An Elementary Study of Efficient Markets

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Introduction

In recent months following the stock market crash of March, many stocks have reached all-time highs, bringing market rationality and market efficiency into question. Is the market still incorporating all information into stock prices in an efficient (ie instantaneous) manner? Given the recent stock market "exuberance", I examine the question over the time period from March 21, 2020 (the one-year low) up to the present day, using stock split information during that time period. Using regression, I find that, for a sample of 21 reverse stock splits, abnormal returns continue to show significance from zero on the day of the announcement on average, but surprisingly show significance on the day of the split on average also. For the second part of this paper, I do an event study with an anticipation and adjustment window on varying corporate announcements with four technology stocks. I then run the regressions with returns adjusted to the NASDAQ composite instead of the S&P 500 and find that abnormal returns are no longer significant on the event day.

Motivation: The EMH and Event Studies

The Efficient Markets Hypothesis (EMH) makes a simple yet strong statement about markets, especially financial markets: prices fully reflect all publicly available information. The

EMH has three different "state strengths." In a weak-form efficient market, prices fully reflect all information from past prices so forecasting using trends is useless. In semistrong-form efficient markets, using public information of a company will also generate no profit. Lastly, in strong-form efficient markets, not even insider information can be used to make a profit. Event studies are concerned with semistrong-form efficiency and are used to judge the manner and speed at which markets incorporate information through studying stock prices during "events" - corporate announcements such as dividend increases, stock splits, or product releases.

In one of the first event studies published in 1969, four members of finance academia - Fama, Fisher [1], Jensen, and Roll (FFJR) - examined the impact of a stock split on the price of the stock. In the past, a stock split typically meant business was going well and thus, they were often followed by dividend increases. This means that investors should usually want to buy stock when a stock splits. FFJR found that stock prices changed significantly on the day of the split announcement but showed no clear movement on the actual day of the split. Therefore, they concluded that stock prices already fully reflected all available information on the day of the announcement, supporting semistrong-form efficiency.

The EMH, as a model of physics, depends on enough market participants optimizing their decision-making. Many accusations of irrationality have come up during the stock market's surprisingly rapid growth since April. Market irrationality has many implications, both good and bad. This means that the EMH, one of the most well-tested and proven theories in modern finance, would no longer hold for the time-being as prices no longer fully reflect all publicly available information. Profit opportunities will exist but the market could also be in a bubble. A large part of this study is to examine if markets are still incorporating information into prices instantaneously by analyzing stock splits with a modification of the FFJR methodology.

[1] When I was first reading this paper, I noticed that Lawrence Fisher was given a Rutgers email. It turns out that he was a professor at RBS. Go RU! Sadly, he passed away in 2008, but his memory will live on in this important paper

The Data

The 21 stocks I have chosen for the first analysis of stock splits had a stock split announcement and stock split occurrence from between April 1st to October 31st. Splits were found on Fidelity's stock split calendar for the year 2020. For this study, I chose reverse splits as there were many more reverse splits than normal splits in recent months. Reverse splits tend to mean bad news for business, contrary to the normal splits that FFJR studied, so markets usually react negatively to the news. To ensure sufficient trading competition, these shares must also have had a daily trading volume of at least 200,000 shares on average per day from 10 days before the announcement to 10 days after the actual split although many of them traded in the millions. Announcements and splits that were noted on Fidelity's calendar to have occurred on consecutive days were also mostly avoided as it was unclear whether both events happened in the same hours that the market closed, thereby preventing the market from trading on announcement information. Daily returns from closing prices of these 21 shares were calculated from March 21, 2020 (the lowest dip of the S&P 500) up to December 3, 2020. For this analysis, I am only concerned with two particular days for each stock - the day of the announcement and the day of the split - and dummy variables are coded as such. Lastly, in order to control for general market conditions, I also calculate daily returns of the S&P 500 from March 21, 2020 to December 3, 2020. All pricing data was taken from Yahoo Finance.

Methodology, Results, and Interpretation

Methodology In this study, I use dummy variable regression. Using this powerful tool, we can find statistical significance of abnormal returns from zero over a time frame of interest by estimating the coefficients and standard errors of the dummy variables.

In the first analysis with stock splits, I do a modified version of FFJR's event time window methodology. I use no time window but only two particular days for each stock - the day of the

announcement and the day of the split. The regression for this analysis is

$$R_{it} = \alpha_i + \beta_i R_{S\&P,t} + \gamma_{i,ann} D_{ann} + \gamma_{i,split} D_{split} + u_{it}$$

where two dummies are added to the market model. The first is the announcement dummy, with "1" coded on the announcement date and "0" on all other dates. The second is the split dummy with "1" coded on the split date and "0" everywhere else. The subscript t also runs from March 21, 2020 to December 3rd, 2020. Estimating the coefficients and standard errors for each γ can allow us to discern significance from zero of the average abnormal returns for both the announcement date and the split date of the 21 stocks. Note that in a semistrong-form efficient market, abnormal returns should be statistically significant different from zero on the announcement date but show no significance on the split date which is essentially the conclusion that FFJR came to. Results for my study are shown in Regressions and Results.

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Regressions and Results Below is Table 1 for the stock split analysis.

OLS Regression Results

Dep. Variable:	returns	**R-squared (uncentered):**	0.043
Model:	OLS	**Adj. R-squared (uncentered):**	0.042
Method:	Least Squares	**F-statistic:**	55.59
Date:	Sun, 24 Jan 2021	**Prob (F-statistic):**	3.82e-35
Time:	23:38:59	**Log-Likelihood:**	3582.3
No. Observations:	3724	**AIC:**	-7159.
Df Residuals:	3721	**BIC:**	-7140.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
S&P Returns	1.0991	0.091	12.138	0.000	0.922	1.277
Announcement	-0.0665	0.021	-3.130	0.002	-0.108	-0.025
Split	-0.0560	0.021	-2.637	0.008	-0.098	-0.014

Table 1: This table shows the regression results for the stock split analysis for the 21 stocks. Three variables - the returns of the S&P 500, one dummy for the announcement date (noted on the table as "Event") and one dummy for the actual date of the split. Results show high statistical significance of abnormal returns from zero of for the 21 stocks on the day of the announcement and on the day of the split are both highly significant at $\alpha = .05$. In addition, the sign of both coefficients is negative, indicating that returns from stock split announcements are negative on average for both days.

Interpretation of Results Regarding the stock split analysis in Table 1, the results show something substantial. The first thing to note is that on average, the market typically does not like reverse splits since the coefficients on both the announcement dummy and split dummy are negative. Secondly, if we assume that this study had proper execution, the findings that abnormal returns are present on the split date are contrary to that of FFJR. Abnormal returns significantly differ from zero on the announcement day as expected, but also significantly differ from zero on the split date. FFJR concluded that all information regarding a stock split should have already been priced in on the day of the announcement. But between April and October, markets reacted to reverse split announcements by selling, and continued to trade on that split information on the split date too with further selling. Thus the market may no longer exhibit semistong-form efficiency when it comes to reverse stock splits.

Conclusions

The interpretations above lie largely on the assumption of proper execution. Proper execution in my study is unlikely for several reasons.

For the stock split analysis, the sample size was 21 stocks with 21 splits over a seven moth

period. FFJR on the other hand used a sample of 622 stocks with 940 splits over 32 years. My small sample size could potentially have led to erroneous conclusions. It is also uncertain if abnormal returns at either the announcement date or the spit date were solely due to split announcements as the market may have reacted to other news as well. Lastly, this analysis concerns only reverse stock splits. Perhaps the market has only been irrational with stock split announcements, but rational with other kinds of announcements. So a statement about inefficiency with reverse stock splits could be made, but it cannot be generalized to a comment about overall market efficiency[2]. To expand this analysis, I would want to add an anticipation and adjustment window to the split date to better examine how the market behaved on days preceding and following the actual split. I'd also want to control for other non-split announcements that may have occurred around the announcement and split dates.

If we assume proper execution in this study, the fact that abnormal returns persist on the day of the split means that the market continues to incorporate information on the split date although, per FFJR, all information should have already been incorporated on the announcement date. A major implication is that prices (at least of stocks that had a reverse stock split) are no longer fully reflecting all available information at all times. Instead, some information is incorporated on the announcement date and even more is incorporated on the split date. These new findings show that profit opportunities were possible from April to October by shorting a company that announced a reverse stock split anytime between the announcement date and the split date because prices continued to move down on the split date, a sign of market inefficiency when incorporating reverse stock split information into prices.

[2]One of the texts I read assumed a generalization of FFJR's stock split conclusions to the whole market. I would have to look more into that

References

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5. Special thanks to MIT's online course in finance that taught me the basics of event studies.