generalized beyond the firms included in the study.

It will be recalled that several selection criteria were applied in the process of gathering the management forecasts. Not the least significant of these selection criteria was that the firm must have published a forecast of earnings per share. This might lead to a bias in the study because firms not publishing usable forecasts may be different from those that published usable forecasts. As an example, a firm might not have published a forecast because it felt unable to generate an accurate forecast.

Another selection criterion was that forecasts were taken from the January-April editions of The Wall Street Journal. This meant that most of the firms in the sample had years ending on December 31. However, it was possible for a firm having a year ending in September, October, or November to be included in the sample. The results of the study could then be peculiar to the period from which forecasts were selected. However, in view of the variety of firms selected and of the economic conditions existing during the selection period this again may not be a serious limitation.

Implications

The results of the study definitely indicate that management forecasts are more accurate than forecasts generated by the naive models used in the study. These results while significant must be viewed with a certain amount of caution. Perhaps if alternative naive models had been used one or more of these models would have generated forecasts more accurate than those made by management.

Given that management forecasts appeared to be more accurate than forecasts made by the naive models, it is somewhat surprising that a stronger relation was not found to exist between management forecasts and stock prices. It was true that in some cases a stronger relationship existed between management forecasts and stock prices than existed between naive model forecasts and stock prices. However, no pattern of consistent superiority was found in the associations between management forecasts and stock prices. If such superiority had existed, it could have been concluded that there was a stock price reaction to management forecasts. However, in the absence of such clear superiority of management forecasts over naive model forecasts such a conclusion does not seem warrented.

The results of the study do not then clearly indicate that management forecasts of earnings per share have informational content.

This finding may have been the result of management forecasts not being sufficiently more accurate than the naive model forecasts. An alternative explanation might be that investors make use of other methods in forming expectations of future earnings per share. This might explain why low correlations existed between all of the forecast errors and stock prices.

Recommendations

The results of the study seem to point to areas for future research. As a first step some of the limitations of the present study could be removed or at least reduced. Since management forecasts are now allowed to be a part of Securities and Exchange Commission reports it may become possible to obtain a larger sample of management forecasts. This would allow another limitation to be eliminated in that forecasts taken from such reports would have actually been a part of published financial reports.

It might also be possible to expand the number of management forecasts available by expanding the portion of the year from which management forecasts are taken. This would have the additional advantage of eliminating any bias which might have existed as a result of the forecasts being taken from the first four months of the calendar year. In addition, it might be possible to use forecasts made by firms listed on other than the New York Stock Exchange.

Another area of research activity could be to increase the number of naive models used in comparison to management forecasts. In this same vein perhaps analysts' forecasts could be included to make further research more comprehensive.

The first chapter indicated that a number of questions had been raised concerning the possible publication of management forecasts as a part of a firm's financial statements. Many of these questions could be developed into researchable areas. For example, does the publication of management earnings forecasts lead to manipulations of the actual reported earnings to bring such earnings in line with the forecast?

The area of management forecasting appears to offer many possibilities for future research efforts. Since this is an area in which the accounting profession might better serve the investment community, it is hoped that such research efforts will be pursued.

APPENDIX A

SAMPLE FIRMS

Company Name	Mfg or Non Mfg	Industry Code	Industry
Airco, Inc.	Mfg	281	Industrial Inorganic and Organic Chemicals
Allegheny Power System, Inc.	Non Mfg	491	Electric Companies and Systems
Allied Chemical Corp.	Mfg	281	Industrial Inorganic and Organic Chemicals
Alpha Portland Industries, Inc.	Mfg	324	Cement, Hydraulic
Amlac Industries, Inc.	Mfg	361	Electrical Equipment and Machinery
American Can Co.	Mfg	341	Metal Cans
American Electric Power Co., Inc.	Non Mfg	491	Electric Companies and Systems
American Export Industries, Inc.	Non Mfg	441	Deep Sea Transportation
American Telephone & Telegraph Co.	Non Mfg	481	Telephone Communication
Ametek, Inc.	Mfg	381	Engineering and Scientific Instruments
Arizona Public Service Co.	Non Mfg	491	Electric Companies and Systems
Armco Steel Corp.	Mfg	331	Blast Furnaces, Steel Works, and Rolling and Finishing Mills
Arvin Industries, Inc.	Mfg	371	Motor Vehicles and Motor Vehicle Equipment
Avco Corp.	Mfg	372	Aircraft and Parts

Company Name	Mfg or Non Mfg	Industry Code	Industry
Babcock & Wilcox Co.	Mfg	349	Miscellaneous Fabricated Metal Products
Bangor Panter Corp.	Mfg	221	Textile Mill Products
Belco Petroleum Corp.	Non Mfg	131	Crude Petroleum and Natural Gas
Bliss & Laughlin, Inc.	Mfg	331	Blast Furnaces, Steel Works, and Rolling and Finishing Mills
C.I.T. Financial	Non Mfg	614	Personal Credit Institutions
Central Hudson Gas & Electric	Non Mfg	491	Electrical Companies and Systems
Central Illinois Light Co.	Non Mfg	493	Combination Companies and Systems-Electric and Gas
Central & Southwest Corp.	Non Mfg	491	Electrical Companies and Systems
Cessna Aircraft Co.	Mfg	372	Aircraft and Parts
Chesapeake Corp. (Va.)	Mfg	262	Paper and Allied Products
Chicago Pneumatic Tool Co.	Mfg	354	Metalworking Machinery and Equipment
Commonwealth Edison Co.	Non Mfg	491	Electric Companies and Systems
Continental Can Co.	Mfg	341	Metal Cans
Continental Steel Corp.	Mfg	331	Blast Furnaces, Steel Works, and Rolling and Finishing Mills
Copper Range Co.	Mfg	333	Smelting and Refining of Nonferrous Metals
Crompton & Knowles Corp.	Mfg	355	Special Industry Machinery

Company Name	Mfg or Non Mfg	Industry Code	Industry
Crown Cork & Seal Co., Inc.	Mfg	341	Metal Cans
Cummins Engine Co., Inc.	Mfg	351	Engine and Turbines
Curtiss Wright Corp.	Mfg	372	Aircraft and Parts
Detroit Edison	Non Mfg	491	Electric Companies and Systems
Dr. Pepper Co.	Mfg	209	Non-alcoholic Beverages and Carbonated Waters
Dow Chemical Co.	Mfg	281	Industrial Inorganic and Organic Chemicals
Duke Power Co.	Non Mfg	491	Electric Companies and Systems
Eaton Corporation	Mfg	371	Motor Vehicles and Motor Vehicle Equipment
Evans Products Co.	Mfg	241	Lumber and Wood Products, except Furniture
Ex-Cell-O Corp.	Mfg	354	Metalworking Machinery and Equipment
Far West Financial Corp.	Non Mfg	612	Savings and Loan Associations
Federal Mogul, Inc.	Mfg	356	General Industrial Machinery and Equipment
Federal Paper Board	Mfg	262	Paper and Allied Products
Ferro Corp.	Mfg	285	Paints, Varnishes, Lacquers, Enamels and Allied Products
Flintkote Co.	Mfg	326	Miscellaneous Nonmetallic Mineral Products

Company Name	Mfg or Non Mfg	Industry Code	Industry
FMC Corp.	Mfg	281	Industrial Inorganic and Organic Chemicals
Foster Wheeler Corp.	Mfg	355	Special Industrial Machinery
General Public Utilities	Non Mfg	591	Electric Companies and Systems
General Steel Industries, Inc.	Mfg	331	Blast Furnaces, Steel Works, and Rolling and Finishing Mills
General Tire & Rubber Co.	Mfg	301	Tires and Inner Tubes
Gulf Oil Corp.	Mfg	291	Petroleum Refining
Gulf States Utilities Co.	Non Mfg	491	Electric Companies and Systems
High Voltage Engineering Corp.	Mfg	366	Communication Equipment, Electronic Components, and Accessories
Household Finance	Non Mfg	614	Personal Credit Institutions
Iowa Power & Light Co.	Non Mfg	493	Combination Companies and Systems-Electric and Gas
Johns Manville Corp.	Mfg	326	Miscellaneous Nonmetallic Mineral Products
Jonathan Logan, Inc.	Mfg	231	Miscellaneous Fabricated Textile Products
Earl M. Jorgensen Co.	Non Mfg	509	Miscellaneous Wholesalers
Joy Manufacturing Co.	Mfg	352	Farm Machinery, Construction, Mining and Materials Handling Machinery and Equipment

Company Name	Mfg or Non Mfg	Industry Code	Industry
Libby Owens Ford Co.	Mfg	321	Blast Furnaces, Steel Works, and Rolling and Finishing Mills
McNeil Corp.	Mfg	355	Special Industrial Machinery
Medusa Portland Cement	Mfg	324	Cement, Hydraulic
Montana Dakota Utilities Co.	Non Mfg	493	Combination Companies and Systems-Electric and Gas
Mountain Fuel Supply Co.	Non Mfg	492	Gas Companies and Systems
NVF Co.	Mfg	306	Miscellaneous Rubber and Plastic Products
National Distillers & Chemical Corp.	Mfg	208	Alcoholic and Malt Beverages
National Fuel Gas Co.	Non Mfg	492	Gas Companies and Systems
Occidental Petroleum Corp.	Non Mfg	509	Miscellaneous Wholesalers
Overnight Transportation Co.	Non Mfg	421	Trucking, Local and Long Distance
Pacific Lighting	Non Mfg	492	Gas Companies and Systems
Pepsico, Inc.	Mfg	209	Non-alcoholic Beverages and Carbonated Waters
Public Service Co. of Indiana, Inc.	Non Mfg	491	Electric Companies and Systems
Reichhold Chemicals	Mfg	281	Industrial Inorganic and Organic Chemicals
Reliance Electric Co.	Mfg	361	Electrical Equipment and Machinery

Company Name	Mfg or Non Mfg	Industry Code	Industry
Royal Crown Cola	Mfg	209	Non-alcoholic Beverages and Carbonated Waters
Scott Paper	Mfg	262	Paper and Allied Products
Scovill Mfg Co.	Mfg	333	Smelting and Refining of Nonferrous Metals
Simmons Co.	Mfg	251	Furniture and Fixtures
Stauffer Chemical Co.	Mfg	281	Industrial Inorganic and Organic Chemicals
Sun Chemical Corp.	Mfg	285	Paints, Varnishes, Lacquers, Enamels and Allied Products
Sundstrand Corp.	Mfg	356	General Industrial Machinery and Equipment
Toledo Edison	Non Mfg	491	Electric Companies and Systems
UAL Inc.	Non Mfg	451	Air Transportation
United States Gypsum	Mfg	326	Miscellaneous Non-metalic Mineral Products
U.S. Industries, Inc.	Mfg	354	Metalworking Machines and Equipment
Uniroyal Corp.	Mfg	301	Tires and Inner Tubes
Vulcan Materials Co.	Mfg	326	Miscellaneous Non-metalic Mineral Products
Washington Water Power Co.	Non Mfg	491	Electric Companies and Systems

Company Name	Mfg or Non Mfg	Industry Code	Industry
Weyerhauser Co.	Mfg	241	Lumber and Wood Products, except Furniture
White Motor	Mfg	371	Motor Vehicles and Motor Vehicle Equipment

*The information included in these columns was taken from Securities and Exchange Commission, Directory of Companies Filing Annual Reports With the Securities and Exchange Commission. 1967 (Washington, D.C., U.S. Government Printing Office, 1967).

APPENDIX B

AN EXAMPLE OF THE COMPUTATION OF THE PRICE RESPONSE, ASSUMING DISCRETE COMPOUNDING

The starting point in obtaining the compound price response was to obtain monthly rates of return for individual securities. This was accomplished through the application of the market model. What was desired, however, was the price response which occurred over a test period. To accomplish this end the monthly rates of return were compounded over the test period for each security. Assuming discrete compounding, the compounding formula would be as follows:

$$PR_M = \prod_{m=1}^{M} (1 + C_{im})$$

Where:

M = month 1,2,...T

C_{im} = the rate of return of firm (i), for month (m).

For purposes of illustration the following monthly rates of return were assumed for six companies.

Abnormal Rates of Return

Month	Monthly Abnormal Rates of Return (C_{im}) for Company				
	1	2	3	6	7
1	-.01	+.01	+.02	-.06	-.06
2	+.03	+.03	-.01	-.02	-.05
3	+.06	_.04	+.03	-.01	-.06
4	+.00	+.01	+.02	-.01	-.05
5	+.02	+.02	+.02	-.02	-.01
6	+.05	+.05	+.01	-.03	-.02
7	-.01	+.02	+.01	-.04	.00
8	+.03	+.00	+.01	-.03	.01
9	+.02	-.01	+.02	+.01	-.02
10	+.01	+.00	+.03	+.00	+.03
11	+.01	+.01	+.00	+.02	-.01
12	+.03	.04	+.04	-.03	-.04

Then the monthly rates of return were compounded using a process of consecutive multiplication. Companies one and six illustrate the computations.

Calculation of the Compound Price Response of a Company

Month	1	6
1	1-.01 = .99	1-.06 = .94
2	.99(1+.03) = 1.0197	.94(1-.02) = .9212
3	1.0197(1+.06) = 1.0808	.9212(1-.01) = .9119

The following table presents the results of the discrete compounding process.

	Compound Price Response for Company				
Month	1	2	3	6	7
1	.9900	1.0100	1.0200	.9400	.9400
2	1.0197	1.0403	1.0098	.9212	.8930
3	1.0808	1.0819	1.0401	.9199	.8394
4	1.0808	1.0927	1.0609	.9107	.7975
5	1.1024	1.1146	1.0821	.8925	.7895
6	1.1575	1.1703	1.0929	.8657	.7737
7	1.1459	1.1937	1.1039	.8311	.7737
8	1.1803	1.1937	1.1149	.8062	.7817
9	1.2039	1.1817	1.1372	.8142	.7658
10	1.2159	1.1817	1.1713	.8142	.7428
11	1.2281	1.1936	1.1713	.8305	.7354
12	1.2649	1.2414	1.2182	.8056	.7060

BIBLIOGRAPHY

American Accounting Association. A Statement of Basic Accounting Theory (Evanston: American Accounting Association, 1966).

Baker, J. Kent, and Haslem, John A. "Information Needs of Individual Investors," The Journal of Accountancy, November, 1973, 136(15), pp. 64-69.

Baskin, Elba F. "The Communicative Effectiveness of Consistency Exceptions," The Accounting Review, January, 1972, XLVII, pp. 38-51.

Beaver, William H. "The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, A Supplement to Volume 6 of the Journal of Accounting Research, pp. 67-101.

Beaver, William H. "The Time Series Behavior of Earnings," Empirical Research in Accounting: Selected Studies, 1970, A Supplement to Volume 8 of the Journal of of Accounting Research, pp. 62-99.

Beaver, William H. and Dukes, Roland E. "Interperiod Tax Allocation, Earnings Expectations, and the Behavior of Security Prices," The Accounting Review, April, 1972, XLVII, pp. 320-332.

Beaver, William H., Kennelly, John W. and Voss, William M. "Predictive Ability as a Criterion for the Evaluation of Accounting Data," The Accounting Review, October, 1968, XLIII, pp. 675-683.

Benston, George J. "Published Corporate Accounting Data and Stock Prices," Empirical Research in Accounting: Selected Studies, 1967, A Supplement to Volume 5 of the Journal of Accounting Research, pp. 1-54.

Bernstein, Allen L. A Handbook of Statistics Solutions for the Behavioral Sciences (New York: Holt, Rinehart and Winston, Inc., 1964).

Board of Governors, Federal Reserve System, 1973 Historical Chart Book (Washington D. C. Federal Reserve System, 1973).

Brown, Phillip, and Ball, Ray. "Some Preliminary Findings on the Association Between the Earnings of the Firm, Its Industry and the Economy," Empirical Research in Accounting: Selected Studies, 1967, A Supplement to Volume 5 of the Journal of Accounting Research, pp. 55-85.

"Business Fears Profit Forecasting," Business Week, November 4, 1972, p. 44.

Cooper, W. W., Dopuch, N., and Keller, T. F. "Budgeting Disclosure and Other Suggestions for Improving Accounting Reports," The Accounting Review, October, 1968, XLIII, pp. 640-647.

Copeland, Ronald M. and Marioni, Robert J. "Executives Forecasts of Earnings Per Share Versus Forecasts of Naive Models," Journal of Business, April, 1972, 45(4), pp. 497-512.

"Corporate Earnings Forecasts," Financial Analysts Journal, March/April, 1972, 28(2), p. 17.

Dyckman, Thomas R. "On the Investment Decision," The Accounting Review, April, 1964, XXIX, pp. 285-295.

Elton, Edwin J. and Gruber, Martin J. "Improved Forecasting Through the Design of Homogeneous Groups," The Journal of Business, October, 1971, 44(4), pp. 432-450.

Fama, Eugene F. "Efficient Capital Markets: A Review of Theory and Empirical Work," The Journal of Finance, May, 1970, XXV, pp. 383-417.

Fama, Eugene F., Fisher, Lawrence, Jensen, Michael C. and Rall, Richard. "The Adjustment of Stock Prices to New Information," International Economic Review, February, 1969, X, pp. 1-21.

Freund, John E. Mathematical Statistics (Englewood Cliffs: Prentice-Hall, Inc., 1962).

"Full Disclose and the Changing Business Environment," Haskins & Sells, The Week in Review, April 27, 1973, pp. 9-10.

Gapay, Les. "SEC Plans to Let Concerns Forecast Profit in Filings," The Wall Street Journal, February 2, 1973, p. 3.

Gonedes, Nicholas J. "Efficient Capital Markets and External Accounting," The Accounting Review, January, 1972, XLVII, pp. 11-21

Gonedes, Nicholas J. "The Significance of Selected Accounting Procedures: A Statistical Test," Empirical Research in Accounting: Selected Studies, 1969, A Supplement to Volume 7 of the Journal of Accounting Research, pp. 90-123.

Gonedes, Nicholas J. "Some Evidence on Investor Actions and Accounting Messages--Part I," The Accounting Review, April, 1971, XLVI, pp. 320-328.

Gonedes, Nicholas J. "Some Evidence on Investory Actions and Accounting Messages--Part II," The Accounting Review, July, 1971, XLVI, pp. 535-551.

Gray, William S. "Proposal for Systematic Disclosure of Corporate Forecasts," Financial Analysts Journal, January/February, 1973, 29(1), pp. 64-71.

Green, David and Segall, Joel. "The Predictive Power of First-Quarter Earnings Reports," The Journal of Business, January, 1967, XXXX, pp. 44-45.

Green, David and Segall, Joel. "The Predictive Power of First-Quarter Earnings Reports: A Replication," Empirical Research in Accounting: Selected Studies, 1966, A Supplement to Volume 4 of the Journal of Accounting Research, pp. 21-36.

Janell, Paul A. An Empirical Evaluation of the Relationship Between Errors in Analysts' Forecasts of Earnings Per Share and Stock Prices. (Unpublished Ph.D. dissertation, Michigan State University, 1974.)

Kapnick, Harvey F. "Will Financial Forecasts Really Help Investors?" Financial Executive, August, 1972, pp. 50-54.

King, Benjamin F. "Market and Industry Factors in Stock Price Behavior," The Journal of Business, January, 1966, XXXIX, pp. 139-190.

Lorie, James and Brealey, Richard. Modern Developments In Investment Management. (New York: Praeger Publishers, 1972).

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

May, Robert G. "An Empirical Evaluation of the Significance of Quarterly Accounting Data in Investor Decision Making, (Unpublished Ph.D. dissertation, Michigan State University, 1970).

Mendenhall, William. Introducation to Probability and Statistics, 2nd Edition (Belmont: Wadsworth Publishing Company, Inc., 1969).

Mlynarczyk, Francis A., Jr. "An Empirical Study of Accounting Methods and Stock Prices," Empirical Research in Accounting: Selected Studies, 1969, A Supplement to Volume 7 of the Journal of Accounting Research, pp. 63-89.

New York Stock Exchange Guide, Volume III--Related Laws and Regulations. (New York: Commerce Clearing House, Inc., 1962).

Niederhoffer, Victors and Regan, Patrick J. "Earnings Changes, Analysts' Forecasts, and Stock Prices," The Financial Analysts Journal, May/June, 1972, XXVIII(3), pp. 65-71.

Philippatos, George C. Financial Management Theory and Techniques. (San Francisco; Holden-Day, Inc., 1973).

Prestbo, John A. "....And An Expert Who Says They Won't Work." The Wall Street Journal, December 11, 1972, LIII(40), p. 8.

Schattke, Rudy. "Expected Income--A Reporting Challenge," The Accounting Review, October, 1962, XXXVII, pp. 670-676.

Sharpe, William F. "A Simplified Model For Portfolio Analysis," Management Science, January, 1973, IX(2), pp. 277-293.

Siegel, Sidney. Nonparametric Statistics. (New York: McGraw-Hill, 1956).

Stewart, Jr., Samuel S. "Research Report On Corporate Forecasts," Financial Analysts Journal, January/February, 1973, 29(1), pp. 77-85.

Wilkinson, T. R., and Doney, L. D. "Extending Audit and Reporting Boundaries," The Accounting Review, October, 1965, XL, pp. 753-756.

Williamson, J. Peter. Investments, New Analytic Techniques. (New York: Praeger Publishers, 1971).