ALTERNATIVE ECONOMETRIC MODELS FOR DETECTING THE EFFECTS OF ACCOUNTING POLICY DECISIONS

By

Joel Edward Thompson

A DISSERTATION

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

DOCTOR OF PHILOSOPHY

Department of Accounting

1982

ABSTRACT

ALTERNATIVE ECONOMETRIC MODELS
FOR DETECTING THE EFFECTS OF
ACCOUNTING POLICY DECISIONS

By

Joel Edward Thompson

The primary purpose of this study is to compare the power of three models in detecting the effects of accounting policy decisions on individual firm common stock returns. The three models are the market model, the valuation model, and the zero model.

The problem inherent in models which contain a stock market index is that the stock market index may be affected by an accounting policy decision. Hence, the market model is examined when the market index is affected by an accounting policy decision as well as when the market index is not affected by an accounting policy decision.

The power comparisons in this study are based on a simulation procedure similar to that used by Brown and Warner (1980). The simulation procedure is performed by adding an artificial accounting policy decision effect to actual firm stock returns for a randomly selected set of months. Abnormal firm returns are examined statistically

to determine which model can best detect the presence of the artificial effect.

For market index effects (the relative size of the accounting policy decision effect on the market index compared to the accounting policy decision effect on a firm) as large as 50%, the valuation model and zero model are more powerful than the market model in right-hand tail tests. Further, they are more powerful than the market model with a 50% index effect for larger accounting policy decision effects in left-hand tail tests and in two tail tests.

For hypothetical average firms with estimated betas greater than or equal to one and after adjusting for levels of significance, the valuation model becomes more powerful than the market model when the index effect reaches a level of about 4% in right-hand tail tests and 12% in left-hand tail tests. For the zero model the comparable percentages are 7% in a right-hand tail test and 5% in a left-hand tail test.

One method of adjusting levels of significance is described and the problem of using the market model for a representative sample of firms is discussed.

To Barbara

ACKNOWLEDGMENTS

Special thanks to Ken Janson, Ron Marshall, and Peter Schmidt for their numerous useful suggestions. Also thanks to Deloitte, Haskins, and Sells for financial support.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

INTRODUCTION

Accounting policy decisions are pronouncements by organizations such as the Financial Accounting Standards Board and the Securities and Exchange Commission concerning the content of the financial statements of firms. Being able to detect the effects of accounting policy decisions on common stock returns of firms provides objective evidence on some of the consequences of accounting policy decisions. Common stock returns are examined in this study as in most accounting policy decision research (Foster, 1980, p. 30).

Evidence on the consequences of accounting policy decisions on stock returns can help answer the following questions: (1) did the accounting policy decision produce any results which affected the investment behavior of common stock investors; (2) how many firms' common stock prices were affected by the accounting policy decision; (3) which firms' common stock prices were affected by the accounting policy decision; and (4) by how much were firms' common stock prices changed because of the accounting policy decision. Answers to these questions are the first steps in determining why common stock prices were affected by an accounting policy decision and whether or not the accounting policy decision was beneficial to society. Answers to all of these questions should provide useful feedback to members of policy making organizations.

This dissertation is concerned with the first three questions listed above. Thus, the primary purpose of this study is to compare the power of three models in detecting the effects of accounting policy decisions on individual firm common stock returns. The three models are the market model, a valuation model which is based upon the present value of the expected cash dividends per share of common stock, and the zero model which treats stock returns as random error terms.

The power comparisons in this study are based on a simulation procedure similar to that used by Brown and Warner (1980). The simulation procedure is performed by adding an artificial accounting policy decision effect, DR, to actual firm stock returns for a randomly selected set of months. Thus, the simulated firm return equals DR plus the actual firm return.

Next, individual firm returns are predicted by each of the models. Abnormal firm returns, which are defined as the simulated firm return minus the predicted firm return, are examined to statistically determine which model can best detect the presence of the artificial accounting policy decision effect. In studies of actual accounting policy decisions, abnormal firm returns are the actual firm return minus the predicted firm return. Examples of studies which analyze individual firm abnormal returns are Hong, Kaplan, and Mandelker (1978), Lev (1979), and Gheyara and Boatsman (1980).

The problem inherent in models which contain a stock market index such as the market model is that the stock market index may be affected by an accounting policy decision. Thus, in examining abnormal returns, part of the effect of the accounting policy decision may be hidden by the effect on the stock market index. In evaluating the research methodology of Gheyara and Boatsman (1980), Watts and Zimmerman (1980, p. 101) claim: "Since ASR 190 affected about 55% of the firms listed on the NYSE, the market index contains a portion of the average effect of ASR 190 and the measured residual contains less than the total effect on each firm." Moreover (p. 102): "At present, no one has overcome the problem of using market model residuals...to effect a completely satisfactory control."

A major objective of this study is to retain the entire effect of an accounting policy decision in a firm's abnormal return. Further, to determine the consequences of the impact of an accounting policy decision on the stock market index, the market model is examined when the market index is affected by DR as well as when the market index is not affected by DR. The equally weighted market index is used in both forms of the market model.

In the case of the market index being affected by an accounting policy decision the entire accounting policy decision effect may be removed from the abnormal return. As an example, suppose that the accounting policy decision effect on the return of firm i, DR_i, is equal to the average accounting policy decision effect on the returns of those firms comprising the market index, $\frac{1}{N}\sum_{i=1}^{N} DR_i$. Also, suppose that the estimate of the coefficient of the market index in the market model for firm i is one. DR_i is in the return of the firm while $1 \cdot \frac{1}{N}\sum_{i=1}^{N} DR_i$ is in the predicted return of the firm. Thus, in computing the firm return minus the predicted firm return the entire accounting policy decision effect is removed from the abnormal return. In this case, the accounting policy decision effect on firm i cannot be detected by examining the abnormal return based on the market model for firm i. Lemma 1 gives a more general statement concerning the removal of the accounting policy decision effect from the abnormal return. All proofs are contained in Appendix A.

<u>Lemma 1</u>. Let p_i be the ratio of the average accounting policy decision effect on the returns of those firms comprising the market index to the non-zero accounting policy decision effect on the return of firm i. Let b_i be the estimate of β_i, the coefficient of the market index in the market model for firm i. Then $b_i p_i = 1$ implies that the abnormal return based on the market model for firm i contains zero accounting policy decision effect.

In the simulations in this study, $p_i = .5$ for all i. This will sometimes be called a 50% index effect. This level of p_i was chosen since about 55% of the firms listed on the New York Stock Exchange (NYSE) were affected by Accounting Series Release (ASR) 190 (Watts and Zimmerman, 1980, p. 101). If each of the 55% of the firms was affected by k% because of the accounting policy decision, then p_i would be .55 for all i.

The general findings of the simulations are the following.

(1) The market model without an index effect tends to be more powerful than the market model with a 50% index effect in all tests while the market model without an index effect tends to be more powerful than the valuation model and the zero model in left-hand tail tests.

(2) The market model without an index effect is statistically more powerful than the market model with a 50% index effect when the accounting policy decision effect is as small as 1% for positive effects and as small as |-4%| for negative effects.

(3) The valuation model is statistically more powerful than the market model with a 50% index effect when the accounting policy decision effect is as small as 0.5% for positive effects and as small as |-5%| for negative effects. However, there do exist instances in which the market model with a 50% index effect is statistically more powerful than the valuation model.

(4) The zero model is statistically more powerful than the market model with a 50% index effect when the accounting policy decision is as small as 4% for positive

effects and as small as |-10%| for negative effects. However, there do exist instances in which the market model with a 50% index effect is statistically more powerful than the zero model.

(5) The valuation model tends to be statistically more powerful than the zero model when detecting negative effects. The two models tend to have about the same power when detecting positive effects.

(6) The market model without an index effect, the valuation model, and the zero model, are statistically more powerful than the market model with a 50% effect for sufficiently large effects in absolute value. This statement is true for each of the six cases examined in this study even though the levels of significance of the tests which used the valuation and zero models tended to be smaller than the levels of significance for the tests which used the market model with a 50% index effect.

The results of this study also showed that for a hypothetical average firm with $b_i = 1$, the valuation model becomes more powerful than the market model when the market index effect reaches a level of about 19%. For this same hypothetical firm, the zero model becomes more powerful than the market model when the index effect reaches a level of about 21%. After adjusting for levels of significance, the valuation model becomes more powerful than the market model when the market index effect reaches a level of about 4% in right-hand tail tests and 12% in left-hand tail tests. For the zero model the comparable percentages are 7% in a right-hand tail test and 5% in a left-hand tail test.

The detection ability of the market model, the valuation model, and the zero model were also considered in tests of samples of firms in addition to the tests of individual firms. Numerous other models were considered in tests of samples of firms. While conclusions cannot be drawn from these tests since the approximate true levels of significance were not determined, these investigations led to two statements which may not be fully appreciated in the accounting literature. The first statement is the following theorem.

Theorem 1. On average in a representative sample of firms of the population, the market model, with an equally weighted index based on the population, is unable to detect the effects of an accounting policy decision when the statistic of interest is the average abnormal return of the sample.

The second statement is a corollary of Theorem 1 and concerns individual firm tests.

Corollary 1.1. In a representative sample of firms, examination of abnormal returns in individual firm tests based on the market model, with an equally weighted index based on the population, is equivalent to trying to detect a quanity which on average is zero in the sample of firms.

Thus, Theorem 1 and Corollary 1.1 describe circumstances where the market model will not generally aid in the detection of the effects of those accounting policy decisions which affect firm stock returns in one direction.

This study explores the usefulness of the valuation model and the zero model as alternatives to the market model for detecting the effects of accounting policy decisions on stock returns. The use of these models in accounting research may help provide additional objective evidence on the consequences of accounting policy decisions.

LITERATURE REVIEW

Studies which examine the possible effects of accounting policy decisions on common stock returns are given an important place in the accounting literature. An entire 1980 issue of the *Journal of Accounting and Economics* was devoted to studies trying to detect the effects of Accounting Series Release 190 on stock returns. Foster (1980, p. 29) states that there has been substantial research activity of the effects of accounting policy decisions on stock returns and claims that there were at least five such studies concerning *Statement of Financial Accounting Standards No. 8* and at least four such studies concerning *Statement of Financial Accounting Standards No. 19*.

Other techniques besides analyzing abnormal returns are used in market-based research in accounting, but these techniques may be deficient in determining the effects of accounting policy decisions. Watts and Zimmerman (1980, pp. 100-102) in their review of three studies examining the effects of ASR 190 cite criticisms of partitioned portfolios used by Beaver, Christie, and Griffin (1980) and a matched-pair design used by Ro (1980) and Gheyara and Boatsman (1980). The partitioned portfolios technique involves the examination of differences in returns between two portfolios based upon the expected different effects of the accounting policy decision, but it cannot detect the effect which is common to both portfolios. A matched-pair design involves finding a control firm for each firm subject to an accounting policy decision and analyzing the differences in returns. However, it is difficult to find a suitable control group in accounting studies since ideally the only difference between the firm subject to an accounting policy decision and the control firm should be the possible effect of the accounting policy decision (see Foster, 1980, pp. 42-47, for a discussion).

As an example of the difficulty involved in finding a control group, consider the study by Vigeland (1981). Vigeland used three criteria in trying to match each of 122 firms affected be <u>Statement of Financial Accounting Standards No. 2</u> (pp. 319-320): (1) same three or four digit S.I.C. code; (2) a beta within plus-or-minus 0.4 of the affected firm; and (3) total sales or total assets within plus-or-minus 50 percent of the comparable figures for the affected firm. If no potential control firm met all three criteria, criterion (3) was dropped. Following these criteria which are not very restrictive, Vigeland was unable to find a suitable match for 27 of the 122 firms.

Thus, to avoid the problems with a partitioned portfolio or a matched-pair design, this study examined individual firm abnormal returns without the use of control groups. Examples of studies which examine individual firm abnormal returns are Hong, Kaplan, and Mandelker (1978), Lev (1979), and Gheyara and Boatsman (1980). However, there are problems with the existing methodology of examining individual firm abnormal returns.

The problem of a market index effect for models employing a market index is a major issue of this dissertation. Watts and Zimmerman (1980, p. 101) and Noreen and Sepe (1981, p. 259) have pointed out the problem.

Thus, one of the major objectives of this study is to try to retain the entire effect of an accounting policy decision in a firm's abnormal return. The approach in this study is to use independent or right-hand side variables in a regression model which should be affected very little or not at all by accounting policy decisions. The use of this type of variable should allow most of the total effect of an accounting policy decision to be retained in the abnormal return.

Researchers have used right-hand side variables other than stock market indexes in regressions with stock prices or stock returns as the dependent variable. However, researchers generally have stock market indexes as right-hand variables in these regressions.

The purpose here is to review the literature to determine what right-hand side variables have been used by other researchers in regression equations which use stock prices or returns as dependent variables. Except for non-monthly data such as financial statement items, most of the variables used in the studies cited here have also been used in this study.

Homa and Jaffe (1971) estimated the following regression equation using quarterly data for the period, fourth quarter, 1954, to the fourth quarter, 1969:

$$SP = -26.77 + .61M + 3.14G + 1.46G_{-1} + .87U_{-1}$$

$$R^2 = .968 \qquad S_e = 3.70 \qquad D.W. = 2.14$$

where: SP = S&P 500 index;

M = money supply narrowly defined;

$G = (M - M_{-1})/M_{-1}$;

U_{-1} = previous period's residual error.

Thus, Homa and Jaffe are able to explain much of the variation of the S&P 500 index based on their description of the relationship between the money supply and stock prices.

Malkiel and Quandt (1972) replicated Homa and Jaffe's results and also examined the relationships of fiscal variables to stock prices. Malkiel and Quandt were able to explain almost as much of the variation (.947) using the following variables: triple A corporate bond rate; new defense obligations incurred; new orders for durable goods; unemployment rate; consumer price index; and index of consumer sentiment. These variables were lagged one period compared to the S&P 500 index. When the lagged money supply and growth of money supply variables were included in the regression, R^2 remained the same and the coefficients of the monetary variables were not significant.

Keran (1971) was able to explain 98% of the variation for the S&P 500 index using quarterly data with the following variables: changes in the real money supply for the current and prior two quarters; changes in real growth of GNP for the current and prior seven quarters; changes in implicit price deflator divided by unemployment rate for the current and prior 16 periods; and changes in earnings adjusted for inflation for the current period and prior 20 periods. Keran used Almon distributed lags in his estimation procedure. Keran also linked the behavior of the S&P 500 index with the St. Louis monetarist model of the U.S. economy.

The leading composite index may be useful in explaining returns. Umstead (1977) was able to obtain an R^2 of .623 for the S&P 500 index by using a transfer function and the leading composite index. However, this series is not suitable for this study since the S&P 500 index is part of the leading composite index.

Researchers have used P/E ratios (Malkiel and Cragg, 1970; Whitbeck and Kisor, 1963) and rates of return (Nerlove, 1968; McKibben, 1972) as the dependent variables in cross-sectional regressions. Variables employed in these studies include: financial statement variables such as earnings, sales, and growth rate of earnings; dividends; market price of stock; and systematic risk.

Researchers have used time series regressions for individual stocks with returns as the dependent variable. Variables in addition to stock market returns include: profitability variables, leaverage, and dividends (Lee and Zumwalt, 1981; Lee and Vinso, 1980); short and long-term bond return indexes (Lynge and Zumwalt, 1980); industry variables (King, 1966); and 30-day Treasury bill rate, 20-year Aaa corporate bond rate, FRB index of industrial production, and consumer price index (Aber, 1976).

Equilibrium pricing models of individual stock returns provide some guidance as to which non-stock return variables should be associated with firm returns. The Sharpe-Lintner model (Sharpe, 1964; Lintner, 1965) uses a risk-free interest rate. The arbitrage pricing theory assumes that returns are a function of expected returns and several common factors which each have a zero mean (Roll and Ross, 1980, p. 1076). Based on factor analysis, Roll and Ross conclude (1980, p. 1092) "...that at least three factors are important for pricing, but that it is unlikely that more than four are present." Further, they suggest that if only a few factors are important, then (p. 1077) "...one would expect these to be related to fundamental economic aggregates, such a GNP, or to interest rates or weather (although no causality is implied by such relations)."

Merton (1973) constructs an intertemporal capital asset pricing model which contains terms representing unfavorable shifts in the investment opportunity set or other economic conditions. Although not derived from the model, Merton (p. 879) suggests that interest rates may describe shifts in the investment opportunity set.

Breedon (1979) develops a single-beta intertemporal asset pricing model in which equilibruim returns are related to changes in consumption. Schipper and Thompson (1980), examining models based largely on Merton's and Breedon's work, show that individual firm returns are related to unanticipated changes in consumption and GNP, and almost statistically related to changes in the price level.

In cross-sectional regressions with firm returns as the dependent variable, Banz (1981) and Reinganum (1981) find evidence that firm market value, in addition to systematic risk, is associated with firm returns, Litzenberger and Ramaswamy (1979) find that dividend yield and systematic risk are related to firm returns.

There have been other criticisms of the market model such as nonstationarity of systematic risk or the coefficient of the market index (Blume, 1971; Levy, 1971). However, similar criticisms may apply to models which do not use market indexes as right-hand side variables.

However, the most important question is the ability of models to detect the effects of accounting policy decisions on firm returns. To help answer that question, the procedure introduced by Brown and Warner (1980) is used in this study. The simulation procedure is performed by adding an artificial effect to actual firm stock returns. Abnormal returns are examined to statistically determine which model can best detect the presence of the artificial effect.

Brown and Warner examined tests of sample of firms rather than tests of individual firms. Further, Brown and Warner were concerned with comparing existing methodologies and they did not consider market index effects. They found that the market model did as well as other models in detecting the artificial effects which occur in the same month for all firms in a sample (Brown and Warner, 1980, p. 234).

THE MODELS

A. The Market Model

The purpose of this chapter is to introduce the models in this study.

The market model is (Sharpe, 1963):

$$\tilde{R}_{it} = \alpha_i + \beta_i \tilde{R}_{mt} + \tilde{\varepsilon}_{it}$$

where: $\tilde{R}_{it}$ = return of firm i in month t;

$\tilde{R}_{mt}$ = market index;

$\tilde{\varepsilon}_{it}$ = error term of firm i in month t which is assumed to be normally distributed with a zero mean and variance σ_i^2 for all t, i.e., $\tilde{\varepsilon}_{it} \sim N(0,\sigma_i^2)$ for all t;

$\alpha_i = E(\tilde{R}_{it}) - \beta_i E(\tilde{R}_{mt})$;

$$\beta_i = \frac{\mathrm{cov}(\tilde{R}_{it},\tilde{R}_{mt})}{\sigma^2(\tilde{R}_{mt})}.$$

Brown and Warner (1980) used both an equally weighted index and a value weighted index in some of their simulations. The equally weighted index was slightly better than the value weighted index in detecting the presence of artificial effects (Brown and Warner, 1980, p. 243). Hence, the equally weighted index from the CRSP tapes was used in this study. Thus,

$$\tilde{R}_{mt} = \frac{1}{N}\sum_{j=1}^{N}\tilde{R}_{jt}$$

where N = the number of firms in the market index. The market model can be derived from the assumption that returns are multivariate normal (Fama, 1976, pp. 63-69).

The predicted return using the market model for the month t is:

$$\tilde{P}_{it} = a_i + b_i\tilde{R}_{mt}$$

where: a_i = the ordinary least squares estimate of α_i;

b_i = the ordinary least squares estimate of β_i.

Thus, the abnormal return for firm i in month t, $\tilde{A}_{it}$, is:

$$\tilde{A}_{it} = \tilde{R}_{it} - a_i - b_i\tilde{R}_{mt}.$$

B. The Zero Model

The zero model is:

$$\tilde{R}_{it} = \tilde{\varepsilon}_{it}$$

where $\tilde{\varepsilon}_{it} \sim N(0,\sigma_i^2)$ for all t. The predicted return using the zero model is:

$$\tilde{P}_{i0} = 0.$$

Thus, the name, the zero model. The abnormal return for firm i in month 0 is

$$\tilde{A}_{i0} = \tilde{R}_{i0}.$$

Although naive, the zero model serves as a useful benchmark for models of firm returns. Predictions of the zero model are made without any information regarding the behavior of other variables. Lev (1979) used this model.

C. The Valuation Model

The valuation model is:

$$\tilde{R}_{it} = \beta_{i0} + \beta_{i1}\frac{TB_{t-1}}{\tilde{TB}_t} + \beta_{i2}TB_{t-1} + \tilde{\varepsilon}_{it}$$

where: $\tilde{TB}_t$ = the effective interest rate on new issues of three-month U.S. Treasury bills for month t;

β_{i0}, β_{i1}, β_{i2} = coefficients;

$\tilde{\varepsilon}_{it} \sim N(0,\sigma_i{}^2)$ for all t.

The predicted return using the valuation model is:

$$\tilde{P}_{i0} = c_i + d_i\frac{TB_{-1}}{\tilde{TB}_0} + e_iTB_{-1}$$

where c_i, d_i, and e_i are the respective ordinary least squares estimates of β_{i0}, β_{i1}, and β_{i2}. The abnormal return for firm i in month 0 is :

$$\tilde{A}_{io} = \tilde{R}_{i0} - \left(c_i + d_i\frac{TB_{-1}}{\tilde{TB}_0} + e_iTB_{-1}\right).$$

The valuation model is derived in the following manner. A popular valuation model for the common stock of a firm is (Sharpe, 1981, p. 366; Haley and Schall, 1979, p. 191):

$$PR_0 = \sum_{t=0}^{\infty} \frac{d_t}{(1+r_0)^{t+1}}$$

where: PR_t = price per share of stock at beginning of period t;

d_t = expected cash dividend per share occuring at the end of period t;

r_t = firm specific effective interest rate at beginning of period t, $r_t > 0$ for all t.

Then, letting d_{A0} = the actual cash dividend during period 0,

$$PR_1 + d_{A0} = \left[\sum_{t=1}^{\infty} \frac{d_t}{(1+r_1)^t}\right] + d_{A0}$$

which is a convergent series since, based upon empirical observation, $PR_0 + d_{A0}$ is finite. It can be shown that there exists a real number D_1 such that:

$$PR_1 + d_{A0} = \sum_{t=0}^{\infty} \frac{D_1}{(1+r_1)^t}$$

where D_t = a firm's expected "normal" cash dividend per share per period determined at the beginning of period t.

Now, $\sum_{t=0}^{\infty} \frac{D_1}{(1+r_1)^t}$ is a convergent geometric series since $r_1 > 0$. Thus (Olmsted, 1961, p. 383):

$$\sum_{t=0}^{\infty} \frac{D_1}{(1+r_1)^t} = \frac{D_1}{1 - \left[\frac{1}{1+r_1}\right]},$$

which can be written as,

$$\frac{D_1}{\left[\frac{1+r_1-1}{1+r_1}\right]} = \frac{D_1}{\left[\frac{r_1}{1+r_1}\right]} = \frac{D_1(1+r_1)}{r_1} = \frac{D_1}{r_1} + D_1.$$

Similarly,

$$PR_0 = \sum_{t=0}^{\infty} \frac{d_t}{(1+r_0)^{t+1}} = \sum_{t=0}^{\infty} \frac{D_0}{(1+r_0)^{t+1}}$$

$$= D_0 + \left[\sum_{t=0}^{\infty} \frac{D_0}{(1+r_0)^{t+1}}\right] - D_0$$

$$= \left[\sum_{t=0}^{\infty} \frac{D_0}{(1+r_0)^{t}}\right] - D_0$$

$$= \frac{D_0}{r_0} + D_0 - D_0 = \frac{D_0}{r}.$$

Since the common stock return for period 0, R_0, is:

$$R_0 = \frac{PR_1 + d_{A0} - PR_0}{PR_0}$$

then by substituting from above,

$$R_0 = \frac{\frac{D_1}{r_1} + D_1 - \frac{D_0}{r_0}}{\frac{D_0}{r_0}}$$

$$= \frac{D_1 r_0}{D_0 r_1} + \frac{D_1}{D_0} r_0 - 1.$$

Now, suppose $r_t = RK_t RF_t$

where: RF_t = the risk-free interest rate at the beginning of period t;

RK_t = the firm specific risk adjustment factor at the beginning of period t, $RK_t \geq 1$.

Further, suppose $RF_t = TB_{t-1}$. That is, stock market participants use the effective interest rate on new issues of three-month U.S. Treasury bills during month t-1 as the risk-free rate at the beginning of month t.

Substituting for r_0 and r_1 in the previous expression for R_0 gives:

$$R_0 = \frac{D_1 RK_0 TB_{-1}}{D_0 RK_1 TB_0} + \frac{D_1 RK_0}{D_0} TB_{-1} - 1$$

or, more generally for firm i and period t:

$$R_{it} = \frac{D_{it+1} RK_{it} TB_{t-1}}{D_{it} RK_{it+1} TB_t} + \frac{D_{it+1}}{D_{it}} RK_{it} TB_{t-1} - 1.$$

This can be estimated as:

$$\tilde{R}_{it} = \beta_{i0} + \beta_{i1} \frac{TB_{t-1}}{\tilde{TB}_t} + \beta_{i2} TB_{t-1} + \tilde{\varepsilon}_{it}.$$

An assumption of ordinary least squares is that the coefficients are constant parameters (Neter and Wasserman, 1974, p. 30). This leads to Lemma 3.

Lemma 3. When applying ordinary least squares to the valuation model, it is implictly assumed that RK_{it} and D_{it+1}/D_{it} are constant for t = 2,...,T+1. T is the number of consecutive time series observations used to estimate the model.

Hence, if the valuation model does not fit the data well during the estimation period, it may be because the risk adjustment factor or the normal dividend ratio, D_{it+1}/D_{it}, is not constant during the estimation period. Alternative reasons for possible lack of fit include: an inappropriate model of the price per share of common stock; an invalid assumption of the relationship between the firm specific effective interest rate and the risk-free rate; an invalid assumption that the risk-free rate is equal to the effective interest rate on new issues of three-month U.S. Treasury bills; or that common stocks are mispriced.

An important feature of the valuation model is that the predicted return should not be significantly affected by an accounting policy decision. In particular, the Treasury bill rate should not be significantly affected by a contemporaneous accounting policy decision. Thus, most of the accounting policy decision effect on firm i will be retained in the abnormal return of firm i. It is assumed throughout this study that the Treasury bill rate is not affected by an accounting policy decision. Obviously, the zero model's prediction will not be affected by an accounting policy decision. Hence, all of the accounting policy decision effect will be retained in the abnormal return of each firm.

Thus, the potential usefulness of both the zero and valuation model lies in the fact that the predicted firm return is not affected by an accounting policy decision. Hence, although these models may not fit the firm return data as well as the market model, if they fit the data sufficiently well they may be used as a more powerful procedure than the market model with an index effect for detecting the effects of accounting policy decisions.

PROCEDURES

A. Individual Firm Tests

The models in this study were compared by conducting simulations similar to those conducted by Brown and Warner (1980). The purpose of the simulations was to compare the power of the models for detecting the effects of accounting policy decisions on individual firms. Power is the probability of rejecting a false null hypothesis:

$$\Pr(\text{reject } \tilde{DR}_{it} = 0 \mid \tilde{DR}_{it} \neq 0)$$

where: Pr = probability;

$\tilde{DR}_{it}$ = return of firm i in month t due to an accounting policy decision.

The simulations were conducted in the following manner. For the event month, i.e., the month in which a hypothetical accounting policy decision took place, artificial accounting policy decision effects were added to the actual returns of each firm in the sample. Thus, simulated firm return equals artificial accounting policy decision effect ($\tilde{DR}_{it}$) plus actual firm return. The sizes of the artificial accounting policy decision effects examined were the following monthly return percentages: 0, ±0.5, ±1.0, ±1.5, ±2.0, ±3.0, ±4.0, ±5.0, ±7.5, ±10, ±15, ±20, ±30, ±40, ±50, ±75, and ±100. Hence, a wide range of monthly return percentages were examined.

Next, predictions of the firm return were made by each model. For each model an abnormal return was computed and then statistically analyzed to determine if the null hypothesis of no accounting policy decision effect could be rejected. This null hypothesis is: $H_0^1{:}\tilde{DR}_{it} = 0$.

Six event months were examined. The six months were March, 1976, through August, 1976. All firms had the same event months since accounting policy decisions generally affect firms in the same month. Consecutive event months were examined so that a single estimated model could be used for each event month. Models estimated on 60 monthly observations should be valid for the subsequent six months. Six months were examined so that the findings were not unduly influenced by an unusual month.

The six month period was selected at random from the period July, 1968, to June, 1979. This eleven year period covers several pronouncements by regulatory bodies including the effective date of _Accounting Principles Board Opinion No. 15_ through the issuance of _Statement of Financial Accounting Standard No. 29_ (AICPA, 1980). Hence, the eleven year period contains several accounting policy decisions which researchers may wish to analyze with the models examined in this study.

The 60 month period from March, 1971, through February, 1976, was used to estimate each of the models. A 60 month estimation period has been used in accounting research. For example, Beaver, Christie, and Griffin (1980, p. 141) used 60 months to estimate beta in the market model.

Four hundred fifty-seven firms were selected at random without replacement from the CRSP monthly tape available at Michigan State University. Each firm that was selected had to have complete data for the 66 month period from March, 1971, to August, 1976. A sample size of 457 and an observed level of significance of .05 in a two-tail test ensures that the true level of significance is within ±.02 of .05 at a 95% confidence level. A range of ±.01 requires a sample size of 1,825 firms which exceeds the number of firms which satisfy the data requirements. These calculations are based on the normal approximation to the binomial distribution (Mood, Graybill, and Boes, 1974, pp. 395-396). The observed level of significance of a model for a given month t is defined as:

$$\frac{\text{\# of rejections of } H_0^1 \text{ when } \tilde{DR}_{it} = 0 \text{ for all i}}{457}.$$

The true level of significance of a model for a given month t is defined as:

$$\Pr(\text{reject } H_0^1 | \tilde{DR}_{it} = 0).$$

Dummy variables were employed to compute the abnormal returns. Six dummy variables, one for each event month, were added to the right-hand side of each model. Each dummy variable had the value 1 for its corresponding event month and had the value zero for the other 65 observations. The coefficient of the dummy variables is equal to the abnormal return for the corresponding month as stated in the following theorem.

Theorem 2. In an ordinary least squares regression of n + k observations, the coefficient of a dummy variable that is 1 for period n + j and 0 for all other periods, j = 1,...,k, is the abnormal return for period n + j where the equation is estimated over n observations without the k dummy variables.

This theorem allows the fitting of the model and computation of the abnormal returns to be accomplished in the calculation of a single regression equation.

The usual t-statistic for testing if a coefficient, i.e., abnormal return, is significantly different from zero was employed to test H_0^1 (for example, see Neter and Wasserman, 1974, p. 230). The degrees of freedom depended on the model: market, 58; valuation, 57; and zero, 60. The specified levels of significance depended on the test: two tail, .05; right-hand tail, .025; and left-hand tail, .025.

A difference in means for paired observations test was employed to compare the power and levels of significance of the models in tests of H_0^1. The null hypothesis of this test is:

$$H_0^2\text{:Pr(model X rejects } H_0^1 \mid \tilde{DR}_{it}^*) = \text{Pr(model Y rejects } H_0^1 \mid \tilde{DR}_{it}^*)$$

where $\tilde{DR}_{it}^*$ has a specified value. The statistic is

$$\frac{\overline{D}}{\left[\frac{\sum_{i=1}^{n}(D_i - \overline{D})^2}{n(n-1)}\right]^{\frac{1}{2}}}$$

where: $D_i = X_i - Y_i$;

$\overline{D} = \frac{1}{n}\sum_{i=1}^{n} D_i$;

X_i = a binomial random variable, taking the value 1 if H_0^1 is rejected and zero otherwise, for model X;

Y_i = same as X_i except for model Y.

The statistic is derived by applying the Central Limit Theorem (Conover, 1971, pp. 53-54) to the D_i's which are assumed to be independent and identically distributed. Thus, the standard normal distribution is the approximate distribution of this statistic. The correlation of X_i and Y_i is taken into account by the statistic.

For this study two tail tests were performed using the difference in means for paired observations statistic. The sample size was 457 and the level of significance was .05.

B. Adjusting Levels of Significance

Examination of the results of the next chapter reveals that many of the observed levels of significance are significantly different from the specified levels of significance in tests of H_o^1. A method for adjusting the observed levels of significance is the following.

Compute the critical point for each firm during a set of time periods during which no unusual event such as an accounting policy decision has taken place. The critical point is the distance between the observed abnormal return and the standard error times the appropriate percentile of the t-distribution. For the market model, with 58 degrees of freedom, the critical point for firm i in month t, CRP_{it}, is:

$$CRP_{it} = +2.002S.E. - (R_{it} - P_{it})$$

for a right-hand tail test, and

$$CRP_{it} = -2.002S.E. - (R_{it} - P_{it})$$

for a left-hand tail test. Here, S.E. represents the standard error which is the denominator of the individual firm t-ratio. The critical point is the amount which would need to be added to the abnormal return to just reject H_0^1.

In a sample size of 457 firms and a specified level of significance of .025, one would expect to observe 457 x .025 = 11.425 or about 11 rejections of H_0^1 when there is no unusual event such as an accounting policy decision. Thus, one can now compute the α adjustment factor which is the amount that would need to be added to each firm abnormal return for a given time period in order to reject H_0^1 11 times in the sample of 457 firms.

For a specified event month, the α adjustment factor was computed for the other five event months. The average α adjustment factor for these other five months was added to the abnormal returns of the firms in the specified event month. On average the number of rejections of H_0^1 in the specified event month when $\tilde{DR}_{it} = 0$ for all i should be about 11. The assumption of this procedure is that the distribution of the t-statistics used to test H_0^1 is the same for all the event months.

C. Market Index Effects

The purpose of Part C of the next chapter is to determine the magnitudes of market index effects which make the valuation and zero models as powerful as the market model. The procedure is to examine a hypothetical average firm. Recall that the numerator of the t-ratios is the abnormal return, $\tilde{A}_{it}$, which can be written as:

$$\tilde{A}_{it} = \tilde{DR}_{it} + \tilde{WR}_{it} - \tilde{P}_{it}$$

where: $\tilde{DR}_{it}$ = return of firm i in month t due to an accounting policy decision;

$\tilde{WR}_{it}$ = return of firm i in month t due to all causes except the accounting policy decision;

$\tilde{P}_{it}$ = the predicted return of firm i in month t.

If $\tilde{P}_{it}$ is an unbiased estimate of $\tilde{WR}_{it}$, then on average $\tilde{A}_{it} = \tilde{DR}_{it}$. Thus, in this case the power of the t-tests depends on the denominator of the t-ratios, i.e., the standard error, and the degrees of freedom.

The models are compared by examining their average standard errors in the sample of 457 firms and their appropriate degrees of freedom. For the market model, with 58 degrees of freedom, the critical value for a hypothetical average firm, CRM, is:

$$CRM = 2.002 S.E.M.$$

where S.E.M. is the average standard error for the market model. The critical value is the size in absolute value of the accounting policy decision effect which would be required to just reject H_0^1 for a hypothetical average firm.

The numerator of the t-ratio for the market model, assuming $\tilde{P}_{it} = \tilde{WR}_{it}$, when there is an index effect is:

$$\tilde{DR}_{it}(1 - p_i b_i)$$

where: p_i = market index effect;

b_i = the estimated coefficient of the market index in the market model for firm i.

Thus, for the market model when there is an index effect, the critical value for a hypothetical average firm, CRI, is:

$$CRI = \frac{2.002 S.E.M.}{1 - p_i b_i} = \frac{CRM}{1 - p_i b_i}.$$

Solving:

$$CRV = \frac{CRM}{1 - p_i b_i^*}$$

for p_i shows how large the market index effect would have to be in order for the valuation model to be just as effective in detecting $\tilde{DR}_{it}$ as the market model. Here, CRV is the critical value for a hypothetical average firm for the valuation model and b_i^* is a specified value for b_i. A similar computation is made for the zero model.

D. Sample of Firms Tests

Now, $\tilde{A}_{it} = \tilde{DR}_{it} + \tilde{WR}_{it} - \tilde{P}_{it}$.

Clearly, the ideal prediction is $\tilde{P}_{it} = \tilde{WR}_{it}$ since then $\tilde{A}_{it} = \tilde{DR}_{it}$ which makes the accounting policy decision directly observable. Failing the achievement of the ideal, intuitively one would expect that the smaller the prediction errors, the easier it would be to detect the accounting policy decision effect.

For example, consider the following two statistics. The event month t-statistic for a sample of n firms is (Mood, Graybill, and Boes, 1974, p. 250):

$$\frac{\overline{A}_0}{\left(\frac{\left(\frac{1}{n-1}\sum_{i=1}^{n}(A_{i0} - \overline{A}_0)^2\right)^{\frac{1}{2}}}{n^{\frac{1}{2}}}\right)} \sim t_{(n-1)}. \qquad \text{(T-1)}$$

The statistic (T-1) is derived under the assumptions that the A_{i0}'s are independent and identically distributed as $N(0,\sigma^2)$ and that there is no accounting policy decision effect. In (T-1) and the statistic (T-2) below, $\overline{A}_t = \frac{1}{n}\sum_{i=1}^{n} A_{it}$.

However, suppose that the A_{i0}'s are not independent. Then (T-1) is not distributed as $t_{(n-1)}$. A more appropriate statistic may be:

$$\frac{\overline{A}_0}{\left(\frac{1}{5}\sum_{t=-5}^{-1}(\overline{A}_t)^2\right)^{\frac{1}{2}}} \sim t_{(5)} \qquad \text{(T-2)}$$

where, 0 represents the month in which the accounting policy decision takes place and -1,...,-5 represent months in which the accounting policy decision does not take place and in which predictions are made by the prediction models. The statistic (T-2) is derived under the assumption that the $\overline{A}_t$'s are independent and identically distributed as $N(0,\sigma^2)$ and that there is no accounting policy decision effect. Cross-sectional dependence of firm abnormal returns is taken into account by (T-2) since the variance of $\overline{A}_t$ includes the effects of any cross-sectional dependence. The statistic (T-2) is similar to the t-statistic with crude dependence adjustment suggested by Brown and Warner (1980, p. 251).

Inspection of (T-2) shows that as prediction errors become uniformly smaller across firms, the denominator is smaller since the denominator is a function of only prediction errors under the null hypothesis of no accounting policy decision effect. Hence, as the prediction errors tend to become smaller, the more likely it is to reject the null hypothesis when it is false and the more powerful the testing procedure.

It is more difficult to see the importance of small prediction errors for (T-1) since the denominator is affected by an accounting policy decision effect. However, if the effect of the accounting policy decision on the denominator is small, then smaller prediction errors will tend to result in a smaller denominator and a more powerful tests.

Thus, one way to compare the power of models in sample of firm tests is to examine how well the models predict. The mean absolute prediction error (MAPE) and the mean square prediction error (MSPE) were used in a preliminary study to compare power. These results are reported in the next chapter. Also reported are (T-1) and (T-2) for the market model, the valuation model, and the zero model when there is no simulated accounting policy decision effect for the sample of 457 firms used in the individual firm tests.

RESULTS

A. Power Comparisons

The null hypothesis of the individual firm t-tests, H_0^1, is that the accounting policy decision effect for a firm is zero. Table 1 through Table 24 show the number of rejections of H_0^1 in a random sample of 457 firms when the same simulated effect has been added to each firm's actual return. Thirty-three levels of accounting policy decision effects were simulated. The simulated effects range from -100% to 100%. Right-hand tail tests (α = .025), left-hand tail tests (α = .025), and two-tail tests (α = .05) are presented for each of the six event months.

Table 25 through Table 48 show the difference in means for paired observations statistic. The null hypothesis of these tests, H_0^2, is that the probabilities of rejection of H_0^1 by two models are equal. Difference in means statistics are presented for all pairs of models for all levels of accounting policy decision effects reported in Tables 1 through 24. The names of the models are abbreviated in these tables as follows: market model without an index effect, M; market model with a 50% index effect, I; valuation model, V; and zero model, Z. H_0^2 is rejected if the difference in means statistic in absolute

Table 1. Number of rejections of null hypothesis March, 1976, in right-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	15	15	7	8
0.5	17	16	10	8
1.0	20	16	10	9
1.5	21	18	13	10
2.0	23	20	13	13
3.0	30	23	16	16
4.0	38	25	19	20
5.0	45	29	25	25
7.5	78	38	44	36
10.0	108	59	74	68
15.0	213	97	164	153
20.0	309	154	260	248
30.0	417	254	384	382
40.0	447	323	439	438
50.0	457	355	452	452
75.0	457	400	457	457
100.0	457	420	457	457

Table 2. Number of rejections of null hypothesis March, 1976, in left-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	2	2	0	0
-0.5	3	2	0	0
-1.0	4	4	0	0
-1.5	4	4	0	0
-2.0	6	4	2	1
-3.0	7	7	3	1
-4.0	15	8	3	3
-5.0	22	10	4	3
-7.5	51	18	14	11
-10.0	94	36	31	25
-15.0	194	82	101	89
-20.0	284	138	192	188
-30.0	396	221	345	344
-40.0	433	293	412	415
-50.0	452	349	437	436
-75.0	456	400	455	455
-100.0	457	417	456	456

Table 3. Number of rejections of null hypothesis March, 1976, in two tail tests, positive effects, for 457 firms with α=.05.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	17	17	7	8
0.5	19	18	10	8
1.0	22	18	10	9
1.5	22	18	13	10
2.0	23	20	13	13
3.0	30	23	16	16
4.0	38	25	19	20
5.0	45	29	25	25
7.5	78	38	44	36
10.0	108	59	74	68
15.0	213	97	164	153
20.0	309	154	260	248
30.0	417	254	384	382
40.0	447	323	439	438
50.0	457	355	452	452
75.0	457	400	457	457
100.0	457	420	457	457

Table 4. Number of rejections of null hypothesis March, 1976, in two tail tests, negative effects, for 457 firms with α=.05.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	17	17	7	8
-0.5	17	16	7	6
-1.0	17	18	6	6
-1.5	16	18	6	6
-2.0	18	17	8	7
-3.0	17	19	9	6
-4.0	22	19	7	8
-5.0	28	21	8	7
-7.5	55	28	17	14
-10.0	97	43	33	26
-15.0	195	87	102	90
-20.0	285	143	193	189
-30.0	396	222	345	344
-40.0	433	294	412	415
-50.0	452	350	437	436
-75.0	456	400	455	455
-100.0	457	417	456	456

Table 5. Number of rejections of null hypothesis April, 1976, in right-hand tail tests for 457 firms with α=.025.

Effect %	Model			
	Market	Market with 50% Index Effect	Valuation	Zero
0	10	10	4	4
0.5	12	11	4	4
1.0	13	13	4	4
1.5	15	13	4	5
2.0	18	15	5	6
3.0	22	16	5	8
4.0	30	17	9	10
5.0	37	23	9	13
7.5	64	36	15	18
10.0	107	52	29	45
15.0	196	95	86	106
20.0	280	140	166	197
30.0	413	239	311	341
40.0	445	299	407	423
50.0	455	344	441	445
75.0	457	400	456	457
100.0	457	422	457	457

Table 6. Number of rejections of null hypothesis April, 1976, in left-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	0	0	1	0
-0.5	0	0	1	0
-1.0	2	1	3	0
-1.5	2	2	3	0
-2.0	3	2	3	1
-3.0	7	4	6	2
-4.0	10	6	8	2
-5.0	12	7	11	3
-7.5	29	10	28	10
-10.0	74	16	60	26
-15.0	200	62	195	122
-20.0	314	124	307	249
-30.0	422	247	415	386
-40.0	450	301	451	440
-50.0	454	345	454	453
-75.0	455	406	455	455
-100.0	457	427	456	457

Table 7. Number of rejections of null hypothesis April, 1976, in two tail tests, positive effects, for 457 firms with α=.05.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	10	10	5	4
0.5	12	11	5	4
1.0	13	13	4	4
1.5	15	13	4	5
2.0	18	15	5	6
3.0	22	16	5	8
4.0	30	17	9	10
5.0	37	23	9	13
7.5	64	36	15	18
10.0	107	52	29	45
15.0	196	95	86	106
20.0	280	140	166	197
30.0	413	239	311	341
40.0	445	299	407	423
50.0	455	344	441	445
75.0	457	400	456	457
100.0	457	422	457	457

Table 8. Number of rejections of null hypothesis April, 1976, in two tail tests, negative effects, for 457 firms with α=.05.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	10	10	5	4
-0.5	8	9	4	4
-1.0	9	9	4	4
-1.5	8	10	4	4
-2.0	9	9	4	5
-3.0	11	10	7	6
-4.0	14	12	9	6
-5.0	16	12	12	7
-7.5	33	14	29	13
-10.0	78	20	61	29
-15.0	203	66	196	123
-20.0	315	128	307	249
-30.0	422	249	415	386
-40.0	450	303	451	440
-50.0	454	347	454	453
-75.0	455	408	455	455
-100.0	457	428	456	457

Table 9. Number of rejections of null hypothesis May, 1976, in right-hand tail tests for 457 firms with $\alpha=.025$.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	4	4	0	0
0.5	4	4	1	0
1.0	4	4	2	0
1.5	4	4	3	1
2.0	6	6	3	3
3.0	12	7	5	3
4.0	16	9	8	6
5.0	24	13	9	6
7.5	47	23	19	14
10.0	77	34	36	30
15.0	189	70	102	86
20.0	303	135	205	182
30.0	412	222	356	342
40.0	448	306	434	423
50.0	454	346	451	450
75.0	457	395	457	457
100.0	457	423	457	457

Table 10. Number of rejections of null hypothesis May, 1976, in left-hand tail tests for 457 firms with α=.025.

Effect %	Model			
	Market	Market with 50% Index Effect	Valuation	Zero
0	1	1	0	1
-0.5	3	3	0	1
-1.0	4	3	1	1
-1.5	4	4	1	1
-2.0	5	4	2	2
-3.0	8	5	2	2
-4.0	11	8	3	4
-5.0	20	10	8	6
-7.5	45	18	19	19
-10.0	98	35	43	46
-15.0	213	80	146	149
-20.0	295	145	247	249
-30.0	414	232	380	383
-40.0	450	302	436	443
-50.0	455	352	455	455
-75.0	457	409	457	457
-100.0	457	427	457	457

Table 11. Number of rejections of null hypothesis May, 1976, in two tail tests, positive effects, for 457 firms with $\alpha=.05$.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	5	5	0	1
0.5	5	5	1	1
1.0	5	5	2	0
1.5	5	5	3	1
2.0	7	7	3	3
3.0	12	8	5	3
4.0	16	10	8	6
5.0	24	13	9	6
7.5	47	23	19	14
10.0	77	34	36	30
15.0	189	70	102	86
20.0	303	135	205	182
30.0	412	222	356	342
40.0	448	306	434	423
50.0	454	346	451	450
75.0	457	395	457	457
100.0	457	423	457	457

Table 12. Number of rejections of null hypothesis May, 1976, in two tail tests, negative effects, for 457 firms with α=.05.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	5	5	0	1
-0.5	7	7	0	1
-1.0	8	7	1	1
-1.5	7	7	1	1
-2.0	8	7	2	2
-3.0	10	8	2	2
-4.0	11	11	3	4
-5.0	20	12	8	6
-7.5	45	19	19	19
-10.0	98	35	43	46
-15.0	213	80	146	149
-20.0	295	145	247	249
-30.0	414	232	380	383
-40.0	450	302	436	443
-50.0	455	352	455	455
-75.0	457	409	457	457
-100.0	457	427	457	457

Table 13. Number of rejections of null hypothesis June, 1976, in right-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	10	10	15	10
0.5	11	10	17	10
1.0	13	11	17	13
1.5	17	13	17	16
2.0	18	16	20	20
3.0	20	18	26	21
4.0	28	19	33	28
5.0	38	23	45	34
7.5	65	33	78	63
10.0	105	49	127	109
15.0	213	97	242	219
20.0	315	146	334	311
30.0	411	251	417	413
40.0	445	314	448	447
50.0	452	353	453	453
75.0	457	405	457	457
100.0	457	422	457	457

Table 14. Number of rejections of null hypothesis June, 1976, in left-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	2	2	0	0
-0.5	4	3	0	0
-1.0	5	4	0	0
-1.5	6	4	0	0
-2.0	8	5	0	1
-3.0	11	8	1	1
-4.0	12	9	1	1
-5.0	18	10	1	1
-7.5	39	14	2	2
-10.0	79	30	8	6
-15.0	189	71	47	47
-20.0	293	118	118	115
-30.0	407	216	291	300
-40.0	443	305	403	403
-50.0	453	350	436	435
-75.0	356	395	455	455
-100.0	357	422	457	457

Table 15. Number of rejections of null hypothesis June, 1976, in two tail tests, positive effects, for 457 firms with $\alpha=.05$.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	12	12	15	10
0.5	13	12	17	10
1.0	15	13	17	13
1.5	18	15	17	16
2.0	19	18	20	20
3.0	21	19	26	21
4.0	28	20	33	28
5.0	38	24	45	34
7.5	65	34	78	63
10.0	105	50	127	109
15.0	213	97	242	219
20.0	315	146	334	311
30.0	411	251	417	413
40.0	445	314	448	447
50.0	452	353	453	453
75.0	457	405	457	457
100.0	457	422	457	457

Table 16. Number of rejections of null hypothesis June, 1976, in two tail tests, negative effects, for 457 firms with α=.05.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	12	12	15	10
-0.5	14	13	14	10
-1.0	14	13	11	8
-1.5	14	13	9	6
-2.0	14	14	7	6
-3.0	15	16	7	6
-4.0	15	15	6	5
-5.0	21	16	4	4
-7.5	41	17	5	4
-10.0	81	33	10	8
-15.0	191	74	49	49
-20.0	293	121	120	117
-30.0	407	219	291	300
-40.0	443	307	403	403
-50.0	453	351	436	435
-75.0	456	396	455	455
-100.0	457	423	457	457

Table 17. Number of rejections of null hypothesis July, 1976, in right-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	10	10	4	4
0.5	11	11	4	4
1.0	12	11	4	4
1.5	13	12	4	4
2.0	18	14	5	5
3.0	20	19	5	5
4.0	24	20	6	11
5.0	29	21	9	15
7.5	53	30	20	27
10.0	94	42	33	42
15.0	198	74	82	108
20.0	292	128	177	205
30.0	414	229	348	368
40.0	446	306	425	433
50.0	456	351	447	449
75.0	457	400	457	457
100.0	457	427	457	457

Table 18. Number of rejections of null hypothesis July, 1976, in left-hand tail tests for 457 firms with $\alpha=.025$.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	1	1	1	1
-0.5	1	1	1	1
-1.0	2	2	1	1
-1.5	2	2	2	1
-2.0	2	2	2	2
-3.0	6	3	4	2
-4.0	7	5	5	2
-5.0	7	6	6	2
-7.5	28	7	16	5
-10.0	71	16	47	16
-15.0	207	64	163	89
-20.0	322	126	272	216
-30.0	420	244	407	382
-40.0	445	307	440	435
-50.0	455	346	453	450
-75.0	457	412	457	457
-100.0	457	423	457	457

Table 19. Number of rejections of null hypothesis July, 1976, in two tail tests, positive effects, for 457 firms with α=.05.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	11	11	5	5
0.5	12	12	5	5
1.0	13	12	5	5
1.5	14	13	5	4
2.0	19	15	6	5
3.0	21	20	5	5
4.0	24	21	6	11
5.0	29	22	9	15
7.5	53	30	20	27
10.0	94	42	33	42
15.0	198	74	82	108
20.0	292	128	177	205
30.0	414	229	348	368
40.0	446	306	425	433
50.0	456	351	447	449
75.0	457	400	457	457
100.0	457	427	457	457

Table 20. Number of rejections of null hypothesis July, 1976, in two tail tests, negative effects, for 457 firms with $\alpha = .05$.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	11	11	5	5
-0.5	10	10	5	5
-1.0	11	11	5	4
-1.5	8	11	6	4
-2.0	8	11	6	5
-3.0	11	10	8	5
-4.0	11	11	9	5
-5.0	11	12	10	5
-7.5	32	12	19	8
-10.0	74	20	48	18
-15.0	209	67	164	90
-20.0	322	129	272	216
-30.0	420	245	407	382
-40.0	445	308	440	435
-50.0	455	346	453	450
-75.0	457	412	457	457
-100.0	457	423	457	457

Table 21. Number of rejections of null hypothesis August, 1976, in right-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	9	9	2	2
0.5	11	10	2	2
1.0	13	11	2	2
1.5	14	14	2	3
2.0	16	15	3	5
3.0	23	15	5	6
4.0	31	20	6	9
5.0	35	25	9	13
7.5	73	35	20	23
10.0	102	53	37	46
15.0	193	91	88	103
20.0	297	131	162	187
30.0	410	234	325	347
40.0	444	309	412	426
50.0	454	354	443	446
75.0	457	401	457	457
100.0	457	421	457	457

Table 22. Number of rejections of null hypothesis August, 1976, in left-hand tail tests for 457 firms with α=.025.

Effect %	Model: Market	Market with 50% Index Effect	Valuation	Zero
0	3	3	2	1
-0.5	3	3	2	1
-1.0	3	3	2	2
-1.5	3	3	3	2
-2.0	5	3	3	3
-3.0	7	6	6	3
-4.0	10	6	7	5
-5.0	11	6	10	6
-7.5	33	10	19	10
-10.0	63	18	50	19
-15.0	187	52	159	109
-20.0	297	124	282	222
-30.0	425	233	411	395
-40.0	451	303	450	440
-50.0	455	358	455	455
-75.0	457	405	457	457
-100.0	457	422	457	457

Table 23. Number of rejections of null hypothesis August, 1976, in two tail tests, positive effects, for 457 firms with α=.05.

Effect %	Model: Market	Model: Market with 50% Index Effect	Model: Valuation	Model: Zero
0	12	12	4	3
0.5	13	12	4	3
1.0	15	13	4	2
1.5	15	15	4	3
2.0	17	16	5	5
3.0	23	16	6	6
4.0	31	20	6	9
5.0	35	25	9	13
7.5	73	35	20	23
10.0	102	53	37	46
15.0	193	91	88	103
20.0	297	131	162	187
30.0	410	234	325	347
40.0	444	309	412	426
50.0	454	354	443	446
75.0	457	401	457	457
100.0	457	421	457	457

Table 24. Number of rejections of null hypothesis August, 1976, in two tail tests, negative effects, for 457 firms with α=.05.

Effect %	Model			
	Market	Market with 50% Index Effect	Valuation	Zero
0	12	12	4	3
-0.5	11	11	4	3
-1.0	9	11	4	4
-1.5	7	9	5	4
-2.0	9	8	4	5
-3.0	9	10	7	4
-4.0	12	9	8	6
-5.0	13	9	11	7
-7.5	35	12	20	11
-10.0	64	20	51	20
-15.0	188	53	159	110
-20.0	298	125	282	222
-30.0	425	234	411	395
-40.0	451	304	450	440
-50.0	455	359	455	455
-75.0	457	405	457	457
-100.0	457	422	457	457

Table 25. Difference in means statistics March, 1976, for right-hand tail tests.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.851	2.663	2.851	2.663	-1.000
0.5	1.000	2.663	3.027	2.463	2.851	1.416
1.0	2.007	3.194	3.354	2.463	2.663	0.577
1.5	1.736	2.545	3.079	1.895	2.545	1.736
2.0	1.736	2.910	2.910	2.345	2.345	0
3.0	2.663	3.796	3.544	2.663	2.119	0
4.0	3.654	4.447	4.094	2.130	1.670	-0.577
5.0	4.067	4.568	4.568	1.416	1.266	0
7.5	6.164	5.703	6.622	-1.903	0.577	2.851
10.0	7.400	5.703	6.440	-3.483	-2.335	2.463
15.0	12.455	7.237	8.147	-8.851	-7.980	2.862
20.0	15.299	6.940	8.227	-11.735	-10.866	3.027
30.0	15.900	5.957	6.150	-13.464	-13.320	0.577
40.0	13.031	2.851	3.027	-12.455	-12.383	0.378
50.0	11.446	2.246	2.246	-11.084	-11.084	0
75.0	8.061	0	0	-8.061	-8.061	0
100.0	6.338	0	0	-6.338	-6.338	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 26. Difference in means statistics March, 1976, for left-hand tail tests.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	1.416	1.416	1.416	1.416	0
-0.5	1.000	1.736	1.736	1.416	1.416	0
-1.0	0	2.007	2.007	2.007	2.007	0
-1.5	0	2.007	2.007	2.007	2.007	0
-2.0	1.416	2.007	1.895	1.416	1.343	0.577
-3.0	0	2.007	2.463	2.007	2.463	1.416
-4.0	2.663	3.507	3.507	2.246	2.246	0
-5.0	3.507	4.324	4.447	2.463	2.663	1.000
-7.5	5.957	6.338	6.614	1.636	2.663	1.736
-10.0	8.142	8.539	9.005	1.670	3.354	2.130
-15.0	12.167	10.794	11.663	-4.222	-2.119	3.027
-20.0	14.631	10.721	11.012	-7.817	-7.485	1.069
-30.0	16.822	7.568	7.652	-13.031	-12.958	0.333
-40.0	14.191	4.687	4.324	-12.671	-12.887	-1.134
-50.0	11.879	3.934	4.067	-10.794	-10.721	1.000
-75.0	7.980	1.000	1.000	-7.899	-7.899	0
-100.0	6.614	1.000	1.000	-6.523	-6.523	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 27. Difference in means statistics March, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	3.194	3.027	3.194	3.027	-1.000
0.5	1.000	3.027	3.354	2.851	3.194	1.416
1.0	2.007	3.507	3.654	2.851	3.027	0.577
1.5	1.000	2.733	3.240	2.345	2.910	1.736
2.0	0.447	2.910	2.910	2.733	2.733	0
3.0	2.130	3.796	3.544	2.851	2.320	0
4.0	3.240	4.447	4.094	2.345	1.903	-0.577
5.0	4.067	4.568	4.568	1.416	1.266	0
7.5	6.614	5.703	6.622	-1.903	0.577	2.851
10.0	7.400	5.703	6.440	-3.483	-2.335	2.463
15.0	12.455	7.237	8.147	-8.851	-7.980	2.862
20.0	15.299	6.940	8.227	-11.735	-10.866	3.027
30.0	15.900	5.957	6.150	-13.469	-13.320	0.577
40.0	13.031	2.851	3.027	-12.455	-12.383	0.378
50.0	11.446	2.246	2.246	-11.084	-11.084	0
75.0	8.061	0	0	-8.061	-8.061	0
100.0	6.338	0	0	-6.338	-6.338	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 28. Difference in means statistics March, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	3.194	3.027	3.194	3.027	-1.000
-0.5	1.000	3.194	3.354	3.027	3.194	1.000
-1.0	-1.000	3.354	3.354	3.507	3.507	0
-1.5	-1.416	3.194	3.194	3.507	3.507	0
-2.0	0.577	3.194	3.079	3.027	2.910	0.577
-3.0	-1.416	2.851	3.354	3.194	3.654	1.736
-4.0	0.904	3.934	3.796	3.507	3.354	-1.000
-5.0	1.701	4.568	4.687	3.654	3.796	1.000
-7.5	4.410	6.431	6.704	3.079	3.796	1.736
-10.0	7.233	8.618	9.158	2.691	4.198	2.345
-15.0	11.342	10.794	11.663	-3.027	-0.774	3.027
-20.0	13.785	10.721	11.012	-6.891	-6.540	1.069
-30.0	16.591	7.568	7.652	-12.817	-12.745	0.333
-40.0	13.902	4.687	4.324	-12.248	-12.464	-1.134
-50.0	11.593	3.934	4.067	-10.367	-10.294	1.000
-75.0	7.980	1.000	1.000	-7.899	-7.899	0
-100.0	6.614	1.000	1.000	-6.523	-6.523	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 29. Difference in means statistics April, 1976, for right-hand tail tests.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.463	2.463	2.463	2.463	0
0.5	1.000	2.851	2.851	2.663	2.663	0
1.0	0	3.027	3.027	3.027	3.027	0
1.5	1.416	3.354	3.194	3.027	2.545	-1.000
2.0	1.736	3.654	3.507	3.194	3.027	-1.000
3.0	2.463	4.198	3.796	3.353	2.851	-1.736
4.0	3.654	4.687	4.568	2.851	2.663	-1.000
5.0	3.796	5.455	5.027	3.796	3.194	-2.007
7.5	5.455	7.400	7.144	4.687	4.324	-1.343
10.0	7.899	9.688	8.460	4.916	1.461	-4.067
15.0	11.374	12.023	10.575	2.511	-3.079	-4.568
20.0	14.191	12.311	9.776	-5.245	-8.061	-5.760
30.0	16.744	11.446	9.234	-9.086	-11.446	-5.469
40.0	14.631	6.431	4.802	-11.879	-13.031	-4.067
50.0	12.095	3.796	3.194	-11.084	-11.374	-2.007
75.0	8.061	1.000	0	-7.980	-8.061	-1.000
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 30. Difference in means statistic April, 1976, for left-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	-1.000	0	-1.000	0	1.000
-0.5	0	-1.000	0	-1.000	0	1.000
-1.0	1.000	-1.000	1.416	-1.416	1.000	1.736
-1.5	0	-1.000	1.416	-1.000	1.416	1.736
-2.0	1.000	0	1.000	-1.000	0.577	1.000
-3.0	1.736	1.000	2.246	-1.416	1.416	2.007
-4.0	2.007	1.416	2.851	-1.416	2.007	2.463
-5.0	2.246	0.447	3.027	-2.007	2.007	2.851
-7.5	4.447	0.242	4.447	-4.324	0	4.324
-10.0	8.142	3.161	7.315	-6.977	-2.910	6.054
-15.0	13.902	0.762	9.688	-13.681	-8.147	9.162
-20.0	18.014	1.402	8.695	-17.451	-13.103	7.986
-30.0	16.822	1.947	6.245	-16.281	-13.975	5.559
-40.0	14.852	-0.577	3.194	-14.926	-14.118	3.350
-50.0	11.951	0	1.000	-11.951	-11.879	1.000
-75.0	7.400	0	0	-7.400	-7.400	0
-100.0	5.660	1.000	0	-5.559	-5.660	-1.000

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 31. Difference in means statistics April, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	1.895	2.463	1.895	2.463	1.000
0.5	1.000	2.345	2.851	2.130	2.663	1.000
1.0	0	3.027	3.027	3.027	3.027	0
1.5	1.416	3.354	3.194	3.027	2.548	-1.000
2.0	1.736	3.654	3.507	3.194	3.027	-1.000
3.0	2.463	4.198	3.796	3.353	2.851	-1.736
4.0	3.654	4.687	4.568	2.851	2.663	-1.000
5.0	3.796	5.455	5.027	3.796	3.194	-2.007
7.5	5.455	7.400	7.144	4.687	4.324	-1.343
10.0	7.899	9.688	8.460	4.916	1.461	-4.067
15.0	11.374	12.023	10.575	2.511	-3.079	-4.568
20.0	14.191	12.311	9.776	-5.245	-8.061	-5.760
30.0	16.744	11.446	9.234	-9.086	-11.446	-5.469
40.0	14.631	6.431	4.802	-11.876	-13.031	-4.067
50.0	12.095	3.796	3.194	-11.084	-11.374	-2.007
75.0	8.061	1.000	0	-7.980	-8.061	-1.000
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 32. Difference in means statistics April, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	1.895	2.463	1.895	2.463	1.000
-0.5	-1.000	1.636	2.007	1.895	2.246	0
-1.0	0	1.343	2.246	1.134	2.246	1.000
-1.5	-1.416	1.000	2.007	1.636	2.463	1.000
-2.0	0	1.343	1.636	1.343	1.636	0.447
-3.0	0.447	1.416	2.246	0.447	2.007	1.343
-4.0	0.816	1.736	2.851	0.447	2.463	1.895
-5.0	1.636	0.816	3.027	-0.816	2.246	2.345
-7.5	4.447	0.471	4.568	-3.962	1.000	4.324
-10.0	8.142	3.591	7.400	-6.222	-2.511	5.501
-15.0	13.690	1.044	9.837	-13.050	-7.483	9.162
-20.0	17.308	1.571	8.773	-16.539	-12.274	7.986
-30.0	16.365	1.947	6.245	-15.832	-13.555	5.559
-40.0	14.419	-0.557	3.194	-14.492	-13.690	3.354
-50.0	11.529	0	1.000	-11.529	-11.457	1.000
-75.0	6.910	0	0	-6.910	-6.910	0
-100.0	5.351	1.000	0	-5.043	-5.351	-1.000

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 33. Difference in means statistics May, 1976, for right-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	2.007	2.007	2.007	2.007	0
0.5	0	1.736	2.007	1.736	2.007	1.000
1.0	0	1.000	2.007	1.000	2.007	1.416
1.5	0	0.447	1.736	0.447	1.736	1.416
2.0	0	1.736	1.343	1.343	1.736	0
3.0	2.246	2.663	3.027	1.416	2.007	1.416
4.0	2.663	2.545	3.194	0.577	1.736	1.416
5.0	3.354	3.934	4.324	1.636	2.663	1.736
7.5	5.027	5.259	5.957	1.155	2.733	2.246
10.0	6.882	6.531	7.230	-0.707	1.636	2.463
15.0	12.671	10.073	11.240	-5.860	-3.827	3.625
20.0	16.281	11.157	12.814	-9.082	-7.230	4.519
30.0	18.014	7.980	8.932	-13.754	-12.742	3.544
40.0	14.705	3.796	5.137	-13.681	-12.887	2.862
50.0	11.879	1.736	2.007	-11.663	-11.591	1.000
75.0	8.460	0	0	-8.460	-8.460	0
100.0	6.054	0	0	-6.054	-6.054	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 34. Difference in means statistics May, 1976, for left-hand tail tests.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	1.000	0	1.000	0	-1.000
-0.5	0	1.736	1.416	1.736	1.416	-1.000
-1.0	1.000	1.736	1.736	1.416	1.416	0
-1.5	0	1.736	1.736	1.736	1.736	0
-2.0	1.000	1.343	1.343	1.000	1.000	0
-3.0	1.736	2.463	2.463	1.736	1.736	0
-4.0	1.736	2.851	2.663	2.246	1.636	-1.000
-5.0	3.194	3.507	3.796	1.000	2.007	1.416
-7.5	5.351	5.043	5.245	-0.378	-0.378	0
-10.0	8.460	7.817	7.568	-2.851	-3.354	-1.736
-15.0	13.539	8.557	8.465	-8.773	-8.855	-0.688
-20.0	14.926	7.400	7.144	-11.374	-11.449	-0.625
-30.0	17.372	6.054	5.760	-14.779	-15.000	-1.134
-40.0	14.779	3.796	2.663	-13.754	-14.264	-2.345
-50.0	11.519	0	0	-11.519	-11.519	0
-75.0	7.315	0	0	-7.315	-7.315	0
-100.0	6.150	0	0	-6.150	-6.150	0

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 35. Difference in means statistics May, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.246	2.007	2.246	2.007	-1.000
0.5	0	2.007	2.007	2.007	2.007	0
1.0	0	1.343	2.246	1.343	2.246	1.416
1.5	0	0.816	2.007	0.816	2.007	1.416
2.0	0	2.007	1.636	1.636	2.007	0
3.0	1.636	2.663	3.027	1.736	2.246	1.416
4.0	2.130	2.545	3.194	1.000	2.007	1.416
5.0	3.354	3.934	4.324	1.636	2.663	1.716
7.5	5.027	5.259	5.927	1.155	2.733	2.246
10.0	6.882	6.531	7.230	-0.707	1.636	2.463
15.0	12.671	10.073	11.240	-5.860	-3.827	3.625
20.0	16.281	11.157	12.814	-9.082	-7.230	4.519
30.0	18.014	7.980	8.932	-13.754	-12.742	3.544
40.0	14.705	3.796	5.137	-13.681	-12.887	2.862
50.0	11.879	1.736	2.007	-11.663	-11.591	1.000
75.0	8.460	0	0	-8.460	-8.460	0
100.0	6.054	0	0	-6.054	-6.054	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 36. Difference in means statistics May, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.246	2.007	2.246	2.007	-1.000
-0.5	0	2.663	2.463	2.663	2.463	-1.000
-1.0	1.000	2.663	2.663	2.463	2.463	0
-1.5	-1.000	2.463	2.463	2.663	2.663	0
-2.0	1.000	2.130	2.130	1.895	1.895	0
-3.0	1.000	2.851	2.851	2.463	2.463	0
-4.0	0	2.851	2.663	2.851	2.345	-1.000
-5.0	2.320	3.507	3.796	1.636	2.463	1.416
-7.5	5.043	5.043	5.245	0	0	0
-10.0	8.460	7.817	7.568	-2.851	-3.354	-1.736
-15.0	13.539	8.557	8.465	-8.773	-8.855	-0.688
-20.0	14.926	7.400	7.144	-11.374	-11.449	-0.625
-30.0	17.372	6.054	5.760	-14.779	-15.000	-1.134
-40.0	14.779	3.796	2.663	-13.754	-14.264	-2.345
-50.0	11.519	0	0	-11.519	-11.519	0
-75.0	7.315	0	0	-7.315	-7.315	0
-100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 37. Difference in means statistics June, 1976, for right-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	-1.895	0	-1.895	0	2.246
0.5	1.000	-2.130	0.447	-2.345	0	2.663
1.0	1.416	-1.636	0	-2.130	-1.000	2.007
1.5	2.007	0	0.577	-1.636	-1.343	0.577
2.0	1.416	-0.816	-1.000	-1.416	-1.636	0
3.0	1.416	-2.130	-0.447	-2.545	-1.343	1.895
4.0	3.027	-1.388	0	-3.544	-2.733	1.667
5.0	3.934	-2.119	1.155	-4.588	-3.079	3.079
7.5	5.860	-3.184	0.632	-7.058	-5.660	3.934
10.0	7.980	-4.400	-0.816	-9.688	-8.302	4.324
15.0	12.455	-5.031	-1.134	-14.558	-12.887	4.206
20.0	16.358	-3.574	-0.816	-17.852	-16.052	4.916
30.0	15.673	-1.736	-0.500	-16.128	-15.824	1.416
40.0	13.537	-1.736	-1.000	-13.754	-13.681	1.000
50.0	11.230	-1.000	-1.000	-11.302	-11.302	0
75.0	7.652	0	0	-7.652	-7.652	0
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 38. Difference in means statistics June, 1976, for left-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	1.416	1.416	1.416	1.416	0
-0.5	1.000	2.007	2.007	1.736	1.736	0
-1.0	1.000	2.246	2.246	2.007	2.007	0
-1.5	1.416	2.463	2.463	2.007	2.007	0
-2.0	1.736	2.851	2.345	2.246	1.636	-1.000
-3.0	1.736	3.194	3.194	2.663	2.663	0
-4.0	1.736	3.354	3.354	2.851	2.851	0
-5.0	2.851	4.198	4.198	3.027	3.027	0
-7.5	5.137	6.338	6.338	3.507	3.507	0
-10.0	7.400	9.158	9.311	4.802	5.027	1.000
-15.0	12.598	14.337	14.337	5.027	5.027	0
-20.0	16.822	16.822	17.056	0	0.727	0.904
-30.0	17.934	12.313	11.807	-9.462	-9.989	-2.511
-40.0	14.045	6.614	6.614	-11.157	-11.157	0
-50.0	11.519	4.198	4.324	-10.281	-10.208	1.000
-75.0	7.125	1.000	1.000	-8.302	-8.302	0
-100.0	6.150	0	0	-6.150	-6.149	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 39. Difference in means statistics June, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	-1.000	0.816	-1.000	-1.000	2.246
0.5	1.000	-1.266	1.134	-1.510	0.816	2.663
1.0	1.416	-0.707	0.707	-1.266	0	2.007
1.5	1.343	0.577	1.000	-0.707	0.378	0.577
2.0	0.577	-0.378	-0.447	-0.632	-0.707	0
3.0	1.416	-1.667	0	-2.119	-0.816	1.896
4.0	2.545	-1.388	0	-3.184	-2.320	1.670
5.0	3.544	-2.119	1.155	-4.279	-2.691	3.079
7.5	5.571	-3.184	0.632	-6.801	-5.365	3.934
10.0	7.740	-4.400	-0.816	-9.466	-8.066	4.324
15.0	12.455	-5.031	-1.134	-14.558	-12.887	4.206
20.0	16.358	-3.574	-0.816	-17.852	-16.052	4.916
30.0	15.673	-1.736	-0.500	-16.128	-15.824	1.416
40.0	13.537	-1.736	-1.000	-13.754	-13.681	1.000
50.0	11.230	-1.000	-1.000	-11.302	-11.302	0
75.0	7.652	0	0	-7.652	-7.652	0
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 40. Difference in means statistics June, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	-1.000	0.816	-1.000	0.816	2.246
-0.5	1.000	0	1.416	-0.333	1.134	2.007
-1.0	1.000	0.904	1.903	0.632	1.670	1.736
-1.5	0.577	1.670	2.545	1.416	2.345	1.736
-2.0	0	2.119	2.545	2.345	2.545	0.577
-3.0	-0.378	2.320	2.733	2.511	2.910	1.000
-4.0	0	2.511	2.910	2.511	2.910	1.000
-5.0	1.510	4.198	4.198	3.507	3.507	0
-7.5	4.820	6.064	6.338	3.240	3.654	0.577
-10.0	7.151	9.158	9.311	4.916	5.137	1.000
-15.0	12.385	14.278	14.337	5.137	5.137	0
-20.0	16.144	16.365	16.596	0.301	0.943	0.904
-30.0	17.240	12.313	11.807	-8.809	-9.365	-2.511
-40.0	13.756	6.614	6.614	-10.732	-10.732	0
-50.0	11.446	4.198	4.324	-10.063	-9.989	1.000
-75.0	8.302	1.000	1.000	-8.222	-8.222	0
-100.0	6.054	0	0	-6.054	-6.054	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 41. Difference in means statistics July, 1976, for right-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	2.463	2.463	2.463	2.463	0
0.5	0	2.663	2.663	2.663	2.663	0
1.0	1.000	2.851	2.851	2.663	2.663	0
1.5	1.000	3.027	3.027	2.851	2.851	0
2.0	2.007	3.654	3.654	3.027	3.027	0
3.0	1.000	3.934	3.934	3.796	3.796	0
4.0	2.007	4.324	3.654	3.796	3.027	-2.246
5.0	2.851	4.568	3.796	3.507	2.463	-2.463
7.5	4.916	5.957	5.245	3.194	1.343	-2.663
10.0	7.652	8.381	7.652	3.027	0	-3.027
15.0	13.031	12.455	10.575	-2.545	-6.054	-5.245
20.0	15.976	12.383	10.211	-7.400	-9.613	-5.455
30.0	17.611	8.773	6.977	-12.671	-14.118	-4.568
40.0	14.191	4.687	3.395	-12.671	-13.247	-2.545
50.0	11.663	3.027	2.663	-11.012	-11.157	-1.416
75.0	8.061	0	0	-8.061	-8.061	0
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 42. Difference in means statistics July, 1976, for left-hand tail tests.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	0	0	0	0	0
-0.5	0	0	0	0	0	0
-1.0	0	1.000	1.000	1.000	1.000	0
-1.5	0	0	1.000	0	1.000	1.000
-2.0	0	0	0	0	0	0
-3.0	1.736	1.416	1.736	-1.000	0	1.000
-4.0	1.736	1.416	2.007	-0.577	1.000	1.416
-5.0	1.000	0.577	2.007	0	1.736	1.736
-7.5	4.687	3.026	4.916	-3.027	1.416	3.354
-10.0	7.899	4.472	7.899	-5.760	0	5.760
-15.0	14.411	6.231	12.598	-11.230	-4.932	9.386
-20.0	18.505	7.170	11.735	-14.631	-10.432	7.980
-30.0	16.900	3.654	6.431	-15.900	-14.045	4.932
-40.0	14.045	2.246	3.194	-13.681	-13.320	2.246
-50.0	11.951	1.416	2.246	-11.807	-11.591	1.736
-75.0	7.057	0	0	-7.057	-7.057	0
-100.0	6.054	0	0	-6.054	-6.054	0

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 43. Difference in means statistics July, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	2.463	2.463	2.463	2.463	0
0.5	0	2.663	2.663	2.663	2.663	0
1.0	1.000	2.851	2.851	2.663	2.663	0
1.5	1.000	3.027	3.194	2.851	3.027	1.000
2.0	2.007	3.654	3.796	3.027	3.194	1.000
3.0	1.000	4.067	4.067	3.934	3.934	0
4.0	1.343	4.324	3.654	3.934	3.194	-2.246
5.0	2.345	4.568	3.796	3.654	2.663	-2.463
7.5	4.916	5.957	5.245	3.194	1.343	-2.663
10.0	7.652	8.381	7.652	3.027	0	-3.027
15.0	13.031	12.455	10.575	-2.545	-6.054	-5.245
20.0	15.976	12.383	10.211	-7.400	-9.613	-5.455
30.0	17.611	8.773	6.977	-12.671	-14.118	-4.568
40.0	14.191	4.687	3.395	-12.671	-13.247	-2.545
50.0	11.663	3.027	2.663	-11.012	-11.157	-1.416
75.0	8.061	0	0	-8.061	-8.061	0
100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 44. Difference in means statistics July, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.463	2.463	2.463	2.463	0
-0.5	0	2.246	2.246	2.246	2.246	0
-1.0	0	2.463	2.463	2.463	2.463	0
-1.5	-1.736	1.416	1.736	2.246	2.463	1.000
-2.0	-1.736	1.416	1.000	2.246	1.895	0
-3.0	0.447	1.736	2.007	1.000	1.736	1.000
-4.0	0.447	1.416	2.007	0.447	1.736	1.416
-5.0	-0.577	0.577	2.007	0.816	2.246	1.736
-7.5	4.347	3.184	5.027	-2.119	2.007	3.354
-10.0	7.657	4.701	7.980	-4.922	0.707	5.469
-15.0	14.193	6.321	12.671	-10.806	-4.354	9.386
-20.0	17.786	7.170	11.735	-13.990	-9.812	7.980
-30.0	16.668	3.654	6.431	-15.676	-13.829	4.932
-40.0	13.829	2.246	3.194	-13.990	-13.105	2.246
-50.0	11.951	1.416	2.246	-11.807	-11.591	1.736
-75.0	7.057	0	0	-7.057	-7.057	0
-100.0	6.054	0	0	-6.054	-6.054	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 45. Difference in means statistics August, 1976, for right-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	2.663	2.663	2.663	2.663	0
0.5	1.000	3.027	3.027	2.851	2.851	0
1.0	1.416	3.354	3.354	3.027	3.027	0
1.5	0	3.507	3.354	3.507	3.354	-1.000
2.0	1.000	3.654	3.354	3.507	3.194	-1.416
3.0	2.851	4.324	4.198	3.194	3.027	-1.000
4.0	3.354	5.137	4.802	3.796	3.354	-1.736
5.0	3.194	5.245	4.802	4.067	3.507	-2.007
7.5	6.431	7.725	7.485	3.934	3.240	-1.736
10.0	7.400	8.695	7.980	4.067	2.119	-3.027
15.0	11.446	11.663	10.575	1.000	-3.240	-3.934
20.0	16.128	13.827	12.023	-5.760	-7.980	-5.137
30.0	16.900	10.208	8.539	-10.648	-12.239	-4.802
40.0	13.827	5.860	4.094	-11.519	-12.527	-3.796
50.0	11.302	3.354	2.545	-10.501	-10.721	-1.736
75.0	7.980	0	0	-7.980	-7.980	0
100.0	6.245	0	0	-6.245	-6.245	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 46. Difference in means statistics August, 1976, for left-hand tail tests.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	1.000	1.416	1.000	1.416	1.000
-0.5	0	1.000	1.416	1.000	1.416	1.000
-1.0	0	1.000	1.000	1.000	1.000	0
-1.5	0	0	1.000	0	1.000	1.000
-2.0	1.416	1.416	1.000	0	0	0
-3.0	1.000	1.000	2.007	0	1.736	1.736
-4.0	2.007	1.736	2.246	-1.000	1.000	1.416
-5.0	2.246	0.447	2.246	-2.007	0	2.007
-7.5	4.916	3.544	4.907	-2.733	0	3.027
-10.0	7.057	2.427	6.970	-5.860	-0.378	5.760
-15.0	13.754	4.111	9.688	-11.735	-7.980	7.322
-20.0	16.667	2.713	9.462	-15.523	-11.157	8.302
-30.0	18.176	3.544	5.660	-17.056	-15.825	4.067
-40.0	14.779	1.000	3.354	-14.705	-13.973	3.194
-50.0	11.084	0	0	-11.084	-11.084	0
-75.0	7.652	0	0	-7.652	-7.652	0
-100.0	6.150	0	0	-6.150	-6.150	0

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 47. Difference in means statistics August, 1976, for two tail tests with positive effects.

Effect %	Model Comparison[1] MI	MV	MZ	IV	IZ	VZ
0	0	3.027	2.851	3.027	2.851	1.000
0.5	1.000	3.026	3.194	2.851	3.027	1.000
1.0	1.416	3.354	3.654	3.027	3.354	1.416
1.5	0	3.079	3.507	3.079	3.507	0.577
2.0	1.000	3.240	3.507	3.079	3.354	0
3.0	2.345	3.962	4.198	3.194	3.194	0
4.0	3.345	5.137	4.802	3.796	3.354	-1.736
5.0	3.194	5.245	4.802	4.096	3.507	-2.007
7.5	6.431	7.735	7.485	3.934	3.240	-1.736
10.0	7.400	8.695	7.980	4.067	2.119	-3.027
15.0	11.446	11.663	10.575	1.000	-3.240	-3.934
20.0	16.128	13.827	12.023	-5.760	-7.980	-5.137
30.0	16.900	10.208	8.539	-10.648	-12.239	-4.802
40.0	13.827	5.860	4.094	-11.519	-12.527	-3.796
50.0	11.302	3.354	2.545	-10.501	-10.721	-1.736
75.0	7.980	0	0	-7.980	-7.980	0
100.0	6.245	0	0	-6.245	-6.245	0

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 48. Difference in means statistics August, 1976, for two tail tests with negative effects.

Effect %	Model Comparison[1]					
	MI	MV	MZ	IV	IZ	VZ
0	0	2.851	3.027	2.851	3.027	1.000
-0.5	0	2.663	2.851	2.663	2.851	1.000
-1.0	-1.416	2.246	2.246	2.663	2.663	0
-1.5	-1.416	1.416	1.736	2.007	2.246	1.000
-2.0	0.577	2.246	1.636	2.007	1.343	-0.577
-3.0	-0.577	1.416	2.246	1.736	2.463	1.736
-4.0	1.343	2.007	2.463	0.577	1.736	1.416
-5.0	1.636	0.816	2.463	-0.816	1.416	2.007
-7.5	4.916	3.688	5.027	-2.320	0.447	3.027
-10.0	6.801	2.427	6.970	-5.571	0	5.760
-15.0	13.754	4.218	9.688	-11.521	-7.980	7.083
-20.0	16.667	2.850	9.537	-15.300	-10.942	8.302
-30.0	17.934	3.544	5.660	-16.823	-15.600	4.067
-40.0	14.559	1.000	3.354	-14.486	-13.756	3.194
-50.0	10.868	0	0	-10.870	-10.870	0
-75.0	7.652	0	0	-7.652	-7.652	0
-100.0	6.150	0	0	-6.150	-6.150	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

value is greater than or equal to 1.96 (α = .05).

The order of the models listed in the column headings show how the comparisons were made. For example, IV means that I was the X_i variable and V was the Y_i variable in computing $D_i = X_i - Y_i$ (see Procedures, Part A). Thus, in Table 25, the difference in means statistic of 2.851 in the column IV and in the row of 0% effect implies that the probability of rejecting H_0^1 by I is significantly greater than the probability of rejecting H_0^1 by V. However, the difference in means statistic of -3.483 in the column IV and in the row of 10% effect implies that the probability of rejecting H_0^1 by V is significantly greater than the probability of rejecting H_0^1 by I.

In making power comparisons between two tests it is important that the true level of significance in the two tests be the same or at least nearly the same. Increasing the true α level increases the power of the test (Chou, 1969, Chapter 10). Thus, one test may appear more powerful than another test simply because the first test has a higher true α level than the second test.

The observed α levels for each of the models in this study was determined by examining the proportion of rejections of H_0^1 in the sample of 457 firms when the simulated effect was 0% (as defined in Procedures, Part A). These observed α levels were compared using the difference in means statistic to determine whether the true α levels of two models were significantly different from one another.

That is, H_0^2 was tested with $DR_{it}^* = 0$ as described in Procedures, Part A. The results of these comparisons are reported in Table 25 through Table 48 in the rows for 0% accounting policy decision effects.

All power and α level comparisons are summarized in Table 49 through Table 52. For models whose true α levels were not significantly different from each other, power comparisons were made at each level of simulated accounting policy decision effects. These power comparisons are classified into three categories based on the difference in means statistic: greater, less, and equal. The order of listing of the models in the comparison column of Table 49 through Table 52 tells how the power comparisons were made. For example, in comparison MI, the comparisons are reported as M has "greater" power than L; M has "less" power than I; and M and I have "equal" power.

For models whose true α levels were significantly different from each other (H_0^2 was rejected when $DR_{it}^* = 0$), power comparisons could be made at only certain levels of simulated accounting policy decision effects. Suppose model A had a significantly greater α level than model B. Then for simulated effects where model A had a significantly greater probability of rejecting H_0^1 than model B, the simulated effects are reported as not comparable in Table 49 through Table 52. However, if model B had a significantly greater probability of rejecting H_0^1 than model A, model B was considered more powerful. Similarly, if model

Table 49. Right-hand tail power comparisons.

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %: Not Comparable	Greater	Less	Equal
March	MI	0	No	-	1,3-100	-	.5,1.5,2
April	MI	0	No	-	3-100	-	.5,2
May	MI	0	No	-	3-100	-	.5,2
June	MI	0	No	-	1.5,4-100	-	.5,1,2,3
July	MI	0	No	-	2,4-100	-	.5,1.5,3
August	MI	0	No	-	3-100	-	.5,2
March	MV	0.0241	Yes	.5-50	-	-	75,100
April	MV	0.0209	Yes	.5-50	-	-	75,100
May	MV	0.0171	Yes	3-40	-	-	.5-2,50-100
June	MV	0.0226	No	-	-	.5,3,5-20	1-2,4,30-100
July	MV	0.0209	Yes	.5-50	-	-	75,100
August	MV	0.0225	Yes	.5-50	-	-	75,100
March	MZ	0.0224	Yes	.5-50	-	-	75,100
April	MZ	0.0209	Yes	.5-50	-	-	75,100
May	MZ	0.0171	Yes	.5,1,3-50	-	-	1.5,2,75,100
June	MZ	0.0172	No	-	-	-	.5-100
July	MZ	0.0209	Yes	.5-50	-	-	75,100
August	MZ	0.0225	Yes	.5-50	-	-	75,100
March	IV	0.0241	Yes	.5,1,2-4	-	10-100	1.5,5,7.5
April	IV	0.0209	Yes	.5-15	-	20-100	-
May	IV	0.0171	Yes	-	-	15-100	.5-10
June	IV	0.0226	No	-	-	.5,1,3-100	1.5,2
July	IV	0.0209	Yes	.5-10	-	15-100	-
August	IV	0.0225	Yes	.5-10	-	20-100	15

Table 49 (cont'd.)

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α level Significantly Different ?	Power Classification by Effect %: Not Comparable	Greater	Less	Equal
March	IZ	0.0224	Yes	.5-3	-	10-100	4-7.5
April	IZ	0.0209	Yes	.5-7.5	-	15-100	10
May	IZ	0.0171	Yes	.5,1,3,5,7.5	-	15-100	1.5,2,4,10
June	IZ	0.0172	No	-	-	4-100	.5-3
July	IZ	0.0209	Yes	.5-5	-	15-100	7.5,10
August	IZ	0.0225	Yes	.5-10	-	15-100	-
March	VZ	0.0086	No	-	7.5-20	-	.5-5,30-100
April	VZ	0	No	-	-	5,10-50	.5-4,7.5,75, 100
May	VZ	0	No	-	7.5-40	-	.5-5,50-100
June	VZ	0.0191	Yes	.5,1,5-20	-	-	1.5-4,30-100
July	VZ	0	No	-	-	4-40	.5-3,50-100
August	VZ	0	No	-	-	5,10-40	.5-4,7.5, 50-100

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 50. Left-hand tail power comparisons.

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %[2]			
				Not Comparable	Greater	Less	Equal
March	MI	0	No	-	4-100	-	.5-3
April	MI	0	No	-	4-100	-	.5-3
May	MI	0	No	-	5-100		.5-4
June	MI	0	No	-	5-100	-	.5-4
July	MI	0	No	-	7.5-100	-	.5-5
August	MI	0	No	-	4-100	-	.5-3
March	MV	0.0121	No	-	1-50	-	.5,75,100
April	MV	0	No	-	10-30	-	.5,7.5,15, 20,40-100
May	MV	0.0086	No	-	3-40	-	.5-2,50-100
June	MV	0.0121	No	-	.5-50	-	75,100
July	MV	0	No	-	7.5-40	-	.5-5,50-100
August	MV	0.0086	No	-	7.5-30	-	.5-5,40-100
March	MZ	0.0121	No	-	1,1.5,3-50	-	.5,2,75,100
April	MZ	0.0086	No	-	3-40	-	.5-2,50-100
May	MZ	0	No	-	3-40	-	.5-2,50-100
June	MZ	0.0121	No	-	.5-50	-	75,100
July	MZ	0	No	-	4-50	-	.5-3,75,100
August	MZ	0.0121	No	-	3-40	-	.5-2,50-100
March	IV	0.0121	No	-	1,1.5,3-5	15-100	.5,2,7.5,10
April	IV	0	No	-	-	5-100	.5-4
May	IV	0.0086	No	-	4	10-100	1-3,5,7.5
June	IV	0.0121	No	-	1-15	30-100	.5,20
July	IV	0	No	-	-	7.5-100	.5-5
August	IV	0.0086	No	-	-	5-100	.5-4

Table 50 (cont'd.)

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %[2]			
				Not Comparable	Greater	Less	Equal
March	IZ	0.0121	No	-	1,1.5,3-10	15-100	.5,2
April	IZ	0.0086	No	-	4-5	10-100	.5-3,7.5
May	IZ	0	No	-	5	10-100	.5-4,7.5
June	IZ	0.0121	No	-	1,1.5,3-15	30-100	.5,2,20
July	IZ	0	No	-	-	15-100	.5-10
August	IZ	0.0121	No	-	-	15-100	.5-10
March	VZ	0	No	-	10,15	-	.5-7.5,20-100
April	VZ	0.0086	No	-	3-40	-	.5-2,50-100
May	VZ	0.0086	No	-	-	40	.5-30,50-100
June	VZ	0	No	-	-	30	.5-20,40-100
July	VZ	0	No	-	7.5-40	-	.5-5,50-100
August	VZ	0.0086	No	-	5-40	-	.5-4,50-100

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

[2]All effects are negative.

Table 51. Two tail power comparisons--positive effects.

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %: Not Comparable	Greater	Less	Equal
March	MI	0	No	-	1,3-100	-	.5,1.5,2
April	MI	0	No	-	3-100	-	.5-2
May	MI	0	No	-	4-100	-	.5-3
June	MI	0	No	-	4-100	-	.5-3
July	MI	0	No	-	2,5-100	-	.5-1.5,3-4
August	MI	0	No	-	3-100	-	.5-2
March	MV	0.0269	YES	.5-50	-	-	75,100
April	MV	0.0226	No	-	.5-50	-	75,100
May	MV	0.0191	YES	.5,2-40	-	-	1,1.5,50-100
June	MV	0.0257	No	-	-	5-20	.5-4,30-100
July	MV	0.0209	YES	.5-50	-	-	75,100
August	MV	0.0241	YES	.5-50	-	-	75,100
March	MZ	0.0255	YES	.5-50	-	-	75,100
April	MZ	0.0209	YES	.5-50	-	-	75,100
May	MZ	0.0171	YES	.5-1.5,3-50	-	-	2,75,100
June	MZ	0.0210	No	-	-	-	.5-100
July	MZ	0.0209	YES	.5-50	-	-	75,100
August	MZ	0.0255	YES	.5-50	-	-	75,100
March	IV	0.0269	YES	.5-4	-	10-100	5,7.5
April	IV	0.0226	No	-	.5-15	20-100	-
May	IV	0.0191	YES	.5	-	15-100	1-10
June	IV	0.0257	No	-	-	3-100	.5-2
July	IV	0.0209	YES	.5-10	-	15-100	-
August	IV	0.0241	YES	.5-10	-	20-100	15

Table 51 (cont'd.)

Month (1976)	Comparison	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %: Not Comparable	Greater	Less	Equal
March	IZ	0.0255	YES	.5-3	-	10-100	4-7.5
April	IZ	0.0209	YES	.5-7.5	-	15-100	10
May	IZ	0.0171	YES	.5-7.5	-	15-100	10
June	IZ	0.0210	No	-	-	4-100	.5-3
July	IZ	0.0209	YES	.5-5	-	15-100	7.5,10
August	IZ	0.0255	YES	.5-10	-	15-100	-
March	VZ	0.0086	No	-	7.5-20	-	.5-5,30-100
April	VZ	0.0086	No	-	-	5,10-50	.5-4,7.5, 75,100
May	VZ	0.0086	No	-	7.5-40	-	.5-5,50-100
June	VZ	0.0191	YES	.5,1,5-20	-	-	1.5-4,30-100
July	VZ	0	No	-	-	4-40	.5-3,50-100
August	VZ	0.0086	No	-	-	5,10-40	.5-4,7.5, 50-100

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 52. Two tail power comparisons--negative effects.

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %[2] Not Comparable	Greater	Less	Equal
March	MI	0	No	-	7.5-100	-	.5-5
April	MI	0	No	-	7.5-100	-	.5-5
May	MI	0	No	-	5-100	-	.5-4
June	MI	0	No	-	7.5-100	-	.5-5
July	MI	0	No	-	7.5-100	-	.5-5
August	MI	0	No	-	7.5-100	-	.5-5
March	MV	0.0269	YES	.5-50	-	-	75,100
April	MV	0.0226	No	-	10	-	.5-7.5,15-100
May	MV	0.0191	YES	.5-40	-	-	50-100
June	MV	0.0257	No	-	2-50	-	.5-1.5,75,100
July	MV	0.0209	YES	.5,1,7.5-40	-	-	1.5-5,50-100
August	MV	0.0241	YES	.5,1,2,4,7.5-30	-	-	1.5,3,5,40-100
March	MZ	0.0255	YES	.5-50	-	-	75,100
April	MZ	0.0209	YES	.5-1.5,3-40	-	-	2,50-100
May	MZ	0.0171	YES	.5-40	-	-	50-100
June	MZ	0.0210	No	-	1.5-50	-	.5,1,75,100
July	MZ	0.0209	YES	.5,1,3-50	-	-	1.5,2,75,100
August	MZ	0.0255	YES	.5,1,3-40	-	-	1.5,2,50-100
March	IV	0.0269	YES	.5-10	-	15-100	-
April	IV	0.0226	No	-	-	7.5-100	.5-5
May	IV	0.0191	YES	.5-1.5,3,4	-	10-100	2,5,7.5
June	IV	0.0257	No	-	2-15	30-100	.5-1.5,20
July	IV	0.0209	YES	.5-2	-	7.5-100	3-5
August	IV	0.0241	YES	.5-2	-	7.5-100	3-5

Table 52 (cont'd.)

Month (1976)	Comparison[1]	Length of 95% Confidence Interval	α Level Significantly Different ?	Power Classification by Effect %[2]: Not Comparable	Greater	Less	Equal
March	IZ	0.0255	YES	.5-10	-	20-100	15
April	IZ	0.0209	YES	.5-1.5,3-5	-	10-100	2,7.5
May	IZ	0.0171	YES	.5-1.5,3-5	-	10-100	2,7.5
June	IZ	0.0210	No	-	1.5-15	30-100	.5,1,20
July	IZ	0.0209	YES	.5-1.5,5, 7.5	-	15-100	2-4,10
August	IZ	0.0255	YES	.5-1.5,3	-	15-100	2,4-10
March	VZ	0.0086	No	-	10,15	-	.5,7.5,20-100
April	VZ	0.0086	No	-	5-40	-	.5-4,50-100
May	VZ	0.0086	No	-	-	40	.5-30,50-100
June	VZ	0.0191	YES	.5	-	30	1-20,40-100
July	VZ	0	No	-	7.5-40	-	.5-5,50-100
August	VZ	0.0086	No	-	5-40	-	.5-4,50-100

[1] M = market model; I = market model with 50% index effect: V = valuation model; Z = zero model.

[2] All effects are negative.

B did not have a significantly different probability of rejecting H_0^1 than model A, the power of model B was considered equivalent to that of model A. For example, examine the IV comparison for March, 1976, in Table 49. I had a significantly greater α level than V. However, V was considered more powerful than I for the simulated effect levels of 10 to 100%.

Also reported in Table 49 through Table 52 is the length of the 95% confidence interval for the difference in the true α levels. The largest confidence interval for α levels which were not significantly different has length 2.574% (MV and IV comparisons in two tail tests for June). Most of the confidence intervals for α levels which were not significantly different have length less than 1% Thus, for α levels which were not significantly different, the true α levels appear sufficiently close to make valid power comparisons at all levels of simulated accounting policy decision effects.

Examination of Table 49 reveals that in right-hand tail tests, M has significantly more power than I when the accounting policy decision effect is as small as 1% per firm (see March) and M has significantly greater power than I in every event month at accounting policy decision effect levels of $\geq$ 4%. Thus, a 50% market index effect can have a significant impact on the detection of even small accounting policy decision effects.

V has significantly more power than M for certain simulated effect levels for June, 1976. But, for the most part, power comparisons could not be made between V and M.

V has significantly more power than I when the accounting policy decision effect is as small as .5% per firm (see June) and V has significantly greater power than I in every event month at accounting policy decision effect levels of ≥ 20%. This is true even though I has a significantly greater true α level than V in every event month except June.

While Z and M have equal power in the one event month in which all simulated effect levels could be compared (see June), Z has significantly greater power than I when the accounting policy decision effect is as small as 4%. Z has significantly greater power than I in every event month at accounting policy decision effect levels ≥ 15%. As with V, this is true even though I has a significantly greater true α level in five of the six event months.

Finally, comparisons of V and Z reveal that one model is not clearly more powerful than the other model.

Examination of Table 51 for positive effects in two tail tests leads to observations similar to those made for right-hand tail tests. The one major difference being in comparisons between M and V. Now, M has significantly more power V for certain simulated effect levels for April, 1976, while V still has significantly more power than M for certain simulated effect levels for June, 1976. Thus, the dominance of one model over the other is not established in a two tail test.

Examination of Table 50 reveals that in left-hand tail tests, M has significantly more power than I when the accounting policy decision effect is as small as $|-4\%|$ per firm and M has significantly greater power than I in every event month at accounting policy decision effect levels of $|-7.5\%|$. M is more powerful than V or Z for certain simulated levels of accounting policy decisions in every event month examined.

As with the right-hand tail tests, both V and Z exhibit more power than I for sufficiently large effects in absolute value in every event month. However, there do exist occurences of I exhibiting more power than V and Z at some of the smaller simulated effect levels in absolute value for some of the event months. Finally, V tends to be more powerful than Z in left-hand tail tests.

Examination of Table 52 for negative effects in two tail tests leads to observations similar to those for left-hand tail tests although fewer comparisons can be made. That is, M tends to be more powerful than I, V, or Z. V and Z are more powerful than I for sufficiently large effects in absolute value in every event month. V tends to be more powerful than Z.

The implications for an accounting researcher of the results of this study at this point are the following. In right-hand tail tests both V and Z are more powerful than I based on the one month (June) in which the true α

levels of the models were not significantly different from one another. This conclusion is supported by the other five event months in which V and Z had smaller true α levels than I. In these months V and Z were still more powerful than I for a wide range of accounting policy decision effects. There are too few power comparisons to choose between M and V or M and Z. An accounting researcher could use V or Z since they seem to have about the same power in right-hand tail tests.

In left-hand tail tests I is more powerful than both V and Z when the accounting policy decision effect is less than about $|-5\%|$. V seems more powerful than I for accounting policy decision effects greater than about $|-5\%|$. Z seems more powerful than I for accounting policy decision effects greater than about $|-10\%|$. V is more powerful than Z while M is more powerful than both V and Z.

In two tail tests both V and Z are more powerful than I for accounting policy decision effects larger than about $|15\%|$. This is true even though I has a significantly larger true α level than V in four of the six months (except April and June) and I has a significantly larger true α level than Z in five of the six months (except June). There are not clear conclusions regarding other power comparisons.

B. Levels of Significance

Examination of Tables 1 through 24 reveals that many of the observed levels of significance are significantly different from the specified levels of significance. For one tail tests if the number of rejections of H_0^1 when $\tilde{DR}_{it} = 0$ for all i falls between 4.88 and 17.97, the observed level of significance is not significantly different from .025. For two tail tests, if the number of rejections of H_0^1 when $\tilde{DR}_{it} = 0$ for all i fall between 13.72 and 31.98, the observed level of significance is not significantly different from .05. These calculations are based on the normal approximation to the binomial distribution ($\alpha = .05$).

Table 53 summarizes the number of event months in which the observed α level is not significantly different from the specified α level. Only the observed α levels for the market model in a right-hand tail test tend to correspond to the specified α levels. Further, in every case in which the observed α levels are significantly different from the specified α levels, the observed α levels are significantly smaller than the specified α levels. Hence, the individual firm t-tests tend to be conservative in terms of the true levels of significance. However, conservative levels of significance make it more difficult to reject the null hypothesis since there is a direct relationship between the level of significance and the power of the test. Hence, it is desirable to obtain the specified α levels in actual tests.

The α adjustment procedure (described in Procedures, Part B) was applied to each event month in this study

Table 53. Observed vs. specified α levels.

Model[1]	Number of cases out of 6 in which the observed α level is not significantly different from the specified α level Right-hand Tail	Left-hand Tail	Two Tail
M or I	5	0	1
V	2	0	1
Z	2	0	0

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 54. Adjusted vs. specified α levels.

Model[1]	Number of cases out of 6 in which the adjusted α level is not significantly different from the specified α level Right-hand Tail	Left-hand Tail	Two Tail
M or I	5	6	5
V	4	4	4
Z	4	4	4

[1] M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

using the other five event months to compute the average α adjustment factor. Table 54 summarizes the number of event months in which the adjusted α level is not significantly different from the specified α levels. While the adjustment procedure is not 100% effective, it does considerably better in obtaining the specified α levels than when the levels are not adjusted.

Tables 55 and 56 report respectively the average number of rejections of H_0^1 when $\tilde{DR}_{it} = 0$ for all i over the six event months when the α levels are not adjusted and when α levels are adjusted. Recall that for the right and left-hand tail tests the number of rejections of the null hypothesis at a specified α level of .025 should be about 11. For a two tail test the number of rejections of the null hypothesis at a specified α level should be about 23. In every case reported in Tables 55 and 56 the average of the number of rejections is closer to the proper number when the α levels are adjusted than when the α levels are not adjusted.

Hence, on average the α level adjustment procedure does better in obtaining the specified α levels than not adjusting the α levels. However, there are periods in which the observed α level after adjustment was significantly different from the specifed α level. Further, unlike the unadjusted α levels, the true α level after adjustment may be unconservative. There are six occurrences of unconservative α levels in right and left-hand

Table 55. Average number of rejections -- α levels not adjusted.

Model[1]	Right-hand Tail	Left-hand Tail	Two Tail
M or I	9.67	1.50	11.17
V	5.33	0.67	6.00
Z	4.67	0.50	5.17

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

Table 56. Average number of rejections -- α levels adjusted.

Model[1]	Right-hand Tail	Left-hand Tail	Two Tail
M or I	10.50	12.00	22.50
V	13.50	12.50	26.00
Z	13.00	13.50	26.50

[1]M = market model; I = market model with 50% index effect; V = valuation model; Z = zero model.

tail tests. The observed rejections of the null hypothesis in these cases were: 38, 32, 29, 23, 20, and 20.

There are two implications for an accounting researcher. First, for all the models examined in this study, the true α levels tend to be smaller than the specified α levels. Conservative α levels make it more difficult to reject H_0^1. Second, on average the α adjustment procedure described in this study will approximate the specified α level although there may be occurrences of unconservative true α levels.

C. Market Index Effects

The purpose of this section is to determine the magnitude of market index effects which make the valuation and zero models as powerful as the market model. The method of analysis is explained in Part C of Procedures.

Table 57 reports the average standard errors of the 457 firms. Also reported in Table 57 are the corresponding critical values, i.e., the size in absolute value (the t distribution is symmetric) of the accounting policy decision effect which would be required to just reject H_0^1. Table 58 reports, using the average critical values for the six event months, how large the market index effect would have to be in order for the valuation or zero model to be equally effective in detecting DR_{it}.

For hypothetical firms with $b_i \geq 1.00$, the valuation model is more effective than the market model when the

Table 57. Average standard errors and corresponding critical values.

Month (1976)	Average Standard Errors[1]			Critical Values[1]		
	M	V	Z	M	V	Z
March	0.0879	0.1088	0.1110	0.1759	0.2179	0.2221
April	0.0879	0.1088	0.1110	0.1760	0.2179	0.2221
May	0.0879	0.1090	0.1110	0.1761	0.2182	0.2221
June	0.0881	0.1087	0.1110	0.1764	0.2177	0.2221
July	0.0879	0.1086	0.1110	0.1759	0.2177	0.2221
August	0.0879	0.1086	0.1110	0.1760	0.2175	0.2221
6-month Average	0.0879	0.1087	0.1110	0.1760	0.2178	0.2221

[1]M = market model; V = valuation model; Z = zero model.

Table 58. Market index effects--α levels not adjusted.

b_i	The size of p_i which makes the valuation or zero model as powerful as the market model for hypothetical firms	
	Valuation	Zero
0.25	0.7673	0.8294
0.50	0.3836	0.4147
0.75	0.2558	0.2765
1.00	0.1918	0.2074
1.25	0.1534	0.1659
1.50	0.1279	0.1382
1.75	0.1096	0.1185
2.00	0.0959	0.1037

index effect is greater than or equal to about 19.2%. Similarly, the zero model is more effective than the market model when the index effect is greater than or equal to about 20.7%. Implicit in the comparisons in Table 57 and Table 58 is that each model has the same α level. Based on the empirical results of Part A of Results, the market model tends to have a higher α level than both the valuation and the zero model. Hence, the results are slightly biased in favor of the market model.

It is interesting to look at these comparisons when the α levels are nearly the same. This is accomplished by adjusting the critical values listed in Table 57 for the average α adjustment factor over the six event months. The average α adjustment factors are listed in Table 59. Recall that the α adjustment factor is that amount which would need to be added to each firm's abnormal return to observe 11 rejections out of 457 firms when the simulated accounting policy decision effect is zero.

Table 60 reports the average critical values with the α levels adjusted. While the market model is still the most powerful, its advantage over the other two models has been significantly reduced. Also, the valuation model is more powerful than the zero model in right-hand tail tests and less powerful in left-hand tail tests.

The left-hand tail results for the valuation and zero model are the opposite of the findings of Part A of Results. Recall that the results here are based only

Table 59. Average α adjustment factors over 6 months.

Model	Right-hand Tail	Left-hand Tail
market	0.0025	-0.0422
valuation	0.0367	-0.0663
zero	0.0353	-0.0809

Table 60. Average critical values--α levels adjusted.

Model	Right-hand Tail	Left-hand Tail
market	0.1736	-0.1337
valuation	0.1812	-0.1515
zero	0.1868	-0.1412

Table 61. Market index effects--α levels adjusted.

b_i	The size of p_i which makes the valuation or zero model as powerful as the market model for hypothetical firms			
	Right-hand Tail		Left-hand Tail	
	Valuation	Zero	Valuation	Zero
0.25	0.1674	0.2835	0.4696	0.2112
0.50	0.0837	0.1418	0.2348	0.1056
0.75	0.0558	0.0945	0.1565	0.0704
1.00	0.0419	0.0709	0.1174	0.0528
1.25	0.0335	0.0567	0.0939	0.0422
1.50	0.0279	0.0472	0.0783	0.0352
1.75	0.0239	0.0405	0.0671	0.0302
2.00	0.0209	0.0354	0.0587	0.0264

on a hypothetical average firm. Further, the shape of distribution of the abnormal returns has been removed from this analysis. These comments also apply to comparisons between the market model and the other models.

In any case, the size of the index effect which would make the valuation models and zero models equally effective has been reduced after taking into account the α levels as reported in Table 61. Thus, for hypothetical firms with $b_i \geq 1.00$, the valuation model is more effective than the market model when the index effect is greater than or equal to about 4.2% in right-hand tail tests and 11.7% in left-hand tail tests. Similarly, the zero model becomes more effective than the market model when the index effect is greater than or equal to about 7.1% in right-hand tail tests and about 5.3% in left-hand tail tests. The implication for an accounting researcher is that for firms with $b_i \geq 1.00$ both the valuation model and zero model can be more powerful than the market model for relatively small index effects.

D. Testing Samples of Firms

There are several questions which tests on individual firms can answer but tests on sample of firms cannot answer. Individual firm tests can reveal which firms were affected by an accounting policy decision. Examining the affected firms can lead to a greater understanding of the information preferences of investors. Individual firm tests can reveal how many firms were affected by an accounting policy decision as noted by Lev (1979, p. 498). Individual firm tests can detect accounting policy decisions effects whose average effect in a sample of firms is zero. Individual firm tests can detect effects of accounting policy decisions on a small number of firms which would escape detection in examining the average accounting policy decision effect in a large number of firms. However, testing samples of firms is common in accounting literature and was examined in part in this study.

Table 62 shows the average mean absolute prediction error and the average mean square prediction error for the three models during two different time periods. The average MAPE and average MSPE are based upon two different random samples of 20 firms each. Each model was used to predict the monthly returns of the firms for the specified time periods. The market model and valuation model were estimated over the 60 month period immediately preceding the six month prediction period. The market model is the best predictor although the valuation model and zero model do not predict a great deal worse. Appendix B discusses numerous other models which were used to predict firm returns. None of the models in Appendix B do significantly better than the valuation model.

Table 63 shows the average prediction errors and their standard errors for the sample of 457 firms used in the individual firm t-tests. The average prediction errors

Table 62. Predictive ability, average of 20 firms.

Model	MAPE 10/72-3/73	MAPE 10/69-3/70	MSPE 10/72-3/73	MSPE 10/67-3/70
market	0.0662	0.0578	0.0085	0.0059
zero	0.0738	0.0669	0.0095	0.0076
valuation	0.0713	0.0697	0.0089	0.0079

Table 63. Average and standard error of prediction errors.

Month (1976)	Market Model Average	Market Model Standard Error	Valuation Model Average	Valuation Model Standard Error	Zero Model Average	Zero Model Standard Error
March	0.0109	0.0042	0.0222	0.0042	0.0222	0.0041
April	0.0014	0.0037	-0.0367	0.0039	-0.0107	0.0038
May	-0.0017	0.0032	-0.0092	0.0033	-0.0170	0.0033
June	0.0080	0.0038	0.0598	0.0039	0.0541	0.0038
July	-0.0006	0.0034	-0.0207	0.0035	0.0012	0.0033
August	0.0014	0.0033	-0.0298	0.0033	-0.0093	0.0033

of the market models tended to be considerably smaller than the average prediction errors of the valuation and the zero models. However, the standard errors of all the models are about the same which is consistent with the models having about the same predictive power.

Table 64 reports the (T-1) statistics for each of the models. At a level of significance of .05 in a two tail test, a t-ratio of greater than or equal to 1.96 causes the null hypothesis to be rejected. All the models tended to reject the null hypothesis too often since the probability of observing two or more rejections at a level of significance of .05 in a sample of six is .0328 based on the binomial distribution and assuming that the six samples are independent (Conover, 1971, p. 368).

Table 65 reports the (T-2) statistics for each of the models. The statistic was computed for each event month by using the average prediction errors of the other five event months to compute the denominator. In this case, the number of rejections is not too many since the probability of observing one rejection is .2321 and for no rejections it is .7351 (Conover, 1971, p. 368). The critical t-value is 2.571 at a level of significance of .05 with five degrees of freedom (Neter and Wasserman, 1974, p. 805). Although the power of the models cannot be assessed since the level of significance cannot be determined in such a small number of trials, the market model would appear to have the greatest power since the denominators of its

Table 64. (T-1) values.

Month (1976)	Market Model	Valuation Model	Zero Model
March	2.6005	5.2905	5.3922
April	0.3877	-9.5130	-2.8435
May	-0.5155	-2.8055	-5.1511
June	2.0864	15.4393	14.0597
July	-0.1599	-5.9226	0.3664
August	0.4202	-8.9222	-2.8476

Table 65. (T-2) values.

Month	Market Model		Valuation Model		Zero Model	
(1976)	Denominator	(T-2)	Denominator	(T-2)	Denominator	(T-2)
March	0.0038	2.8910	0.0356	0.6250	0.0262	0.8510
April	0.0061	0.2373	0.0331	-1.1107	0.0276	-0.3886
May	0.0061	-0.2721	0.0367	-0.2516	0.0269	-0.6329
June	0.0050	1.5940	0.0255	2.3459	0.0141	3.8472
July	0.0061	0.0896	0.0357	-0.5783	0.0280	0.0436
August	0.0061	0.2242	0.0344	-0.8658	0.0277	-0.3373

(T-2) statistic are by far the smallest.

Examination of Table 63 reveals that the reason that the denominators of the market model's (T-2) statistics are relatively small compared with the other models' (T-2) statistics is that the average prediction errors of the market model are relatively small compared with the other models' average prediction errors. These observations led to Theorem 1 (see Introduction). The essence of the proof of Theorem 1 is that in a representative sample of firms, the average accounting policy decision effect in the sample is the same on average as the average accounting policy decision effect in the market index times the average β_i in the sample of firms which is 1. These terms cancel each other out removing the entire accounting policy decision effect from the average abnormal return.

This theorem is important, as stated in Corollary 1.1, to individual firm tests which employ the market model. The importance of Corollary 1.1 is that it holds when firm returns are affected by an accounting policy decision in one direction.

The proof of the theorem also explains why one would expect the average prediction errors of the market model to be small. In a representative sample of n firms from a population of N firms, $\frac{1}{n}\sum_{i=1}^{n} WR_i \simeq \frac{1}{N}\sum_{j=1}^{N} WR_j\left(\frac{1}{n}\sum_{i=1}^{n} b_i\right)$.
The tendency of the average prediction errors to be greater than zero in Table 56 can be explained in part by

the fact $\frac{1}{457}\sum_{i=1}^{457} b_i = .917$. Having an average $b_i < 1$ is not surprising given the data requirements. One would expect that those firms which do not survive on the New York Stock Exchange very long also would tend to be the riskier firms whose β_i's would tend to be greater than one. Note that with an average b_i of about .9, only about 10% of the accounting policy decision effect would appear in the abnormal return (subject to how representative the sampled firms are of the population as a whole).

Theorem 1 and Corollary 1.1 are important to those accounting researchers who may examine a representative sample of firms from the New York Stock Exchange (NYSE). Accounting researchers may wish to examine a representative sample of firms when an accounting policy decision affects all firms on the NYSE such as Accounting Principles Board Opinion No. 15 Earnings Per Share (AICPA, 1980). Theorem 1 and Corollary 1.1 state conditions where the market model will not generally aid in the detection of the effects of those accounting policy decisions which affect firm stock returns in one direction.

SUMMARY AND CONCLUSIONS

The primary purpose of this study is to compare the power of three models in detecting the effects of accounting policy decisions on individual firm common stock returns. The three models are the market model, the valuation model, and the zero model.

The problem inherent in models which contain a stock market index such as the market model is that the stock market index may be affected by an accounting policy decision. A major objective of this study is to try to retain the entire effect of an accounting policy decision in a firm's abnormal return. Hence, the market model is examined when the market index is affected by DR as well as when the market index is not affected by DR. In the simulations in this study, the market index effect is 50%. The equally weighted index is used in both forms of the market model.

The power comparisons in this study are based on a simulation procedure similar to that used by Brown and Warner (1980). The simulation procedure is performed by adding an artifical accounting policy decision effect, DR, to actual firm stock returns for a randomly selected set of months. Abnormal firm returns are examined statistically to determine which model can best detect the presence of the artificial accounting policy decision effect.

The implications for an accounting researcher of the simulation results are the following. In right-hand tail tests both the valuation and zero models are more powerful than the market model with a 50% index effect. In left-hand tail tests the market model with a 50% index effect is more powerful than both the valuation and zero models when the accounting policy decision effect is less than about |-5%|. The valuation model seems more powerful than the market model with a 50% index effect for accounting policy decision effects greater than about |-5%| in left-hand tail tests. The zero model seems more powerful than the market model with a 50% index effect for accounting policy decision effects greater than about |-10%|. In two tail tests both the valuation and zero models are more powerful than the market model for accounting policy decision effects larger than about |15%|.

The valuation model is more powerful than the zero model in left-hand tail tests. The market model without an index effect is more powerful than both the valuation and zero models in left-hand tail tests. There are no clear conclusions regarding other power comparisons.

The results of this study show that for all the models the true levels of significance tend to be conservative in tests of H_0^1. Hence, accounting researchers may wish to adjust the levels of significance. One method of adjusting levels of significance is described which does better than not adjusting levels of significance in achieving the specified levels of significance.

For hypothetical average firms with $b_i \geq 1$, the valuation model becomes more powerful than the market model when the index effect reaches a level of about 19%. For this same hypothetical firm, the zero model becomes more powerful than the market model when the index effect reaches a level of about 21%. After adjusting for levels of significance, the valuation model becomes more powerful than the market model when the market index effect reaches a level of about 4% in right-hand tail tests and 12% in left-hand tail tests. For the zero model the comparable percentages are 7% in a right-hand tail test and 5% in a left-hand tail test. The implication for an accounting researcher is that for firms with $b_i \geq 1.00$ both the valuation model and zero model can be more powerful than the market model for relatively small index effects.

Theorem 1 shows that on average the effects of an accounting policy decision cannot be detected in a representative sample of firms by examining the average abnormal return of the sample when employing the market model with an equally weighted index.

Corollary 1.1 shows that in a representaive sample of firms, examination of abnormal returns in individual firm tests based on the market model, with an equally weighted index based on the population, is equivalent to trying to detect a quantity which on average is zero in the sample of firms. The importance of Corollary 1.1 is that it holds when firm returns are affected by accounting policy decision effects in one direction.

The overall results of this study lead to the following comments for an accounting researcher who is interested in detecting the effects of accounting policy decisions on stock returns. There is little chance of detecting accounting policy decision effects which occur in one direction in representative samples of firms when using the market model.

The market model seems to be the best choice of the models examined in this study when market index effects are expected to be very small. There is no conclusive evidence in this study which shows that the zero or valuation models are more powerful than the market model without an index effect. Perhaps the best single comparison of the market model with the other models is based on Table 60. The market model has the smallest critical values for both right and left-hand tail tests with the α levels adjusted. Yet, the advantage of the market model with respect to the critical values over the zero and valuation models is small as can be seen in Table 60. Thus, the zero and valuation models become more powerful than the market model for relatively small index effects as can be concluded from examining Table 61.

Market index effects are more important with respect to power for firms with larger b_i's. Examination of Table 61 suggests that an accounting researcher might consider using the market model for firms with smaller b_i's and the valuation or zero model for firms with larger b_i's. An even more sophisticated approach would be to compute both a market model and (say) a valuation model for a given firm and then use that model which would be more powerful on average after taking into account the denominators of the t-ratios, the degrees of freedom, the α adjustment factors, b_i, and the likely size of the market index effect.

There is need to improve models used to detect accounting policy decision effect on individual firms. For the market model without an index effect and with the α levels adjusted to about .025, an accounting policy decision effect would have to be about 17.4% or larger to be detected in a right-hand tail test and |-13.4%| or larger to be detected in a left-hand tail test for the average firm (see Table 60). Until improvement in models is accomplished, many accounting policy decision effects may not be detected in individual firm tests applied on a monthly basis.

If models cannot be easily improved with respect to power, perhaps an accounting researcher should try to suggest accounting policies to policy makers whose effects on stock returns could be detected. That is, perhaps an accounting researcher's time would be better spent by taking a more direct role in developing accounting policies which would have significant meaning to investors.

In any event, for market index effects as large as 50%, the valuation model and zero model are more powerful than the market model in right-hand tail tests. Further, they are more powerful than the market model with a 50% index effect for larger accounting policy decision effects in left-hand tail tests and in two tail tests.

Thus, both the valuation and zero models should aid in the detection of accounting policy decision effects. Improvement in detecting the effects of accounting policy decisions should provide additional feedback to members of policy making organizations.

APPENDICES

APPENDIX A-PROOFS

__Lemma 1__. Let p_i be the ratio of the average accounting policy decision effect on the returns of those firms comprising the market index to the non-zero accounting policy decision effect on the return of firm i. Let b_i be the estimate of β_i, the coefficient of the market index in the market model for firm i. Then, $b_i p_i = 1$ implies that the abnormal return for firm i contains zero accounting policy decision effect. This lemma applies as well to a value weighted index.

__Proof__. Let $\tilde{R}_{it} = \tilde{DR}_{it} + \tilde{WR}_{it}$

where: $\tilde{R}_{it}$ = return of firm i in month t;

$\tilde{DR}_{it}$ = return of firm i in month t due to an accounting policy decision;

$\tilde{WR}_{it}$ = return of firm i in month t due to all causes except the accounting policy decision.

The market model is:

$$\tilde{R}_{it} = \alpha_i + \beta_i \tilde{R}_{mt} + \tilde{\varepsilon}_{it}$$

where: $\tilde{R}_{mt} = \frac{1}{N} \sum_{j=1}^{N} \tilde{R}_{jt}$;

N = the number of firms in the market index;

$\tilde{\varepsilon}_{it}$ = the error term of firm i in month t;

α_i = intercept coefficient;

β_i = slope coefficient.

The predicted return of firm i in month t using the market model is:

$$\tilde{P}_{it} = a_i + b_i\tilde{R}_{m0}$$

where; a_i = the estimate of α_i;

b_i = the estimate of β_i.

Let the accounting policy decision effect take place in month 0. Then the abnormal return for firm i in month 0, $\tilde{A}_{i0}$, is:

$$\tilde{A}_{i0} = \tilde{R}_{i0} - \tilde{P}_{i0}.$$

Substituting for $\tilde{R}_{i0}$ and $\tilde{P}_{i0}$ using the expressions from above gives:

$$\tilde{A}_{i0} = \tilde{DR}_{i0} + \tilde{WR}_{i0} - a_i - b_i\tilde{R}_{m0}.$$

$\tilde{R}_{m0}$ can be written as:

$$\tilde{R}_{m0} = \frac{1}{N}\sum_{j=1}^{N}\tilde{R}_{j0} = \frac{1}{N}\sum_{j=1}^{N}(\tilde{DR}_{j0} + \tilde{WR}_{j0})$$

$$= \frac{1}{N}\sum_{j=1}^{N}\tilde{DR}_{j0} + \frac{1}{N}\sum_{j=1}^{N}\tilde{WR}_{j0}.$$

Substituting for $\tilde{R}_{m0}$ in the previous equation for $\tilde{A}_{i0}$ gives:

$$\tilde{A}_{i0} = \tilde{DR}_{i0} + \tilde{WR}_{i0} - a_i - b_i\frac{1}{N}\sum_{j=1}^{N}\tilde{DR}_{j0} - b_i\frac{1}{N}\sum_{j=1}^{N}\tilde{WR}_{j0}.$$

By hypothesis,

$$p_i = \frac{\frac{1}{N}\sum_{j=1}^{N}\tilde{DR}_{j0}}{\tilde{DR}_{i0}}$$

$$\Longleftrightarrow p_i\tilde{DR}_{i0} = \frac{1}{N}\sum_{j=1}^{N}\tilde{DR}_{j0}.$$

Substituting for $\frac{1}{N}\sum_{j=1}^{N}\tilde{DR}_{j0}$ in the previous equation for $\tilde{A}_{i0}$ gives:

$$\tilde{A}_{i0} = \tilde{DR}_{i0} + \tilde{WR}_{i0} - a_i - b_i p_i \tilde{DR}_{i0} - b_i \frac{1}{N}\sum_{j=1}^{N}\tilde{WR}_{i0}.$$

By hypothesis $b_i p_i = 1$. So,

$$\tilde{A}_{i0} = \tilde{WR}_{i0} - a_i - b_i \frac{1}{N}\sum_{j=1}^{N}\tilde{WR}_{j0}.$$

Thus, $\tilde{A}_{i0}$ contains zero accounting policy decision effect.

<u>Lemma 2</u>. In a population of N firms, $\frac{1}{N}\sum_{i=1}^{N}\beta_i = 1$ and $\frac{1}{N}\sum_{i=1}^{N}\alpha_i = 0$ when the market index in the market model is the equally weighted average of the returns of the N firms. (For convenience, the "~" denoting random variables will be omitted.)

<u>Proof</u>: Now, $\beta_i = \dfrac{\operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)}{\operatorname{var}\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right)}$ by Fama (1976, p. 67).

$$\text{Hence, } \frac{1}{N}\sum_{i=1}^{N}\beta_i = \frac{1}{N}\sum_{i=1}^{N}\frac{\operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)}{\operatorname{var}\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right)}$$

$$= \frac{1}{N\operatorname{var}\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right)}\sum_{i=1}^{N}\operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)$$

$$= \frac{1}{N\operatorname{cov}\left(\frac{1}{N}\sum_{i=1}^{N} R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)} \sum_{i=1}^{N} \operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)$$

$$= \frac{1}{N\frac{1}{N}\sum_{i=1}^{N} \operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right)} \sum_{i=1}^{N} \operatorname{cov}\left(R_i, \frac{1}{N}\sum_{j=1}^{N} R_j\right) = 1.$$

Also, by Fama (1976, p. 67),

$$\alpha_i = E(R_i) - \beta_i E\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right).$$

Hence, $\frac{1}{N}\sum_{i=1}^{N} \alpha_i = \frac{1}{N}\sum_{i=1}^{N}\left(E(R_i) - \beta_i E\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right)\right)$

$$= \frac{1}{N}\sum_{i=1}^{N} E(R_i) - E\left(\frac{1}{N}\sum_{j=1}^{N} R_j\right)\frac{1}{N}\sum_{i=1}^{N} \beta_i$$

$$= \frac{1}{N}\sum_{i=1}^{N} E(R_i) - \frac{1}{N}\sum_{j=1}^{N} E(R_j) = 0.$$

Theorem 1. On average in a representative sample of firms, the market model, with an equally weighted index based on the population, is unable to detect the effects of an accounting policy decision when the statistic of interest is the average abnormal return of the sample. (For convenience, the "~" denoting random variables will be omitted.)

Proof: Let n be the number of firms in the sample from a population of N firms. The average abnormal return using the market model is:

$$\frac{1}{n}\sum_{i=1}^{n} A_i = \frac{1}{n}\sum_{i=1}^{n}\left[WR_i + DR_i - \alpha_i - \beta_i\frac{1}{N}\sum_{j=1}^{N}(WR_j + DR_j)\right]$$

$$= \frac{1}{n}\sum_{i=1}^{n} WR_i + \frac{1}{n}\sum_{i=1}^{n} DR_i - \frac{1}{n}\sum_{i=1}^{n}\alpha_i - \frac{1}{n}\sum_{i=1}^{n}\beta_i\left(\frac{1}{N}\sum_{j=1}^{N} WR_j + \frac{1}{N}\sum_{j=1}^{N} DR_j\right).$$

On average in a representative sample of firms:

$$\frac{1}{n}\sum_{i=1}^{n} WR_i = \frac{1}{N}\sum_{j=1}^{N} WR_j;$$

$$\frac{1}{n}\sum_{i=1}^{n} DR_i = \frac{1}{N}\sum_{j=1}^{N} DR_j;$$

$$\frac{1}{n}\sum_{i=1}^{n} \alpha_i = \frac{1}{N}\sum_{j=1}^{N} \alpha_j;$$

$$\frac{1}{n}\sum_{i=1}^{n} \beta_i = \frac{1}{N}\sum_{j=1}^{N} \beta_j.$$

By Lemma 2, $\frac{1}{N}\sum_{j=1}^{N}\alpha_j = 0$ and $\frac{1}{N}\sum_{j=1}^{N}\beta_j = 1$.

Thus,

$$\frac{1}{n}\sum_{i=1}^{n} A_i = \frac{1}{N}\sum_{j=1}^{N} WR_j + \frac{1}{N}\sum_{j=1}^{N} DR_j - 0 - 1\left(\frac{1}{N}\sum_{j=1}^{N} WR_j + \frac{1}{N}\sum_{j=1}^{N} DR_j\right) = 0.$$

Corollary 1.1. In a representative sample of firms, examination of abnormal returns in individual firm tests based on the market model, with an equally weighted index based on the population, is equivalent to trying to detect a quanity which on average is zero in the sample of firms.

Proof. The accounting policy decision effect in the abnormal return of firm i based on the market model is:

$$DR_i - \beta_i\frac{1}{N}\sum_{j=1}^{N} DR_j.$$

In a representative sample of n firms

$$\frac{1}{n}\sum_{i=1}^{n}\left(DR_i - \beta_i\frac{1}{N}\sum_{j=1}^{N} DR_j\right)$$

$$= \frac{1}{n}\sum_{i=1}^{n} DR_i - \frac{1}{N}\sum_{j=1}^{N} DR_j\frac{1}{n}\sum_{i=1}^{n}\beta_i$$

$$= \frac{1}{N}\sum_{j=1}^{N} DR_j - \frac{1}{N}\sum_{j=1}^{N} DR_j = 0.$$

Lemma 3. When applying ordinary least squares to the valuation model, it is implicitly assumed that RK_{it} and D_{it+1}/D_{it} are constant for t = 2,...,T+1. T is the number of consecutive time series observations used to estimate the model.

Proof. Since an assumption of ordinary least squares is that the coefficients of the valuation model are constant:

$$\frac{\beta_{i2}}{\beta_{i1}} = \frac{\left(\frac{D_{it+1}RK_{it}}{D_{it}}\right)}{\frac{D_{it+1}RK_{it}}{D_{it}RK_{it+1}}} = RK_{it+1} \text{ for } t = 1,\ldots,T.$$

Thus, RK_{it} is constant for t = 2,...,T+1.

Further,

$$\beta_{i1} = \frac{D_{it+1}RK_{it}}{D_{it}RK_{it+1}} = \frac{D_{it+1}}{D_{it}} \text{ for } t = 2,\ldots,T+1,$$

since $RK_{it} = RK_{it+1}$ for t = 2,...,T+1.

Thus, D_{it+1}/D_{it} is constant for t = 2,...,T+1.

Theorem 2. In an ordinary least squares regression of n + k observations, the coefficient of a dummy variable that is 1 for period $n + j$ and 0 for all other periods, $j = 1,\dots,k$, is the abnormal return for period $n + j$ where the equation is estimated over n observations without the k dummy variables.

<u>Proof</u>. The ordinary least squares solution is that set of coefficients, $b_0,\dots,b_{p+k}$, which minimizes:

$$Q = \sum_{i=1}^{n+k}(Y_i - \beta_0 - \beta_1 X_{1i} - \beta_2 X_{2i} - \dots - \beta_p X_{pi} - \beta_{p+1} d_{1i} - \beta_{p+2} d_{2i} - \dots - \beta_{p+k} d_{ki})^2$$

where: Y = dependent variable;

$X_1,\dots,X_p$ = right-hand side variables excluding dummy variables and the constant term;

$p+1 \leq n$;

$d_{ji} = 0$ for $i \neq n+j$, $j = 1,\dots,k$;

$d_{ji} = 1$ for $i = n+j$, $j = 1,\dots,k$.

After substituting in Q the values of the dummy variables, the first order conditions are:

$$\frac{\partial Q}{\partial \beta_0} = -2\sum_{i=1}^{n}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \dots - b_p X_{pi}) -2\sum_{i=n+1}^{n+k}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \dots - b_p X_{pi} - b_{p+i-n}) = 0;$$

$$\frac{\partial Q}{\partial \beta_1} = -2\sum_{i=1}^{n} X_{1i}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \dots - b_p X_{pi}) -2\sum_{i=n+1}^{n+k} X_{1i}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \dots - b_p X_{pi} - b_{p+i-n}) = 0;$$

$$\vdots$$

$$\frac{\partial Q}{\partial \beta_p} = -2 \sum_{i-1}^{n} X_{pi}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \cdots - b_p X_{pi})$$

$$-2 \sum_{i=n+1}^{n+k} X_{pi}(Y_i - b_0 - b_1 X_{1i} - b_{2i} X_{2i} - \cdots - b_p X_{pi}$$

$$-b_{p+i-n}) = 0;$$

$$\frac{\partial Q}{\partial \beta_{p+1}} = -2(Y_{n+1} - b_0 - b_1 X_{1n+1} - b_2 X_{2n+1} - \cdots$$

$$-b_p X_{pn+1} - b_{p+1}) = 0;$$

$$\vdots$$

$$\frac{\partial Q}{\partial \beta_{p+k}} = -2(Y_{n+k} - b_0 - b_1 X_{1n+k} - b_2 X_{2n+k} - \cdots$$

$$- b_p X_{pn+k} - b_{p+k}) = 0.$$

For $p+i-n$, $i = n+1,\ldots,n+k$, $\frac{\partial Q}{\partial \beta_{p+i-n}} = 0$ implies

$$b_{p+i-n} = Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \cdots - b_p X_{pi} \quad (*).$$

The first order conditions (*) imply:

$$\frac{\partial Q}{\partial \beta_0} = -2 \sum_{i=1}^{n} (Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \cdots$$

$$- b_p X_{pi}) = 0,$$

$$\vdots$$

$$\frac{\partial Q}{\partial \beta_p} = -2 \sum_{i=1}^{n} X_{pi}(Y_i - b_0 - b_1 X_{1i} - b_2 X_{2i} - \cdots$$

$$- b_p X_{pi}) = 0,$$

which are the first order conditions for n observations when no dummy variables are present. Thus, the ordinary least squares solution for $b_0,\ldots,b_p$ is the same regardless of the inclusion of k dummy variables. Further, the coefficient of the n + j*th* dummy variable given by (*) is the abnormal return for the n + j*th* observation, $j = 1,\ldots,k$.

The theorem holds regardless of the ordering of the observations. The event periods, each represented by a dummy variable, and the estimation periods can be intermixed. The theorem also holds when $\beta_0 = 0$.

APPENDIX B-OTHER ECONOMETRIC MODELS

A. Sets of Variables

As stated in Part B of Procedures for tests on samples of firms, the ideal prediction is $\tilde{P}_{it} = \tilde{WR}_{it}$ since then $\tilde{A}_{it} = \tilde{DR}_{it}$ which makes the accounting policy decision directly observable. It was also argued that the smaller the prediction errors, the easier it is to detect the accounting policy decision effects.

Also, the objective is to predict $\tilde{WR}_{it}$ whether or not it represents an equilibrium return or some other concept such as the return expected by investors. Suppose

$$\tilde{WR}_{it} = \tilde{OR}_{it} + \tilde{ER}_{it}$$

where: $\tilde{ER}_{it}$ = equilibrium return;

$\tilde{OR}_{it}$ = other disequilibrium effects besides $\tilde{DR}_{it}$.

And suppose that $\tilde{ER}_{it}$ could be predicted with certainty by $\tilde{P}_{it}*$. Then,

$$\begin{aligned}\tilde{A}_{it} &= \tilde{R}_{it} - \tilde{P}_{it}* \\ &= \tilde{DR}_{it} + \tilde{OR}_{it} + \tilde{ER}_{it} - \tilde{P}_{it} \\ &= \tilde{DR}_{it} + \tilde{OR}_{it}.\end{aligned}$$

The examination of $\tilde{A}_{it}$ for $\tilde{DR}_{it}$ is confounded by $\tilde{OR}_{it}$. Hence, $\tilde{WR}_{it}$ is the relevent return to predict. Moreover, an equilibrium model may not be able to detect $\tilde{DR}_{it}$ as well as a model designed to predict $\tilde{WR}_{it}$. Thus, the predictive ability of regression models based on six sets of variables was examined. It is assumed that $\tilde{DR}_{it} = 0$ for all i and t in these tests.

The first set of variables is listed in Table 66. These variables were selected in the following manner. A popular valuation model gives the market price of common stock as a function of expected dividends and discount rates (Sharpe, 1981, p. 366). Hence, returns, which are primarily a function of prices, are a function of expected dividends and discount rates. Based on empirical work and interviews with corporate executives, Sharpe claims that most firms have a desired ratio of dividends to long-run earnings (Sharpe, 1981, p. 371). Thus, expected dividends may be viewed as a function of expected earnings. Alternatively, Miller and Modigliani (1961) show that under perfect markets, rational behavior, and perfect certainty, a firm may be valued based directly on earnings and investments. Thus, returns may be a function of earnings. The first three variables listed in Table 66 may be associated with expected earnings although the series should be more appropriate for manufacturers than, for example, banks.

It is assumed that investors determine the appropriate discount rates by adjusting the future risk-free interest rates for risk (Haley and Schall, 1979, p. 191). Types of risk include (Latané, Tuttle, and Jones, 1975, pp. 240-243; Stevenson and Jennings, 1976, pp. 106-109): interest rate risk, purchasing power risk, market risk, industry

Table 66. F variables.

Series	Source[1]
Index of industrial materials prices	HCI
Index of labor cost per unit of output, total manufacturing	HCI
Manufacturing and trade sales in 1972 dollars	HCI
3-month U.S. Treasury bill rate	BS
Consumer price index	BS
Prime commercial paper rate, 4-6 months	FRB

[1]HCI = *The Handbook of Cyclical Indicators*; BS = *Business Statistics*; FRB = *Federal Reserve Bulletin*.

Table 67. S variables.

Series	Source[1]
Triple A corporate bond rate (used Aaa corporate bond rate)	BS
New defense obligations incurred (used defense department obligations total, excluding military assitance)	HCI
New orders for durable goods	BS
Unemployment rate	HCI
Consumer price index	BS

[1]HCI = *The Handbook of Cyclical Indicators*; BS = *Business Statistics*.

risk, and political risk. The 3-month U.S. Treasury bill rate was used as the risk-free rate. Market risk, industry risk, and political risk may be taken into account to some extent by the prime commercial paper rate. Although the consumer price index may not be a good indicator of purchasing power risk, the consumer price index may still be associated with discount rates since it seems plausable that the higher the consumer price index, the higher the discount rate which would be desired by investors.

The second set of variables is listed in Table 67. Malkiel and Quandt (1972) were able to explain almost 95% of the variance in the quarterly level of the S&P 500 index by using this set of variables and the index of consumer sentiment. Since individual security returns are generally related to the market return which is a function of security price levels, then individual security returns may be associated with these variables.

The third set of variables is listed in Table 68. These variables were chosen by examining three finance textbooks (Latané, Tuttle, and Jones, 1975; Stevenson and Jennings, 1976; Fischer and Jordon, 1979) for economy-wide variables which are claimed to be associated with stock prices or returns. Those variables which were mentioned in at least two of the three books are listed in Table 68. Also shown are the monthly series selected for each variables. Variables were considered available if they are included on a monthly basis in <u>Business Statistics</u>,

Table 68. T variables.

Variable	Series (Source[1])
GNP	--[2]
Corporate profits	--
Interest rates	Aaa corporate bond rate (BS)
Taxes	--
Employment	Unemployment rate (HCI)
Consumer sentiment	--
Industrial production	Index of industrial production total (HCI)
Federal government expenditures	--
State and local government expenditures	--
Investment in plant and equipment	Contracts and orders for plant and equipment in current dollars (HCI)
Inventory investment	Ratio of inventory to sales (BS)
Money supply	M1 (HCI)
Inflation	Consumer price index (BS)
Personal income	Personal income (BS)

[1]HCI = The Handbook of Cyclical Indicators; BS = Business Statistics.

[2]series not available on a monthly basis.

<u>Federal Reserve Bulletin</u>, or <u>The Handbook of Cyclical Indicators</u>.

Each textbook also included at least a partial list of the "Short List of Indicators" compiled by the National Bureau of Economic Reaearch (Moore and Shiskin, 1967). There are twenty-five indicators in the short list some of which are included in Table 68. The remaining variables were omitted from Table 68 to keep the number of variables manageable. However, the fifth and sixth set of variables are based on variables provided by the National Bureau of Economic Research.

The fourth set of variables, which is listed in Table 69, is a collection of twenty-one interest rates, discount rates, and yields on investments. Based on earlier prediction attempts, it was found that regression models based on the Aaa corporate bond rate had an average MSPE of .0089 compared to the market model's average MSPE of .0085 for a random sample of twenty firms. All the models were estimated over a 60 month period and the predictions were made for the subsequent six month period. Since it seemed unlikely that this interest rate was the optimal interest rate from a predictive ability point of view, a more comprehensive set of interest rates, discount rates, and yields was considered.

The fifth set of variables is listed in Table 70. These variables were selected based on the information compiled by the National Bureau of Economic Research and

Table 69. INT variables.

Series	Source[1]
Finance co. paper placed directly, 3-6 month rate	FRB
Prime bankers' acceptances, 90 days rate	FRB
3-month U.S. Treasury bills, market yield	FRB
3-month U.S. Treasury bill rate	FRB
6-month U.S. Treasury bills, market yield	FRB
6-month U.S. Treasury bill rate	FRB
9-12 month U.S. Treasury bills, market yield	FRB
9-12 month issues of other U.S. government securities rate	FRB
3-5 year issues of U.S. government securities rate	FRB
Prime commercial paper rate, 4-6 months	FRB
U.S. government long-term bond yield	FRB
Aaa state and local government bond yield	FRB
Baa state and local government bond yield	FRB
Aaa corporate bond yield	FRB
Baa corporate bond yield	FRB
Federal funds rate	HCI
Home mortgage rates - new home purchase	BS
Home mortgage rates - existing home purchase	BS
New York Federal Reserve Bank discount rate	BS
Federal intermediate credit bank loan rate	BS
Prime rate	HCI

[1] HCI = *The Handbook of Cyclical Indicators*; BS = *Business Statistics*; FRB = *Federal Reserve Bulletin*.

Table 70. NBER variables.

Series	Source[1]
Inventory investment and purchasing	HCI
Vendor performance, slower deliveries	HCI
New orders capital goods industries, non-defense, current dollars	HCI
Net change in inventories on hand and on order in 1972 dollars, smoothed data	HCI
Change in sensitive prices	HCI

[1] HCI = *The Handbook of Cyclical Indicators*

reported in Table 2 of The Handbook of Cyclical Indicators (1977, pp. 6-8). In particular, Table 2 reports the mean and standard deviation in months of the timing of numerous variables at peaks and troughs of their respective cycles compared to the business cycle. For example, the peak of the index of stock prices, 500 stocks, has historically had an average lead of nine months with a standard deviation of 3.2 months with respect to the peak of the business cycle. The trough of the index of stock prices, 500 stocks, has historically had an average lead of five months with a standard deviation of 1.6 months with respect to the trough of the business cycle.

Those variables whose peaks and troughs have a timing similar to that of the index of stock prices, 500 stocks, with respect to the business cycle, may be associated with the movement in prices of stocks. Such variables may produce reasonable prediction models of individual firm returns. Thus, Table 70 reports those variables whose average timing at peaks and troughs with respect to the business cycle are within one standard deviation of the average timing of the index of stock prices at peaks and troughs with respect to the business cycle.

The sixth set of variables is reported in Table 71. These variables were also selected based upon their timing with respect to the business cycle. Table 71 lists those variables whose difference between the average timing at peaks and the average timing at troughs is within

Table 71. TNBER variables.

Series	Source[1]
Four roughly coincident indicators	HCI
Inventory investment and purchasing	HCI
Employee hours in non-agricultural establishments	HCI
Employees in goods-producing industries	HCI
Wages and salaries in mining, manufacturing, and construction, 1972 dollars	HCI
Industrial production, durable manufacturers	HCI
Vendor performance, slower deliveries	HCI
Manufacturing and trade sales, current dollars	HCI
New orders, capital goods industries, non-defense, current dollars	HCI
Net change in inventories on hand and on order, 1972 dollars, smoothed data	HCI
Manufacturers' inventories of finished goods	HCI
Labor cost per unit of output, manufacturing	HCI
Money supply (M1), 1972 dollars	HCI
Ratio, personal income to money supply (M2)	HCI
Treasury bond yields	HCI
Ratio, consumer installment debt to personal income	HCI

[1] HCI = The Handbook of Cyclical Indicators

-3 to -5 months. For the index of stock prices this difference is -9 -(-5) = -4 months. Thus, by suitable lagging or leading of variables, the cycle of the variables in Table 71 can be made to approximately agree with the cycle of the index of stock prices. Hence, the variables upon lagging and leading in Table 71 may exhibit an association with stock prices and returns.

B. Procedures and Results

Table 72 shows the average MAPE and average MSPE for models based on the six sets of variables described above. Also shown are the results for the market, zero, and valuation models. All of the models were used to predict the same returns for the same set of 20 firms which were randomly selected from the CRSP tapes. For each firm the prediction period was the six month period of October, 1972, through March, 1973, which was randomly selected from the period July, 1968, to June, 1979. The estimation period for the models was the period immediately preceding the prediction period.

The first entry in each model description shows the number of months used to estimate the model. The second entry in each model description identifies the set of variables used to estimate the model: F = Table 66; S = Table 67; T = Table 68; INT = Table 69; NBER = Table 70; and TNBER = Table 71. The models ALLTRY and INALLTRY are described below.

Table 72. Predictive ability, average of 20 firms, October, 1972 through March, 1973.

Model Description	MAPE	MSPE
60 market	0.0662	0.0085
0 zero	0.0738	0.0095
60 valuation	0.0713	0.0089
48 valuation	0.0705	0.0087
36 valuation	0.0709	0.0089
60 F L	0.0750	0.0096
60 F C	0.0775	0.0099
60 F F	0.0721	0.0092
60 F LC	0.0777	0.0106
60 F CF	0.0775	0.0098
60 F LCF	0.0804	0.0103
60 S L	0.0742	0.0093
60 S C	0.0717	0.0088
60 S F	0.0732	0.0093
60 S LC	0.0706	0.0085
60 S CF	0.0717	0.0088
60 S LCF	0.0717	0.0086
60 T L	0.0756	0.0102
60 T C	0.0727	0.0089
60 T F	0.0731	0.0092
60 T LC	0.0769	0.0099
60 T CF	0.0731	0.0090
60 T LCF	0.0717	0.0097
48 F L	0.0743	0.0097

Table 72 (cont'd.)

Model Description	MAPE	MSPE
48 F C	0.0776	0.0098
48 F F	0.0723	0.0095
48 F LC	0.0753	0.0104
48 F CF	0.0763	0.0094
48 F LCF	0.0782	0.0102
48 S L	0.0748	0.0094
48 S C	0.0716	0.0086
48 S F	0.0741	0.0094
48 S LC	0.0720	0.0087
48 S CF	0.0680	0.0090
48 S LCF	0.0681	0.0089
48 T L	0.0757	0.0104
48 T C	0.0743	0.0090
48 T F	0.0748	0.0099
48 T LC	0.0772	0.0096
48 T CF	0.0726	0.0085
48 T LCF	0.0761	0.0095
36 F L	0.0738	0.0096
36 F C	0.0793	0.0107
36 F F	0.0719	0.0092
36 F LC	0.0793	0.0104
36 F CF	0.0771	0.0102
36 F LCF	0.0764	0.0100
36 S L	0.0741	0.0094
36 S C	0.0714	0.0085

Table 72 (cont'd.)

Model Description	MAPE	MSPE
36 S F	0.0738	0.0092
36 S LC	0.0723	0.0087
36 S CF	0.0739	0.0090
36 S LCF	0.0738	0.0092
36 T L	0.0753	0.0103
36 T C	0.0727	0.0089
36 T F	0.0712	0.0091
36 T LC	0.0733	0.0091
36 T CF	0.0725	0.0084
36 T LCF	0.0748	0.0094
60 NBER C	0.0769	0.0103
60 NBER LCF	0.0840	0.0122
60 TNBER C	0.0822	0.0119
60 TNBER LCF	0.1105	0.0211
60 ALLTRY C	0.0721	0.0083
60 INT C	0.0702	0.0081
60 INTALLTRY C	0.0689	0.0077

The third entry in each model description, if applicable, shows the timing of the right-hand side variables, which were eligible for inclusion in the models, with respect to the firm returns: L, the right-hand side variables were lagged one month; C, the right-hand side variables were contemporaneous with firm returns; F, the right-hand side variables were led one month and also included as a contemporaneous variable; CF, each right-hand side variable was led one month and also included as a contemporaneous variable; LCF, each right-hand side variable was lagged one month, led one month and also included as a contemporaneous variable.

However, for 60 TNBER C, the right-hand side variables were suitably led or lagged so that the peak of a right-hand side variable agreed with the peak of the index of stock prices. This leading and lagging of variables is defined as a C model. The 60 TNBER LCF variables have the same timing as those in the C model but each right-hand side variable was additionally included after lagging one additional month and leading one additional month.

The variables for the models F, S, T, and INT were transformed as follows. All variables whose units were dollars were put into constant dollars by dividing each observation by the corresponding level of the consumer price index; the first difference of these constant dollar variables was used as the right-hand side variables in the regression models. All variables which were indexes or ratios were converted to percentage changes. The first difference was taken for all other variables.

The purposes of these transformations were twofold. First, since Malkiel and Quandt (1972) found that the level of stock prices was associated with the level of economic variables, then it seemed reasonable, as a first approximation, that returns which are percentage changes would be associated with changes or the first differences of the economic variables. Second, the purpose of the constant dollar and percentage changes transformations was to put the variables into constant units. The same transformations were applied to the NBER and TNBER variables except that dollar variables were not converted into constant dollars since this could alter the timing of the variables at peaks and troughs. Also, the seasonally adjusted version for all variables was used whenever it was available.

The F, S, and T models were constructed in the following manner. The zero model was considered as the base model. A stepwise regression program to construct the models (see Neter and Wasserman, 1974, pp. 382-386 for a discussion) was used. A variable had to have at least a F ratio of 1.0 to enter the model at a given step, and had to have at least a F ratio of 0.999 to be retained in the model at a given step. This procedure will give a solution which approximates the minimum mean square error criterion for selection of variables (see Neter and

Wasserman, 1974, p. 379 for a discussion of the minimum mean square error criterion model). If the final model contained no variables, then the zero model was used to make predictions.

Also for the F, S, and T models the variables which were eligible for inclusion in the models were modified in the following way. If the range of the right-hand side variable during the prediction period was not within the range of that same variable during the estimation period than that variable was omitted from the set of variables eligible for inclusion in the model. Neter and Wasserman (1974, pp. 248-249) caution against making predictions outside of the region used to estimate the model. In a prior study based on four firms, this modification of the variables eligible for inclusion in the models improved the predictive ability of the models.

Examination of Table 72 reveals that none of the F, S, and T models had a lower average MAPE than the market model and only one of the models, 36 T CF, had a lower average MSPE than the market model. Thus, attempts were made to find a better set of variables than F, S, and T.

The first attempt consisted of treating F, S, and T as a single set of variables and trying to find how good a model could be constructed. The following procedure was performed in the search for a better set of variables. The zero model with an average MSPE of .0095 for the 20 firms was considered as the base model. The variable which decreased the average MSPE the most, using the stepwise procedure described above to construct the firm models, was added to the set of variables eligible for inclusion in the firm models. The procedure terminated when the average MAPE of the 20 firms could not be reduced by the addition of a single variable to the set of variables eligible for inclusion in the firm models. The procedure was applied to only contemporaneous variables using 60 observations to estimate the model. The resulting model is reported as 60 ALLTRY C in Table 72. The average MSPE of 60 ALLTRY C was .0083 which was not a large improvement over the average MSPE of .0085 for the market model.

Hence, the procedure which was used to construct 60 ALLTRY C was applied to the set of 21 variables named INT. The resulting model is reported as 60 INT C in Table 72. The average MSPE of 60 INT C was .0081 and, again, this was not a large improvement over the average MSPE for the market model.

So, the set of variables used for 60 INT C was supplemented by the variables in F, S, and T. That is, the set of variables used for 60 INT C was considered as the base set of variables. Then, the procedure used to construct 60 ALLTRY C was applied to see if any further reduction in the average MSPE could be obtained by including variables from F, S, and T. The resulting model is reported as 60 INTALLTRY C. The improvement of 60 INTALLTRY C over the market model is nearly as good as the improvement of the market model over the zero model.

To determine if the procedure which was used to construct 60 ALLTRY C would lead to sets of variables which would predict well in different time periods and for different firms, another randomly selected six month period for a different set of 20 randomly selected firms was selected. Models were constructed using the stepwise regression program. Table 73 shows the average MAPE and average MSPE for 60 INT C and 60 INTALLTRY C. Since these models do considerably worse than the market model, it does not appear that the procedure used to construct 60 ALLTRY C will lead to sets of variables which predict stock returns well in general.

Thus, the NBER and TNBER sets of variables were tried using the stepwise regression program with the zero model as the base model. Table 72 reveals that all of these models did considerably worse than the market model.

Although the models examined do not predict better than the market model, their potential usefulness lies in the fact that the variables employed in these models may not be affected by accounting policy decisions. Thus, these models may be able to detect accounting policy decisions better than the market model. On the other hand, the valuation model does better than most of the models reported in Table 72. Thus, the potential benefits of the F, S, T, NBER, and TNBER models over the valuation model seem small.

Table 73. Predictive ability, average of 20 firms, October, 1969 through March, 1970.

Model Description	MAPE	MSPE
60 market	0.0578	0.0059
0 zero	0.0669	0.0076
60 valuation	0.0697	0.0079
48 valuation	0.0683	0.0076
36 valuation	0.0692	0.0077
60 INT C	0.0740	0.0104
60 INTALLTRY C	0.0765	0.0117

BIBLIOGRAPHY

BIBLIOGRAPHY

Aber, J., "Industry Effects and Multivariate Stock Price Behavior," _Journal of Financial and Quantitative Analysis_ (November 1976), 617-624.

American Institute of Certified Public Accountants, _Accounting-Current Text_, as of June 1, 1980.

Banz, R. W., "The Relationship Between Return and Market Value of Common Stocks," _Journal of Financial Economics_ 9 (1981), 3-18.

Beaver, W., A. Christie, and P. Griffin, "The Information Content of SEC Accounting Series Release No. 190," _Journal of Accounting and Economics_ 2 (1980), 127-157.

Blume, M., "On the Assessment of Risk," _Journal of Finance_ (March 1971), 1-10.

Breedon, D., "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment," _Journal of Financial Economics_ 7 (1979), 265-296.

Brown, S. J. and J. B. Warner, "Measuring Security Price Performance," _Journal of Financial Economics_ 8 (1980), 205-258.

Chou, Y., _Statistical Analysis with Business and Economic Applications_ (New York: Holt, Rinehart and Whinston, Inc.), 1969.

Conover, W. J., _Practical Nonparametric Statistics_, (New York: John Wiley and Sons, Inc.), 1971.

Fama, E. F., _Foundations of Finance_ (New York: Basic Books, Inc.), 1976.

Fischer, D. E. and R. J. Jordon, _Security Analysis and Portfolio Management_, (Englewood Cliffs, N. J.: Prentice-Hall, Inc.), 1979.

Foster, G., "Accounting Policy Decisions and Capital Market Research," _Journal of Accounting and Economics_ 2 (1980), 29-62.

Gheyara, K. and J. Boatsman, "Market Reaction to the 1976 Replacement Cost Disclosures," Journal of Accounting and Economics 2 (1980), 107-125.

Haley, C. W. and L. D. Schall, The Theory of Financial Decisions, second edition, (U.S.A.: McGraw-Hill, Inc.), 1979.

Homa, K. and D. Jaffe, "The Supply of Money and Common Stock Prices," Journal of Finance (December 1971), 1045-1066.

Hong, H., R. Kaplan, and G. Mandelker, "Pooling vs. Purchase: The Effects on Stock Prices," The Accounting Review (January 1978), 31-47.

Keran, M. A., "Expectations, Money, and the Stock Market," Federal Reserve Bank of St. Louis Review (January 1971), 16-31.

King, B., "Market and Industry Factors in Stock Price Behavior," Journal of Business (1966 Supplement), 139-190.

Latané, H., D. Tuttle, and C. Jones, Security Analysis and Portfolio Management, second edition, (U.S.A.: The Ronald Press Co.), 1975.

Lee C. F. and J. D. Vinso, "The Single vs. Simultaneous Equation Model in Capital Asset Pricing," Journal of Business Research vol. 10 (1980), 65-80.

________ and J. K. Zumwalt, "Associations Between Alternative Accounting Profitability Measures and Security Returns," Journal of Financial and Quantitative Analysis (March 1981) 71-93.

Lev, B., "The Impact of Accounting Regulation on the Stock Market: The Case of Oil and Gas Companies," The Accounting Review (July 1979), 485-503.

Levy, R. A., "On the Short-term Stationarity of Beta Coefficients," Financial Analysts Journal (November-December 1971), 55-62.

Lintner, J., "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," Review of Economics and Statistics (February 1965), 13-37.

Litzenberger, R. H. and K. Ramaswamy, "The Effect of Personal Taxes and Dividends on Capital Asset Prices: Theory and Empirical Evidence," Journal of Financial Economics 7 (1979), 163-195.

Lynge, M. and J. Zumwalt, "An Empirical Study of the Interest Rate Sensitivity of Commercial Bank Returns: A Multi-Index Approach," Journal of Financial and Quantitative Analysis (September 1980), 731-742.

Malkiel, B. G. and J. G. Cragg, "Expectations and the Structure of Share Prices," American Economic Review (September 1970), 601-617.

______________ and B. E. Quandt, "The Supply of Money and Common Stock Prices: Comment," Journal of Finance (September 1972), 921-926.

McKibben, W., "Econometric Forecasting of Common Stock Investment Returns: A New Methodology Using Fundamental Operating Data," Journal of Finance (May 1972), 371-380.

Merton, R. C., "An Intertemporal Capital Asset Pricing Model," Econometrica (September 1973), 867-887.

Miller, M. and F. Modigliani, "Dividend Policy Growth and the Valuation of Shares," Journal of Business (October 1961), 411-433.

Mood, A. M., F. A. Graybill, and D. C. Boes, Introduction to the Theory of Statistics, third edition, (U.S.A.: McGraw-Hill, Inc.), 1974.

Moore, G. and J. Shiskin, Indicators of Business Expansions and Contractions (New York: National Bureau of Economic Research), 1967.

Nerlove, M., "Factors Affecting Differences Among Rates of Return on Investments in Individual Common Stocks," Review of Economics and Statistics (August 1968), 312-331.

Neter, J. and W. Wasserman, Applied Linear Statistical Models (Homewood, Illinois: Richard D. Irwin, Inc.), 1974.

Noreen, E. and J. Sepe, "Market Reactions to Accounting Policy Deliberations: The Inflation Accounting Case," The Accounting Review (April 1981), 253-269.

Olmsted, J., Advanced Calculus (Englewood Cliffs, N. J.: Prentice-Hall, Inc.), 1961.

Reinganum, M. R., "Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings Yields and Market Values," Journal of Financial Economics 9 (1981), 19-46.

Ro, B.T., "The Adjustment of Security Returns to the Disclosure of Replacement Cost Accounting Information," Journal of Accounting and Economics 2 (1980), 159-189.

Roll, R. and S. A. Ross, "An Empirical Investigation of the Arbitrage Pricing Theory," Journal of Finance (December 1980), 1073-1103.

Schipper, K. and R. Thompson, "Common Stocks as Hedges Against Shifts in the Consumption or Investment Opportunity Set," Journal of Business 2 (1981), 305-328.

Sharpe, W. F., "A Simplified Model for Portfolio Analysis," Management Science (January 1963), 277-293.

____________, "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance (September 1964), 425-442.

____________, Investments, second edition, (Englewood Cliffs, N. J.: Prentice-Hall, Inc.), 1981.

Stevenson, R. and E. Jennings, Fundamentals of Investments (U.S.A.: West Publishing Co.), 1976.

Umstead, D., "Forecasting Stock Market Prices," Journal of Finance (May 1977), 427-448.

Vigeland, R. L., "The Market Reaction to Statement of Financial Accounting Standards No. 2," The Accounting Review (April 1981), 309-325.

Watts, R. L. and J. L. Zimmerman, "On the Irrelevance of Replacement Cost Disclosures for Security Prices," Journal of Accounting and Economics 2 (1980), 95-106.

Whitbeck, V. S. and M. Kisar, Jr., "A New Tool in Investment Decision-Making," Financial Analysts Journal (May-June 1963), 55-62.