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ABSTRACT

THE INFLUENCE OF QUARTERLY EARNINGS ANNOUNCEMENTS ON INVESTOR DECISIONS AS REFLECTED IN COMMON STOCK PRICE CHANGES

by

Robert George May

Unless specifically exempted, every company whose securities are listed on either the New York Stock Exchange or American Stock Exchange is required to report unaudited earnings summaries every quarter. As a result of the influence of major securities exchanges, the practice of reporting quarterly earnings is well established in our economy and shows no sign of diminishing in spite of the doubts that practicing accountants have expressed from time-to-time about the reliability of quarterly income measurements.

Although accountants recognize that their earnings measurements for any finite period, short of the full life of an entity, are subject to uncertainty, their expressed concern about quarterly measurements is grounded on their knowledge of problems affecting quarterly income measurements to which annual measurements are not vulnerable. Furthermore, their anxiety is heightened by the fear that investors do not share accountants' knowledge of the relative limitations of quarterly measurements and will therefore be misled by relying too heavily on quarterly accounting data.

During the last decade writers have frequently made suggestions that show promise of increasing the reliability of quarterly accounting measurements relative to their annual counterparts. But recent evidence indicates that there is still a great deal to be done and that the pace

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of improvement has apparently been slow. What has been lacking in discussions of needed improvements in quarterly accounting data is evidence of the influence of quarterly data on actual investment decisions. The purpose of this study has been to provide the needed evidence both to facilitate decisions having to do with improving quarterly data and to provide information about investor sensitivity to the quality (reliability) of accounting data.

Examination of investor response to quarterly earnings announcements, as reflected by common stock price changes in the week of announcements, produced the basic evidence of the study. Average stock price-change responses (corrected for market changes) in weeks of quarterly earnings announcements were compared to average stock price changes in annual announcement weeks and in non-announcement weeks for a sample of 105 American Stock Exchange firms over a three-year period. Generally, it was found that whereas average price-change response to quarterly earnings announcements was significantly greater than the average price change in non-announcement weeks (the difference was highly significant), the response to quarterly announcements was not significantly less than the response to the more reliable annual announcements.

That investor response to quarterly data is not significantly different from investor response to annual data led to two conclusions: (1) that the lesser effort invested in quarterly accounting measurement relative to annual measurement is not justified on the basis of greater influence of annual data on investor decisions, and (2) that it is not clear that investors are aware of or take account of differences in

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quality of quarterly and annual data in making investment decisions. Since quarterly data were found to be highly significant in their influence on investors, the implication is that significant benefits to investors can be realized by accountants and managements who take steps to improve the quality of their quarterly data relative to annual data and to clearly apprise investors of remaining relative deficiencies in their quarterly data. To the extent that investors are made aware of the relative limitations of quarterly data it will become less likely that they will act with a strength of conviction not justified by the reliability of the data on which their decisions are based. On the other hand, since actual investor decisions are clearly influenced by quarterly earnings data, any increases in the reliability of the data presumably will lead to more efficient investor decisions.

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By

Robert George May

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CHAPTER I

INTRODUCTION

This chapter briefly outlines the institutional background of interim accounting reports, the problems associated uniquely with interim accounting measurement, the purpose and motivation of the study, and finally the approach and organization of the dissertation.

Institutional Background of Interim Reporting¹

In spite of attendant theoretical and practical problems, quarterly financial statements (or announcements), giving summary sales and earnings data for periods less than a year, are currently well entrenched in our economy and appear to be "here to stay."

The stock exchanges and financial analysts have been the primary proponents of interim financial reports. The New York Stock Exchange has advocated interim reports for its listed companies since 1910 and has been the dominant influence in expanding the practice of quarterly reporting. The American Stock Exchange, in its listing requirements, revised in 1962, requires its listed companies to make quarterly financial reports to the public. At the time that the revised requirements went into effect some 60% of its listed companies were already conforming to the

¹This brief description of the institutional framework of interim reporting essentially paraphrases a fine review given by Robert G. Taylor, "A Look at Published Interim Reports," The Accounting Review, XL, No. 1 (January, 1965), pp. 89-96.

quarterly reporting requirement. It was largely as a result of pressure from the Financial Analysts Federation that the SEC adopted a requirement for the brief and unaudited semi-annual income statement 9-K, on June 23, 1955.

Practicing accountants and their professional associations have generally been reluctant to endorse interim financial reports and have, in the past, resisted interim reporting requirements by authorities such as the SEC. The American Institute of Accountants noted in its 1936 bulletin that it pointed out to Congress during consideration of the Securities and Exchange Bill that statements for interim periods are likely to mislead investors.¹ Carman Blough, then editor of the Journal of Accountancy, editorialized against the 1952 proposal by the SEC for an interim reporting requirement.²

Although sharing some of the caution of practicing accountants, academic accountants have been much more positive in recognizing the value of interim reports to investors. In 1934 Sanders suggested that investors needed interim information and that accountants should supply it, each reporting firm dealing with seasonality and other problems as best it can.³ In Accounting and Reporting Standards the Committee on

¹American Institute of Accountants, "Discussion of Proper Basis for Quarterly Reports," Bulletin of the American Institute of Accountants, No. 144 (April 16, 1936), p. 14, as cited in Taylor, The Accounting Review, Vol. XL, No. 1.

²Carman D. Blough (editor), "Some Dangers Inherent in Quarterly Financial Statements," Journal of Accountancy, Vol. XCV, No. 2 (February, 1953), pp. 221-222.

³Sanders, T. H., "Reports to Stockholders," The Accounting Review, Vol. IX, No. 3 (September, 1934), as cited in Taylor, The Accounting Review, Vol. XL, No. 1.

Concepts and Standards Underlying Corporate Financial Statements of the American Accounting Association exhibited a belief in the potential value of interim accounting information in the statement that:

...it endorses the growing practice of supplementing annual reports by statements giving highlights of interim periods operations and suggests the need for special and prompt recording of unusually significant events.¹

Unfortunately, the SEC has generally been caught in the middle of the positions of these interested groups, first agreeing with one position, then the other. In 1946 the SEC began requiring quarterly sales data and later proposed requiring quarterly income statements as well. But resistance to these proposals was so strong that even the sales requirement was withdrawn in 1953. As was noted above, in response to pressure from security analysts, the SEC in 1955 finally set interim income statement requirements that have endured to the present.

The Wheat Disclosure Study, still under consideration by the SEC, has again recommended, among other things, that the SEC require unaudited quarterly reports of companies with registered securities.² As of the time of this writing, however, "The Commission has neither adopted, approved nor disapproved the report."³

¹American Accounting Association, Accounting and Reporting Standards (Columbus, Ohio: American Accounting Association, 1957), p. 46.

²U. S. Securities and Exchange Commission, "Summary of Disclosure Policy Study Report Entitled: Disclosure to Investors--A Re-appraisal of Administrative Policies Under the '33 and '34 Acts."

³Ibid., p. 1.

Problems of Interim Income Measurement

Although measurement of income for any period shorter than the life of the enterprise presents difficult problems¹ there are additional problems of income measurement for periods as short as a fiscal quarter that are not encountered in annual income measurement. Indeed, an examination of some of the additional problems seems to explain partially the historical resistance to interim reporting requirements on the part of some representatives of practicing accountants. The additional problems of income determination can be conveniently grouped by their source. The three major sources are: (1) the institutionalization of the one-year period, (2) seasonality, and (3) degree of aggregation of the effects of random events.

Institutionalization of the One-Year Period

Institutionalization of the one-year period is manifest in the many accounting variables whose measurement is finalized only once each year. Income tax expense, pension costs and profit shares are typically finalized at the end of the fiscal year either by fiat or in accordance with contractual provisions. But the measurement of many other accounting variables is finalized only once a year for reasons of economy or practicality. Examples of the latter are the adjustment of recorded inventory for physical shrinkage and obsolescence, and the variety of other adjustments that may result from the typically once-a-year application of audit procedures.

Institutionalization of the one year accounting period means

¹Eldon S. Hendriksen, Accounting Theory (Homewood, Illinois: Richard D. Irwin, Inc., 1965), p. 103.

that for interim purposes the values of many variables must be estimated with a lesser degree of certainty than their annual counterparts. To the extent that the values of particular variables are incorrectly estimated for the first three quarters of a fiscal year, their patterns may potentially mislead investors in forming expectations of the annual values that ultimately supercede them.¹ In a research study that will be described in the next chapter, Gale E. Newell confirmed that this potential is reflected in the actual patterns of reported quarterly accounting information.²

Seasonality

Seasonal fluctuations in various activities of business enterprises can lead to substantial within-year mismatching of expense with related revenue unless considerable additions to the procedures for

¹A classic example of the potential of quarterly values for misleading investors in forming their expectations of annual values, due to a typically once-a-year measurement cycle, was reported by Gordon Shillinglaw in "Concepts Underlying Interim Financial Statements," Accounting Review, Vol. XXXVI, No. 2 (April, 1961), p. 228. Relating the results of a survey of the interim accounting practices of six companies the author noted that:

"...Each of the companies makes an equal provision for year-end bonus in each of the first three quarters, based on the bonus paid in the previous year, despite the fact that in every case the amount of the annual bonus is based on the operating results of the current year. Any change in the annual bonus is concentrated in the fourth quarter statements only."

For another classic example having to do with annual inventory adjustments see discussion of the case of Kaiser Frazer vs. Otis and Company in SEC Accounting Practice and Procedure (2nd edition; New York: Ronald Press Co., 1963), by Louis H. Rappaport.

²Gale E. Newell, "Published Quarterly Financial Data: Their Adequacy for Investment Decision Making" (unpublished doctoral dissertation, Michigan State University, East Lansing, Michigan, 1968).

allocating expense among years are employed in allocating expense within years. A well-known and widely adopted additional within-year allocation practice with respect to production costs is the accrual of vacation pay throughout the year. Many manufacturing and non-manufacturing expenses, however, are not clearly amenable to within-year allocation, although they vary with both the season and production. For instance, employers' shares of F.I.C.A. tax, heat, light and similar expenses which may be incurred at uneven within-year rates unrelated to production rates, cause variation in incurrence of factory overhead that cannot be attributed to production or efficiency levels. Thus interim overhead variances will in part stem from the usual causes, efficiency and activity levels, and in part from seasonal fluctuations in expense incurrence. As Shillinglaw points out, if each variance is totally deferred at interim dates, adjustment of income for deviations from budgeted levels of activity and efficiency will be felt in the fourth quarter, whereas if each variance is totally charged or credited to income and/or inventory" ...fluctuations in reported income may be either damped or intensified depending on the relationship between seasonal patterns in costs [incurred], in production, and in sales."¹ A more refined treatment requires charging or crediting the efficiency and activity-related portions of variances to income and inventory accounts, while deferring the season-related portions.² But such treatment requires more sophisticated observation and analysis of cost patterns on the part of management.

Just as some factory costs may vary with the time of year as

¹Shillinglaw, The Accounting Review, Vol. XXXVI, No. 2, p. 226.

²Ibid., pp. 226-227.

well as with production levels, some variable non-manufacturing costs may bear different relations to sales volume in different seasons. Furthermore, some non-manufacturing costs that do not vary in any discernable way with sales may nevertheless vary with the time of year, e.g., the cost of heat and light in administrative office buildings. As with the season-related factory costs the effects of such non-manufacturing cost patterns can be accommodated by management or allowed to "flow through" to interim income.¹ In any case the problems caused by seasonality of both manufacturing and non-manufacturing costs are not avoided. Their burden may simply be transferred to investors to a greater or lesser degree through more or less sophisticated cost allocation procedures.²

Random Fluctuations

In the researcher's experience, discussions in the literature of the problems of interim reporting merely mention greater random fluctuation as one limitation of interim measurements relative to annual measurements. The reasons for and nature of the limitation are left to the experienced reader's intuition or imagination. The reason for greater relative variability³ of interim measurements is their lesser

¹Ibid., p. 227.

²The notion that the degree of within-year allocation of season-related cost elements merely regulates the portion of season-related income determination problems that the investor must cope with was first encountered by the researcher in "On Criteria for Judging Accounting Earnings Estimators," adapted from John W. Kennelly, "An Empirical Investigation of Interim Earnings Reports" (unpublished Ph.D. dissertation University of Chicago, in progress).

³Relative variability for present purposes is intended to mean the range of chance variability of a variable compared to the average size of that variable.

degree of aggregation (over partially chance-determined events) relative to annual measurements. Since the relation between relative variability and aggregation may not be intuitively obvious to every reader, an illustration is provided in the Appendix.¹ A reader who is not really secure in his understanding of the nature of the relationship between aggregation and variability is encouraged to read this Appendix before going on. The present discussion will continue with consideration of the limitation imposed on interim accounting measurements by their greater chance variability.

Chance variability in measured variables essentially tends to obscure the non-chance-determined portion of a given measured level of the variable. As a result, inferences (including estimates or predictions) that an interested person wishes to draw from partially chance-determined variables are not perfectly efficient.² In fact, the efficiency of inference generally decreases as the chance variability in available observations increases.

That accounting variables are used for inferences is a well established belief among accountants.³ Their traditional concern that

¹The illustration has been omitted from the body of the discussion because it is necessarily abstract and requires knowledge of the properties of random variables on the part of the reader.

²Efficiency of estimate in statistics, the discipline devoted to accommodating chance variability in making inferences from observations, is defined as the variance of estimated values with respect to the true value of interest. Perfect efficiency may be thought of as zero variance of estimate.

³Eldon S. Hendriksen, Accounting Theory (Homewood, Illinois: Richard D. Irwin, Inc., 1965), p. 103.

investors will be misled by interim reports due to random fluctuations reflects at least an intuitive understanding of the effects of chance variability on efficiency of inference. For if investors fail to recognize the expected lesser efficiency of inferences based on more variable interim data, they will presumably act on those inferences with a strength of conviction that is not justified. Unlike the effects of institutionalization of the one year period and seasonality, there is nothing accountants can do about chance variability itself. They can only attempt to improve investors' understanding of the different degrees of chance variability inherent in accounting measurements covering accounting periods of different lengths.

Improvement in Quarterly Accounting Practice

As was pointed out in the discussion above, the limitations on quarterly accounting measurements imposed by seasonality and chance variability cannot be completely eliminated by the efforts of accountants. But the limitations imposed by institutionalization of the one year period can be substantially avoided, in some cases, by changing the law or traditional contract provisions, e.g., the cases of federal income tax expense and pension costs, in other cases by simply devoting additional resources to the measurement process, e.g., by making counts of physical inventory quantities quarterly rather than only annually. In addition, investors may be spared some avoidable effects of seasonality by more sophisticated cost allocation procedures than are required for making allocations of costs between annual periods. Furthermore, accountants could conceivably take it upon themselves to better apprise users of the implications of the greater chance-variability of interim

measurements relative to their annual counterparts.

Many specific procedural suggestions have been made in the literature for improving quarterly accounting data relative to annual data.

Some of the more widely suggested and more promising are:

1. Always defer the season related portion of factory variances at interim dates.¹
2. Separate administrative and selling expenses into fixed and sales related portions. Allocate the former to interim periods in equal lump sums, deferring a charge or credit for the difference between the amount incurred to date and the amount allocated. Allocate the latter in proportion to sales at a standard rate for the whole year with deferrals for only season-related differences in the cost-to-sales relation through the year.²
3. In all cases base quarterly estimates of once-a-year measurements on management's carefully formed judgement of the expected annual level of the measurement, not on the prior years' level or some other value unrelated to current year-to-date experience.³
4. Instigate at least limited surveillance of interim reports by independent auditors.⁴
5. Convey to the public the differential lack of precision inherent in quarterly reports by informative commentary or footnotes and/or by reporting quarterly income (and annual income) as falling in an interval rather than as a single value.⁵ The sizes of ranges given for quarterly

¹See Shillinglaw, The Accounting Review, XXXVI, No. 2, p. 227.

²Ibid., pp. 227-230. For a still more comprehensive approach to seasonality see David Green, Jr., "Towards a Theory of Interim Reports," Journal of Accounting Research, Vol. II, No. 1 (Spring, 1964), pp. 35-49.

³Shillinglaw, The Accounting Review, XXXVI, No. 2, pp. 227-230.

⁴See for example: Lee J. Seidler and William Benjes, "The Credibility Gap in Interim Financial Statements," Financial Analysts Journal, Vol. XXIII, No. 5 (September-October, 1967), pp. 114-115; Robert G. Taylor, "The Published Interim Report and the CPA," Journal of Accountancy, Vol. CXX, No. 3 (September, 1965), p. 57; and Gale E. Newell, 1968, p. 155.

⁵Newell, pp. 153 and 154.

and annual data should, of course, reflect the differential precision in measurements covering periods of different lengths.

That current accounting reporting practice does not include wide-spread adoption of most of the above suggestions is apparent to most students of interim reporting. It is reflected in the findings of research studies specifically concerned with the quality of reporting practice. For instance, consider the following statement from an official summary of the SEC's recent "Wheat Disclosure Study":

...The Study carefully examined a significant sample of quarterly financial reports and releases provided by the two [national securities] exchanges. It was readily apparent (and acknowledged by representatives of the exchanges) that they varied from extremely useful to extremely poor and uninformative.¹

and this statement from the conclusions of Newell's study of the patterns of quarterly accounting data:

The evidence presented in this study indicates that quarterly data are often inaccurate and suggests that the potential mis-advising from the use of such data is significant. As this paper has indicated, reported quarterly net income is often unreliable and therefore many of the items that are used in its determination must also be unreliable.²

Two things that seem to stand in the way of wide-spread improvement in the quality of quarterly accounting data are (1) the motivation of accountants and managers and (2) the high cost of implementing specific improvements in measurement procedures for interim reports relative to the cost of solving other problems facing accountants. The motivation

¹U.S. Securities and Exchange Commission, Disclosure to Investors: a Reappraisal of Federal Administrative Policies Under the 33 and 34 Acts (New York: Commerce Clearing House, Inc., 1969), p. 39.

²Newell, p. 155. As was promised earlier, this study's findings will be reviewed in greater detail in Chapter II.

of accountants and managers will, of course, be directly related to the cost-benefit relations inherent in each problem that demands their attention. But whereas accountants and managers may have some definite grasp of the probable costs of improvements in quarterly accounting measurement, the potential relative benefits have not been well established. Certainly information concerning the degree of use of quarterly data by investors and/or the significance of the influence of quarterly data on investors would be useful to accountants and managers who must decide whether to devote themselves to greater quality of quarterly reports or to other demanding accounting problems.

Purpose and Motivation of the Study

Although the major securities exchanges have been the prime source of organized demand for quarterly accounting data, they have not been particularly active in assessing the significance of the reports they require to the investing public. Accountants have made attempts to assess both the usefulness of quarterly data and the degree to which they are used by or influence investors. Their major efforts will be reviewed in some detail in the next chapter. But it will be seen that while the investigations into the usefulness of quarterly data may have been fruitful, the investigations into the significance of their use and/or influence have been unsatisfactory.

The purpose of this study is to provide information and motivation to accountants and managers who have to make decisions affecting the resources devoted to improving quarterly accounting measurements by attempting to answer the following two empirical research questions:

1. Do quarterly accounting data, in the form of public earnings announcements, have a significant effect

on investor decisions as reflected in market price changes?

2. Does there appear to be a significant difference between the influence on investors of quarterly and annual earnings announcements? Does the difference, if any, reflect investor awareness of the lesser quality of measurement inherent in quarterly income?

In addition to providing information relevant to the specific issue of improvement in quarterly accounting measurement, the second research question shows promise of contributing to the much broader issue of investor sensitivity to the nuances of the accounting measurement process in general. Knowledge of the sensitivity of investors to the difference in quality of annual and quarterly accounting measurements is a positive (if limited) contribution to our understanding of investor behavior. The central importance of understanding of investor behavior to future development of accounting theory is clearly expressed in the following segment from A Statement of Basic Accounting Theory:

Because of the great value of accounting information to external users, and because we have some knowledge of many users' needs, it is possible to develop significant accounting information even though the precise and total needs of each user for each decision are unknown. This is so because even crudely measured and only generally appropriate information may be of considerable use to external users in view of their highly uncertain situation. It follows that it is not necessary to develop a detailed list of all user needs in advance. On the contrary, until much more is known of the behavioral characteristics of external users, accounting information must be developed from a broad and imprecise understanding of the informational needs of external users. When and as the results of fundamental research on the informational needs of external users bear fruit, the structure of accounting theory and reporting based upon it can logically be expected to expand.¹

¹American Accounting Association, A Statement of Basic Accounting Theory (Evanston, Illinois: American Accounting Association, 1966), p. 20.

The Approach and Organization of the Study

The approach of the study is to infer from measured price changes, immediately following earnings announcements, the relative effects of quarterly earnings announcements on investors' expectations. Other ways of measuring the significance of accounting data to investors, namely questionnaire or interview-based methods, have been rejected because of their dissociation from actual decisions.¹ Price changes on the other hand, while perhaps not perfect reflections, are believed to reflect changes in expectations or at least the resulting decisions to buy, sell or hold particular securities. In addition, price changes have economic significance quite apart from any theory relating them to investor expectations.

As will be seen in Chapter II, other attempts to use price changes to assess the significance of quarterly data have not been particularly successful in answering the research questions of interest in this study. They are reviewed in Chapter II, along with other empirical research concerning interim accounting data, to provide background and a point of departure for development of more promising methodology.

Because of the experience of prior research efforts and the high level of so-far unexplained variability in stock prices, a major portion of this study is devoted to careful elaboration of a measurement system that will satisfy the two research questions of interest. Chapter III will be devoted to developing a basic expected relationship between

¹One of the major weaknesses in questionnaire and interview techniques is that the subject is not being observed under actual operating conditions but is only talking about his thought process and actions under those conditions. Thus, unrestricted by operating pressures and constraints, he is free to answer queries as he wants and may be influenced by what he believes the questioner wants to hear.

earnings announcements as specific news events about a firm and carefully measured stock price responses. Chapter IV will employ the relationship developed in Chapter III to construct measurements and tests that will satisfactorily answer the two research questions of interest in terms of sample data. Chapter V describes the selection of a population of firms for the study, the further selection of sample firms, data gathering and transformation, the results of the tests developed in Chapter IV, and finally the preliminary findings of the study with respect to the research questions.

Before reaching final conclusions based on the sample results, however, certain assumptions and potential procedural weaknesses of the methodology will be reviewed in Chapter VI, in light of the information contained in the sample data. Chapter VII will examine, ex post, the effects of sample composition on the findings of the study.

Chapter VIII will be devoted to final conclusions and recommendations.

CHAPTER II

PAST RESEARCH CONCERNING QUARTERLY ACCOUNTING DATA

Research to date concerning quarterly accounting data can be classified into the following categories:

1. A survey of reporting practice (to shareholders).
2. Studies of the utility of quarterly data for various purposes.
3. Surveys of opinion as to the usefulness of quarterly data.
4. Empirical studies of the impact on actual investor decisions of quarterly accounting data.

This chapter will simply review several studies that fall into the first three categories. But because of their similarity of purpose and approach to this project the two studies making up the fourth category will be evaluated as well as reviewed.

Survey of Reporting Practice

Robert Taylor conducted a survey of reporting practices in quarterly reports sent to shareholders during the early nineteen-sixties, following the tradition of the A.I.C.P.A. surveys of annual reporting practice.¹ Briefly, some of his detailed findings for the 600 companies surveyed were:

¹Taylor, The Accounting Review, Vol. XL, No. 1.

1. Comparative summary income statement figures were found in 97% of the cases.
2. Cumulative figures, i.e., covering the full period from the beginning of the fiscal year, were found in 38% of the cases.
3. The median number of items displayed in the income statements was nine.
4. Approximately 20% of the reports contained balance sheets.
5. The greatest variety in practices was found in the textual material included in the reports.
6. The evolution of reporting practices was observed to be in the directions of more frequent interim reports (from semi-annual to quarterly reports), more reporting directly to stockholders, and special reports to the financial community.

In the summary of his survey findings Taylor noted that the quarterly reports were more extensive than he had expected and that they were "...constantly being changed and worked on."¹

Evaluations of the Usefulness of Reported Data

With one exception the past research efforts that have focused on the usefulness of quarterly data for investment decision purposes have generally explicitly or implicitly used the criterion of ability to predict annual earnings as the determinant of usefulness. The exception, a study by George Staibus, employed the criterion of ability of comparative earnings levels to predict discounted future cash flows (measured in

¹Ibid., p. 92.

retrospect) to holders of common stocks.¹

Most explicit in the use of prediction of annual earnings as a measure of usefulness have been the forecasting studies of Green and Segall² and Brown and Neiderhoffer.³

G & S began what was to become a series of three related studies by attempting to determine whether naive but plausible forecasting models using first-quarter as well as prior years' earnings data would better predict current year annual earnings than would models using only prior years' earnings data. In a study of 50 NYSE firms for years 1959 through 1964 they computed three measures of success, the percent difference between actual and forecast earnings, the absolute percent difference, and the squared percent difference. Based on these measurements the authors tentatively concluded that first-quarter data did not promise any improvement in forecasting ability. Finding these results rather remarkable, the authors replicated the study for an additional year using the same sample of firms and an additional sample of 44 firms. The replications produced substantially the same results and conclusions as the original study.

¹George J. Staibus, "Earnings Periods for Common Share Analysis," Journal of Business, Vol. XLI (October, 1968), pp. 472-476.

²David Green Jr. and Joel Segall, "The Predictive Power of First Quarter Earnings Reports," Journal of Business, Vol. XL, No. 1 (January, 1967), pp. 44-55; "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.

³Phillip Brown and Victor Neiderhoffer, "The Predictive Content of Quarterly Earnings," Journal of Business, Vol. XLI, No. 4 (October, 1968), pp. 488-497.

B & N, apparently stimulated by the findings of the G & S studies dealing with first-quarter data, undertook to apply the G & S methodology to all three quarters' data. Their results for first-quarter data, using the same measurements but a much larger sample of firms, were mildly contradictory to the G & S findings. But as would be hoped, they found that forecasts of annual earnings improved progressively as second and third quarter data were included in the inputs to the forecasting models. Nevertheless, the average absolute forecast errors experienced by the two best models, using all three quarters data in forecasting a given annual datum, ranged from 12.9% for 1963 using one of the models to 9.3% in 1965 using the other model. Additionally, although not recognized by B & N, their tables of error measurements seem to indicate that forecasts based on quarterly as well as annual data tend to be more consistently conservative (forecast earnings lower than actual) than forecasts based on annual data alone.

Newell approached the usefulness of quarterly earnings reports from a different point of view than did the forecasting studies.¹ He evaluated the extent to which the problems associated with quarterly accounting income measurement were reflected in actual patterns of reported quarterly and annual earnings figures. Working with 87 American Stock Exchange companies, Newell found that fourth quarter ratios of net income to net sales deviated most from the annual results more frequently than would occur by chance one time in one hundred thousand. Furthermore,

¹Gale E. Newell, "Published Quarterly Financial Data: Their Adequacy for Investment Decision Making" (unpublished doctoral dissertation, Michigan State University, East Lansing, Michigan, 1968).

his finding that the fourth quarter results tended to deviate more frequently on the high side is consistent with the B & N results that indicated that forecasts based on first three quarters' data tend to be conservative. Newell concluded that "...these results verify that the problems that are inherent in quarterly reporting do affect the reported results and that quarterly statements are limited in their reliability."¹

Although, in another analysis using ratios of income tax to net income before taxes Newell did not find any conclusive evidence that management "managed" quarterly income by exercising discretion over quarterly income tax charges, he did indicate that there was some evidence that taxes were charged to interim earnings so as to state interim earnings-after-taxes conservatively. Additionally, after evaluating instances where quarterly data had been revised, it was concluded that revision did not make the quarterly data more predictive (as measured by the methodology of the forecasting studies). Indeed, as with other areas of the analysis, it was found that restatement of one year's quarterly earnings data tended to make the next year's data appear more conservative by comparison.

Staubus attempted to determine which of several lengths of observation period of firms' past earnings proved best in predicting performance of common stocks over subsequent periods of one to twelve years.² Performance was measured by discounting the actual cash flows of common stocks over the performance periods at nine percent. For each of several

¹Ibid., pp. 103-104.

²Staubus, Journal of Business, Vol. XLI.

samples, the average correlation of the performance of the sample common stocks with their related aggregate historical earnings numbers was computed for several decision dates. Conclusions were based on the number of times earnings aggregated over an historical earnings observation period of a particular length achieved the highest average correlation with subsequent performance of the stocks in a given sample and decision date. Two of the historical periods chosen by Staubus were the most recent quarter (prior to the cut-off date) and the most recent half year. The conclusion with respect to the two interim periods was that they did not show up well in comparison to observation periods of one, two, three and four years.

Surveys of Opinion as to Usefulness of Quarterly Data

In addition to the survey of reporting practice reviewed above, Taylor surveyed both executives of companies listed on the American Stock Exchange and financial analysts.¹ He reported that 84% of the companies responding indicated strong positive feelings on the usefulness of quarterly reports. Representative responses from financial analysts indicated that they also strongly felt that quarterly financial data are useful.

Like Taylor, Newell surveyed financial analysts as to their feelings about quarterly data. He asked the specific question: "How useful do you consider published quarterly reports to be in your analysis of investment quality of a firms' securities?"² The responses that he received were as follows:

¹Taylor, The Accounting Review, Vol. XL, No. 1.

²Newell, p. 163.

<u>degree of usefulness</u>	<u>percent of total response</u>
very useful	45%
quite useful	36%
of limited usefulness	19%
of no use	0%

The inference drawn was that, "As these analysts feel quarterly data are useful in their analysis, it is presumed that they use these data in their analysis."¹

Except for the work of Newell the research reviewed up to this point provides neither information about general investor behavior nor information that would be useful in making decisions aimed at improving quarterly accounting measurements. Whereas the forecasting studies perhaps established that quarterly data can aid in forecasting annual results, they provided no idea of how the performance of quarterly data measures up to potential. Whereas the opinion surveys as to usefulness of quarterly data indicated that significant segments of the financial and corporate communities, when asked, say that they feel quarterly data are useful, they do not indicate that quarterly data are significant in actual investment decisions.

Newell's investigation is significant in the sense that it establishes that the potential differences in quality between quarterly and annual accounting measurements actually influence the pattern of reported data in a significant way. This result adds to the conviction of the researcher that significant improvements in quarterly accounting measurement can be achieved. In addition, since they suggest that quarterly data

¹Ibid., p. 144 (emphasis added).

have significant potential to mislead, Newell's findings should tend to heighten interest in the question of how significantly quarterly data influence actual investor decisions (the first research question that will be undertaken in this project).

The discussion may now turn to research efforts that approached (with very limited success) the empirical questions of concern in this study.

Empirical Studies of the Influence of Quarterly Data on Actual Investor Decisions

The studies by George Benston and Brown and Kennelly, that will be briefly described and evaluated below, are given exceptional treatment because they are the only large-scale studies to date that attempted to measure empirically the significance to investor decisions of quarterly accounting data.¹ However, as will be seen in the discussion, Benston's efforts to explain investor response to quarterly data, limits the application of his findings to the research questions of interest in this study. A similar limitation results from Brown and Kennelly's specification of the kind of news, i.e. good or bad, contained in accounting data and measuring consistency of response with the type of news. Any mismeasurement of the type of news contained in accounting data leads to a mismeasurement of investor response to that data.

¹George J. Benston, "Published Corporate Accounting Data and Stock Prices," Empirical Research in Accounting: Selected Studies, 1967, a Supplement to Volume V of the Journal of Accounting Research and Phillip Brown and John W. Kennelly, "The Information Content of Quarterly Earnings: A Clarification and an Extension," forthcoming in the Journal of Business. Thanks to the generous cooperation of Professor Kennelly the researcher has had access to an early draft of the latter paper. The evaluation in the following pages may not apply to the later, published version of the article.

While it may appear to the reader that the discussion in the next few pages is rather negative, no expression of dissatisfaction with the overall efforts of other researchers is intended. It is simply necessary to evaluate negative points in order to improve on the approaches taken in earlier work. Furthermore, in all fairness to Benston and Brown and Kennelly it should be pointed out that they did not set out to answer the exact research questions of this study. Hence it is no surprise that their findings have not already answered them satisfactorily.

Using changes in market prices of common stocks as a reflection of investor decisions concerning the stocks, Benston hypothesized a relationship between the changes in stock prices and the measured rate of change in an accounting variable. His complete relationship, however, included variables other than accounting variables and may best be summarized (in the manner that Benston found most significant) in the following functional form:

$$\Delta P_t = F(\Delta R_t, QR_t, \Delta D, I_j, U)$$

- F indicates that the variable on the left is a function of the variables in brackets.
- ΔP_t is the measured price change (corrected for market-wide changes) around time T.
- ΔR_t is equal to the change in the annual level of an accounting variable, measured as a rate of change.
- QR_t is equal to the rate of change in the same accounting variable, measured for the first three quarters of the current and past year.
- ΔD is a variable measuring any rate of change in dividends.
- I_j is a dummy variable identifying the industry, j, to which a particular observed firm belongs.
- U is the residual, unexplained factor, thought to behave randomly.

To test the significance of the accounting variables Benston tested the above, hypothetical relationship using the multiple regression equation:

$$\Delta P_t = a_1 + a_2 AR_t + a_3 QR_t + a_4 \Delta D + a_5 I_j + U.$$

Using this equation form as well as several more complicated ones, regression analyses were performed for each of several different accounting variables, e.g. net income, net sales, net operating income plus depreciation, etc. As was noted above the equation with the accounting variables in the simple rate of change form was most significant, but certain of Benston's conclusions pertain to all forms and variables.

The rate of change in dividends was found to be a significant variable in less than half of the regressions and the industry identity in less than 20%.

The quarterly data were statistically significant only for the accounting variable "sales". In the case of some of the income variables the addition of the quarterly data variable, although not significant itself, seemed to increase the significance of the annual data variable.

Even with the quarterly data variable, however, and the best functional form, the annual accounting data exhibited a very weak relationship to price changes. In Benston's own words: "...the effects (as measured here) of published accounting data on stock prices are not very great, especially when one considers that the market is capitalizing future expected changes in income."¹

But the researcher is cautious in accepting Benston's results. The assumption implicit in all the regression equations that Benston

¹Benston, Empirical Research in Accounting: Selected Studies, 1967, p. 22.

tried was that annual and first three-quarter measurements of the same accounting variable are independently related to end-of-year stock price changes. That is, the rate of change in, say, sales between the current year and last year would have one effect on the stock price around the end of the year, while the rate of change experienced between the first three quarters of this year and last year in the same variable would have a separate and independent effect on the stock price around year-end. This seems to be a highly implausible assumption, indeed. It denies any correlation between quarterly and annual levels of the variables or any cumulative effect of "readings" on the same variables in interim periods.

But Benston makes the point himself:

...a shortcoming of the study may be that insufficient attention was given to the specification of quarterly data. A comparison of the final quarter's data with those of the previous three quarters may have proved more fruitful than the comparison made between the third quarter and annual results of succeeding years.¹

The intent of the research of Brown and Kennelly was "...to clarify the previous results [of the forecast studies and Staubus' work] and to extend the empirical knowledge of current interim reports in a limited sense."² As in the forecast and Staubus studies, ability to predict was the criterion selected to judge the usefulness of quarterly earnings data. But the choice of the events predicted and the concept of prediction used were quite different from those employed in the forecast and Staubus studies. Hence the researcher feels that it is more

¹Ibid., pp. 25-26.

²Brown and Kennelly, "Information Content of Quarterly Earnings," p. 1.

appropriate to view the work of Brown and Kennelly, not as an attempt to clarify the forecast and Staubus studies, but rather as an inquiry into the nature of the impact of quarterly earnings data on common stock prices.

In the manner of a previous study, Brown and Kennelly define the information content of an earnings-per-share number relative to the difference between the number and a forecast or expectation of the number.¹ If the actual number is larger than the forecast the actual number is considered good news; if the actual number is less than the forecast it is considered bad news; and if there is no difference the number is considered to have zero information content. To test whether this is a good model of the information content of earnings numbers, an hypothetical situation is established wherein a simulated investor is given the sign of the difference between forecast and actual earnings for each of 94 common stocks 12 months in advance of the date that actual earnings become known to the market. If the sign is positive the investor buys the security at the advance date; if negative he sells short; if neither positive nor negative no action is taken. His cumulative monthly investment performance in excess of general market performance is then mapped from the advance date to a date several months subsequent to the time when the actual earnings number first becomes generally available in the market.

Performance in excess of market performance is determined by first regressing a firms' monthly rate of return for some sample period on the monthly rate of return of a market index for the same period to

¹The methods employed by Brown and Kennelly were first used in Ray Ball and Phillip Brown, "An Empirical Evaluation of Accounting Income Numbers," Journal of Accounting Research, Vol. VI, No. 2 (Autumn, 1968), pp. 159-178.

establish an average relationship. Then the excess or unexpected rate of return for the month of interest is computed as the difference between the actual rate of return and the rate of return predicted by the regression relationship, given the actual market rate of return for the month. The justification for this technique is strongly supported empirically, and will be fully elaborated in a later chapter.

If the excess return is positive and the hypothetical investor is holding the security or if the excess return is negative and the investor has sold the security short, he has gained and conversely. The cumulative performance of the investor from the advance date, τ , to the end of any subsequent month, M , is the product:¹

$$C = \prod_{t=\tau}^M (1 + r_t)$$

where r_t is the excess rate of return for the month t for a particular security with its sign adjusted according to the strategy of the investor.

The more frequently the investor experiences large positive r_t 's the larger C will be. That is, the more often the signs of the unadjusted excess returns of months up to and including the month of announcement of the actual earnings number are consistent with the sign of the difference between forecast and actual earnings, the greater will be the cumulative performance of the strategy that is determined by the sign of that difference.

¹The upper-case greek letter pi, Π , is used to represent iterative multiplication in the same way that the upper-case sigma, Σ , is used to represent iterative addition.

Besides measuring the aggregate cumulative performance C, Brown and Kennelly noted the frequency of consistency between (1) the signs of monthly excess rates of return and (2) the signs of annual earnings forecast errors for the investment strategy based on foreknowledge of annual earnings forecast errors. They then constructed an analogous strategy based on foreknowledge of the signs of forecast errors for the three quarterly earnings numbers. It essentially permits a switching of positions in each stock starting with the month after each quarterly earnings announcement based on prior knowledge of the error in forecasting the next quarterly earnings number.

Their hypothesis was essentially that if the quarterly numbers have information content, then strategies exploiting foreknowledge of that content would do better than strategies exploiting foreknowledge of the content of the annual number only. Their results confirmed their hypothesis. Based on the cumulative excess returns their conclusion was that "...interim reports increase apparently by some 30-40 per cent, the value of information contained in annual EPS."¹

As did Ball and Brown in an earlier study, the authors found that for strategies based only on annual earnings forecast errors, "...the markets's anticipation of annual EPS is sufficiently accurate that its release does not appear to cause any unusual jumps ...in the announcement month."² In addition, when quarterly switching of strategies was permitted the authors found that the months of the first, second, and third quarter

¹Brown and Kennelly, "Information Content of Quarterly Earnings," p. 10.

²Ibid., p. 11.

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earnings announcements were months of remarkable excess returns whereas the month of the fourth quarter (annual) was not nearly as remarkable. In addition, the frequency of agreement in sign between forecast errors and excess rates of return for months of quarterly announcements was more highly significant than for months of annual announcements. They conclude that this pattern "...suggests again that annual EPS when it is finally released is not usually newsworthy, although the previous three quarterly reports may be of interest to investors."¹

Although Brown and Kennelly's findings establish at least that the direction of investor response to quarterly announcements is significantly related to the direction of forecast error, the researcher is cautious in accepting their conclusion on the comparative newsworthiness of quarterly and annual earnings announcements. There is at least one limitation of the Brown and Kennelly design that renders such a conclusion tenuous.

As the authors put it: "It is clear that the validity of the exercise depends largely on how well earnings reports are classified into 'good', 'bad', and 'indifferent.'"² If their forecasts of earnings are poor characterizations of market forecasts, then the signs of their forecast errors which govern the classification of earnings reports could be poor estimates of the kind of information contained in the reports, i.e. good news, bad news, etc. Thus their measurement of information content is subject to measurement error due to misspecification of forecast earnings. Because of the importance of this limitation of their

¹Ibid.

²Ibid., p. 4.

design, discussion of the three specific forecast models used by Brown and Kennelly has been postponed until now.

One of the forecast models employed, a regression relation with a market earnings number, is analogous to the model described above for computing excess monthly rate of return of common stocks. However, the authors give little credence to its use. In their own words the model was included "...more to show the specification and estimation weaknesses than for any other purpose."¹

In addition to the regression model the authors use two models that they call "naive". The first consists of forecasting current period earnings equal to the earnings of the comparable period of the prior year. If the object of forecast is annual earnings, the forecast will be the prior years' earnings. If quarterly earnings is the object of interest, the earnings of the same quarter of the prior year is the forecast amount. The second naive model makes the same type of forecast but adds an historical average change in earnings of the comparable period of the prior year.

In order for Brown and Kennelly's conclusions regarding the relative newsworthiness of quarterly and annual earnings numbers to be valid, these forecast models must be equally good characterizations of market expectations of both quarterly and annual earnings numbers. That the forecasts of annual earnings numbers do not incorporate any of the information contained in the quarterly numbers ignores the widely held belief that investors use quarterly data to forecast annual results. Although nonrigorous, this reason alone is enough to cause the reviewer to doubt

¹Ibid., p. 6.

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the homogeneity of Brown and Kennelly's measurements with respect to comparisons of newsworthiness of quarterly and annual earnings numbers.

Thus the reviewer agrees that Brown and Kennelly's results support a conclusion that their forecast models were remarkably good estimates of market expectations of quarterly earnings numbers but not of annual earnings numbers. Their results do not support the conclusion that "...annual EPS when finally released is not usually newsworthy, although the previous three quarterly reports may be of interest to investors."¹

The purpose of this study is to attempt to measure investor response to quarterly and annual earnings announcements in a way unclouded by potential specification error of the types present in both the work of Brown and Kennelly and Benston. The next chapter begins the elaboration of a measurement methodology intended to serve this purpose.

¹Ibid., p. 11.

CHAPTER III

STOCK PRICES, EXPECTATIONS AND INFORMATION

The starting point in studying the impact of quarterly financial data on investors' decisions must be a theory that relates financial information to those decisions. A widely accepted theory of stock prices provides a basis for assuming a cause-and-effect relationship between financial information flows, in the form of quarterly data, and stock price changes.¹

The theory holds that the price of a common stock at a point in time is equal to the present value of the expected future cash flows to the holder of a share of the stock, discounted at the expected opportunity rate of return for the expected level of risk attendant upon the flows. Each investor forms his own expectations about future flows, risk, and the opportunity rate of return and arrives at his own price. If his price is different from the price at which he can buy and sell he will presumably change his holdings. In the aggregate the buying and selling activity of individuals whose valuations differ from a particular market price will change the price in the direction of the difference.

A change in the price of a common stock may therefore be caused by a change in expectations regarding any or all of the elements of the

¹Benjamin Graham, David L. Dodd, and Signey Cottle, Security Analysis: Principles and Technique. (fourth ed.; New York: McGraw-Hill Book Company, 1962), p. 450.

theoretical relationship. Expectations change in response to new stimuli that are not perfectly consistent with expectations just prior to their perception. That is, new information that is not exactly as expected, has the power to change expectations with respect to related events that are yet to occur. Therefore any new bit of information about events or conditions related to the elements of the theoretical basis of a stock's price has the power to change expectations with respect to those elements, and hence, to change the stock's price as well.

Thus, in theory at least, one can gauge the effect of a particular bit of new information by measuring the change in a stock's price that resulted from it. In practice, however, it is very difficult to attribute a particular change in a stock's price to a particular bit of new information. Nevertheless, this is the approach that will be taken in this study. It is considered the most relevant approach to the study of the impact of quarterly financial data on investors' decisions, because changes in stock prices are considered to be the best reflection of actual investor decisions.

Fortunately, the researcher is not without reported research aimed directly at the operational problem of relating a specific bit of new information to a specific market price change as well as methodology suggested by similar studies that had to deal with the problem. In particular, the methodology arrived at in this chapter and the next to satisfy the general research questions of this project will be an elaboration (with similar results) of the methodology developed and used by Beaver in his study of what he termed the "information content" of annual earnings reports.¹

¹William H. Beaver, "The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, a supplement to Volume 5 of the Journal of Accounting Research, pp. 67-92.

Rather than review that work in detail and then proceed to the research questions at hand, though, the researcher prefers to elaborate the methodology in a manner that he believes will be better understood by the reader.

Information Classes and Correction of Stock
Price Changes for "Market Effects"

Benjamin King attempted to isolate the effects of different classes of information on the stock price of a firm.¹ He started with the following proposition concerning information inflows to the stock market:

The stock market is subjected to a steady flow of information, much of which will have an effect on the set of anticipations that determine the price of security *j*. This does not mean, however, that all of the information affecting *j* affects *j* only. In fact, it is intuitively appealing to think of incoming information as falling into various classes according to the scope of its effects on the market.²

King proceeded by factor analysis to determine to what extent market-wide and industry "effects" explained the variances in stock price changes for 63 firms listed on the NYSE from 1927 through 1960. Some of his findings that are of interest here are that:

1. The average proportion of the variance of each security's price changes explained by the mean change of the other securities in the sample (representing the market as a whole), from August, 1952 through December, 1960, was .307.

¹Benjamin F. King, "Market and Industry Factors in Stock Price Behavior," Security Prices: A Supplement, Journal of Business, Vol. XXXIX, No. 1, Part 2 (January, 1966), pp. 139-190.

²Ibid., p. 140.

2. The proportion of variance explained by the SEC two-digit industry classification is .113.

The implication of King's findings is that in trying to relate a bit of new information, specific to a firm, to a market price change, it would be fruitful to first correct for the portion of the change in the stock price that is attributable to factors affecting all stocks in the market and, perhaps, all stocks in the same industry as well.

Such a correction for market-wide factors will be made, following a method first suggested by Sharpe,¹ and evaluated and found to be "... a satisfactory method for abstracting from the effects of general market conditions as monthly rates of return on individual securities"² by Fama, et al. The method has been adopted in several studies related in methodology to this study.³ It consists of the following steps:

1. First, all price observations for a particular firm to be included in the study are corrected to an equivalent capital basis. Essentially this means adjustments will be made retroactively for any stock dividends or splits that occur during the periods from which observations will be taken. For reasons that will be discussed later, observations of weekly closing prices are contemplated for the study.

¹William F. Sharpe, "A Simplified Model for Portfolio Analysis," Management Science, Vol. IX, No. 2 (January, 1963), pp. 277-293.

²Eugene F. Fama, et al., "The Adjustment of Stock Prices to New Information," International Economic Review, Vol. X, No. 1 (February, 1969), pp. 1-21.

³See, for instance, Beaver, 1968 Supplement to Journal of Accounting Research, VI, Ball and Brown, Journal of Accounting Research, VI, No. 2, or Benston, 1967 Supplement to Journal of Accounting Research, V.

2. Second, parameter estimates, a_j and b_j , for the following relationship will be obtained by regression of observed values of the variables over the period of observation:

$$P_{jt} = A_j + B_j M_t + R_{jt}$$

P_{jt} is the difference between the natural logarithm of the equivalent closing price¹ of the j^{th} stock at the end of week t and the natural logarithm of the closing price at the end of $t - 1$ ($P_{jt} = \ln (p_{jt} + D_{jt}) - \ln (p_{jt-1})$). M_t is the difference between the logarithm of the closing value of a market index at the end of week t and the logarithm of the closing value at the end of week $t - 1$ ($M_t = \ln m_t - \ln m_{t-1}$). Logarithmic measurements will be used because they have been found by other researchers to better satisfy the assumptions of the linear regression model.²

R_{jt} is a term representing the non-market related portion of P_{jt} . R_{jt} is assumed to be a random term in the above relationship. A_j and B_j are the intercept and slope, respectively, of the assumed underlying relationship. (a_j and b_j are sample estimates of A_j and B_j , respectively.

¹ D_{jt} is the amount of cash dividend, if any, that became the legal right of owners of stock j during week t . It is added to the closing price of week t to correct it to a basis comparable to the closing price of week $t-1$.

²Fama, et al., International Economic Review, X, No. 1, p. 4, note 8.

3. After a_j and b_j have been found for each stock, the above relationship will be reversed to give the values of the non-market-related portions of the price change measurements:

$$R_{jt} = P_{jt} - (a_j + b_j M_t)$$

The R_{jt} will then represent a set of weekly price change measurements for each firm that have been "corrected" for factors that have affected all stocks in general. Each stock's price change measurements will be corrected according to its uniquely estimated relationship to the market in general, represented by its unique a_j and b_j .

Because of the expected high cost (effort) and low return in additional accuracy, no correction is planned for industry effects. Such a correction would require considerable effort. Whereas indexes of market prices are readily available, the researcher would have to construct indexes of two-digit industry classes. In order to economize on this effort, an undesirable restriction of observations to relatively few industries might be necessary.

However, since King found that the proportion of stock-price-change variance explained by industry effects was only .113 for price changes measured over month-long periods, it is expected that the degree of precision lost by not correcting for industry effects in weekly price changes is negligible. Price changes measured over shorter periods can be expected to display much less systematic relation to industry (and market) effects and much more randomness of fluctuation than price changes measured over longer monthly periods. However, the relatively

strong relationship found between monthly stock price changes and the changes in the total market suggests that a significant relationship may exist even on a weekly basis. Hence, the correction for market movements will be made even though it is expected that much less than 30% of the variance of the weekly stock price changes will be explained by the correction.

Specific Information Flows and Measured Stock Price Responses

After correcting for influences that affect the changes in all stock prices, the remaining or residual price changes may be attributable to new bits of information specific to the individual firm plus random factors. (Industry effects will be assumed to be incorporated in this random element.) There still remains the problem of relating specific new bits of information to specific price changes. To solve this problem some of the basic elements of the "random walk" theory of stock price behavior will be relied upon.

The Random Walk Theory

The random walk theory is based on the assumption that the major security exchanges approximate "efficient" markets.¹ An efficient market is one in which at any point in time security prices already reflect information about relevant events that have occurred and relevant events that the market expects to take place in the future. In an efficient market the price of a security at any point in time will approximate its intrinsic value. (Intrinsic value is used here in the sense of equilibrium

¹Eugene F. Fama, "Random Walks in Stock Market Prices," Financial Analysts Journal, Vol. XXI, No. 5 (September-October, 1965), pp. 55-59.

value) The price will diverge from intrinsic value but the actions of many informed and intelligent market participants will prevent the price from deviating from intrinsic value (by more than commission costs) in any way other than by chance. Hence, actual prices will wander about intrinsic values randomly.

Intrinsic value may change in response to new information of all kinds. Theoretically, in an efficient market the transition to a new intrinsic value in response to new information will be "instantaneous." In practice, instantaneous means at least two things:¹

1. The market overadjusts as often as it underadjusts, i.e., the expected value of the new price is the new intrinsic value. (The expected value of the price at any point in time before the new information became available was the prior intrinsic value.)
2. The time lag between the first perception of the changed condition and complete adjustment is, itself, a random variable.

This implies that successive price changes will be independent. No period's change in stock price can be predicted from the preceding period's change. Even if the moment of first perception of a new bit of information is known, the shift in intrinsic value will not occur at a predictable moment (except that with intelligent and informed market participants the maximum delay will be short).

¹Ibid.

Relating Specific Information to Specific Price Changes

Ideally, the way to relate a particular new bit of information to the attendant shift in intrinsic value is to pinpoint the moment of first perception and observe the stock price movement over a span of time long enough to include the maximum lag before response, but short enough to exclude responses to other bits of new information specific to the firm. On the average, measurements over such periods would be without bias. That is, the expected value of the errors in measurement would be equal to zero. To illustrate, consider a model representing the features of the random walk theory discussed above. The price observed at any moment, t , is a function of the intrinsic value at t , IV_t , plus a random term, r_t , with an expected value of zero.

$$P_t = IV_t + r_t$$

The change in price over a given period can therefore be represented as

$$\Delta P_{(t,t+1)} = IV_{t+1} + r_{t+1} - IV_t - r_t.$$

The expected value of this difference is

$$\begin{aligned} E[\Delta P] &= E[IV_{t+1} - IV_t] + E[r_{t+1} - r_t] \\ &= E[IV_{t+1} - IV_t] + 0 \\ &= E[IV_{t+1} - IV_t] \\ &= IV_{t+1} - IV_t \end{aligned}$$

which is the difference in the intrinsic values.

It is clear that as a practical matter no period will completely satisfy the two conditions mentioned above, i.e. sufficiently short to

exclude shifts in intrinsic value due to other bits of information and yet long enough to include the lagged response to the bit of information under study.

Of great help in this choice, however, are the corrections that have already been suggested to abstract from influences of information affecting the whole market. They cut the number of bits of significant information down to those that pertain only to the individual security whose price is being observed. (Among these relatively few bits of new information are the quarterly announcements that are the subject of this study.) Even with the benefit of this shrinking of the number of bits of information that could interfere with the shift in intrinsic value that we wish to associate with a quarterly earnings announcement, the choice of a period of measured response is still largely arbitrary. But, with the two conditions mentioned above in mind, a satisfactory, though arbitrary response period can be selected.

Selection of Price-Change-Response Period

The period selected for measuring price changes attributable to quarterly announcements is the week in which the announcement is made. The attributes that make this particular length of period a good choice are listed below:

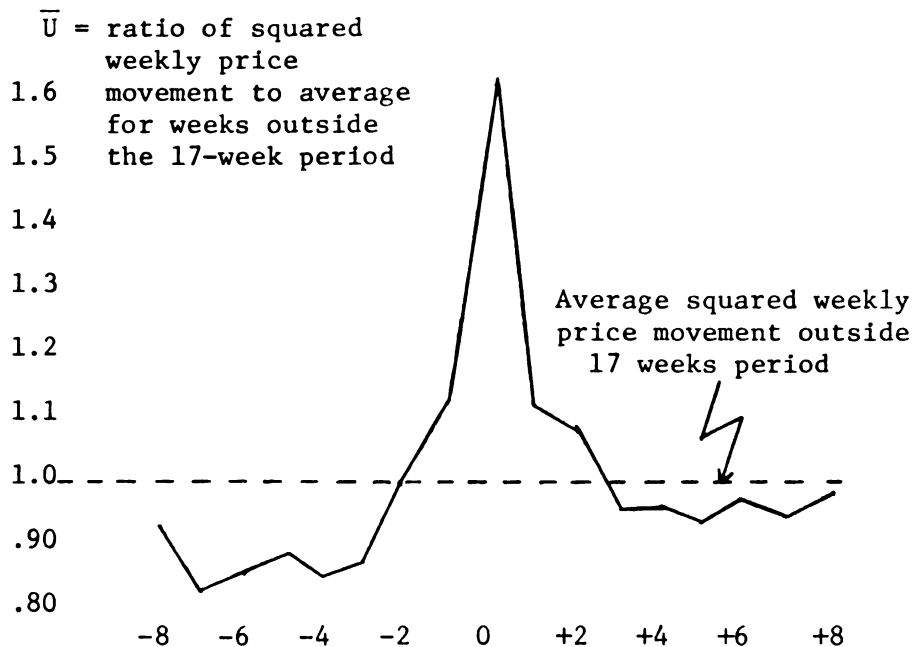
1. The week is not so long as to create insurmountable difficulties in generally finding observations wherein the only new specific bit of significant information entering the market during the response period is the quarterly or annual earnings announcement.
2. Weekly price changes, observed without regard to the

effects of specific bits of new information, have been found to behave in very nearly random fashion. Serial correlation tests of successive weekly price changes conducted by Cootner and others have yielded sample correlation coefficients extremely close to zero.¹

3. Beaver conducted a study of the impact of annual financial data on stock prices.² Judging from his results, a week is a sufficiently long period to pick up responses that lag behind the first perception of the annual announcements. The graph shown in Figure 1, typical of Beaver's results, bears out this judgment. It represents the average of a ratio based on changes in prices, after adjustment for market effects, in the week of the annual earnings announcements, week 0, and each of the eight weeks before and eight weeks after. The averages were computed over 143 sample firms and several cross-section years. The remarkable average price change ratio in week zero is consistent with with the discussion above and with the predicted behavior pattern of price changes if annual earnings announcements in general have sufficient information content to alter the intrinsic value of securities.

¹Paul H. Cootner, "Stock Prices: Random vs. Systematic Changes," Industrial Management Review, Vol. III, No. 2 (Spring, 1962), pp. 24-45.

²Beaver, 1968 Supplement to the Journal of Accounting Research, VI.



Source: William H. Beaver, "The Information Content of Annual Earnings Announcements," Empirical Research in Accounting: Selected Studies, 1968, A Supplement to Volume VI of the Journal of Accounting Research.

Figure 1.--Profile of mean price-response ratios for 17 weeks surrounding 506 annual earnings announcement dates of 143 firms for years 1961 through 1965.

Pinpointing the Moment of First Perception of Announced Earnings

Regardless of the choice of length of period for observation of price-movement responses, the measurements that will be used in the study still depend on recording price-change responses in periods immediately following the markets' first perception of quarterly and annual financial data. The day of first perception is to be pinpointed by reference to the date of publication of the earnings numbers in the

Eastern edition of the Wall Street Journal.¹ In choosing this method of dating the information, reliance will be placed on general conformity to the disclosure requirements of the major exchanges and on the publication policies of Dow Jones & Co., Inc. The American Stock Exchange, for instance requires:

As to procedure, information of this type should be issued as quickly as circumstances permit, to as broad an audience as possible, on an "immediate release" or "not held" basis. It should be distributed to one or more New York City newspapers which regularly publish financial news, to the newsticker services operated by Dow Jones & Company, Inc. and Reuters Economic Services and to the news-wire services of the Associated Press and United Press International. When, in spite of proper precautions, inaccurate information or rumors, true or false, are circulated, companies are expected to clarify the situation promptly through a public announcement.²

According to a telephone interview with Mr. Ralph Doddridge, Head of Research, Dow Jones and Company, Inc., the flow of earnings announcements to the public through the media supplied by his firm is as follows:

1. Earnings announcements are received by Dow Jones and Company, Inc. via telephone, wire, mail or public relations newswire service.
2. If received indirectly, the information contained in the announcement is confirmed by direct telephone conversation with a company officer. Questionable information, from direct or indirect sources, is clarified by the same means.

¹The Wall Street Journal Index (New York: Dow Jones and Company, Inc., Issued Monthly with annual cumulations).

²American Stock Exchange. "Listing Form L." (Revised September 15, 1966).

3. Information of satisfactory accuracy is released over the "broad tape" immediately and appears in the next issue of each edition of the Wall Street Journal.

According to Mr. Doddridge, Dow Jones is rarely "scooped" in the publication of corporate earnings information. However, if a particular announcement is cleared for release at a time of day too late to make that day's issue of the Eastern edition of the WSJ it will be printed in that edition on the following day. Since the Eastern edition is the edition that will be used in this study to determine the week of first perception of an earnings announcement, the time basis of associating price-change responses to earnings announcements described earlier might occasionally be thwarted, e.g. an announcement appearing on the "broad tape" or in the Midwestern edition of the WSJ on Friday of one week might not appear in the earlier Eastern edition until Monday of the following week. Depending on just how "instantaneous" the market response is to bits of new information, the methodology of the study is vulnerable to error in pinpointing the time of response to earnings announcements selected for study. But since the Wall Street Journal Index is only available for the Eastern edition, there is no practical way for the researcher to refine his dating methodology, e.g. by pinpointing the first publication of an earnings announcement in any edition of the Wall Street Journal. Instead an attempt will be made to gauge the degree of "leakage" in the methodology from all sources, including the one just described, using measurements to be developed in a later chapter.

Summary

This chapter has been devoted to showing in general terms how the effect of specific bits of new information on investors decisions can be

observed by careful measurement of the residual price response in a period immediately following the market's first perception of the bit of information.

Sharpe's method of abstracting from the effects of information affecting the market in general is adopted. Portions of individual firms' price changes not explained by changes in an appropriate market index, will be assumed to be composed of changes attributable to specific information related only to the firm, plus random changes.

The moment of first market perception of the quarterly earnings numbers of firms will be determined by the dates of publication of the earnings numbers in the Wall Street Journal. It is expected that the "instantaneous," non-random response, if any, to the quarterly earnings numbers will take place in the week in which first perception occurs.

The next chapter will be devoted to operationalizing the general research questions of the study in terms of measured residual price changes in weeks of quarterly earnings announcements.

CHAPTER IV

THE BEHAVIOR AND SIGNIFICANCE OF PRICE-CHANGE RESPONSES TO QUARTERLY DATA

The first research question mentioned in Chapter I calls for a determination of the significance of price-change responses in weeks of quarterly earnings announcements. Questioning the significance of a response implies a standard of comparison. The standard of comparison for price responses to quarterly earnings announcements will be the average price response for all weeks of the year, excluding weeks of earnings announcements.

The first principal hypothesis of this study is that quarterly earnings announcements have a significant effect on investor expectations. Since changes in expectations lead to changes in intrinsic value, sustained (non-random) price changes should take place in periods when quarterly earnings announcements are made. On the average, then, price movements should tend to be greater in the weeks of quarterly earnings announcements than in other weeks of the year.

Other weeks in the year may experience bits of information that can by chance have a significant effect on investor expectations. But every week of a quarterly earnings announcement may be considered to have a bit of new information with such potential, if the principal hypothesis is correct. Thus to test the significance of the effects of

quarterly earnings numbers on investor expectations, it seems reasonable to test the significance of price changes in weeks of quarterly earnings announcements relative to other weeks in the year.

To facilitate such a test the standard of comparison will be directly incorporated in the measurements employed. Recall that the weekly price changes for each firm will already be converted, in the manner described in the previous chapter, to residual price changes, R_{jt} , free of estimated effects of market-wide influences. The transformation of these measurements into a form well suited to the satisfaction of the first research question will be accomplished in three steps:

1. Since the research question is not concerned with the direction of changes in investor expectations but only their magnitude, the R_{jt} will be converted to their absolute values, $|R_{jt}|$.¹
2. The average value of the $|R_{jt}|$ will be computed for each firm, excluding $|R_{jt}|$ of the weeks of earnings announcements, i.e. $\overline{|R_{jt}|} = \frac{1}{n} \sum_t |R_{jt}|$ where t takes on the numbers of all weeks in the study period except weeks of earnings announcements.
3. Finally, the ratio $|R_{jt}| + \overline{|R_{jt}|}$ will be computed for each

¹To accomplish the same purpose Beaver reported using a measure of magnitude of price response equivalent to R_{jt} ² in his study of the price-change response to annual earnings announcements appearing in the 1968 Supplement to the Journal of Accounting Research. The choice of $|R_{jt}|$ in this study was determined by a desire to minimize the effects on average measurements of a possible few large price change responses occurring in weeks of earnings announcements. Since squaring a number gives disproportionate weight to size as well as eliminating the sign, Beaver's method was not adopted.

week in the research period. For convenience the ratio will hereinafter be denoted RR_{jt} . Note that the average of these ratios over all the weeks of the study period except weeks of earnings announcements, will be 1.0.

The Significance of Price-Change Responses to Quarterly Announcements

The average ratio RR_{jt}^* for the weeks of all the quarterly announcements of a firm may be considered a random variable for which observations may be gathered over the firms in a sample. For each firm, the ratio measures the average relationship between the price change in the week of the announcement and the average weekly price change that the firm experiences throughout the study period. If there were nothing unusual about the price changes in weeks of quarterly earnings announcements for individual firms, then these ratios would have an expected value of 1.0, the average of the ratios of all other weeks. Thus, the significance of the price changes that firms experience in the weeks of quarterly earnings announcements can be tested in the form of the following set of hypotheses:

1. Null hypothesis, H_0 : The mean of the average ratios, RR_{jt}^* , of quarterly earnings announcement weeks is less than or equal to 1.0.
2. Alternative hypothesis, H_1 : The mean of the average ratio is greater than 1.0.

Since the sample of firms is intended to be large, the Central Limit Theorem may be relied upon in choosing the "z test" to be applied

to the sample mean of the average ratios.¹ The null hypothesis will be rejected if the "z" statistic is greater than the critical value, z^* , for the level of significance that will be chosen (The level will be at least as significant as .05). The "z" statistic will be computed as follows:

$$z = \frac{(\bar{x}-1)}{\frac{s}{\sqrt{n}} \cdot \sqrt{1-\frac{n}{N}}}$$

where \bar{x} is the sample mean of the average ratios, i.e.

$$\bar{x} = \frac{1}{n} \sum_{j=1}^n RR_{jt}^*$$

s is the square root of the sample variance,

n is the number of firms in the sample, and

N is the finite number of firms from which the sample is drawn.

If the null hypothesis cannot be rejected, then it cannot be concluded on the basis of this test that the price changes firms experience in weeks of quarterly earnings announcements are, on the average, significantly different from the price changes experienced by the same firms in other weeks.

Although it is important to know the significance of price responses in the weeks of quarterly earnings announcements on an average basis, such averages may be distorted by very large price changes experienced by relatively few firms. It is therefore useful as an additional test of the significance of quarterly earnings numbers, to determine the significance of the frequency with which "significant" price changes are

¹John E. Freund, Mathematical Statistics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962), p. 263.

experienced in the week of the earnings announcement by individual firms.

The researcher is not aware of a technique that can be used to test both the significance of the individual price changes and the significance of the frequency of their occurrence in "zero-week" for individual firms at the same time. (The term "zero-week" is used to refer to the week of an earnings announcement for a particular firm.) Hence the significance of zero-week price changes will be a matter of definition and the frequency of significant zero-week price changes will be subject to test.

Within each firm the significance of average zero-week price changes will be determined by rankings relative to surrounding weeks. The 11 weeks including zero-week and the five before and after will be compared according to the size of their average ratios, RR_{jt}^* . An average zero-week ratio will be considered significant if it is the largest, i.e. highest ranking, ratio in the 11 week profile of average ratios.

To test the significance of the frequency of significant week zero price changes across firms, a test based on the hypergeometric distribution will be used.¹ If ranks were assigned to the 11 weeks on a uniformly random basis, the probability of any firm's zero week receiving the highest rank would be $1/11$.

1. The null hypothesis, H_0 , is therefore that the probability of significant zero-week price changes is $p \leq 1/11$.
2. The alternate hypothesis, H_1 , is that $p > 1/11$.

¹Freund, pp. 70-71.

If the probability of obtaining the sample count of x or more highest zero-week ranks in n firms, assuming $p = 1/11$, is sufficiently low (as low as .05) the null hypothesis will be rejected and it will be concluded that p is greater than $1/11$, i.e. that there is a significant (non-random) rate of occurrence of significant average price responses to quarterly earnings announcements among firms. The probability, of obtaining x or more significant ranks will be computed as follows:¹

$$\pi = \sum_{r=x}^e \frac{C_r^d C_{n-r}^{N-d}}{C_n^N}$$

where d is the number of occurrences in the field expected under the null hypothesis,

x is the actual number of occurrences in the sample,

n is the sample size, and

N is the size of the finite population.

r is the hypothetical number of occurrences in the sample starting with x , the number actually experienced, and going to e , the minimum of n and d (the maximum number of occurrences that could possibly be experienced.)

¹Notation of the form C_y^x indicates the number of unique combinations of y number of items that can be formed from x available items. Computationally

$$C_y^x = \frac{x!}{y!(x-y)!}$$

where "!" is said "factorial" and $x!$ means $x \cdot (x-1) \cdot (x-2) \cdot \dots (1)$.

The Response to Quarterly Data Relative
to the Response to Annual Data

The second research question mentioned in Chapter I calls for a comparison of the degree of price-change response to quarterly and annual earnings announcements.

An investor who is "knowledgeable" should be aware of the limitations of the accounting information he uses. He should be aware for instance of the problems associated with assigning a particular earnings numbers to a particular year. The more limitations that a particular bit of accounting information is subject to, the less should the knowledgeable investor rely on that bit of information.

Quarterly earnings figures are subject to considerably more limitations than annual earnings numbers.¹ In other words, quarterly earnings numbers may be considered to be subject to more measurement error than annual earnings numbers. That accountants are aware of this difference is unquestionable.² Their awareness of these limitations is largely responsible for their resistance to early SEC proposals to adopt quarterly reporting requirements.³ That at least some members of the financial community are aware of the differences between quarterly and annual data (in measurement error potential) is reflected in the following concluding remarks from a recent article appearing in the

¹A brief discussion of additional limitations of quarterly earnings relative to annual earnings was given above in Chapter I.

²For example, see Blough, Journal of Accountancy, VC, No. 2, and Newell, p. 123.

³Taylor, Accounting Review, Vol. XL, No. 1, pp. 89-96.

Financial Analysts Journal:

Certainly, there is a substantial difference between the quality of information in the annual report and in interim statements. It would seem wise to regard interim reports, at a minimum in the same manner that one views direct statements from the company's management and not in the same way that one might view audited financial statements.¹

If a large percentage of investors are truly aware of the difference in reliability between quarterly and annual earnings numbers, then quarterly earnings numbers should have less potential for changing investors' expectations than annual earnings numbers. Less potential to change expectations, on the average, should lead to smaller average price changes in weeks of quarterly earnings announcements than in weeks of annual earnings announcements. This essentially is the second principal hypothesis of the study.

Just as the standard of comparison for the first research question, average price changes in non-announcement weeks, was built into the measurements, a single measure incorporating a comparison of the average responses to quarterly and annual earnings numbers can be readily constructed. The average ratio, RR_{jt}^* , within each firm, can be computed separately for all quarterly and all annual earnings announcement weeks in the study period. The average quarterly ratio can then be subtracted from the average annual ratio to arrive at a difference measure for each firm.

If indeed there is no difference between investor response to quarterly earnings numbers and investor response to annual earnings numbers, the differences between average ratios will be purely chance determined

¹Seidler and Benjes, Financial Analysts Journal, Vol. XXIII, No. 5, p. 114.

and will have a long-run expected value of zero. Thus the significance of the difference between investor response to quarterly data and investor response to annual data can be tested in the form of the following set of hypotheses:

1. The null hypothesis, H_0 , is that the difference, among firms, between the average price change ratio in weeks of annual announcements and the average price change ratio in weeks of quarterly earnings announcements is less than or equal to zero.
2. The alternate hypothesis is that the difference is greater than zero.

Since we are referring to the same large sample of firms as before, the Central Limit Theorem may again be relied upon in satisfying the assumption of a normal distribution required for the "z test" to be applied to the sample mean difference in average ratios. The null hypothesis will be rejected if the "z" statistic is greater than the critical value, z^* , for the desired level of significance. For this test the "z" statistic will be computed as follows:

$$z = \frac{\bar{x}}{\frac{s}{\sqrt{n}} \sqrt{1 - \frac{n}{N}}}$$

where \bar{x} is the sample average of the differences,

s is the square root of the sample variance,

n is the sample size, and

N is the size of the finite population.

If the null hypothesis is rejected, it can be concluded that

investors recognize the differences in "quality" of quarterly and annual earnings numbers. Because of the nature of the test, however, if the null hypothesis is not rejected it may not be concluded that investors do not recognize the difference between quarterly and annual earnings numbers. Rather, because of the possibility that a sample result not inconsistent with the null hypothesis could occur by chance even though there actually was a difference between investor response to annual and quarterly earnings, it can only be said that there was no significant evidence of such a difference.

Furthermore, if no significant difference between investor response to quarterly and annual earnings shows up in the sample results, it may only mean that the measurements employed in the study are not equally applicable to quarterly and annual earnings. Although this possibility will be examined at some length in Chapter VI in light of the sample data, it does not pose as serious a threat to the usefulness of the sample measurements as one might think. For whatever reason, if investor response to annual earnings as measured in the study is not significantly greater than investor response to quarterly earnings, there would seem to be reason to question the relatively low priority given to interim reporting in theory and practice.

Clarification of the Approach to Measuring Investor Response

Note that the measurements and tests developed in this and preceding chapters does not rely in any way on knowledge of specific investor expectations at the time of quarterly or annual earnings announcements. It only relies on the hypothetical potential of quarterly

earnings announcements to change investors expectations (whatever they are) of factors that are relevant to their decisions to buy, sell, or hold a particular security. Note also that as a result the mode of measurement concentrates only on the magnitude of price changes. In the absence of specific knowledge of expectations prior to a quarterly earnings announcement, the direction of change in expectations is irrelevant. What is relevant is summed up in the proposition that, if expectations are actually changed in periods of quarterly earnings announcements, the magnitude of price changes will be greater, on the average, than if the prices merely changed in random fashion during these periods.

Implicit in this reasoning is the assumption that in any sample of firms there will be representative numbers and degrees of inconsistencies between actual quarterly earnings numbers and the expectations held by investors. While there is some risk that this implicit assumption will not be met, there is a great advantage in avoiding specific measurement of the degree of inconsistency between actual and expected quarterly earnings numbers for each firm in the sample.¹ That advantage is avoidance of the kind of potential error due to misspecification of investor expectations, that was present in the work of Benston, Brown and Kennelly, etc.² Both research questions of this study are sufficiently general to be satisfied without specification of investor expectations provided the assumption is met. Of course, efforts will be made

¹Beaver, 1968 Supplement to the Journal of Accounting Research, Vol. VI, p. 68.

²See Chapter II, above.

to ensure that the assumption is met by initially selecting a large sample of firms randomly and thereafter eliminating as few firms as possible in satisfying needs for control of the sample measurements. Furthermore, each firms' price changes will be observed over a cross section of several years in order to reduce the possibility of the results of the study being completely determined by an unusual or non-representative time period. In selecting the cross section, due care will be given to including some variety in market conditions.

Summary

In this chapter the general measurement methodology suggested in Chapter III was used to develop pairs of operational hypotheses that will, within the limits of the methodology, provide answers to the two general research questions of the study. The next chapter will discuss the population of firms selected for study, the sample of firms drawn for observation, the data gathering and transformation procedures, and, finally, the actual sample results of the test of hypotheses described above.

CHAPTER V

SAMPLE SELECTION, DATA GATHERING AND RESEARCH FINDINGS

This chapter is largely descriptive. It sets forth the details of the main body of the research starting with the selection of the population to be studied and proceeding to the research findings that resulted from applying the tests described in the preceding chapter to a sample of firms drawn from that population. In order that the reader can observe the degree of fidelity maintained between the application described in this chapter and the a priori reasoning of earlier chapters, few details have been omitted.

Selection of a Population

Ideally the researcher would like to draw sample firms from a population that displays all of the following desirable properties:

1. Homogeneity with respect to the phenomena or characteristics under study.
2. Selected as the population of prior, related studies being extended, replicated or contrasted by the current research, or contributing to the hypotheses of the current research.
3. Size and stature sufficient so that the study will be meaningful both academically and otherwise.
4. Ease of access to accurate data.

For purposes of this study the fourth property restricts the researcher to firms for which detailed records of earnings announcements and prices (at which stocks were actually traded) are readily available. This of course would include both of the major national stock exchanges which also happen to readily satisfy the requirements of the third property, i.e. size and stature. On the basis of this latter property one would tend to favor the New York Stock Exchange over the American Stock Exchange, other things equal and assuming one had to choose. But two properties remain to be considered.

There would be no reason to choose between the New York and American Stock Exchanges if together they represented a single, homogeneous population with respect to investor response to quarterly and annual earnings announcements, i.e., if together they possessed the first property listed above. Unfortunately, there is no direct evidence bearing upon this issue that has come to the attention of the researcher. But there is some relevant circumstantial evidence that has led the researcher to the belief that the two exchanges differ significantly.

During preliminary investigations, the researcher noticed that a number of American Stock Exchange firms successfully apply for listing on the New York Stock Exchange each year, while not one case of the reverse has been encountered. (It should be noted that these are side observations and were not the main objective of the preliminary investigations). This one-way mobility of firms would seem to imply that there are reasons for firms' managements to want their firms listed on the New York Stock Exchange even though they are already listed on a major exchange, in spite of the effort of applying for listing and the problems

involved in the changeover. One can only speculate as to the degree to which those reasons are associated with the way that investors evaluate information about the firm, e.g. earnings numbers, in making their decisions about its common stock. But more importantly, the researcher has observed that the number of news events other than earnings announcements appearing in the Wall Street Journal tends to be far less for American Stock Exchange firms than for New York Stock Exchange firms. Although there is no precise theory or empirical evidence indicating unequivocally that this difference is significant, the researcher considers it important for two reasons:

1. It seems reasonable to assume that other news events may preempt some of the newsworthiness of earnings data. However, the reporting of other news events is subject to the judgment, discretion and promotional motives of management and their public relations advisors. Earnings numbers, on the other hand, meet the basic, unavoidable requirements of both major securities exchanges. Hence, the basic significance of earnings numbers may be most discernable in cases where they are supplemented by only a minimum of other reporting.
2. The principal measurement technique employed in this study is a comparison (ratio) of firms' residual price changes in weeks of earnings announcements with their average residual price change in other weeks of the study period. In order for conclusions based on these measurements to be valid conclusions about the absolute significance of earnings

announcements, rather than their significance relative to other news events, an heretofore implicit assumption must be met. The assumption is that significant "other" news events are just as likely to occur in weeks of earnings announcements as in "other weeks" of the study period. An attempt was made to identify other types of news events for which this assumption might not hold at the time of data collection. The results of this effort are reported in a later section of this chapter. In spite of this measure, however, it is felt that the fewer "other" news events among the firms studied, the less dependent the results of the study will be on the above assumption.

In his study of the significance of annual earnings announcements of New York Stock Exchange firms Beaver attempted to minimize dependence on the same assumption by limiting his study to firms with a maximum of twenty news events per year.¹ After preliminary investigation, the researcher felt that such an arbitrary selection criterion would be unnecessary if firms from the American Stock Exchange were selected. Few American Stock Exchange firms have more than a few significant news events other than earnings announcements; only very rarely do they have more than twenty. Thus on the basis of maximizing the power of the measurements employed to satisfy the research questions of the study and minimizing arbitrary sampling restrictions, the researcher favored American Stock Exchange firms over New York Stock Exchange firms.

¹Beaver, 1968 Supplement to the Journal of Accounting Research, Vol. VI, p. 70.

In addition to promising greater potential for measurement of the absolute significance of quarterly earnings announcements, the researcher felt that the choice of American Stock Exchange firms would better relate this study to the most important related prior research concerning the usefulness of quarterly accounting information. Recall that Newell's study confirmed that potential differences in the quality of annual and quarterly accounting data were indeed realized among American Stock Exchange firms.¹ These results stimulated the second research question of this study, the question of whether investors' response to quarterly and annual data reflect this difference in quality or not. The researcher, of course, will be able to state more clearly and confidently the implications of the results of the second part of the study if the results are based on observations from the population to which Newell's empirical results are applicable.

Therefore, on the basis of expected sharper measurement of the phenomenon of interest and stronger links with important antecedent research, the researcher has chosen to draw sample firms from among those listed on the American Stock Exchange. It is the opinion of the researcher that the considerations favoring selection of American Stock Exchange firms outweigh the greater stature and economic significance of New York Stock Exchange firms.

Selection of Study Period

The selection of a study period is largely an arbitrary process. There are a number of important considerations entering into the decision

¹See Chapter II, above.

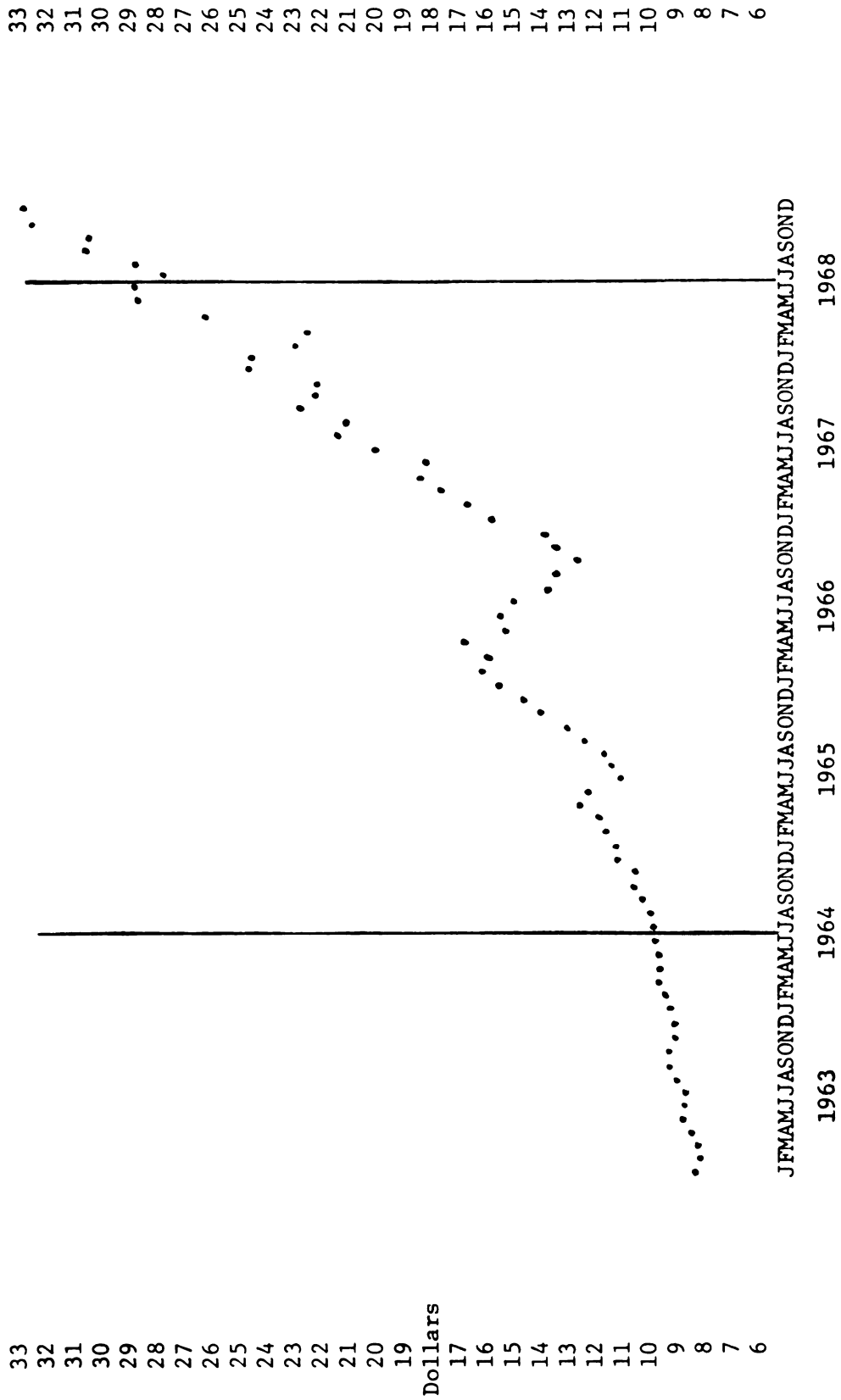
but no precise way of optimizing their joint satisfaction. The considerations that entered into the selection of the period of study used in this project are:

1. That there be a variety of stock market dispositions represented in relatively few years.
2. That the observations be recent enough to be relevant to the present and future.
3. That data be available in readily accessible form.

The period selected for this study extends roughly from July, 1964 through June, 1968. As can be seen in Figure 2 this period includes a moderately "bullish" market through April, 1966, a brief but pronounced "bear" market through October, 1966, and a segment of the dramatic upswing that persisted through January, 1969. The selection of three years was largely determined by a need to keep the requirements of data collection and preparation within reasonable limits. Furthermore, the use of more than one year is more a matter of ensuring that there be no great impediment to achieving a representative sample distribution of newsworthy earnings numbers, than an attempt to gauge the significance of a possible systematic "time effect" on investor responses to earnings announcements.

The question of whether the period selected is relevant to the present and future can only be answered subjectively. The researcher obviously feels the answer is affirmative. However, the reader may judge for himself. The results of the study will be meaningful only to those who agree to some extent with the judgment of the researcher.

Figure 2



Sample Selection Procedures

A sample of 105 firms was selected from among all firms whose common stocks were listed on the American Stock Exchange in the fourth calendar quarter of 1965. All firms selected had to satisfy the following selection criteria.

1. Each firm must have reported earnings on a quarterly basis during the study period.
2. No more than one earnings report for a given fiscal year could be unavailable for study, e.g. not reported in the Wall Street Journal.
3. Each firm must have been continuously listed during the time that it reported quarterly and annual earnings for its three fiscal years starting and ending during the study period and the annual earnings number reported for the fiscal year just ended at the beginning of the study period.
4. The firm must not have had more than one dividend announcement in the week of an annual earnings announcement or more than two dividends announcements that coincide with quarterly and/or annual earnings announcements.

The first three of the selection criteria were meant to provide a relatively consistent pattern of observation among the sample firms. That pattern consisted of three years' quarterly earnings announcements interspersed between four years' annual announcements.

This general pattern is illustrated in Figure 3, below.

fiscal year	1964				1965				1966				1967				1968			
fiscal quarters	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	
announcements					A	1	2	3	A	1	2	3	A	1	2	3	A			
					<div style="text-align: center;">Study Period</div>															

Figure 3.--Pattern of observation of individual firms' earnings announcements during the study period.

This pattern was considered desirable since a comparison between investor response to quarterly announcements and investor response to annual announcements is an important part of this study. Starting the sequence with an annual report ensures that the annual reports are not systematically preceded in time by quarterly reports, thus mitigating against a time bias in the comparison test to be made.

The fourth selection criterion was instituted to preserve the comparability of measured residual price responses in the weeks of earnings announcements and the measured residual price responses in other weeks, the standard of comparison throughout this study. Since any week of any year can potentially contain a news event of significance and a related change in the intrinsic value of the stock of the company to which it applies, the average of weekly residual price responses of "other weeks" is not an absolute (newsless) standard for gauging the significance of residual price responses in weeks of earnings announcements. Yet, if it can be assumed that the probability of such "other" news events occurring in weeks of earnings announcements is not significantly different from

the probability of their occurrence in "other weeks", no incomparability will be suspected.

But the pattern of some firms' cash dividend announcements made it clear that the above assumption did not hold. In the absence of any means of specifying the exact numerical affect that the inclusion of these firms would have on the measurements used in the study, these firms were eliminated. The fourth criterion listed above was the basis on which the researcher rejected the assumption that dividends announcements were equally probable in both earnings-announcement weeks and non-earnings-announcement weeks for individual firms. By rejecting firms that announced cash dividends in weeks of earnings announcements the researcher, of course, tended to increase the ratio of non-dividend-paying firms to dividend-paying firms in the sample. An attempt will be made in a later chapter to assess the effect of this unbalancing on the outcome of the tests conducted in the study.

In all, 251 common stocks, selected randomly from all securities listed on the American Stock Exchange in the fourth calendar quarter of 1965, were evaluated according to the sample selection criteria. The composition of acceptances and rejection under the four criteria are given below in Table 1.

Firms were considered successively in random order and either accepted or rejected until the original objective of 100 sample firms was reached. Subsequent review of all firms rejected, however, produced five additional firms that were marginal but acceptable.

Rejection occurred at the point when it was noted that the firm failed to conform to any one of the selection criteria. Hence, a firm

TABLE 1.--Results of application of sample selection criteria

Disposition of Firms	Number of Firms
a. Rejected for lack of available quarterly or annual reports during the study period (criteria 1 and 2)	63
b. Rejected; not listed for a substantial portion of the study period (criterion 3)	49
c. Rejected for having excessive dividends announcements in weeks of earnings announcements (criterion 4)	34
d. Accepted	<u>105</u>
Total Considered	251

rejected under one criterion might also fail to qualify under any of the other criteria as well. However, once a firm was rejected under one criterion no attempt was made to proceed with consideration of that firm's qualifications under the other criteria.

Finite Population Represented by the Sample Selected

Strictly speaking the conclusions drawn in this study, based on the results of the sample of 105 firms, are applicable only to the set of all American Stock Exchange firms satisfying the four sample selection criteria listed in the previous section. To the extent that these firms are not materially dissimilar to firms not listed on the American Stock Exchange or not meeting the sample criteria, readers may wish to extrapolate the conclusions reached in the study. However, no rigorously defensive generalizations may be made about firms not meeting the sample

criteria and none will be attempted herein.

The source of firms listed on the American Stock Exchange used for sample selection purposes was the ISL Daily Stock Price Index: American Stock Exchange for the fourth calendar quarter of 1965.¹ According to the Index just under 1050 securities of various kinds, including common stocks, preferred stocks, warrants, etc., were listed on the AMX in the fourth quarter of 1965. Because the sample statistics described in the preceding chapter depend on the size of the finite population from which the sample was drawn, it is useful to know just how many of the total 1050 securities comprise the population meeting the sample selection criteria. Since application of the sample criteria to every security would be extremely tedious and time consuming a process of estimation was followed instead.

In the preceding section it was mentioned that 251 common stocks were examined in the process of selecting 105 for observation. The 251 common stocks actually were part of a master random sample of 323 securities of all kinds drawn from among the total 1050 available. Securities other than common stocks were eliminated as encountered in random order, as were common stocks not satisfying the sample criteria. Hence, the 323 securities may be thought of as a random sample of all securities listed on the AMX in the fourth quarter of 1965 and the 105 firms may be thought of as the sample frequency of common stocks (firms) meeting the selection criteria. From the sample frequency a confidence interval can be constructed for estimates of the actual rate of occurrence of securities

¹ISL Daily Stock Price Index: American Stock Exchange (Palo Alto, California: Investment Statistics Laboratory, Inc., published quarterly for years starting with 1962).

meeting the selection criteria in the population of 1050. The procedure may be summarized in the following steps:

1. Select the maximum tolerable probability, π , that the true size of the population will fall outside the limits of the interval to be estimated.
2. To estimate the lower limit of the interval, find the sub-population size for which the probability is $\frac{1}{2} \pi$ that a sample frequency of 105 or more could occur in a sample of 323 drawn from a population of 1050.
3. To estimate the upper limit of the interval find the sub-population size for which the probability is $\frac{1}{2} \pi$ that a sample frequency of 105 or less could occur in a sample of 323 drawn from a population of 1050.

Steps 2 and 3 essentially call for a search procedure that involves cumulation trials with successively smaller or larger values of D in the following formula:

$$\frac{1}{2} \pi = \sum_{R=X}^L \frac{C_R^D C_{N-R}^{P-D}}{C_N^P}$$

where P is the population size (in this case 1050),

N is the sample size (in this case 323),

D is the trial subpopulation size,

R is the variable sample frequency that runs from

X, the experienced sample frequency, to

L, the limit of either zero or the minimum of N and D, depending on whether the upper or lower limit of the subpopulation is being estimated.

Obviously a great deal of effort can be avoided by resorting to interval limits in available tables already prepared for various values of P, N, D, and X. In doing so, however, one must be satisfied with the results shown in the table for values of P, N, D and X that are close to, but not exactly equal to, the values actually experienced. In the case at hand, tabled intervals were available for a population size of 1000, sample size of 300 and sample proportion of .35 (the actual sample proportion was $105 \div 323 = .33$).¹ The 99% confidence interval for the nearest tabled values was from 307 to 433. But, since the table proportion of .35 was greater than the sample proportion of .33 this interval will tend to be higher than the interval the researcher is really interested in. However, it does provide good starting points for trials with the formula described above.

Choosing the lower, round-numbered interval of 300 to 400 for its convenience, the researcher computed the probability of accepting 105 or more firms out of 323 if the population of all acceptable firms was really 300 out of 1050. That probability was approximately .036. Similarly the researcher computed the probability of accepting 105 or less firms out of 323 if the population of all acceptable firms was actually 400 out of 1050 and found it to be approximately .0076 -- very small indeed.

Since the combined probability of the true population size being greater than 400 or less than 300 is less than .05, the search process was not pursued further. For the remainder of this study it will be assumed that the 105 firms selected for study are representative of from

¹Herbert Arkin, Handbook of Sampling for Auditing and Accounting (New York: McGraw-Hill Book Company, Inc., 1963), Table F-23, p. 494.

300 to 400 American Stock Exchange Firms. Sample statistics, depending on a correction for the size of the sample relative to the population, will employ either the upper or lower limit, whichever leads to the more conservative conclusion.

Data Gathered

As was mentioned in the earlier section of this chapter dealing with sample selection criteria, the desired pattern of observation was such that three fiscal years' quarterly announcements (a total of nine) and four fiscal years' annual announcements would be observed. In order to provide eleven-week price-change observation periods including each of the thirteen earnings announcements it was necessary to collect from thirteen to fifteen quarters' weekly price quotations for each firm (the minimum block of price quotations gathered was that of one calendar quarter). Generally fourteen quarters' price quotations were gathered as a matter of course, with a fifteenth added if either the first or last annual report in the study period occurred within five weeks of the beginning or end, respectively, of its calendar quarter.

The price quotation for a week was taken to be the last closing price of that week, usually the Friday close price, listed in the ISL Daily Stock Price Index: American Stock Exchange.¹ If none of the shares of the particular company was traded on Friday of a given week the price used was the close price of the last day on which stock was traded. In very rare cases when no stock was traded for the week, the price used was that of the prior week. Thus no price change was

¹ISL Daily Stock Price Index: American Stock Exchange, parts 1, 2, 3 and 4 of 1964 through 1968.

registered in a week in which no trading took place. The dates on which the sample firms' stock sold "ex dividend" or "ex split", and the related dividends and split ratios were recorded from the same source as the price quotations, the ISL Index.

Earnings announcement dates were initially taken from the Wall Street Journal Index.¹ The dates were then confirmed for all announcements of the first 100 firms accepted in the sample by tracing them to the appropriate Wall Street Journal issues. Of the 1349 announcement dates taken from the Wall Street Journal Index only two were in error, a remarkable degree of accuracy indeed. As a result of this experience, no confirmation was made of the announcement dates of the additional 5 firms added to the sample as a result of the second review of all initially rejected firms.

While the data were being gathered an unanticipated methodological difficulty was encountered in determining which of several statements made by a company over a span of several months was the first announcement of a factual earnings number. For instance, cases were encountered in which shortly after a quarter's earnings announcement a statement was made about the general outlook for the next fiscal quarter's earnings, then perhaps at the end of the fiscal quarter another statement was made giving an expected level of earnings that would be reported for the quarter just ended, and finally, some weeks later a precise set of figures appeared in the "Earnings Digest" column of the Wall Street Journal. Since the methodology described in Chapter IV calls

¹Wall Street Journal Index, 1964 through 1968.

for picking a point in time (a week) when the market first perceived the actual level of earnings for a quarter, it was necessary to choose between the several statements made in some cases.

Since this study is concerned with the effect on investors of actual accounting numbers, criteria were required to determine which of several statements were disclosures of actual outputs of the accounting process and which were management forecasts of actual accounting outputs. In order to be considered a disclosure of actual outputs of the accounting process, a statement appearing in the financial press had to:

1. Appear on or after the close of the fiscal period to which it applied so that the accounting cycle could reasonably be assumed complete.
2. Be a statement of equality or near equality to an actual earnings number.

Sixty of the total 105 firms had at least one earnings number to which the criteria had to be applied. Nevertheless, only about 110 earnings numbers out of 1339 included in the results of the study required dating under the criteria.

While the application of the first criterion was quite straightforward, the second criterion required somewhat subjective decisions. Statements to the effect that earnings would be greater than or less than some level, e.g. greater than last year's level, were disqualified as too vague, whereas statements that earnings would be only slightly greater or slightly less than a particular level were considered to be statements of near equality. Similarly, a statement that earnings would be up 40% over last year qualified under criterion 2, whereas a statement that earnings

would be at least 140% of last year's was not considered to qualify. But the first criterion tended to reduce the number of these difficult cases that had to be considered since, as one would expect, statements after the close of the fiscal period tended to be much more precise than those made before. Application of criteria 1 and 2 resulted in dating each earnings announcements in the week of the first statement on or after the close of the fiscal period that in the researcher's judgment was a reasonably precise statement of earnings for the fiscal period. In the next chapter an alternative methodology will be used to determine the effect on the results reported later in this chapter of restriction of the measured response to the week of only one of several announcements concerning a particular earnings number.

Correction and Transformation of Prices

The first step in transforming the sample firms' price data into the final price-response ratios on which the hypotheses of the study are based, was to correct all price quotations for each firm to a constant capital base. This was accomplished by appropriately adjusting downward all prices prior to the effective week of splits and stock dividends and to adjust cash dividends paid prior to or simultaneously with stock dividends or stock splits.

The second step was to convert the corrected price quotations to price-change measurements. Recall, however, that the change measurements desired are not simple differences between successive weeks' closing prices. Rather, the price-change measurement for firm j in week t , P_{jt} , was defined as:

$$P_{jt} = \ln (p_{jt} + D_{jt}) - \ln (p_{jt-1})$$

where p denotes price and D denotes dividends paid. Not only was this mode of measurement chosen for its conformity to the assumptions of the linear regression model to be used for abstracting from market effects, but because it corrects for the scale factor among firms as well.¹ It can be shown that P_{jt} computed as above is equivalent to the rate of return on p_{jt-1} , continuously compounded, that would be required to give an investor the equivalent of $p_{jt} + D_{jt}$ at the end of a one week holding period.² In other words, p_{jt} is the continuously compounded rate of change in the price of security j in week t . By using the rate of change rather than simple change measurements the researcher avoids the pitfall of regarding identical price changes as equivalent for securities selling at widely disparate prices.

The third step in converting the price measurements to the form on which the hypotheses of the study are based was the correction for

¹Fama, et al., International Economic Review, Vol. X, No. 1, p. 4, Note 8.

$$P_{jt} = \ln (p_{jt} + D_{jt}) - \ln (p_{jt-1})$$

restating $p_{jt} + D_{jt}$ in terms of p_{jt-1} and a rate of interest,

$$r, \text{ gives } P_{jt} = \ln (p_{jt-1}(1 + r)) - \ln (p_{jt-1})$$

compounding continuously gives

$$P_{jt} = \ln \left(\lim_{m \rightarrow \infty} p_{jt-1} \left(1 + \frac{r}{m}\right)^m \right) - \ln (p_{jt-1})$$

$$= \ln (p_{jt-1} e^r) - \ln (p_{jt-1})$$

$$= \ln (p_{jt-1}) + r - \ln (p_{jt-1})$$

$$= r$$

market effects. As was described in Chapter III, the correction takes the form of first finding a unique linear relation between the changes in log prices of each firm and some market index, then correcting each of the firms' log price changes to the amount not explained by this relation with the market index.

The index selected for this purpose is the American Stock Exchange Price Level Index, the only index constructed specifically to be representative of common stocks listed on the American Stock Exchange.¹ The Index is based on price changes prior to and subsequent to the base date of April 29, 1966. On that date the average price of all common stocks and warrants admitted to trading was 16.88. All subsequent daily and hourly values of the index have been arrived at by adding the average change in all common stock and warrant prices, adjusted for capital changes, to the preceding value of the index, unadjusted for capital changes. Values of the index prior to April 29, 1966, back to October 1, 1962, were computed in a manner analogous to values subsequent to the base date. Although failure to adjust already quoted values of the index for subsequent (or prior) stock splits and other capital changes creates a potential for the index to drift away from the average price of a share on the Exchange, no such drift was detected in a four-year study period starting with July 1, 1963 (a period covering most of the weeks of interest in this study).

For purposes of regressing the transformed price changes of individual firms on the changes in the Index, the Index changes, M_j , were

¹Alva B. Schoomer, Jr., "The American Stock Exchange Index Systems," reprint of article appearing in the Financial Analysts Journal, Vol. XXIII, No. 3 (May-June, 1967).

also measured in logarithmic form:

$$M_t = \ln(m_t) - \ln(m_{t-1}).$$

The index changes were measured in logarithmic form for the same two reasons that the firms' price changes were measured that way, to adjust all changes to a constant scale (rate of return) and to better satisfy the assumptions of the linear regression model.

For each of the 105 sample firms estimates of A_j and B_j were found by the least squares criterion for the simple linear model:

$$P_{jt} = A_j + B_j M_t + R_{jt}$$

using as inputs the actual measured P_{jt} and M_t for all weeks of the study period for which price data were gathered for firm j except weeks of earnings announcements. The residual price change measurements, R_{jt} , were then calculated for all weeks including the weeks of earnings announcements. The R_{jt} constitute a set of net price-change measurements free of estimated effects of influences affecting all common stocks and warrants listed on the American Stock Exchange during the weeks of observation of each firm.

One measure of the magnitude or significance of the "market effect" is the R^2 of the time-sample regression of each firm's price changes on the changes in the index. The R^2 is the proportion of the variance of each firm's price change measurements, P_{jt} , about their mean, \bar{P}_{jt} , explained by the relations $P_{jt}^* = A_j + B_j M_t$.¹ If, for instance R^2

¹ P_{jt}^* is the estimate of P_{jt} based on the market change for week t . $R_{jt} = P_{jt} - P_{jt}^*$.

were .5 it would mean that the regression relation explained one half of the variance in the price changes of a particular firm.

Figure 4 shows the frequency of R^2 's of various sizes that resulted from the regression relations estimated for the 105 firms included in the study. The average proportion of explained variance of .11 was less than the .307 explained variance in monthly price changes found by King in the research discussed in Chapter III. However, as was mentioned in the earlier discussion, the greater chance variability of weekly price changes relative to monthly price changes would lead to an expectation that the proportion of variance in the former explained by a market index would be less than for the latter.

Before continuing the discussion of the steps in the correction and transformation of the price data used in the study it would be useful at this point to recall that it was assumed earlier, on the basis of the evidence of past empirical research, that in the absence of foreknowledge of the timing of specific news events, the successive weekly price changes of individual firms would be consistent with the random walk theory, i.e. be independent. The correlation coefficient is a measure of the degree and direction of the linear dependence of one variable on another. When the two variables to which simple correlation is applied are successive values of the same time series, the coefficient is called the autocorrelation coefficient. Figure 5 is the frequency distribution of the absolute values¹ of the autocorrelation coefficients, $|R_a|$, of the two series,

¹Absolute values of correlation coefficients indicate degree but not direction of dependence. But since the assumption is only concerned with dependence, the absolute value of the correlation coefficient is the relevant measure.

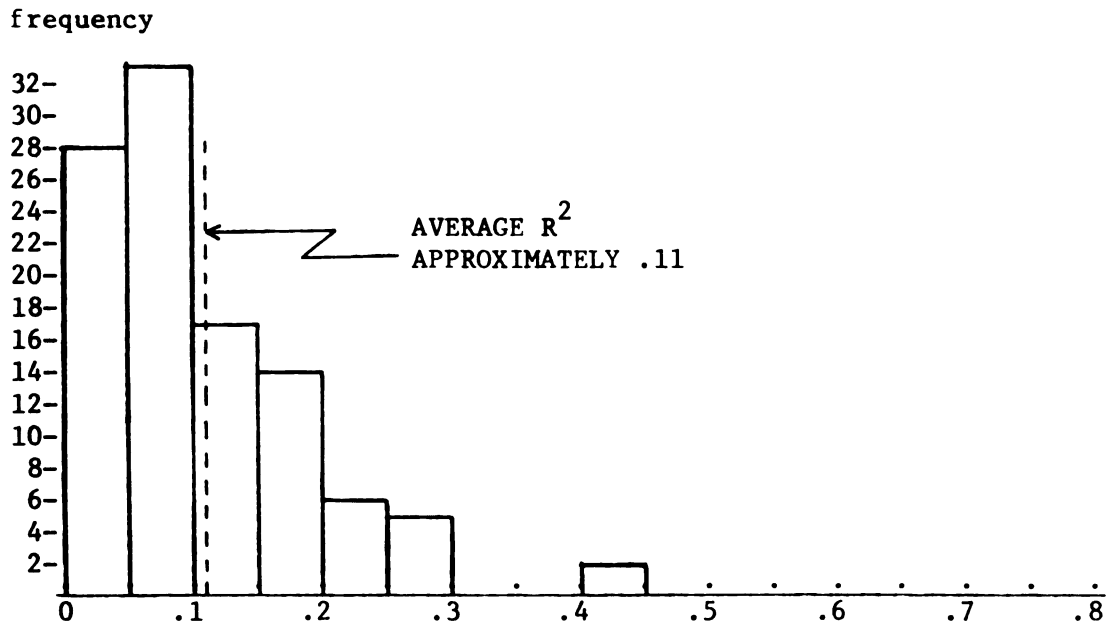


Figure 4.--Frequency distribution of firms' proportions of explained variance due to regression of price-change measurements on price-index changes.

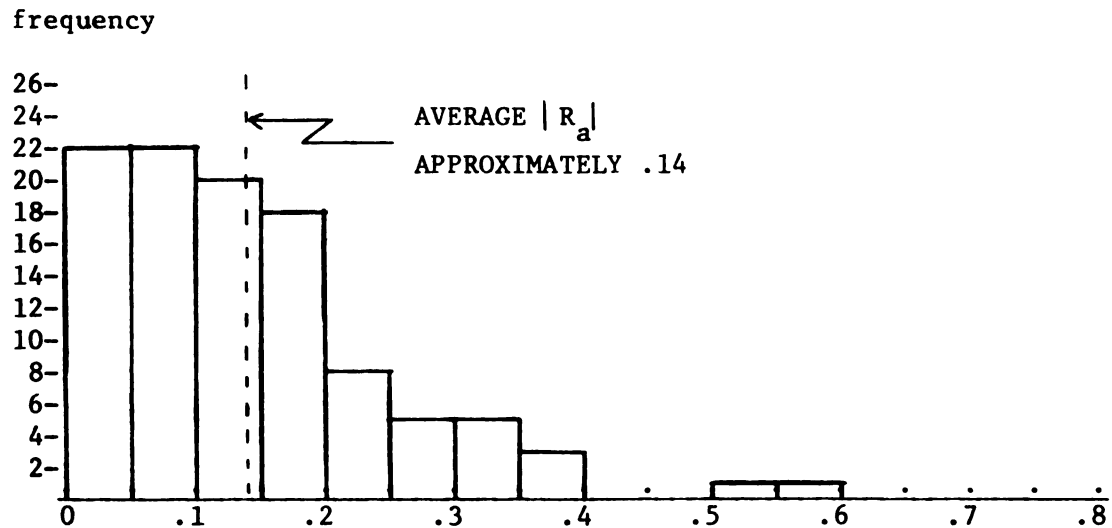


Figure 5.--Frequency distribution of firms' coefficients of autocorrelation of residual price change measurements.

R_{jt} and R_{jt+1} , for all of the 105 sample firms. The low average autocorrelation of the price residuals, .14, tends to support the assumption that the residual weekly price changes of the sample firms conform to the random walk theory, i.e. that the residual price change in a particular week, say $t+1$, is independent of the change in the prior week, t .

The fourth step in converting the price data gathered to the form on which the hypotheses of the study are based was the conversion to a form that measures the magnitude of the residual price change in a given week relative to the typical or average magnitude of all weekly residual price responses. Thus, for each firm the average was found of the absolute values of all residual weekly price changes other than those for weeks of earnings announcements (assumed to be atypical). Each week's relative residual, denoted RR_{jt} , was determined by the ratio of the absolute value of that week's residual price change to the average for all weeks, i.e.

$$RR_{jt} = |R_{jt}| \div \overline{|R_{jt}|} \quad (\text{the bar denotes average}).$$

Investor responses in the form of price changes were thus put in the form of the ratios that provide the observational measurements with which the operational hypotheses of the study will be accepted or rejected.

Testing the Significance of Investor Response to Quarterly Announcements

Recall that to answer the question of whether or not quarterly earnings announcements have a significant impact on investors, the specific (alternate) hypothesis was formed that the average of the ratios, RR_{jt} , for weeks of earnings announcements is greater than 1.0, the expected value of the ratio for all other weeks. To test this hypothesis

the following sample measurements were performed:

1. For each firm the response ratios, RR_{jt} , for the weeks of all quarterly announcements (generally nine for each firm) were averaged to get a measure of average investor response to the firm's quarterly announcements. The averaging was performed for each of the five weeks before and five weeks after the quarterly announcements as well, to get a kind of visual profile of the response to the announcements.
2. A count was kept of the number of times each week of the eleven week profile had the highest average response ratios for an individual firm.
3. The sample mean and variance of the average response ratios was then computed for the sample of 105 firms. The sample means were also computed for the five weeks before and after the weeks of the quarterly announcements.

The sample mean of the average within-firm responses to quarterly earnings announcements was 1.205. The sample variance was .1574. Conversion to the standard normal variate, Z , for the sample mean proceeded as described in the preceding chapter:

$$Z = \frac{1.205 - 1.0}{\frac{\sqrt{.1574}}{\sqrt{105}} \cdot \frac{\sqrt{1-105}}{400}}$$

$$Z = 6.1655$$

Since the sample Z is greater (actually remarkably greater) than the critical value for a one-tailed significance level of .05 ($Z = 1.64$), the

null hypothesis that the mean of the average ratios of response to quarterly earnings announcements is equal to or less than 1.0 is rejected. The alternative hypothesis that the mean average ratio is greater than 1.0 is accepted. Thus, that first principal hypothesis of the study that investor response to quarterly announcements is significant, is supported by this test.

Of the eleven weeks making up the profiles of investor response for each firm, the average ratio was the highest for the week of announcement 18 out of 105 times. The probability of achieving a frequency of 18 or more out of 105 by chance alone was also computed as described in the preceded chapter:

$$\pi = \sum_{R=18}^{36} \frac{C_R^{36} \cdot C_{105-R}^{400-36}}{C_{105}^{400}}$$

$$\pi = .0012$$

Since the probability of the sample frequency of "significant" (highest ranking) ratios in weeks of earning announcements is very small, it is concluded that the high frequency among sample firms of significant average investor responses to quarterly earnings announcements is itself significant, i.e. not simply due to chance alone.

Note that in both of the tests applied above to the sample results, the finite population size used was 400, the upper limit of the interval estimated in an earlier section of this chapter. Examination of the formula for Z shows that the greater the size of the finite population relative to the sample, the smaller the sample value of Z will be, ceteris paribus. The smaller Z tends to be, the less likely it will

exceed the critical value called for in the test and lead to rejection of the null hypothesis. Thus the use of the upper limit of estimate of the finite population size leads to a more conservative rejection of the null hypothesis than do lesser values. Analogous reasoning applies to the computation of π according to the hypergeometric distributibution.

Sample computations identical to those made for all quarterly announcements were made for first, second, third quarter, and annual announcements separately, and for all announcements of all kinds. The sample computations for all of these groupings are shown on Table 2.

TABLE 2.--Sample results of average response ratio measurements for various groupings of announcements

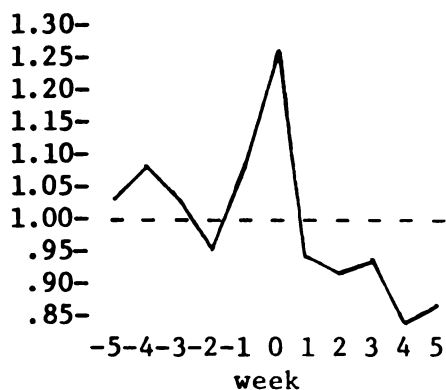
	Mean Average RR_{jt}	Sample Variance of Average RR_{jt}	Sample Z
1. First Quarter Announcements	1.257	.3981	4.8602
2. Second Quarter Announcements	1.184	.4091	3.4325
3. Third Quarter Announcements	1.165	.3364	3.3782
4. Annual Announcements	1.252	.5701	3.9823
5. All Quarterly Announcements	1.205	.1574	6.1655
6. All Announcements	1.222	.1445	6.9684

Eleven week profiles of mean average price response ratios are depicted visually on Figure 6. Eleven week profiles of the sample frequencies of incidence of highest within-firm average response ratios are shown in Figure 7, along with values of π for the frequencies of the announcement weeks, denoted as week zero in the profiles.

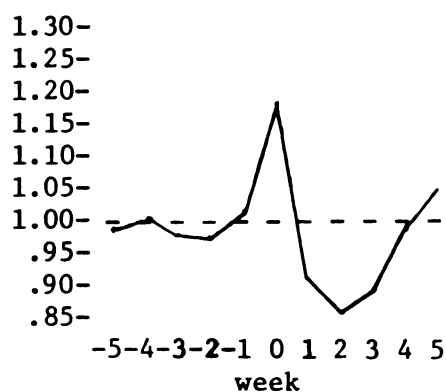
Since the sample was gathered with the primary goal of satisfying the question of significance of quarterly earnings numbers in general, and since the results of at least four of the other groupings are clearly not independent of the results determined for all quarterly announcements combined,¹ the researcher counsels caution in interpreting the data shown in Table 2 for groupings other than "all quarterly announcements". The researcher suggests that the data be interpreted from the speculative "what if" point of view. For instance, one might ask: what if we had set out to test the significance of investor response to first quarter announcements only? Given the Z statistic of 4.8602 for first quarter announcements on Table 2 we know that, had we selected this sample of firms to satisfy the question, we would have judged investor response to first quarter announcements highly significant, i.e. having a probability of occurring under the null hypothesis much less than .05. Similar reasoning would apply to all "other" groupings shown in Table 2 with the

¹The within-firm measured response to all quarterly announcements includes the response to each individual 1st quarter announcement, each second quarter announcement, and each third quarter announcement. Hence the within-firm measured response to quarterly announcements of each type is related algebraically to the measured response to all quarterly announcements. Thus, once it is known that the sample investor response to all quarterly announcements is significant at a certain level, we are in a position of greater certainty about the significance of the sample response to quarterly announcements of each type.

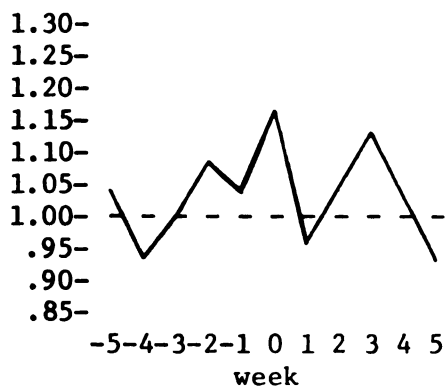
1st Quarter Announcements



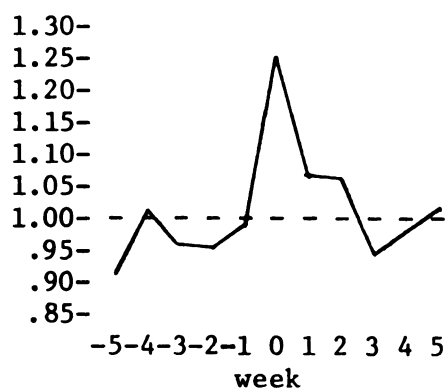
2nd Quarter Announcements



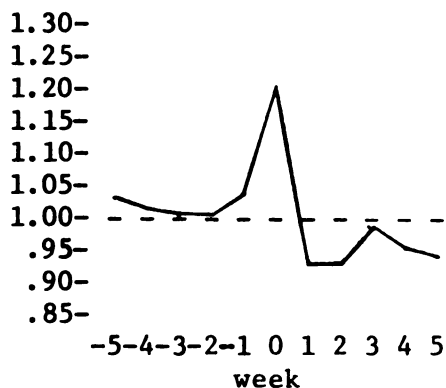
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

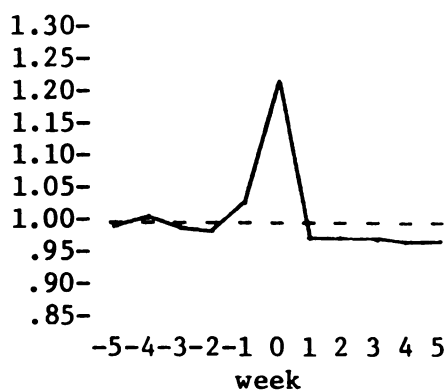
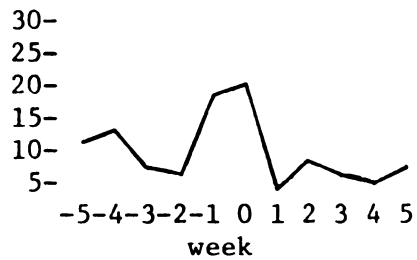


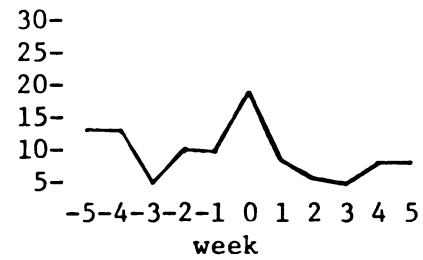
Figure 6.--Eleven week profiles of mean average response ratios for various groupings of earnings announcements.

1st Quarter Announcements



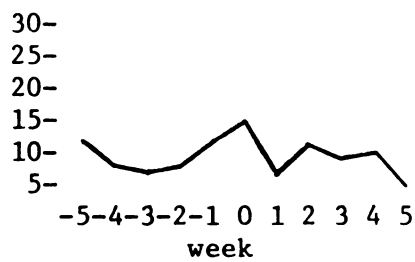
$$\pi = .000084$$

2nd Quarter Announcements



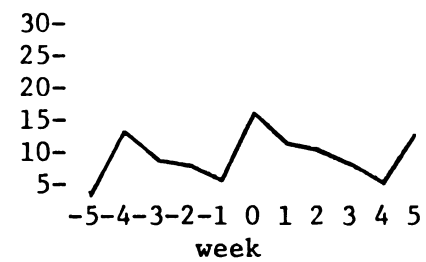
$$\pi = .00033$$

3rd Quarter Announcements



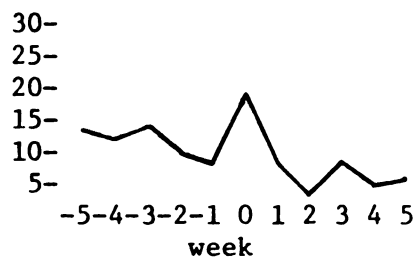
$$\pi = .023$$

Annual Announcements



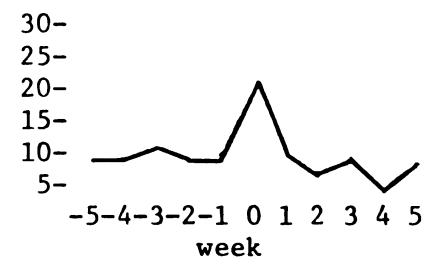
$$\pi = .01$$

All Quarterly Announcements



$$\pi = .0012$$

All Announcements



$$\pi = .0012$$

Figure 7.--Frequency distributions of highest average response ratios according to week relative to announcements.

same conclusion. The reader is cautioned to use the same approach to the interpretation of the values of π given for the announcement - week frequencies of highest average ratios in Figure 7 as well. For instance, in interpreting the .00033 value of π for second quarter announcements, one can say that: had the study investigated the frequency of "significant" responses to second quarter announcements only, it would have found the frequency large enough to make it highly improbable that it occurred by chance alone. It may be noted that the result of such interpretation, however, will be the same as the result of interpretation of the Z statistics of mean average response ratios for the several "other" groupings.

In general, had we set out to test the significance of investor response to any category or subcategory of earnings announcements, we would have concluded from the sample data gathered that the response is indeed significant whether measured on the basis of average or frequencies. The eleven week visual presentations in Figure 6 and 7 basically support the conclusions arrived at by analysis of the sample statistics.

For each grouping of earnings announcements the mean average ratio and frequency of highest ratio is greatest for zero-week, the week of the earnings announcements. For all but the third quarter profile of mean average ratios the zero-week measurement is dramatically greater than the measurements for surrounding weeks. Furthermore, the several remarkably high and low weeks on the profiles of the individual quarters' groupings tend to be "washed out" at greater levels of aggregation within firms, i.e. when ratios are averaged over more types of announcements, as evidenced by the profiles for all quarterly announcements and for all quarterly and annual announcements.

Testing the Significance of the Difference Between
Investor Response to Quarterly Earnings and
Investor Response to Annual Earnings

Recall that the second principal hypothesis of the study was that there is a significant difference between investor response to annual earnings announcements and investor response to quarterly earnings announcements. To put this hypothesis in testable form, it was proposed that for each firm the difference be measured between the average response to all quarterly announcements and the average response to all annual announcements. The specific null hypothesis was that if there is no difference between investor response to quarterly announcements and investor response to annual announcements the expected value of the difference in average ratios is zero.

The differences in average ratios were recorded for each of the 105 firms in the sample. The sample mean of the differences was .0471; the sample variance was .6602. The value of Z of .7368 computed as described in the preceding chapter, was considerably smaller than the 1.64 at which the null hypothesis could be rejected with a probability of error as low as .05. Indeed, although the positive mean difference in average ratios indicates that the sample within-firm response to annual announcements exceeds the sample within-firm response to quarterly announcements, a sample difference as great or greater than the one experienced would occur slightly more than 23% of the time if there were no true difference between investor response to annual announcements and investor response to quarterly announcements. Hence, the alternative hypothesis that investor response to the more reliable annual announcements is greater than investor response to quarterly announcements,

cannot be safely accepted.¹

Table 3 gives the sample statistics for each of the three types of quarterly announcements separately, as well as for all quarterly announcements combined. When interpreted from the same point of view suggested above for interpreting Table 2, it shows that our conclusion would have been the same had we chosen to test the difference in

TABLE 3.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Difference	Sample Z
1. First Quarter vs. Annual Earnings	-.0046	.7462	-.0677
2. Second Quarter vs. Annual Earnings	.0679	.9469	.8869
3. Third Quarter vs. Annual Earnings	.0666	1.032	.8293
4. All Quarterly Earnings vs. Annual Earnings	.0471	.6602	.7368

¹Since the lower limit of the population size interval estimated earlier in this chapter was used in computing the Z values in Table 3, the conclusions reached based on those Z values would be the same if the true population size were any value greater than 300. The Z values in Table 3 are the largest values, i.e. the closest to the critical value of 1.64, that would result from any reasonable assumption about the size of the population. Thus not rejecting the null hypothesis at those levels virtually eliminates the effects of our uncertainty about the true size of the population on the results of the test of differences.

response to annual announcements and the response to first quarter announcements only, second quarter announcements only, or third quarter announcements only. In general, had we set out to test the significance of difference between investor response to annual announcements and investor response to any one or all quarters' announcements, we would have concluded from the sample data gathered that the difference is not significant.

Summary

This chapter has been devoted to population and sample selection, data gathering and transformation, and sample application of the tests of hypotheses described in Chapter IV. The findings were essentially that:

1. Investor response to quarterly earnings announcements is highly significant as measured by price-change responses in weeks of announcements relative to price changes in other weeks of the study period.
2. The measured investor response to annual announcements was slightly greater than measured investor response to quarterly announcements, but the difference was not significant.

Since these findings are subject to limitations imposed by the assumptions underlying the measurements employed in the study and possible procedural weaknesses inherent in employing them, a statement of conclusions and recommendations based on the findings will not be made immediately. Rather, the next chapter will be devoted to a reconsideration of some of the limitations of the methodology in view of information contained in the sample data, hitherto not available.

CHAPTER VI

ANALYSIS OF THE EFFECTS OF CERTAIN ASSUMPTIONS ON THE REPORTED FINDINGS

The methodology used to arrive at the findings reported in the preceding chapter was based on certain critical assumptions, some of them only implicit in the earlier discussion. Since the findings of the study depend for their validity on the reasonableness of the assumptions made, the opportunity to evaluate the extent to which the sample data behave contrary to assumption should not be foregone. As most of the assumptions inherent in the methodology have been made on the strength of widely accepted and/or tested theory, the point of view of this chapter will be to accept the reasonableness of assumptions unless evaluation of the sample data is clearly contradictory.

The first section of this chapter will address itself to an assumption implicit in the correction of individual firms' price changes for "market effects". The three sections following the first will be devoted to the degree to which the measurement methodology is equally applicable to the measurement of investor response to annual earnings numbers and investor response to quarterly earnings numbers, a question of utmost importance in interpreting the findings of the study relative to the second research question. Specifically, the second through the fourth sections will be devoted to discussion of multiple announcements

of earnings numbers, reevaluation of the one week price response period, and the density of "other" news events in weeks prior to earnings announcements.

Correction of Price Changes for Market Effects

Market behavior patterns are nothing more than abstractions. They do not exist apart from the behavior patterns of trading in individual securities. We typically describe what the market is doing with some descriptive statistic such as the average of the price changes of all securities traded within a particular jurisdiction (exchange). Any behavior pattern common to a sufficiently large number of the securities within a jurisdiction will, therefore, impress an observer as a market pattern by algebraically dominating the descriptive statistic used to characterize the securities as a group. This suggests a hazard in "correcting" the price changes of an individual firm for "market effects".

The correction for market effects employed in this study was intended to isolate that portion of a price change attributable to chance or to true changes in the firms' equilibrium price due to unique alterations in investors' expectations regarding only that firm. In particular the study has been concerned with isolating the price changes attributable to changes in equilibrium price due to the impact of earnings numbers on investors' expectations regarding individual firms. But if, as Beaver pointed out, large numbers of firms' earnings announcements were made in the same weeks, the unique effects on individual prices of the earnings numbers of individual firms might combine into a market effect--provided there was sufficient similarity in the separate effects of many

firms' earnings numbers.¹ Were this the case, the correction of firms' price changes for market effects would also be a correction for some of the unique effects of their earnings announcements.

Beaver attempted to minimize the potential for correcting away the unique effects of the annual announcements that he studied by selecting firms that did not end their fiscal years on December 31.² He found that the annual earnings announcements of all non-December 31 firms were well dispersed over the calendar year.³ However, in making this decision Beaver apparently overlooked the fact that the weeks of annual earnings announcements of approximately 47% of his sample firms, e.g. those with fiscal closing on March 31, June 30, and September 30, would roughly coincide with the weeks of quarterly and annual earnings announcements of all other firms with fiscal closings at the ends of calendar quarters, including December 31 firms.⁴ Hence, selectively eliminating firms from study was no real solution to the potential problem created by bunching of earnings announcements. Although the firms included in Beaver's study were not representative of all firms contributing to an "earnings effect" on the market, their individual earnings effects would nevertheless be corrected away, to the extent that they were similar to the individual effects experienced by many other firms announcing earnings in the same weeks.

¹ Beaver, 1968 Supplement to the Journal of Accounting Research Vol. VI, p. 71.

² Ibid.

³ Ibid., p. 86, Table 2.

⁴ Ibid.

The approach of this study has been to assume that while earnings announcements may be somewhat bunched in certain weeks, their individual effects are sufficiently diverse so as not to create "earnings effects" on the market. Although it would require a large scale research project to rigorously test such an assumption, the sample data in this study can provide some indication of whether or not it is seriously violated.

Figure 8 depicts the weekly distribution of all earnings announcements made by the sample firms in calendar 1966, the middle year of the study period. It shows that with the exception of only a few weeks the sample earnings announcements were remarkably spread out. If in spite of this dispersion there are significant "earnings effects" on the American Stock Exchange Index, it would be expected that the measured effects of individual earnings announcements net of market effects would be less than the effects of individual announcements without market correction. Therefore all the sample measurements reported in the preceding chapter were replicated without correcting the firms' price changes for changes in market prices generally. Figure 9 consists of the eleven week profiles of mean average ratios without market correction. The dotted lines represent the profiles of ratios without market correction; the continuous lines represent the profiles of corrected ratios reported in the preceding chapter (Figure 6). Rather than controlling away the unique effects of individual earnings announcements, the market correction appears to bring them out, e.g. the mean average ratio for the weeks of announcements is greater after market correction than before. Since this observation is contrary to expectation assuming there is an "earnings effect", it tends to support the assumption that there is no substantial

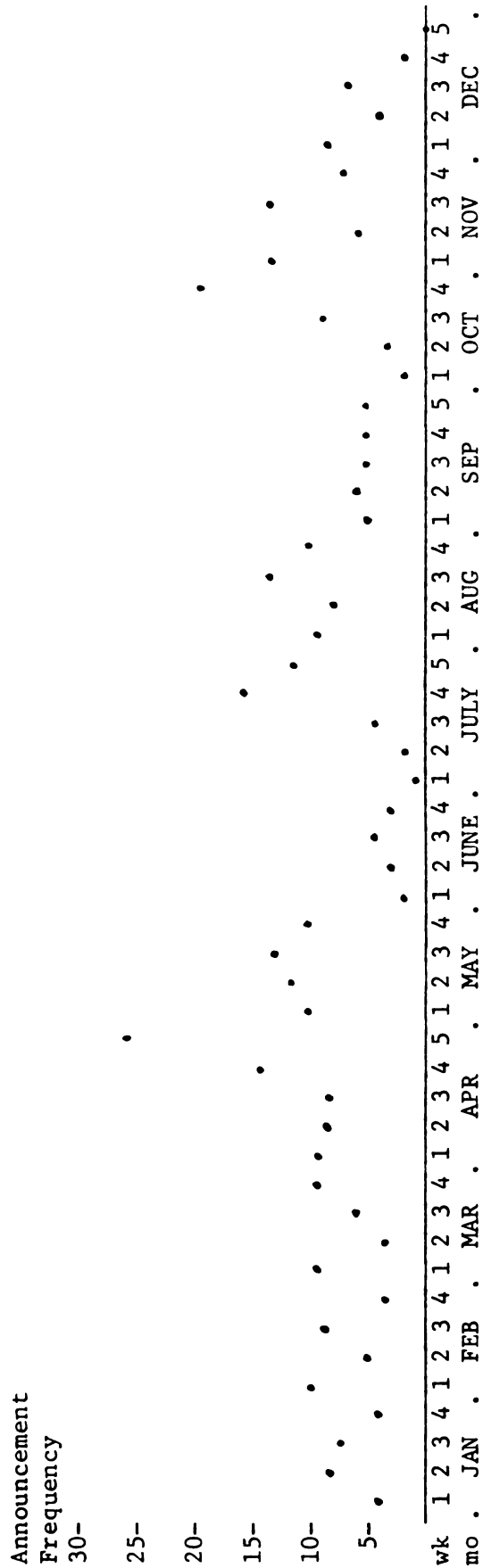
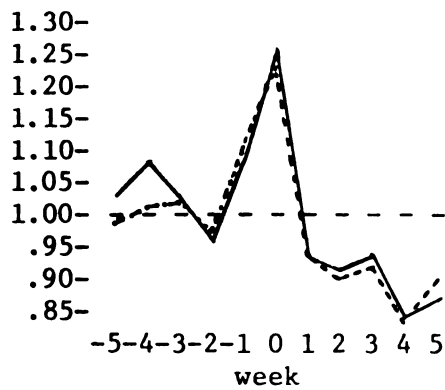
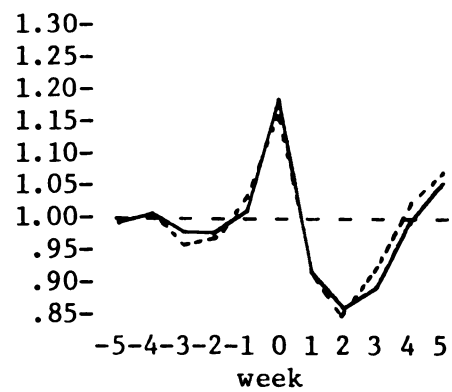


Figure 8.--Frequency of incidence of earnings announcements in the weeks of 1966.

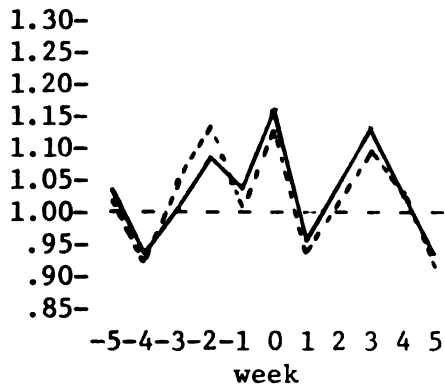
1st Quarter Announcements



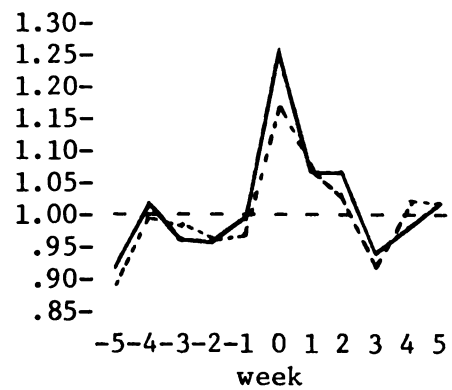
2nd Quarter Announcements



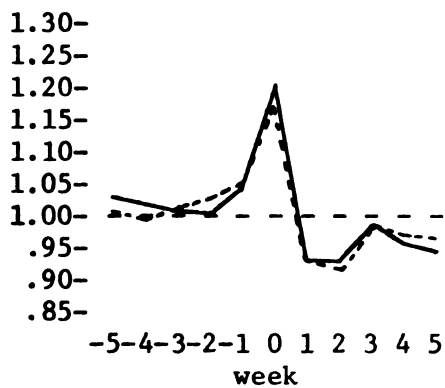
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

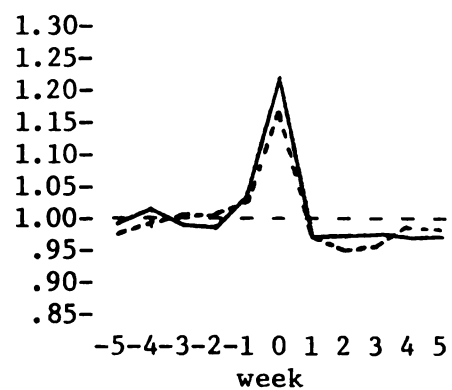


Figure 9.--Eleven week profiles of mean average response ratios with market correction and without market correction. (dotted lines without correction)

earnings effect. As an additional safeguard, however, all the sample statistics used to test the hypotheses of the study were recomputed using the uncorrected measurements. Table 4 gives the sample statistics related to the mean average price response ratios in the weeks of various groupings of earnings announcements. Table 5 gives the mean difference in average ratios between annual announcements and various groupings of quarterly announcements.

TABLE 4.--Sample results of average response ratio measurements without market correction for various groupings of announcements

	Mean Average RR_{jt}	Sample Variance of Average RR_{jt}	Sample Z
1. First Quarter Announcement	1.240	.4506	4.2661
2. Second Quarter Announcements	1.164	.4253	3.0006
3. Third Quarter Announcements	1.113	.3617	2.2312
4. Annual Announcements	1.173	.5434	2.8003
5. All Quarterly Announcements	1.173	.1733	4.9586
6. All Announcements	1.176	.1490	5.4404

Since all the Z values of Table 4 are greater than the critical value of 1.64 it is clear that we would have concluded on the basis of the uncorrected measurements that investor response to any one of the earnings announcements groups is indeed significant. Since all the Z

TABLE 5.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements-without market correction

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	-.0664	.7722	-.9604
2. Second Quarter vs. Annual Earnings	.0094	.9390	.1233
3. Third Quarter vs. Annual Earnings	.0433	1.01	.5450
4. All Quarterly Earnings vs. Annual Earnings	.00037	.6413	.0059

values of Table 5 are less than 1.64 we would have concluded on the basis of the uncorrected measurements that investor response to annual announcements and investor response to any of the groups of quarterly announcements are not significantly different. Thus even though the assumption of no "earnings effect" seems reasonable in retrospect, we have the comforting knowledge that the findings of the study are not particularly sensitive to it.

Multiple Announcements and Comparability of Measurements of Response to Annual and Quarterly Earnings

In the preceding chapter it was noted that cases were encountered in the study periods of some sample firms in which the earnings number for a particular fiscal period was mentioned explicitly (with varying amounts of precision) in more than one statement following the earnings

announcement for the prior fiscal period. For instance, a firm on a calendar year basis might have announced its third quarter earnings on November 1, following on say December 15 with a vague statement that annual earnings were expected to be greater than those of the prior year, and finally announcing exact annual earnings on February 15 of the next calendar year. Recall that the approach adopted for such cases was somewhat arbitrarily to select the first statement on or after the end of the fiscal period that was judged to be a precise statement of the earnings number for the fiscal period. All other statements about the level of the earnings number for the same fiscal period were ignored. The justification for the adopted procedure was that it concentrated on historical accounting data rather than management forecasts of accounting data. Upon reflection, however, the risk of failing to measure properly the market's full adjustment to the value of a new earnings number outweighs the perhaps superficial distinction between a historical earnings number and a management forecast based on the experience of virtually all of the fiscal period of interest.

Application of the adopted procedure meant that the price changes for the weeks of 113 statements concerning earnings numbers of the sample firms were ignored because prior or subsequent statements were judged to be the first precise disclosures of actual accounting earnings for the fiscal periods. Of these, 65 referred to annual earnings and only 48 referred to a quarterly earnings number. Although 113 is a relatively small number considering the total of 1339 earnings announcements on which findings have thus far been based, the imbalance between quarterly and annual earnings numbers clearly suggests a potential for bias in the

measurement of investor response to annual earnings relative to quarterly earnings. In the absence of additional analysis there would thus be some doubt as to the reliability of the finding reported in the preceding chapter that the difference between measured investor response to annual earnings and measured investor response to quarterly earnings was not significant. Fortunately a modification can be made in the methodology that is consistent with the reasoning used to develop the measurements on which the findings have so far been based.

It would seem that the investor response pattern to multiple statements regarding the level of the same earnings number could take on either of the following forms:

1. Complete adjustment of expectations to the earnings number could take place in response to any of the statements with no adjustment in response to prior or subsequent statements concerning that particular earnings number.
2. Adjustment to an earlier statement concerning an earnings number may be complemented or reversed by adjustments to subsequent, more precise statements about the same number.

In either case the price change in the week of each statement concerning a particular period's earnings number will still be partly chance determined but will also reflect any new change in equilibrium value in response to the incremental information contained in the statement regarding the period's earnings. Thus, the algebraic sum of the residual price responses in the weeks of all statements concerning a particular earnings number would be an estimate of the total (or net) price-change effect of that earnings number on investors' expectations.

Implementing this reasoning is a relatively simple matter. In each case of multiple statements about a particular period's earnings, the following modified procedure was followed:

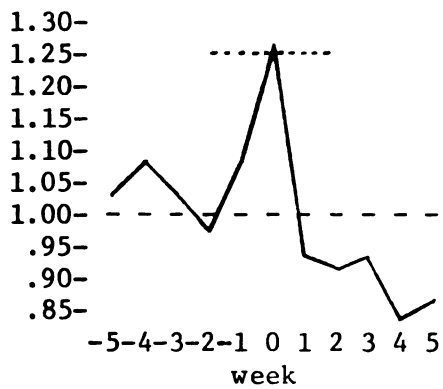
1. The signed residual weekly price changes, R_{jt} , for the weeks of each statement about a particular earnings number were added together.
2. The residual price change for the week of the one statement selected according to the original procedure was then replaced by the sum of the residual price changes of the weeks of all statements concerning the same earnings number.¹
3. The ratios, RR_{jt} , were then computed as before and all sample statistics were reproduced using the revised ratios.

Figure 10 presents the revised eleven week profiles of mean average response ratios. Since the modification does not effect the measured mean average ratio of any weeks other than the weeks of earnings announcements, no comparative profiles were necessary. The dotted line across the top of each profile shows the size of the zero-week ratio reported earlier in Table 2 and Figure 6 under the original procedure.

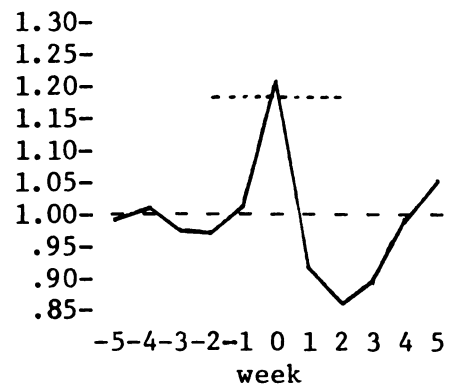
The greater increase in the measured response to annual earnings confirms the suspicion that the earlier procedure was perhaps biased downward in measuring investor response to annual earnings announcements

¹No attempt was made to exclude the R_{jt} 's of weeks of statements about an earnings number, other than the statement originally chosen as the first precise disclosure, from the regression computations or the computation of $\overline{R_{jt}}$, the base of the RR_{jt} 's. Considerable reprogramming would be involved in such a modification and the effects on the computations would be quite insignificant, i.e. each firm's computations are based on a minimum of about 169 R_{jt} 's.

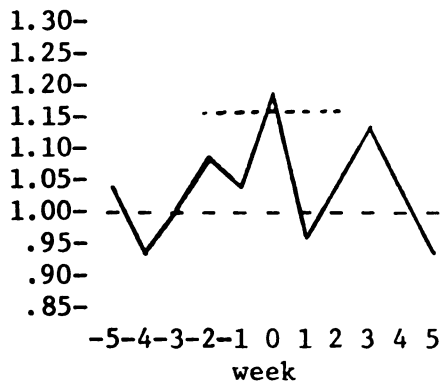
1st Quarter Announcement



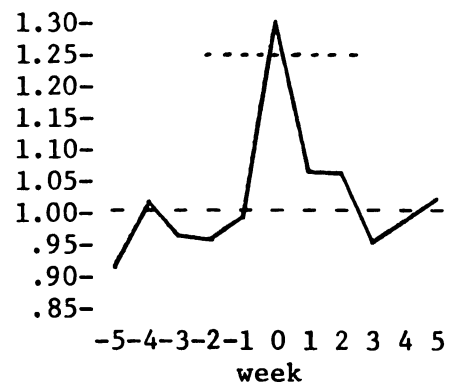
2nd Quarter Announcements



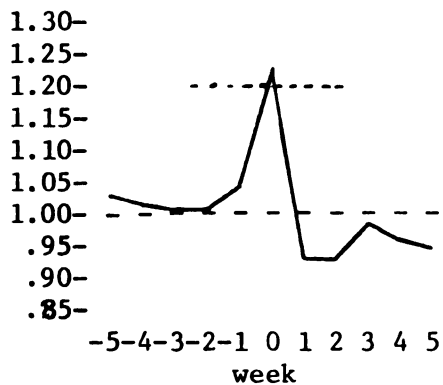
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

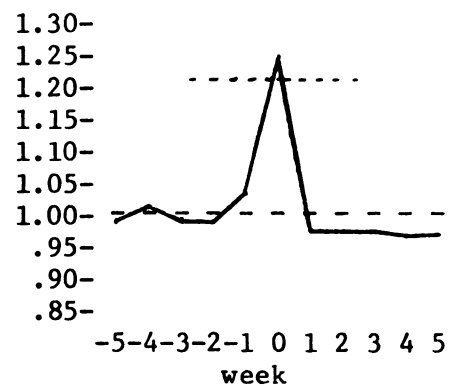


Figure 10.--Eleven week profiles of mean average response ratios incorporating multiple statements. (unrevised levels indicated by dotted lines)

relative to investor response to quarterly earnings.

Nevertheless, the revised sample statistics shown in Table 6 for the mean difference in average ratios of annual earnings and average ratios of the various groups of quarterly earnings, indicate that the findings of the study do not differ even after eliminating the potential bias. Although the mean differences are all positive their Z values are all less than the 1.64 critical value. Thus it cannot be concluded that the slightly greater response to annual earnings observed in the sample is significantly different from the response to quarterly earnings.

Although, like the correction for market effects, the accommodation of multiple statements of earnings numbers did not alter the findings of the study, it seems to be conceptually superior to arbitrarily selecting only one of several statements to represent the full

TABLE 6.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements-incorporating multiple statements

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	.0390	.8080	.5514
2. Second Quarter vs. Annual Earnings	.0964	.945	1.2604
3. Third Quarter vs. Annual Earnings	.0972	1.051	1.1993
4. All Quarterly Earnings vs. Annual Earnings	.0812	.6713	1.2596

informational impact on investors of the earnings for a period. Hence, all remaining discussion of response ratio measurements will refer to the modified procedure discussed in this section rather than the original methodology.

Reevaluation of the One Week Response Period

The modification in measurements introduced in the preceding section reaffirmed the finding that there is no significant difference between investor response to quarterly and annual earnings numbers, after correcting a possible procedural deficiency in the methodology that tended to understate the response to annual earnings numbers. This section explores the possibility that the one week response period employed in this study was inadequate for purposes of isolating investor response to quarterly earnings, to annual earnings, or to both. The two types of inadequacies that could seriously jeopardize the validity of findings reported here are:

1. The market (or any subgroup of the people active in the market) may first perceive the news of earnings numbers at some date before the week pinpointed in the study.
2. The market response to earnings numbers may be much more long-lived than is assumed in using a measurement period that accommodates a maximum lag of one week for market response to be fully realized.

The first possibility can be examined by reference to the measurements already employed in the study. If it frequently occurred that the news of earnings numbers predated the week selected in the study as the week of first perception, the same reasoning that was used to form

hypotheses about zero-week would apply to prior (and subsequent) weeks as well. For instance, if it frequently occurred that the market perceived and completely responded to a new earnings number, say, one week prior to publication in the Wall Street Journal, then the expectation of the mean average response ratio for week -1 would be greater than 1.0. The same expectation would apply to any other weeks before or after zero-week in which the actual market response to the earnings number took place frequently.

Examination of the eleven week profile in Figure 10 for all earnings announcements (lower right) does not support such a suggestion. The profile for all earnings announcements is based on the full 1339 announcements included in the study and thus eliminates as much of the effects of randomness on the mean average ratios as is possible with the sample data. Any systematic predating or post dating of the true first perception of earning numbers would show through. The closeness of the profile weeks to the 1.0 line for all weeks other than week zero therefore indicates that no serious misdating of earnings perception occurred in the study.

That the -1 week's mean average ratio is higher than any other non-zero weeks' level is perhaps an indication that, as suspected, a few of the earnings announcements first published on Monday mornings in the Eastern edition of the Wall Street Journal went out on the broad tape and were published in other editions on Friday of the prior week. But the error from this source does not appear serious enough to warrant the rather extensive effort that would be required to eliminate it.

In order to analyze the second possible inadequacy of the one week response period (that of the one week periods of observation being

too short) a different approach than has been used up to this point is required. The ratios used in preceding analyses are measures of relative magnitude of weekly price change responses. From the profile of ratios discussed immediately above, it is clear that if the full response to earnings announcements is actually of several weeks duration, the amount of response taking place in weeks before and after the week of announcement cannot be very large. For if they were, the ratios for those weeks would be larger than indicated in the profile. However, it is still possible that responses in weeks other than the week of announcement, though small in any one week, might persist for several weeks in the same direction and thus be significant in total. For instance suppose that the news of the earnings announcements somehow reached the market five weeks before the formal announcement date used in this study, but the effect on equilibrium price was gradual. Then, were it not for random fluctuations, one would expect to see a sequence of small price changes in the same direction including an adjustment in the week of announcement.¹ Similarly, if the adjustment to a particular announcement was realized gradually over the weeks following the announcement the reverse pattern would underly the series of observed price changes. For convenience such patterns of sequential price adjustments will be referred to as "diffusion effects."

¹It is assumed on the basis of the zero-week "peak" in the aggregate profiles of Figure 10 that some adjustment does take place in week zero. But, it is presumably possible that adjustments to the earnings numbers could take place in sequences of weeks not including the announcement week. To the extent that this latter possibility actually describes reality this study, which is basically anchored to the announcement week, is limited in its ability to measure investor response at all. In view of the almost classical shape of the aggregate profiles, however, this seems to be a remote possibility.

To test for the presence of diffusion effects it is only necessary to retreat a step or two in the process used in developing the relative response ratios employed in the study. For the general purposes of the study the relative magnitudes of price changes were relevant, the signs of the changes were not. The reverse is true in testing for diffusion effects. What is sought is the presence of frequent residual price changes, R_{jt} 's, before and/or after the announcement week, that have the same sign as the price changes in the announcement weeks. Table 7 gives the proportions of price changes in each of the five weeks before and after announcement that have the same sign as the price change in the announcement week.

Regardless of the sign of the price changes in the weeks of the announcements, if there was no systematic relationship between the directions of price changes in prior and subsequent weeks and the direction in the week of announcements, then the signs of the price changes in the other weeks would be the same as the signs of the price changes in the week of announcement about half of the time.¹ Thus the expectation of the proportion of identical signs for each week before and after the announcement week is .50. The asterisks in Table 7 indicate the

¹ If the R_{jt} conform well to the assumptions of the linear regression model as is indicated by Fama et. al., International Economic Review, Vol. X, No. 1, then one would expect the R_{jt} of any given week to have an equal (.5) probability of being positive or negative. Furthermore the sign of the R_{jt} for any given week will be independent of the sign of the R_{jt} for any other week.

proportions found to be significantly larger or smaller¹ than .50. The test used to determine significance is the familiar Z test, applicable by virtue of the Central Limit Theorem to large sample frequencies with large expected proportions.² The value of Z was computed from:

$$Z = \frac{X - .5 N \pm .5}{\sqrt{NP(1-P)}}$$

where X is the frequency of signs identical to the sign of the price change in the week of announcement, N is the number of announcements for which the comparison is made, and P is the .5 proportion expected if no diffusion effect exists.

The last column of Table 7 contains the only remarkable set of significantly large proportions. But even though weeks -5, -4, -3 have significant proportions of price-change signs that are the same as the announcement week price-change signs, the actual excesses over the expected proportion of .50 hardly indicate the existence of substantial

¹Consistent proportions significantly less than .50 in the weeks prior to the week of announcement might indicate that there is significant speculative activity in anticipation of the earnings announcements, but that the speculators frequently misjudge the impact that the earnings will have on other investors, when announced. This type of behavior would tend to move the price of stocks in one direction in the weeks leading up to announcement and in the other direction in the week of announcement. Hence, there is a possibility of observing significantly low rates of consistency between signs of price changes in the weeks of earnings announcements and the signs of prior week's price changes.

²William Mendenhall, Introduction to Probability and Statistics (2nd edition; Belmont, California: Wadsworth Publishing Company, Inc., 1967), pp. 131-132.

TABLE 7.--Proportion of price changes in prior and subsequent weeks
having the same sign as the price change in the announcement week

Week Relative to Announcement	Type of Announcement					All Announcement Combined
	1st Quarter	2nd Quarter	3rd Quarter	Annual	Multiple Statement	
-5	.5627*	.5000	.5066	.5273	.5945*	.5297*
-4	.5723*	.5403	.5364	.5062	.4594	.5307*
-3	.5112	.5155	.5529	.5434	.4594	.5258*
-2	.5273	.5217	.4933	.4888	.4464	.5021
-1	.4726	.4534	.5033	.4987	.5044	.4845
+1	.4887	.4596	.4834	.5247	.4778	.4904
+2	.4951	.5124	.5298	.4405**	.5221	.4931
+3	.4919	.5343	.5562*	.4975	.4910	.5161
+4	.5016	.5000	.4834	.5173	.5625	.5065
+5	.5176	.5217	.5098	.5000	.5982*	.5134
Maximum Number of Sign Comparisons	311	322	302	404	113	1425

* Significantly larger than .5000 at the .05 level.

** Significantly smaller than .5000 at the .05 level.

diffusion effects. Furthermore, it gives the researcher pause to observe that the significance of the overall proportions of weeks -5 and -4 are largely due to the significance of the weeks -5 and -4 for first quarter announcements.

As it happens, the comparisons of signs of weekly price changes did not exclude weeks of prior or subsequent earnings announcements. Thus since there were announcements of annual earnings in the fourth and fifth weeks preceding approximately 45 of the total 311 first quarter announcements, the significant proportion of like signs in those two weeks may be due in part to the similarity of investor response to an annual earnings number and the succeeding first quarter's earnings. Were there pronounced diffusion patterns in other quarters' or the annual announcement periods, some effort would have been made to evaluate this possibility. More refined procedures, however, do not seem to promise any change in the conclusion that no substantial diffusion effect appears to exist in the weekly price changes around the weeks of earnings announcements.

In summary, upon reevaluation, there appears to be no reason to doubt the validity of the one week period selected in the study for the observation of investor response to quarterly and annual earnings announcements. The use of the Wall Street Journal Index to determine the week whose residual price change would be attributed to an earnings announcement did not appear to lead to substantial misspecification of the first period in which actual investor response to the earnings announcement took place. Nor did a substantial cumulative or counter response appear to take place outside the response week selected.

Density of Other News Events in Weeks
Prior to Earnings Announcements

This section like the preceding two sections will be devoted to a question regarding the degree of comparability between the measured response to quarterly and annual earnings numbers. If there is some reason to doubt that the measurements employed in the study are not more or less equally applicable to investor response to quarterly and annual earnings, the finding of the study will not clearly serve the purpose expressed in the second research question, that of measuring the effect of quarterly earnings on investors relative to the effects of annual earnings.

Information about earnings clearly does not exist in a vacuum. Investors are exposed to other information about firms via the public news media and by word of mouth as well. Indeed some of what might be classified as other information may affect investor decisions by influencing their expectation about future earnings. Dividends announcements are perhaps the category of other information most generally suspected of this potential.¹

All earnings announcements may be thought of as being made in the context of all prior information about the firm to which the market has had access. However, information that becomes available just prior to an earnings announcement may tend to "preview" the information of earnings announcements themselves by informing investors of events or management's response to events that have determined the fiscal period's

¹Ezra Solomon, The Theory of Financial Management (New York: Columbia University Press, 1963), p. 58.

earnings record. Intuitively, such information, while not diminishing the importance of the earnings record to investors, might reduce the measured response to the subsequent explicit announcement.

Such a tendency does not affect the conclusion of the study regarding the basic significance of quarterly earnings to investors. If the measured response is less than the total response but the measured response is significant, the total response is significant also. However, if the measured response to annual earnings bears a different relationship to total response than the measured response to quarterly earnings bears to total response to quarterly earnings, the meaning of comparisons of the two measured responses is not as clear as is desirable. Such might be the case if the density of other information in the weeks just prior to the annual earnings announcements were dramatically different from the density in weeks prior to quarterly announcements.

In anticipation of this issue the dates of other news events noted in the WSJ Index were recorded at the times that the necessary data were gathered for the central analyses of the study. A count was made of the numbers of other news events occurring in each of the seven weeks prior to quarterly and annual announcements. The frequencies of other prior news events for each type of announcement are shown in Table 8. Since it was considered desirable to make use of all information available in the sample data the frequencies take into account the period prior to about 4 annual announcements for every 3 of each quarters' announcements. The ratio is approximately 4 to 9 if all quarters are considered together. The reader should bear this in mind in interpreting the columns of frequencies in Table 8. To assist in

comparing the columns an index of the density of other news events appears at the bottom of each column. The index, as indicated by the label in the left hand margin of Table 8, is the result of first finding the average weekly frequency in the column then correcting for the relative number of announcements examined of the type indicated by the column heading. Thus the weekly averages for the first three columns were divided by 3, for the fourth by 9, and for the last by 4. The values of the index certainly do not indicate any dramatic difference between the density of other news events before quarterly earnings announcements and the density before annual announcements. If anything the index values indicate a slightly greater density in the weeks before quarterly announcements.

Because they are thought by some theorists to contain information about future returns to common stockholders, announcements of dividends, stock dividends and stock splits were counted separately as well as being included with all other news events in Table 8.¹ Table 9 was prepared for these events on the same basis as Table 8 for all events. The index values at the bottom of Table 9 lead to the same conclusion about the relative densities of dividend-related news events prior to earnings announcements that was reached about all news events. If anything, the density is slightly greater for quarterly announcements,

¹For firms that paid cash dividends during the study period, announced stock dividends and stock splits were considered tantamount to announced changes in dividend paying policy. For firms that never paid cash dividends during the study period, such capital changes were not considered news about dividends and hence were omitted from this analysis.

TABLE 8.--Frequencies of other news events in
the weeks prior to earnings announcements

Week Relative to Announcement	Type of Announcement			
	1st Quarter	2nd Quarter	3rd Quarter	All Quarters
-7	7	30	23	60
-6	23	26	31	80
-5	33	21	24	78
-4	32	28	30	90
-3	32	32	27	91
-2	23	24	23	70
-1	<u>24</u>	<u>23</u>	<u>29</u>	<u>76</u>
Approximate Weekly Average	25	26	27	78
Weekly Average Corrected for Numbers of Observations	8.33	8.66	9.00	8.66
				8.00

TABLE 9.--Frequencies of dividend related news events
in the weeks prior to earnings announcements

Week Relative to Announcement	Type of Announcement			
	1st Quarter	2nd Quarter	3rd Quarter	All Quarters
-7	1	7	6	14
-6	6	7	7	20
-5	9	7	8	24
-4	8	6	8	22
-3	11	11	9	31
-2	4	7	4	15
-1	<u>5</u>	<u>5</u>	<u>15</u>	<u>25</u>
Approximate Weekly Average	6	7	8	22
Weekly Average Corrected for Numbers of Observations	2.0	2.33	2.66	2.44
				2.25

but only slightly.

In summary, there is no evidence in the density of other news prior to quarterly and annual earnings announcements, that would strongly suggest that investor responses as measured in this study are of a basically different character for the two types of earnings numbers.

Summary

This chapter has dealt with evaluations of possible weaknesses in the findings of the study, with emphasis on errors of procedure or assumption that might indicate that the comparison of measured investor response to quarterly and annual earnings numbers is invalid. The results of the evaluations discussed so far do not lead to any serious questioning of the validity of the findings as reported. Although, on reexamination, there did appear to be reason to believe that the elimination of all but one statement about a particular earnings number caused a relative bias against annual earnings numbers, correction of the sample measurements did not change the basic nature of the findings.

CHAPTER VII

ANALYSIS OF THE EFFECTS OF TIME SERIES AND SAMPLE COMPOSITION ON THE REPORTED FINDINGS

This chapter is concerned with the contribution of various subgroups of earnings announcements to the overall sample findings of the study. With one exception the researcher has no a priori basis for expecting differences between subgroups of earnings announcements included in the sample. Rather, the comparisons generally are made in a purely positivistic sense. The purpose is to determine in retrospect whether there is reason to suspect that the sample results are not applicable to firms and time periods clearly represented by the sample measurements (to say nothing of other similar, but unrepresented, firms).

The method of approach will be first to partition the full set of earnings announcements included in the study with respect to one characteristic at a time, then compare the subgroups on the basis of the measurements employed in arriving at the findings of the study. The several ways that earnings announcements are partitioned and compared in this chapter are: (1) according to the calendar quarter in which the announcement was made, (2) according to whether the announcement was that of a dividend-paying firm or not, and (3) according to whether the announcement was that of a firm with a calendar fiscal year or not. As in the preceding chapter the thrust of this chapter will be aimed at the comparability of measured investor response to quarterly and annual earnings numbers.

Calendar Quarter Time Series of Response Ratio Profiles

It is beyond the scope of this study to examine rigorously the pattern of investor response to earnings announcements over time. Hence, as was mentioned in Chapter V, the decision to select a study period of several years duration was a modest attempt to lower the risk that the findings of the study would be based on a short, atypical period of investor behavior. Nevertheless, an examination of the measured investor response to earnings announcements across even a short span of time offers potential insight. To the extent that the measured investor response to earnings varies widely within the period of study, the decision to use more than one year will be justified in retrospect and future researchers will be cautioned to follow suit. On the other hand, the degree of consistency of response within the time period will perhaps aid readers in their own decisions about the applicability of the findings, necessarily based on an historical period, to decisions confronting them now and in the future.

In order to isolate any time-pattern of measured investor response to earnings announcements in the study period, the following procedure was employed:

1. Each firm's earnings announcements were identified as to the calendar quarter in which they occurred.
2. The eleven-week response ratio profiles for each announcement were then averaged with those of every other announcement occurring in that same calendar quarter.
3. The average profiles for each calendar quarter in the years 1965, 1966, and 1967 were plotted in sequence on Figure 11.

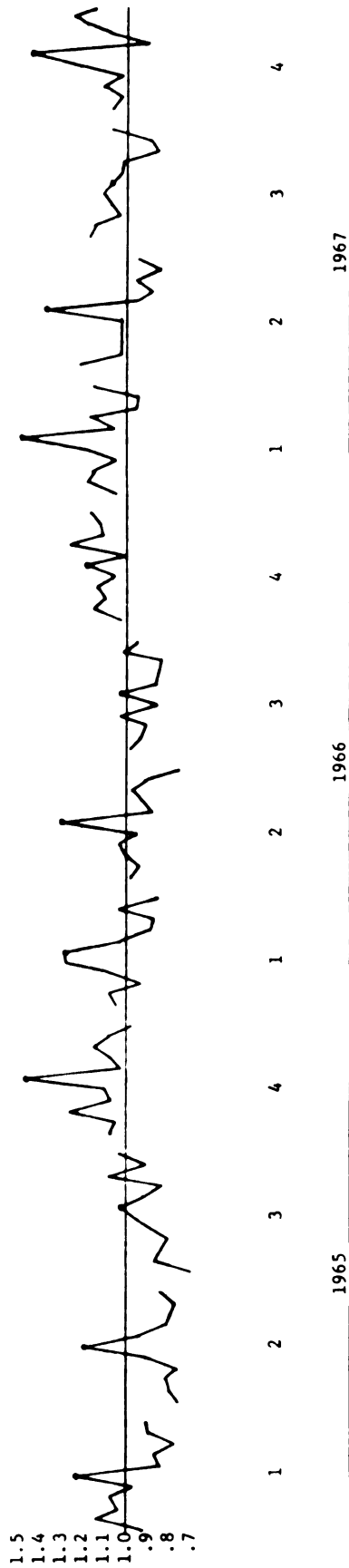


Figure 11.--Eleven week profiles of mean price response ratios according to time of earnings announcement.

For simplicity the week zero in each profile is identified simply by a large dot.

Figure 11 does not represent a plot of response ratios averaged over successive calendar weeks. Rather, it is the result of lining up the surrounding weekly price response ratios for all earnings announcements occurring in any week of a particular calendar quarter. The tails of the profiles of individual earnings announcements that occurred early or later in a calendar quarter actually lie outside the calendar quarter, but are combined with other announcements' profiles completely contained within the calendar quarter. But because of the great amount of chance variability in individual price responses, some method of aggregation was necessary to bring out the contrast in investor response to earnings over time.

For the same reason, only the middle three (complete) calendar years were included on Figure 11. Although the observation of price changes began as early as the third quarter of 1964 for some firms and ended as late as the second quarter of 1968 for others, depending on fiscal year-end and other considerations, few firms overlapped at both ends. Thus the profiles for the last two quarters of 1964 and the first two quarters of 1968 are based on too few announcements to be very meaningful. Furthermore the 1964 and 1968 profiles differ with respect to variables other than time, e.g. with respect to composition of firms contributing to the profiles.

Because of the nature of the response ratios employed in the study an evaluation of Figure 11 must proceed in two stages. Recall that the demoninator of the response ratios for each firm is the average

absolute value of the weekly residual price responses for the firm over the whole study period, excluding weeks of announcements. The numerators are the absolute values of the individual weekly residual price responses. Thus any aggregate pattern in the absolute value of firms' residuals over the study period will show up in their aggregated response ratios for "other weeks" in the profiles. That is, if residual price responses were generally smaller in magnitude than average early in the study period and larger later, the "other weeks" average ratios in the profiles would tend to be lower than the 1.0 line in early quarters and higher later.

Some evidence of such a pattern exists in the low profiles of the second and third quarters of 1965 and the slightly higher profiles of some of the later quarters in Figure 11. Furthermore, there appears to be a gentle oscillation within years, i.e. the second and third calendar quarters' profiles are generally lower than the first and fourth (but only slightly in years other than 1965). The implication of such patterns, of course, is that if one desired to make detailed comparisons of investor response to earnings between periods as short as a year or shorter, some refinement in computing response ratios would be necessary.

One possibility would be to compute the average absolute values of residual responses (the base of the response ratios) over shorter, more localized periods. But since some of the profiles appear to run "up hill" or "down hill" within calendar quarters, it is not altogether clear that even a period length as short as a quarter would be wholly satisfactory.

Perhaps what is more certain is that whatever period is chosen for computing the bases of measurements similar to those employed in this study, some variability between aggregates over subperiods is to be expected. Comparisons between subperiods should be avoided, therefore, unless "base" measurements are computed separately for each subperiod.

Since the comparisons between time-subperiods made in this chapter are not intended to be very rigorous, no adjustment in ratios is considered necessary. In addition, recall that in the major analyses of the study the ratios of all earnings announcements of a particular kind were averaged within a firm for the whole study period, before being averaged over firms. Thus the major analyses of the study already conform to the above admonition that the period of aggregation be the same as the period of computation of "base" measurements.

Because refinement of the measurements will not be attempted, the next step in evaluating the time series of profiles depicted in Figure 11 is slightly more complicated than it otherwise would be. To assess the effects of different quarters on the reported findings of the study, one must visualize each calendar quarter's contribution to the overall average week zero ratio, relative to its contribution to the overall ratio for each of the "other weeks" in the eleven week profile. In other words, it is the contrast within a quarter's profile that determines its contribution to the overall contrast found in the study between residual price changes in weeks of earnings announcements and residual price changes in other weeks.

On the basis of within-profile contrast, the years of the study period are remarkably consistent. The first and second quarter profiles

show consistently dramatic contrast and the third quarters show a consistent lack of contrast. Only the fourth quarters are mixed--but with two out of three years' fourth quarters having contrast comparable to first and second quarters.

The apparent within-year seasonality of relative price response will be examined further in the next section of this chapter. The implication of the consistency of within-quarter contrast between years is very simply that there is some evidence that the relationship between price changes in weeks of earnings announcements and price changes in other weeks is somewhat stable over time. But since the evidence has been examined in retrospect, a post hoc conclusion is not warranted. The experience of this study can only properly support an hypothesis that the relative magnitude of price-change response to earnings announcements is stable over time (and perhaps seasonal within years). The hypothesis must be tested with respect to sample data other than the data that suggested it, before it can properly be accepted. In the meantime, the researcher is able to draw conclusions from and make recommendations on the basis of the findings of the study with more confidence, knowing that the substance of the findings does not all stem from a pattern of extreme investor response to earnings in only one year of the study period with virtually no response in the other years.

Evaluation of Differences Between Subgroups of Sample Firms

For reasons that will be discussed below, this section is concerned with sample firms that differ with respect to dividend payout and firms that differ with respect to timing of their fiscal years. A breakdown

of the total sample of 105 firms on the basis of payout policy and fiscal years appears in Table 10 below:

TABLE 10.--Distribution of sample firms
by payout policy and fiscal year

	Dividend Paying	Non- Paying	Total
Calendar-Year Firms	22	34	56
Non-Calendar-Year	<u>18</u>	<u>31</u>	<u>49</u>
Total	40	65	105

For the most part, since the subsample sizes are rather small when firms are classified on the basis of both characteristics, the evaluation of this section will deal with one characteristic at a time.

There are essentially two reasons why it is felt that a discussion of the influence of cash-dividend-paying firms on the sample findings of the study is appropriate at this point. First, the sample of firms included in the study is biased against cash-dividend-paying firms. The reader will recall from the discussion in Chapter V that firms that frequently announced cash dividends in the same weeks as earnings announcements were eliminated from the sample. This, of course, reduced the sample proportion of cash dividends firms relative to the level that would have been experienced had the restriction not been imposed. Assuming that the cash-dividends-paying firms eliminated and those included in the sample are similar in all respects other than timing of dividend announcements,

the effect on the sample measurements of reducing the proportion of dividend-paying firms can be appraised by comparing the separate sample measurement results of the dividend paying firms included in the sample with those of all other firms included.

A second reason for comparing dividend-paying firms with all other firms is to assess the effects on investor response to earnings of the availability of information contained in dividend policies (in particular, policy changes). It is especially important that an attempt be made to evaluate any differential effects that dividend information might have on measured investor response to quarterly and annual earnings.

The reason for directing interest to a comparison between calendar-year and non-calendar-year firms is the potential effects on the sample measurements of the apparent seasonality of contrast between price changes in weeks of earnings announcements and price changes in other weeks. The reader will recall from the preceding section that the within-profile contrast between zero-weeks and other weeks was fairly consistently dramatic for the first, second and fourth calendar quarters of the cross-section years. However the profiles of the third calendar quarters (summers) of all three cross-section years were consistently lacking in contrast. A time pattern of this sort would not affect the findings of the study if each type of earnings announcement had a more-or-less equal likelihood of occurring in any calendar quarter--but of course they do not. Of the 105 sample firms used in the study, 56 operated on a calendar year basis.

Whereas the other 49 sample firms as a group had earnings announcements of all kinds occur in the third calendar quarters, the calendar-year

firms generally reported only second fiscal quarter's earnings in the third calendar quarter. Therefore, measured investor response to calendar-year companies' second quarter announcements might be considerably less pronounced than measured response to their other quarterly announcements or their annual announcements, for whatever reason is responsible for the apparent slump in investor response to earnings announced in the third calendar quarter. Since the measured response to all quarterly announcements combined would tend to be pulled down relative to the measured response to annual announcements, it would be useful to examine any possible tendency of the inclusion of calendar-year firms' second quarter reports to bias the findings of the study.

For purposes of comparing firms on the basis of payout and fiscal year characteristics the now familiar eleven week profiles will be used. Figures 12, 13, 14 and 15 give eleven week profiles by announcement types for each subgroup of sample firms.

Cash-Dividend-Paying Firms vs. Non-Paying Firms

A comparison of cash-dividend-paying firms with non-cash-dividend-payers involves Figures 12 and 13. An examination of the profiles of the two subgroups reveals two things:

1. The first and second quarters' profiles and the profiles of all quarters of the dividend payers exhibit more contrast (relative to the contrast in the annual announcement profile) than the non-payers.
2. The third quarter profile of the dividend payers is strikingly different in pattern than any other profile in either Figure 12 or 13.

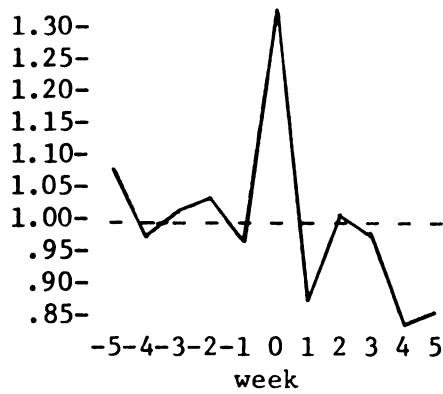
The first observation might lead to a tentative conclusion that dividend information tends to damp investor response to annual earnings relative to first and second quarter earnings. However the second observation mitigates against such a conclusion. The highly anomalous third quarter profile of the dividend payers suggest that the differences between dividend-paying and non-dividend-paying firms is largely reflected in investor response to third quarter announcements. A reexamination of the pattern of dividend announcements tends to confirm this suspicion.

In the preceding chapter it was noted that there was no remarkable difference in the density of dividend-related announcements in the weeks before quarterly and annual earnings announcements. This is largely attributable to dividend paying practice. Most firms in the sample that paid dividends paid them quarterly. Thus dividend announcements tended to occur quarterly. However, dividend changes (generally in form of stock splits or stock dividends) tended to be first announced more frequently in the fourth fiscal quarters of firms' operating years than any other quarter. Now it happens that third quarter earnings announcements are made in the middle of the fourth fiscal quarter, i.e., generally toward the end of the interval from two to six weeks after the end of the third fiscal quarter. Thus it happens that the third quarter announcement is often made at the time when the market has just received or perhaps is anticipating the most newsworthy dividend announcement of the year.

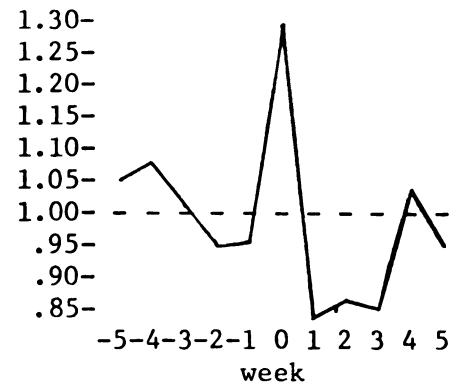
One might speculate that there would be two effects of the approximate coincidence of third quarter announcements and announced changes in dividend payout. First, the importance of dividend information might damp investor interest in and response to third quarter earnings, when

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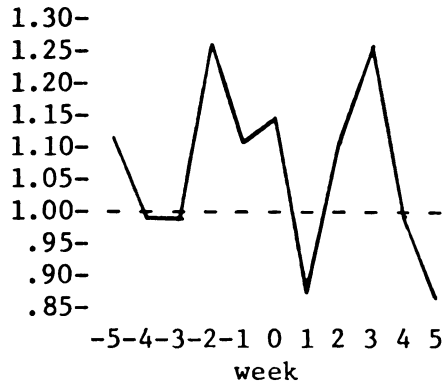
1st Quarter Announcements



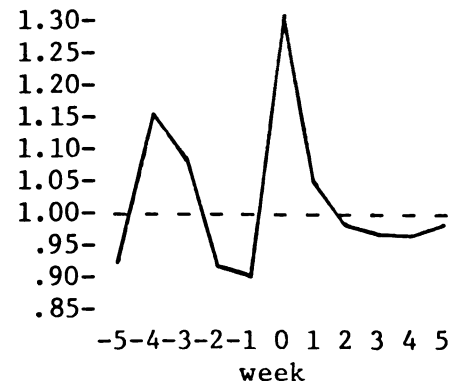
2nd Quarter Announcements



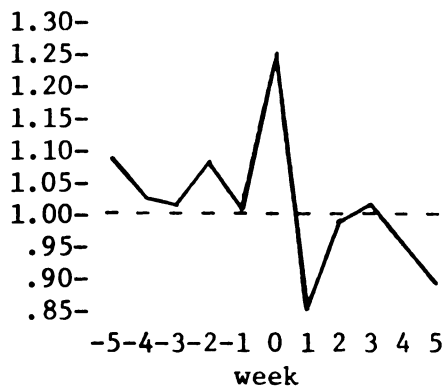
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

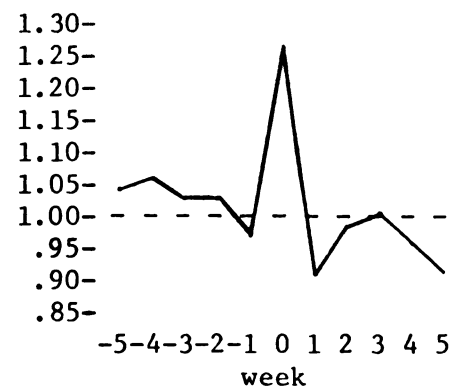
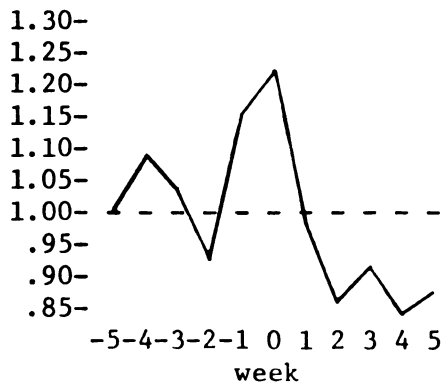
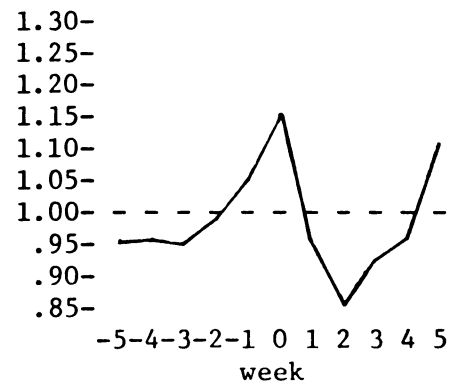


Figure 12.--Eleven week profiles of mean average response ratios of the 40 cash-dividend-paying sample firms.

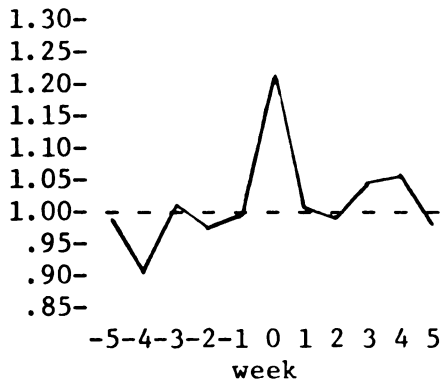
1st Quarter Announcements



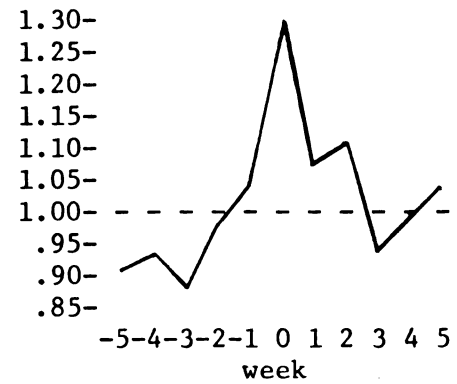
2nd Quarter Announcements



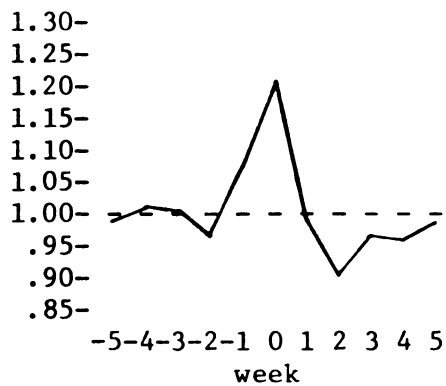
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

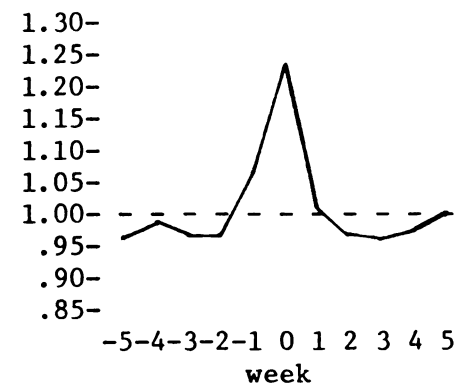


Figure 13.--Eleven week profiles of mean average response ratios of the 65 non-dividend-paying sample firms.

announced. Second, significant investor responses to dividend (change) announcements should be reflected in large "other week" ratios of the third quarter profile.

The first expectation appears to be realized in the low week zero ratio of 1.145 of the third quarter announcements of dividend-paying firms. Indeed, the Z value from Table 11 associated with the 1.145 ratio is not significant at the .05 (1.64) level. It should be noted, however, that the investor response to third quarter announcements of individual firms is not so low as to be significantly different from response to the firms' annual announcements, i.e. the Z value in Table 12 associated with the mean difference in response ratios between third quarter and annual announcements is less than 1.64. In other words, the average measured price-change response to third quarter announcements of dividend-paying firms falls in a "grey zone" between the average magnitude of price changes in non-announcement weeks and the magnitude of changes in the weeks of annual announcements.

The second expectation appears to be realized in the high aggregate values of non-zero-week ratios in the third quarter profile. However, the presence of large aggregate ratios is not enough. In order to confirm the expectation properly, the large ratios should be traceable to individual news announcements occurring in the weeks in which the large aggregates are observed. To this purpose the researcher looked for significant news events in the third week following and the second week prior to third quarter earnings announcements that had ratios greater than 2.00 in the +3 and -2 weeks of their individual profiles. It was hoped that this procedure would explain the large aggregate ratios of the weeks +3 and -2 in the

TABLE 11.--Sample results of average response ratio measurements for various groupings of announcements of dividend-paying firms

	Mean Average RR_{jt}	Sample Variance of Average RR_{jt}	Sample Z
1. First Quarter Announcement	1.330	.2825	4.4692
2. Second Quarter Announcements	1.297	.4759	3.0990
3. Third Quarter Announcements	1.145	.4331	1.5860
4. Annual Announcements	1.314	.544	3.0644
5. All Quarterly Announcements	1.251	.1252	5.1061
6. All Announcements	1.272	.1218	5.6100

TABLE 12.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements of dividend-paying firms

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	-.0158	.5917	-.1756
2. Second Quarter vs. Annual Earnings	.0178	1.072	.1470
3. Third Quarter vs. Annual Earnings	.1696	1.04	1.4222
4. All Quarterly Earnings vs. Annual Earnings	.0636	.6303	.6850

aggregate third quarter profile. The attempt was largely unsuccessful. Few of the large individual ratios were traceable to specific news events. The conclusion was reached that an examination of the interaction between specific dividend and earnings information must await a research effort specifically designed for that purpose.

In the absence of a clear understanding of the interaction between dividend and earnings information, the posture of this paper will be to suppose for the sake of argument that, in spite of at least weak evidence to the contrary, the presence of dividend information tends to reduce measured investor response to annual earnings more than to quarterly earnings. On the basis of this supposition the reported finding of the study that there is no significant difference between measured investor response to quarterly and annual earnings may be attributable to the supposed influence of dividend information on what would otherwise be a significantly greater investor response to annual earnings.

In the absence of "hard" evidence that the supposition is false, the only way to eliminate ambiguity short of an additional large-scale study, is to eliminate all effects of cash-dividend-paying firms from the sample measurements, then re-test the hypotheses of the study using the measurements for only the 65 non-dividend-paying firms in the study. The results of this procedure are shown in Tables 13 and 14. The Z values in Table 13 indicate that we would judge the differences between price-change responses in the weeks of any group of earnings announcements and price changes in other weeks to be highly significant for non-dividend-paying firms, i.e., all of the Z values are considerably greater than 1.64. More importantly, the Z values of Table 14 indicate that we would

judge the difference between price-change response to the quarterly and annual earnings announcements of these firms to be not significant, i.e., none of the Z values is greater than 1.64. Thus it has been shown that for firms without the potential damping influence of dividend information, the findings of the study are the same: that there is no statistically significant difference between price-change response to quarterly and annual earnings announcements. Although it is felt that most of the damping influence of dividend information is reflected in investor response to third quarter rather than annual earnings, this last analysis gives assurance that even if the reverse is true, the findings of the study needn't be equivocated in either case.

TABLE 13.--Sample results of average response ratio measurements for various groupings of announcements of non-dividend-paying sample firms

	Mean Average RR_{jt}	Sample Variance of Average RR_{jt}	Sample Z
1. First Quarter Announcement	1.226	.5152	2.9176
2. Second Quarter Announcements	1.154	.3614	2.3738
3. Third Quarter Announcements	1.216	.3519	3.348
4. Annual Announcements	1.299	.5472	3.7455
5. All Quarterly Announcements	1.207	.1846	4.4644
6. All Announcements	1.240	.1475	5.7906

TABLE 14.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements of non-dividend-paying firms

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	.0727	.9494	.7798
2. Second Quarter vs. Annual Earnings	.1447	.8761	1.6158
3. Third Quarter vs. Annual Earnings	.0520	1.069	.5216
4. All Quarterly Earnings vs. Annual Earnings	.0921	.7065	1.1453

Calendar-Year Firms vs. Non-Calendar-Year Firms

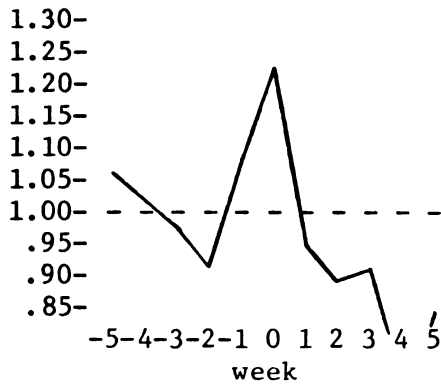
Whereas in the face of the uncertain influence of cash dividend information on measured response to earnings announcements the concern of the analysis was that the sample measurements might tend to understate the true significance of annual earnings announcements relative to quarterly earnings, the opposite possibility is the concern with calendar-year firms. It was noted in the time series analysis that price responses to earnings numbers announced in the July-September quarter were consistently not dissimilar to price changes in surrounding, non-announcement weeks. Since calendar-year firms report only quarterly earnings (generally second quarter) in the summer quarter, their quarterly earnings would tend to be less significant, *ceteris paribus*, than their annual earnings. And since calendar-year firms make up more than half (56 out of 105) of the total sample their behavior will tend

to influence the overall sample results. To evaluate this possibility, Figures 14 and 15 were prepared to show the response ratio profiles separately for calendar-year firms and non-calendar-year firms, respectively.

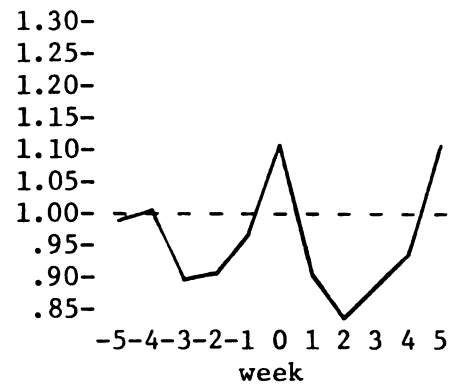
It is immediately noticeable in Figure 14 that the measured investor response to second quarter announcements for calendar-year firms is quite low, as expected. In fact the week zero ratio of the second quarter profile contrasts sharply with the week zero ratio of the annual profile. The influence of the second quarter profile is also evident in the unusually large difference between the week zero ratios of the all quarter profile and the annual profile. The low level of the second quarter is also brought out by comparison with the second quarter profile of non-calendar-firms appearing in Figure 15. To assess the effects of the observed "depression" in measured response to the second quarter announcements of calendar-year firms the sample measurements were all recomputed for the calendar-year firms only. The sample results appear in Table 15 and 16.

Not surprisingly, the Z values of Table 15 indicate that the week zero ratios of all announcement groups are highly significant with the exception of the ratio of the second quarter announcements. The Z values of Table 16 suggests the type of effect that the measured investor response to the second quarter earnings of calendar-year firms might have on the findings reported for the whole sample. The large Z values (greater than 1.64) of the average differences between response ratios of second quarter and annual and all quarters' and annual earnings, indicate mixed results. Had the study only been concerned with calendar-year firms the findings would have been that: while the measured investor response to first and third quarters' earnings is not significantly less than to annual earnings, response to second quarter

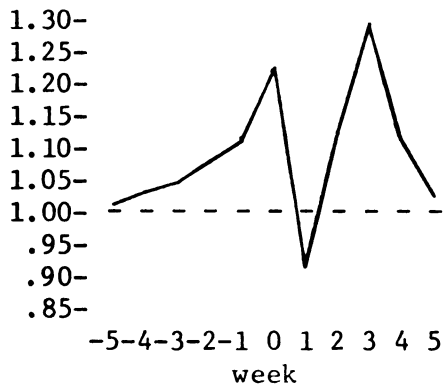
1st Quarter Announcements



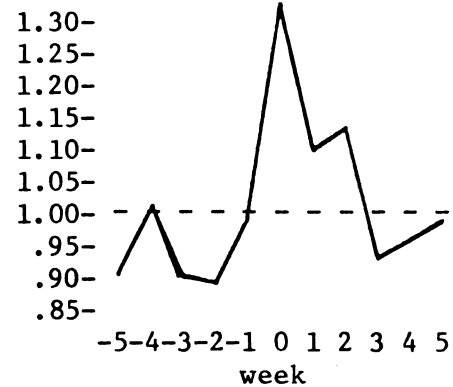
2nd Quarter Announcements



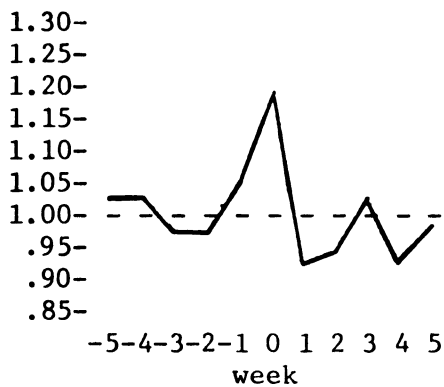
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

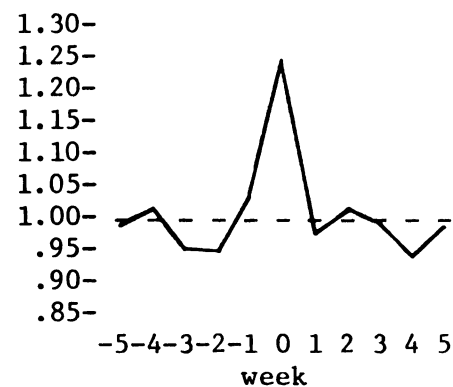
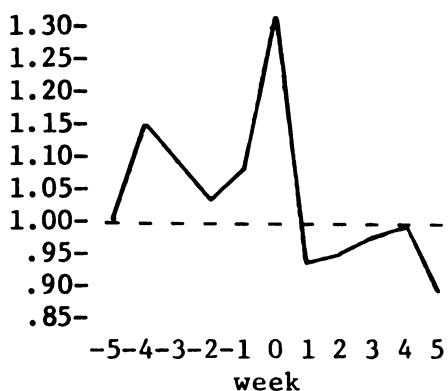
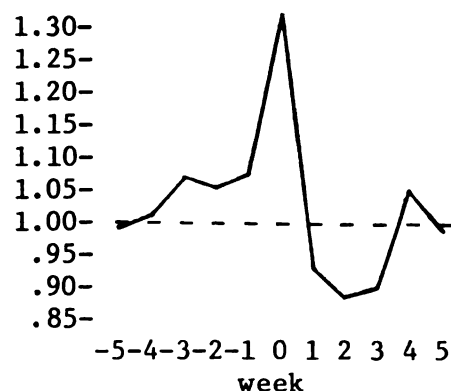


Figure 14.--Eleven week profiles of mean average response ratios of the 56 calendar-year sample firms.

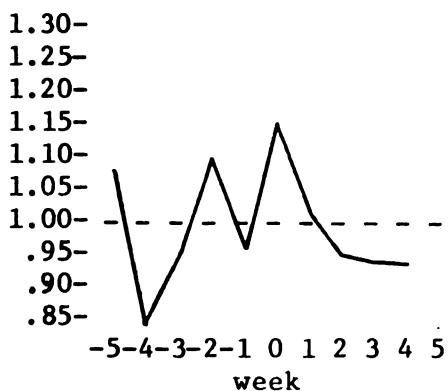
1st Quarter Announcements



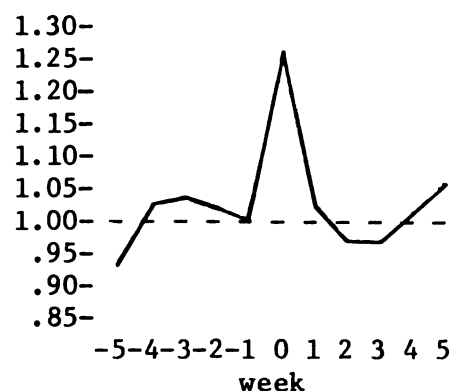
2nd Quarter Announcements



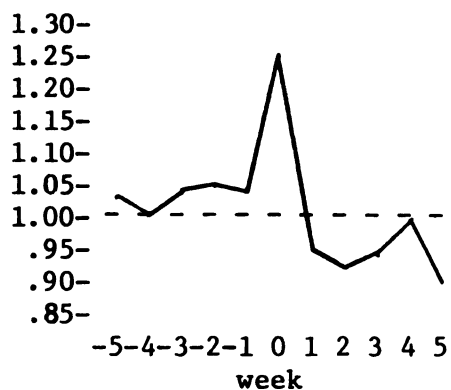
3rd Quarter Announcements



Annual Announcements



All Quarterly Announcements



All Announcements

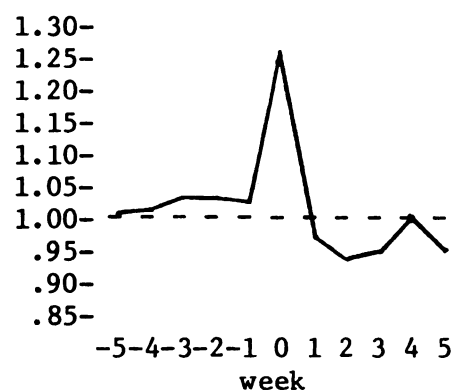


Figure 15.--Eleven week profiles of mean average response ratios of 49 non-calendar-year sample firms.

TABLE 15.--Sample results of average response ratio measurements for various groupings of announcements of calendar-year firms

	Mean Average RR_{jt}	Sample Variance of Average RR_{jt}	Sample Z
1. First Quarter Announcement	1.225	.4368	2.9014
2. Second Quarter Announcements	1.106	.3512	1.5244
3. Third Quarter Announcements	1.222	.3186	3.3219
4. Annual Announcements	1.344	.5624	3.9093
5. All Quarterly Announcements	1.196	.1444	4.3958
6. All Announcements	1.245	.1492	5.4057

TABLE 16.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements of calendar-year firms

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	.1188	.729	1.3353
2. Second Quarter vs. Annual Earnings	.2372	.7312	2.6622
3. Third Quarter vs. Annual Earnings	.0867	1.077	.7946
4. All Quarterly Earnings vs. Annual Earnings	.1474	.5990	1.8278

TABLE 17.--Sample results of average response ratio measurements for various groupings of announcements of non-calendar-year firms

	Mean Average RR_{jt}	Sample Variance of Average RR_{jt} 's	Sample Z
1. First Quarter Announcement	1.313	.4174	3.8698
2. Second Quarter Announcements	1.325	.4506	3.8673
3. Third Quarter Announcements	1.151	.4552	1.7877
4. Annual Announcements	1.260	.5236	2.8701
5. All Quarterly Announcements	1.255	.1815	4.7810
6. All Announcements	1.260	.1251	5.8717

earnings was significantly less. As one would expect from these results and observation of Figure 15, a somewhat opposite effect is experienced when the sample measurements are recomputed for non-calendar-year firms only.

The Z values in Table 17 indicate that the measured responses to all groups of announcements of non-calendar-year firms are significant, all but the response to third quarter announcements being highly significant. Furthermore, the mean differences in average response to annual earnings and quarterly earnings (Table 18) indicate that, not only are measured responses to first and second quarter announcements not significantly less than to annual announcements, they are slightly greater. The Z value for the

third quarter announcements indicates that although response to annual announcements is greater than to third quarter announcements it is not significantly greater. Both the mean difference between average response to all quarterly announcements and to annual announcements, and its related Z value, indicate that there is virtually no difference between measured investor response to all quarterly announcements and to annual earnings announcements of non-calendar-year firms. Thus, as with non-cash-dividend firms, no equivocation of the general findings of the study appears necessary in applying them to non-calendar-year firms.

As was true of the effects of dividends information on investor response to the earnings of dividend paying firms, the reason for the apparently seasonal response to calendar-year firms' second quarter earnings is a research challenge that falls outside the scope of this study. It would

TABLE 18.--Sample results of differences between average response ratios of annual announcements and average response ratios of quarterly announcements of non-calendar-year firms

	Sample Mean Difference in Average RR_{jt} 's	Sample Variance of Differences	Sample Z
1. First Quarter vs. Annual Earnings	-.0522	.8994	-.5094
2. Second Quarter vs. Annual Earnings	-.0645	1.160	-.5543
3. Third Quarter vs. Annual Earnings	.1090	1.044	.9874
4. All Quarterly Earnings vs. Annual Earnings	.0056	.7572	.0596

be particularly interesting, however, to determine if the apparent seasonality is actually due to some lack of new information in the earnings announced in the July-September quarter or whether some seasonal condition results in little investor interest in what would otherwise be newsworthy earnings data.

Summary of Evaluation of Subgroups of Sample Firms

One of the two general findings of the study reported in Chapter V is that the measured investor response to annual announcements was slightly greater than measured response to all quarterly announcements combined, but the difference is not significant. This chapter has largely been devoted to questioning the degree to which this finding is applicable to subgroups of sample firms. In particular it was found that the finding applies, but not unambiguously, to the third quarter earnings announcements of dividend-paying firms, and that it does not apply to the second quarter earnings announcements of calendar-year firms. Otherwise, however, it was determined that the general finding applies. Indeed, the measured response to the announcements of certain quarters of subgroups of firms was greater than the measured response to those firms' annual announcements (although not significantly greater).

The evaluation was conducted for only one characteristic at a time because a two-way classification would have divided the total sample into subsample groups too small (the smallest would be only 18 firms) to be relied upon to overcome the amount of random variability inherent in price-change measurements. Thus the non-dividend-paying firms included both calendar-year and non-calendar-year firms, the non-calendar-year firms

included both dividend-paying firms and non-dividend-paying firms, etc. This limits the evaluations of this chapter, but only in the way that any study is limited to capabilities for which it is designed and for which adequate amounts of data have been gathered.

Given the scope and purpose of this study the conclusions and recommendations will not be greatly affected by the fact that investor response to annual earnings numbers was significantly greater than investor response to one quarters' earnings of a certain group of firms. It is more important that the evidence produced by the study did not indicate that quarterly earnings generally have significantly less average influence on investors than annual earnings.

CHAPTER VIII

SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

This study has been an inquiry into the degree to which quarterly accounting data influence actual investor decisions as reflected in market price changes. The data on which the findings of the study are based pertain to 105 firms whose common stocks were listed on the American Stock Exchange during the full study period of three fiscal years between July 1964 and June 1968. All of the 105 firms included in the sample reported quarterly earnings throughout their study periods and, at most, only occasionally announced a dividend payment in the same week that earnings were announced. It was estimated that the 105 sample firms are strictly representative of from 300 to 400 total firms that conform to the above specifications. The findings and conclusions of the study that will be given below are intended to apply strictly only to the population represented by the sample.

Because of the limited population and sample chosen for study, the recommendation of most immediate importance that will be made in this paper is not one of the suggestions of appropriate action for accountants that will appear after the conclusions section of this chapter. Rather, it is considered most important that this study be replicated and extended to more time periods and types of firms. Since the methodology of the

study withstood the ex post evaluation described in Chapter VI, extension and replication would largely consist of extensive data gathering and preparation, primarily clerical efforts. Extension and replication will ensure that before undertaking the expense of implementing the recommendations that will be made in the following pages, accountants and managers will be certain that the findings and conclusions of the study are not simply the result of an extreme and unusual sample and that they apply more widely than to the somewhat limited population from which the sample was drawn. Furthermore, the implications of the effects of dividend information and the observed seasonality of investor response to earnings described in Chapter VII deserve more rigorous examination than has been possible in this study.

Summary of the Findings of the Study

The inquiry into the influence of quarterly earnings data on investors consisted of two basic comparisons. The first was a comparison of the magnitude of price-change responses of the market in the weeks in which quarterly earnings were announced to the average magnitude of market price changes for the sample firms in all other weeks of the study period. The second was a comparison of the relative magnitude of price-change responses in weeks of various kinds of quarterly announcements with the relative magnitude of price-change responses in weeks of annual announcements. The results of the comparisons are as follows:

1. In general the magnitude of price-change responses in weeks of all types of earnings announcements was greater than the average price change for non-announcement weeks. With the exception of a particular quarter's announcements

of each of two subgroups of firms, the magnitude of price-change responses in the weeks of announcements was significantly greater than the average for other weeks.

In the cases of the two exceptions, namely the second quarter announcements of calendar-year firms and the third quarter announcements of dividend-paying firms, the lack of significance appears to be a result of the special environmental or contextual conditions in which these particular quarterly announcements are made, rather than evidence of any general lack of influence of quarterly announcements on investor decisions.

2. Generally, the relative price-change response to quarterly earnings was less than response to annual earnings, but, with one exception, not significantly less. The single exception was the second quarter announcements of calendar-year firms. As above, this exceptional result is attributed to an apparently seasonal slump in which second quarter earnings of calendar-year firms are announced rather than any generally lesser degree of influence on investors of quarterly earnings. Indeed this position is somewhat secured by the observation that the investor response to certain quarterly earnings announcements of some subgroups of firms were actually greater (although not significantly greater) than the response to the annual announcements of the same firms.¹

¹Referring to Table 16 the reader will note that the measured response to first and second quarter earnings of non-calendar-year firms is greater than response to annual earnings.

Conclusions and Recommendations

A conclusion that there is significant demand for quarterly accounting data to be used by investors in actual decisions seems to be justified by the first finding of the study, i.e. that price changes in the weeks of quarterly earnings announcements are significantly greater than average price changes. But the second finding of the study, that relative price-change responses to quarterly earnings are not significantly less than responses to annual earnings, leads to the conclusion that investors may be unaware of, or unable to take account of the difference in quality (reliability) of quarterly and annual accounting data. The implications of these two conclusions for accountants seem clear:

1. Any significant improvement in the quality of quarterly data themselves will lead to significant social benefits since the data will then provide an improved basis for actual investment decisions.
2. Any effort on the part of accountants that succeeds in unambiguously conveying to investors the lesser reliability of quarterly data, will contribute to the prevention of potentially significant market inefficiencies, i.e. under or overvaluation of securities in the period between market adjustments to quarterly earnings numbers and subsequent adjustments to the superceding, more reliable annual earnings numbers.

In view of the recommendations made by past writers, outlined in Chapter I of this paper, there appears to be no difficulty finding starting

points for improvements in quarterly accounting practice. What appears to be most needed is additional research concerned with problems of implementation and questions of specific benefits to investors of the more sophisticated techniques recommended.¹ For certain relatively unsophisticated recommendations, though, accountants and managers can move immediately toward improvement of quarterly data.

In particular, improvements that would stem from straight-forward application, on a quarterly basis, of efforts comparable to those now being applied only once per year, do not present any great barriers to feasibility. That they are costly seems to be the only barrier to their implementation.

Although the findings of this study do not indicate that such additional costs would be worthwhile in any absolute sense, they do clearly indicate that the sometimes great differential in effort (cost) expended on annual accounting measurements relative to quarterly measurements is not justified on the basis of the importance to investors of annual data relative to the importance of quarterly data. Thus the researcher recommends that the following steps be taken by individual firms and, where applicable, by firms and their independent auditors together:

¹The researcher is aware of current research in progress that is addressed to the questions of the cost relative to benefits to be obtained for investors of different degrees of accounting effort to compensate for the effects of seasonality on revenues, costs, income, etc. The source of the awareness is "On Criteria for Judging Accounting Earnings Estimators," adapted from John W. Kennelly, "An Empirical Investigation of Interim Earnings Reports" (unpublished Ph.D. dissertation, University of Chicago, in progress).

1. Wherever possible shift from typically once-per-year measurements to quarterly (or more frequent) measurements.
2. Extend audit surveillance of at least limited scope to quarterly accounting information.

Whereas it may appear at first glance that the researcher is suggesting a total measurement effort four times as extensive as currently expended, such is not the case at all. If measurements are conducted at more frequent intervals, present levels of reliability obtained in annual measurements might be obtained throughout the year with much less measurement effort expended each quarter than is now expended once per year. A case in point is reconciliation of perpetual inventory records to physical count data.

It is not clear that all inventory items need be counted every quarter to achieve the same level of reliability as is now achieved by some firms once per year. For even if only certain segments were fully counted in each successive quarter, the perpetual records would have less opportunity to "drift" away from physical reality from one reporting date to the next. Thus each quarterly (and annual) report might be just as reliable as current annual reports with respect to inventory valuation with a full count of only, say, one-fourth of all inventory classifications each quarter, augmented perhaps by representative samples of other classifications.

Of course the amounts of quarterly effort suggested here have no basis in experience but rather are simply suggested for illustrative purposes. Hence, as a corollary recommendation, it must be suggested that

firms arrive at proper levels and types of effort to achieve quarterly levels of reliability now experienced only annually, by individual research and experimentation. It is also suggested that general guidelines might emanate from the naturally more extensive research efforts of professional organizations.

Although there appears to be no great difficulty in finding starting points for improving quarterly accounting data, it ~~is~~ not immediately clear how accountants might unambiguously convey to investors the relative degree of unreliability of quarterly data. Even if all possible efforts to improve quarterly data were expended, quarterly data would still be less reliable than annual data due to residual seasonal and chance-variability effects; thus the problem is of great long-run importance to accounting.

A minimal starting effort would be a requirement by authorities that the qualifying language of the form: "unaudited, subject to year-end adjustments", that sometimes appears in quarterly reports to stockholders, also appear conspicuously in the more widely circulated releases in the financial press. But the researcher harbors little hope that such a measure could be anything more than a possibly face-saving gesture for accountants, permitting an "I told you so" response in the event of a large-scale criticism involving investor experience with quarterly data. The evidence indicates that the investor would still have to bear the major burden of quantifying the degree of unreliability inherent in any given quarterly datum, a burden made extreme by the wide variety of quality of quarterly data among firms. To appreciate the task that the investor now faces and would still face if the efforts of accountants

stopped with merely labeling quarterly data as unreliable, one need only consider the statement quoted in Chapter I from the Wheat Disclosure Study:

...The Study carefully examined a significant sample of quarterly financial reports and releases provided by the two [national securities] exchanges. It was readily apparent (and acknowledged by representatives of the exchanges) that they varied from extremely useful to extremely poor and uninformative.¹

and the experience of Gale E. Newell, related as follows:

This study had indicated that the reported quarterly data of certain firms...appear to fluctuate much more than expected and the pattern of such fluctuations lead [sic] one to question the reliability of the data. Other firm's [sic] reported quarterly data fluctuate very little and the discrepancy between the fourth quarter's data and the data of the other three quarters is insignificant... It does not appear that such fluctuations occur within certain industries but rather that the fluctuations occur in certain firms in many different industries.²

In view of the variety in the quality of quarterly data among firms, it is little wonder that even though some investors are undoubtedly aware of the general lesser quality of quarterly data, the actions of the market as a whole do not reflect that the knowledge enters into actual investment decisions. The problem facing accountants is how to ensure that if the same observation holds in the future, it is not due to a misperception on the part of investors of the degree of reliability inherent in specific quarterly data. What is needed is a technique that is capable of conveying the degree of reliability of quarterly data uniquely for every reporting firm.

¹U.S. Securities and Exchange Commission, Disclosure to Investors: a Reappraisal of Federal Administrative Policies Under the 33 and 34 Acts., (New York: Commerce Clearing House, Inc., 1969), p. 39.

²Newell, pp. 156-157.

Such a technique has been suggested by Newell for specific application to the relative-reliability dilemma that is presented to accountants by quarterly data.¹ It consists of stating accounting data as intervals rather than single values. Although the technique is particularly suited to solution of the specific problem of conveying relative reliability of quarterly data to investors, it has great future potential for improving the presentation of accounting data generally, a prediction supported by the following quotation from A Statement of Basic Accounting Theory:

...Another aspect of multiple valuations involves the use of non-deterministic measures or quantum ranges with or without probabilistic measures. In view of uncertainties surrounding business activities and the measurement of their impact, the use of such non-deterministic measures is likely to become a part of an expanded accounting discipline of the future.²

What makes the range technique particularly suited to the problem of conveying differing degrees of reliability in quarterly and annual data of different firms, is that the size of the range can be altered according to the unique characteristics of the measurements and conditions that produced the data. Furthermore the range technique is completely flexible over time and compatible with other recommendations of the study since, when applied properly, it would convey only the degree of reliability that applies to a given set of data for a particular firm. That is, as individual firms improve their quarterly measurements relative to annual measurements, they would automatically convey the improvement of relative reliability of the quarterly data by reporting smaller ranges, ceteris paribus. This study therefore strongly recommends that ranges-of-value

¹Ibid., p. 154.

²American Accounting Association, 1966, p. 65.

reporting be adopted in the long run as a solution to the problem of conveying the lesser degree of reliability of quarterly data to investors.

That the range-of-values solution will prove difficult and expensive to apply properly is unquestionably true. But the difficulty that accountants will have in quantifying the relative reliability of quarterly and annual data only serves to emphasize the plight of the investor who has less knowledge of the unique conditions existing in particular firms' cases and perhaps less knowledge of accounting nuances as well, but who must now perform this function for himself.

APPENDIX

An Illustration of the Nature of the Effects of Degree of Aggregation on Relative Chance Variability of Aggregates.

To see the potential effects of aggregation on income computations for varying period lengths, assume a very simplistic situation in which every event (transaction) of the enterprise creates a small increment in income that is partly a function of the systematic efforts of the enterprise and partly a function of the chance combination of conditions that existed at the time of performance of the particular event. In the long run the income increments of the individual events will average out to the amount due to the enterprise's systematic efforts but individual events will vary above and below average, depending on the chance factors. Assuming that the events take place continuously over time at a uniform rate their individual income increments can be represented as:

$$i_t = s + c_t$$

where i_t represents the income increment from the event taking place at instant t , s represents the portion due to the systematic efforts of the enterprise, and c_t is the portion due to chance causes, which for the sake of discussion is assumed to be a normally distributed random variable with a mean of zero and a variance of σ^2 . The income increment will therefore also be a normally distributed random variable with a variance of σ^2 but with a mean of s .

If a fiscal quarter can be thought of as containing n events then the income for the quarter will be the sum:

$$I_q = \sum_{t=1}^n i_t$$

which is also a normally distributed random variable with a mean of ns and variance of $n\sigma^2$. If a fiscal year may be thought of as containing four fiscal quarters, each containing exactly n events then the income for the fiscal year will be the sum:

$$I_a = \sum_{t=1}^{4n} i_t$$

which, like quarterly income is a normally distributed random variable but with a mean of $4ns$ and a variance of $4n\sigma^2$.

The reader may recall that one of the properties of the normal distribution is that approximately two-thirds of the values of normally distributed random variables will, in the long run, fall in the range of plus or minus one standard deviation of the mean.¹ Further, the ratio of one standard deviation of a random variable to its mean is an index of variability that is convenient for comparison purposes because of its independence of the scale of the variable. For normally distributed random variables, it measures the limit of the size of most (two-thirds) deviations of individual observations of the variable, relative to their long-run average. Thus we have a means of comparing the relative variability of the normally distributed aggregates described above.

The means of the income increment for one event, for the events of a quarter, and for a year were s , ns , and $4ns$, respectively. The related standard deviations (square roots of the variances) are σ , $\sqrt{n}\sigma$, and $2\sqrt{n}\sigma$. The indexes of variability are σ/s , $\sqrt{n}\sigma/ns$, and $2\sqrt{n}\sigma/4ns$. A

¹The standard deviation is by definition the square root of the variance of a random variable.

glance at the indexes in this simple progression of aggregation from the basic event to the hypothetical year, demonstrates the fundamental relationship between aggregation and chance variability. Whereas the denominator of the index, the expected value of the aggregate, increases with the number of basic events included in the aggregate, the numerator increases disproportionately less i.e., with the square root of the number of events. Thus the relative variability of the aggregate decreases with the degree of aggregation. In the example the index of relative variability of the quarterly income aggregate, $\sqrt{n}\sigma/ns$, is twice as large as the index of variability of the annual income aggregate, $2\sqrt{n}\sigma/4ns$.

Although the situation constructed in the preceding paragraphs is extremely simple, the parallels to the aggregation over events (transactions) inherent in accounting income determination is clear. Indeed, the notion that each event can be associated with a specific income increment (or decrement) is not completely foreign to accounting, e.g., computation of gross margin under a specific identification approach to inventory and cost of sales valuation. Although a difficult and time consuming task, the reasoning employed could be extended to a much more clearly representative model of the accounting income determination process (as practiced.) However, it is felt that the discussion above has been adequate to illustrate the nature of the difference in chance variability to be expected in interim accounting measurements relative to their annual counterparts.

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