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Stock split and its impact on stock market – Evidence from Indian stocks

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ABSTRACT

The study attempted to assess the impact of the stock split on the stock price, volatility, and liquidity. To do this a sample of 365 companies are considered which has undergone split during the period 2011 to 2017. The paired t-test is carried out for pre and post values of Mean Return, Volatility, Beta, Sharpe's Ratio, Treynor Ratio, CAPM Return, Abnormal Return, and Liquidity to assess the impact of the split event on the stock performance. Overall results say that there is a drop in stock returns and increase in volatility after the split. There is no significant change in liquidity with the split. But when the analysis is done separately for costly and cheap stocks, it revealed that for costly stocks, there is the drop in returns, there is no further worsening of volatility and significant improvement in liquidity post-split. Thus split is effective to some extent only for costly stocks in terms of increase in the volume of trades after the split. Otherwise, this corporate action is not of any positive impact on wealth creation, volatility or liquidity.

Keywords: *Stock split, Volatility, Liquidity, CAPM return, Abnormal return, Beta*

1. INTRODUCTION

A stock split is a corporate action in which a company divides its existing shares into multiple shares. Here only the number of shares outstanding increases by a specific multiple, but the total value of the shares remains the same compared to pre-split amounts because the split does not add any real value. The most common split ratios are 2-for-1 or 3-for-1, which means that the stockholder will have two or three shares for every share held earlier.

For example, ABC Corp. has 1 crore shares outstanding and the shares are trading at INR 1000, which would give it INR 1000 crores market capitalization. The company's board of directors decides to split the stock 2-for-1. Right after the split takes effect, the number of shares outstanding would double to 2 crores, while the share price would be INR 500, leaving the market cap unchanged at INR 1000 crores.

The motivation behind Stock Splits

The question arises that what could be the reason behind this action of the corporates to go through the hassle and expense of a stock split? Some justifications are as:

Primarily, a split is generally executed when the stock price is fairly high, making it too costly for investors to acquire a decent quantity of shares, say 100 shares. If ABC Corp.'s shares were worth INR 1000 each, an investor would need to invest INR 1,00,000 to own 100 shares. If each share was worth INR 500, the investor would only need to pay INR 50,000 to own 100 shares.

Additionally, the higher number of outstanding shares may lead to greater liquidity for the stock, which facilitates trading and may narrow the bid-ask spread.

So, theoretically speaking, the stock split should not have any effect on the stock price. Only a positive psychological impact on the investors could play. Blue chip companies often resort to split to give investors this positive impetus. As for example, Wal-Mart has split its shares as many as 11 times on a 2-for-1 basis from the time it went public in October 1970 to March 1999. An investor who had 100 shares at Wal-Mart's IPO would have seen that little stake grows to 204,800 shares over the next 30 years.

Impact of Split on IPO

Another motivation for the companies to perform stock split is to bring down the number of outstanding shares prior to the issue of IPO. But this objective is accomplished through a reverse stock split which takes the per share value to the same level as the IPO price.

The companies should conform to the requirements of SEBI and stock exchanges before the Stock Split. A sample list taken from BSE site is as follows:

SEBI guidelines for Companies listed in BSE w.r.t. Stock Split – Fixing of Record date / Book Closure
The company will have to fix a Record Date/ Book Closure (BC/RD) for Stock Split. The procedure for the same is as follows:
As per provisions of Regulation 42 of SEBI LODR, the company may fix a BC/RD for the stock split and give advance intimation of at least 7 working days to BSE.
The following documents need to be submitted with the notice of Record Date:
1. Certified true copy of the Resolution passed by the shareholders of the company for Stock Split.
The resolution passed for treatment of Fractional entitlements, if any, should also be provided.
2. The undertaking of the company for Stock Split (Format below).
3. NEFT /Demand draft of Rs. 10,000/- +applicable GST drawn in favor of BSE Ltd.
4. The new ISIN number assigned by the depository should be informed to the Exchange at least 2 days prior to the RD/BC date.
Undertaking by the Company
The Board of Directors of the company has fixed a record date/ book closure of DD/MM/YYYY for purpose of sub-division/stock split of Rs. /- per share of the company into the shares of Rs. /- each.
We hereby undertake that the company will set up Auto Corporate Action with both the Depositories – CDSL & NSDL for execution before beginning of the day (BOD) on the first date of book closure period (in case of Book Closure) or before BOD on the trading day succeeding the record date (in case of Record Date) Further, the company undertakes to resolve any complaint on account of the failure on the part of company to complete all formalities for execution of Auto Corporate Action.

Impact of Split on various risk/ return parameters
While a split, in theory, should have no effect on a stock's price, it often results in renewed investor interest, which can have a positive impact on the stock price. While this effect can be temporary, the fact remains that stock splits by blue-chip companies are a great way for the average investor to accumulate an increasing number of shares in these companies. Many of the best companies routinely exceed the price level at which they had previously split their stock, causing them to undergo a stock split yet again. With this in the background, this paper tries to analyze if at all such action leave behind any impact on the stock return, volatility or liquidity.
The return and risk parameters on which the impact of the split can be studied can have various perspectives. Apart from quarterly price changes, and Standard deviation of changes, the following parameters may be tested.

Beta
Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole. Beta is used in the capital asset pricing model (CAPM), which calculates the expected return of an asset based on its beta and expected market returns. Beta is calculated using regression analysis. Beta represents the tendency of a security's returns to respond to swings in the market. A security's beta is calculated by dividing the covariance the security's returns and the benchmark's returns by the variance of the benchmark's returns over a specified period.

Return as per 'Capital Asset Pricing Model - CAPM'
The capital asset pricing model (CAPM) is a model that describes the relationship between systematic risk and expected return for assets, particularly stocks. CAPM is widely used throughout finance for the pricing of risky securities, generating expected returns for assets given the risk of those assets and calculating costs of capital.
The formula for calculating the expected return of an asset given its risk is as follows:

$$\overline{r_a} = r_f + \beta_a(\overline{r_m} - r_f)$$

Where:
r_f = Risk free rate
β_a = Beta of the security
$\overline{r_m}$ = Expected market return

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money and risk. The time value of money is represented by the risk-free (rf) rate in the formula and compensates the investors for placing money in any investment over a period of time. The risk-free rate is customarily the yield on government bonds.

The other half of the CAPM formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk. This is calculated by taking a risk measure (beta) that compares the returns of the asset to the market over a period of time and to the market premium (Rm-rf): the return of the market in excess of the risk-free rate. Beta reflects how risky an asset is compared to overall market risk and is a function of the volatility of the asset and the market as well as the correlation between the two. For stocks, the market is usually represented by the Sensex

The CAPM model says that the expected return of a security or a portfolio equals the rate on a risk-free security plus a risk premium. If this expected return does not meet or beat the required return, then the investment should not be undertaken. The security market line plots the results of the CAPM for all different risks (betas).

Sharpe Ratio

The Sharpe ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Subtracting the risk-free rate from the mean return, the performance associated with risk-taking activities can be isolated. One intuition of this calculation is that a portfolio engaging in "zero risks" investment, such as the purchase of Treasury bills (for which the expected return is the risk-free rate), has a Sharpe ratio of exactly zero. Generally, the greater the value of the Sharpe ratio, the more attractive is the risk-adjusted return.

$$\text{Sharpe ratio} = (\text{Mean stock return} - \text{Risk-free rate})/\text{Standard deviation of stock return}$$

The ex-ante Sharpe ratio formula uses expected returns while the ex-post Sharpe ratio uses realized returns.

Treynor Ratio

Treynor ratio attempts to measure how successful an investment is in providing investors compensation, with consideration for the investment's inherent level of risk. The Treynor ratio is reliant upon beta – that is, the sensitivity of an investment to movements in the market – to judge risk. The Treynor ratio is based on the premise that risk inherent to the entire market (as represented by beta) must be penalized because diversification will not remove it.

When the value of the Treynor ratio is high, it is an indication that an investor has generated high returns on each of the market risks he has taken. The Treynor ratio allows for an understanding of how each investment within a portfolio is performing. It also gives the investor an idea of how efficiently capital is being used.

Jensen's alpha as a measure of abnormal return

The Jensen's measure is a risk-adjusted performance measure that represents the average return on a portfolio or investment, above or below that predicted by the capital asset pricing model (CAPM), given the portfolio's or investment's beta and the average market return. This metric is also commonly referred to as Jensen's alpha, or simply alpha.

The capital asset pricing model (CAPM) is a framework used to calculate a security's or portfolio's expected return based on the risk-free rate of return, beta, and the expected market return. After a security's or portfolios expected return is calculated, the abnormal return could be calculated by subtracting the expected return from the realized return. The abnormal return may be positive or negative, depending on the performance of the security or portfolio over the specified period.

2. LITERATURE REVIEW

Ansary and Hussien (2017) studied the effect of Stock Split on the share prices, liquidity, and volatility and also investigated into the market efficiency of the stock market in response to the announcement of split and dividend declaration. Their research helps the investors assess the market reaction in relation to these corporate actions and make better investment decisions. They adopted the "Event Study" approach to assessing the impact of these corporate actions on the stock performance around the announcement day (for a period of 30 prior and 30 days post announcement). The analysis concluded that the announcement of both of stock split and the stock dividend has a positive impact on stock prices.

Agara (2014) established that stock split encompasses the technique of psychological pricing where new prices are more attractive to the incoming retail investors as well as fulfilling to the existing shareholder. Knowledge of share prices and its movement enables investors to choose the companies in which to invest it wisely. His study investigated the effect of the stock split on stock prices for firms listed at the Nairobi Securities Exchange. This study employed an event study methodology where the effect of the stock split on share price was explored for a period of 181 days in pre and post stock split date. The study covered the period between 2009 and 2013 with a sample size of 7 companies. Secondary data collected from Nairobi Securities Exchange on the daily stock prices of the 7 companies and the NSE 20- Share price index for 90-days pre and 90-day post-split announcement date was used. His study established that the events of stock split announcements affect stock prices almost immediately and that on average; it takes 3 days for prices to react to stock splits. In conclusion, this study established that stock split positively impacts on the share prices and hence recommended that regulators must review the policy on this event to encourage firms to adopt stock splitting, educate the public on the operations at the NSE to reduce abnormal reaction of prices caused by speculative retail trading.

Hua and Ramesh (2013) scrutinized the stock price response to the stock split declaration and a test of market efficiency in Colombo Stock exchange (CSE) by using a sample of 64 events (52 companies) from 14 different sectors of the emerging market during the period 2009 to 2012. They employed standard event study methodology to find the results. The empirical results show that average abnormal return (1.46%) is statistically significant at 5% level on the stock split announcement day. This study finds that stock splits have a significant signal and information content in the Colombo Stock Exchange (CSE). On average, market positively reacts significantly to the announcement. Further, the large negative cumulative average abnormal return (-6%) is observed during the period of (0, 10). These results support the semi-strong form efficient market hypothesis for the sample companies within the study period since stock prices adjust so fast to public information that investor cannot earn an abnormal return by trading in the stocks following the stock split announcement day.

Kalay and Kronlund (2009) re-examined the original "information hypothesis" which seeks to explain the abnormal returns around stock split announcements. While recent research focuses on liquidity and catering theories, their evidence re-affirms a link between the abnormal returns and earnings growth. Analysts revise earnings forecasts by 2.2-2.5% around split announcements, and this revision is significantly larger than that for matched firms. They further showed that the earnings information in a split likely arises from the fact that splitting firms experience less mean reversion in their earnings growth relative to matched firms. Consistent with an earnings information hypothesis, the analyst revision and the abnormal returns are stronger for firms with more opaque information environments. Furthermore, the cross-sectional variation in analyst revisions is related to the variation in abnormal returns. They also found evidence on splitting activity and the market reaction to splits that is inconsistent with liquidity-based theories and mixed with respect to catering.

A couple of Indian studies are also reviewed in this context:

Bodhanwala (2016) tried to explore the rationale behind the corporate actions of share split and reverse split and the impact of such action on liquidity and price of shares. His study focused on splits and reverse splits between 2006 and 2014. Splits declaration were highest in the year 2010 (104 companies) whereas reverse splits were evenly distributed over years. The results suggested that there is an optimal price for the shares, at which they appear to be the best value for money. On analyzing the data, they reached a conclusion that splitting of shares substantially increases the wealth of shareholders, but no such conclusion could be drawn for reverse splitting.

Thirunellai (2013) aimed to examine four important aspects related to the stock split event: the effect on the liquidity of firms that go in for a split; the trading range hypothesis related to the impact on stock price; the signaling hypothesis related to the company's growth prospects; and the multiple events hypothesis. The results of the study indicated that in the post-announcement period, while the stock prices of the firms that announce the split earned only insignificant excess returns over the broad market, the firms announcing the split were successful in increasing the liquidity of their stocks. The historical price movement indicates that for a given holding period (5-day, 10-day, 30-day, 60 days and 360 days), buyers of stock in the post-split period are inadequately rewarded compared to the pre-split/pre-announcement buyers.

Joshipura (2009) studied price and liquidity effect associated with stock split surrounding its announcement and effective day by using standard event study methodology which, measures the significance of abnormal return and change in liquidity associated with an event. His results are slightly different from the evidence found from the US, Germany etc. where there is some significant positive abnormal return is observed to be associated with a stock split. His results suggested that though there is some positive abnormal return associated surrounding announcement and effective day of the stock split It reverses in just a few days after the event day and ultimately generates significant negative abnormal return in slightly longer post-effective (ED to ED+51 days) window. However, there is a significant improvement seen in liquidity surrounding announcement and effective day of the stock split. So the analysis suggested that stock split does not have any positive impact on the wealth of the shareholder at all but it improves the liquidity of the stock very significantly.

2.1 The Research Gap

The studies on stock split done so far are based on the event study for a specific period applicable on all types of stocks, irrespective of their price. The generalized findings from the statistical analysis are assumed as a universal phenomenon. The findings are not always justified by rationality. So, it calls for a study to give practical justification to this corporate action, backed by empirical analysis.

3. OBJECTIVES OF THE STUDY

To fill the vacuum identified from the existing literature, a detailed study became necessary wherein the various aspects of stock market variables are analyzed pre and post split to study the impact of split event on them, if any. The research thus aims to

- To study the consequences of stock split that has occurred in recent years in Indian stock market
- To justify the corporate action of stock split with respect to the impact on different risk and return parameters related to the stock price

4. RESEARCH METHODOLOGY

In this study, the stock split data has been collected from 10/11/2011 to 30/09/2017. There has been 365 cases of split during this time period. From BSE website the ex dates and pre and post Face Value of the shares are collected.
Quandl database is accessed to get the closing price data and number of trades for the stocks for 180 days prior to the ex-date and 90 days post ex-date. Complete sets of data were obtained for 365 companies in total.

Also as a proxy for the risk-free return, the 91 day T Bill rates are collected from RBI website for the same period. Since the T bill rates are published on a weekly basis, the rate for the subsequent 6 days after the publication date is taken to be the same as the last published one. Thus the daily data for the risk-free rate is generated. Since these rates are in terms of per annum rates, they are converted to quarterly rates by the formula $Rf(q) = (1+Rf(a))^{0.25} -1$.

Now from the price data, quarterly returns are generated on daily basis. Approximately, it is established that one quarter consists of 62 working days. So, the quarterly returns are calculated using the formula $\ln(P_i/P_{i-62})$.
But since the price gets revised after the split event, the post-split prices are adjusted by multiplying by a factor (old FV / new FV). Next, the BSE Sensex closing values are collected dynamically between the start date and end date of each scrip based on the ex-dates, as mentioned earlier using Quandl database. The quarterly returns for Sensex on daily basis are calculated using the same logic as was used for the company stocks. This return is used as a proxy for market return. The company-wise closing price data is too voluminous to be included as a part of this paper.

Finally before analysis, the input dataset constituted of the following

- Quarterly stock returns on daily basis 90 days pre and post-split for each of the splitting firms
- Quarterly market returns on daily basis 90 days pre and post split
- Risk-free returns on daily basis 90 days pre and post split
- Number of trades on daily basis 90 days pre and post split

With this data the following parameters are calculated:

- Mean quarterly return pre and post-split for each of the splitting firms
- SD of quarterly return pre and post-split for each of the splitting firms as a measure of volatility
- The beta of quarterly return pre and post-split for each of the splitting firms as a measure of market sensitivity calculated using the following formula:

  beta = cov(stock return, market return)/var(market return)
- CAPM quarterly return pre and post-split for each of the splitting firms using the formula

  CAPM Return = Risk free return + (Market Return – Risk free Return)* beta
- Sharpe's Ratio for pre and post-split for each of the splitting firms using the formula:

  Sharpe's Ratio = Mean (Stock Return- Risk Free Return)/SD
- Treynor Ratio for pre and post-split for each of the splitting firms using the formula

  Treynor Ratio = Mean (Stock Return- Risk Free Return)/beta
- Abnormal Return for pre and post-split for each of the splitting firms using the formula

  Abnormal Return = Mean (Stock Return- CAPM Return)
- Number of trades pre and post-split for each of the splitting firms as a measure of liquidity using the formula

  mean (Number of trades on daily basis 90 days pre and post-split)

The paired t-test is carried out for all the above pre and post parameters listed above, i.e., Mean Return, Volatility, Beta, Sharpe's Ratio, Treynor Ratio, CAPM Return, Abnormal Return, and Liquidity to assess the impact of the split event on the stock performance. R programming language is used for the purpose of analysis. The corresponding R code is given in the appendix.

5. RESULTS AND ANALYSIS

The following table gives the results of the paired t-test to assess if there is significant similarity or disparity between the pre-split and post-split values of the parameters listed above, i.e., Mean Return, Volatility, Beta, Sharpe's Ratio, Treynor Ratio, CAPM Return, Abnormal Return, and Liquidity for the in sample 365 companies under study.

Table 1: Results of Paired T-Tests

Test Parameters	T Statistic	df	p-value (two-sided test)	Interpretation with 95% confidence
Mean Quarterly Returns	6.5711	364	1.69E-10	p<0.025
Volatility of Returns	-3.3701	364	8.30E-04	p<0.025
Sharpe Ratio	4.2852	364	2.33E-05	p<0.025
Beta	-1.8251	364	6.88E-02	p>0.025
CAPM Returns	1.0852	364	2.79E-01	p>0.025
Treynor Ratio	1.3795	364	1.69E-01	p>0.025
Jensen's Alpha	5.6117	364	3.93E-08	P<0.025
Number of Trades	-1.8414	364	6.64E-02	p>0.025

Results show that there is a significant fall in the return and increase in volatility post-split. The beta and CAPM returns are unaffected by the split event. Thus the abnormal return dropped significantly. So, Sharpe's ratio significantly decreased, but Treynor's ratio is undisturbed. There is also no significant change in liquidity in terms of a number of trades before and after the split event.

Fig. 1: Closing Prices Before and After Split

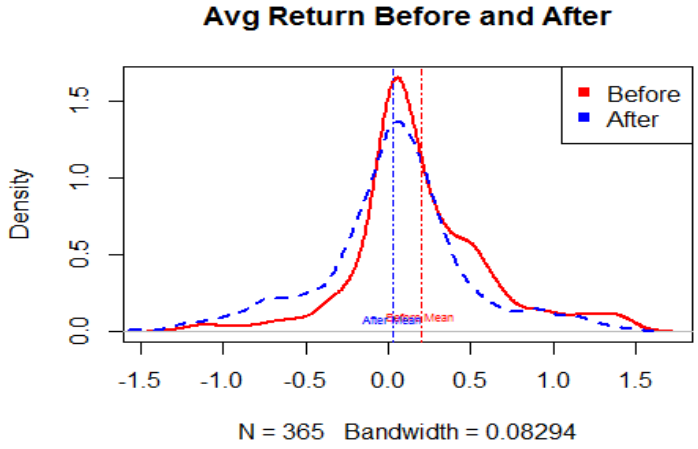

Fig. 2: Average Return Before and After Split

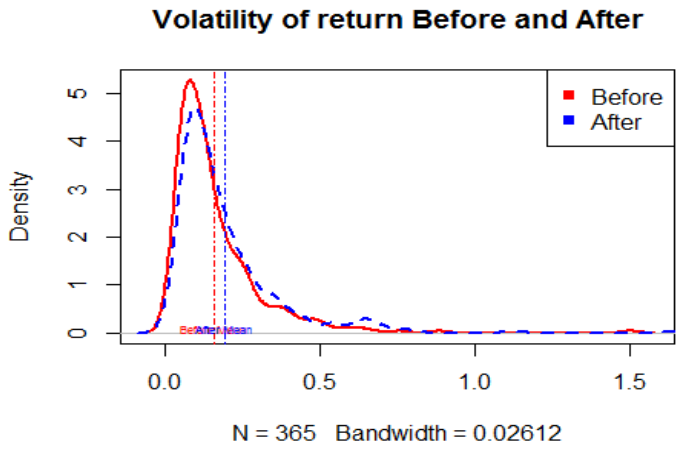

Fig. 3: Volatility Before and After Split

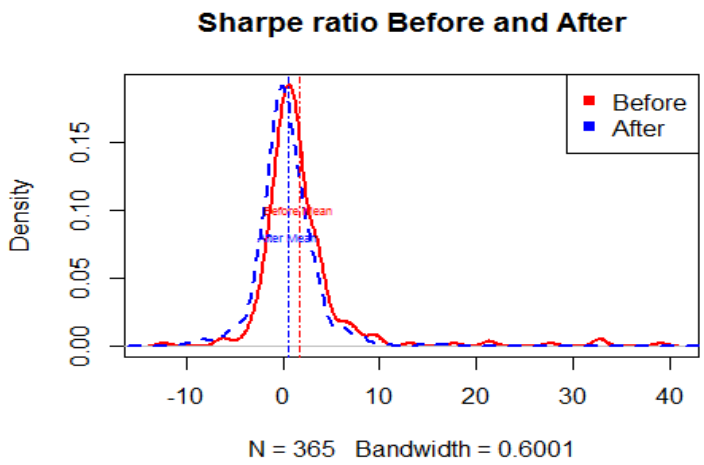

Fig. 4: Sharpe Ratio Before and After Split

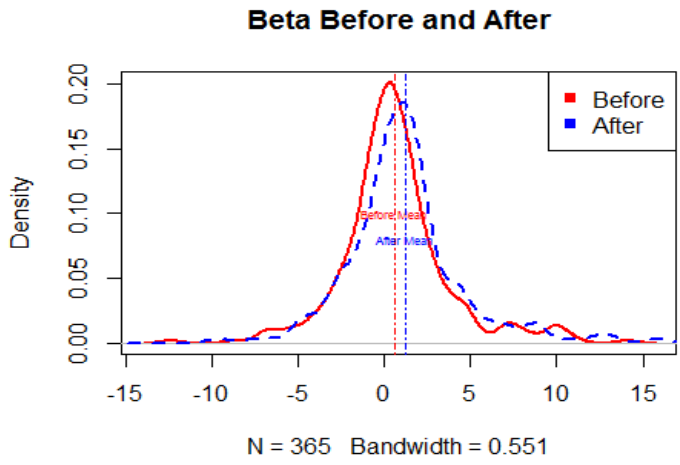

Fig. 5: Beta Before and After Split

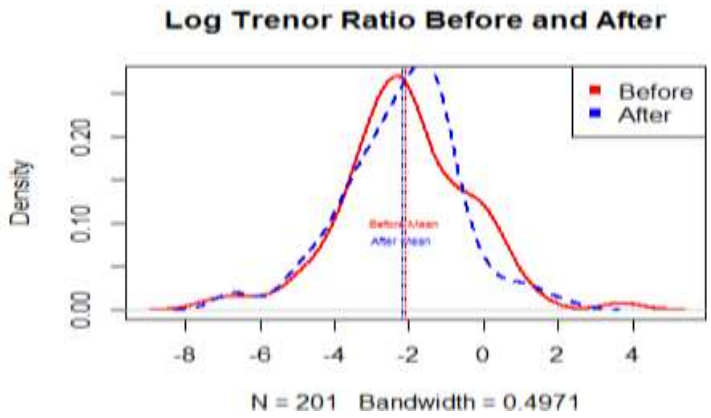

Fig. 6: Trenor Ratio Before and After Split

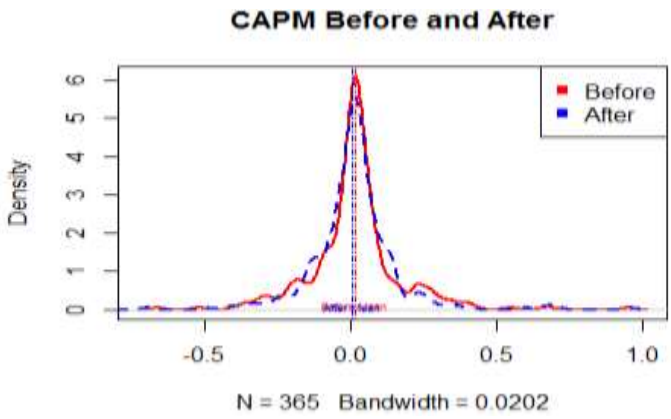

Fig. 7: CAPM Return Before and After Split

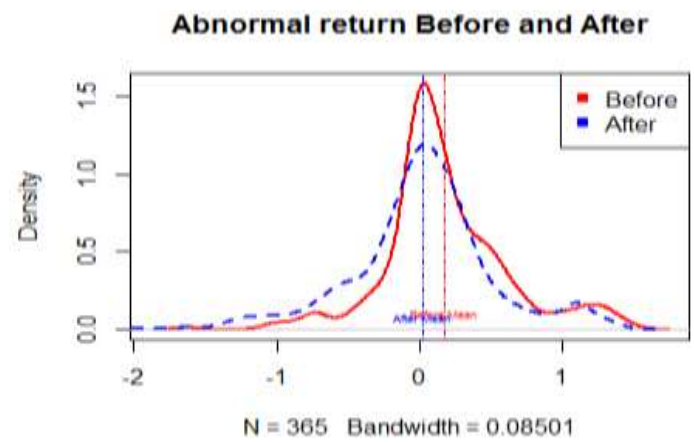

Fig. 8: Abnormal Return Before and After Split

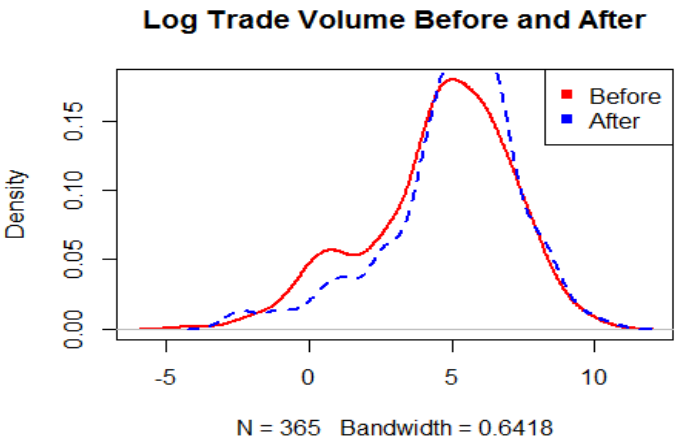

Fig. 9: Trade Volume Before and After Split

So, it was observed that this corporate action failed to increase either wealth or liquidity for the present and potential owners. Then what is the basic purpose of such actions. In order to investigate into the matter a little deeper, now the sample set is categorized into two groups on the basis of their pre-split average closing prices. The average closing price is nearly 730. So, the cut off closing price is taken to be Rs 700. Stocks with pre-split average closing price more than Rs 700 are designated as costly stocks and those with pre-split average closing price less than Rs 700 are designated as cheap stocks.

Now the entire exercise is done separately for the costly and cheap stocks. It is found that of the 365 stocks, 80 are costly and 285 are cheap. The results are tabulated hereunder:

Table 2: Paired T-Test for Costly Stocks:

Test Parameters	T Statistic	df	p-value (two-sided test)	Interpretation with 95% confidence
Mean Quarterly Returns	4.6917	79	0.00001	$p < 0.025$
Volatility of Returns	-0.5012	79	0.61760	$p > 0.025$
Sharpe Ratio	3.7901	79	0.00028	$p < 0.025$
beta	-2.2420	79	0.02773	$p > 0.025$
CAPM Returns	-0.8507	79	0.39750	$p > 0.025$
Treynor Ratio	0.2731	79	0.78550	$p > 0.025$
Jensen's Alpha	4.2304	79	0.00006	$p < 0.025$
Number of Trades	-3.4693	79	0.00084	$p < 0.025$

In case of costly stocks, there is also a drop in return after the split event. But there is no significant change in volatility of returns. There is a significant drop in the Sharpe's Ratio. Market-related parameters like beta, CAPM returns and Treynor Ratio is unperturbed here as well. There is a drop in the abnormal return. The only remarkable difference is that the number of trades increased significantly post-split. Thus for the high priced stocks, the split results in increased liquidity, which is certainly a desirable outcome.

Table – 3: Paired T-Test for Cheaper Stocks:

Test Parameters	T Statistic	df	p-value (two-sided test)	Interpretation with 95% confidence
Mean Quarterly Returns	5.1148	284	0.000001	$p < 0.025$
Volatility of Returns	-3.4524	284	0.000638	$p < 0.025$
Sharpe Ratio	2.8886	284	0.004161	$p < 0.025$
beta	-1.0735	284	0.283900	$p > 0.025$
CAPM Returns	1.5805	284	0.115100	$p > 0.025$
Treynor Ratio	1.3567	284	0.175900	$p > 0.025$
Jensen's Alpha	4.1584	284	0.000042	$p < 0.025$
Number of Trades	0.8574	284	0.391900	$p > 0.025$

For the cheaper stocks, the results are exactly same as those for the total sample. That is to say, there is a significant drop in return, increase in volatility, fall in Sharpe's Ratio and also Abnormal Return. While the market-linked beta, CAPM return, and Treynor's Ratio did not show any significant change. Here also there is no improvement in liquidity in terms of significant increase in a number of trades.

6. CONCLUSION

So to conclude, the study revealed quite satisfactory results. The split event does not change the value of a firm. So, it is unlikely to create wealth. So, there has not been any significant increase in return post-split. Rather the quarterly return and the abnormal return declined significantly. So, split as a corporate action is not very acceptable to the investors.

Table 4: Summary of Results

Stock Category	Test Parameters	Whether there is significant change between pre and post split	Nature of Change
All Stocks N= 365	Mean Quarterly Returns	Yes	Decrease
	Volatility of Returns	Yes	Increase
	Sharpe Ratio	Yes	Decrease
	Beta	No	-
	CAPM Returns	No	-
	Treynor Ratio	No	-
	Jensen's Alpha	Yes	Decrease
	Number of Trades	No	-
Costlier Stocks Price per Share >700 N= 80	Mean Quarterly Returns	Yes	Decrease
	Volatility of Returns	No	-
	Sharpe Ratio	Yes	Decrease
	Beta	No	-
	CAPM Returns	No	-
	Treynor Ratio	No	-
	Jensen's Alpha	Yes	Decrease
	Number of Trades	**Yes**	**Increase**
Cheaper Stocks Price per Share <=700 N= 285	Volatility of Returns	Yes	Increase
	Sharpe Ratio	Yes	Decrease
	Beta	No	-
	CAPM Returns	No	-
	Treynor Ratio	No	-
	Jensen's Alpha	Yes	Decrease
	Number of Trades	No	-

The volatility also increased for the cheap stocks but not for the costly ones, thus increasing the Sharpe's ratios for the cheap ones. One of the main objectives of the split is to bring down the price of one share. The too high share price has a negative psychological impact on the investors. Shareholders hesitate to sell because they don't find the price suitable for an exit. The buyers also hesitate feeling it be a wrong time to enter because they feel that the prices are already at a peak and a downward journey is ahead. In order to break this ice, the split event could be a way out. So, said the results. For the costly stocks, the volume of trade increased significantly, establishing the fact that not for all, but only for the costly stocks, the split event has a positive impact on liquidity. The market-linked variables like CAPM return, beta and Treynor ratios are not affected by the split event and quite rationally.

Limitations of the Study

The study is itself elaborate enough. The sample has been made quite exhaustive. The availability of secondary data had made it possible. Only data regarding risk-free rate was not available prior to 10/11/2011. The return of 90 days T Bill is used for the purpose because the stock returns considered in the study were quarterly returns. For this reason, the present research is confined to the split events from and after this date, though other relevant data were well available. This can be cited as a major limitation of this study.

Scope for Further Research

This is an event study with respect to the corporate action of the stock split. The methodology adopted handles huge historical database from Indian stock market. The extensive study thus conducted can offer a benchmark methodology for event study in connection to any other event like dividend declaration, M&A decisions etc. There is thus the immense scope of further research.

7. REFERENCES

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APPENDIX

R Code used for analysis

```
library(Quandl)
token="f6TuzPvMdEb1NGC2jbA_"
Quandl.api_key(token)
#-------------Market split data----------------------
bse=read.csv("split_BSE_2000.csv")
#Dates are taken from 2011-11-10 as older t-bills rate are not available
bse.2012=bse[as.Date(bse$Ex.Date,format="%d %b %Y")>as.Date('2011-11-10'),]
bse.2012$Ex.Date=as.Date(bse.2012$Ex.Date,format="%d %b %Y")
df=data.frame(oldFV=numeric(),newFV=numeric())
len=length(bse.2012$Purpose)
fs='From Rs.[A-Z0-9]{1,50}/-'
ts='/- to Rs.[A-Z0-9]{1,50}/-'
for(i in seq(from=1,to=len,by=1)){
  s=bse.2012$Purpose[i]
  r=regexpr(fs,s,TRUE)
  oldFV=substring(s,r[1]+nchar('From Rs.'),r[1]+attr(r,'match.length')-3)
  r=regexpr(ts,s,TRUE)
  newFV=substring(s,r[1]+nchar('/- to Rs.'),r[1]+attr(r,'match.length')-3)
  df=rbind(df,data.frame(as.numeric(oldFV),as.numeric(newFV)))
}
names(df)=c("oldFV","newFV")
bse.2012=cbind(bse.2012,df)
#------------now read rbi data of 91 days tb---------
rf=read.csv("91dtb.csv",skip=1)
rf$Date=as.Date(rf$Date,format="%d/%m/%Y")
rf$Rate=rf$Rate/100
rf$Rate=(rf$Rate+1)^0.25-1
#-------------------------------------------------------
#------FUNCTION-------
qtlyRet=function(cl){
  return(log(cl/lag(cl,62)))
}
sharpe=function(s.a,s.b){
  return(mean(s.a-s.b)/sd(s.a))
}
beta=function(Ra,Rm){
  return(cov(Ra,Rm)/var(Rm))
}
CAPMRet=function(Rf,Rm,beta){
  return((Rf+(Rm-Rf)*beta))
}
treynor=function(Ra,Rf,beta){
  return(mean((Ra-Rf)/beta))
}
fetchData=function(code,sDate,eDate,exDate,mFactor){
  Rm=Quandl("BSE/SENSEX",start_date=sDate,end_date=eDate, type="xts",column_index=c(4))
  names(Rm)=c("Sensex")
  t=Quandl(code,start_date=sDate,end_date=eDate, type="xts",column_index=c(4,7))
  names(t)=c("Close","Trades")
  t$Close[time(t)>=exDate,]=t$Close[time(t)>=exDate,]*mFactor
  Diff=merge(Rm,t)
  Diff$Trades[is.na(Diff$Trades)]=0
  Diff$Close=na.locf(Diff$Close)
  Diff$Close=na.locf(Diff$Close,fromLast = T)
  pClose=mean(t$Close[paste((sDate+90),"/",sep="")])#mean closing price

  Diff$Sensex=qtlyRet(Diff$Sensex)#return data of sensex
  Diff$Close=qtlyRet(Diff$Close)#return data of scrip
  Diff=Diff[!is.na(Diff$Sensex),]

  Rf=rf[rf$Date>=sDate & rf$Date<=eDate,]#fixed return
  Rf=as.xts(Rf$Rate,order.by = Rf$Date)
  Diff=merge(Diff,Rf)
```

```
  Diff=Diff[!is.na(Diff$Close),]
  Diff$Rf=na.locf(Diff$Rf)
  Diff$Rf=na.locf(Diff$Rf,fromLast = TRUE)

  Mean=mean(Diff$Close)
  SD=sd(Diff$Close)
  Sharpe=sharpe(Diff$Close,Diff$Rf)
  Beta=beta(Diff$Close,Diff$Sensex)[1,]
  CAPM=mean(CAPMRet(Diff$Rf,Diff$Sensex,Beta))
  Treynor=treynor(Diff$Close,Diff$Rf,Beta)
  Abnormal=mean(Diff$Close-CAPMRet(Diff$Rf,Diff$Sensex,Beta))
  Trades=mean(Diff$Trades)
  return(cbind(pClose,Mean,SD,Sharpe,Beta,CAPM,Treynor,Abnormal,Trades))
}

#Main function
len=length(bse.2012$Security.Code)
final=data.frame()
before=data.frame()
after=data.frame()
for(i in seq(from=1,to=len,by=1)){
  #i=1
  tryCatch({
    #i=12
    bom=bse.2012$Security.Code[i]
    st=paste("BSE/BOM",bom,sep="")
    #--------BEFORE------#
    exDate=as.Date(bse.2012$Ex.Date[i])#split date of the script
    sDate=exDate-180
    eDate=exDate-1
    before=rbind(before,cbind(bom,fetchData(st,sDate,eDate,exDate,1)))

    #--------AFTER------#
    mFactor=bse.2012$oldFV[i]/bse.2012$newFV[i]
    sDate=exDate-90
    eDate=exDate+90
    after=rbind(after,fetchData(st,sDate,eDate,exDate,mFactor))
  },error=function(cond) {
    message(paste("code does not seem to exist:", st))
    message(paste("Index :",i))
    message(paste("Error message is ",cond))
  })
}
names(before)=c("BOM","BClose","BMean","BSD","BSharpe" ,"BBeta","BCAPM","BTreynor","BAbnormal","BTrades")
names(after)=c("AClose","AMean","ASD","ASharpe" ,"ABeta","ACAPM","ATreynor","AAbnormal","ATrades")
final=cbind(before,after)
write.csv(final,"final.csv")

library(dplyr)
bse.2012=bse.2012[,c(1,3,4,12,13)]

final1=left_join(final,bse.2012,by=c("BOM"="Security.Code"))
final1$AClose=final1$AClose*final1$newFV/final1$oldFV
mean(final1$BClose)
length(final1[final1$BClose>=700,1])
final1$costly=(final1$BClose>=700)

costly=final1[final1$costly,]
cheap=final1[!final1$costly,]

t.test(costly$BMean,costly$AMean,paired = T)
#t.test(costly[,c(3:10)],costly[,c(12:19)],paired=T)
head(costly[,c(10,19)])
t.test(costly[,c(3)],costly[,c(12)],paired=T)#means
t.test(costly[,c(4)],costly[,c(13)],paired=T)#SD
t.test(costly[,c(5)],costly[,c(14)],paired=T)#Sharpe
```

```
t.test(costly[,c(6)],costly[,c(15)],paired=T)#Beta
t.test(costly[,c(7)],costly[,c(16)],paired=T)#CAPM
t.test(costly[,c(8)],costly[,c(17)],paired=T)#Treynor
t.test(costly[,c(9)],costly[,c(18)],paired=T)#Abnormal
t.test(costly[,c(10)],costly[,c(19)],paired=T)#Trades

t.test(cheap[,c(3)],cheap[,c(12)],paired=T)#means
t.test(cheap[,c(4)],cheap[,c(13)],paired=T)#SD
t.test(cheap[,c(5)],cheap[,c(14)],paired=T)#Sharpe
t.test(cheap[,c(6)],cheap[,c(15)],paired=T)#Beta
t.test(cheap[,c(7)],cheap[,c(16)],paired=T)#CAPM
t.test(cheap[,c(8)],cheap[,c(17)],paired=T)#Treynor
t.test(cheap[,c(9)],cheap[,c(18)],paired=T)#Abnormal
t.test(cheap[,c(10)],cheap[,c(19)],paired=T)#Trades

t.test(final1[,c(3)],final1[,c(12)],paired=T)#means
t.test(final1[,c(4)],final1[,c(13)],paired=T)#SD
t.test(final1[,c(5)],final1[,c(14)],paired=T)#Sharpe
t.test(final1[,c(6)],final1[,c(15)],paired=T)#Beta
t.test(final1[,c(7)],final1[,c(16)],paired=T)#CAPM
t.test(final1[,c(8)],final1[,c(17)],paired=T)#Treynor
t.test(final1[,c(9)],final1[,c(18)],paired=T)#Abnormal
t.test(final1[,c(10)],final1[,c(19)],paired=T)#Trades
write.csv(final1,"final1.csv")
```

