The Adjustment Of Stock Prices To New Information

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Abstract

There is an impressive body of empirical evidence which indicates that successive price changes in individual common stocks are very nearly independent. Recent papers by Mandelbrot and Samuelson show rigorously that independence of successive price changes is *consistent* with an "efficient" market, i.e., a market that adjusts rapidly to new information.

It is important to note, however, that in the empirical work to date the usual procedure has been to *infer* market efficiency from the observed independence of successive price changes. There has been very little actual testing of the speed of adjustment of prices to *specific kinds* of new information. The prime concern of this paper is to examine the process by which common stock prices adjust to the information (if any) that is implicit in a stock split. In doing so we propose a new "event study" methodology for measuring the effects of actions and events on security prices.

Keywords: efficient markets, effect of information on stock prices, stock splits, dividend increases, market conditions, rate of return, effect of split(s) on return(s), residuals, average dividends, dividend "increases", and dividend "decreases".

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1. Introduction

There is an impressive body of empirical evidence which, indicates that successive Price changes in individual common stocks are very nearly independent.[2] Recent papers by Mandelbrot (1966) and Samuelson (1965) show rigorously that independence of successive price changes is *consistent* with an "efficient" market, i.e., a market that adjusts rapidly to new information.

It is important to note, however, that in the empirical work to date the usual procedure has been to *infer* market efficiency from the observed independence of successive price changes. There has been very little actual testing of the speed of adjustment of prices to *specific kinds* of new information. The prime concern of this paper is to examine the process by which common stock prices adjust to the information (if any) that is implicit in a stock split.

1 This study way suggested to us by Professor James H. Lorie. We are grateful to Professors Lorie, Merton H. Miller, and Harry V. Roberts for many helpful comments and criticisms.

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2 Cf.Cootner (1964) and the studies reprinted therein, Fama (1965a), Godfrey, Granger, and Morgenstern (1964) and other empirical studies of the theory of random walks in speculative prices.

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2. Splits, Dividends, And New Information: A Hypothesis

More specifically, this study will attempt to examine evidence on two related questions: (1) is there normally some "unusual" behavior in the rates of return on a split security in the months surrounding the split?[3] and (2) if splits are associated with "unusual" behavior of security returns, to what extent can this be accounted for by relationships between splits and changes in other more fundamental variables?[4]

In answer to the first question we shall show that stock splits are usually preceded by a period during which the rates of return (including dividends and capital appreciation) on the securities to be split are unusually high. The period of high returns begins, however, long before any information (or even rumor) concerning a possible split is likely to reach the market. Thus we suggest that the high returns far in advance of the split arise from the fact that during the pre-split period these companies have experienced dramatic increases in expected earnings and dividends.

In the empirical work reported below, however, we shall see that the highest average monthly rates of return on split shares occur in the few months immediately preceding the split. This might appear to suggest that the split itself provides some impetus for increased returns. We shall present evidence, however, which suggests that such is not the case. The evidence supports the following reasoning: Although there has probably been a dramatic increase in earnings in the recent past, in the months immediately prior to the split (or its announcement) there may still be considerable

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3 A precise definition of "unusual" behavior of security returns will be provided below.

4 There is another question concerning stock splits, which this study does not consider. That is, given that splitting is not costless, and since the only apparent result is to multiply the number of shares per shareholder without increasing the shareholder's claims to assets, why do firms split their shares? This question has been the subject of considerable discussion in the professional financial literature. (Cf. Bellemore and Blucher (1956).) Suffice it to say that the arguments offered in favor of splitting usually turn out to be two-sided under closer examination—e.g., a split, by reducing the price of a round lot, will reduce transactions costs for some relatively small traders but increase costs for both large and very small traders (i.e., for traders who will trade, exclusively, either round lots or odd lots both before and after the split). Thus the conclusions are never clear-cut. In this study we shall be concerned with identifying the factors which the *market* regards as important in a stock split and with determining how market prices adjust to these factors rather than with explaining why firms split their shares.

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uncertainty in the market concerning whether the earnings can be maintained at their new higher level. Investors will attempt to use any information available to reduce this uncertainty, and a proposed split may be one source of such information.

In the past a large fraction of stock splits have been followed closely by dividend increases-and increases greater than those experienced at the same time by other securities in the market. In fact it is not unusual for the dividend change to be announced at the same time as the split. Other studies (cf. Lintner (1956) and Michaelsen (1961)) have demonstrated that, once dividends have been increased, large firms show great reluctance to reduce them, except under the most extreme conditions. Directors have appeared to hedge against such dividend cuts by increasing dividends only when they are quite sure of their ability to maintain them in the future, i.e., only when they feel strongly that future earnings will be sufficient to maintain the dividends at their new higher rate. Thus dividend changes may be assumed to convey important information to the market concerning management's assessment of the firm's long-run earning and dividend paying potential.

We suggest, then, that unusually high returns on splitting shares in the months immediately preceding a split reflect the market's anticipation of substantial increases in dividends which, in fact, usually occur. Indeed evidence presented below leads us to conclude that when the information effects of dividend changes are taken into account, the apparent price effects of the split will vanish.[5]

3. Sample And Methodology

a. *The data*. We define a "stock split" as an exchange of shares in which at least five shares are distributed for every four formerly outstanding. Thus this definition of

5 It is important to note that our hypothesis concerns the information content of dividend changes. There is nothing in our evidence which suggests that dividend *policy* per se affects the value of a firm. Indeed, the information hypothesis was first suggested by Miller and Modigliani in {, 1961 # 1108, p. 430}, where they show that, aside from information effects, in a perfect capital market dividend policy will not affect the total market value of a firm.

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splits includes all stock dividends of 25 per cent or greater. We also decided, arbitrarily, that in order to get reliable estimates of the parameters that will be used in the analysis, it is necessary to have at least twenty-four successive months of price-dividend data around the split date. Since the data cover only common stocks listed on the New York Stock Exchange, our rules require that to qualify for inclusion in the tests a split security must be listed on the Exchange for at least twelve months before and twelve months after the split. From January 1927, through December 1959, 940 splits meeting these criteria occurred on the New York Stock Exchange.[6]

b. *Adjusting security returns for general market conditions*. Of course, during this 33 year period, economic and hence general stock market conditions were far from static. Since we are interested in isolating whatever *extraordinary* effects a split and its associated dividend history may have on returns, it is necessary to abstract from general market conditions in examining the returns on securities during months surrounding split dates. We do this in the following way: Define

P_{jt} = price of the j-th stock at end of month t.

P'_{jt} = P_{jt} adjusted for capital changes in month t+1. For the method of adjustment see Fisher (1965).

D_{jt} = cash dividends on the j-th security during month t (where the dividend is taken as of the ex-dividend data rather than the payment date).

R_{jt} = $\left(P_{jt} + D_{jt}\right)/P'_{j,t-1}$ = price relative of the j-th security for month t.

L_t = the link relative of Fisher's "Combination Investment Performance Index" (Fisher {, 1966 #1099, table Al). It will suffice here to note that L_t is a complicated average of the R_{jt} for all securities that were on the N.Y.S.E. at the end of months t and t—1. L_t is the measure of "general market conditions" used in this study.[7]

6 The basic data were contained in the master file of monthly prices, dividends, and capital changes, collected and maintained by the Center for Research in Security Prices (Graduate School of Business, University of Chicago). At the time this study was conducted, the file covered the period January, 1926 to December, 1960. For a description of the data see Fisher and Lorie (1964).

7 To check that our results do not arise from any special properties of the index L_t we have also performed all tests using Standard and Poor's Composite Price Index as the measure of market conditions; in all major respects the results agree completely with those reported below.

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One form or another of the following simple model has often been suggested as a way of expressing the relationship between the monthly rates of return provided by an individual security and general market conditions:[8]

(1) $$\log_e R_{jt} = \alpha_j + \beta_j \log_e L_t + u_{jt} \ ,$$

where α_j and β_j are parameters that can vary from security to security and u_{jt} is a random disturbance term. It is assumed that u_{jt} satisfies the usual assumptions of the linear regression model. That is, (a) u_{jt} has zero expectation and variance independent of t; (b) the u_{jt} are serially independent; and (c) the distribution of u_j is independent of $\log_e L$.

The natural logarithm of the security price relative is the rate of return (with continuous compounding) for the month in question; similarly, the log of the market index relative is approximately the rate of return on a portfolio which includes equal dollar amounts of all securities in the market. Thus (1) represents the monthly rate of return on an individual security as a linear function of the corresponding return for the market.

c. Tests of model specification. Using the available time series on R_{jt} and L_t least squares has been used to estimate α_j and β_j in (1) for each of the 622 securities in the sample of 940 splits. We shall see later that there is strong evidence that the expected values of the residuals from (1) are non-zero in months close to the split. For these months the assumptions of the regression model concerning the disturbance term in (1)

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[8] Cf. Markowitz (1959, pp. 96-101), Sharpe (1963; 1964) and Fama (1965b). The logarithmic form of the model is appealing for two reasons. First, over the period covered by our data the distribution of the monthly values of $\log_e L_t$ and $\log_e R_{jt}$ are fairly symmetric, whereas the distributions of the relatives themselves are skewed right. Symmetry is desirable since models involving symmetrically distributed variables present fewer estimation problems than models involving variables with skewed distributions. Second, we shall see below that when least squares is used to estimate α and β in (1), the sample residuals conform well to the assumptions of the simple linear regression model.

Thus, the logarithmic form of the model appears to be well specified from a statistical point of view and has a natural economic interpretation (i.e., in terms of monthly rates of return with continuous compounding). Nevertheless, to check that our results do not depend critically on using logs, all tests have also been carried out using the simple regression of R_{jt} on L_t. These results are in complete agreement with those presented in the text.

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are not valid. Thus if these months were included in the sample, estimates of α and β would be subject to specification error, which could be very serious. We have attempted to avoid this source of specification error by excluding from the estimating samples those months for which the expected values of the residuals are apparently non-zero. The exclusion procedure was as follows: First, the parameters of (1) were estimated for each security using all available data. Then for each split the sample regression residuals were computed for a number of months preceding and following the split. When the number of positive residuals in any month differed substantially from the number of negative residuals, that month was excluded from subsequent calculations. This criterion caused exclusion of fifteen months before the split for all securities and fifteen months after the split for splits followed by dividend decreases.[9]

Aside from these exclusions, however, the least squares estimates $\hat{\alpha}_j$ and $\hat{\beta}_j$ for security j are based on all months during the 1926-60 period for which price relatives are available for the security. For the 940 splits the smallest effective sample size is 14 monthly observations. In only 46 cases is the sample size less than 100 months, and for about 60 per cent of the splits more than 300 months of data are available. Thus in the vast majority of cases the samples used in estimating α and β in (1) are quite large.

Table I provides summary descriptions of the frequency distributions of the estimated values of α_j, β_j, and r_j, where r_j is the correlation between monthly rates of return on security j (i.e., $\log_e R_{jt}$) and the approximate monthly rates of return on the market portfolio (i.e., $\log_e L_t$). The table indicates that there are indeed fairly strong relationships between the market and monthly returns on individual securities; the mean value of the $\hat{r}_j$ is 0.632 with an average absolute deviation of 0.106 about the mean.[10]

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[9] Admittedly the exclusion criterion is arbitrary. As a check, however, the analysis of regression residuals discussed later in the paper has been carried out using the regression estimates in which no data are excluded. The results were much the same as those reported in the text and certainly support the same conclusions.

[10] The sample average or mean absolute deviation of the random variable x is de fined as

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Table 1
Summary Of Frequency Distributions Of Estimated
For The Different Split Securities

Statistic	Mean	Median	Mean Absolute Deviation	Standard deviation	Extreme values	Skewness
$\hat{\alpha}$	0.000	0.001	0.004	0.007	-0.06, 0.04	Slightly left
$\hat{\beta}$	0.894	0.880	0.242	0.305	-0.10*, 1.95	Slightly right
$\hat{r}$	0.632	0. 655	0.106	0.132	-0.04*, 0.91	Slightly left

* Only negative value in distribution.

Moreover, the estimates of equation (1) for the different securities conform fairly well to the assumptions of the linear regression model. For example, the first order auto-correlation coefficient of the estimated residuals from (1) has been computed for every twentieth split in the sample (ordered alphabetically by security). The mean (and median) value of the forty-seven coefficients is -0.10, which suggests that serial dependence in the residuals is not a serious problem. For these same forty-seven splits scatter diagrams of (a) monthly security return versus market return, and (b) estimated residual return in month $t + 1$ versus estimated residual return in month t have been prepared, along with (e) normal probability graphs of estimated residual returns. The scatter diagrams for the individual securities support very well the regression assumptions of linearity, homoscedasticity, and serial independence.

It is important to note, however, that the data do not conform well to the normal, or Gaussian linear regression model. In particular, the distributions of the estimated residuals have much longer tails than the Gaussian. The typical normal probability graph of residuals looks much like the one shown for Timken Detroit Axle in Figure 1. The departures from normality in the distributions of regression residuals are of the same sort as those noted by Fama (1965a) for the distributions of returns themselves. Fama

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$$\frac{\sum_{t=1}^{N} \left| x_t - \bar{x} \right|}{N}$$

where $\bar{x}$ is the sample mean of the x 's and N is the sample size.

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(following Mandelbrot (1963)) argues that distributions of returns are well approximated by the non-Gaussian (i.e., infinite variance) members of the stable Paretian family. If the stable non-Gaussian distributions also provide a good description of the residuals in (1), then, at first glance, the least squares regression model would seem inappropriate.

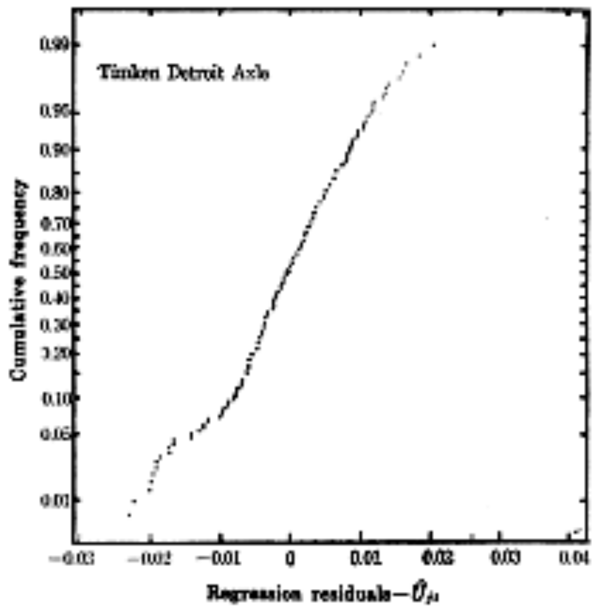

FIGURE 1
NORMAL PROBABILITY PLOT OF RESIDUALS*

Wise (1963) has shown, however, that although least square estimates are not "efficient," for most members of the stable Paretian family they provide estimates which are unbiased and consistent. Thus, given our large samples, least squares regression is not completely inappropriate. In deference to the stable Paretian model, however, in measuring variability we rely primarily on the mean absolute deviation rather than the variance or the standard deviation. The mean absolute deviation is used since, for long-tailed distributions, its sampling behavior is less erratic than that of the variance or the standard deviation.[11]

[11] Essentially, this is due to the fact that in computing the variance of a sample, large deviations are weighted more heavily than in computing the mean absolute deviation. For empirical evidence concerning the reliability of the mean absolute deviation relative to the variance or standard deviation see Fama (1965a, pp. 94-8).

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In sum we find that regressions of security returns on market returns over time are a satisfactory method for abstracting from the effects of general market conditions on the monthly rates of return on individual securities. We must point out, however, that although (1) stands up fairly well to the assumptions of the linear regression model, it is certainly a grossly over-simplified model of price formation; general market conditions alone do not determine the returns on an individual security. In (1) the effects of these "omitted variables" are impounded into the disturbance term u. In particular, if a stock split is associated with abnormal behavior in returns during months surrounding the split date, this behavior should be reflected in the estimated regression residuals of the security for these months. The remainder of our analysis will concentrate on examining the behavior of the estimated residuals of split securities in the months surrounding the splits.

3. "Effects" Of Splits On Returns: Empirical Results

In this study we do not attempt to determine the effects of splits for individual companies. Rather we are concerned with whether the process of splitting is in general associated with specific types of return behavior. To abstract from the eccentricities of specific cases we can rely on the simple process of averaging; we shall therefore concentrate attention on the behavior of cross-sectional averages of estimated regression residuals in the months surrounding split dates.

a. *Some additional definitions.* The procedure is as follows: For a given split, define month 0 as the month in which the effective date of a split occurs. (Thus month 0 is not the same chronological date for all securities, and indeed some securities have been split more than once and hence have more than one month 0)."[12] Month 1 is then defined as the month immediately following the split month, while month –1 is the month preceding, etc. Now define the average residual for month m (where m is always

12 About a third of the securities in the master file split. About a third of these split more than once.

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measured relative to the split month) as

$$u_m = \frac{\sum_{j=1}^{Nm} \hat{u}_{jm}}{N_m}$$

where $\hat{u}_{jm}$ is the sample regression residual for security j in month m and n_m is the number of splits for which data are available in month m.[13] Our principal tests will involve examining the behavior of u_m for m in the interval $-29 \leqq m \leqq 30$, i.e., for the sixty months surrounding the split month.

We shall also be interested in examining the cumulative effects of abnormal return behavior in months surrounding the split month. Thus we define the cumulative average residual U_m as

$$U_m = \sum_{k=-29}^{m} u_k .$$

The average residual u_m can be interpreted as the average deviation (in month m relative to the split month) of the returns of split stocks from their normal relationships with the market. Similarly, the cumulative average residual U_m can be interpreted as the cumulative deviation (from month –29 to month m); it shows the cumulative effects of the wanderings of the returns of split stocks from their normal relationships to market movements.

Since the hypothesis about the effects of splits on returns expounded in Section 2 centers on the dividend behavior of split shares, in some of the tests to follow we examine separately splits that are associated with increased dividends and splits that are associated with decreased dividends. In addition, in order to abstract from general changes in dividends across the market, "increased" and "decreased" dividends will be measured relative to the average dividends paid by all securities on the New York Stock

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13 Since we do not consider splits of companies that were not on the New York Stock Exchange for at least a year before and a year after a split, n_m will be 940 for $-11 \leqq m \leqq 12$. For other months, however, $n_m < 940$.

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Exchange during the relevant time periods. The dividends are classified as follows: Define the dividend change ratio as total dividends (per equivalent unsplit share) paid in the twelve months after the split, divided by total dividends paid during the twelve months before the split."[14] Dividend "increases" are then defined as cases where the dividend change ratio of the split stock is greater than the ratio for the Exchange as a whole, while dividend "decreases" include cases of relative dividend decline."[15] We then define u_m^+, u_m^- and U_m^+, U_m^- as the average and cumulative average residuals for splits followed by "increased" $(+)$ and "decreased" $(-)$ dividends.

These definitions of "increased" and "decreased" dividends provide a simple and convenient way of abstracting from general market dividend changes in classifying year-to-year dividend changes for individual securities. The definitions have the following drawback, however. For a company paying quarterly dividends an increase in its dividend rate at any time during the nine months before or twelve months after the split can place its stock in the dividend "increased" class. Thus the actual increase need not have occurred in the year after the split. The same fuzziness, of course, also arises in classifying dividend "decreases." We shall see later, however, that this fuzziness fortunately does not obscure the differences between the aggregate behavior patterns of the two groups.

b. *Empirical Results*. The most important empirical results of this study are summarized in Tables 2 and 3 and Figures 2 and 3. Table 2 presents the average residuals, cumulative average residuals, and the sample size for each of the two dividend classifications ("increased," and "decreased") and for the total of all splits for each of the

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14 A dividend is considered "paid" on the first day the security trades ex-dividend on the Exchange.

15 When dividend "increase" and "decrease" are defined relative to the market, it turns out that dividends were never "unchanged." That is, the dividend change ratios of split securities are never identical to the corresponding ratios for the Exchange as a whole.

In the remainder of the paper we shall always use "increase" and "decrease" as defined in the text. That is, signs of dividend changes for individual securities are measured relative to changes in the dividends for all N.Y.S.E. common stocks.

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sixty months surrounding the split. Figure 2 presents graphs of the average and cumulative average residuals for the total sample of splits and Figure 3 presents these graphs for each of the two dividend classifications. Table 3 shows the number of splits each year along with the end of June level of the stock price index.

Several of our earlier statements can now he substantiated. First, Figures 2a, 3a and 3b show that the average residuals (u_m) in the twenty-nine months prior to the split are uniformly positive for all splits and for both classes of dividend behavior. This can hardly be attributed entirely to the splitting process. In a random sample of fifty-two splits from our data the median time between the announcement date and the effective date of the split was 44.5 days. Similarly, in a random sample of one hundred splits that occurred between 1/1/1946 and 1/l/1957 Jaffe (1957) found that the median time between announcement date and effective date was sixty-nine days. For both samples in only about 10 per cent of the cases is the time between announcement date and effective date greater than four months. Thus it seems safe to say that the split cannot account for the behavior of the regression residuals as far as two and one-half years in advance of the split date. Rather we suggest the obvious—a sharp improvement, relative to the market, in the earnings prospects of the company sometime during the years immediately preceding a split.

Thus we conclude that companies tend to split their shares during "abnormally" good times—that is during periods of time when the prices of their shares have increased much more than would be implied by the normal relationships between their share prices and general market price behavior. This result is doubly interesting since, from Table 3, it is clear that for the exchange as a whole the number of splits increases dramatically following a general rise in stock prices. Thus splits tend to occur during general "boom" periods, and the particular stocks that are split will tend to be those that performed "unusually" well during the period of general price increase.

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TABLE 2
ANALYSIS OF RESIDUALS IN MONTHS SURROUNDING THE SPLIT

	Split followed by Dividend "increases"			Split followed by Dividend "decreases"			All Splits		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Month m	Aver-Age u_m^+	Cumu-lative U_m^+	Sample size N_m^+	Aver-age u_m^-	Cumu-lative U_m^-	Sample size N_m^-	Aver-age u_m	Cumu-lative U_m	Sample size N_m
-29	0.0062	0.0062	614	0.0033	0.0033	252	0.0054	0.0054	866
-28	0.0013	0.0075	617	0.0030	0.0063	253	0.0018	0.0072	870
-27	0.0068	0.0143	618	0.0007	0.0070	253	0.0050	0.0122	871
-26	0.0054	0.0198	619	0.0085	0.0155	253	0.0063	0.0185	872
-25	0.0042	0.0240	621	0.0089	0.0244	254	0.0056	0.0241	875
-24	0.0020	0.0259	623	0.0026	0.0270	256	0.0021	0.0263	879
-23	0.0055	0.0315	624	0.0028	0.0298	256	0.0047	0.0310	880
-22	0.0073	0.0388	628	0.0028	0.0326	256	0.0060	0.0370	884
-21	0.0049	0.0438	633	0.0131	0.0457	257	0.0073	0.0443	890
-20	0.0044	0.0482	634	0.0005	0. 0463	257	0.0033	0.0476	891
-19	0.0110	0.0592	636	0.0102	0.0565	258	0.0108	0.0584	894
-18	0.0076	0.0668	644	0.0089	0.0654	260	0.0080	0.0664	904
-17	0.0072	0.0739	650	0.0111	0.0765	260	0.0083	0.0746	910
-16	0.0035	0.0775	655	0.0009	0.0774	260	0.0028	0.0774	915
-15	0.0135	0.0909	659	0.0101	0.0875	260	0.0125	0.0900	919
-14	0.0135	0.1045	662	0.0100	0.0975	263	0.0125	0.1025	925
-13	0.0148	0.1193	665	0.0099	0.1074	264	0.0134	0.1159	929
-12	0.0138	0.1330	669	0.0107	0.1181	266	0.0129	0.1288	935
-11	0.0098	0.1428	672	0.0103	0.1285	268	0.0099	0.1387	940
-10	0.0103	0.1532	672	0.0082	0.1367	268	0.0097	0.1485	940
- 9	0.0167	0.1698	672	0.0152	0.1520	268	0.0163	0.1647	940
-8	0.0163	0.1862	672	0.0140	0.1660	268	0.0157	0.1804	940
-7	0.0159	0.2021	672	0.0083	0.1743	268	0.0138	0.1942	940
-6	0.0194	0.2215	672	0.0106	0.1849	268	0.0169	0.2111	940
-5	0.0194	0.2409	672	0.0100	0.1949	268	0.0167	0.2278	940
-4	0.0260	0.2669	672	0.0104	0.2054	268	0.0216	0.2494	940
-3	0.0325	0.2993	672	0.0204	0.2258	268	0.0289	0.2783	940
-2	0.0390	0.3383	672	0.0296	0.2554	268	0.0363	0.3147	940
-1	0.0199	0.3582	672	0.0176	0.2730	268	0.0192	0.3339	940
0	0.0131	0.3713	672	-0.0090	0.2640	268	0.0068	0.3407	940
1	0.0016	0.3729	672	-0.0088	0.2552	268	-0.0014	0.3393	940
2	0.0052	0.3781	672	-0.0024	0.2528	268	0.0031	0.3424	940
3	0.0024	0.3805	672	-0.0089	0.2439	268	-0.0008	0.3416	940
4	0.0045	0.3951	672	-0.0114	0.2325	268	0.0000	0.3416	940
5	0.0048	0.3898	672	-0.0003	0.2322	268	0.0033	0.3449	940
6	0.0012	0.3911	672	-0.0038	0.2285	268	-0.0002	0.3447	940

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(Continued on next page)

TABLE 2
(continued)

	Splits followed by dividend "Increases"			Splits followed by dividend "decreases"			All splits		
(1) Month m	(2) Aver-Age u_m^+	(3) Cumu-lative U_m^+	(4) Sample size N_m^+	(5) Aver-age u_m^-	(6) Cumu-lative U_m^-	(7) Sample size N_m^-	(8) Aver-age u_m	(9) Cumu-lative U_m	(10) Sample size N_m
7	0.0008	0.3919	672	-0.0106	0.2179	268	-0.0024	0.3423	940
8	-0.0007	0.3912	672	-0.0024	0.2155	268	-0.0012	0.3411	940
9	0.0039	0.3951	672	-0.0065	0.2089	268	0.0009	0.3420	940
10	-0.0001	0.3950	672	-0.0027	0.2062	268	-0.0008	0.3412	940
11	0.0027	0.3977	672	-0.0056	0.2006	268	0.0003	0.3415	940
12	0.0018	0.3996	672	-0.0043	0.1963	268	0.0001	0.3416	940
13	-0.0003	0.3993	666	0.0014	0.1977	264	0.0002	0.3418	930
14	0.0006	0.3999	653	0.0044	0.2021	258	0.0017	0.3435	911
15	-0.0037	0.3962	645	0.0026	0.2047	258	-0.0019	0.3416	903
16	0.0001	0.3963	635	-0.0040	0.2007	257	-0.0011	0.3405	892
17	0.0034	0.3997	633	-0.0011	0.1996	256	0.0021	0.3426	889
18	-0.0015	0.3982	629	0.0025	0.2021	255	-0.0003	0.3423	883
19	-0.0006	0.3976	620	-0.0057	0.1964	251	-0.0021	0.3402	871
20	-0.0002	0.3974	604	0.0027	0.1991	246	0.0006	0.3409	850
21	-0.0037	0.3937	595	-0.0073	0.1918	245	-0.0047	0. 3361	840
22	0.0047	0.3984	593	-0.0018	0.1899	244	0.0028	0.3389	837
23	-0.0026	0.3958	593	0.0043	0.1943	242	-0.0006	0.3383	835
24	-0.0022	0.3936	587	0.0031	0.1974	238	-0.0007	0.3376	825
25	0.0012	0.3948	583	-0.0037	0.1936	237	-0.0002	0.3374	820
26	-0.0058	0.3890	582	0.0015	0.1952	236	-0.0037	0.3337	818
27	-0.0003	0.3887	582	0.0082	0.2033	235	0.0021	0.3359	817
28	0.0004	0.3891	580	-0.0023	0.2010	236	-0.0004	0.3355	816
29	0.0012	0.3903	580	-0.0039	0.1971	235	-0.0003	0.3352	815
30	-0.0033	0.3870	579	-0.0025	0.1946	235	-0.0031	0.3321	814

It is important to note (from Figure 2a and Table 2) that when all splits are examined together, the largest positive average residuals occur in the three or four months immediately preceding the split, but that after the split the average residuals are randomly distributed about 0. Or equivalently, in Figure 2b the *cumulative* average residuals rise dramatically up to the split month, but there is almost no further systematic

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movement thereafter. Indeed during the first year after the split, the cumulative average residual changes by less than one-tenth of one percentage point, and the total change in the cumulative average residual during the two and one-half years following the split is less than one percentage point. This is especially striking since 71.5 per cent (672 out of 940) of all splits experienced greater percentage dividend increases in the year after the split than the average for all securities on the N.Y.S.E.

TABLE 3
NUMBER OF SPLITS PER YEAR AND LEVEL OF THE STOCK MARKET INDEX

Year	Number of splits	Market Index* (End of June)
1927	28	103.5
28	22	133.6
29	40	161.8
1930	15	98.9
31	2	65.5
32	0	20.4
33	1	82.9
34	7	78.5
35	4	73.3
36	11	124.7
37	19	147.4
38	6	100.3
39	3	90.3
1940	2	91.9
41	3	101.2
42	0	95.9
43	3	195.4
44	11	235.0
45	39	320.1
46	75	469.2
47	46	339.9
48	26	408.7
49	21	331.3
1950	49	441.6
51	55	576.1
52	37	672.2
53	25	691.9
54	43	818.6
55	89	1190.6
56	97	1314.1
57	44	1384.3
58	14	1407.3
59	103	1990.6

*Fisher's "Combination Investment Performance Index" shifted to a base January, 1926=100. See (1966) for a description of its calculation.

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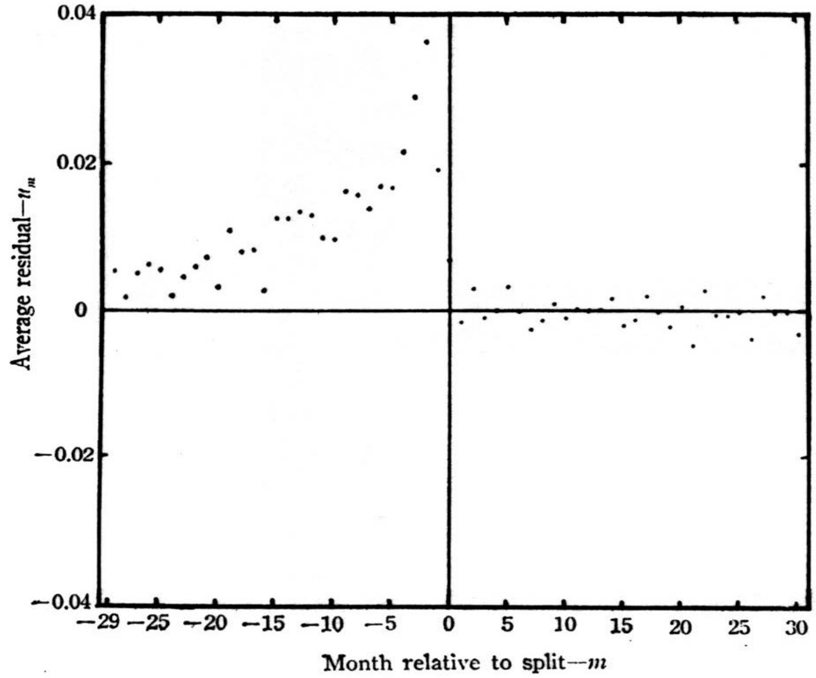

FIGURE 2a
AVERAGE RESIDUALS—ALL SPLITS

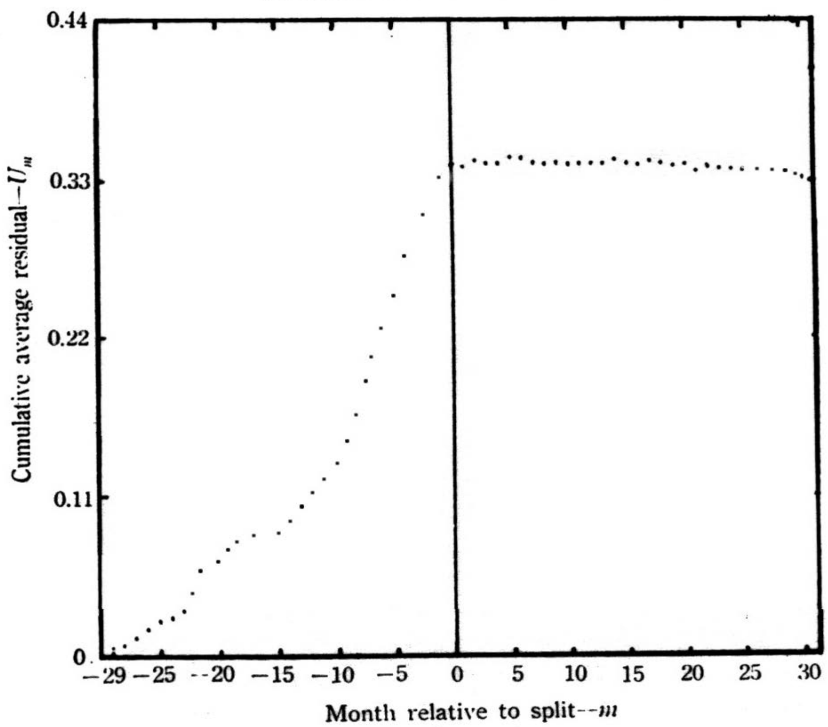

FIGURE 2b
CUMULATIVE AVERAGE RESIDUALS—ALL SPLITS

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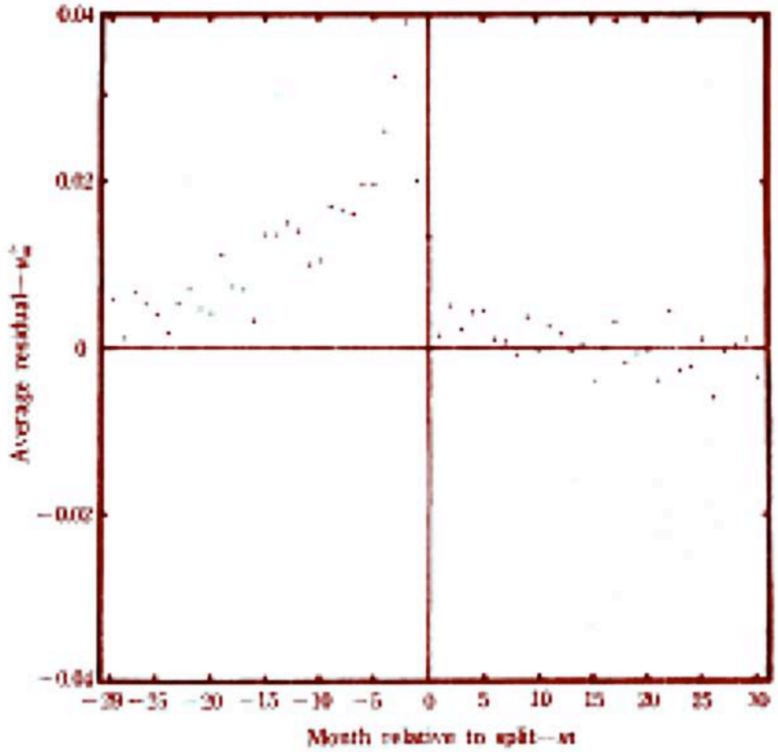

FIGURE 3a
AVERAGE RESIDUALS FOR DIVIDEND "INCREASES"

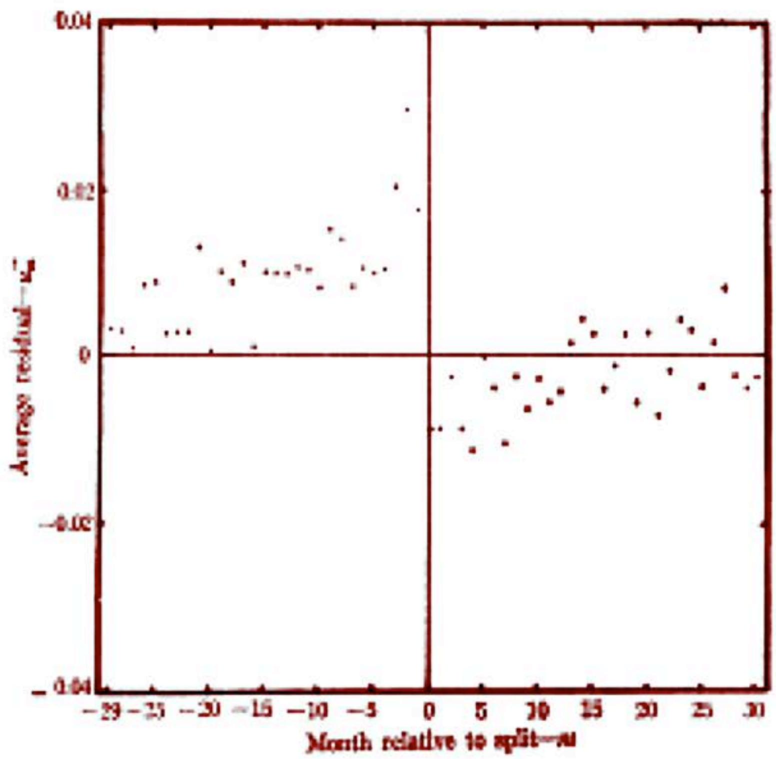

FIGURE 3b
AVERAGE RESIDUALS FOR DIVIDEND "DECREASES"

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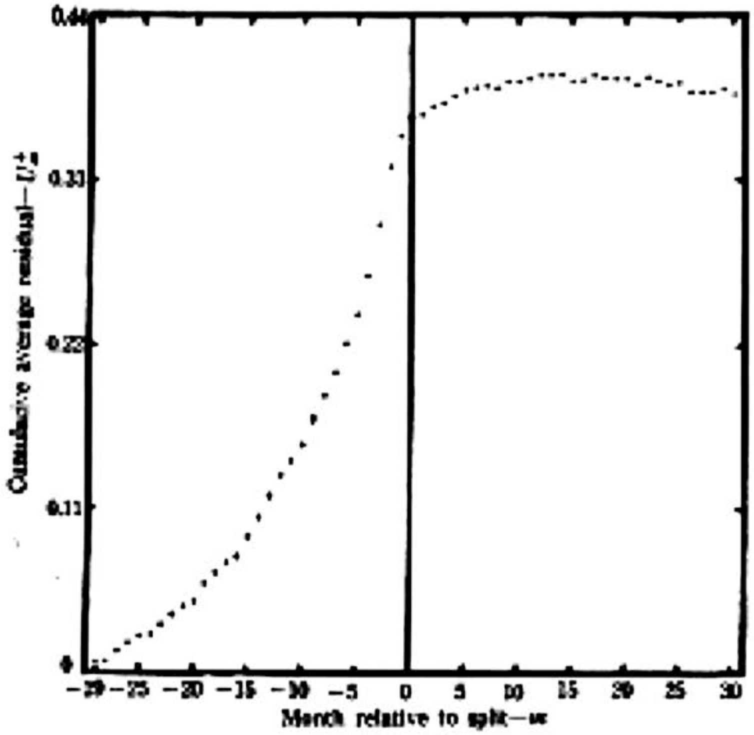

FIGURE 3c

CUMULATIVE AVERAGE RESIDUALS FOR DIVIDEND "INCREASES"

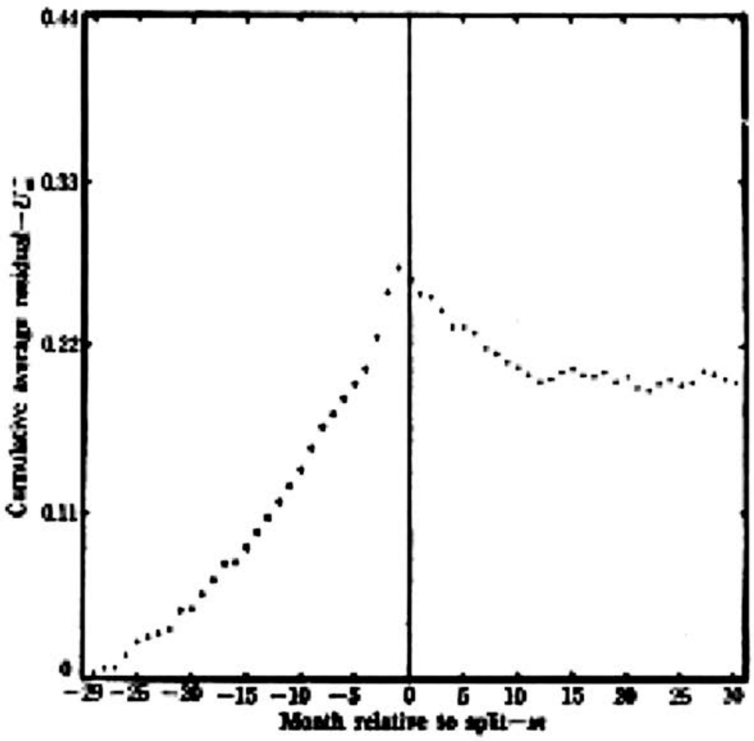

FIGURE 3d

CUMULATIVE AVERAGE RESIDUALS FOR DIVIDEND "DECREASES"

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We suggest the following explanation for this behavior of the average residuals. When a split is announced or anticipated, the market interprets this (and correctly so) as greatly improving the probability that dividends will soon be substantially increased. (In fact, as noted earlier, in many cases the split and dividend increase will be announced at the same time.) If, as Lintner (1956) suggests, firms are reluctant to reduce dividends, then a split, which implies an increased expected dividend, is a signal to the market that the company's directors are confident that future earnings will be sufficient to maintain dividend payments at a higher level. If the market agrees with the judgments of the directors, then it is possible that the large price increases in the months immediately preceding a split are due to altering expectations concerning the future earning potential of the firm (and thus of its shares) rather than to any intrinsic effects of the split itself.[16]

If the information effects of actual or anticipated dividend increases do indeed explain the behavior of common stock returns in the months immediately surrounding a split, then there should be substantial differences in return behavior subsequent to the split in cases where the dividend increase materializes and cases where it does not. In fact it is apparent from Figure 3 that the differences are substantial-and we shall argue that 'they are in the direction predicted by the hypothesis.

The fact that the cumulative average residuals for both dividend classes rise sharply in the few months before the split is *consistent* with the hypothesis that the market recognizes that splits are usually associated with higher dividend payments. In some cases, however, the dividend increase, if it occurs, will be declared sometime during the year after the split. Thus it is not surprising that the average residuals (Figure 3a) for stocks in the dividend "increased" class are in general slightly positive, in the year

16 If this stock split hypothesis is correct, the fact that the average residuals (where the averages are computed using all splits (Figure 2) are randomly distributed about 0 in months subsequent to the split indicates that, on the average, the market has *correctly* evaluated the implications of a split for future dividend behavior and that these evaluations are fully incorporated in the price of the stock by the time the split occurs. That is, the market not only makes good forecasts of the dividend implications of a split, but these forecasts are fully impounded into the price of the security by the end of the split month. We shall return to this point at the end of this section.

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after the split, so that the cumulative average residuals (Figure 3c) drift upward. The fact that this upward drift is only very slight can be explained in two (complementary) ways. First, in many cases the dividend increase associated with a split will be declared (and the corresponding price adjustments will take place) before the end of the split month. Second, according to our hypothesis when the split is declared (even if no dividend announcement is made), there is some price adjustment in anticipation of future dividend increases. Thus only a slight *additional* adjustment is necessary when the dividend increase actually takes place. By one year after the split the returns on stocks which have experienced dividend "increases" have resumed their normal relationships to market returns since from this point onward the average residuals are small and randomly scattered about zero.

The behavior of the residuals for stock splits associated with "decreased" dividends, however, provides the strongest evidence in favor of our split hypothesis. For stocks in the dividend "decreased" class the average and cumulative average residuals (Figures 3b and 3d) rise in the few months before the split but then plummet in the few months following the split, when the anticipated dividend increase is not forthcoming. These split stocks with poor dividend performance on the average perform poorly in each of the twelve months following the split, but their period of poorest performance is in the few months immediately after the split—when the improved dividend, if it were coming at all, would most likely be declared.[17] The hypothesis is further reinforced by the observation that 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 which, we venture to say, is probably about the earliest time reliable information concerning a possible split is likely

[17] Though we do not wish to push the point too hard, it is interesting to note in Table 2 that after the split month, the largest negative average residuals for splits in the dividend "decreased" class occur in months 1, 4, and 7. This "pattern" in the residuals suggests, perhaps, that the market reacts most strongly during months when dividends are declared but not increased.

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to reach the market.[18] Thus by the time it has become clear that the anticipated dividend increase is not forthcoming, the apparent effects of the split seem to have been completely wiped away, and the stock's returns have reverted to their normal relationship with market returns. In sum, our data suggest that once the information effects of associated dividend changes are properly considered, a split *per se* has no net effect on common stock returns."[19]

Finally, the data present important evidence on the speed of adjustment of market prices to new information. (a) Although the behavior of post-split returns will be very different depending on whether or not dividend "increases" occur, and (b) in spite of the fact that a substantial majority of split securities do experience dividend "increases," when all splits are examined together (Figure 2), the average residuals are randomly distributed about 0 during the year after the split. Thus there is no net movement either up or down in the cumulative average residuals. According to our hypothesis, this implies that on the average the market makes unbiased dividend forecasts for split securities and these forecasts are fully reflected in the price of the security by the end of the split month.

5. Splits And Trading Profits

Although stock prices adjust "rapidly" to the dividend information implicit in a split, an important question remains: Is the adjustment so rapid that splits can in no way be used to increase trading profits? Unfortunately our data do not allow full examination of this question. Nevertheless we shall proceed as best we can and leave the reader to judge the arguments for himself.

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[18] In a random sample of 52 splits from our data in only 2 cases is the time between the announcement date and effective date of the split greater than 162 days. Similarly, in the data of Jaffe (1957) in only 4 out of 100 randomly selected splits is the time between announcement and effective date greater than 130 days.

[19] It is well to emphasize that our hypothesis centers around the information value of dividend changes. There is nothing in the empirical evidence which indicates that dividend policy per se affects the market value of the firm. For further discussion of this point see Miller and Modigliani (1961, p. 430).

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First of all, it is clear from Figure 2 that expected returns cannot be increased by purchasing split securities after the splits have become effective. After the split, on the average the returns on split securities immediately resume their normal relationships to market returns. In general, prices of split shares do not tend to rise more rapidly after a split takes place. Of course, if one is better at predicting which of the split securities are likely to experience "increased" dividends, one will have higher expected returns. But the higher returns arise from superior information or analytical talents and not from splits themselves.

Let us now consider the policy of buying splitting securities as soon as information concerning the possibility of a split becomes available. It is impossible to test this policy fully since information concerning a split often leaks into the market before the split is announced or even proposed to the shareholders. There are, however, several fragmentary but complementary pieces of evidence which suggest that the policy of buying splitting securities as soon as a split is *formally announced* does not lead to increased expected returns.

First, for a sample of 100 randomly selected splits during the period 1946-1956, Bellemore and Blucher (1956) found that in general, price movements associated with a split are over by the day after the split is announced. They found that from eight weeks before to the day after the announcement, 86 out of 100 stocks registered percentage price increases greater than those of the Standard and Poor's stock price index for the relevant industry group. From the day after to eight weeks after the announcement date, however, only 43 stocks registered percentage price increases greater than the relevant industry index, and on the average during this period split shares only increased 2 per cent more in price than nonsplit shares in the same industry. This suggests that even if

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one purchases as soon as the announcement is made, split shares will not in general provide higher returns than nonsplit shares.[20]

Second, announcement dates have been collected for a random sample of 52 splits from our data. For these 62 splits the analysis of average and cumulative average residuals discussed in Section 4 has been carried out first using the split month as month 0 and then using the announcement month as month 0. In this sample the behavior of the residuals after the announcement date is almost identical to the behavior of the residuals after the split date. Since the evidence presented earlier indicated that one could not systematically profit from buying split securities after the effective date of the split, this suggests that one also cannot profit by buying after the announcement date.

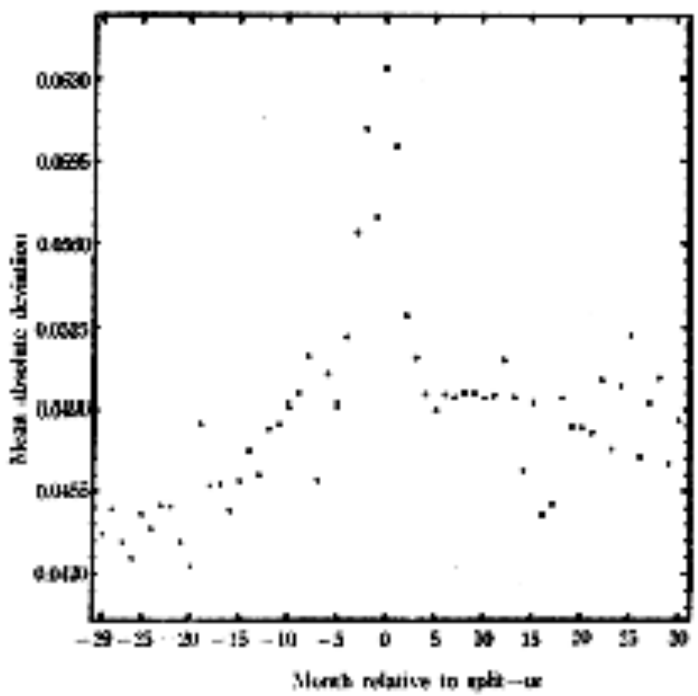

FIGURE 4

CROSS SECTIONAL MEAN ABSOLUTE DEVIATION OF RESIDUALS—ALL SPLITS

[20] We should note that though the results are Bellemore and Blucher's, the interpretation is ours.
Since in the vast majority of cases prices rise substantially in the eight weeks prior to the announcement date, Bellemore and Bluener conclude that if one has advance knowledge concerning a contemplated split, it can probably be used to increase expected returns. The same is likely to be true of all inside information, however.

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Although expected returns cannot in general be increased by buying split shares, this does not mean that a split should have no effect on an investor's decisions. Figure 4 shows the cross-sectional mean absolute deviations of the residuals for each of the sixty months surrounding the split. From the graph it is clear that the variability in returns on split shares increases substantially in the months closest to the split. The increased riskiness of the shares during this period is certainly a factor which the investor should consider in his decisions.

In light of some of the evidence presented earlier, the conclusion that splits cannot be used to increase expected trading profits may seem a bit anomalous. For example, in Table 2, column (8), the cross-sectional average residuals from the estimates of (1) are positive for at least thirty months prior to the split. It would seem that such a strong degree of "persistence" could surely be used to increase expected profits. Unfortunately, however, the behavior of the *average* residuals is not representative of the behavior of the residuals for *individual securities*; over time the residuals for individual securities are much more randomly distributed about 0. We can see this more clearly by comparing the average residuals for all splits (Figure 2a) with the month by month behavior of the cross-sectional mean absolute deviations of residuals for all splits (Figure 4). For each month before the split the mean absolute deviation of residuals is well over twice as large as the corresponding average residual, which indicates that for each month the residuals for many *individual* securities are negative. In fact, in examining residuals for individual securities the following pattern was typical: Prior to the split, successive sample residuals from (1) are almost completely independent. In most cases, however, there are a few months for which the residuals are abnormally large and positive. These months of large residuals differ from security to security, however, and these differences in timing explain why the signs of the *average* residuals are uniformly positive for many months preceding the split.

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Similarly, there is evidence which suggests that the extremely large positive average residuals in the three or four months prior to the split merely reflect the fact that, from split to split, there is a variable lag between the time split information reaches the market and the time when the split becomes effective. Jaffe (1957) has provided announcement and effective dates for the 100 randomly chosen splits used by herself and Bellemore (1956). The announcement dates occur as follows: 7 in the first month before the split, 67 in the second and third months, 14 in the fourth month, and 12 announcements more than four months before the split. Looking back at Table 2, column (8), and Figure 2a we see that the largest average residuals follow a similar pattern: The largest average residuals occur in the second and third months before the split; though smaller, the average residuals for one and four months before the split are larger than those of any other months.

This suggests that the pattern of the average residuals immediately prior to the split arises from the averaging process and thus cannot be assumed to hold for any particular security.

6. Conclusions

In sum, in the past stock splits have very often been associated with substantial dividend increases. The evidence indicates that the market realizes this and uses the announcement of a split to re-evaluate the stream of expected income from the shares. Moreover, the evidence indicates that on the average the market's judgments concerning the information implications of a split are fully reflected in the price of a share at least by the end of the split month but most probably almost immediately after the announcement date. Thus the results of the study lend considerable support to the conclusion that the stock market is "efficient" in the sense that stock prices adjust very rapidly to new information.

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The evidence suggests that in reacting to a split the market reacts only to its dividend implications. That is, the split causes price adjustments only to the extent that it is associated with changes in the anticipated level of future dividends.

Finally, there seems to be no way to use a split to increase one's expected returns, unless, of course, inside information concerning the split or subsequent dividend behavior is available.

References

Bellemore, Douglas H. and Lillian Blucher (Jaffee). 1956. "A Study of Stock Splits in the Postware Years." *Financial Analysts Journal* 15: November 1956, pp 19-26.

Cootner, Paul H., ed. 1964. *The Random Character of Stock Market Prices*. Cambridge, MA: MIT press. Alternate Journal.

Fama, Eugene F. 1965a. "The Behavior of Stock Market Prices." *Journal of Business* 37: January 1965, pp 34-105.

Fama, Eugene F. 1965b. "Portfolio Analysis in a Stable Paretian Market." *Management Science* 11: January 1965, pp 404-41.

Fisher, Lawrence. 1965. "Outcomes for 'Random' Investments in Common Stocks Listed on the New York Stock Exchange." *Journal of Business* 38: April 1965, pp 149-161.

Fisher, Lawrence. 1966. "Some New Stock Market Indexes." *Journal of Business* 39: January, 1966 Supplement, pp 191-225.

Fisher, Lawrence and James H. Lorie. 1964. "Rates of Return on Investments in Common Stocks." *Journal of Business* 37: January 1964, pp 1-21.

Godfrey, Michael D., Clive W. J. Granger, and Oscar Morgenstern. 1964. "The Random Walk Hypothesis of Stock Market Behavior." *Kyklos* 17: pp 1-30.

Jaffe (Blucher), Lillian H. 1957. A Study of Stock Splits, 1946-1956, New York University.

Lintner, John. 1956. "Distribution of Incomes of Corporations Among Dividends, Retainted Earnings and Taxes." *American Economic Review* XLVI: May 1956, pp 97-113.

For an electronic copy of this paper, please visit: http://ssrn.com/abstract=321524

Mandelbrot, Benoit. 1963. "The Variation of Certain Speculative Prices." *Journal of Business* 36: October, pp 394-419.

Mandelbrot, Benoit. 1966. "Forecasts of Future Prices, Unbiased Markets, and 'Martingale' Models." *Journal of Business* 39, no. Part 2: pp 242-255.

Markowitz, Harry. 1959. *Portfolio Selection: Efficient Diversification of Investments*. New York: Wiley.

Michaelson, Jacob B. 1961. The Determinants of Dividend Policies: A Theoretical and Empirical Study. Unpublished Doctoral Dissertation, University of Chicago.

Miller, Merton H. and Franco Modigliani. 1961. "Dividend Policy, Growth and the Valuation of Shares." *Journal of Business* 34: October, pp 411-433.

Samuelson, Paul A. 1965. "Proof That Property Anticipated Prices Fluctuate Randomly." *Industrial Management Review* Spring: pp 41-49.

Sharpe, William F. 1963. "A Simplified Model for Portfolio Analysis." *Management Science* 19: September, pp 425-442.

Sharpe, William F. 1964. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk." *Journal of Finance* 19: September, pp 425-442.

Wise, John. 1963. "Linear Estimators for Linear Regression Systems Having Infinite Variances". Unpublished paper presented at the Berkeley-Stanford Mathematical Economics Seminar.

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