



Stock Market Anomaly: Day of the Week Effect in Bombay Stock Exchange with the Application of GARCH Model

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Abstract: It has observed from many stock markets around the world that index value used to vary due to fluctuation in stock prices. One of the most important factors of variation in the stock prices is the day of the week effect, which indicates calendar irregularities in stock markets. Investment in the stock market is the most uncertain; therefore investors get worried regarding the appropriate day to trade in the financial market. The main objective of the present study is to find out the appropriate day of the week effect of developing the stock market of an emergent nation like India from 1st January 2000 to 31st December 2018. For fulfilling the objectives of the study, the daily closing value of four major indices of the Bombay Stock Exchange has been taken into consideration. To test the equality between average returns to different days and to examine the distribution pattern of daily returns series that measure the day of the week analysis, the parametric tools alike Mean and Standard deviation have employed. Apart from the parametric test, t-test has also applied to the daily returns in order to test the hypothesis. In this study, descriptive statistics and the GARCH model has also used with the purpose of measuring the day of the week effect analysis. Conferring to the results, the coefficients express that the return among different days of the week are statistically significant,

Keywords: Stock Market Anomaly, Indian Stock Market, BSE, Indices, Day-Of-The-Week effects, GARCH model, Intra- day effects.

I. INTRODUCTION

The capital market reveals the movement of different stock prices, which use to volatile by the changes of different factors. The investors both buyers and sellers are responsible for the changes in the stock prices. Essentially, share price use to change because of the demand and supply of different stock. If a large number of people want to buy a particular stock then the price of the stock goes up. Inversely, if many people want to sell a stock then the price of that stock would start falling. The pricing of financial securities depends upon the anomaly in each stock. Stock prices fluctuate more with the increase in the stock market anomaly. Investors are worried about variation in stock prices. Seasonality is a factor in forecasting stock market performance. The presence of seasonal actions in stock returns may lead to rewarding trading policies and provide reasonable returns. The existence of calendar anomalies has been recognized for the last few decades of financial markets [11].

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The day of the week effects on the same manner has also been present in India [22]. In different stock exchanges, Tuesday's returns appear maximum negative returns and show a fairly high return in Friday as compared to that of Monday [14]. Thus, seasonality in stock market's return has been widely recognized. Seasonal effects have been observed among the stock markets, which is the seasonality across the days of a week. It was also observed that the day of the week effect exists on sixteen out of eighteen countries have either on Monday or Tuesday the lowest returns [2]. The pattern of stock returns to other days in the week at the Indian stock market has been studied by many researchers.

II. LITERATURE REVIEW

Bayar and Kan (2002), in their study, analysed nineteen countries' daily returns and witnessed that it fluctuate from the dollar and native currency returns. The dollar returns being shown lower daily returns and higher standard deviations as related to the currency. They observed that native currency have higher returns to the mid of the week, and a lower return to the end of the week [4].

On the other hand, Aly Mehdian and Perry (2004) examined the calendar effect in Capital Market Authority Index in Egypt. The study related to the period starting from 1998 to 2001. However, the analysis considers a Multiple Linear Regression Model incorporating dummy variables. The results conclude that the Monday return is encouraging and statistically associated. In addition, the other day has an insignificant impact on average return. Moreover, the Monday return is significantly high volatile than other days of the week [3].

Basher and Sadorsky (2006) inspected days of the week effect in the world's twenty-one developing stock markets. This study has done for the period 31 December 1992 to 31 October 2003. Nevertheless, five models have estimated to accomplish their objectives. Though various models gave diverse results the day of the week effect was there in Pakistan, Phillipine, and Taiwan even later altering the market risk [5]. Patjoshi (2011) studied the instability in the Indian Stock Market by considering different indices in BSE and NSE [16]. On the other hand, Patjoshi and Tanty (2016) studied the volatility of BSE and NSE [19]. Patjoshi (2016) examined the correlation between risk and return of the Sensex and banking stocks of BSE thirty (Sensex). During this study Sensex and banking stock indices are analysed to examine the risk-return trade-off of Sensex therewith of HDFC Bank, ICICI Bank, Axis Bank, and SBI.

It had been found that Sensex returns, and also all the stock returns, shows positive average daily returns except ICICI Bank return for the chosen period [20].

Patjoshi (2016) studies the constancy of the day of the week effect in return as well as in volatility sign from BSE [18]. On the opposite hand Patjoshi and Tanty (2017) scrutinized the volatility pattern of Bombay securities market and BSE thirty companies. This study includes the impact of various BSE thirty companies on BSE Sensex. The study relies on the daily returns of various indices and corporations. The daily returns for the analysis have been taken from the BSE [21].

Nandini, Patra, Mishra (2012) studied that the usual market anomalies are the January effect, the size effect, also the day of the week effect. Rendering to the month of the year effect, the normal monthly returns of the market are not alike for all the months of the year. The objective of this paper is to observe the month of the year effects in Bombay Stock exchange (BSE). This paper examines the month of the year effect of the Bombay Stock exchange from January 1993 to December by using simple statistical techniques as well as GARCH (1, 1) model. Nandini (2013) investigated the pattern of volatility in the Indian Stock Market. The research shows daily returns of the market is not equal for all days of the week and it shows the existence of day of the week effect in the Indian Stock market for the chosen period. [10]. . Tevdovski, Mihajlov & Sazdovski (2012) found the day of the week effect in different stock exchanges in South-Eastern Europe. This study has conducted for the period 2006 to 2011. The findings indicate the mean returns of Monday are adverse and least as compared to other days [21].

Patjoshi (2016) studied the issue and challenges faced by the Indian Stock Market [17]. Patjoshi (2016), examined to find a suitable day for investment, in the Bombay Stock Exchange (BSR), India in 15 years. So as to justify the objectives of the paper the daily return data of four main indices of BSE have categorized by concentrating on the day of the week from Monday to Friday. While sample indices display Wednesday return was the highest and Monday provides the lowest return with higher volatility [18].

The different empirical analysis has exposed that the Monday market returns have significantly negative returns and on Friday significantly positive returns. The behavior of stock returns to different days in a week is an interesting topic for researchers for long. This has not only interested the financial economists of old scribes but also to the modern-day financial researchers. The present study tries to discover the presence of “day of the week effect” in BSE of different indices. The different indices of “day of the week effect” would serve mainly to confirm or reject the presence or otherwise of “day of the week effect”. More or less of the additional precise opinions are

(1) Accept or reject the presence of the “seasonality” in the Bombay stock exchange.

(2) Projecting past patterns into the future. By examining the past pattern the investor can predict the short-range future and can reap good return by using the pattern.

(3) Portfolio management, dependable volatility approximations are vital for hedging against risk.

The main importance of this study is that it will give the day of the week effect on the Indian stock market. The observed patterns of the study are beneficial to understand volatility and therefore by exploring the occasion can earn a good amount of return.

III. OBJECTIVES OF THE STUDY

- To determine the day of the week effect on the Bombay stock exchange returns.
- To find out whether there is a presence of calendar anomalies of buying on Monday & selling on Friday.

IV. HYPOTHESIS OF THE STUDY

Hypothesis (Ho): There is no significant difference between the average daily return among different days of the week.

$$a_1 = a_2 = a_3 = a_4 = a_5$$

Where a_1 to a_5 is the average returns of different day of the week from Monday to Friday

V. RESEARCH METHODOLOGY:

The study has examined for finding out the day of the week pattern in four different selected Indices specifically the Sensex, the BSE 100, the BSE 200 and the BSE 500. The data for the study is taken for a period of 19 years which is from January 3, 2000 to December 31, 2018. The daily closing value has been used for calculating the daily returns.

$$R_t = \ln [I_t / (I_{t-1})]$$

Where

R_t is the return of the indices day t .

I_t is the closing indices value of day t

I_{t-1} is the closing indices value of day $t-1$

And \ln is Natural log.

The daily indices returns have been calculated over the week from Monday to Friday for analysing the equivalence of mean returns of different days. Parametric tests alike Mean, Standard deviation, Skewness and Kurtosis have been used to study the fluctuation pattern of the each day return of the week. T-test has been employed to the returns in order to test the hypothesis. In this study, descriptive statistics and GARCH model also used in order to measure the day of the week effect analysis.

The GARCH (1,1) model explains the conditional variance as a function of three variables:

$$h_t = \omega + \alpha h_{t-1} \varepsilon_{t-1}^2 + \beta h_{t-1}$$

VI. ANALYSIS OF DAY OF THE WEEK EFFECT IN BOMBAY STOCK EXCHANGE

A. The day of the week effect in Sensex

BSE Sensex represents the price movement of the Indian stock market. The Sensex includes 30 companies, which are vigorously traded stocks and represent several industrial sectors. The result of descriptive statistics analysis is depicted in the Table I.

Table I: Sensex- Day of the Week Effect

| Particulars | Mon | Tue | Wed | Thus | Fri |
|--------------------|---------|---------|---------|---------|---------|
| Mean | 0.0100 | 0.0231 | 0.0947 | 0.0171 | 0.0371 |
| Standard Deviation | 1.7339 | 1.4336 | 1.4032 | 1.3946 | 1.6246 |
| Kurtosis | 12.5005 | 4.3640 | 3.1471 | 2.4982 | 5.5654 |
| Skewness | 0.1096 | -0.3009 | -0.0102 | -0.2678 | -0.5325 |

Source: Results obtained from SPSS package for statistical analysis

It has found from the Table-I that the investment on Wednesday has given a higher return (0.0947) whereas; the investment on Monday has given lower return (0.0100) as compared to other days. The standard deviation measures the volatility is found to be the highest (1.7339) on Monday but it is lowest (1.3946) on Thursday. The return distribution is positively skewed on Monday. And all other days it is negatively skewed. The Monday return distribution (0.1096) is more skewed than from the other days. The return distributions are observed to be more peaked on Monday and Friday.

B. The day of the week effect in BSE 100

BSE-100 was removed to Free-Float practice effective from 5th April 2004. The results of intra-week seasonality pattern for the BSE 100 have been given in the Table II.

Table II: BSE 100 - Day of the Week Effect

| Particulars | Mon | Tue | Wed | Thus | Fri |
|--------------------|--------|--------|--------|--------|--------|
| Mean | 0.0275 | 0.0193 | 0.096 | 0.0049 | 0.0355 |
| Standard Deviation | 1.7948 | 1.4681 | 1.4363 | 1.4188 | 1.6683 |
| Kurtosis | 10.814 | 4.5942 | 3.2172 | 2.8259 | 5.3647 |
| Skewness | 0.2438 | 0.3592 | -0.067 | 0.3722 | 0.7274 |

Source: Results obtained from SPSS package for statistical analysis

It has depicted from the Table No. II that the mean return is the lowest on Thursday (0.0049) and highest on Wednesday is the (0.0960). Therefore, investment on Wednesday has given a higher return whereas; the investment on Thursday has given lower return as compared to other days. The standard deviation is found to be the highest (1.7948) for the Monday and the lowest (1.4188) for the Thursday. Return distributions are found negatively skewed for all days from Monday to Friday. The return distributions are found to be leptokurtic for four days Monday, Tuesday, Wednesday and Friday).

C. The day of the week effect in BSE 200

BSE 200 index has included 200 companies, which represents broader market capitalization of the stock market, and this Index was launched on May 27, 1994. Index calculation method shifted to free-float market capitalization later on. The index base year is 1989-90 and base index value is 100. Results of intra-week seasonality pattern for the BSE 200 have been shown in the Table III.

Table III: BSE 200 - Day of the Week Effect

| Particulars | Mon | Tue | Wed | Thus | Fri |
|-------------|------------|------------|------------|------------|------------|
| Mean | 0.037 0 | 0.014 1 | 0.103 1 | 0.004 9 | 0.032 0 |

| | | | | | |
|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Standard Deviation | 1.778 4 | 1.448 4 | 1.409 5 | 1.390 1 | 1.636 5 |
| Kurtosis | 11.24 28 | 4.486 6 | 3.293 7 | 2.882 4 | 5.887 2 |
| Skewness | - 0.435 4 | - 0.382 3 | - 0.065 9 | - 0.435 3 | - 0.854 5 |

Source: Results obtained from SPSS package for statistical analysis

It is found from the Table III that mean returns for all the days are positive. While, the mean return for the Thursday has recorded the lowest (0.0049), and the mean return of Wednesday is the highest (0.1031). Standard deviation is highest (1.7784) for Monday, on the other hand lowest for the Thursday (1.3901), which specifies volatility is the highest on Monday but lowest on Thursday. The return distributions all days found negatively skewed.

The return distributions are found to be leptokurtic in Monday, Tuesday, Wednesday and Friday, the value being highest for Monday (11.2428).

D. The day of the week effect in BSE 500

BSE-500 index indicates nearly 85% of the total market capitalisation on the Bombay Stock Exchange. Results of intra week seasonality pattern for the BSE 500 have been given in the Table IV.

Table IV: BSE 500 - Day of the Week Effect

| Particulars | Mon | Tue | Wed | Thus | Fri |
|--------------------|-------------|-----------------|-----------------|-----------------|-----------------|
| Mean | 0.045 1 | 0.007 7 | 0.105 9 | 0.007 4 | 0.027 4 |
| Standard Deviation | 1.760 7 | 1.431 6 | 1.392 | 1.369 8 | 1.609 4 |
| Kurtosis | 10.79 06 | 4.523 3 | 3.326 3 | 3.049 2 | 5.988 |
| Skewness | - 0.532 | - 0.424 7 | - 0.128 9 | - 0.511 2 | - 0.911 6 |

Source: Results obtained from SPSS package for statistical analysis

It depicted from the Table IV that mean return for Thursday is the lowest (0.0074), though the mean return of Wednesday recorded highest (0.1059). Standard deviation as a measure of volatility is found to be the highest (1.7607) on Monday, whereas lowest on Thursday (1.3698). The return distributions are negatively skewed in all the days. The Friday return distribution is more negatively skewed, and that for the Wednesday is the least skewed. Return distributions are found to be leptokurtic in all the days, the value being highest for Monday (10.7906).

Table V: Comparative Study of the Indices for Day of the Week Effect

| INDICES | Minimum Returns | Maximum Returns | Minimum S.D | Maximum S.D |
|---------|-----------------|-----------------|-------------|-------------|
| SENSEX | Monday | Wednesday | Thursday | Monday |
| BSE 100 | Thursday | Wednesday | Thursday | Monday |
| BSE 200 | Thursday | Wednesday | Thursday | Monday |
| BSE 500 | Thursday | Wednesday | Thursday | Monday |

Source: Results obtained from SPSS package for statistical analysis

The results presented in the Table V highlighted that, all four Indices have same results about the minimum along with maximum returns. Consequently the seasonality pattern exists between the days in a week. It has found that Wednesday exhibits the uppermost mean return, and Tuesday has lowermost mean return. The risk on investment is the highest on Monday in all Indices. But investment on Thursday involved lowest risk. Thus, it specifies the volatility is highest on Monday.

VII. ANALYSIS THROUGH GARCH MODEL

The most extensively used requirement is the GARCH model familiarized by Bollerslev (1986). This model is conditionally heteroskedastic but have a constant unconditional variance [7].

E. The day of the week effect in Sensex

The day of the week pattern of the Sensex through GARCH model results have analysed in the Table VI.

Table VI: Evaluation of the Day of the Week Effect through GARCH Model in BSE Sensex

| Particulars | Monday | Tuesday | Wednesday | Thursday | Friday |
|-------------|-----------|----------|-----------|----------|-----------|
| Omega | 0.1156 | 0.1286 | 0.0238 | 0.3563 | 2.3440 |
| Alpha_1 | 0.8045 | 0.7482 | 0.8788 | 0.5825 | 0.0005 |
| beta_1 | 0.1729 | 0.2141 | 0.1167 | 0.2382 | 0.5459 |
| Jarque Bera | 5432.4432 | 675.5776 | 343.4666 | 225.4245 | 1095.9694 |
| Ljung-Box | 0.2907 | 0.5732 | 0.1130 | 0.4900 | 0.2088 |
| P value | 0.0003 | 0.0000 | 0.0127 | 0.0000 | 0.0000 |

Source: Results obtained from SPSS package for GARCH model

Table VI indicates the value of omega, alpha, beta, Jarque Bera, Ljung-box and p-value. The value of beta indicates that Friday, shows the highest (0.5459) followed by Thursday (0.2382). And the volatility is the least in Wednesday (0.1167) in Sensex. The sum of α_1 and β_1 represents the persistence of volatility. Here the sum of α_1 and β_1 is less than 1, which shows the presence of mean reversion for all the days. Here the calculated P value is less than .01. As the difference in returns among different days

of the week in Sensex is significant at 1% level, consequently the null hypothesis is rejected, so alternative hypothesis will be accepted.

F. The day of the week effect in BSE-100

The result of intra-week seasonality pattern for the BSE 100 has been shown in the Table VII.

Table VII: Evaluation of the Day of the Week Effect through GARCH Model in BSE-100

| Particulars | Monday | Tuesday | Wednesday | Thursday | Friday |
|-------------|-----------|----------|-----------|----------|-----------|
| Omega | 1.7864 | 0.1142 | 0.0498 | 0.3567 | 2.4740 |
| Alpha_1 | 0.2840 | 0.7787 | 0.7684 | 0.5784 | 0.0002 |
| beta_1 | 0.3087 | 0.1849 | 0.2282 | 0.2537 | 0.1757 |
| Jarque Bera | 4071.8159 | 752.8948 | 359.5865 | 295.1792 | 1054.9251 |
| Ljung-Box | 0.3821 | 0.1173 | 1.1075 | 0.8835 | 11.3573 |
| P value | 0.0000 | 0.0000 | 0.0006 | 0.0000 | 0.0000 |

Source: Results obtained from SPSS package for GARCH model

Table VII highlighted the value of omega, alpha, beta, Jarque Bera, Ljung-box and p-value. The value of beta indicates that on Monday the volatility is highest (0.3087) and least in Friday (0.1757) in BSE-100. The sum of α_1 and β_1 represents the persistence of volatility. Here the sum of α_1 and β_1 is less than 1, which shows the presence of mean reversion for all the days. Conferring to the P value, there is

significant difference among different days of the week in BSE-100.

G. The day of the week effect in BSE-200

The results of intra-week seasonality pattern for the BSE 200 has been depicted in the Table VIII

Table VIII: Evaluation of the Day of the Week Effect through GARCH Model in BSE-200

| Particulars | Monday | Tuesday | Wednesday | Thursday | Friday |
|-------------|-----------|----------|-----------|----------|-----------|
| Omega | 0.0947 | 0.1155 | 0.0231 | 0.3617 | 2.3660 |
| Alpha_1 | 0.8270 | 0.7716 | 0.8916 | 0.5676 | 0.0000 |
| beta_1 | 0.1640 | 0.1941 | 0.1039 | 0.2563 | 0.1869 |
| Jarque Bera | 4418.9814 | 721.2505 | 376.8777 | 313.4786 | 1283.5448 |
| Ljung-Box | 0.5018 | 0.3467 | 0.2046 | 0.9455 | 5.5717 |
| P value | 0.0003 | 0.0000 | 0.0034 | 0.0000 | 0.0000 |

Source: Results obtained from SPSS package for GARCH model

Table VIII shows the value of omega, alpha, beta, Jarque Bera, Ljung-box and p-value. The value of beta indicates that the volatility is the highest on Thursday (0.2563) and lowest on Wednesday (0.1039) in BSE-200. The sum of α_1 and β_1 represents the persistence of volatility. Here the sum of α_1 and β_1 is less than 1, which shows the presence of mean reversion for all the days. Here the calculated P value is less than .01. Therefore, the differences in returns value

among different days of the week in BSE-200 is significant at the 1% level, hence the null hypothesis is rejected, which suggests the evidence in the favour of the day of the week effect.

H. The day of the week effect in BSE-500

The empirical results of intra-week seasonality pattern for the BSE 500 are shown in the Table IX.

Table IX: Evaluation of the Day of the Week Effect through GARCH Model in BSE-500

| Particulars | Monday | Tuesday | Wednesday | Thursday | Friday |
|-------------|-----------|----------|-----------|----------|-----------|
| Omega | 0.5844 | 1.7855 | 0.0077 | 0.3555 | 2.2927 |
| Alpha_1 | 0.5523 | 0.0000 | 0.8319 | 0.5760 | 0.0000 |
| beta_1 | 0.1951 | 0.5149 | 0.2072 | 0.2437 | 0.5422 |
| Jarque Bera | 4085.5951 | 737.6010 | 386.1085 | 357.7990 | 1338.3410 |
| Ljung-Box | 0.5558 | 1.9160 | 1.8293 | 0.9288 | 0.0207 |
| P value | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Source: Results obtained from SPSS package for GARCH model

Table IX indicates the value of omega, alpha, beta, Jarque Bera, Ljung-box and p-value. The value of beta indicates that in Friday the volatility is highest (0.5422) and lowest (0.1951) in Monday in BSE-500. The sum of α_1 and β_1 represents the persistence of volatility. Here the sum of α_1 and β_1 is less than 1, which shows the presence of mean reversion for all the days. As the calculated P value is less than .01, hence the null hypothesis is rejected. This reflects that the day of the week effect is existed in BSE- 500.

VIII. CONCLUSION

This paper examines the day-of-the-week effect on returns and volatility of the Indian stock markets mainly evidence from Bombay Stock Market. In this study it has examined that the day of the week effect for four indices viz. Bombay Sensitivity Index (Sensex), the BSE 100, the BSE 200 and the BSE 500 over the period of January 2000 to December 2018. It has found that all the four Indices have same results regarding the minimum as well as maximum returns. Wednesday displays the maximum return, and Tuesday has the lowest return. The standard deviation is highest on Monday in all Indices. But Tuesday as well as Thursday has recorded the lowest standard deviation. Consequently, it reveals the volatility is higher on Monday. The P value infers the rejection of null hypothesis of equal mean returns at 1% level of significance for the Sensex, the BSE 100, the BSE 200, and the BSE 500. Accordingly, the seasonality pattern occurs between the days in a week. Rendering to the conclusions of GARCH (1,1) Model finds that returns on Mondays recorded lower and returns Fridays recorded higher than the other days of the week for all the sample

indices. Conferring to the results, the coefficients express that the returns among different days of the week are statistically significant for all the sample indices. This findings of this research will help to the different retail investors and institutional investors.

IX. FUTURE SCOPE

It is clearly identified in the literature review; there are very few works that have been conducted till date in anomalies especially with respect to sectoral indices and, also by collecting the primary data.

Therefore, there are a range of potential areas where further research can be done in the Indian as well as global context.

- The anomalies can also be studied by collecting the primary data from different retail investors and institutional investors on Day of the Week effect anomalies. This would provide additional understanding of different aspect of anomalies over the period, which will help in framing trading strategies.
- It would have been interesting, if the study could have been conducted by considering different sectoral indices of several developed and developing countries during different time periods.
- It would be very interesting to conduct another study within the same area of research, with the help of different country indices, which will give more integrated result to the topic and better utility to the investors and corporate sector.

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