SHORT-RUN PROFITS FROM STOCK SPLITS

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Frank K. Reilly
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INTRODUCTION

For almost half a century stock splits have been analyzed for their value to the issuing firms, to the stockholders of those firms, and to potential stockholders. Despite a number of assumed advantages, the prior studies have generally indicated no long-run benefit to the corporation from a stock-split except that in some cases there has been an increase in the number of stockholders. Even so, many observers still contend that investors can make abnormal profits by investing in stocks that are going to split although the academic studies have indicated that stock prices apparently have discounted all the favorable news prior to the split. Notably, most prior studies that examined the effect of a stock split on stock prices employed monthly data and examined stock price movements relative to the split date rather than the more relevant announcement date. The purpose of this study is to conduct a test of the semi-strong efficient market hypothesis by examining the price and volume changes surrounding the day a split is announced and analyze the potential for abnormal trading profits from acquiring the stock of companies immediately before the announcement of

a stock split or immediately after the announcement. Therefore, in contrast to prior studies that examined monthly stock price data, this study examines daily stock prices, it also considers trading volume data which has not been examined in prior work and concentrates on the period surrounding the announcement of the stock split contained in the Wall Street Journal rather than the split date.

The initial section contains a discussion of prior studies that analyzed the effect on returns of stock splits. In section two we consider the study sample, the period of analysis, and analyze absolute and relative price and trading volume for the period surrounding the announcement. Section three contains a description of alternative trading rules and presents the results of implementing the rules. The final section contains a summary and conclusion followed by a discussion of the implications of the results for the efficient market hypothesis.

PRIOR RESEARCH ON PRICE EFFECTS OF STOCK SPLITS

Early Studies

Ninety-five stocks listed on the New York Stock Exchange which split during the period 1921 to 1931 were examined for profit potential by Dolley.[1] Sixty percent of the stocks involved enjoyed a rapid price increase while 27 percent suffered a price decline following the split. All price activity was reported without adjustment for market movement.

Fifteen years later Myers and Bakay used the Standard and Poor's Index to remove market movement from the price changes of 70 split stocks during the period eight weeks before to eight weeks after the split date.[2]

[1] J. C. Dolley, "Characteristics and Procedures of Common Stock Split-Ups," Harvard Business Review, Vol. 11, No. 3 (April, 1933), pp. 316-326.

[2] J. H. Myers and A. J. Bakay, "Influence of Stock Split-Ups on Market Price," Harvard Business Review, Vol. 26, No. 2 (March, 1948), pp. 251-255.

The results indicated excess returns of almost 20 percent during the 16 week period surrounding the split date.

Concentrating on the relative-to-market price activity prior to the announcement in the financial press of 39 stock splits in 1947 Burrell investigated a modified version of the strong form of the efficient market hypotheses.[3] He found an average relative increase of five percent during the 30 days before the announcement date. Above average profits were possible if investments were made based on inside formation or in anticipation of a forthcoming stock split.

Barker

A series of studies by Barker questioned the expected higher prices accruing to stockholders owning shares that split or paid stock dividends supposedly because of broader markets and increases in demand. Barker examined 90 firms on the NYSE that split their stock during 1951-1953.[4] Prices were acquired for three dates: split date minus one year, the split date, and split date plus six months. These prices were converted to price relatives by applying the appropriate Standard and Poor's industry subgroup index.

The influence of cash dividends was studied by dividing the total sample into a group of 35 stocks which enjoyed dividend increases and 55 stocks which received no dividend increases. The average price relative of the group receiving dividend increases was 15 percent higher at

[3] O. K. Burrell, "Price Effects of Stock Dividends and Split-Ups," The Commercial and Financial Chronicle, (December 2, 1948), p. 10.

[4] C. Austin Barker, "Effective Stock Splits," Harvard Business Review, Vol. 34, No. 1 (January-February, 1956), pp. 101-106.

the split date and six months following the split. The average price
relative for the group without dividend increases was six percent higher
on the split date but declined during the six months after the split
date to its relative level of one year prior to the split.[5]

Barker observed that the dividend increase group experienced "a
short but sharp run-up for one to three days in a strong bull market at
the date of announcement or other published news of the split-up."[6]

Subsequently Barker examined the performance of 190 firms which
paid stock dividends accompanied by total cash dividend increases during
the period 1951-1954. He observed "that there is often a strong but
short-lived price run-up during the first few days after news of a stock
dividend reaches the public...."[7] Unfortunately, both splits and stock
dividends were analyzed using only a few spot price relatives centered
on split dates and ex-dividend dates.

In a follow-up article Barker studied the effect of splits during
the strong bull market period of 1954-1955.[8] Eighty-eight firms which
had splits of between 2-to-1 and 3-to-1 were divided into 75 stocks en-
joying total cash dividend increases and 13 stocks not accompanied by
dividend increases. Again the results indicated substantial relative
gains for the split stocks that had dividend increases at the split date
and six months after. In contrast, those stocks that did not have a

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[5] Ibid., pp. 102, 103.

[6] Ibid., p. 103.

[7] C. Austin Barker, "Evaluation of Stock Dividends," Harvard Business
Review, Vol. 36, No. 4 (July-August, 1958), pp. 99-113.

[8] C. Austin Barker, "Stock Splits in a Bull Market," Harvard Business
Review, Vol. 35, No. 3 (May-June, 1957), pp. 72-79.

dividend increase were higher at the split date, but their relative prices declined during the subsequent six months to a point below the prior year price. Barker concluded that it was the cash dividend paying ability and not the mechanical act of splitting which favorably affected stock prices. Similarly he again observed "the many instances in which a very sharp increase occurred when news of the projected split first reached the public."[9] While Barker's long-run conclusions are reasonable, his data precludes an investigation of both the timing and the duration of stock price activity surrounding the announcement date.

Kimball and Papera

Kimball and Papera investigated short-term price activity surrounding a stock split by an analysis of 28 NYSE stocks that split during the first half of 1961.[10] They considered prices on the announcement date, the record date and the split date. They concluded that the stock split itself favorably influenced market prices both for a 30 day period prior to the announcement date and for 14 days after the announcement, record, and split dates. The impact of the conclusions are reduced because of the limited sample, a limited number of observations, but mainly because almost none of the prices are adjusted for aggregate market activity.

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[9] Ibid., p. 75.

[10] Peter Kimball and D. Robert Papera, "Effect of Stock Splits on Short-Term Market Prices," Financial Analysts Journal, Vol. 20, No. 3 (May-June, 1964), pp. 75-80.

Johnson

A much more rigorous and expansive test of the effect of splits on price was conducted by Johnson.[11] Johnson developed a least-squares multiple regression which attempted to explain relative price changes based on measures of dividends, earnings, split or non-split status, and the relevant industry stock price index. The test sample consisted of 73 New York Stock Exchange shares which split at least 2 for 1 during 1957. A similar number of non-split stocks which also had increased their cash dividends were randomly chosen.

Because there was "evidence of some extraordinary price activity prior to the split date, especially around the time of the announcement by a board,"[12] the study began and ended with stock prices seven and one-half months prior to the split date and four and one-half months after the split date.

Employing various combinations of the above variables the largest coefficient of determination derived was 0.54 ($\overline{R}^2$). The industry index variable was found to possess no explanatory power and the dividend coefficients were negative and not statistically significant. However, a significant relative price change was associated with stock splits. Based on these results the author concluded that investors owning stocks seven and one-half months prior to a split in 1959 and holding those shares until four and one-half months after the split would have earned

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[11]Keith B. Johnson, "Stock Splits and Price Change," Journal of Finance, Vol. 21, No. 5 (December, 1966), pp. 675-686.

[12]Ibid., p. 679.

higher relative returns than those generated from a similar investment
in non-split stocks regardless of dividends.[13]

Fama, Fisher, Jensen and Roll

By far the most exhaustive study of the impact of stock splits, as
far as the size of the data base is concerned, is the classic study by
Fama, Fisher, Jensen and Roll (FFJR).[14] All stocks listed on the New
York Stock Exchange between January, 1927 and December, 1959 which had
stock distributions of 25 percent or more and were listed for a period
of 24 months surrounding the split date were included. The sample con-
sisted of 622 securities for a total of 940 splits.

Recall that prior studies adjusted for market movements by subtracting
the price change for an aggregate market series or an industry series.
In contrast, FFJR contended that each stock had a unique relationship to
the market (as implied by the capital asset pricing model) and derived
this unique relationship by examining the linear regression model for
each stock with the Fisher Link Relative Index of all stocks on the NYSE.
Because the preliminary analysis indicated that the residuals were non-
zero for the period surrounding the splits, the regression models ex-
cluded the observations 15 months before and after the split. Given
this regression model which provided a unique market adjustment for each
stock, the analysis centered on the analysis of the residuals from this

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[13]Ibid., p. 15.

[14]Eugene F. Fama, Lawrence Fisher, Michael C. Jensen and Richard Roll,
"The Adjustment of Stock Prices to New Information," International Economic
Review, Vol. 10, No. 1 (February, 1969), pp. 1-22.

model for the 60 months surrounding the split in order to trace the
possible existence of any abnormal returns related to stock splits.
Split securities were grouped according to whether cash dividends either
increased or decreased relative to the average dividends paid by all
securities on the NYSE. Results show that the average residuals prior
to the month of the actual split were uniformly positive for both divi-
dend groups with the highest average residuals (and the highest average
monthly rates of return) occurring in the four months immediately pre-
ceding the split month after which the residuals for the total sample
were randomly distributed around zero.[15] Notably, since the anouncement
date varies between one and four months before the actual split date,
opportunities for abnormal profits might remain once the public is in-
formed of the impending split.

An analysis of the splits grouped according to relative dividend
action indicated that the residuals for the dividend decrease stocks did
not rise as high during the pre-split period and subsequently fell during
the post-split period whereas the dividend increase stocks continued a
modest gain for approximately 15 months into the post-split period.[16]
The authors concluded that for the dividend decrease group the cumulative
average residuals "plummet in the few months following the split when
the anticipated dividend increase is not forthcoming ... when a year has
passed after the split, the cumulative average residual has fallen to
about where it was five months prior to the split ... the apparent effects

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[15]Ibid., p. 13.

[16]Ibid., p. 15.

of the split seem to have been completely wiped away, and the stock's returns have reverted to their normal relationship with market returns."[17]

Finally, an attempt was made to determine the speed with which the market reacts to split information. Average and cumulative average residuals were computed for a random sample of 52 splits using the announcement month as month zero rather than the split month as previously defined. While admitting that their "data do not allow full examination of this question," ... they concluded that "the behavior of the residuals after the announcement date is almost identical to the behavior of the residuals after the split date."[18] The large positive residuals (found previously) in the three or four months before the split month are explained away in that "the behavior of the average residuals was not representative of the behavior of the residuals for individual securities."[19] It is contended that these large positive residuals "merely reflect the fact that, from split to split, there is a variable lag between the time the split information reaches the market and the time when the split becomes effective."[20] The current authors find these latter results somewhat puzzling because they appear to conflict with the major results. Specifically, moving the center vertical axis of zero to the left up to four months, from the split month to the announcement month, places the average large positive residuals and the high and rising cumulative

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[17] Ibid., p. 17.

[18] Ibid., p. 18.

[19] Ibid., p. 19.

[20] Ibid., p. 20.

average residuals to the right and, therefore, subsequent to the time

the split information becomes publicly known. An acceptance of the

sample's conclusions along with the attendant rationalization would

serve to cast serious doubt upon the results of the primary investigation.

At any rate, end-of-month prices were not sufficiently specific for use

in short-term trading activity.

Hausman, West and Largay

A discriminating study by Hausman, West and Largay (HWL) attempted

to synthesize the results from Johnson and FFJR and also to partially

replicate Johnson's results.[21] Since the Johnson procedure analyzed

the total 12 months from seven and one-half months prior to the split

date to four and one-half months after the split date HWL questioned

whether the significant positive split variable may have been due to

the expected price increases prior to the split. FFJR's tentative con-

clusions about the behavior of prices subsequent to the announcement

month provided an additional incentive for study.

In addition to the beginning and ending values used and supplied

to the authors by Johnson they also examined prices on the split date,

the announcement date in the Wall Street Journal, and a point four

weeks prior to the announcement date. The return variable did not

include cash dividends received during the period and thus may have

understated the returns especially for split stocks which received

increased cash dividends. In essence, the HWL model was the same as

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[21] W. H. Hausman, R. R. West, and J. A. Largay, "Stock Splits, Price
Changes, and Trading Profits: A Synthesis," Journal of Finance, Vol.
14, No. 1 (January, 1971), pp. 69-77.

the Johnson model except that they did not include a dividend variable because it had been negative and insignificant in the Johnson study.[22]

Regressions were run covering all possible time periods from combinations of the five observations. While the coefficient of determination (R^2) did not attain a value greater than 0.51, the coefficients had the expected signs and were reasonably significant. The coefficient for the split variable was significant for all runs which included the four-week period _prior_ to the announcement date and the split coefficient reached its largest value during that specific period. The split coefficient was _not_ significant for intervals that included only periods following the announcement date.[23]

HWL concluded "that buying stocks on (or after) the date on which a split has been publicly announced does not lead to systematic price appreciation greater than the appreciation that might be expected from underlying factors such as corporate earnings and the industry-by-industry outlook."[24] Because of the limited observation points it is not possible to derive conclusions regarding short-term trading opportunities. It is felt that more observations on both sides of the crucial announcement date are necessary.

Millar and Fielitz

Millar and Fielitz were concerned with whether stock dividends and splits contained information about future price performance and whether

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[22]_Ibid._, p. 74.

[23]_Ibid._, p. 75.

[24]_Ibid._, p. 76.

resultant prices were a function of the market period, the size of the distribution, and the terminology used to describe the distribution.[25]

Three years representing alternative market phases were selected from the period July 1963 to December 1968 in an effort to identify the effect of underlying market trends. Using the Dow Jones Industrial Average 1964 was designated a bull market, 1966 a bear market, and mid-1967 to mid-1968 a stable or no-change market. Distributions of 20 percent or greater that were termed splits or stock dividends from either the NYSE or the ASE were identified and placed; 39 in the bull market, 41 in the bear market, and 42 in the stable market. Of these 79 were stock splits and 43 were stock dividend distributions. Monthly data for price, dividends, earnings, industry stock price index, and general market stock price index for 12 months surrounding the distribution data were collected. They collected similar data for a control group of 122 stocks that were not splitting or issuing stock dividends during the same time interval. The estimated residual price effect from a multiple regression model was computed and analyzed. Similar to FFJR the residuals were averaged and cumulated around the split or new-distribution month. The patterns of the residuals of the new-distribution stocks and the control stocks were significantly different. For the distribution group the pre-distribution months generated no negative residuals, while the greatest positive average residuals occurred two or three months before the distribution month and during the distribution month itself. The cumulative average residuals increased each

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[25] James A. Millar and Bruce D. Fielitz, "Stock-Split and Stock-Dividend Decisions," _Financial Management_, Vol. 2, No. 4 (Winter, 1973), pp. 35-45.

month during the pre-distribution period and reached their highest value one month follcwing the distribution month.[26]

These results are similar to the FFJR primary results because they concentrated on the split month. As a result, short-term trading profits might be possible due to large, positive residuals around the announcement date and continuing through the split date or distribution month. Further examination showed no significant difference in the residuals when the sample was grouped by market phase or type or size of distribution.

Anna Merjos

Anna Merjos examined 60 OTC stocks which split at least 2-for-1 from July 1975 through April, 1976 by analyzing prices at three points in time: two months before the announcement date, the announcement date, and two months following the announcement. Percentage changes were computed between these three dates adjusted for the DJIA.[27]

Eighty-two percent of the stocks experienced an absolute price increase during the two month pre-announcement period. Half the group experienced absolute price increases over the two month post-announcement period. Sixty percent of the stocks had a relative-to-market gain during the pre-announcement period. Fifty-five percent of the stocks enjoyed relative-to-market average price increases during the two month post-announcement period.

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[26] Ibid., pp. 40, 41.

[27] Anna Merjos, "Sell On the News - When Stocks Split Take the Money and Run," Barrons (May 31, 1976), pp. 11, 16, 17.

Bar-Yosef and Brown

A study by Bar-Yosef and Brown raised questions concerning the constant beta procedure employed by FFJR.[28] Specifically, the assumption made by FFJR that the systematic risk of split securities remained constant during the period surrounding the split date was questioned. They argued that it is likely that information about changes in cash dividends was uncertain prior to the announcement date thereby causing abnormally large variability in returns (increased systematic risk) during the period around the split date. Determining whether this variability results in increased systematic risk was the major thrust of the study.

They examined 108 monthly stock prices for 219 securities which split (distributions of 25 percent or more) between 1945 and 1964. Moving betas for each security were averaged for each of the 108 months. Abnormal returns (residuals) for each security were estimated for each month. The total sample was also divided into a group of 156 securities which increased total cash dividends after the split and 63 stocks which did not increase their cash dividends. Similar to FFJR, the residuals were centered around the split month.

The analysis demonstrated that for the entire sample the moving average betas (N=30) increased, peaked approximately one year prior to the split month and then returned to beginning levels by the split month plus three years.[29] The beginning and ending betas were similar to the median, non-moving beta computed by FFJR.

[28]Sasson Bar-Yosef and Lawrence D. Brown, "A Reexamination of Stock Splits Using Moving Betas," Journal of Finance, Vol. 32, No. 4 (September, 1977), pp. 1069-1080.

[29]Ibid., p. 1072.

This study also pointed out that firms which split following higher earnings reduced uncertainty regarding future cash dividends since the plot of moving betas fell farther and at a steeper rate for those firms which increased total cash dividends after the split. In contrast, the moving average betas for firms which split but did not increase total cash dividends continued to rise until approximately 20 months after the split month.[30] Often because these firms had not generated rising earnings investors found the split difficult to interpret and uncertainty was increased. This belief was tested by generating residuals by both the FFJR constant beta method and the moving average beta technique. The cumulative average residuals increased more under the constant beta method than under the moving beta calculation. Investors in firms which split and increased cash dividends therefore gained less than posited under the constant beta procedure. Firms which split and failed to increase total cash dividends actually generated average cumulative residuals below the value reached around the announcement date when calculated by the moving beta method. It was concluded that FFJR overstated returns to investors since their method understated the attendant risks posed by stock splits.[31]

Summary of Prior Studies

Because of the widespread interest in stock splits and the folklore involved numerous studies have examined the pattern of returns for the period surrounding the split. The strong consensus using

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[30] Ibid., p. 1073.

[31] Ibid., pp. 1075-1080.

monthly data is that almost all the positive abnormal price movements
occur prior to the split or during the month of the split which implies
that there are few if any long term benefits to the firm. The results
as applied to the semi-strong efficient market hypothesis likewise in-
dicate that most of the abnormal price movement occurs prior to the split
and even prior to the announcement. Unfortunately, these results are
dampened by the use of monthly data or data for specific days prior to
the announcement (e.g., four weeks; seven months) and individual days
after the announcement. Assuming that one is attempting to determine
the pattern of price adjustment to a split announcement, it would appear
preferable to examine a number of consecutive days surrounding the
announcement. Also, in order to examine the information impact of the
announcement, it would be important to examine the volume of trading
for the period surrounding the announcement and none of the prior studies
examined volume. The current study considers these factors by examining
price and volume for a number of consecutive days surrounding the announce-
ment of the stock splits.

SAMPLE AND OVERALL ANALYSIS

The Sample

The sample includes a number of common stocks listed on the New
York Stock Exchange (NYSE), that split two-for-one during the 13 year
period 1964-1976. For each year ten stocks were randomly selected from
those that split two-for-one. Therefore, the split sample includes 130
stocks. For each split, a control common stock was likewise randomly
selected from those stocks listed on the NYSE at the time of the split

announcement. Also, there was a comparison to the Standard & Poor's Composite Index of 500 stocks.

Sample Period

The total sample period encompassed 36 trading days including the 15 trading days before the announcement in the _Wall Street Journal_, the day of the announcement, and the 20 trading days following the announcement. For each of the 36 days the analysis considers the closing price and the volume of trading for the split stock, the random stock, and the aggregate NYSE as represented by the S&P 500 Index.

Analysis of Price Changes

The price changes surrounding the announcement are analyzed in absolute terms, relative to a random stock, and relative to the market index. Specifically, we computed the average cross-sectional price for all the split stocks and the random stocks for each day during the 36 day period surrounding the split announcement as follows:

$$MAP_t = \sum_{i=1}^{130} P_{i,t}/N$$

MAP_t = mean average closing price of the split stock or the randomly selected stock on day t.

$P_{i,t}$ = closing price of split stock or random stock i, on day t.

N = 130 split stocks or random stocks.

The result is a time series of average closing prices for the split stocks or the random stocks for days running from t - 15 to t + 20, t = 0 is the day of the split announcement. The purpose of this analysis is to determine the difference in movement for the two stock price series

during the period surrounding the split announcement. Those who expect
investors to react to the announcement of the split would hypothesize
a difference in the price movements for the split stocks during the period
immediately before and after the day of the announcement.

In addition to the mean of the absolute prices, we computed the
ratio of the price of the split stock divided by the price of the random
stock, and the ratio of the price of the split stock divided by the stock
market index. The time series plot of this cross sectional average price
ratio indicates the relative price performance for the split stocks during
the period surrounding the split announcement. Finally, we computed the
ratio of the random stock divided by the market index and computed the
daily cross sectional average. The time series plot of this relative
price series should be a straight line which would indicate the appro-
priateness of the random stock selection.

Analysis of Volume

We also analyzed the time series of volume of trading for the cross
section of split stocks, random stocks, and the aggregate market. Specifi-
cally, we examined the time series of mean average volume defined as follows:

$$MAV_t = \sum_{i=1}^{130} V_{i,t}/N$$

MAV_t = mean average daily volume on day t.

$V_{i,t}$ = volume of trading for stock i on day t.

N = 130 split stocks, random stocks, or the aggregate stock
market as represented by daily volume on the NYSE.

Again, in addition to the individual volume figures, we computed
the ratio of split stock volume to random stock volume, split stock

volume to aggregate market volume, and random stock volume to market volume. The time series plot of relative trading volume should high-light any unique trading effect surrounding the announcement of the stock split.

Discussion of Adjustment Technique

The analysis of the split stock price and volume relative to the price and volume for a random stock and the aggregate market is intended to control for the market. The authors are aware that this procedure differs from the widely used technique employed by FFJR in their study of stock splits.[32] The FFJR technique examines the abnormal returns from the security's characteristic line. Such an analysis requires the computation of the stock's characteristic line based upon numerous observations before and after the split and requires the assumption that the parameters of the characteristic line are stable during the period of analysis. Notably, the study by Bar-Yosef and Brown discussed earlier indicated that the beta for the split stocks is not generally stable during this period and, therefore, it is necessary to derive a moving beta.[33] In the case of daily stock price observations it is likely that the general instability of the parameters would be more pronounced and, therefore, the use of such a technique would either require many more observations or other adjustments for the instability. In addition, a study by Kraus and Stoll dealing with daily stock price movements surrounding block trades indicated that the use of the assumption of an alpha

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[32]Fama, Fisher, Jensen and Roll, "Price Adjustments ...," Op. Cit.

[33]Bar-Yosef and Brown, "A Reexamination of Stock Splits ...," Op. Cit.

equal to zero and a beta of unity did not change their results.[34] Also,

a study by Hopewell and Schwartz that also examined the daily stock price

adjustments surrounding temporary trading suspensions on the NYSE also

considered models with and without specific market adjustments and con-

tended that the results did not differ qualitatively and only slightly

quantitatively.[35]

Results for Daily Stock Prices

There are time series plots for the cross section of split stocks,

random stocks and the market series but they are not included due to

space constraints. Basically, the time series plot of random stocks

and the market series is a straight line, while the split stock plot

indicates a rising pattern prior to the announcement and a definite

decline after day t+4. The time series plot of the stock price series

relative to the random stocks is contained in Figure 1. The plot in-

dicates a rising pattern almost from the beginning whereby the ratio

goes from about 1.90 to a high of 1.98 on day t+1, continues at that

level for three days and then begins a steady decline through day t+21.

Notably, the major relative price changes occur from the close on day

t-2 to the close on day t-1 and from t-1 to day t.

The relative price change from the close on day t-2 to the close

on day t-1 is not so much an indication of an information leak or inside

information as it is evidence of very rapid adjustment to pre-publication

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[34]Alan Kraus and Hans R. Stoll, "Price Impacts of Block Trading on the New York Stock Exchange," *Journal of Finance*, Vol. 27, No. 3 (June, 1973), pp. 569-588.

[35]Michael H. Hopewell and Arthur L. Schwartz, Jr., "Temporary Trading Suspensions in Individual NYSE Securities," *Journal of Finance*, Vol. 33, No. 5 (December, 1978), p. 1363.
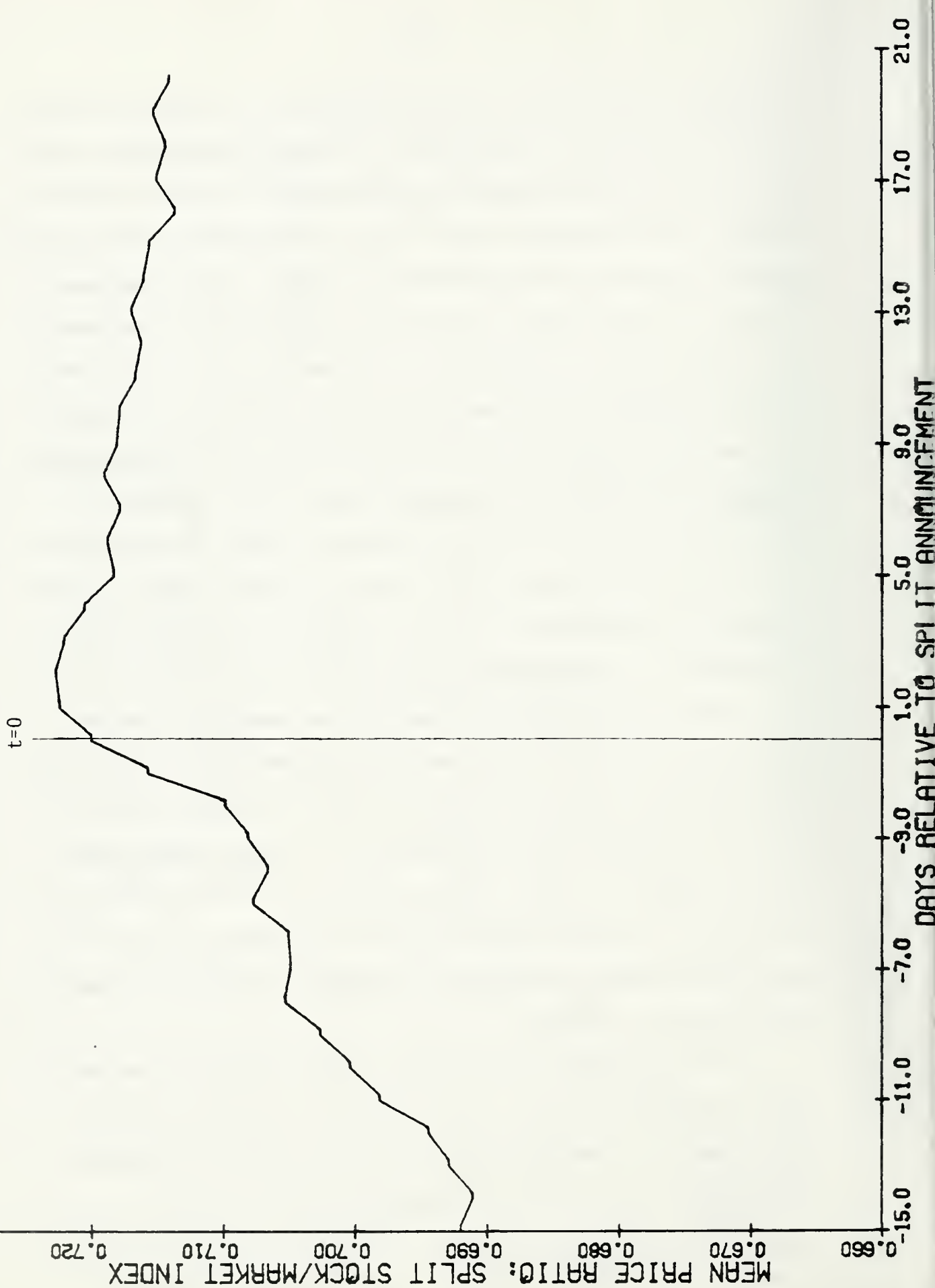
Figure 1

Time Series Plot of Mean Relative Stock Prices for Split Stocks
(Split Stock Price Relative to Random Stock Prices)
for Period Surrounding Day of Stock Split Announcement
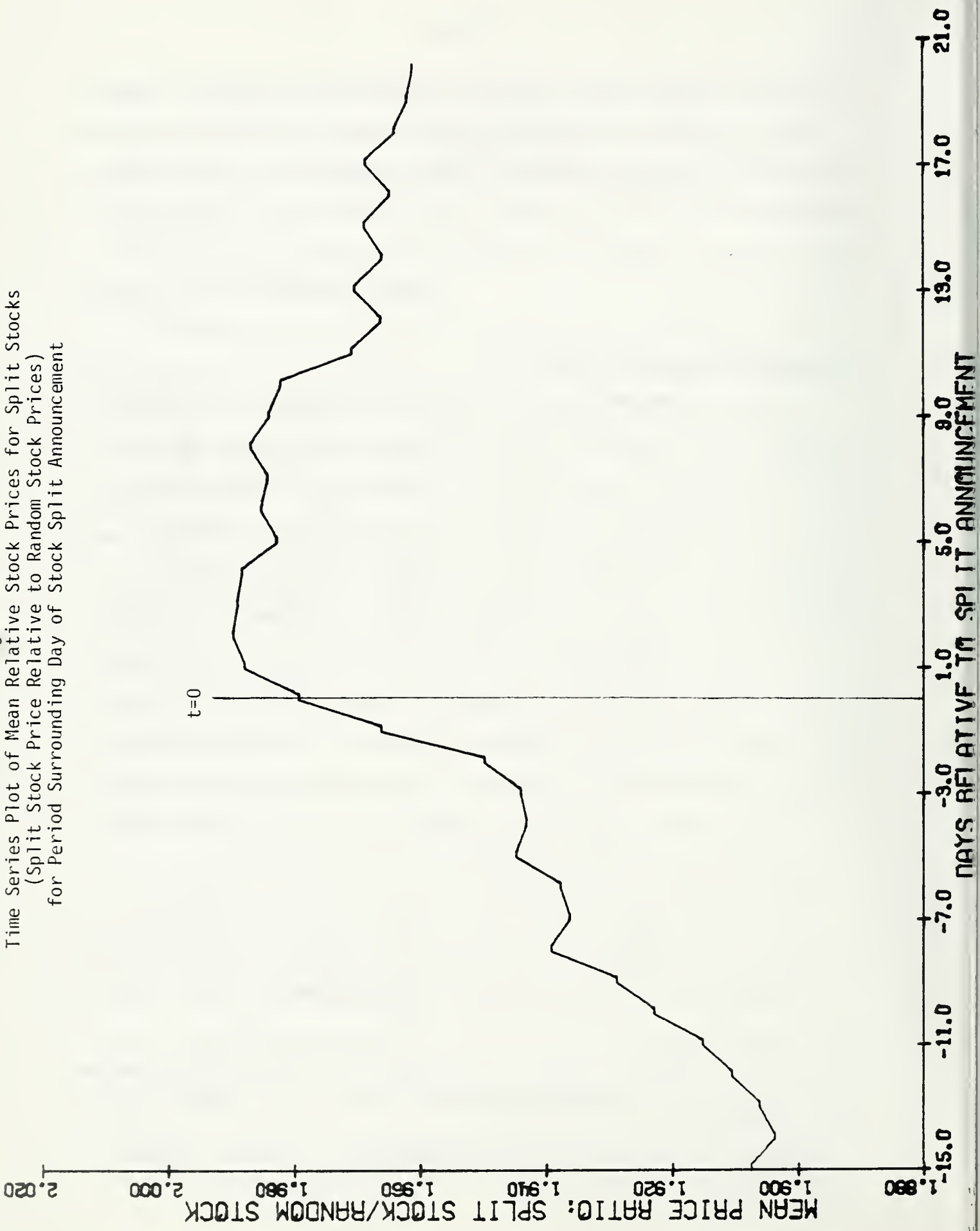
information. Specifically, the announcement date was specified on the
basis of when the split was announced in the Wall Street Journal. The
fact is that in many instances the announcement of the split comes out
through the Dow-Jones News Service (i.e., the broad tape) during the day
prior to the day of the announcement in the paper. One can envision a
meeting of a firm's Board of Directors at 10:00 a.m. and a subsequent
news release before noon regarding a proposed stock split. This news
release regarding the forthcoming stock split is then put out through
the news service during the afternoon and published in the Wall Street
Journal and other papers the following morning. Such a sequence of
events would mean that certain professional investors who have access
to the Dow-Jones news service or receive a call from a broker who sub-
scribes to the service could act the day before the completely public
announcement in the Wall Street Journal (i.e., they could act on day
t-1). These time series results indicate that apparently there are
investors who do react to this news service announcement. In addition
these results indicate that there is a further adjustment during the
day of the completely public announcement in the Wall Street Journal
and other papers. Finally, there appears to be a further adjustment on
day t+1, but it is much less than the prior adjustments. The relative
price pattern during the subsequent three days is constant followed by
price declines as noted.

As one might expect, the pattern of prices relative to the market
index contained in Figure 2 is very similar to the plot of Figure 1.
Again there is a generally rising pattern from t-14 to t-2, a sharp
rise from t-2 to t+1 and a declining pattern from t+2 to t+21.

Figure 2
Time Series Plot of Mean Relative Stock Prices for Split Stocks
(Split Stock Price Relative to Market Index)
for Period Surrounding Day of Stock Split Announcement

Results for Daily Trading Volume

The time series plot of daily trading volume for the split stocks relative to the random stocks is contained in Figure 3. The plot indicates a slight secular increase prior to the split announcement but the series is rather volatile. In contrast, there is a very obvious peak on day t=0, a small decline on day t+1, followed by a sharp drop on day t+2 and generally low volume on all subsequent days.

The time series plot for volume relative to aggregate market volume is contained in Figure 4. The pattern is similar but again somewhat smoother and somewhat more pronounced. Again there is some slight evidence of an increase prior to the announcement, a major spike on the day of the public announcement, then a drop on day t+1 and generally declining volume thereafter.

These volume results are especially interesting in terms of pinpointing the public impact of the announcement. Combined with the prior discussion of the relative price pattern, these results would indicate that prices began to experience relative increases several weeks before the announcement on fairly normal volume, but experienced a significant relative price change during day t-1 on relatively normal volume and another large price increase during the day of the announcement with very heavy volume. All subsequent price changes including the relative price declines are on normal or declining volume. These combined results indicate that the general public apparently does not react to the news until it appears in the Wall Street Journal, but that there is some prior price reaction from insiders or professionals on reasonable volume. This includes the major price adjustment during day t-1 which apparently is caused by professional investors reacting to the announcement on the news service.

Figure 3
Time Series Plot of Split Stock Volume Relative to Random Stock Volume
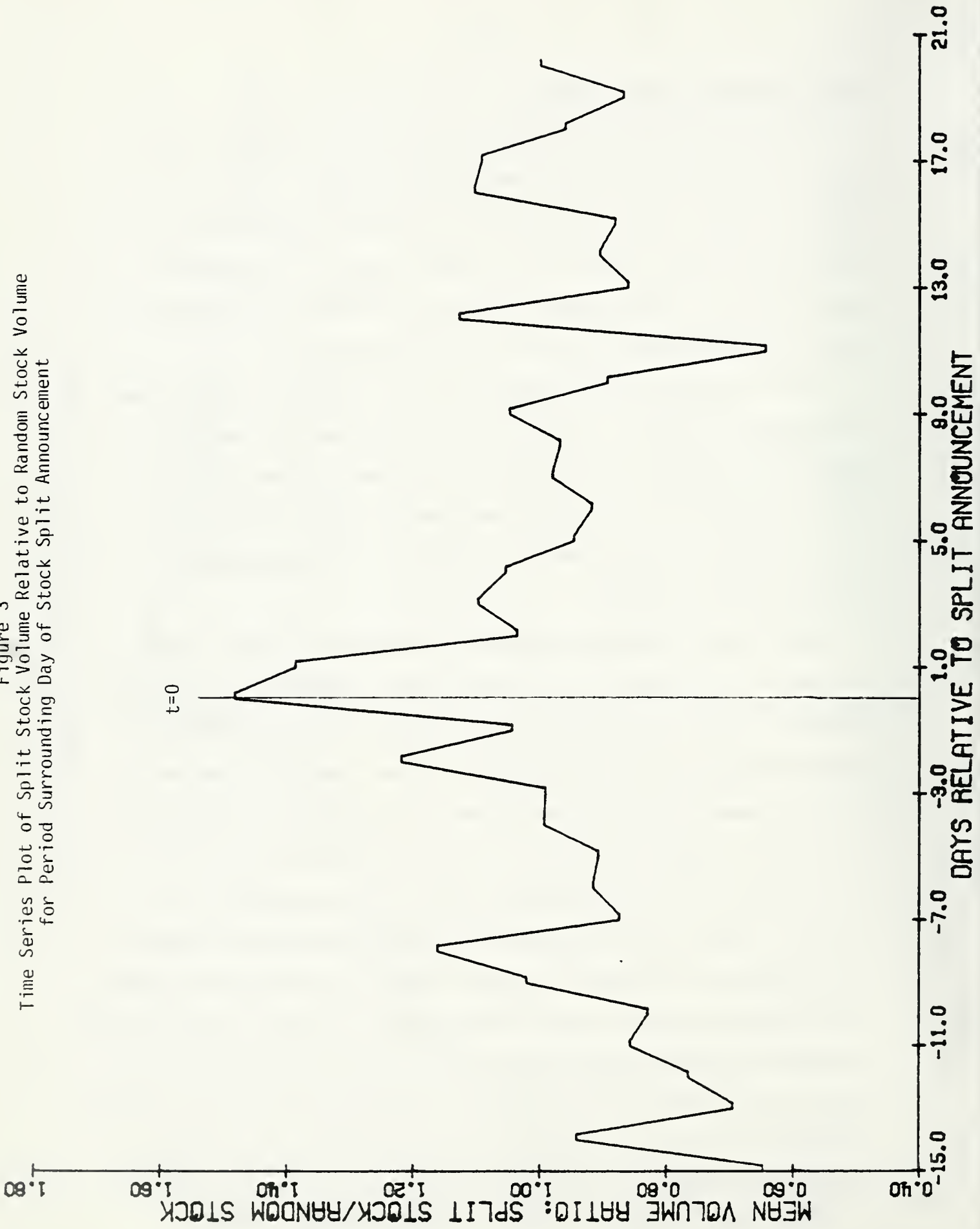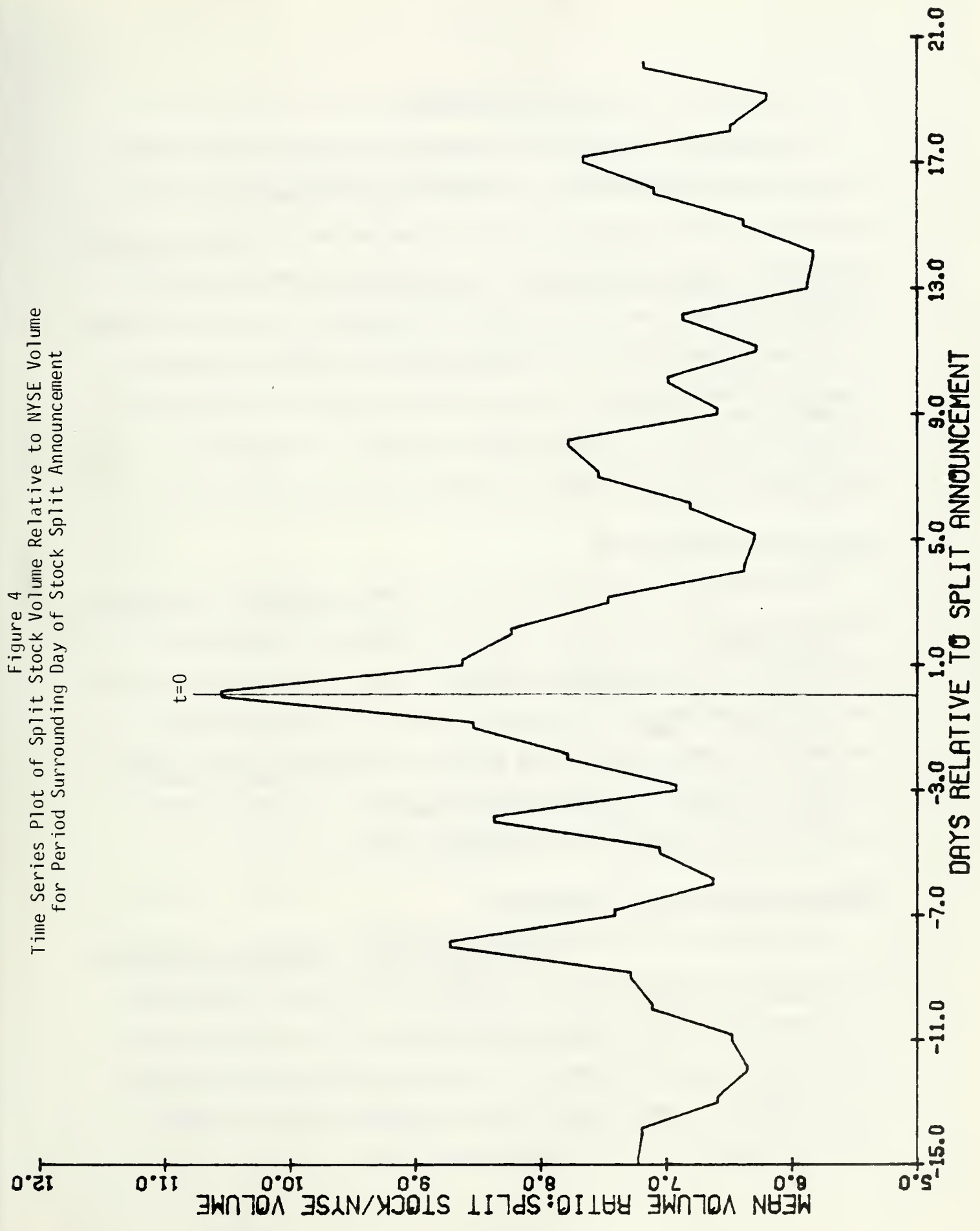for Period Surrounding Day of Stock Split Announcement

Figure 4
Time Series Plot of Split Stock Volume Relative to NYSE Volume
for Period Surrounding Day of Stock Split Announcement

TESTS OF TRADING RULES

In addition to the analysis of absolute and relative price movements surrounding the announcement of a stock split, the ultimate test of the semi-strong efficient market hypothesis is an analysis of whether a trading rule using the public announcement of a significant economic event would be more profitable than a simple buy-and-hold policy. A number of trading rules were considered with and without commissions. The tests without commissions were intended to see if there were significant abnormal price changes; the tests with commissions were intended to determine if one could profit from any abnormal price changes in a real world environment.

Day of Announcement (Day 0)

The first set of tests analyze the investment results for an investor who acquires the stock that is to be split at the close on the day of the announcement in the Wall Street Journal. Given a purchase at the close on Day 0, it is assumed that the stock is sold at the close on each Day 1 through 20. These results for the split stocks are taken alone, but also compared to similar investment results for the cross section of random stocks and for an investment in the market index.

Purchase Prior to Public Announcement

The second set of tests analyze the investment results for an investor who acquires the stock that is to be split at the close on the day prior to the announcement in the Wall Street Journal. Given a purchase at the close on Day t-1, it is assumed that the stock is sold at the close on Day 0 through 20. Again these results are compared to similar investments in a random stock and the aggregate market.

The results for this trading rule should indicate whether professionals who have access to the Dow Jones News Service could invest on the basis of this semi-public information and generate abnormal returns.

Purchase on Day -2

This set of tests is for investors with inside information regarding the forthcoming announcement. As such, it is really not a test of the semi-strong efficient market, but would indicate whether anybody with prior knowledge could experience abnormal returns from this announcement.

In this case, it is assumed the stock is acquired at the close two days before the announcement and is sold at the close on day -1, through day 19.

Short Sale on Announcement Day

In contrast to acquiring the stock on the day of the announcement, one might speculate that there would be a unjustified increase in the stock price as a result of the announcement, so it would be preferable to sell the stock short at the close on Day 0 or shortly thereafter and cover the short sale on a subsequent day. Obviously, the returns from this investment test would be the opposite of the results that tested a purchase on Day 0.

## Results from Purchase on Announcement Day

The results generated by a trading rule that assumes a purchase at the closing price on day 0 and a sale during subsequent days are contained in Table 1 and a time series plot of the cumulative series is in Figure 5. The results for the unadjusted split stocks in the first column indicate that there were positive price changes the first two days that

TABLE 1

MEAN CUMULATIVE PERCENT PRICE CHANGES FOR SPLIT STOCKS
UNADJUSTED AND RELATIVE TO RANDOM STOCKS AND THE AGGREGATE
STOCK MARKET ASSUMING PURCHASE AT CLOSE ON DAY
OF THE SPLIT ANNOUNCEMENT

| | Mean Cumulative Percent Price Change | | |
	Split Stock	Split Stock Minus Random Stock	Split Stock Minus Market Index
Close of:			
Day 1	0.487	0.558	0.464
2	0.682	0.651	0.575
3	0.605	0.729	0.377
4	0.283	0.721	0.129
5	0.000	0.423	-0.161
6	-0.091	0.308	-0.234
7	-0.316	0.332	-0.389
8	-0.364	0.320	-0.397
9	-0.439	0.320	-0.535
10	-0.531	0.322	-0.503
11	-0.653	0.036	-0.535
12	-0.822	-0.277	-0.608
13	-0.605	-0.041	-0.424
14	-0.749	0.054	-0.441
15	-0.851	0.031	-0.508
16	-1.037	-0.080	-0.705
17	-0.843	0.307	-0.513
18	-1.179	-0.010	-0.787
19	-1.255	-0.256	-0.735
20	-1.382	-0.341	-0.832

Figure 5

Time Series Plot of Cumulative Percent Price Changes Assuming a Purchase
at the Close on the Day of the Announcement

(S-unadjusted split stock; R-split stock minus random stock; M-split stock minus market index)
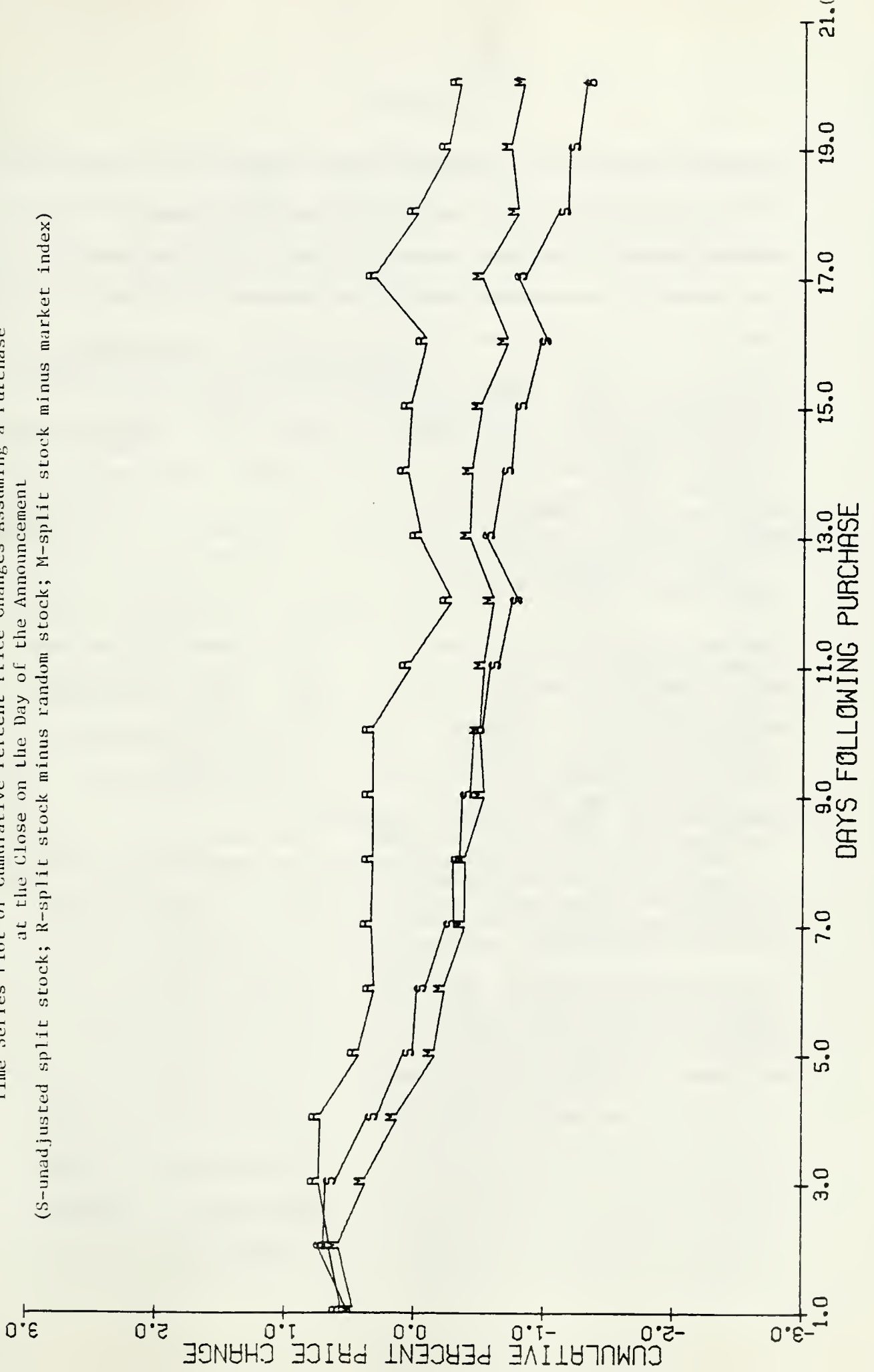
cumulated to 0.682 percent. Subsequent price changes were negative such
that the cumulative percent change declined and became negative by the
close of day six and continued negative through day 20. The abnormal
price changes relative to the random stocks (the cumulative percent
price change for the split stock minus the cumulative percent price
change for the random stocks) was positive during the first three days
after the announcement as the cumulative abnormal price change increased
to a peak of 0.729 percent at the close on day three. There were sub-
sequent declines followed by small changes in both directions such that
the cumulative series varied between 0.30 and -0.30 percent. The final
column contains abnormal price changes relative to the aggregate market
(the cumulative percent price change for the split stock minus the cumu-
lative percent price change for the market index). This abnormal price
change series peaked at the end of the second day at 0.575 percent, de-
clined and became negative by the close of the fifth day after the
announcement and remained negative through day 20.

One can derive three major conclusions from these results. First,
the cumulative series tends to peak at the end of the second or third
day after the announcement which implies that the reaction is fast and
is completed rather quickly. The second conclusion is that the positive
cumulative abnormal price changes that last for several days indicate
that there is a definite positive impact from the announcement of a
stock split as contended by the folklore. The third conclusion, which
is important since it relates directly to the EMH, contends that an in-
vestor who acquired the stock of a company that announced a forthcoming
stock split at the close on the day of the announcement and sold it

during any of the following 20 days would not experience positive ab-
normal rates of return after considering a typical transaction cost of
2 percent (one percent to buy and one percent to sell) because the peak
cumulative percent change never exceeds 0.73 percent.

Results From Purchase on Day Minus One

The results generated by a trading rule that assumes a purchase at
the closing price on day minus one and a sale during subsequent days are
contained in Table 2 and a time series plot of the cumulative series is
in Figure 6. The cumulative percent change results are similar in pattern
to those in Table 1, but at a generally higher level than the results
assuming a purchase on the announcement day.

The unadjusted split stock series reached a peak of 1.425 percent
at the close of day two. Subsequently the series generally declined and
ended with negative cumulative returns. The split stock minus random
stock series peaked on day three at 1.628 percent and subsequently de-
clined but never became negative during the 20 days after the announce-
ment. Finally, when the split stock price was adjusted for the market
return the cumulative series peaked on day two at 1.355 percent and sub-
sequently declined to about zero on day 20.

The conclusions are from these results are very similar to those derived
when we assumed an acquisition on the day of the announcement. Specifi-
cally, the peak cumulative price change likewise occurs on either day
two or day three. This is to be expected since the only difference is
the base price--i.e., the assumed purchase price which is lower on day
minus one. Again, the important conclusion is that, although there de-
finitely were positive price changes after the semi-public announcement

TABLE 2

MEAN CUMULATIVE PERCENT PRICE CHANGES FOR SPLIT STOCKS
UNADJUSTED AND RELATIVE TO RANDOM STOCKS AND THE AGGREGATE
STOCK MARKET ASSUMING A PURCHASE AT CLOSE ON DAY PRIOR
TO THE SPLIT ANNOUNCEMENT

| | Mean Cumulative Percent Price Change | | |
	Split Stock	Split Stock Minus Random Stock	Split Stock Minus Market Index
Close of:			
Day 0	0.730	0.896	0.765
1	1.233	1.475	1.248
2	1.425	1.563	1.355
3	1.342	1.628	1.152
4	1.015	1.618	0.899
5	0.741	1.329	0.617
6	0.652	1.222	0.547
7	0.421	1.237	0.386
8	0.370	1.219	0.376
9	0.292	1.218	0.235
10	0.193	1.215	0.261
11	0.072	0.292	0.231
12	-0.093	0.619	0.162
13	0.121	0.856	0.342
14	-0.022	0.955	0.326
15	-0.124	0.931	0.258
16	-0.307	0.822	0.064
17	-0.116	1.205	0.254
18	-0.470	0.869	-0.036
19	-0.545	0.634	0.018
20	-0.672	0.545	-0.081

Figure 6

Time Series Plot of Cumulative Percent Price Changes Assuming a Purchase
at the Close on the Day Before the Public Announcement

(S-unadjusted split stock; R-split stock minus random stock; M-split stock minus market index)
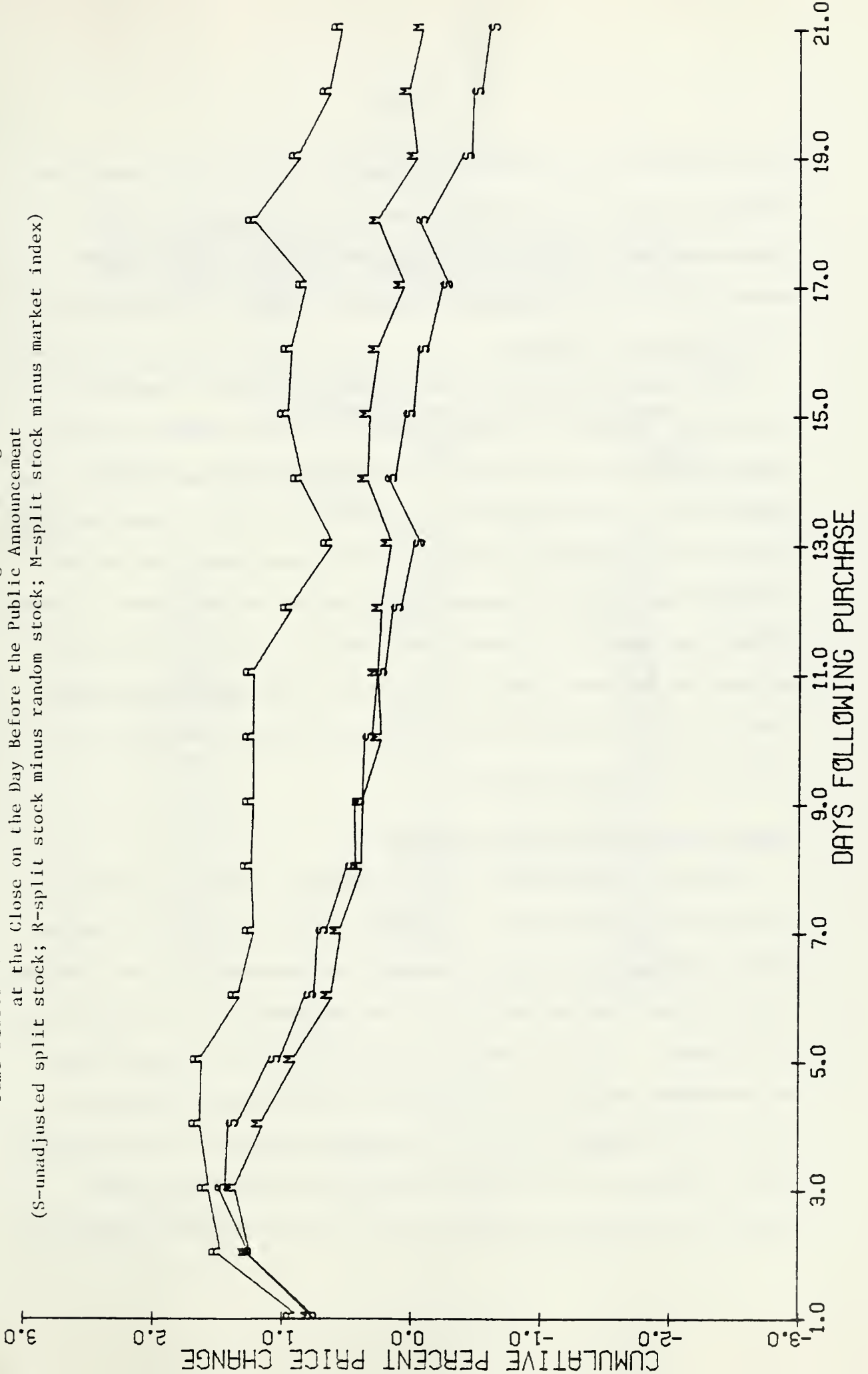
on the broad tape, an investor who acquired the stock of a company who announced a split at the closing price on the day before the public announcement in the Wall Street Journal would not experience above average price changes after taking account of normal transactions costs of approximately 2 percent.

These results that reflect the probable investment experience for professional investors who have access to the split announcement information prior to its publication in the Wall Street Journal provide strong support for the semi-strong efficient market hypotheses. These results indicate that stock prices reflect the split announcement information so rapidly that most professionals cannot derive abnormal rates of return. Further, the majority of investors who cannot act until the following day when the forthcoming split is announced in the Wall Street Journal clearly do not experience positive abnormal returns but apparently lose money due to transactions costs.

Results From Purchase on Day Minus Two

The results generated by a trading rule that assumes an investor acquires the stock to be split at the close two days prior to the announcement in the Wall Street Journal and sells on subsequent days are contained in Table 3 and a time series plot of the cumulative percent change series is in Figure 7. As noted before, these results are really not testing the semi-strong efficient market hypothesis (EMH) since we assume the purchase is made prior to any form of public announcement. This analysis could be considered a test of the strong form EMH because one could assume that some insiders might be aware of the forthcoming announcement.

TABLE 3

MEAN CUMULATIVE PERCENT PRICE CHANGES FOR SPLIT STOCKS
UNADJUSTED AND RELATIVE TO RANDOM STOCKS AND THE AGGREGATE
STOCK MARKET ASSUMING A PURCHASE AT THE CLOSE TWO DAYS
PRIOR TO THE SPLIT ANNOUNCEMENT

	Mean Cumulative Percent Price Changes		
	Split Stock	Split Stock Minus Random Stock	Split Stock Minus Market Index
Close of:			
Day -1	1.089	0.986	1.059
0	1.832	1.896	1.837
1	2.346	2.491	2.328
2	2.552	2.597	2.448
3	2.468	2.660	2.243
4	2.134	2.640	1.981
5	1.863	2.357	1.704
6	1.781	2.270	1.642
7	1.543	2.275	1.472
8	1.492	2.258	1.461
9	1.414	2.257	1.320
10	1.315	2.256	1.345
11	1.188	1.968	1.310
12	1.022	1.655	1.240
13	1.247	1.908	1.432
14	1.109	1.997	1.420
15	0.997	1.969	1.342
16	0.810	1.863	1.145
17	1.004	2.248	1.338
18	0.642	1.903	1.040
19	0.557	1.659	1.085

Figure 7

Time Series Plot of Cumulative Percent Price Changes Assuming a Purchase
at the Close Two Days Before the Public Announcement

(S-unadjusted split stock; R-split stock minus random stock; M-split stock minus market index)
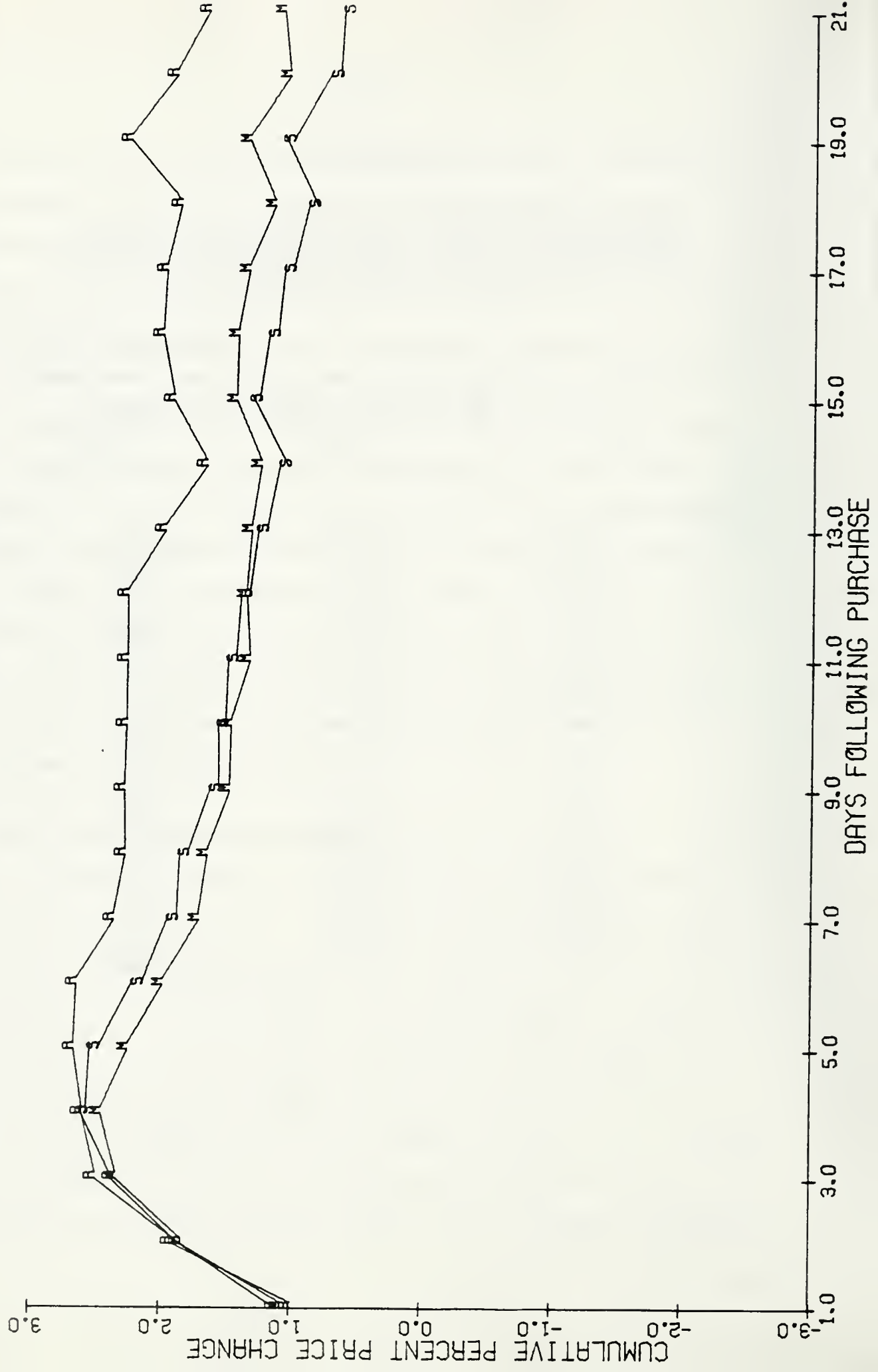
Again, as expected, the pattern of cumulative price changes is the same whereby all the series either peak at the close of day two or day three. The major difference is the _size_ of the cumulative price changes. In the case of the unadjusted series, the peak is 2.55 percent on day two. The series adjusted for random stocks had a peak on day three of 2.66 percent, while the market adjusted series peaked at 2.45 percent on day two.

These results indicate that it _is_ possible to derive abnormal price changes after normal transactions costs if one can acquire the stock at the close on the day prior to any public announcement of the split. This is conceivably only available to corporate insiders which would indicate evidence against the strong form EMH. Notably, because it is necessary to sell the stock within three days after the announcement, the trading activity would be rather obvious to anybody investigating the event.

Results From Selling Short

As noted, because the pattern of cumulative price changes peaks shortly after the announcement and declines thereafter, one might conjecture that it is possible to derive abnormal profits from selling the stock short and subsequently covering the sale. The results in Table 1 can be used to determine what would happen under these conditions since a short sale would imply a reversal of all signs.

Assuming a short sale at the close on the day of the announcement, the results would be exactly as shown with the signs reversed. In this case, one can see that the cumulative percent price changes peak on the last day at 1.38 percent for the unadjusted price series, 0.34 percent for the random stock adjusted series, and 0.83 percent for the market

adjusted series. Again, none of these cumulative percent price changes would imply superior abnormal returns after normal transactions costs of 2 percent.

Alternatively, one might assume that investors recognize that the prices on these stocks do not peak until the close two or three days after the announcement. To examine the results under this assumption one should consider the difference in the cumulative percent price changes from day two or three and day 20. In the case of the unadjusted prices this implies a difference of 2.064 percent (0.682 plus 1.382) which is just above the 2 percent breakeven point after commissions. An analysis of the more relevant adjusted series indicates that the difference for the random stock adjusted series is 1.070 percent (0.729 plus 0.341) and the implied abnormal return for the market adjusted series is 1.407 percent (0.575 plus 0.832). The implied returns from the two adjusted series are below the normal transactions costs and would imply that it is not possible to derive abnormal returns from selling the stock short even at its peak price following the split announcement.

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

A number of prior studies have examined the price movements sur- rounding stock splits in order to determine the profit opportunities. Most of these prior studies either used monthly data or employed the split date as the base period. This study examined in detail the short- run profit opportunities surrounding stock splits by examining daily stock price changes surrounding the public announcement of the stock split which should be the relevant day in terms of testing the efficient

market hypothesis. We also examined the trading volume during this
period which has not been considered in prior studies.

The analysis of the price series for the split stocks relative to
a sample of random stocks and an aggregate stock market index indicated
that the price series displayed generally positive abnormal price changes
beginning several weeks before the announcement with a major price change
occuring between the close on day minus two and the close on day minus
one. There was another large price change from the close on day minus
one to the close on the day of the announcement. Notably, the large
relative price change on day minus one is not attributable to inside
information, but is probably caused by the actions of professionals who
have access to the Dow Jones News Service. There are further small in-
creases the two days after the announcement followed by generally de-
clining stock prices.

The relative volume figures indicated a small secular increase in
volume prior to the announcement, but a major "spike" in relative volume
on the day of the announcement. Subsequently, there was a sharp drop in
volume and generally declining figures for the subsequent 20 days. These
results indicate that the principle information impact comes from the
announcement in the Wall Street Journal.

The final section examined the specific profit opportunities avail-
able from acquiring the stocks involved on alternative days. Specifically,
we assumed acquisitions of the stock on the day of the announcement in
the Wall Street Journal when the information would be completely public;
on the day prior to the completely public announcement when the infor-
mation would be available to most professionals; and two days prior to

the public announcement when the information might be available to in-
siders. All cumulative price series peaked on either day two or three
after the announcement which would indicate a positive response to the
information, but rather rapid price adjustment to the announcement. On
the important question of abnormal profit opportunities, the results in-
dicated that there were clearly no excess returns available to investors
who acquired the stock on the day of the announcement and who paid normal
transactions costs. Further, although the abnormal returns were higher
for investors who were able to acquire the stock at the close on the
day before the announcement in the Wall Street Journal, the returns were
likewise not enough to derive excess returns after taking account of
normal transactions costs. Finally, the results for investors able to
acquire the stock two days prior to the public announcement indicated
that these investors with apparent inside information regarding the
forthcoming announcement could experience abnormal returns even after
paying normal transactions costs. Because of the obvious decline in
relative price after the announcement we also considered short selling
opportunities. Short selling on the day of the announcement was defin-
itely not profitable and neither was selling short when the stock peaked
two or three days after the announcement if one assumed normal trans-
actions costs.

Conclusion

In general the results consistently supported the semi-strong effi-
cient market hypothesis because they indicated that stock prices either
adjusted prior to or very shortly after the public announcement of stock
splits. Regarding the very important question regarding abnormal profit

opportunities, the results indicated they were <u>not</u> available to the general public or to professionals who had to pay normal transactions costs. The results do not support the strong form EMH because it appears that abnormal profits are available to investors with inside information about the forthcoming split announcement.

A small caveat appears to be in order at this point. Throughout the discussion of profit opportunities we referred to normal transactions costs of 2 percent. Clearly the results would be different for investors who were not required to pay the normal commission such as floor traders on the Exchange. Also, with the requirement of fully negotiated commissions on May 1, 1975 ("May Day"), it is readily acknowledged that the normal discount for institutions has been approximately 40 percent from the fixed commission schedule in effect on May 1, 1975. Also individuals who trade actively in large amounts can likewise derive discounts from proclaimed "discount brokers." Therefore, one may feel that the standard 2 percent is above the current "normal" transaction cost and would contend that the results would differ somewhat under these conditions. While this difference is certainly possible, it is felt that most of the results would hold except for those investors with substantially lower costs because the returns were typically less than 1.5 percent.

Finally, one might feel that we should have used prices other than the closing prices since investors could acquire the stock at other prices during the day. Assuming that prices were generally increasing almost constantly during these periods one might want to imagine some price that is an average of the closing prices. The effect of this assumption on the results would be returns about midway between those reported for

alternative days. It seems clear that even this price adjustment would not be enough to make the investment profitable for investors who bought the stock on the day of the announcement—i.e., it would only increase their return to about 1.20 percent. In contrast such an assumption would provide a cumulative return close to 2 percent for those who could buy during the day prior to the announcement day. Therefore, if one conceived of a purchase prior to the close at a price below the closing price and a lower than normal transaction cost, this could result in superior abnormal returns. Clearly this set of conditions should only be applicable to a limited number of individuals.

Implications

These results consistently confirm the semi-strong EMH based upon price movements and profit opportunities under almost all possible conditions. This implies that the search for abnormal profits by investing in stocks that announce forthcoming splits is best described as a useless exercise except for the few professionals that receive the news early from the broad tape and can buy and sell the stock at below normal transactions costs.

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