This is to certify that the

dissertation entitled

An Examination of the
"Systematic Post-Announcement Drift" Anomaly
Employing a Relative Measure of
Earnings Surprises

presented by

Myung Chul Chung

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Business Adm.

Major professor

Date April 12, 1991

AN EXAMINATION OF THE "SYSTEMATIC POST-ANNOUNCEMENT DRIFT" ANOMALY EMPLOYING A RELATIVE MEASURE OF EARNINGS SURPRISES

by

Myung Chul Chung

A DISSERTATION

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

DOCTOR OF PHILOSOPHY

Department of Finance and Insurance

1991

Nume

"systemat

prices of

unexpecte

surprises.

explain th

This

surprises

earnings ex

causes dela

In or

appropriate

necessary.

of mechanic

forecasts to

These studie

654-650x

ABSTRACT

AN EXAMINATION OF THE "SYSTEMATIC POST-ANNOUNCEMENT DRIFT" ANOMALY EMPLOYING A RELATIVE MEASURE OF EARNINGS SURPRISES

by

Myung Chul Chung

Numerous studies have documented the existence of the "systematic post-announcement drift" anomaly for security prices of stocks that reported large positive or negative unexpected earnings announcements – also called earnings surprises. Efficient market arguments have been unable to explain this phenomenon.

This research proposes that unusually large earnings surprises increase the divergence of opinion on future-earnings expectations. This increase in dispersion of opinion causes delays in the price adjustment process.

In order to properly identify earnings surprises, an appropriate measure of the expected earnings number is necessary. Prior studies have either implemented variations of mechanical time-series models or financial analysts' forecasts to estimate the market's expected earnings numbers. These studies in general, however, applied inferior

methods
surpris

Th
Standar
dispers
relatio
and the
investig
of the p
examined
in their

surprises

The
return;
surprises
stocks wi
that analy
large ear

methods of cross-sectional standardization of earnings surprises.

This study utilizes a relative measure called Standardized Earnings Surprises (SES) that incorporates the dispersion of the expected earnings numbers. First, the relationship between divergence of opinions on future earnings and the relative sizes of the earnings surprises is investigated. Second, the correlation between the durations of the price adjustment and the magnitude of the surprises is examined. Finally, the hypothesis that financial analysts lag in their forecasts revisions of firms with large earnings surprises.

The results show that SES is positively related to excess return; divergence opinion increases after large earnings surprises; the duration of price adjustment is longer for stocks with greater earnings surprises; and, evidence indicate that analysts lag in their revisions of stocks that exhibited large earnings surprises.

Savior, J

DEDICATION

I humbly dedicate this dissertation to our Lord and Savior, Jesus Christ.

disser

Butler

disser

acted a

during

researc

members

encourag

the area

their to

ACKNOWLEDGEMENTS

I would first like to thank the members of my disseration committe: Dr. Joseph H. Anthony, Dr. Kirt C. Butler and especially Dr. John E. Gilster, Jr., my dissertation chairman, for his guidance and patience.

I am also grateful to Dr. John L. O'Donnell who acted as Chairman of the Department of Finance and Insurance during my doctoral program and the preparation of this research.

My deep debt to friends, colleague, and family members is acknowledged for their continual friendship and encouragement. Dr. Kwok Sang Tse was especially helpful in the area of statistics.

Finally, I wish to thank my wife and two sons for their total love and understanding.

TABLE OF CONTENTS

Chapter

VI.

TABLE

1.

2.

3.

4.

5.

6.

7.

8. N

9. F

10. R

LIST OF TABLES

TABLE

11.

12.

TABLE **PAGE**

LIST OF FIGURES

If

stock s

earning

time, a

informa

prices

and Joy

"system

reporte

(hereaf

subsequ

methods

periods

studies

(1981),

Olsen a

(1982,

La

apply th

Chapter I

INTRODUCTION

If capital markets are semi-strong form efficient, then stock selection techniques based on publicly available earnings reports should not produce, on average and over time, abnormal returns. In such a market, earnings information is already fully reflected in these security prices at the time it becomes available. Yet Ball (1978) and Joy and Jones (1979) reviewed eight studies in which "systematic post-announcement drift" in security prices are reported after positive and negative unexpected earnings (hereafter UE) announcements. Several studies published subsequent to these review papers, applying more refined methods and larger data sets (more firms and longer periods), have reported similar results. These include studies by Latane' and Jones (1979), Bidwell and Riddle (1981), Jones, Rendleman, and Latane' (1984, 1985), Foster, Olsen and Shevlin (1984), Rendleman, Jones and Latane' (1982, 1984, 1987), and Bernard and Thomas (1989).

Latane' and Jones (1977) were the first to define and apply the Standardized Unexpected Earnings (hereafter SUE) measure

strong

returns

found t

earned,

compris

positiv

that ex

SUE mea

by othe

effect.

explain

Researc

Th

"system

the arg

deviati

diverge

has bee

good pr

---

[1] The S

SU

[2] Unexpe

measure and document the statistically and economically strong relationship between SUE and excess holding period returns (hereafter HPR) from common stock.[1] These authors found that risk-adjusted abnormal returns could have been earned, at least during the periods studied, by a portfolio comprised of stocks which had recently experienced large positive earnings surprises or by short-selling those stocks that exhibited large negative surprises (as defined by the SUE measure).[2] Additional papers by the same authors and by other researchers support the existence of the SUE effect. Efficient market arguments have been unable to explain this phenomenon.

Research Objectives

This study proposes to provide an explanation for the "systematic post-announcement drift" anomaly by following the argument that unusually large earnings surprises (large deviations from the range of expectations) increase the divergence of opinion on future-earnings expectations. It has been argued that a measure of divergence of opinion is a good proxy as an ex-ante measure of uncertainty, and that

---

[1] The Standardized Unexpected Earnings is defined as:

$$\text{SUE} = \frac{\text{Reported EPS} - \text{Estimated EPS}}{[\text{Standard Error of Estimate for the Estimating Regression Equation}]}.$$

[2] Unexpected earnings is synonymous with earnings surprise.

increas

adjustm

Lintner

direct

"diverg

produce

same so

opinion

market

Ab

outside

would b

earning

such, f

would h

securit

fact it

form of

financi

managem

news, e

degree

surpris

price a

securit

increases in uncertainty may slow down the price adjustments. Miller (1977), expanding on the work of Lintner (1969) and Smith (1967), proposed that there is a direct relationship between a stock's "risk" and its "divergence of opinion." They argued that uncertainty produces both risk and divergence of opinion in that the same sources of uncertainty responsible for divergence of opinion also generate the risk perceived by individual market participants.

Abnormally large earnings surprises, when they are outside the boundaries of what is regarded as probable, would be less likely believed to be sustainable than those earnings that are within the range of expectations. As such, further evidence may be required before the surprise would have its full impact on the price of the underlying security. This confirmation may not be instantaneous — in fact it may be a quite lengthy process — and can come in the form of additional information such as price changes, financial analysts' revisions on future forecasts, managements' forecast revisions, economic news, industry news, etc. In other words, this research proposes that the degree of uncertainty increases after large earnings surprises and is negatively correlated with the speed of price adjustment — the greater the uncertainty about a security's return, the slower the price adjustment. The followi

above a

H_1

H_2

H_3

In

effects

essenti

Previou

definit

relativ

Earning

several

in the

the mor

analyst

signifi

returns,

may be a

Moreove

are ref

in price

following hypotheses will be tested to substantiate the above arguments:

H_1 The divergence of opinion on future earnings expectations increases relative to the size of the earnings surprise;

H_2 The duration of the price adjustment for firms with larger earnings surprises is longer than for firms with smaller earnings surprises; and

H_3 There are lags in the revisions of financial analysts' forecasts of quarterly earnings for firms with large earnings surprises.

In order to properly test the above hypotheses on the effects of an earnings surprise on future return, it is essential to have an appropriate measure of the surprise. Previous studies in this area have differed in their definitions of earnings surprises. Chapter III introduces a relative earnings surprise measure called "Standardized Earnings Surprise" (hereafter SES). This measure has several desirable properties similar to the SUE measure used in the existing literature but also incorporates the use of the more accepted proxy for expected earnings — financial analysts' forecasts (hereafter FAF). If there exists a significant relationship between SES and future excess returns, then the refinements offered in this new measure may be a meaningful contribution to future research. Moreover, changes in analysts' "divergence of opinion" (H_1) are reflected in this SES measure. In fact, the "duration in price adjustments" (H_2) and "lags in the revisions of

FAF of earnings" (H_3) may be directly related to changes in the divergence of opinion due to an earnings surprise.

The results in this paper show that SES is postively correlated to excess returns. The relationship, although highly significant, was not as symmetrical as those reported in other studies. Results support all three hypotheses lending support to the contention that "systematic post-earnigs announcement drift" is due to delay in price reponse to new information.

The sizes of the earnings surprise displayed positive correlation with the changes in the range of expectations of financial analysts and stocks with larger surprises exhibited longer price adjustments periods than those with smaller surprises. Finally, evidence support the hypothesis that analysts lag in their revisions for those securites with large SES values.

Organization of the Study

Chapter II presents the literature review. The review is divided into two sections: (1) studies on the "systematic post-announcement drift" in security prices after positive and negative UE; and (2) studies on the use of FAF.

Chapter III introduces a relative earnings surprise measure. Numerical examples compare the measure to others. Chapter IV presents the arguments underlying the hypotheses to be

sets th

reports

with th

to be tested and describes empirical methodologies and data sets that are used to test the hypotheses. Chapter V reports the results of the hypotheses. Chapter VI follows with the conclusion.

Chapter II

LITERATURE REVIEW

This chapter reviews the major studies related to this research. The studies are divided into two sections. The first section covers the "post-earnings announcement drift" studies in chronological order, and the second section includes those studies that deal with the use of FAF as the proxy for the expected earnings number.

Post-earnings Announcement Drift Studies

Ball and Brown (1968)

Ball and Brown's initial objective was "to assess the usefulness of existing accounting income numbers by examining their information content and timeliness" (p. 176). In their research, however, they also found clues to what later would be known as the "systematic post-announcement drift" anomaly. This study is generally noted to be the first comprehensive paper providing evidence of such an anomaly.

In

classifi

minus th

expectat

of 261 C

The

where δ1

for peri

Squares

for secu

firms (

Ba

(hereaf

annual

where m

announc

In their study, each annual earnings announcement is classified as favorable (unfavorable) when actual earnings, minus the expected earnings obtained from a simple earnings expectation model, are greater (less) than zero for a sample of 261 COMPUSTAT firms over the period 1946 through 1966.

The UE change (UE_{it}) is defined as:

$$UE_{it} = \delta I_{it} - E(I_{it})$$

where δI_{it} denotes the actual earnings change of security i for period t; and $E(I_{it})$ is estimated by Ordinary Least Squares (hereafter OLS), regressing the change in earnings for security i, on the change in average earnings of all firms (other than security i) in the market.

Ball and Brown utilize the Abnormal Performance Index (hereafter API) to investigate the information content of annual earnings reports. API is defined as:

$$API_M = \left[\sum_{n}^{N} \prod_{m=-11}^{M} (1 + v_{nm}) \right] / M$$

where month 0 is defined as the month of the annual report announcement; the API_M is the API at month M; and v_{nm} is the

return
value c
securit
month t
to the
10,...,

Ba
monthly
announc
annual
monthly

<u>Jones an</u>

Jon
applied
earnings
numbers
lines to
quarters.
quarter f
coefficie
They repo
announceme
quarterly
standard d

return on security n for the month M. Then API traces the value of one dollar invested — in equal amounts — in all securities n (n = 1,2,...,N), beginning at the end of the month that is 12 months prior to the annual report and held to the end of the some arbitrary holding period (M = -11,-10,...,T), while subtracting the monthly market effects.

Ball and Brown found, from observing the abnormal monthly rates of return for each of the two classes of announcements, that firms that have favorable (unfavorable) annual earnings changes show positive (negative) abnormal monthly returns.

Jones and Litzenberger (1970)

Jones and Litzenberger used quarterly earnings and applied simple linear regression to calculate the expected earnings per share (hereafter EPS) number. Expected EPS numbers were estimated for each firm by fitting straight lines to actual quarterly EPS for eight consecutive quarters. Earnings projections were made for the ninth quarter for firms whose earnings trend have a correlation coefficient in excess of 0.7 for the given two-year period. They report returns in the six months following the announcement of quarterly earnings for securities whose quarterly EPS exceeds predicted EPS by more than 1.5 standard deviations.

Using Treynor's excess return measure, excess returns are +7.1%, +13.6%, +12.9%, +7.9%, and +12.1% during the first 5 overlapping periods (May 1964 to November 1964, August 1964 to February 1965, November 1964 to May 1965, February 1965 to August 1965, and May 1965 to November 1965), and +0.7%, +16.4%, +20.0%, +25.0%, and +16.4% during the second five overlapping periods (May 1966 to November 1966, August 1966 to February 1967, November 1966 to May 1967, February 1967 to August 1967, and May 1967 to November 1967). The excess returns were computed over +2 to +8 months relative to the end of the fiscal quarter (not the announcement date). The number of securities whose actual EPS exceeded the predicted EPS varied across time from 9 to 47 securities, out of a population of 510 for the first sample period, and 618 for the second sample period. Similar results were obtained applying Sharpe's "reward to variability ratio."[3]

A noteworthy result in this study is that the performance of stocks whose earnings were 1.5 standard deviations below a trend prediction is not significantly different from the performance of the Standard and Poor's

---

[3] Reward to variability ratio = $(R_j - R_f)/\sigma_j$
where
R_j = the return of the jth asset;
R_f = the return on a risk-free asset (assumed arbitrarily to be 2.5% per six-month period); and
σ_j = the standard deviation of return on the jth asset.

Industri
perform
in its
performe

Jo
earning
because
cause i
of this
brokers
demand
on the
revisio
slow do
short i

Th
drift"
surpris
provide
the gra
interme

Joy, Li

Joy,
return p

Industrial Index. The first sample of these stocks did not perform as well as the Standard and Poor's Industrial Index in its respective periods, but the second sample of stocks performed better than the Index.

Jones and Litzenberger speculated that positive earnings surprises cause gradual upward price revisions because a favorable earnings report would be expected to cause increased professional interest, gradual dissemination of this interest to the general investing public through brokers and advisory services, and subsequent increase in demand for the security. But negative earnings surprises, on the other hand, would cause more rapid downward price revisions. Brokers and advisory services are less likely to slow down the dissemination because advising clients to sell short is less likely.

Their results support the "systematic post-announcement drift" anomaly at least for stocks with positive earnings surprises. They did not, however, attempt to test or provide specific evidence to support their conjecture that the gradual price revisions may be caused by financial intermediaries such as brokers and advisory services.

Joy, Litzenberger and McEnally (1977)

Joy, Litzenberger and McEnally evaluated the rate of return performance around quarterly earnings announcements of a rand

Their only

listed dur

earnings ex

observed ea

unfavorable

uses the pr

the expecte

martingale

$$\hat{E}_{j,q} = E_{j,}$$

where $\hat{E}_{j,}$

$E_{j,q-n}$ =

For

were obs

twenty-

Applyi

in add

McEna

annou

rate

earni

signi

of a random sample of 96 firms chosen from NYSE firms. Their only constraint was that these firms be continuously listed during the period from 1963 to 1968. Two naive earnings expectations models were used to categorize observed earnings announcements as favorable, neutral, or unfavorable. The first model, simple martingale, merely uses the prior-year's, corresponding quarterly earnings as the expected EPS number for this year. The second model, martingale with a nonconstant drift, is stated as:

$$\hat{E}_{j,q} = E_{j,q^{-4}} + \left(\frac{1}{3}\right)\left[(E_{j,q^{-1}} - E_{j,q^{-5}}) + (E_{j,q^{-2}} - E_{j,q^{-6}}) + (E_{j,q^{-3}} - E_{j,q^{-7}})\right]$$

where $\hat{E}_{j,q}$ = the expected EPS for firm j in quarter q; and $E_{j,q^{-n}}$ = the expected EPS for firm j in quarter q^{-n}.

For each earnings observation, weekly rates of return were observed over the period thirteen weeks prior to, and twenty-six weeks subsequent to, the announcement week. Applying the API (as was used by Ball and Brown (1968)) and, in addition, the cumulative API, Joy, Litzenberger and McEnally found that stocks with highly favorable earnings announcements generated large, post-announcement, abnormal rates of return. The percentage deviation of reported earnings from the expectation was shown to have a significant association with the magnitude of the subsequent price ad

adjustme

valuatio

favorabl

than ins

222) Th

differen

rates of

found th

to have

provide

Brown (1

Bro

large in

by react

(decreas

through

and a tw

with unu

achieved

then a r

conclude

---

4 The st
coeffi
when s
inform

price adjustment. This finding suggests "that price adjustments to the information concerning security valuations that are contained in unexpected 'highly favorable' quarterly earnings reports are gradual, rather than instantaneous." (Joy, Litzenberger and McEnally, p. 222) They also found that these results hold for several different ways of computing security betas and residual rates of return. Like Jones and Litzenberger (1970), they found that stocks with surprisingly low returns do not tend to have subsequent downward price trends. They did not provide any explanations or speculate as to why this occurs.

Brown (1979)

Brown reports results of rates of return reaction to large increases (decreases) in annual earnings corroborated by reactions to large quarterly earnings increases (decreases). He examined 158 firms over the period 1968 through 1971, using the standard residual analysis paradigm and a two-step selection criterion that selects securities with unusual EPS reports.[4] This selection process was achieved by first using a naive annual forecast model, and then a more sophisticated quarterly forecast model. Brown concluded that the announcement of unusual EPS significantly

[4] The standard residual analysis involves estimating the coefficients of the market model, during a time period when stock returns are not being influenced by other information.

effects

instant

transac

models.

Th

First,

Street

1 and M

had at

extraor

were se

fourth

results

extrapo

year.

[5] Brown s

Decembe

firms w

effects stock prices, that prices do not adjust instantaneously, and that an abnormal return in excess of transaction costs could be earned by using the forecast models.

The selection criterion Brown used is worthy of noting. First, only firms reporting annual EPS numbers in the Wall Street Journal (hereafter WSJ) between the dates of February 1 and March 20 were considered.[5] Second, firms that have had at least a 20 percent change in annual EPS, excluding extraordinary items (splits, nonrecurring events, etc.), were selected. From this selection, securities that had fourth quarter EPS that differed from extrapolations of results from the first three quarters were compared to the extrapolations from the first three quarters of the previous year. In symbols, this is defined as:

$$AFE_j = \left[\frac{\sum_{k=5}^{8} EPS_{j,k}}{\sum_{k=1}^{4} EPS_{j,k}} \right] - 1$$

[5] Brown suggested that this would include most firms with December 31 fiscal years, but would not distinguish those firms whose fiscal years differed.

$$\hat{E}_j = \sum_{k=5}^{7} EPS_{j,k} + \frac{\sum_{k=5}^{7} EPS_{j,k}}{\sum_{k=1}^{3} EPS_{j,k}} EPS_{j,4}$$

$$QFE_j = \frac{\sum_{k=5}^{8} EPS_{j,k}}{\hat{E}_j} - 1$$

where j = an index of firms; k = the kth quarter relative to the first quarter of the previous year; AFE_j = the annual forecast error for firm j; $\hat{E}_j$ = an estimate of annual EPS using interim reports for firm j; and QFE_j = the quarterly forecast error for firm j. Requiring that forecast errors be greater (less) than that extrapolated from previous years is not too different from the criteria set by Jones and Litzenberger (1970).[6] This restricted Brown's sample to include only those firms that have earnings changes in the same direction as the previous changes.

Brown also investigated the question of whether pre-announcement and post-announcement period market model intercepts and betas are similar. He concluded that they

---

[6] Jones and Litzenberger investigated only securities whose quarterly EPS exceeds predicted EPS by more than 1.5 standard deviations.

were not

supporte

paramete

informat

time of

importar

paramete

market i

shifts i

studied.

to see a

his meth

explanat

Reinganu

In

unexpec

abnorma

efficie

like th

sample

two yea

The Lat

Th

that fa

were not. He then proceeded to argue that his data supported the use of post-announcement market model parameters. One may take issue with his use of "advance" information (information that is unknown to investors at the time of the earnings announcements). What appears to be important is that his use of post-announcement market model parameters seriously questions the criticism that observed market inefficiencies of earnings studies are caused by shifts in the risk characteristics of the securities studied. If this criticism were true, one would not expect to see anti-efficient market results in Brown's study, since his methodology is oriented toward removing that potential explanation.

Reinganum (1981)

In contrast to other studies, Reinganum indicated that unexpected quarterly earnings were not associated with abnormal returns. Thus, he found evidence in support of an efficient market. The methodology used in his study is much like that employed by Latane' and Jones (1977, 1979); the sample period is much shorter, however, only encompassing two years.

The Latane' Studies

There are seven studies under review in this chapter that fall under the "Latane' Studies" category. They all include

study of

prices.

introduc

and Litz

applied

quarterl

where T

non-lin

variabl

β_1 and

degree

S_1, S_2,

unexpec

amount

the reg

Fr

were se

firms h

beginni

through

alterna

include Henry Latane' as a co-author and pertain to the study of earnings announcements and their effect on stock prices. The Latane', Jones and Rieke (1974) study introduced the SUE measure as an improvement on the Jones and Litzenberger (1970) model. The following model was applied to calculate the expected EPS number using 20 quarterly earnings observations:

$$E(EPS) = \beta_0 + \beta_1 T + \beta_2 T^2 + \beta_3 S_1 + \beta_4 S_2 + \beta_5 S_3 + e$$

where T and T^2 are dummy variables measuring the linear and non-linear effects of time; and S_1, S_2, and S_3 are dummy variables for capturing the linear effects of seasonality. β_1 and β_2 measure not only the growth in EPS, but also the degree of its acceleration or deceleration. Coefficients of S_1, S_2, and S_3 isolate seasonal influences on EPS. The unexpected EPS are then standardized by dividing their amount by the standard error of estimate (hereafter SEE) of the regression equation which estimated the expected EPS.

From a database consisting of 1,749 firms, 258 firms were selected. The only criteria applied was that these firms have thirty-seven consecutive quarterly earnings beginning with the third quarter of 1962 and continuing through the comparable quarter of 1971. For each period, alternative sample portfolios consisting of firms having the

20 highes

During th

for firm

respecti

calculat

any cash

the begi

stock sp

total sa

firms th

highest

Lat

three-mo

from the

of 1974,

between

SUE port

with an

two poo

and the

portfol

and bea

below t

No

returns

the mar

20 highest and lowest values of SUE were constructed. During these periods the mean excess HPR of .056 and -.030 for firms with 20 highest and lowest values of SUE, respectively, were reported. Three-month HPR were calculated by taking the ending price of a security, plus any cash dividends paid during the period, and dividing by the beginning price after adjustments for stock dividends or stock splits. Excess HPR were found by subtracting the total sample return from the respective returns of those firms that were classified as being one having the 20 highest or lowest values of SUE.

Latane' and Jones (1977) compared the SUE measure with three-month HPR for 975 firms for a total of 13 quarters, from the second quarter of 1971 through the second quarter of 1974, and found significant cross-sectional relationship between SUE and HPR. They found that 11 of the 13 higher SUE portfolios outperformed the 975 stock average portfolio with an average excess of 7.4 percentage points. One of the two poor performances occurred in a bull market environment and the other in a bear market. All 13 of the low SUE portfolios showed lower-than-average returns both in bull and bear markets, with the mean return 9.1 percentage points below the sample average.

No significant correlation was found between the excess returns of either the low or high portfolios selected and the market return; the time-series betas for all portfolios

were th
Further
found t
riskier
portfol
The Lat
earlier
arrived

In
and Lat
sample
sample
to the
abnorma
top 20
the por
the fis
positio
quarter

In
address
three-w
Watts-R
based o
William
no risk

were therefore not significantly different from 1.0. Furthermore, on the basis of standard deviation, it was found that the HPR for the selected portfolios were no riskier than for the market as a whole; that is, selected portfolios stocks were no riskier than the average stock. The Latane' and Jones (1979) study differed from their earlier work primarily by sample period and size, but arrived at the same conclusions.

In response to the Reinganum study, Rendleman, Jones and Latane' (1982) performed a study using a much larger sample period than other previous studies. For the entire sample period of 36 quarters, from the third quarter of 1971 to the second quarter of 1982, they found significant abnormal returns for three-month holding periods (for the top 20 SUE stocks). The returns range from almost 6% for the portfolio whose starting position was one month after the fiscal quarter closed to 3.4% for the portfolio whose position was taken five months after the close of the fiscal quarter.

In addition, Rendleman, Jones, and Latane' (1982) addressed the risk-adjustment issue in detail. They made a three-way comparison of return differences: using the Watts-Reinganum (see Watts (1978)) risk-adjustment technique based on OLS betas; using the same technique with Scholes-Williams (see Scholes and Williams (1977)) betas; and making no risk adjustment at all. Surprisingly, they report very small diff

returns ov

clearly de

and under

adjustment

Jones

Rendleman,

more exter

support o

announceme

<u>Bidwell a</u>

Bidw

relations

firms, be

the third

<u>Foster, (</u>

Fos

of over

1974 to

"sytemat

drift wa

period,

subperio

small differences between the risk-adjusted and non-adjusted returns over the entire test period concluding that "SUE clearly demonstrates an ability to discriminate among over and under performing stocks, with or without risk adjustments" (p. 280).

Jones, Rendleman and Latane' (1984, 1985) and Rendleman, Jones and Latane' (1987) performed similar but more extensive analyses and provided further convincing support of the observed anomalous behavior following UE announcements.

Bidwell and Riddle (1981)

Bidwell and Riddle confirmed the significant relationship between SUE and HPR, using a sample size of 875 firms, between the period from the third quarter of 1976 to the third quarter of 1978.

Foster, Olsen and Shevlin (1984)

Foster, Olsen and Shevlin based their study on a sample of over 56,000 observations covering the time period from 1974 to 1981. They also confirmed the existence of the "sytematic post-announcement drift", and reported that the drift was a persistent phenomenon over the 1974 to 1981 period, with no evidence of being concentrated in a specific subperiod when time-series models were implemented to estimate

expectat

"sytemat

The

Mod

Mod

where FE_i

Model (1)

the day pr

while the

abnormal r

the earnin

the standa

trading-day

being exami

standard de

day period

examined.

estimate the expected EPS number. However, for two expectations models based on the security return series, "sytematic post-announcement drift" was not found.

Their two expectations models were as follows:

Model (1)

$$FE_i = \frac{\sum_{t=-1}^{0} R_{i,t}}{\sigma(R_{i,t})}$$

Model (2)

$$FE_i = \frac{\left[\sum_{t=-60}^{0} R_{i,t}\right]/61}{\sigma(R_{i,t})}$$

where FE_i = forecast error for firm i. The numerator of Model (1) equals the cumulative two-day abnormal return in the day preceding and the day of the earnings announcement, while the numerator of Model (2) sums the cumulative abnormal return in the 61-trading-day period up to day of the earnings announcement. The denominator of Model (1) is the standard deviation of returns for firm i in the 250-trading-day period prior to the (-1,0) event time period being examined and the denominator of Model (2) is the standard deviation of returns for firm i in the 250-trading-day period prior to the (-60,0) event time period being examined. The forecast errors were then ranked from the lowest to the highest, and ten portfolios were constructed into the same order. The underlying assumption was that the stock returns, around the earnings announcement, correctly capture the information content of the earnings announcements as derived from the forecast errors. This was not the case. Furthermore, as the authors confess, it still does not explain why the "systematic post-announcement drift" exists for portfolios constructed from using the time-series models.

<u>Bernard and Thomas (1989)</u>

Bernard and Thomas argued against the inference made from the results of Foster, Olsen and Shevlin (FOS) that "systematic post-announcement drift" reflects some problem in risk measurement:

> The reason that the FOS results are consistent not only with certain explanations under which the drift is a delayed price reponse. Specifically, (1) if there exists some delay in the response to earnings news, and (2) the fraction of the total response that is delayed varies sufficiently across firms, then one could simultaneously detect a drift in the [earnings-based model] tests but not not detect a drift in the [security-return model] tests. (p. 5)

A total of 100,249 data points was obtained from NYSE, AMEX and NASDAQ firms for the quarters from 1974 to 1986. This data was used to repeat the FOS study. For the 1974-1981 period studied by FOS, Bernard and Thomas found an annualized return of 19% for the highest SUE portfolio as compared to the 25% obtained by FOS. They attributed this discrepancy to the differential sample size and makeup. Otherwise, they reported similar results.

After extensively addressing the risk-adjustment issue, Bernard and Thomas found that although there is some merit to the claim that betas shift around earnings announcements, the magnitude of the shifts falls far short of the amounts necessary to explain the magnitude of the drift. Bernard and Thomas concluded that:

> Much of the evidence cannot plausibly be reconciled with arguments built on risk mismeasurement. In contrast, the data are consistent with a delayed price response. (p. 36)

Summary

Table 1 presents a summary of the "systematic post-announcement drift" literature mentioned above. The evidence is overwhelmingly in support of the existence of the "systematic post-announcement drift" phenomenon. Of the relevant literature considered, all but one of the studies found evidence of anomalous security returns surrounding the announcement of unexpected quarterly earnings. However, none of the literature reviewed in this section applied the consensus FAF of earnings as the proxy for the expected EPS number. This leads one to consider whether the "systematic post-announcement drift" anomaly can also be observed when FAF of earnings are implemented.

TABLE 1

Comparison of Findings of Studies in the Area of UE Announcements and Stock Price Effects

Study	Sample Period	Firms In Sample	Price Effect
Jones and Litzenberger [1970]	1962-67	510	Yes
	1965-67	610	Yes
Latane', Jones and Rieke [1974]	1962-65	360	Yes
	1965-69	416	Yes
Joy, Litzenberger and McEnally [1977]	1963-68	261	Yes
Latane', and Jones [1977]	1971-75	258	Yes
Brown [1978]	1968-71	158	Yes
Latane' and Jones [1979]	1974-79	1228	Yes
Bidwell and Riddle [1981]	1976-78	875	Yes
Reinganum [1981]	1975-77	566	No
Rendleman, Jones and Latane' [1982]	1971-80	1496	Yes
Foster, Olsen and Shelvin [1984]	1974-82	1495	Yes
Jones, Rendleman and Latane' [1984]	1971-80	1496	Yes
Jones, Rendleman and Latane' [1985]	1971-80	1503	Yes
Bernard and Thomas [1989]	1974-86	1950*	Yes

*Estimated (the study did not report the number of firms).

<u>Using Financial Analysts' Forecasts of Earnings</u>

The literature dealing with FAF of earnings and earnings growth rates is primarily concerned with either the accuracy of the FAF when compared to mechanical models or with whether FAF influence stock prices.[7]

<u>Cragg and Malkiel (1968)</u>

Cragg and Malkiel compared the five-year earnings growth rate forecasts by five investment houses for 185 firms between 1962 and 1963 with two sets of naive models — one predicting no change, and the other a change equal to past change. They found that "forecasts based on perceived past growth rates ... do not perform much differently from the [analysts'] predictions" (p. 83). They noted, however, that care should be exercised in interpreting their findings, because the results may be due to their small sample size and short sample period.

<u>Malkiel and Cragg (1970)</u>

In contrast to their previous findings, Malkiel and Cragg examined price-earnings ratios for 178 firms between 1961 and 1965 and found that forecasts based on regression

---

[7] The term mechanical models includes all models that primarily use past earnings to extrapolate future earnings.

techniques explained only 50% of the price-earnings ratio, whereas FAF explained 75% of the price-earnings ratio.

Niederhoffer and Regan (1972)

Niederhoffer and Regan examined the earnings characteristics of those common stocks having the largest percentage changes within a given period. Selecting 50 of the best and worst performers for the years 1970 to 1972, they found that analysts consistently underestimated the annual earnings gains of the top 50 firms, and consistently overestimated the earnings of the bottom 50 firms. They concluded that stock prices are strongly dependent on earnings changes, not only the absolute changes but also the relative changes to analysts' estimates.

Barefield and Comiskey (1975)

Barefield and Comiskey found that, for a sample of 100 NYSE firms with earnings forecasts reported in the Standard and Poor's "Earnings Forecaster" for the period between 1967 and 1972, analysts outperformed the simple no-change model for 68 of the 100 firms employing the Theil's U-statistic. Forecast error was defined as the absolute value of the percentage difference between actual and forecasted earnings:

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

where F = forecasted EPS; and A = actual EPS. The average forecast error over the six-year period was also calculated for each firm. And Theil's U-statistic (applied to earnings) is defined as:

$$U = \frac{\sqrt{\sum_{i=1}^{n} (P_i - A_i)^2}}{\sqrt{\sum_{i=1}^{n} A_i^2}}$$

where P_i, A_i = pairs of forecasted (P_i) and actual (A_i) changes; and n total number of observations. Turning-point prediction seemed to be the analysts' forte for this sample and test period, having accurately predicted 132 of a total 197 turning points. They pointed out, however, that the naive no-change model probably was a weak standard of comparison; when matched against more sophisticated mechanical models forecasting, performance might have declined.

Brown and Rozeff (1978)

For fifty firms randomly selected from Moody's Handbook of Common Stocks for the years 1972 to 1975, Brown and Rozeff compared the performance of Value Line forecasts for up to five quarters ahead with forecasts made by three mechanical models — seasonal martingale, seasonal submartingale, and Box-Jenkins (1970) models.[8] The seasonal martingale model's forecast of EPS one quarter ahead was simply:

$$F_{i,t+1} = A_{i,t-3}$$

where $F_{i,t+1}$ = the forecast of EPS for firm i one quarter ahead, t+1; and $A_{i,t-3}$ = the actual EPS four quarters prior to the quarter being forecasted. The seasonal submartingale model's forecast of EPS one quarter ahead is:

$$F_{i,t+1} = A_{i,t-3} + (A_{i,t} - A_{i,t-4})$$

[8] The only constraint for the sample selection is that each firm have the complete actual and forecasted quarterly earnings data available in the Value Line Investment Survey.

Box-Jenkins forecasts were obtained by the standard methods. Value Line's forecasts were taken directly from the issues of the Value Line Investment Survey.

Applying the Theil's U-statistic, Friedman test statistic (Conover (1971)), and Wilcoxon test statistics (Conover (1971)). Brown and Rozeff reported that Box-Jenkins models produced better earnings forecasts than the submartingale models and consistently performed significantly better than the martingale models. The Value Line Investment Survey, however, consistently made significantly better earnings forecasts than the Box-Jenkins and naive time-series models. The Friedman test statistic examines the null hypothesis that error distributions for all four models are identically distributed. The Wilcoxon statistic tests the null hypothesis that the median error difference of two methods being compared exceeds zero. Brown and Rozeff stated that "the findings are in accord with rationality in the market for forecasts and the long-run equilibrium employment of analysts" (p. 13).

<u>Crichfield, Dyckman and Lakonishok (1978)</u>

Crichfield, Dyckman and Lakonishok compared mean forecasts for annual EPS as reported in the Standard and Poor's "Earnings Forecaster" with five mechanical models using Theil's approach for 46 firms covering a period from

1967 to 1976. The following five mechanical models are used in the comparison:

Model (1)	No change model. Last year's EPS serves as this year's prediction.
Model (2)	A 3-year moving average. This year's EPS is the average of the past 3 year's EPS.
Model (3)	A quarterly model. Each quarterly actual EPS serves as an independent prediction of annual EPS.
Model (4)	A quarterly model. Each quarterly actual EPS is averaged with previous quarter's EPS.
Model (5)	A quarterly model. Each quarterly actual EPS adjusted for the previous year to serve as a prediction of annual EPS.

They reported results that indicated the superiority of FAF over the five models used for comparison.

Givoly and Lakonishok (1980, 1987)

Givoly and Lakonishok (1980) looked at whether FAF of earnings were useful to investors by evaluating the performance of six simple trading rules guided by changes in FAF revisions in comparison to a buy-and-hold strategy. Their sample consisted of 49 firms in three industries over a period of eight years from 1967 to 1974.[9] All the firms have a December fiscal year, were listed in the NYSE, and

---

[9] There is no mention of how and why the 49 firms or their industries were chosen, but, probably the database was limited.

had FAF forecasts reported in Standard and Poor's "Earnings Forecaster." They found that stock prices react strongly in the direction of the FAF revisions but comment that "the adjustment of the stock market to their release [was] low and extends beyond the revisions month" (p. 229), and that under some simple trading rules, abnormal returns could have been earned during the period tested.

Givoly and Lakonishok (1987) examined the degree of association between cross-sectional aggregate measure earnings forecasts and the market rate of return for a number of firms ranging from 400 in 1976 to 2,600 in 1983. The data were obtained from the Institutional Brokers Estimate System (hereafter IBES) prepared by the Lynch, Jones & Ryan brokerage house. Givoly and Lakonishok reported that changes in earnings forecasts of individual firms were correlated with the price behavior of respective stocks. However, they found no significant association between the aggregate measure of earnings forecasts and the market return and this lack of association was attributed to the "low commonality in the direction of contemporaneous changes in EPS forecasts across firms ... due primarily to the very low commonality in the revisions of earnings forecasts across firms" (p. 149).

Collins and Hopwood (1980)

Collins and Hopwood randomly selected 50 firms from 205 calendar year-end firms whose reported earnings data was available from 1951 through 1974, and who had twenty consecutive forecasts available from 1970 in the Value Line Investment Survey. The forecasts from Value Line were compared for accuracy against the following four mechanical models:

Model (1)	A consecutively and seasonally differenced first-order moving average model.
Model (2)	A seasonally differenced first-order autoregressive model with a constant drift term.
Model (3)	A seasonally differenced first-order autoregressive and seasonal moving average model.
Model (4)	The Box-Jenkins model.

The mean absolute percentage forecast error, $MAPFE_{k,t}$, for model k in quarter t, was calculated to make the comparison and is specified as:

$$MAPFE_{k,t} = \left[\sum_{i=1}^{N} \left| \frac{A_{i,t} - P_{i,t,k}}{A_{i,t}} \right| \right] / N$$

where $A_{i,t}$ = actual EPS for firm i in quarter t; and $P_{i,t,n}$ = predicted EPS for firm i in quarter t, generated by model k. An outlier-adjusted MAPFE — which assigns a value of 3.0 for all forecast errors that have a value greater than 3.0 — was also utilized to control for outliers. Collins and Hopwood reported that FAF generated fewer outliers than mechanical models, and that none of the outliers resulted because the denominator — actual earnings — was close to zero. The cause was attributed to economic event(s) rather than mathematical calculation. The authors concluded from their analysis that FAF of earnings were superior to mechanical models that were utilized.

Fried and Givoly (1982)

Fried and Givoly compared FAF over the years 1969 to 1979 with two mechanical models against 6,020 observations from 424 distinct firms in terms of both relative accuracy and association with stock price movements.[10] They compared the relative accuracy of the forecasts by comparing their mean relative error, e_t^k, defined as:

$$e_{i,t}{}^k = \left[\sum_{i=1}^{N} e_{i,t}{}^k \right] / N$$

[10] The mechanical models are: (1) a modified submartingale model; and (2) a index model similar to the one used by Ball and Brown (1968) (see literature review in this chapter).

where k denotes the expectation model; i the observation index (i 1,...,N); and t the year. Results show that in almost all years (for 1970 only the index model was superior to FAF), the accuracy of FAF measured by the mean relative error was greater than that of the competing models.

To make the comparison for market reaction, cumulative abnormal returns were computed in order to apply two tests. First, the correlation between the magnitude of the prediction error and the stock price movements was computed. The model which yields the highest correlation was considered to be superior. The second test involved a weighted API in which the weights were determined by size of the prediction error. Fried and Givoly argued that

> If the 'unexpected' earnings (conveyed by the error) are expected to be permanent (consistent with the random-walk behavior of earnings over time) and the security risk is unaltered, the abnormal return will be proportional to the error. (p. 94)

Specifically, the weight $w_{i,t}^{k}$ assigned to each security i in year t of portfolio k is:

$$w_{i,t}^{k} = \frac{|e_{i,t}^{k}|}{\sum_{i=1}^{N} |e_{i,t}^{k}|}$$

and the portfolio's weighted API, $P(API_{k,t})$, is

$$P(API_{k,t}) = \left[\sum_{i=1}^{N} w_{i,t}{}^{k} \right] (API_{k,t}).$$

The model whose signals were the most strongly associated with stock price behavior was considered the best surrogate. The results indicated that FAF are a better surrogate for market expectations of earnings than the mechanical models. They added that an investment strategy of adding stocks to the portfolio on the basis of foreknowledge of the FAF errors were superior to one based on foreknowledge of the prediction errors of the extrapolative models.

Peterson and Peterson (1982)

Peterson and Peterson examined the relation between the distribution of security returns and investor expectations. Data was obtained from IBES and consisted of 172, 193, 236 and 249 firms for four sample periods of 1976-1977, 1977-1978, 1978-1979, and 1979-1980, respectively. Each firm satisfied the following four requirements: the firm (1) was included in the IBES data base at both the beginning and end of the period, and had at least eight analysts provide the IBES with forecasts; (2) had all earnings forecasts greater than zero; (3) was listed on the CRSP tape over the tested period and 60 months prior; and (4) had a fiscal year ending on December 31.

Using alternative methods of modeling divergence and changes of investor opinion, as defined with respect to consensus forecasts, Peterson and Peterson found that changes in the mean consensus EPS estimates had a direct influence on security returns.

Hawkins, Chamberlin and Daniel (1984)

Hawkins, Chamberlin and Daniel determined that large revisions in annual earnings expectations can predict changes in stock prices. Equally weighted portfolios were formed at quarterly intervals by taking the 20 stocks exhibiting the largest monthly percentage increase in their consensus (mean) EPS estimate for each of the 24 quarters from March 1975 though December 1980 as reported in the IBES data base.

Using 12-month cumulative total returns, they found that these portfolios (risk-adjusted) outperformed both the IBES universe and the Standard and Poor's 500 Index. Peterson and Peterson believed that the results of their study strongly suggested that revisions in consensus earnings estimates can be used to predict subsequent stock-price movements. They concluded that the market was inefficient in processing information contained in consensus forecast revisions.

Elton, Gruber and Gultekin (1984)

Elton, Gruber and Gultekin analyzed the errors made by professional forecasters in estimating EPS for 414 firms with fiscal years ending in December, and at least three analysts reporting in the IBES data base for years 1976 through 1978. Using the following three measures of forecast error, they concluded that professional forecasts were more accurate than forecasts created using regression techniques:

Measure (1)	actual minus forecasted EPS;
Measure (2)	the difference between actual growth and forecasted growth; and
Measure (3)	Theil's U-statistic.

They found a decline in monthly annual forecast error over the year, converging upon the actual EPS as the earnings announcement date approaches. On an yearly basis, they found that analysts systematically overestimated the earnings of high-growth firms and underestimated the earnings of low-growth firms. Also, a similarity in the measure of forecast error was found from year to year. Their analysis did not, however, address market efficiency.

Arnott (1985)

Arnott examined consensus earnings estimates using earnings forecasts for one-year and two-year projections. Arnott groups stocks by decile, using the highest earnings surprise as the top decile. Looking at total returns unadjusted for risk, 12 months following the annual earnings announcement, he found the top earnings surprise decile outperformed the bottom decile by ten percent for both the one-year and two-year forecasts. The results represented in this study suggest market inefficiency. However, Arnott did not specifically test for announcement day and post-announcement day returns. Arnott concluded that the highest total returns can be made by predicting the largest earnings surprises.

Brown, Griffin, Hagerman and Zmijewski (1987a,b)

Brown, et al. (1987a) provided evidence of financial analyst superiority relative to three mechanical models in predicting firms' quarterly EPS numbers. Using a measure of forecast error defined as the absolute value of actual EPS minus forecasted EPS divided by the actual EPS, the Friedman test (as used by Brown and Rozeff (1978)) was used to compare the mechanical models to forecasts made by analysts, as reported in Value Line Investment Survey, for 233 firms for years 1975-1979 and 212 firms for 1980. They report that Value Line forecast error has the lowest mean rank — 61 of 69 times – with significance in 47 of the cases. Furthermore, the eight cases in which Value Line forecasts do not possess the lowest mean rank forecast error were not distinguished by any pattern (i.e., they are not confined to particular years, conditioning quarters, or forecast horizons), and the differences were never statistically significant in favor of any the mechanical models.

Brown, et al. (1987b) investigated the association between excess returns and five alternative proxies for the market's assessment of unexpected quarterly earnings on the same data used in the Brown, et al. (1987a) study.[11] While FAF generally explain excess returns better than other proxies, the results indicated that no single proxy consistently dominates.

O'Brien (1988)

O'Brien utilized the IBES data tape that contained individual forecasts made by analysts for years 1975 to 1981. She compared the prediction accuracy of the individual analyst, the mean forecast, the median and forecasts derived from two time-series models. She also examined the associations between the UE (as calculated from above proxies) and abnormal returns. The sample of 184 firms consisted of those with December fiscal years meeting

---

[11] A fifth time-series model is compared.

the following conditions: (1) at least one forecast available for each year of the test period; (2) annual EPS number available on COMPUSTAT; (3) earnings announcement dates available either on COMPUSTAT or in the Wall Street Journal; (4) daily returns data available on CRSP; and (5) 30 continuous quarters of EPS numbers available from the third quarter of 1969 through the fourth quarter of 1975. Data on forecast horizons of 5, 60, 120, 180 and 240 days were analyzed.

O'Brien reported that "the most current forecast weakly dominates the mean and median forecasts" (p. 53) and found FAF more accurate than the time-series models that were applied. However, she found that the time-series models predicted excess stock returns better than prior knowledge of analysts' errors. She commented that "this is inconsistent with previous research, and is anomalous given analysts' greater accuracy" (p. 53). She also pointed out that "because of this anomalous result, it is unclear that analysts provide a better model of the 'market expectation' than mechanical models" (p. 82).

Summary

Table 2 presents a summary of the studies on the superiority of FAF of earnings to mechanical models, along with a comparison of the sample sizes and periods examined. All but one of the nine studies presented in Table 2 report

TABLE 2

Summary of Findings of Studies on the Superiority of FAF of Earnings to Mechanical Models

Study	Sample Period	Firms In Sample	Fore-cast	Supe-riority
Cragg and Malkiel [1968]	1962-63	185	Investment[a] Firms	No
Malkiel and Cragg [1970]	1961-65	178	Investment[b] Firms	Yes
Barefield and and Comiskey [1975]	1967-72	100	Earnings[c] Forecaster	Yes
Brown and and Rozeff [1978]	1972-75	50	Value Line	Yes
Crichfield, Dykman and Lakonishok [1978]	1967-76	49	Earnings Forecaster	Yes
Fried and Givoly [1982]	1969-79	424	Earnings Forecaster	Yes
Elton, Gruber and Gultekin [1984]	1976-78	414	I/B/E/S[d]	Yes
Brown, Griffin, Hagerman and Zmijewski [1987]	1975-79	233	Value Line	Yes
O'Brien [1988]	1975-81	184	I/B/E/S[e]	Yes

Notes:

[a]This study used forecasts furnished by 5 investment firms.

[b]This study used forecasts furnished by 17 investment firms.

[c]The Earnings Forecaster is a Standard and Poor's product providing analysts' consensus forecasts.

[d]The Institutional Brokers Estimate System (I/B/E/S) is a Lynch, Jones, and Ryan product providing anaysts'consensus forecasts.

[e]This study used the I/B/E/S detailed tape which provides data on forecasts of individual analysts.

that FAF of earnings are superior to the mechanical models they were compared against. Although Cragg and Malkiel (1968) found results contrary to the others' studies, they later reverse their conclusion applying a longer period their 1970 study. However, none of the studies which examine the superiority of FAF addressed the market efficiency issue. Table 3 summarizes the studies that unanimously support the conclusion that a direct relation between UE changes and share price fluctuations exists.

TABLE 3

Summary of Findings of Studies on the Effect of FAF of Earnings on Security Prices

Study	Sample Period	Firms In Sample	Forecast	Price Effect
Niederhoffer and Regan [1972]	1970-72	1253	Earnings Forecaster	Yes
Givoly and Lakonishok [1980]	1967-74	49	Earnings Forecaster	Yes
Givoly and Lakonishok [1987]	1976-83	2600	I/B/E/S	Yes
Peterson and Peterson [1982]	1976-80	249	I/B/E/S	Yes
Hawkins, Chamberlin and Daniel [1984]	1975-80	333	I/B/E/S	Yes
Arnott [1985]	1976-82	700	I/B/E/S	Yes

Chapter III

A NEW EARNINGS SURPRISE MEASURE

Motivation and Arguments

Traditionally, surprise is defined as the difference between the actual event and what was expected. In the case of earnings surprises, the surprise is, simply, actual EPS minus forecasted EPS. However, what the market actually expects the EPS to be, for any particular firm, is not observable. Therefore, some difficulty arises when we try to find the best surrogate for the market's expectation of EPS and, consequently, the definition of an earnings surprise.

It is now well accepted in both finance and accounting literature that the FAF are superior to forecasts made by time-series models (see Table 2: Summary of Findings of Studies on the Superiority of FAF of Earnings to Mechanical models). The consensus of FAF serves well as a proxy for the market's expected earnings number.[12] There are still some differences of opinion, however, on what is an

---

[12] Consensus of FAF is defined as the mean forecast of EPS.

appropriate relative measure of earnings surprises. The four most commonly used measures are:

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

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

(3) $$\frac{A - F}{P_t}$$

(4) $$SUE = \frac{\text{Reported EPS - Estimated EPS}}{\text{SEE for the Estimating Regression Equation}}$$

where A = actual EPS; F = forecasted EPS; |A| = the absolute value of actual EPS; and P_t = price of the underlying stock at time t (some use the closing price of the day prior to the announcement date of actual earnings, and some use the closing price of the announcement date).

The first measure, (A - F)/|A|, is arguably the weakest in terms of measuring relative surprises. For example, consider stocks X and Y with share prices of one dollar and ten dollars, respectively. A forecast error of ten cents for Stock X, with actual EPS of twenty cents, is considered by this measure to have the same fifty percent earnings

surprise as a forecast error of one dollar on Stock Y, with two dollars of actual EPS. There is not much improvement when the forecasted earnings number is substituted for the denominator as in the second measure,
(A - F)/F. The third measure, which utilizes the underlying stock price as the denominator, is an improvement on capturing the relative size of the surprise, assume that the share price incorporates the underlying uncertainty about the forecast. It is questionable, however, whether this measure properly reflects the divergence of analysts' opinions regarding the prediction of the actual EPS.[13]

The SUE measure stands out as being the best relative measure of earnings surprise because of its method of standardization. The expected earnings numbers are obtained from a time-series model, and earnings surprises are standardized by the SEE for the estimating regression equation. The larger the variability, the smaller the surprise for a given dollar error in the forecast. Consider stocks A and B which have equal share prices of fifty dollars and forecast errors of one dollar. If the SEE for stock A is greater than that for stock B, it is argued that stock A would have a smaller relative surprise than stock B. However, standard implementation of this method suffers from using a time-series model to estimate the expected earnings

[13] To avoid some of these problems, many studies resort to truncating small and extraordinarily large forecast errors, or to using nonparametric significance tests.

number, which is considered to be an inferior estimate when compared to the consensus of FAF. An inferior proxy for the expected earnings number would naturally result in an inferior measure of UE. Also, the SEE may not reflect the divergence of the market's opinions on the forecasts of earnings, for the very reason that the estimating equation (for the expected earnings number) itself may not be providing a suitable representation of the market's expectations.

The motivation for introducing yet another measure of earnings surprise comes from the desire to improve upon the SUE measure. The new measure, SES, is defined as:

$$SES = \frac{A - F}{STD(FAF)}$$

where A is the actual earnings; F is the mean of analysts' forecasts of earnings; and STD is the cross-sectional standard deviation of analysts' forecasts (hereafter STD(FAF)). This measure is, in fact, very comparable to the SUE measure. The major improvement comes from using the superior earnings number obtained from the consensus of FAF in place of the proxy derived from the times series model. The surprise is then normalized by dividing by the STD(FAF). The STD(FAF) should capture the dispersion of opinion and, thereby, arrive at a better relative surprise measure.

Examples 1 and 2 are given to illustrate how dissimilar conclusions may be arrived at from different measures of UE. In the first example (Example 1) two firms, Firm A and Firm B, with matching actual EPS of \$4 and \$2 for the current period, time t, and the past period, time t-1, respectively, are presented. In addition, the consensus EPS of \$2 (mean forecast) and the current stock price of \$20 are equivalent for both firms. Conclusions from application of the following UE measures are compared:

(1) $$UE = A - F \;;$$

(2) $$UEA = \frac{A - F}{|A|} \;;$$

(3) $$UEF = \frac{A - F}{F} \;;$$

(4) $$UEP = \frac{A - F}{P} \;;$$

(5) $$UET = \frac{A_t - A_{t-1}}{A_{t-1}} \;;$$

and (6) $$SES = \frac{A - F}{STD(FAF)}.$$

All of the measures, except SES, conclude that both Firm A and Firm B had equal earnings surprise, but disagree among themselves as to the magnitude of the surprise. On the other hand, because it takes into consideration the divergence of opinions prior to the announcement of actual earnings, SES shows Firm A to have had the relatively larger earnings surprise. In other words, Firm A had the larger relative surprise because the actual EPS was further out of "the range of expectations."

The second example (Example 2) depicts two firms, Firm X and Firm Y, where actual earnings (both current and past period), consensus forecast of EPS, and prices all differ for both firms. The same measures used in the first example are also applied. Here, not only do the five other measures of UE have conflicting conclusions as to the direction of the surprise when compared to SES, but some also disagree among themselves as to both the direction and magnitude of the surprise. Again, it is shown that SES better captures the relative size of the earnings surprise.

Example 1

Comparison of Earnings Surprise Measures

Suppose the distribution of three analysts' forecasts of EPS for Firm A and Firm B is as follows:

	Firm A	Firm B
Analyst 1	$1.00	0.50
" 2	2.00	2.00
" 3	3.00	3.50
A_{t-1}	2.00	2.00
A_t	4.00	4.00
P_t	20.00	20.00
STD	1.00	1.50

where A_t and A_{t-1} are actual earnings for time t and t-1, respectively.

If the mean forecast is used as the proxy for the market's expectation of EPS, then the following describes the earnings surprise measures relative to each other:

Type of Measure	Result	Conclusion
UE	$2.00 vs $2.00	A = B
UEA	50% vs 50%	A = B
UEF	100% vs 100%	A = B
UEP	10% vs 10%	A = B
UET	100% vs 100%	A = B
SES	2.00 vs 1.33	A > B

Example 2

Comparison of Earnings Surprise Measures

The distribution of the three analysts' forecast of EPS for Firm X and Firm Y is as follows:

	Firm X	Firm Y
Analyst 1	$0.18	1.50
" 2	0.20	2.00
" 3	0.22	2.50
A_{t-1}	0.18	1.50
A_t	0.30	3.00
P_t	3.00	30.00
STD	0.02	0.50

Again, if the mean forecast is used as the proxy for the market's expectation of EPS, then the following describes the earnings surprise measures relative to each other:

Type of Measure	Result	Conclusion
UE	$0.10 vs $1.00	X < Y
UEA	33% vs 33%	X = Y
UEF	50% vs 50%	X = Y
UEP	3% vs 3%	X = Y
UET	67% vs 100%	X < Y
SES	5.0 vs 2.0	X > Y

Correlation Between SES and Future Excess Returns

Parallel to the hypothesis advanced and tested in the SUE papers, it is postulated that there is a significant relationship between SES and future excess returns. To test this, the SES measure will be calculated for all of the firms in the data set and categorized by their respective size of SES. Future excess returns will be calculated in the same manner as in Rendleman, et al (1982). For each quarter, daily excess and cumulative excess returns will be calculated for each stock, for days -20 to +90 surrounding the announcement date of earnings. Excess returns are calculated as the difference between the individual stocks' daily returns and the corresponding market returns, using an equally-weighted NYSE-AMEX index obtained from the CRSP tapes.[14] Next, these excess returns will be aggregated for all stocks within each SES category, over days -20 to +90, relative to the various earnings announcement dates during the quarter, and cumulated over days -20 to +90.

Excess return (ER) will be computed as follows:

$$ER_{j,t,q} = SR_{j,t,q} - MR_{p,t,q}$$

[14] Previous studies have shown that results do not differ significantly when the security returns are value-weighted. The results may be muted, however, as the SUE effect is strongest in small firms.

where $SR_{j,t,q}$ = the return for stock j on day t relative to the announcement date of earnings in quarter q; and $MR_{p,t,q}$ = equally weighted mean return on NYSE-AMEX index on day t relative to the announcement date of earnings in quarter q.[15]

Let M_q denote the number of stocks in a given SES category in quarter q. Then, the average excess return (AER) for stocks in that category for day t in quarter q is:

$$AER_{t,q} = \left[\sum_{j=1}^{M_q} ER_{j,t,q} \right] / M_q .$$

The average excess returns are averaged across all N number of quarters of the sample period to produce an aggregate average excess return (hereafter AAER) for day t:

$$AAER_t = \left[\sum_{q=1}^{N} AER_{t,q} \right] / N .$$

The AAER's are then added from days t1 to t2 to produce a cumulative aggregate average excess return (hereafter CAAER):

---

15 Quarters are specified to calculate the average excess return for stocks per quarter.

$$CAAER_{t1,t2} = \sum_{t=t1}^{t2} AAER_t .$$

To test for the significance of the CAAER's, an estimate of the variance of the CAAER's must be made. Following Ruback (1982), the variance must be estimated by assuming an AR(1) model generating returns so that there may be first-order serial correlation in the AAER's. (All higher order serial correlations are ignored.) The variance of the CAAER's is calculated as follows:

$$var(CAAER_{t1,t2}) = T * var(AAER_t) + 2(T - 1) cov(AAER_t, AAER_{t+1}) \ ;$$

$$T = t1 - t2 + 1 \ ;$$

$$\overline{AAER} = \left[\sum_{t=t1}^{t2} AAER_t \right] / T \ ;$$

$$var(AAER_t) = \left[\sum_{t=t1}^{t2} (AAER_t - \overline{AAER})^2 \right] / (T - 1) \ ; \text{ and}$$

$$cov(AAER_t, AAER_{t+1}) = \left[\sum_{t=t1}^{t2-1} (AAER_t - \overline{AAER})(AAER_{t+1} - \overline{AAER})\right] / (T - 2).$$

To test whether the CAAER's are significantly different from zero, the following t-statistic is calculated:

$$t = \frac{CAAER_{t1,t2}}{std(CAAER_{t1,t2})}.$$

In addition, a test for the significance of the aggregate excess return on the earnings announcement date (day zero) are conducted. The variance employed in this calculation is the variance of the AAER's calculated over the twenty days prior to the earnings announcement date.

Chapter IV

METHODOLOGY AND HYPOTHESIS TESTING

Change in Divergence of Opinion Hypothesis (H_1)

Most information-theory papers argue that uncertainty decreases as more information is received. Pincus (1983) argued that "the 'precision of earnings announcements' is correlated with differences in the rapidity of stock market adjustments and in the variability of unexpected returns" (p. 156). The relationship between the precision of information and the rapidity of market adjustments is said to be direct — the more precise the information, the quicker the adjustment. The association between the precision of information and variability in security prices is also said to be positive. In other words, the greater the precision, the larger the price variability. But consider what would happen if the new information is perceived to be imprecise. It seems logical that the result would then be the opposite — that is, imprecise information increases uncertainty. Large earnings surprises may be interpreted as imprecise information; hence, those stocks that exhibit such surprises may demonstrate slower price adjustments.[16]

In the context of the capital-asset-pricing model and option-pricing parameter estimation uncertainty, Barry and Brown (1985) and Ajinkya and Gift (1985), respectively, propose that divergence of analysts' opinions be used as a proxy for ex-ante earnings uncertainty. In fact, Crichfield, Dyckman, and Lakonishok (1978), Cragg and Malkiel (1982), and Givoly (1985) suggest that the dispersion of analysts' forecasts is useful as an ex-ante risk measure. The standard deviation of FAF (hereafter STD(FAF)), one measure of the degree of dispersion of opinions among the analysts, has been used in previous studies as a proxy for uncertainty. However, the STD(FAF) is an absolute measure of dispersion, not one that has been normalized across firms. Thus, cross-sectional averaging of changes in STD(FAF) may be misleading. To diminish this problem the change in the degree of uncertainty will be analyzed by looking at changes in the coefficient of variation of FAF (hereafter CV(FAF)), from before to after the earnings announcement.[17] One potential problem with

---

[16] Imprecise information is not to be confused with the validity of the reported EPS number. Information is deemed imprecise if it increases the uncertainty about future predictions.

[17]

$$\mathrm{CV(FAF)} = \frac{\text{(standard deviation FAF)}}{\text{(mean of analysts' forecasts of earnings)}}$$

STD(FAF) (and hence, CV(FAF)), however, is the possibility that the forecasts used to calculate it may not be contemporaneous since the dates of the forecasts vary. The problem is not severe if the age distribution of the forecasts is random cross-sectionally. Unfortunately, the severity of this problem is not ascertainable since the age distribution cannot be obtained from the databases used in this research.

It is conjectured that for firms with higher SES values the CV(FAF) will be significantly higher after the earnings announcement than for firms with lower SES values. The following model is used to test this hypothesis:

$$|CVCHG| = \alpha + \beta_1 |SES_1| + e$$

where CVCHG is the percent change in the absolute values of CV(FAF) before and after the earnings announcement. The absolute values for CV(FAF) are used because only the size, and not the direction, of the dispersion is important. Also, the absolute value of SES is employed because the hypothesis is testing the relationship between the size of the surprise and divergence of opinion, and not the direction of the surprise.

Duration of the Market Reaction (H_2)

Hillmer and Yu (1979) conceptualize the measurement of the speed of market adjustment as "the release of information in an economic context as to the length of time market trading takes to return to prior distributions of particular security characteristics" (p. 321). They proposed an operational definition and a statistical method to estimate the points in time where the adjustment process begins and ends. Verrecchia (1980) developed a model which suggests that the rapidity of price adjustments to new information will increase correspondingly to the precision associated with information (as determined by the changes in the consensus judgement among investors). Using the models proposed by Verrecchia (1980) and Holthausen and Verrecchia (1983), and Value Line's Predictability Index as the proxy for information precision, Pincus (1983) tested the following hypotheses:

H_i Earnings announcements ranked as hard to predict will have more rapid adjustments than announcements ranked as easy to predict.

H_{ii} Earnings announcements ranked as hard to predict will have greater variability of unexpected returns at the time of the announcement than announcements ranked as easy to predict.

He found evidence to support H_{ii}, but discovered results that were opposite of H_i – hard-to-predict earnings announcements had longer adjustment durations than easy-to-predict earnings. Pincus finds this to be counter-intuitive and suggests that perhaps it was because he "operationalized the notion incorrectly, or the model does not carry over to the real world, or both" (p. 176). Conceivably, the proxy he used was inappropriate, and the coefficient of variation (discussed in the previous section) is more suitable.

This study adopts the methods developed by Hillmer and Yu to estimate the duration of price adjustments to new information in estimating the adjustment periods of earnings announcements. The effect of earnings announcements on stock returns is assumed to be captured by allowing for a change in either the mean or variance.

Assume that the daily stock-return series $\{R_t\}$ is generated by the following stochastic process:

$$R_t = \mu + \varepsilon_t \qquad for\ t=1,2,3,... \qquad (1)$$

where μ is the mean of the daily stock returns; and the ϵ_t's are independent, normal, random variables identically distributed, with a mean equal to zero and variance equal to σ^2. This then implies that the stock returns R_t's are independent and identically distributed, with mean equal to

μ and variance equal to σ^2. During the period when there is no new information released, the distribution of R_t will not change. The arrival of new information, on the other hand, will change the distribution of R_t. Either the mean or the variance — or both — of R_t will shift in response to the impact of the new information.

Since the mean and variance of R_t do not change when there is no information, the partial sum of ϵ_t (hereafter denoted as S_k) from some beginning time t=1 to some point in time t=k should be normally distributed with a mean of zero and a variance of $k\sigma^2$.

$$S_k = \sum_{t=1}^{k} (R_t - \mu) = \sum_{t=1}^{k} \epsilon_t. \qquad (2)$$

Because ϵ_t's are independent, the covariance of ϵ at two different points in time is therefore zero:

$$Var(S_k) = Var\left(\sum_{t=1}^{k} \epsilon_t\right) = \sum_{t=1}^{k} Var(\epsilon_t) = \sum_{t=1}^{k} \sigma^2 = k\sigma^2. \qquad (3)$$

Suppose, however, that there is new information released at time $t=t_0$ and, further, the mean of the stock returns adjusts to reflect the new information. The mean of the partial sum S_k for $k>t_0$ should deviate from zero. Similarly, if the variance of the stock returns changes at time $t=t_0$, the variance of S_k for $k>t_0$ should deviate from $k\sigma^2$.

Four possible situations in which changes in the mean or variance of stock returns may be used to estimate the adjustment period are discussed in the following sections.

Case 1a: The mean of R_t increases.

Suppose the new information causes an increase in the mean of R_t, wherein the mean of the partial sum S_k shifts up.[18] To detect the point in time when such a shift occurs, the following hypotheses are set up:

Null Hypothesis (H_0): The mean of $S_k=0$; and
Alternative Hypothesis (H_a): The mean of $S_k>0$.

The null hypothesis says the mean R_t does not change. The alternative hypothesis is equivalent to the statement that the R_t increases. In order to test the null hypothesis, a boundary B_k is established. This boundary corresponds to

---

[18] Where time k is after the information arrival time.

some significance level α for each time t and the probability of the partial sum S_k – less than or equal to B_k, conditional on the null hypothesis – is equal to $(1-\alpha)$. That is, a set of B_k must be determined such that:

$$Pr[S_k \leq B_k \mid H_0] = (1-\alpha) \qquad for\ k=1,2,3,... \tag{4}$$

To transform the S_k sequence to standard normal random variables with a mean equal to zero and a variance equal to one, the mean of S_k is subtracted from each S_k, and the difference is divided by the standard deviation of S_k. Since the expected value of S_k, under the null hypothesis, is zero, the standardized normal random variables are $(S_k/\sigma\surd k)$ – following the Central Limit Theorem.[19] Thus the following is obtained:

[19] <u>Central Limit Theorem</u>

Suppose that $\{X_n\}$ is an independent sequence of random variables, having the same distribution with mean c, and finite positive variance σ^2. If $S_n = X_1 + ... X_n$, then:

$$\frac{S_n - nc}{\sigma\sqrt{n}} \Rightarrow N.$$

As n approaches infinity, $(S_n-nc)/(\sigma\surd n)$ behaves as a standard normal variable. (Billingsley, p. 367)

$$Pr\left[\frac{S_k}{\sigma\sqrt{k}} \le \frac{B_k}{\sigma\sqrt{k}} \mid H_0\right] = (1-\alpha). \tag{5}$$

Since $S_k/(\sigma\sqrt{k})$ is a standard, normal random variable, the same equation can be shown as:

$$\Phi\left[\frac{B_k}{\sigma\sqrt{k}}\right] = (1-\alpha) \tag{6}$$

where $\Phi[.]$ is the cumulative normal distribution function. This, in turn, implies that the boundary B_k is given by:

$$B_k = \sigma\sqrt{k}\ \Phi^{-1}(1-\alpha) \qquad for\ k=1,2,3,..... \tag{7}$$

where Φ^{-1} is the inverse cumulative normal distribution function.[20] The set B_k is then applied to test the null hypothesis for each k=1,2,... .

Assume, at some time t=T, the reaction to the new information ends and the partial sum S_T is larger than the corresponding boundary B_T. The null hypothesis, that the mean of the daily return series R_t does not change, is

---

[20] Note that $\Phi^{-1}(1-\alpha)$ is not equal to $(1/\Phi)(1-\alpha)$.

therefore rejected with $(1-\alpha)\%$ confidence level. Hence, at time $t=T$, an increase in the mean of R_t can be detected. However, time T is not when the daily returns starts to respond to the new information. Some time has passed since the day the R_t's started to respond to the new information.

Let t_0 be the time when the market returns begin to respond to the new information. To obtain where time t_0 lies on the time-line, the amount of time the partial sum S_T takes to drift from zero level to B_T is estimated. Then, subtracting the estimated drift time from T will result in obtaining the estimated t_0.

Now consider the partial sum as given by Equation (2). At time t_0, the mean of the market returns increases by $\Delta\mu$; the new mean after reflecting the new information becomes $(\mu + \Delta\mu)$. For $k<t_0$, S_k is normally distributed with a mean of zero and a variance of σ^2. Since the ϵ_t's are identically distributed with a zero mean and a σ^2 variance, the partial sum S_k is also a Weiner process with zero drift. However, for $k>t_0$, the partial sum S_k has a mean equal to $(k - t_0)\Delta\mu$ and a variance equal to $k\sigma^2$.[21] In this case, S_k is a Weiner process with the drift term equal to $\Delta\mu$.

It follows then that, since at time T the response signal of S_T exceeds the confidence limit B_T and is

---

[21] Note that variance is assumed to be constant in this scenario.

detected at time T, the amount of time $(T - t_0)$ for the Weiner process S_T to drift from zero level to B_T is the first passage time. According to Cox and Miller (p. 222), the expected first passage time for a Weiner process with a drift term equal to $\Delta\mu$ to wander from zero level to B_T is $(B_T/\Delta\mu)$. Therefore, an estimate for reponse time t_0 is:

$$\hat{t}_0 = T - \frac{B_T}{\Delta\mu}. \tag{8}$$

Case 1b: The mean of R_t decreases.

Suppose the new information causes a decrease in the mean of R_t, wherein the mean of the partial sum S_k shifts down. To detect the point of time when such a shift occurs, the following hypotheses are set up:

Null Hypothesis (H_0): The mean of $S_k=0$; and
Alternative Hypothesis (H_a): The mean of $S_k<0$.

In order to test the null hypothesis, that the mean of R_t does not change, the boundary B_k is again established. However, under this case, the boundary must correspond to some significance level α for each time t and the probability of the partial sum S_k – <u>greater</u> than or equal to B_k, conditional on the null hypothesis – equal α. And because the set B_k is negative, it follows that

$$Pr[S_k \geq B_k \mid H_0] = \alpha \qquad for\ k=1,2,3,\ldots \qquad (9)$$

and that the boundary B_k is given by:

$$B_k = -\sigma\sqrt{k}\ \Phi^{-1}(\alpha) \qquad for\ k=1,2,3,\ldots \qquad (10)$$

where Φ^{-1} is again the inverse cumulative normal distribution function. The set B_k is then applied to test null hypothesis for each time k=1,2,... .

If at time t=T the partial sum S_T is less than the corresponding boundary B_T, the null hypothesis is rejected with (1-α)% confidence level. Hence, at time t=T a decrease in the mean of the daily return series R_t can be detected. In this case, at time $t=t_0$, the mean of the market returns decreases by $\Delta\mu$ and, therefore, the new mean after reflecting the new information becomes $(\mu - \Delta\mu)$. However, for $k<t_0$, the partial sum S_k has a mean equal to $(k - t_0)(-\Delta\mu)$ and a variance equal to $k\sigma^2$.[22] The expected first passage time for a Weiner process with a drift term equal to $(-\Delta\mu)$ to wander from zero level to B_T is then $[B_T/(-\Delta\mu)]$. Therefore, an estimate for reponse time t_0 is:

[22] Note that variance is again assumed to be constant.

$$\hat{t}_0 = T + \frac{B_T}{\Delta\mu}. \tag{11}$$

Case 2a: The variance R_t increases.

In order to investigate the change in variance, another stochastic process, based on Equation (1), is constructed:

$$Q_t = (R_t - \mu)^2 = \epsilon^2{}_t \qquad for\ t=1,2,3,... \tag{12}$$

where Q_t's are the variances of the daily stock returns. Since $E(R_t - \mu)$ is σ^2, the Q_t's are identical and independently distributed with a mean equal to σ^2 and a variance equal to $VAR(\epsilon_t)$; if $VAR(\epsilon_t)$ is finite. If ϵ is normal, as assumed in Equation (1), then $\epsilon_t{}^2$ is distributed as chi-square with a mean equal to σ^2 and a variance equal to $2\sigma_Q{}^4$, and so is Q. During the period when there is no new information released, the distribution of Q_t will not change. The partial sum of $(Q_t - \sigma^2)$ (hereafter denoted as P_k) from some beginning time t=1 to some point in time t=k

$$P_k = \sum_{t=1}^{k} (Q_t - \sigma^2) = \sum_{t=1}^{k} (\epsilon_t{}^2 - \sigma^2) \tag{13}$$

should have a mean of zero and a variance of $2k\sigma^4$. And $2k\sigma^4$ is derived by

$$E(P_k) = \sum_{t=1}^{k} (E\,\epsilon_t^2) - \sum_{t=1}^{k} \sigma^2 = k\sigma^2 - k\sigma^2 = 0 \quad ; \text{ and}$$

$$Var(P_k) = Var\left[\sum_{t=1}^{k} (\epsilon_t^2 - \sigma^2) \right] = \sum_{t=1}^{k} Var(\epsilon_t^2)$$

$$= \sum_{t=1}^{k} (2\sigma^4) = 2k\sigma^4.$$

Therefore, if the mean of Q_t increases by σ_f^2(new variance) at time $t=t_0$, then

$$P_k = \sum_{t=1}^{t_0-1} (Q_t - \sigma^2) + \sum_{t=t_0}^{k} (Q_t - \sigma_f^2)$$

$$= 0 + (k - t_0 + 1)(\sigma_f^2) = 2k\sigma_f^4.$$

To simplify the notation, $2k\sigma_f^4$ is rewritten as $k\sigma_f^2$ to denote the variance of chi-square random variable ϵ_t^2 (i.e., the variance of the partial sum P_k is written as $k\sigma_Q^2$).

If the arrival of new information causes an increase in the variance of the stock returns, the mean of the partial sum P_k would then shift up. To detect the point in time when such a shift occurs, the following hypotheses are set up:

Null Hypothesis (H_0): The mean of P_k=0 ; and
Alternative Hypothesis (H_a): The mean of P_k>0.

The boundary B_k necessary to test the null hypothesis is then determined by:

$$B_k = \sigma_Q \sqrt{k}\, \Phi^{-1}(1-\alpha) \qquad for\ k=1,2,3,\ldots.. \tag{14}$$

where the derivation for Equation (14) is analogous to that of Equation (7). In this situation, however, the variance of the market returns increases by $\Delta\sigma_Q^2$ and the new variance, after reflecting the new information, becomes $(\sigma_Q^2 + \Delta\sigma_Q^2)$ at time $t=t_0$. For $k<t_0$, P_k is normally distributed with a mean of zero and a variance of $k\sigma_Q^2$. Since $(\epsilon_t - \sigma_Q^2)$ are independent and identically distributed with a mean of zero and a variance of σ_Q^2, the partial sum P_k is also a Weiner process with zero drift.

However, for $k>t_0$ the partial sum P_k has a mean equal to $(k - t_0)\Delta\sigma_Q^2$ and P_k is a Weiner process with the drift term equal to $\Delta\sigma_Q^2$. Accordingly, the expected first passage time for a Weiner process with a drift term equal to $\Delta\sigma_Q^2$ to wander from zero level to B_T is then $(B_T/\Delta\sigma_Q^2)$. Thus, an estimate for the reponse time t_0 is:

$$\hat{t}_0 = T - \frac{B_T}{\Delta\sigma_Q^2} \tag{15}$$

where $\Delta\sigma_Q^2$ is the new variance minus the old variance.

Case 2b: The variance of R_t decreases.

In this situation the new information causes a decrease in the variance of R_t and the mean of the partial sum P_k shifts down. The following hypotheses are set up to detect the point of time when such a shift occurs:

Null Hypothesis (H_0): The mean of $P_k=0$; and
Alternative Hypothesis (H_a): The mean of $P_k<0$.

As in Case 1b: The Mean of R_t Decreases, the boundary B_k necessary to test the null hypothesis must correspond to some significance level α for each time t and the probability of the partial sum P_k – greater than or equal to B_k, conditional on the null hypothesis — equal α.[23] As such, following the derivation for Equation (9), the set B_k must be determined such

$$Pr[P_k \geq B_k \mid H_0] = \alpha \qquad for\ k=1,2,3,... \tag{16}$$

and is obtained by

$$B_k = -\sigma_Q \sqrt{k}\, \Phi^{-1}(\alpha) \qquad for\ k=1,2,3,.... \tag{17}$$

At time t_0, because the variance of the market returns decreases by $\Delta\sigma_Q^2$, the new variance becomes $(\sigma_Q^2 - \Delta\sigma_Q^2)$ after reflecting the new information. In this case, the expected first passage time for a Weiner process with a drift term equal to $(-\Delta\sigma_Q^2)$ to wander from zero level to B_T is $[B_T/(-\Delta\sigma_Q^2)]$. Therefore, an estimate for the reponse time t_0 is

$$\hat{t}_0 = T + \frac{B_T}{\Delta\sigma_Q^2}. \tag{18}$$

[23] Note that Bk is negative for this case as was in Case 1b.

Estimation Procedures

The effect of earnings announcement on the mean of the stock returns, however, is found to be such that differences in the durations of price adjustments are impossible to detect by observing changes in daily returns — intra-day data may perhaps accomplish it. On the other hand, changes in variances can be seen over days. Therefore, this study will examine the differences in the duration of price adjustments to earnings announcements by focusing on the changes in variances.

The arrival of earnings surprise information is assumed to cause an immediate increase in the variance followed by immediate or decline to its "normal" level. The adjustment period of the stock returns to the earnings announcement is defined as the period between two days prior to the announcement to the day the reaction ends. The two-day pre-announcement period serves to capture the impact of earnings information leakage on stock price. Any pre-announcement period longer than two days will likely incorporate noisy signals unrelated to earnings. Therefore, the crucial task is to estimate when the variance reverts to its "normal" level. To detect when the reaction to the announcement ends, Case 2b - The Variance of R_t Decreases scenario will be assumed. The following steps describe the estimation of the duration of price adjustments to earnings announcements.

Step 1:

Plot the daily stock returns against time in terms of days, and inspect the day to day stock return fluctuations. Figure 1 (Estimating the Adjustment Boundaries) graphs an example of a typical return series for a stock whose SES value is greater than or equal to 5.0 (highest positive earnings surprise category).

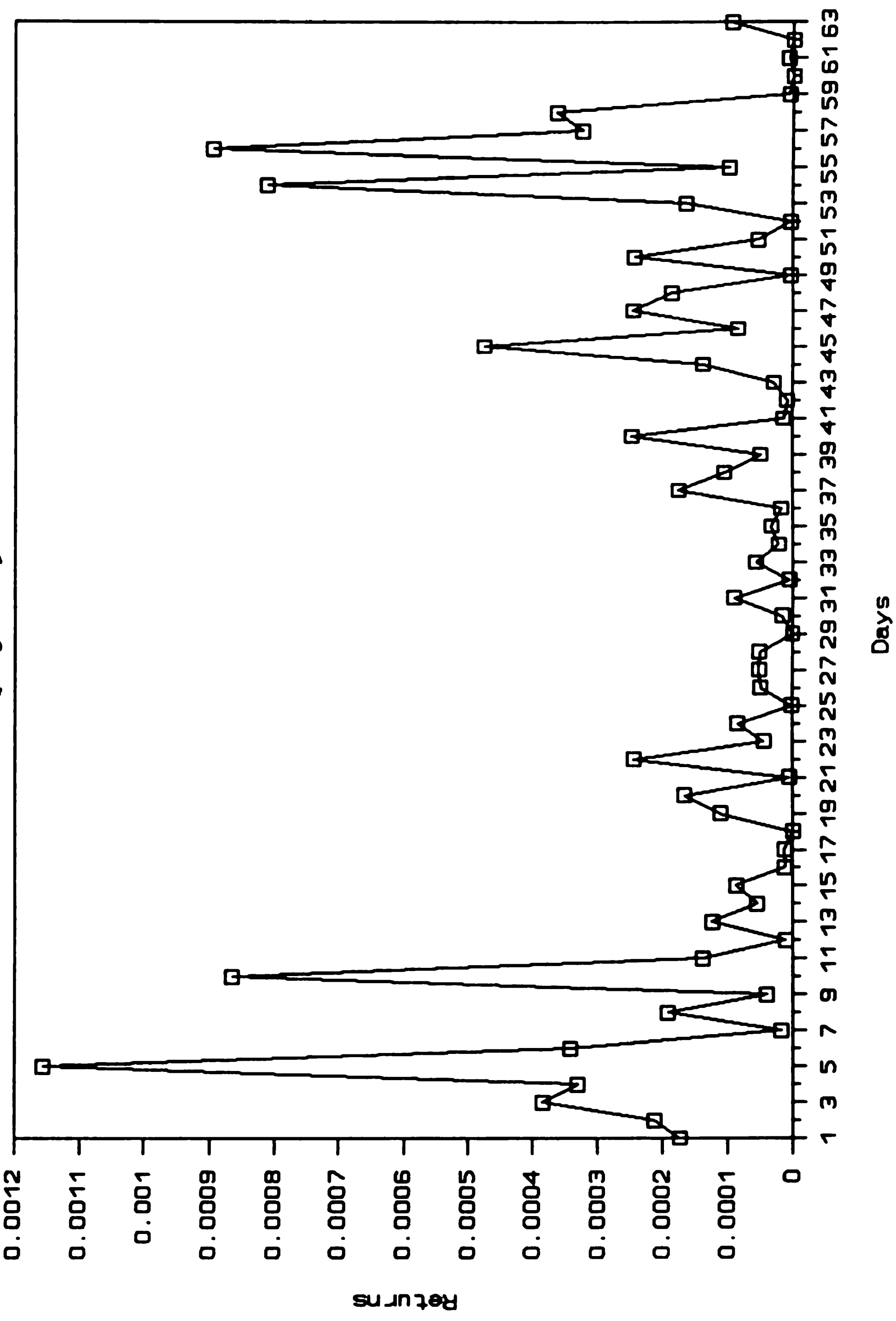
Step 2:

By examining the graph, select two points: (1) t_E, which serves as the rough estimate for the end of the variance adjustment period; and, (2) the following day, t_{E+1}, which serves as the beginning of the post-adjustment (normal) period. Also, visually estimate the end of the normal period t_N.

Shown on Figure 1, the end of the earnings announcement adjustment period, t_E, is estimated to be on Day 12 and the end of the normal period, t_N, to be on Day 36. As one can easily see the variance of the stock return begins to increase again on Day 36. This is assumed to be caused by arrival of information that is not related to current earnings suprise. The adjustment period is from day -2 to t_E and the post-adjustment (normal) period spans from t_{E+1} to t_N.

Estimating the Adjustment Boundaries

(Figure 1)



Step 3:

Let R_t denote the daily stock returns. Estimate the mean of the daily stock returns during the adjustment period by

$$\hat{\mu}_R = \frac{\sum_{t=t_S}^{t_E} R_t}{(t_E - t_S + 1)}$$

where t_S is the starting date which is two days before the announcement date.[25]

Step 4:

Define a series of new random variables (Q_t) with:

$$Q_t = (R_t - \hat{\mu}_R)^2$$

— parallel to Equation (12). Then calculate the earnings-announcement adjustment-period return variance.[26]

---

[25] Note that $\hat{\mu}_R$ is not equal to zero because the expected value of R_t is not zero.

[26] Note that Q_t can be regarded as the sample variance with only one data point.

$$\hat{\sigma}_X^2 = \frac{\sum_{t=t_S}^{t_E} Q_t}{(t_E - t_S + 1)}.$$

Step 5:

Calculate the post-adjustment (normal) period return variance.

$$\hat{\sigma}_Y^2 = \frac{\sum_{t=t_{E+1}}^{t_N} Q_t}{(t_N - t_{E+1} + 1)}.$$

Step 6:

Calculate the adjustment period return variance of Q_t.

$$\hat{\sigma}_Q^2 = \frac{\sum_{t=t_S}^{t_E} (Q_t - \hat{\sigma}_X^2)^2}{(t_E - t_S + 1)}.$$

Step 7:

Calculate the partial sum, P_k, for each point in time

$$P_k = \sum_{t=t_S}^{t_N} (Q_t - \hat{\sigma}_X^2)^2 \qquad \text{for } t=t_S, t_{S+1}, \ldots, t_N.$$

Under the null hypothesis, where the variance of the daily stock returns does not change within the estimation period, the expected value of P_k should be zero. However, if the variance of the stock returns falls back to the normal level, P_k becomes negative for k beyond t_E.

Step 8:

For a chosen significance level α, calculate the $(1-\alpha)$% confidence level B_k for each point in time.[27]

$$B_k = -\hat{\sigma}_Q \sqrt{k}\, \Phi^{-1}(\alpha) \qquad \text{for } k=t_S, t_{S+1}, \ldots, t_N.$$

[27] For this study α equals 5%.

Note again that this equation for B_k is an asymptotical result based on the Central Limit Theorem and is equivalent to Equation (17) and Equation (10).[28] On Figure 2 (Estimating the Adjustment Period), B_k is depicted on the graph as the smooth, downward-curving line.

Step 9:

Compare the sequence P_k with the sequence B_k and record the point T at which P_k crosses B_k. On Figure 2, the point T occurs on Day 20. Note that P_k crossing B_k is a signal that the adjustment of the stock return variance to the earnings announcement has ended. The estimate of the time at which the adjustment actually ends is

$$\hat{t}_E = T + \frac{B_T}{\Delta\hat{\sigma}_Q^2} \qquad where,\ \Delta\hat{\sigma}_Q^2 = (\hat{\sigma}_X^2 - \hat{\sigma}_Y^2)$$

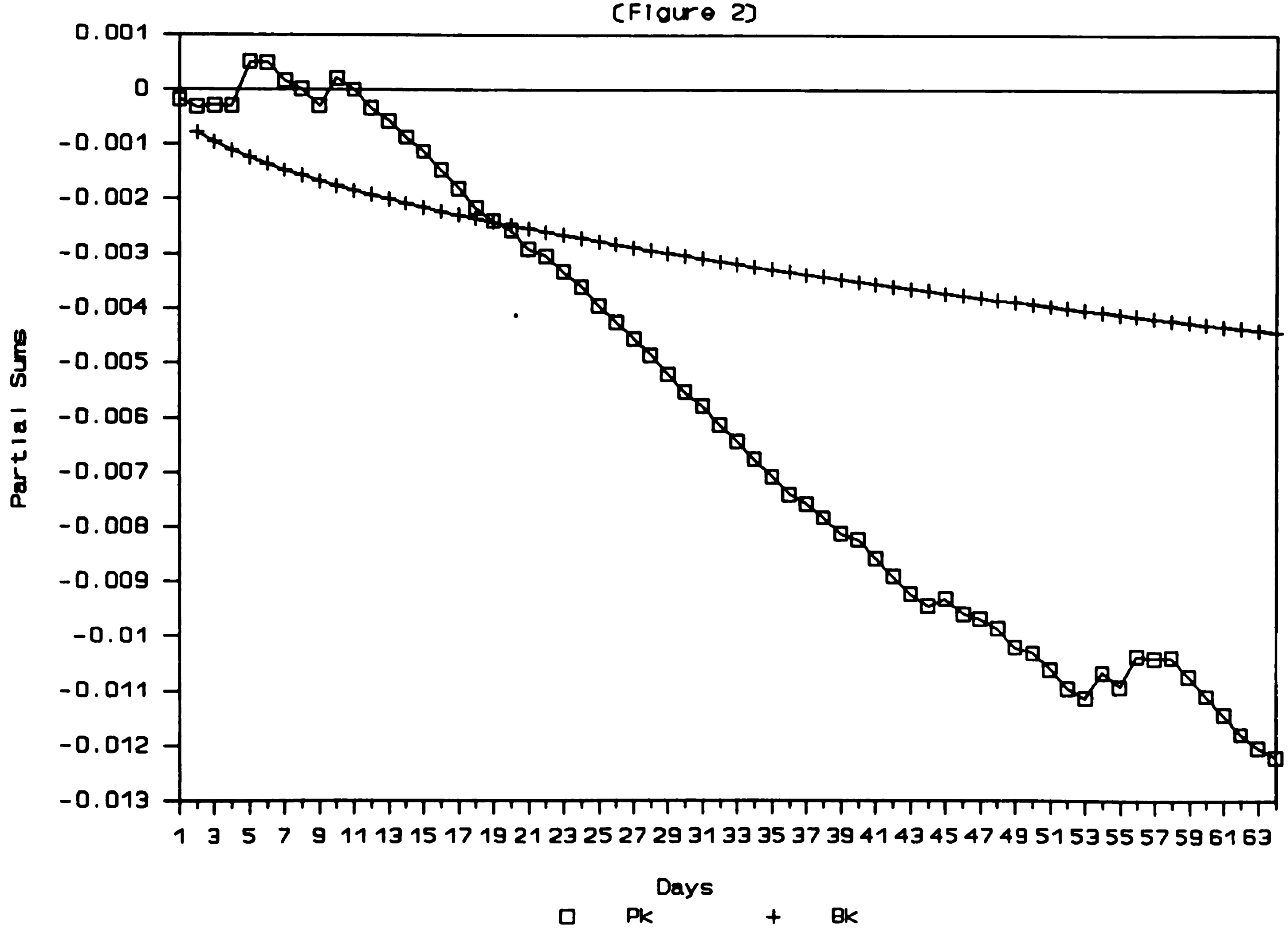
— equivalent to Equation (11) and (18). Now, using the new estimate of t_E, reiterate the whole estimation process by repeating steps 3 through 9 until the t_E converges.[29]

[28] Refer to Footnote 19.

[29] The steps one through nine are repeated for each observation.

Estimating the Adjustment Period

(Figure 2)



Lags in Financial Analysts' Revisions (H_3)

Abdel-Khalik and Espejo (1978) examined the manner by which forecasts of annual earnings are revised in the wake of the release of quarterly reports. Brown and Rozeff (1979) tested the behavior of revisions in FAF of quarterly earnings. Both studies used Value Line forecasts and a cross-sectional regression to test the hypothesis of an adaptive formation of earnings forecasts. Their results show that revisions of FAF of annual and quarterly-earnings reports can be described by an adaptive process in which forecasts are updated based on the prediction error associated with the most recent quarterly earnings numbers. Crichfield, Dyckman and Lakonishok (1978) found that FAF do not contain a systematic bias that can be corrected by using information on past earnings and predictions. All of these studies, however, aggregated all forecast revisions. This aggregation may have obscured the less accurate – or the more predictive – revisions as well as lags in revisions over subsequent periods for firms with large earnings surprises. When these firms are isolated, evidence of systematic bias in analysts' forecast revisions may be found.

The evidence regarding bias in FAF is still evolving. Fried and Givoly (1982) concluded that FAF fully incorporate past data, such as historical earnings and past forecast errors. Crichfield, Dyckman, and Lakonishok (1978) and Givoly (1985) also reported results that are consistent with the notion that FAF are unbiased. Barefield and Comisky (1975), Fried and Givoly (1982), and O'Brien (1988), however, cite evidence that financial analysts tend to be optimistic in forecasting earnings. This is consistent with the common belief that analysts prefer optimistic predictions and "buy" recommendations to help maintain good relations with management. Butler and Lang (1988) reported that, relative to a consensus forecast, optimistic (pessimistic) analysts tended to be persistent in their optimism (pessimism) over time. Their results are related to this study's contention that there are lags in analysts' revisions, but that these lags are isolated to the large positive and negative surprises as measured by SES.

The Lags in Financial Analysts' Revisions Hypothesis (H_3) will be tested by examining whether firms in the top or bottom category of SES in a quintile continue to be in the same quintile in subsequent quarter — adjusting for such factors as predictability and firm size. It will be argued that, if more firms are in the same quintile in the successive quarter than is statistically "acceptable," it can be interpreted as evidence supporting the hypothesis that there are lags in financial analysts' revisions, at least for those firms in the top or bottom category of the SES measure. In other words, when the forecast errors in two consecutive quarters are observed, the forecast errors in the first quarter should not be correlated with those in the second quarter.

Since the underlying probability distribution of the analyst's forecast error is unknown, two non-parametric techniques will be used to investigate this hypothesis: (1) the Spearman's Coefficient of Rank Correlation Test; and (2) the Goodness-of-Fit Test.

First, the observations in each of the two consecutive quarters will be arranged in descending order of magnitude and sign, and divided into quintiles.[29] Second, how those observations in the quintiles of the first quarter are distributed among the different quintiles in the second quarter will be investigated.

Spearman's Coefficient of Rank Correlation

Suppose there is, for two consecutive quarters, a random sample of n pairs of forecast errors as measured by SES:

$$(SES_{11},\ SES_{12},),\ (SES_{21},\ SES_{22}),\ \ldots\ ,\ (SES_{n1},\ SES_{n2}).$$

[29] There are insufficient number of observations to warrant calculation of deciles.

These are drawn from a bivariate distribution with correlation coefficient R. The observations in the first quarter are ranked from lowest to highest using the integers 1, 2, ..., n, and those in the second quarter are ranked separately using the same ranking scheme. Each observation is assigned a rank according to its magnitude relative to the others in its own group. If the marginal distributions of the forecast errors in the first and the second quarter are continuous, hypothetically unique sets of rankings exist. Denoting the respective ranks of the random variables in the samples by:

$$R_i = RANK(SES_{i1}) \quad ; \quad S_i = RANK(SES_{i2}) .$$

The derived sample of observations of n pairs are:

$$(R_1, S_1), (R_2, S_2), \ldots , (R_n, S_n) .$$

The the correlation coefficient of rank R can be computed as:

$$\hat{R} = \frac{12\left[\sum_{i=1}^{n} (R_i - \overline{R})(S_i - \overline{S})\right]}{n[n^2 - 1)}.$$

Under the null hypothesis of "independence between the two quarters' earnings forecast errors," the asymptotic distribution of $\hat{R}$ is normal with:

$$E(\hat{R}|H_0) = 0 \quad ; \quad Var(\hat{R}|H_0) = \frac{1}{n - 1}$$

Therefore, the standardized normal variable used for the test of independence is:

$$Z = \hat{R}\sqrt{n-1}.$$

When there are tied observations, mid-rank will be assigned to the indistinguishable observations. It is a well-accepted fact that for large samples with ties, the above asymptotic test procedure is still valid if the number of ties is not extensive.

The Rank test described above is performed on observations in every set of two consecutive quarters.

Altogether, eleven quarters of data require ten separate tests.

Goodness-of-Fit Test

First, the observations in each of the two consecutive quarters are arranged in descending order, according to magnitude and sign. Second, they are divided into quintiles.[30] If there is no correlation between the forecast errors in the two quarters as caused by the lag in analysts' forecast revisions, the observations in each quintile are, on average, likely to end up in the same proportions in each of the five quintiles in the second quarter.

Suppose there are n_{1i} observations in the first quarter of the ith quintile. Under the null hypothesis of "no lag in analysts' forecast revisions," one-fifth of the firms from the previous quarter's first quintile would be expected to show up in each of the next quarter's quintiles. The observed number of firms in the ith group in the first quarter ending up in the jth group in the second quarter is denoted by f_{ij}, and the expected number by e_{ij}. Then the Pearson's Statistic for testing the null hypothesis is:

---

[30] There are an insufficient number of observations for each pair of quarters to warrant division into deciles.

$$q_i = \frac{\sum_{j=1}^{5} (f_{ij} - e_{ij})^2}{e_{ij}}.$$

A large value of q_i would reflect an incompatibility between the observed and expected relative frequencies. Therefore, the null hypothesis is rejected for a large q on which the e_{ij}'s were calculated. For large samples, the asymptotic distribution of q_i is chi-square with k - 1 degrees of freedom.

Description of the Data Set

This section describes the three databases used in the research: (1) I/B/E/S "Summary History Tape"; (2) CRSP daily tape; and, (3) the COMPUSTAT quarterly tape. The I/B/E/S database, the main source of data for this research, contains monthly-consensus and security forecast information on quarterly and annual data. The CRSP database provides the daily stock returns and the value-weighted index returns needed to compute the risk-adjusted excess returns. The COMPUSTAT database is used to obtain the actual-earnings report date. When an actual-earnings report date is not available on the COMPUSTAT tape, the report date is obtained from the WSJ.

The I/B/E/S database was developed by Lynch, Jones and Ryan in the early 1970's to systematically collect and distribute the FAF information from "leading Wall Street and Regional brokerage firms" on over 2,500 firms. The database contains a summary of financial analysts' quarterly EPS estimates, various related statistics for two quarters, and annual estimates for each year of a two-year forecast horizon at monthly intervals, covering a period from January 1976 to December 1988. The following data items from I/B/E/S are used in this study:

- Mean forecast
- Standard deviation of forecasts
- Number of analysts forecasts available
- Fiscal end date
- Latest actual EPS
- Primary/diluted EPS indicator
- Adjustment for stock splits, etc.
- Dilution factor.

The tape does not include information about the individual analysts or the individual forecasts underlying the above data items.

Sample Selection

The following restrictions are applied to obtain the necessary data set:

- Each consensus quarterly forecast must consist of at least 3 analysts' estimates
- Fiscal year must end on December 31st
- Daily return data must be available on the CRSP database
- Quarterly EPS announcements dates are available on COMPUSTAT or the WSJ
- For each firm, the quarterly consensus EPS being forecasted must have a mean forecast during the month or prior to the month that the actual EPS is announced, and must report a mean forecast for the next quarter in the subsequent month.

The effects of the sample selection criteria on the sample size are summarized on Table 4. The first constraint is necessary in order to arrive at a minimally-acceptable standard deviation number that is required to test the "divergence of opinion" hypothesis. Requiring three or more analysts is a trade-off between a desire for a large sample and the possibility having consensus forecasts reflect the idiosyncracies of one or two analysts. The second constraint means that all analysts would have access to the same macroeconomic information at the time these forecasts were prepared. Since the greatest number of firms have December fiscal years, the largest sample can be obtained by selecting firms with December fiscal years. The application

TABLE 4

The Effects of Sample Criteria on Sample Size

Criteria	No. of Firms
(a) December year end and a 3 analysts minimum	1,154
(b) Return data on CRSP	902
(c) EPS announcement dates on COMPUSTAT or in WSJ	898
(d) Two consecutive quarters of data for quarters observed*	592

*The quarter being forecasted must have a forecast in the month or the prior month the actual EPS is announced and report a forecast for the next quarter in the subsequent month.

of the first two restrictions results in obtaining initially 1,154 firms from the I/B/E/S database.

The third and fourth constraints are needed to test the strength of the SES measure, the Duration of Price Adjustment Hypothesis, and the Lags in Financial Analysts' Revisions Hypothesis. The CRSP criterion reduces the sample to 902 firms; only four firms are lost with the fourth restriction.

The last restriction requires that forecast information for each firm be available for two consecutive months for the corresponding quarters. In order to properly detect a change in the divergence of opinions caused by the earnings surprises, it is necessary to obtain forecasts immediately prior to and after the EPS announcement date. This requirement reduces the sample size to 592 firms, with 3,330 observations for the 11 quarters, from the third quarter of 1984 to the first quarter of 1987.

Chapter V

TEST RESULTS

This chapter reports the findings for the test of the SES measure's (introduced in Chapter 3) ability to predict excess returns, and the test of the hypotheses presented in Chapter 4.

The chapter is organized as follows. First, the assertions for the use of the SES measure are reviewed and test results are reported. Second, the results of the test of the Change in Divergence of Opinion Hypothesis (H_1) are presented. Third, the results of the Duration of Price Adjustment Hypothesis (H_2) are described. Fourth, the results of the two tests, Spearman's coefficient of rank correlation test and the goodness-of-fit test, for the Lags in Revisions Hypothesis (H_3) are shown. This section is followed by a summary.

Test of SES

In Chapter 3, SES was introduced and proposed as being a better relative measure of earnings surprise because it incorporates FAF of earnings as the surrogate for the

market's expected EPS number and the standard deviation of those forecasts as the deflator. There is overwhelming support for the use of FAF of earnings. It can also be argued that the standard deviation is a valid number to be used as a deflator, because it captures the relative dispersion of the opinions of those forecasts and thereby standardizes the dispersion across stocks in accordance to its corresponding "range" of expectations.

Tables 5 and 6 and Figures 3 and 4 show the results of testing the relationship between SES and CAAER for the 11 quarters between 1984.3 and 1971.1. The methods used are similar to the Rendleman, Jones and Latane' (1982) study. The CAAER by SES category are shown for selected days around the announcement date of earnings. These results show the pattern of CAAER for each of the ten categories of stocks, from -20 days to +90 days after the quarterly earnings were announced.[31]

The most obvious point to be derived from these results is that SES has worked effectively in predicting subsequent excess returns. The results are quite parallel to those found by Rendleman, et al. (1982). For the entire test period, the highest SES category, 10, showed a CAAER of

---

[31] The SES categories are as follows: category #1, if $SES \le -4$; #2, if $-4 < SES \le -3$; #3, if $-3 < SES \le -2$; #4, if $-2 < SES \le -1$; #5, if $-1 < SES < 0$; #6, if $0 < SES < 1$; #7 if $1 \le SES < 2$; #8, if $2 \le SES < 3$ #9 if $3 \le SES < 4$; and #10 if $SES \le 4$.

Table 5

Negative SES and CAAER

	SES Category				
	1	2	3	4	5
Days -20 to 90					
CAAER	-7.59	-6.69	-4.19	-2.57	-1.13*
T_STAT	-4.03	-3.34	-2.45	-2.25	-1.37
Days -20 to -1					
CAAER	-2.91	-4.61*	-2.54*	-1.36	-0.58*
T_STAT	-2.44	-1.60	-1.34	-3.24	-1.45
Days 1 to 90					
CAAER	-4.11	-4.61	-2.20	-0.92*	-0.46*
T_STAT	-4.45	-2.90	-1.86	-1.12	-0.68

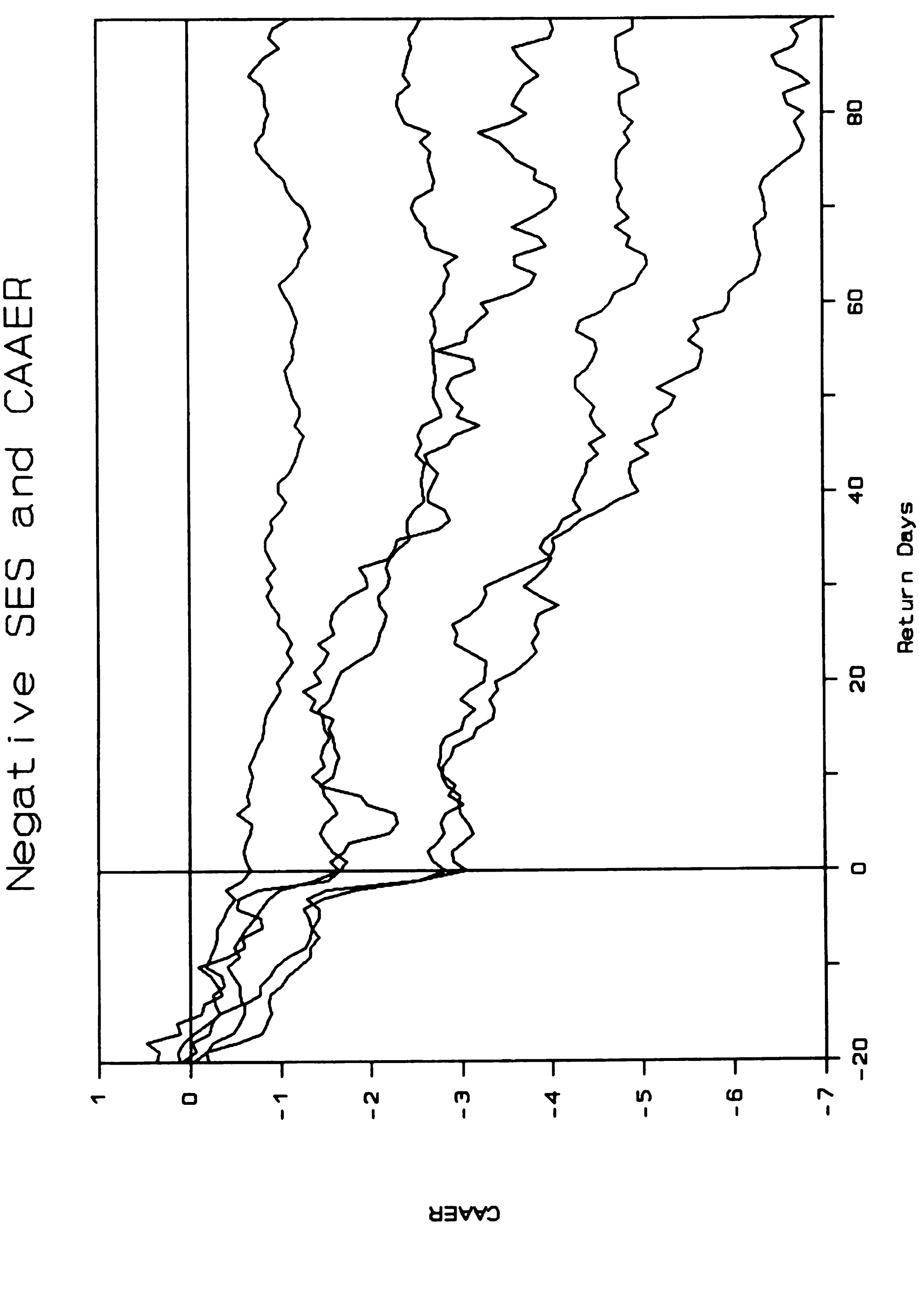
*Not significant at the .05 level.

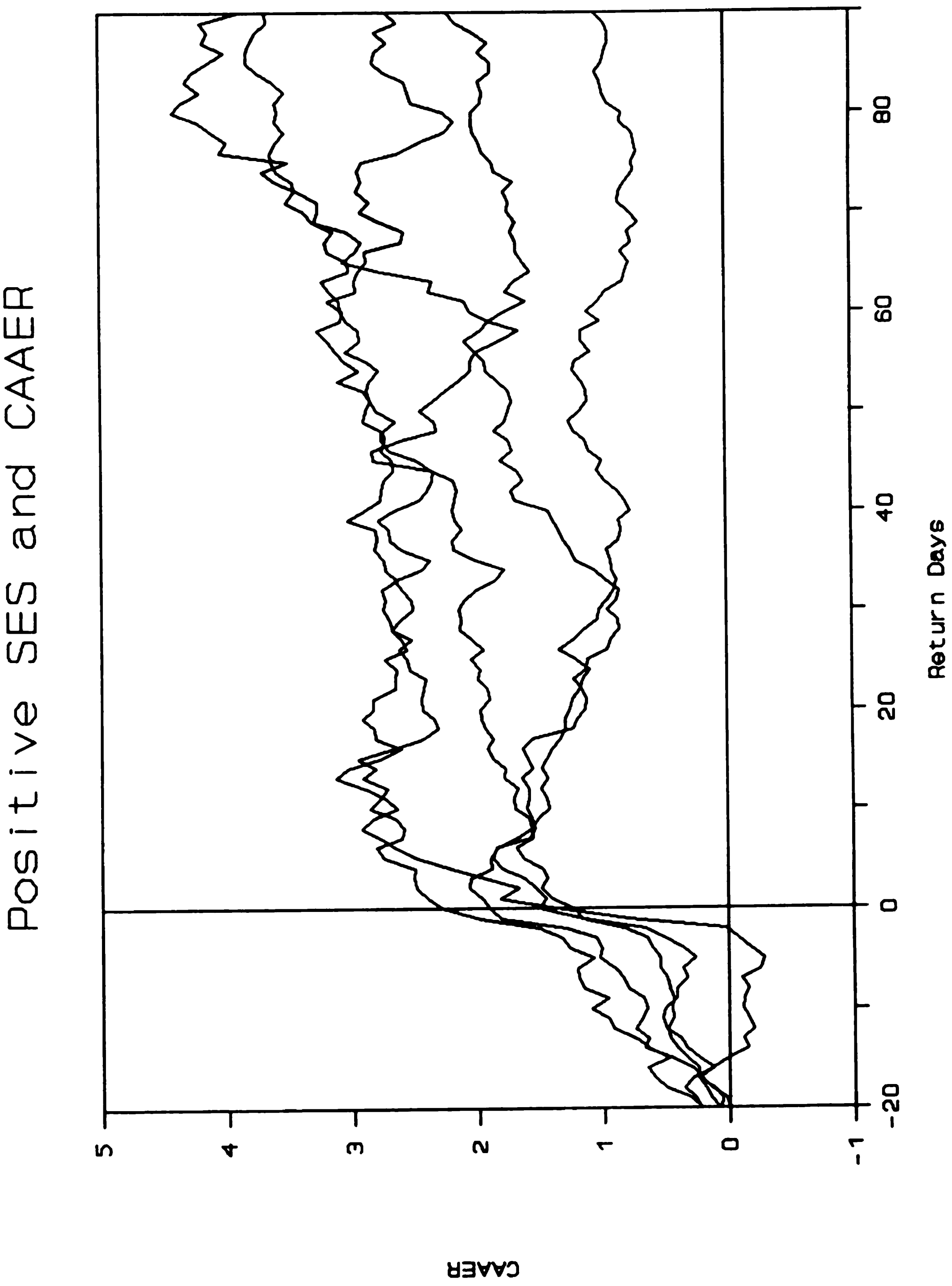
Table 6

Positive SES and CAAER

	SES Category				
	6	7	8	9	10
Days -20 to 90					
CAAER	1.04*	2.22*	4.26	6.49	7.90
T_STAT	1.07	1.59	2.82	2.44	4.07
Days -20 to -1					
CAAER	1.17	1.15	1.78	2.06	2.65
T_STAT	2.06	1.40	3.16	2.21	2.58
Days 1 to 90					
CAAER	-0.19*	0.71*	2.16	3.36	4.40
T_STAT	-0.26	0.73	1.78	1.74	4.31

*Not significant at the .05 level.


Negative SES and CAAER
CAAER
1
0
-1
-2
-3
-4
-5
-6
-7
-20
0
20
40
60
80
Return Days


Positive SES and CAAER
CAAER
5
4
3
2
1
0
-1
-20
0
20
40
60
80
Return Days

7.90%, while the lowest SES category, 1, showed a CAAER of 7.59%. Notice the almost monotonic nature of the results from the lowest category to the highest SES category (shown graphically on Figures 3 and 4): the higher (lower) the SES, the higher (lower) the subsequent excess returns. Also, notice that in the middle two categories (5 and 6), where earnings surprises were small (only slightly negative or slightly positive, respectively), the CAAER were close to zero.

Tables 5 and 6 also show the CAAER for the pre-announcement period (-20 days to -1 day) and the post-announcement period (+1 day to +90 days). For example, in SES category 1, -2.91% points out of a total of -7.59% occurred before the earnings were announced; in SES category 10, 2.65% of the total figure 7.90% occurred prior to the announcement.

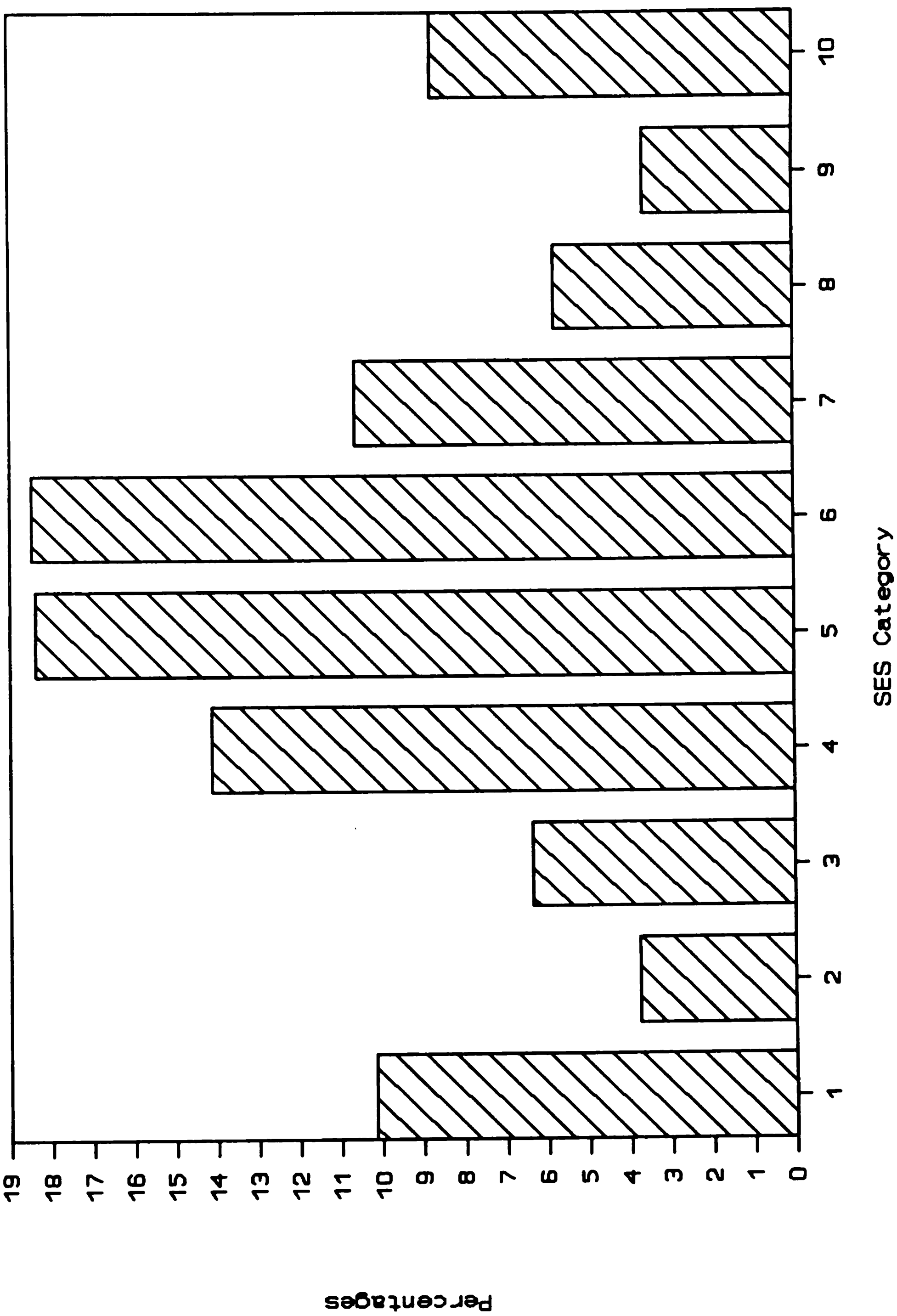
The most important period in the SES analysis is the post-announcement period, days 1 to 90. The results of the SES test are consistent with other studies that document the "systematic post-announcement" drift. The stocks in this sample and test period show that the adjustments to large earnings surprises extend over time. For SES categories 1, 2, 3, 8, 9, and 10, more than half of the total CAAERs occurred after the earnings are announced, and these results are significant at the 0.05 level. Again, notice that the middle two categories showed no substantial effects.

Appendix A shows the results of the test of the relationship between SES and three day CAAER (-1 to +1 day). For the total period, the relationship is shown to be significant at the 0.0001 level. But for individual quarters, only 5 out of the 11 quarters showed significance at the 0.05 level. Because there were large numbers of observations with standard deviations of forecasts less than \$0.05, the relationship between SES and three-day CAAER was tested for a sample that deleted observations with standard deviation numbers less than \$0.05. Stocks with standard deviation of FAF of EPS equal to \$0.05 would have absolute value of SES larger than 10 if the difference between the forecasted and actual EPS are greater than \$0.50. Large SES values would, of course, also result from other combinations of small standard deviations and large forecast errors. This is most likely the reason why the number of the observations in the SES categories 1 and 10 were larger than for those in the 2 and 9 categories. Figure 5 graphically depicts this distribution. Regardless, one can see that the total number of negative SES observations, in percentages, differs little to that of the positive SES observations. The distribution of observations among the categories other than 1 and 10 is fairly symmetrical as shown by Appendices E1, E2, F1 and F2.

For the sample with the adjustment for small standard deviations, Appendix B shows the significance of the

Distribution of SES

(Figure 5)



relationship of SES and three day CAAER to be not significantly different for the entire period (significant at the 0.0001 level). However, for individual quarters, only 3 out of the 11 quarters showed significance at the 0.05 level.

Hypothesis 1 (Change in Divergence of Opinions) Results

It has been argued that divergence of analysts' opinions can effectively be used as a proxy for ex-ante measure of uncertainty. This study assumes that argument to be valid and, accordingly, tests the hypothesis that increase in uncertainty is greater for stocks with larger surprises. In the context of UE, it is hypothesized that for securities with larger relative earnings surprises, the change in divergence of opinions among the analysts would be greater. The change in divergence of opinions is measured by the change in the CV(FAF). The CV(FAF) is tested against absolute values of SES (ABSES), because only the size, and not the direction, of the relative surprise is important.

Table 7 shows the relationship between ABSES and CV(FAF) for 3,330 observations to be significant at the 0.0001 level. Again, because small standard deviation numbers may distort the CV(FAF), the relationship between ABSES and CV(FAF) was also tested for the sample that deleted those observations whose standard deviation numbers

TABLE 7

Test of the Relationship Between ABSES and Change in Divergence of Opinion

Specification	No. of Observation	T-Statistics*
Unadjusted	3,330	5.78
Deleting those with STD < 0.05	1,645	3.51
Deleting those ABSES values > 10.0	3,067	8.74
Only those with negative SES values	1,572	3.63
Only those with positive SES values	1,862	-4.73

*All are significant at better than the .0005 level.

were less than $0.05. Although the t-statistics value decreased, it remained significant at the 0.0001 level.

To test whether outliers affected the sample, a sample that deleted observations with ABSES values greater than 10.0 was also contructed and tested. Results in Table 7 show that the relationship remained highly significant. In fact, the t-statistics value increased for this sample. Tests of whether the relationship was significant for both negative and positive surprises were also performed. They also proved to be significant, and to have the correct signs, for both negative and positive surprises at the 0.0001 level. Appendix C shows the results of the test by individual quarters, while Appendix D shows the test with observations of samples with standard deviation numbers less than $0.05 deleted. Tests for individual quarters did not prove to be as robust. For both tests, only 4 out of the 11 quarters showed significance at the 0.05 level. The evidence for the total 3,330 observations, however, suggests that stocks with larger relative earnings surprises have greater increases in uncertainty.

Hypothesis 2 (Duration of Price Adjustments) Results

The evidence of the "systematic post-announcement" drift itself is an indication of delayed adjustment in prices for stocks with large UE. This is seen as an anomaly, or as evidence against semi-strong market efficiency. The results of the test of the relationship between SES and CAAER supports the existence of the anomaly with a different measure of earnings surprise.

This section reports the results of testing the hypothesis that larger SES exhibit longer duration of price adjustment using methods proposed by Hillmer and Yu (1979) to estimate the duration of the adjustment period. Tables 8 and 9 and Figure 6 show results that reinforce the argument that the larger the surprise, the longer the adjustment period will be.

For the highest negative and positive earnings-surprises categories, the average duration periods were 17.4 and 17.8 days, respectively. The average duration periods declined rather symmetrically toward the middle categories of SES. The middle two categories, 5 and 6, had average durations of 12.4 and 12.5 days, respectively. However, it should be noted that the standard deviation of the estimated duration periods were fairly large. The standard deviations ranged from 9.1 and 9.3 for the highest negative and positive surprises, respectively, to 6.5 and 6.8 for the middle two categories. In addition, the percentage of usable observations (those that were at the 0.05 significance level), averaged about 60% (see also Figure 7 - Distribution of Usable Observations). The results are, nevertheless, in support of the hypothesis that the duration of price adjustment is longer for the larger SES.

TABLE 8

Negative SES and Duration of Price Adjustment

	SES Category				
	1	2	3	4	5
Average duration[a]	17.4	15.2	14.9	14.5	12.4
Standard deviation[b]	9.1	7.7	8.8	8.9	6.8
Usuable no. of of observations[c]	196	79	142	298	341
Total count[d]	338	126	211	470	614
Percentage of total[e]	58%	63%	67%	63%	56%

Total usable observations: 59.3%

Average percentage: 60.5%

Notes:

[a]Average price adjustment period (in days).

[b]Standard deviation of the price adjustment period (in days).

[c]Number of usable observations in the category.

[d]Total number of observations in the category.

[e]Number of usable observations in the category (in percentages).

TABLE 9

Positive SES and Duration of Price Adjustment

	SES Category				
	6	7	8	9	10
Average duration[a]	12.5	14.4	15.4	16.5	17.8
Standard deviation[b]	6.5	7.5	8.3	8.4	9.3
Usuable no. of of observations[c]	349	218	116	74	162
Total count[d]	615	354	193	118	291
Percentage of total[e]	57%	62%	60%	63%	56%

Total usable observations: 59.3%

Average percentage: 60.5%

Notes:

[a]Average price adjustment period (in days).

[b]Standard deviation of the price adjustment period (in days).

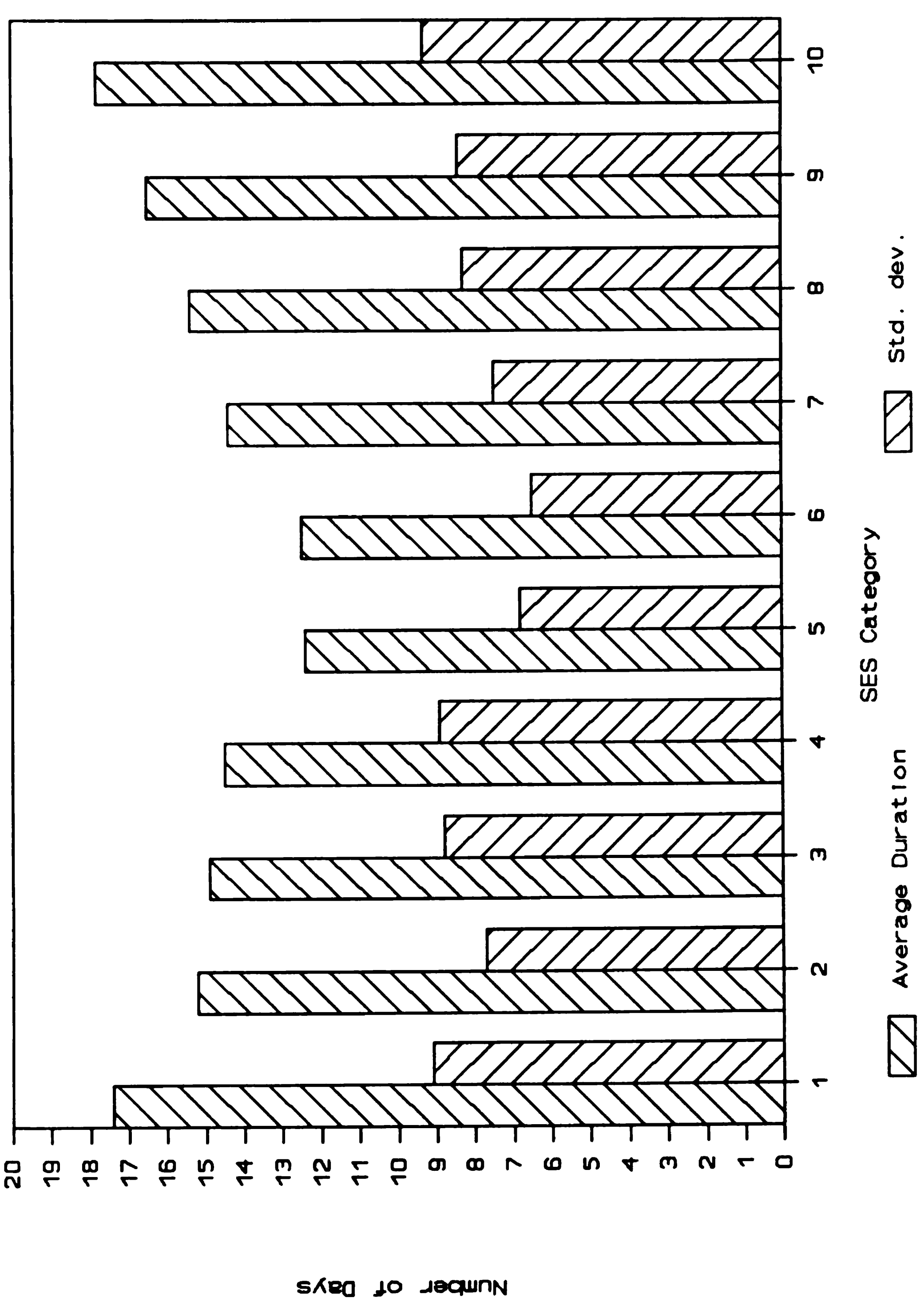
[c]Number of usable observations in the category.

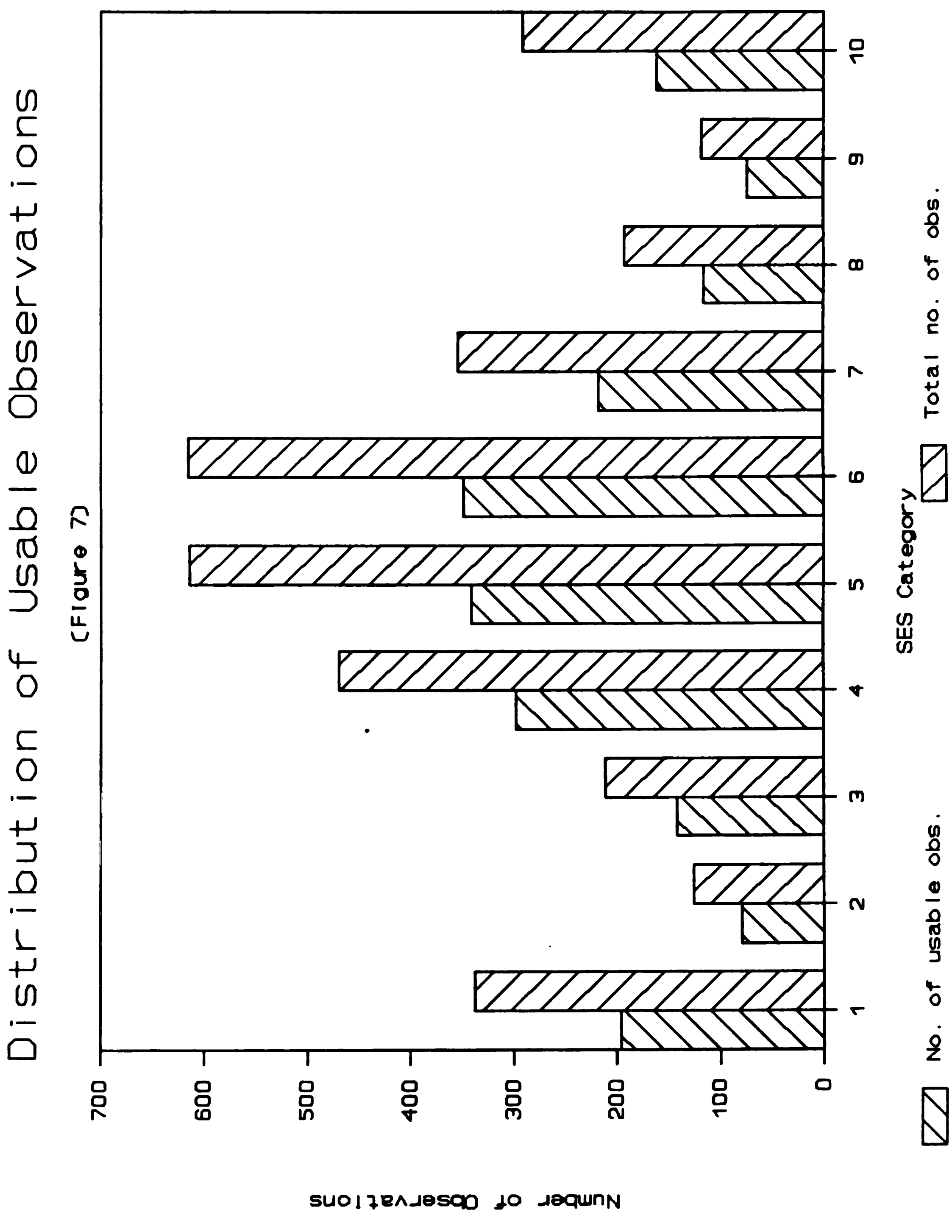
[d]Total number of observations in the category.

[e]Number of usable observations in the category (in percentages).

SES & Duration of Price Adjustment

(Figure 6)




Distribution of Usable Observations
(Figure 7)
Number of Observations
0
100
200
300
400
500
600
700
1
2
3
4
5
6
7
8
9
10
SES Category
No. of usable obs.
Total no. of obs.

Hypothesis 3 (Lags in Revisions) Results

To further support the proposition that stocks with large earnings surprises exhibit delayed price adjustment, it is argued that analysts themselves "lag" in their revisions. It is assumed that if analysts display delayed adjustments in their revisions, it is regarded as an indication of the market also being "slow" in its adjustments. If analysts do not delay their revisions, the forecast errors in one quarter should not be correlated with those of either the previous quarter or the subsequent quarter. The results of two tests indicate that analysts may indeed delay in their revisions.

Spearman's Coefficient of Rank Correlation Test

In Table 10, the results of the Spearman's coefficient of rank correlation test are shown for the 10 pairs of quarters. Spearman's coefficient of rank correlation test measures the degree of association between the ranking of SES in one quarter to the rankings in the next quarter. For 162 to 245 observations, nine out of the ten pairs of quarters show correlation in rankings of SES, between two consecutive quarters, at the 0.05 or better significance level. For the pairs of quarters that showed statistical significance, the coefficient values varied from 0.21 to 0.46 and Z-values ranged from 2.91 to 6.19. Only the SES ranks between the fourth quarter of 1985 and the first

Table 10

Results of the Spearman Rank-Correlation Test (for 10 pairs of quarters)

Pairs of quarters	No. of obs.	Spearman's rank -correlation coefficient	Z-value
1984.3-1984.4	163	0.2400	3.06
1984.4-1985.1	172	0.2934	3.84
1985.1-1985.2	211	0.3744	5.43
1985.2-1985.3	234	0.3241	4.95
1985.3-1985.4	189	0.2932	4.02
1985.4-1986.1	162	0.0281	0.36*
1986.1-1986.2	185	0.4564	6.19
1986.2-1986.3	245	0.3812	5.96
1986.3-1986.4	196	0.2081	2.91
1986.4-1987.1	217	0.2461	3.62
TOTAL	1,974		

*Not significant at .10 level. All others significant at the .005 level or better.

quarter of 1986 did not show sufficient correlation. Therefore, this should be regarded as indication of analysts lagging in their revisions.

Goodness-of-Fit Test

The goodness-of-fit test is performed under the uniform distribution assumption that stocks whose SES value falls into any particular quintile in a quarter are expected to be evenly distributed in different quintiles in the next quarter. For example, given there are 100 stocks in a quarter, 20 stocks would fall in each quintile. The expected number of stocks to be seen in the next quarter in the same quintile would be four. In other words, the chance of a stock repeating its quintile category is 4%, or one fifth of one fifth.

Table 11 presents the aggregated results of this test for the 10 pairs of quarters. Quintile (1,1) represents stocks that belonged in the first quintile of the first quarter and also belonged in the first quintile of the following quarter; quintile (1,2) were stocks that belonged in the first quintile of the first quarter and the second quintile in the subsequent quarter, etc. The first column in Table 11, f_{ij}, reports the observed frequency for the ith pair of quarters in the jth quintile; the second column, e_{ij}, states the expected frequency; and the third and fourth columns calculate the test statistic.

Table 11

Results of the Goodness-of-Fit Test (aggregated over 10 pairs of quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	140	78.2	61.8	48.839
(1,2)	106	78.2	27.8	9.883
(1,3)	57	78.2	-21.2	5.747
(1,4)	42	78.2	-36.2	16.758
(1,5)	46	78.2	-32.2	13.259
Total	391	391.0	0.0	94.486*
(2,1)	79	78.2	0.8	0.008
(2,2)	88	78.2	9.8	1.228
(2,3)	84	78.2	5.8	0.430
(2,4)	77	78.2	-1.2	0.018
(2,5)	63	78.2	-15.2	2.954
Total	391	391.0	0.0	4.639
(3,1)	79	78.2	0.8	0.008
(3,2)	69	78.2	-9.2	1.082
(3,3)	87	78.2	8.8	0.990
(3,4)	81	78.2	2.8	0.100
(3,5)	75	78.2	-3.2	0.131
Total	391	391.0	0.0	2.312
(4,1)	42	78.2	-36.2	16.758
(4,2)	68	78.2	-10.2	1.330
(4,3)	87	78.2	8.8	0.990
(4,4)	108	78.2	29.8	11.356
(4,5)	86	78.2	7.8	0.778
Total	391	391.0	0.0	31.212*
(5,1)	51	78.2	-27.2	9.461
(5,2)	60	78.2	-18.2	4.236
(5,3)	76	78.2	-2.2	0.062
(5,4)	83	78.2	4.8	0.295
(5,5)	121	78.2	42.8	23.425
Total	391	391.0	0.0	37.478*

*Significant at the .005 level.

To facilitate an understanding of Table 11, the SES Contingency Table is constructed and is shown on Table 12. Keeping in mind that these percentages cover the entire 11-quarter period, the first figure in the upper left-hand column of Table 12 [Q(1,1)), 35.8%, is the percentage of firms that showed up in the first quintile (ranked from highest to lowest SES, the top 20% of each quarter) of the initial quarter and that showed up again in the subsequent quarter. This is 79% greater than the expected percentage. On the other hand, reading across the first row to the last column [Q(1,5)], only 11.8% of the firms that were initially in the top quintile were in the bottom quintile (lowest 20% of each quarter) in the next quarter can be seen. This is 41% less than the expected percentage.

Now, consider the opposite case. Of the firms in the bottom quintile, 30.9% still remained in the bottom quintile. This is 54.5% greater than the expected figure. And only 13% of the firms in the bottom quintile rose to the top quintile. This is 35% less than the expected percentage number. As expected, the middle category, the third quintile, showed little difference.

Overall, for the sample of aggregated 1,950 observations, those stocks whose SES values were in the first, fourth and fifth quintiles of the first quarter proved to repeat its category in the next quarter more times than were statistically expected, especially at the 0.005

Table 12

SES Contingency Table

Percentage of SES in Any Quintile
One Quarter Later
(over the 11 quarters 1984.3 - 1971.1)

Initial Quarter Quintile	Next Quarter Quintile Q(i,1)	Q(i,2)	Q(i,3)	Q(i,4)	Q(i,5)
Q(1,j)	35.8	27.1	14.6	10.7	11.8
Q(2,j)	20.2	22.5	21.5	19.7	16.1
Q(3,j)	20.2	17.6	22.3	20.7	19.2
Q(4,j)	10.7	17.4	22.3	27.6	22.0
Q(5,j)	13.0	15.3	19.4	21.2	30.9

significance level. The results of the goodness-of-fit tests for individual pairs of quarters are shown in Appendix G.

These results are consistent with the Spearman's coefficient of rank correlation tests and, hence, also suggest the same conclusion. Analysts, at least during this test period and sample seem to delay their adjustments for stocks with both large negative and positive surprises. The results also rejects the commonly stated supposition that hard-to-predict earnings may be the reason for such outcomes.

SES is shown to be a valid measure of earnings surprise in that it effectively predicts excess returns. This measure is used to test the three proposed hypotheses. The results show that: (1) the larger the absolute value of SES the greater the change in the CV(FAF); (2) the greater the relative earnings surprise, in either direction, the longer the duration of price adjustment; and (3) high (low) SES repeat as high (low) SES one quarter later more often than expected. These results suggest that, for firms with relatively large earnings surprises in either direction, the level of uncertainty will increase, will take longer for prices to adjust to this information, and will more than likely repeat as large earnings surprises with the same sign the following quarter.

Chapter VI

CONCLUSIONS

The existence of the "systematic post-announcement" drift anomaly has been well documented by numerous studies using different data and different periods. This research attempts to provide an explanation why this anomaly is persistent.

The first important finding in this study is that the phenomenon is found using FAF of earnings as the proxy (found to be superior than proxies from mechanical models) for the market's expected earnings number. This is done by introducing a new measure of earnings surprise, the SES measure. SES is arguably a better relative measure of UE because it takes into consideration the "range" of expectations of the forecasted EPS. It is shown that SES also predicts excess return in similar magnitudes to those predicted by SUE. SES is then applied to test the hypotheses that support the contention that the anomaly is the result of increases in perceived risk of the those securities exhibiting large surprises. Although this matter is not addressed directly, evidence from this research does support this explanation.

The change in divergence of opinion, as measured by the CV(FAF) of earnings, is found to be greater for those stocks with larger relative earnings surprises. This increase in the divergence of opinion is seen to be an indicator of an increase in the perceived risk of the underlying stock.

Applying the method suggested by Hillmer and Yu (1979), the duration of price adjustment is shown to be longer for firms with larger earnings surprises. In comparison to the relationship between SES and excess return the differences in the average duration for each category seem small. However, if the estimated length of the adjustment period is accurate, even a one-day difference can be argued to be significant.

Two tests were conducted to evaluate the third hypothesis, which states that analysts lag in revisions on earnings forecasts for stocks that showed large earnings surprises, under the assumption that forecast errors in consecutive quarters would not be correlated if analysts did not lag in their revisions. The results of both tests indicate that analysts may, in fact, delay their revisions.

While results of this research do not completely explain the cause of the systematic post-announcement drift anomaly, they do strongly indicate that the cause may be due to the increase in perceived risk. Further developments in measuring perceived risk in the future may support this contention.

APPENDIX A

Test (by quarter) of the Relationship Between SES & Three Day CAAER

	No. of Observations	T-Statistics
1984.3	295	1.50
4	225	3.12
1985.1	279	3.03
2	321	1.47
3	347	1.70
4	244	0.69
1986.1	267	1.20
2	322	2.33
3	363	0.64
4	262	2.37
1987.1	405	2.03

APPENDIX B

Test (by quarter) of the Relationship Between SES & Three Day CAAER (deleting those with STD < $0.05)

	No. of Observations	T-Statistics
1984.3	133	1.33
4	112	1.64
1985.1	146	2.10
2	160	1.50
3	166	2.37
4	120	0.55
1986.1	135	0.20
2	157	1.96
3	173	1.67
4	142	0.43
1987.1	201	1.98

APPENDIX C

Test (by quarter) of the Relationship Between ABSES & Change in Divergence of Opinion

	No. of Observations	T-Statistics
1984.3	295	1.51
4	225	1.16
1985.1	279	3.69
2	321	1.40
3	347	1.32
4	244	1.76
1986.1	267	0.96
2	322	1.81
3	363	3.58
4	262	3.89
1987.1	405	2.76

APPENDIX D

Test (by quarter) of the Relationship Between ABSES & Change in Divergence of Opinion (deleting those with STD < $0.05)

	No. of Observations	T-Statistics
1984.3	133	1.32
4	112	1.00
1985.1	146	2.49
2	160	0.74
3	166	0.94
4	120	1.55
1986.1	135	0.63
2	157	0.40
3	173	3.12
4	142	2.58
1987.1	201	1.25

APPENDIX E1

Number of Firms in Each SES Category Analyzed by Quarter (negative SES)

Quarter	Total Firms	SES Category 1	2	3	4	5
1984.3	295	30	9	23	41	55
4	225	26	11	18	36	50
1985.1	279	25	11	16	50	60
2	321	40	11	19	58	54
3	347	37	14	27	63	68
4	244	31	12	16	40	45
1986.1	267	24	10	18	40	50
2	322	29	12	24	41	44
3	363	30	12	24	36	64
4	262	39	9	13	29	52
1987.1	405	27	15	13	36	70
TOTAL	3,300	338	126	211	470	612

APPENDIX E2

Number of Firms in Each SES Category Analyzed by Quarter (positive SES)

Quarter	Total Firms	SES Category 6	7	8	9	10
1984.3	295	44	30	13	6	44
4	225	31	18	15	4	16
1985.1	279	50	28	7	13	19
2	321	67	25	19	10	18
3	347	42	33	18	19	26
4	244	47	15	19	8	11
1986.1	267	48	32	14	12	19
2	322	65	39	15	10	43
3	363	81	45	15	12	37
4	262	49	29	17	4	21
1987.1	405	91	60	34	22	37
TOTAL	3,300	615	354	193	120	291

APPENDIX F1

Percentage of Firms in Each SES Category Analyzed by Quarter (negative SES)

	SES Category				
Quarter	1	2	3	4	5
1984.3	10.2	3.1	7.8	13.9	18.6
4	11.6	4.9	8.0	16.0	22.2
1985.1	9.0	3.9	5.7	17.9	21.5
2	12.5	3.4	5.9	18.1	16.8
3	10.7	4.0	7.8	18.2	19.6
4	12.7	4.9	6.6	16.4	18.4
1986.1	9.0	3.7	6.7	15.0	18.7
2	9.0	3.7	7.5	12.7	13.7
3	8.3	3.3	6.6	9.9	17.6
4	14.9	3.4	5.0	11.1	19.8
1987.1	6.7	3.7	3.2	8.9	17.3
AVG:	10.4	3.8	6.4	14.4	18.6
STD:	2.2	0.6	1.4	3.2	2.2

APPENDIX F2

Percentage of Firms in Each SES Category Analyzed by Quarter (positive SES)

	SES Category				
Quarter	6	7	8	9	10
1984.3	14.9	10.2	4.4	2.0	14.9
4	13.8	8.0	6.7	1.8	7.1
1985.1	17.9	10.0	2.5	4.7	6.8
2	20.9	7.8	5.9	3.1	5.6
3	12.1	9.5	5.2	5.5	7.5
4	19.3	6.1	7.8	3.3	4.5
1986.1	18.0	12.0	5.2	4.5	7.1
2	20.2	12.1	4.7	3.1	13.4
3	22.3	12.4	6.1	3.3	10.2
4	18.7	11.1	6.5	1.5	8.0
1981.1	22.5	14.8	8.4	5.4	9.1
AVG:	18.2	10.4	5.8	3.5	8.6
STD:	3.2	2.4	1.6	1.3	3.0

Appendex G

Results of the Goodness-of-Fit Test
(For 1984.3 - 1984.4 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	5	6.4	-1.4	0.306
(1,2)	9	6.4	2.6	1.056
(1,3)	7	6.4	0.6	0.056
(1,4)	6	6.4	-0.4	0.025
(1,5)	5	6.4	-1.4	0.306
Total	32	32.0	0.0	1.750
(2,1)	8	6.4	1.6	0.400
(2,2)	9	6.4	2.6	1.056
(2,3)	4	6.4	-2.4	0.900
(2,4)	6	6.4	-0.4	0.025
(2,5)	5	6.4	-1.4	0.306
Total	32	32.0	0.0	2.688
(3,1)	12	6.4	5.6	4.900
(3,2)	6	6.4	-0.4	0.025
(3,3)	4	6.4	-2.4	0.900
(3,4)	4	6.4	-2.4	0.900
(3,5)	6	6.4	-0.4	0.025
Total	32	32.0	0.0	6.750
(4,1)	5	6.4	-1.4	0.306
(4,2)	5	6.4	-1.4	0.306
(4,3)	7	6.4	0.6	0.056
(4,4)	6	6.4	-0.4	0.025
(4,5)	9	6.4	2.6	1.056
Total	32	32.0	0.0	1.750
(5,1)	2	6.4	-4.4	3.025
(5,2)	3	6.4	-3.4	1.806
(5,3)	10	6.4	3.6	2.025
(5,4)	10	6.4	3.6	2.025
(5,5)	7	6.4	0.6	0.056
Total	32	32.0	0.0	8.938

Appendix G - continued

(For 1984.4 - 1985.1 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	14	6.8	7.2	7.624
(1,2)	11	6.8	4.2	2.594
(1,3)	3	6.8	-3.8	2.124
(1,4)	3	6.8	-3.8	2.124
(1,5)	3	6.8	-3.8	2.124
Total	34	34.0	0.0	16.58*
(2,1)	6	6.8	-0.8	0.094
(2,2)	8	6.8	1.2	0.212
(2,3)	6	6.8	-0.8	0.094
(2,4)	7	6.8	0.2	0.006
(2,5)	7	6.8	0.2	0.006
Total	34	34.0	0.0	0.412
(3,1)	6	6.8	-0.8	0.094
(3,2)	4	6.8	-2.8	1.153
(3,3)	11	6.8	4.2	2.594
(3,4)	7	6.8	0.2	0.006
(3,5)	6	6.8	-0.8	0.094
Total	34	34.0	0.0	3.941
(4,1)	4	6.8	-2.8	1.153
(4,2)	5	6.8	-1.8	0.476
(4,3)	8	6.8	1.2	0.212
(4,4)	8	6.8	1.2	0.212
(4,5)	9	6.8	2.2	0.712
Total	34	34.0	0.0	2.764
(5,1)	4	6.8	-2.8	1.153
(5,2)	6	6.8	-0.8	0.094
(5,3)	6	6.8	-0.8	0.094
(5,4)	9	6.8	2.2	0.712
(5,5)	9	6.8	2.2	0.712
Total	34	34.0	0.0	2.764

*Significant at the .005 level.

Appendix G - continued
(For 1985.1 - 1985.2 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	18	8.4	9.6	10.971
(1,2)	9	8.4	0.6	0.043
(1,3)	5	8.4	-3.4	1.376
(1,4)	2	8.4	-6.4	4.876
(1,5)	8	8.4	-0.4	0.019
Total	42	42.0	0.0	17.28*
(2,1)	8	8.4	-0.4	0.019
(2,2)	12	8.4	3.6	1.543
(2,3)	9	8.4	0.6	0.043
(2,4)	8	8.4	-0.4	0.019
(2,5)	5	8.4	-3.4	1.376
Total	42	42.0	0.0	3.000
(3,1)	7	8.4	-1.4	0.233
(3,2)	9	8.4	0.6	0.043
(3,3)	10	8.4	1.6	0.305
(3,4)	10	8.4	1.6	0.305
(3,5)	6	8.4	-2.4	0.686
Total	42	42.0	0.0	1.571
(4,1)	4	8.4	-4.4	2.305
(4,2)	8	8.4	-0.4	0.019
(4,3)	9	8.4	0.6	0.043
(4,4)	11	8.4	2.6	0.805
(4,5)	10	8.4	1.6	0.305
Total	42	42.0	0.0	3.476
(5,1)	5	8.4	-3.4	1.376
(5,2)	4	8.4	-4.4	2.305
(5,3)	9	8.4	0.6	0.043
(5,4)	11	8.4	2.6	0.805
(5,5)	13	8.4	4.6	2.519
Total	42	42.0	0.0	7.048

*Significant at the .005 level.

Appendix G - continued
(For 1985.2 - 1985.3 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	21	9.2	11.8	15.135
(1,2)	11	9.2	1.8	0.352
(1,3)	8	9.2	-1.2	0.157
(1,4)	3	9.2	-6.2	4.178
(1,5)	3	9.2	-6.2	4.178
Total	46	46.0	0.0	24.00*
(2,1)	13	9.2	3.8	1.570
(2,2)	8	9.2	-1.2	0.157
(2,3)	6	9.2	-3.2	1.113
(2,4)	10	9.2	0.8	0.070
(2,5)	9	9.2	-0.2	0.004
Total	46	46.0	0.0	2.913
(3,1)	4	9.2	-5.2	2.939
(3,2)	10	9.2	0.8	0.070
(3,3)	12	9.2	2.8	0.852
(3,4)	10	9.2	0.8	0.070
(3,5)	10	9.2	0.8	0.070
Total	46	46.0	0.0	4.000
(4,1)	1	9.2	-8.2	7.309
(4,2)	7	9.2	-2.2	0.526
(4,3)	10	9.2	0.8	0.070
(4,4)	19	9.2	9.8	10.439
(4,5)	9	9.2	-0.2	0.004
Total	46	46.0	0.0	18.34*
(5,1)	7	9.2	-2.2	0.526
(5,2)	10	9.2	0.8	0.070
(5,3)	10	9.2	0.8	0.070
(5,4)	4	9.2	-5.2	2.939
(5,5)	15	9.2	5.8	3.657
Total	46	46.0	0.0	7.261

*Significant at the .005 level.

Appendix G - continued
(For 1985.3 - 1985.4 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	10	7.4	2.6	0.914
(1,2)	10	7.4	2.6	0.914
(1,3)	8	7.4	0.6	0.049
(1,4)	5	7.4	-2.4	0.778
(1,5)	4	7.4	-3.4	1.562
Total	37	37.0	0.0	4.216
(2,1)	9	7.4	1.6	0.346
(2,2)	12	7.4	4.6	2.859
(2,3)	3	7.4	-4.4	2.616
(2,4)	10	7.4	2.6	0.914
(2,5)	3	7.4	-4.4	2.616
Total	37	37.0	0.0	9.351
(3,1)	6	7.4	-1.4	0.265
(3,2)	8	7.4	0.6	0.049
(3,3)	11	7.4	3.6	1.751
(3,4)	5	7.4	-2.4	0.778
(3,5)	7	7.4	-0.4	0.022
Total	37	37.0	0.0	2.865
(4,1)	4	7.4	-3.4	1.562
(4,2)	2	7.4	-5.4	3.941
(4,3)	11	7.4	3.6	1.751
(4,4)	10	7.4	2.6	0.914
(4,5)	10	7.4	2.6	0.914
Total	37	37.0	0.0	9.081
(5,1)	8	7.4	0.6	0.049
(5,2)	5	7.4	-2.4	0.778
(5,3)	4	7.4	-3.4	1.562
(5,4)	7	7.4	-0.4	0.022
(5,5)	13	7.4	5.6	4.238
Total	37	37.0	0.0	6.649

Appendix G - continued

(For 1985.4 - 1986.1 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	6	6.4	-0.4	0.025
(1,2)	10	6.4	3.6	2.025
(1,3)	6	6.4	-0.4	0.025
(1,4)	6	6.4	-0.4	0.025
(1,5)	4	6.4	-2.4	0.900
Total	32	32.0	0.0	3.000
(2,1)	5	6.4	-1.4	0.306
(2,2)	5	6.4	-1.4	0.306
(2,3)	7	6.4	0.6	0.056
(2,4)	7	6.4	0.6	0.056
(2,5)	8	6.4	1.6	0.400
Total	32	32.0	0.0	1.125
(3,1)	8	6.4	1.6	0.400
(3,2)	5	6.4	-1.4	0.306
(3,3)	6	6.4	-0.4	0.025
(3,4)	4	6.4	-2.4	0.900
(3,5)	9	6.4	2.6	1.056
Total	32	32.0	0.0	2.688
(4,1)	6	6.4	-0.4	0.025
(4,2)	5	6.4	-1.4	0.306
(4,3)	6	6.4	-0.4	0.025
(4,4)	10	6.4	3.6	2.025
(4,5)	5	6.4	-1.4	0.306
Total	32	32.0	0.0	2.688
(5,1)	7	6.4	0.6	0.056
(5,2)	7	6.4	0.6	0.056
(5,3)	7	6.4	0.6	0.056
(5,4)	5	6.4	-1.4	0.306
(5,5)	6	6.4	-0.4	0.025
Total	32	32.0	0.0	0.500

Appendix G - continued
(For 1986.1 - 1986.2 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	15	7.4	7.6	7.805
(1,2)	15	7.4	7.6	7.805
(1,3)	4	7.4	-3.4	1.562
(1,4)	2	7.4	-5.4	3.941
(1,5)	1	7.4	-6.4	5.535
Total	37	37.0	0.0	26.64[a]
(2,1)	6	7.4	-1.4	0.265
(2,2)	6	7.4	-1.4	0.265
(2,3)	12	7.4	4.6	2.859
(2,4)	6	7.4	-1.4	0.265
(2,5)	7	7.4	-0.4	0.022
Total	37	37.0	0.0	3.676
(3,1)	8	7.4	0.6	0.049
(3,2)	4	7.4	-3.4	1.562
(3,3)	9	7.4	1.6	0.346
(3,4)	10	7.4	2.6	0.914
(3,5)	6	7.4	-1.4	0.265
Total	37	37.0	0.0	3.135
(4,1)	2	7.4	-5.4	3.941
(4,2)	6	7.4	-1.4	0.265
(4,3)	9	7.4	1.6	0.346
(4,4)	14	7.4	6.6	5.886
(4,5)	6	7.4	-1.4	0.265
Total	37	37.0	0.0	10.70[b]
(5,1)	6	7.4	-1.4	0.265
(5,2)	6	7.4	-1.4	0.265
(5,3)	3	7.4	-4.4	2.616
(5,4)	5	7.4	-2.4	0.778
(5,5)	17	7.4	9.6	12.454
Total	37	37.0	0.0	16.37[a]

[a]Significant at the .005 level.

[b]Significant at the .05 level.

Appendix G - continued
(For 1986.2 - 1986.3 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	20	9.8	10.2	10.616
(1,2)	14	9.8	4.2	1.800
(1,3)	7	9.8	-2.8	0.800
(1,4)	3	9.8	-6.8	4.718
(1,5)	5	9.8	-4.8	2.351
Total	49	49.0	0.0	20.28[a]
(2,1)	11	9.8	1.2	0.147
(2,2)	8	9.8	-1.8	0.331
(2,3)	15	9.8	5.2	2.759
(2,4)	9	9.8	-0.8	0.065
(2,5)	6	9.8	-3.8	1.473
Total	49	49.0	0.0	4.776
(3,1)	11	9.8	1.2	0.147
(3,2)	9	9.8	-0.8	0.065
(3,3)	8	9.8	-1.8	0.331
(3,4)	14	9.8	4.2	1.800
(3,5)	7	9.8	-2.8	0.800
Total	49	49.0	0.0	3.143
(4,1)	2	9.8	-7.8	6.208
(4,2)	13	9.8	3.2	1.045
(4,3)	10	9.8	0.2	0.004
(4,4)	12	9.8	2.2	0.494
(4,5)	12	9.8	2.2	0.494
Total	49	49.0	0.0	8.245
(5,1)	5	9.8	-4.8	2.351
(5,2)	5	9.8	-4.8	2.351
(5,3)	9	9.8	-0.8	0.065
(5,4)	11	9.8	1.2	0.147
(5,5)	19	9.8	9.2	8.637
Total	49	49.0	0.0	13.55[b]

[a]Siginificant at .005 level.

[b]Significant at .01 level.

Appendix G - continued
(For 1986.3 - 1986.4 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	14	7.8	6.2	4.928
(1,2)	5	7.8	-2.8	1.005
(1,3)	5	7.8	-2.8	1.005
(1,4)	7	7.8	-0.8	0.082
(1,5)	8	7.8	0.2	0.005
Total	39	39.0	0.0	7.026
(2,1)	7	7.8	-0.8	0.082
(2,2)	11	7.8	3.2	1.313
(2,3)	10	7.8	2.2	0.621
(2,4)	5	7.8	-2.8	1.005
(2,5)	6	7.8	-1.8	0.415
Total	39	39.0	0.0	3.436
(3,1)	10	7.8	2.2	0.621
(3,2)	8	7.8	0.2	0.005
(3,3)	3	7.8	-4.8	2.954
(3,4)	10	7.8	2.2	0.621
(3,5)	8	7.8	0.2	0.005
Total	39	39.0	0.0	4.205
(4,1)	5	7.8	-2.8	1.005
(4,2)	10	7.8	2.2	0.621
(4,3)	12	7.8	4.2	2.262
(4,4)	8	7.8	0.2	0.005
(4,5)	4	7.8	-3.8	1.851
Total	39	39.0	0.0	5.744
(5,1)	3	7.8	-4.8	2.954
(5,2)	5	7.8	-2.8	1.005
(5,3)	9	7.8	1.2	0.185
(5,4)	9	7.8	1.2	0.185
(5,5)	13	7.8	5.2	3.467
Total	39	39.0	0.0	7.795

Appendix G - continued

(For 1964.4 - 1987.1 quarters)

Quintile	f_{ij}	e_{ij}	$(f_{ij} - e_{ij})$	$\frac{(f_{ij} - e_{ij})^2}{e_{ij}}$
(1,1)	17	8.6	8.4	8.205
(1,2)	12	8.6	3.4	1.344
(1,3)	4	8.6	-4.6	2.460
(1,4)	5	8.6	-3.6	1.507
(1,5)	5	8.6	-3.6	1.507
Total	43	43.0	0.0	15.02*
(2,1)	6	8.6	-2.6	0.786
(2,2)	9	8.6	0.4	0.019
(2,3)	12	8.6	3.4	1.344
(2,4)	9	8.6	0.4	0.019
(2,5)	7	8.6	-1.6	0.298
Total	43	43.0	0.0	2.465
(3,1)	7	8.6	-1.6	0.298
(3,2)	6	8.6	-2.6	0.786
(3,3)	13	8.6	4.4	2.251
(3,4)	7	8.6	-1.6	0.298
(3,5)	10	8.6	1.4	0.228
Total	43	43.0	0.0	3.860
(4,1)	9	8.6	0.4	0.019
(4,2)	7	8.6	-1.6	0.298
(4,3)	5	8.6	-3.6	1.507
(4,4)	10	8.6	1.4	0.228
(4,5)	12	8.6	3.4	1.344
Total	43	43.0	0.0	3.395
(5,1)	4	8.6	-4.6	2.460
(5,2)	9	8.6	0.4	0.019
(5,3)	9	8.6	0.4	0.019
(5,4)	12	8.6	3.4	1.344
(5,5)	9	8.6	0.4	0.019
Total	43	43.0	0.0	3.860

*Significant at the .005 level.

LIST OF REFERENCES

Abdel-Khalik, R., and J. Espejo. "Expectations Data and the Predictive Value of Interim Reporting." Journal of Accounting Research, Spring 1978, pp. 1-13.

Ajinkya, B. B., and M. J. Gift. "Dispersion of Financial Analysts' Forecasts and the (Option Model) Implied Standard Deviations of Stock Returns." Journal of Finance, December 1985, pp. 1353-1365.

Ball, R. "Anomalies in Relationships between Securities' Yield Surrogates." Journal of Financial Economics, June/September 1978, pp. 103-126.

Ball, R., and P. Brown. "An Empirical Evaluation of Accounting Income Numbers." Journal of Accounting Research, Autumn 1968, pp. 159-178.

Barefield, R., and E. Comiskey. "The Accuracy of Analysts' Forecasts of Earnings Per Share." Journal of Business Research, July 1975, pp. 241-252.

Barry, C.B. "Effects of Uncertain and Nonstationary Parameters upon Capital Market Equilibrium Conditions." Journal of Financial and Quantitative Analysis, September 1978, pp. 419-433.

Barry, C.B., and S.J. Brown. "Differential Information and Security Market Equilibrium." Journal of Financial Quantitative Analysis, December 1985, pp. 407-422.

Bawa, V.S., S.J. Brown, R. W. Klein. Estimation Risk and Optimal Portfolio Choice. Amsterdam: North Holland, 1979.

Beaver, W.H. "The Information Content of Annual Earnings Announcements." Empirical Research in Accounting: Selected Studies, 1968. Supplement to Journal of Accounting Research 6, pp. 159-178.

Beaver, W.H., R. Clarke, and W. Wright. "The Association Between Unsystematic Security Returns and the Magnitude of Earnings Forecast Errors." Journal of Accounting Research 17, 1979, pp. 316-340.

Bernard, V.L. and J.K. Thomas. "Post-Earnings-Announcement Drift: Delayed Price Response or Risk Premium?" Journal of Accounting Research, Vol. 27 Supplement 1989.

Bidwell, C.M. "A Test of Market Efficiency: SUE/PE." Journal of Portfolio Management, Summer 1979, pp. 53-58.

Bidwell, C.M., and J. R. Riddle. "Market Inefficiencies - Opportunities for Profits." Journal of Accounting, Auditing and Finance, Spring 1981, pp. 198-214.

Box, G.E.P. and G.M. Jenkins. Times Series Analysis: Forecasting and Control, (San Francisco; Holden-Day 1970).

Brown, S.J. "The Effect of Estimation Risk on Capital Market Equilibrium." Journal of Quantitative Analysis, June 1979, pp. 215-220.

Brown, L.D., R.L. Hagerman, P.A. Griffin, and M.E. Zmijewski. "Security Analyst Superiority Relative to Univariate Time-Series Models in Forecasting Quarterly Earnings." Journal of Accounting and Economics, April 1987a, pp. 61-87.

Brown, L.D., R.L. Hagerman, P.A. Griffin, and M.E. Zmijewski. "An Evaluation of Alternative Proxies for the Market's Assessment of Unexpected Earnings." Journal of Accounting and Economics, July 1987b, pp. 159-193.

Brown, L.D., G.D. Richardson, and S.J. Schwager. "An Information Interpretation of Financial Analyst Superiority in Forecasting Earnings." Journal of Accounting Research, Spring 1987, pp. 49-67.

Brown, L.D., and M.S. Rozeff. "The Superiority of Analyst Forecasts as Measures of Expectations: Evidence from Earnings." Journal of Finance, March 1978, pp. 1-16.

Brown, P., G. Foster, and E. Noreen. "Security Analyst Multi-Year Earnings Forecasts and the Capital Markets." American Accounting Association Studies in Accounting Research #21, 1985.

Butler, K.C., and L. Lang. "The Earnings Forecasts of Individual Security Analysts." Working Paper, December, 1988.

Calley, N.O. "A Note on Standardized Unexpected Earnings: The Case of the Electric Utility Industry." Financial Review, February 1985, pp. 102-110.

Conover, W.J. Practical Nonparametric Statistics. New York: John Wiley & Sons, Inc., 1971.

Collins, W.A. and W.S. Hopwood. "A Multivariate Analysis of Annual Earnings Forecasts Generated from Quarterly Forecasts of Financial Analysts and Univariate Time-Series Models." Journal of Accounting Research, Autumn 1980, pp. 390-406.

Cragg, J.G. and B.G. Malkiel. "The Consensus and Accuracy of some Predictions of the Growth of Corporate Earnings." Journal of Finance, March 1968, pp. 67-84.

Cragg, J. and B. Malkiel. Expectations and the Structure of Share Prices. Chicago: University of Chicago Press, 1982.

Crichfield, T., T. Dyckman, and J. Lakonishok. "Evaluation of Security Analysts' Forecasts." Accounting Review, July 1978, pp. 651-668.

Defeo, V.J. "An Empirical Investigation of the Speed of the Market Reaction to Earnings Announcements." Journal of Accounting Research, Autumn 1986, pp. 349-363.

Elton, E.J., M.J. Gruber, and M. Gultekin. "Professional Expectations: Accuracy and Diagnosis of Errors." Journal of Financial and Quantitative Analysis, December 1984, pp. 351-363.

Foster, G., C. Olsen, and T. Shevlin. "Earnings Releases, Anomalies, and the Behavior of Security Returns." Accounting Review, October 1984, pp. 574-603.

Fried, D., and D. Givoly. "Financial Analysts' Forecasts of Earnings." Journal of Accounting and Economics, 1982, pp. 85-107.

Givoly, D. "The Formation of Earnings Expectations." Accounting Review, July 1985, pp. 372-386.

Givoly, D., and J. Lakonishok. "Financial Analyst' Forecast of Earnings." Journal of Banking and Finance, September 1980, pp. 601-617.

______. "The Quality of Analysts' Forecasts of Earnings." Financial Analysts Journal, September-October 1984, pp. 40-47.

______. "Aggregate Earnings Expectations and Stock Market Behavior." Journal of Accounting, Auditing and Finance, Spring 1987, pp. 117-150.

Hawkins, E.H., S.C. Chamberlin, and W.E. Daniel. "Earnings Expectations and Security Prices." Financial Analysts Journal, September-October 1984, pp. 24-74.

Hillmer, S.C., and P.L. Yu. "The Market Speed of Adjustment to New Information." Journal of Financial Economics 7, 1979, pp. 321-345.

Jones, C.P. and R.H. Litzenberger. "Quarterly Earnings Reports and Intermediate Stock Price Trends," Journal of Finance, March 1970, pp. 143-148.

Jones, C.P., R.J. Rendleman, and H.A. Latane'. "Stock Returns and SUEs during the 1970s." Journal of Portfolio Management, Winter 1984, pp. 18-22.

______. "Earnings Announcements: Pre-and-Post Responses." Journal of Portfolio Management, Spring 1985, pp. 28-32.

Joy, O.M. and C.P. Jones. "Earnings Reports and Market Efficiencies: An Analysis of the Contrary Evidence." Journal of Financial Research, Spring 1979, pp. 51-63.

Joy, O.M., and R. H. Litzenberger, and R. W. McEnally. "The Adjustment of Stock Prices to Announcements of Unanticipated Changes in Quarterly Earnings." Journal of Accounting Research, Autumn 1977, pp. 207-225.

Latane', H.A., and C.P. Jones. "Standardized Unexpected Earnings - A Progress Report." Journal of Finance, December 1977, pp. 1457-1465.

______. "Standardized Unexpected Earnings - 1971-77." Journal of Finance, June 1979, pp. 717-724.

Latane', H.A., C.P. Jones, and R.D. Rieke. "Quarterly Earnings Reports and Subsequent Holding Period Returns." Journal of Business Research, April 1974, pp. 119-132.

Lintner, J. "The Aggregation of Investor's Diverse Judgements and Preferences in Purely Competitive Markets." Journal of Quantitative Analysis, December 1969, pp. 347-400.

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

Miller, E.M. "Risk, Uncertainty, and Divergence of Opinion." Journal of Finance, September 1977, pp. 1151-1168.

Niederhoffer, V. and P.J. Regan. "Earnings Changes, Analysts' Forecasts and Stock Prices." Financial Analysts Journal, May-June 1972, pp. 65-72.

O'Brien, P.C. "Analysts' Forecasts as Earnings Expectations." Journal of Accounting and Economics, January 1988, pp. 53-83.

Peterson, D. and P.P. Peterson. "The Effect of Changing Expectations Upon Stock Returns." Journal of Financial and Quantitative Analysis, December 1982, pp. 799-813.

Pincus, M. "Information Characteristics of Earnings Announcements and Stock Market Behavior." Journal of Accounting Research, Spring 1983, pp. 155-183.

Reinganum, M.R. "Misspecification of Capital Assets Pricing: Empirical Anomalies Based on Earnings Yields and Market Values." Journal of Financial Economics, March 1981, pp. 19-46.

Rendleman, R.J., Jr., C.P. Jones, and H.A. Latane'. "Empirical Anomalies Based on Unexpected Earnings and the Importance of Risk Adjustments." Journal of Financial Economics, November 1982, pp. 269-287.

______. "Further Insight into the Standardized Unexpected Earnings Anomaly: Size and Serial Correlation Effects." Financial Review, February 1987, pp. 131-144.

Ruback, R.S. "The Effect of Discriminatory Price Control Decisions on Equity Values." Journal of Financial Economics, March 1982, pp. 83-105.

Scholes, M. and J. Williams. "Estimating Beats from Non-Synchronous Data." Journal of Financial Economics, December 1977, pp. 309-327.

Smith, R.G.E. "The Marginal Opinion Theory." Financial Analysts Journal, November-December 1967.

Theil, H. Applied Economic Forecasting, (Amsterdam: North-Holland Publishing Company, 1966).

Verrecchia, R.E. "The Rapidity of Price Adjustments to Information." Journal of Accounting and Economics 2, 1980, pp. 63-92.

Watts, R. "Systematic 'Abnormal' Returns after Quarterly Earnings Announcements." Journal of Financial Economics, June-Sept 1978, pp.127-150.