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EFFICIENCY OF INDIAN STOCK MARKET : A CASE OF DAY OF THE WEEK EFFECT

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Abstract

The purpose of this study is to test the informational efficiency of Indian securities market with respect to a widely reported market anomaly, i.e., Day of the Week Effect or Weekend Effect. According to the Efficient Market Hypothesis, securities price move randomly and hence there exists no systematic pattern of share price movements. However, during the last two decades, financial researchers discovered that some sort of systematic patterns of stock price movement exist in the stock market. It implies that if an investor is able to find out these patterns in the stock market, he can formulate trading strategies and can make abnormal returns and thereby challenge the validity of EMH. The results of this study shows that day of the week effect exists in the Indian stock market, which affect both the stock returns and volatility, thereby proving that Indian stock market is inefficient.

Introduction

An efficient stock market must ensure rapid information access so that it can instantaneously process the information which would be reflected on security prices. This information transmission mechanism ensures that stock returns across all days of the week are equal and no market participant can earn any abnormal profits. Hence, identical mean returns across all days of the week supports the proposition of the efficient market hypothesis. The stock returns behavior was subject to extensive research in the past and the financial researchers had observed that stock returns are not identical across the time period. They had pointed out that stock returns vary across time periods. More specifically, researchers have found that Monday returns is significantly negative and Fridays experiences a high positive returns. This observation is generally referred to as the day-of-the-week effect or the 'week effect.' In essence, the stock returns across all days of the week widely differ, thus suggesting wide variations in stock returns. The absence of identical mean returns across all days of the week can be attributed to asymmetrical information arrival on each day-of-the-week, announcement of bad news on weekends, settlement effect, timing of earning announcements, measurement error, specialist-related bias, trading pattern of individual investors and institutional investors' behaviour etc. Though various studies have largely accounted for all possible factors responsible for week-end-effect, they differ widely in their findings. Hence, it is difficult to give any specific factor(s) responsible for the week-end effect. In addition, the operational market structure mechanism of a stock exchange in a particular country differs widely from the operational market structure of another country. Thus if an investor has the ability to compound the price swings in earning extra normal returns, he counters the principle of market efficiency. In addition, any systematic pattern of price changes across days of the week may also suggest some trading strategy to earn abnormal returns.

Previous Studies

The studies on the behavior of stock returns to find out the day of the week effect by using different methodologies have grown substantially over the years. French (1980), and Gibbons and Hess (1981) documented weekend effect with a low or negative returns on Mondays in the US stock market. Rogalski

(1984). Damodaran (1989) Dyl and Holland (1990),Abraham and Ikenberry (1994) Geo and Kling (2005) also reported similar results.

In the Indian stock market, there are a few studies on the day of the week effect. Choudhury (1991), Broca (1992), Poshakwale (1996), Arumugam (1998), Anshuman and Goswami (1999), Sarma (2004) and Nath and Dalvi (2004) confirm the presence of day of the week effect/weekend effect in the Indian stock market. All these studies relate to the period varying between 1980s and 1990s. Further ,most of these studies used the closing index values in the returns generating process with an implied assumption that trading is done at the closing values. However none of these studies tested the impact of day of the week effect on stock market volatility.

It is against this back ground that the present study tries to investigate day of the week effect in stock market volatility by examining the SENSEX, BSE 200 and NIFTY during the period from January 1, 1997 to June 30, 2005. The rest of the article has been organized as follows: section two presents the methodology and hypothesis, section three discusses empirical results, and section four gives the concluding remarks.

Methodology and Hypothesis

Methodology

The study has used the PROWESS database information regarding the daily opening, high, low and close values of the SENSEX, BSE 200 and Nifty indices. The study covers a period of eight and a half years spanning from January 1st 1997 to June 30th 2005 comprising a total of 2139 observations for each of the indices.

Ideally, individual stock prices should be used for such an analysis, since the index data suffer from inherent limitations in the shape of non-synchronous trading and omission of dividends. These may lead to statistical problems such as understatement of returns, autocorrelation and distortions in estimated variances. However, French et. al., (1987) had shown that the results are broadly similar when the daily values of the S&P CNX 500 index as well as 30 actively traded shares on the NYSE are taken.

The earlier studies had used the closing values for returns generating process with an implied assumption of trading being done at the closing values. However, there would not be any need for such a restrictive trading assumption in case an average of the available opening, high, low and closing values are used. The continuously compounded annual rate of returns is a well accepted approach to measuring the daily returns. The natural log of daily relative mean index value is, thus, the measure of daily returns used in this study. The formula is stated below:

$$R_t = In\left(\frac{I_t}{I_{t-1}}\right)$$

Where,

R_t = returns on day 't'

I_t = index mean value on day 't'

I_{t-1} = index mean value on day 't-1'

In = natural log

The returns so generated are classified day-wise - from Monday to Friday- and their equalities and volatilities are measured.

For testing whether mean returns are constant across all five days of the week or whether they exhibit statistically significant differences, a non-parametric test method has been employed. This is because of their robustness arising from lack of restrictive assumptions such as population normality and homeostatic variances. Thus, the usual one-way analysis of variance is replaced by its non-parametric alternative, the Kruskal-Wallis test. The relevant test statistic is

$$H = \left[\frac{12}{N(N+1)} \sum_{j=1}^{5} \frac{R_j^2}{n_{ji}} \right] - 3(N+1)$$

Where

R_j = sum of the ranks in the j^{th} column

n_i = number of cases in the jth column

N = sum of observations in all the columns.

For testing whether volatility in stock returns is equal across all five days of the week or does it exhibit statistically significant difference, Modified Levene's test is employed. When the distribution is not normally distributed, Levene test is extremely useful for testing the equality of the variance of daily returns across five days of the week. The formula is as follows.

$$\frac{\left(\sum_{i=1}^{1} n_i (D_j - D..)^2 \right)}{\left(\sum_{i=1}^{i} \sum_{i=1}^{n_i} (D_{ij} - D_j)^2 \right)} \left(\frac{(N-j)}{(j-1)} \right) D_{ij} \left(R_{ij} - M_i \right)$$

R_{ij} = the returns for week 'i' and weekday I for j = 1 to 5,

M_i = the sample median returns for weekday 'j' computed over n_j weeks

$D_j = \sum_{j=1}^{n_i} \frac{D_{ij}}{n_j}$, which is the mean absolute deviation (from median) for weekday 'j'; and

$D = \sum_{i=1}^{i} \sum_{i=1}^{n_j} \frac{D_{ij}}{N}$, which is the grand mean of absolute deviation from median and N is the total number of weekdays.

Hypothesis

The hypotheses formed to study the day of the week effect are:

H_0 : There are no differences in the average returns on stock indices across the days of the week.

H_0 : There are no differences in the volatility of stock indices across the days of the week.

Analysis and Discussion

1) Testing for statistical significance: Equality of Returns

Table 1, 2, and 3 present the descriptive statistics of the day of the week returns for the three selected indices along with that of the comprehensive sample for-'all days',- in addition to the computed 'H' statistics.

It is clear from Table 1, 2 and 3 that the daily mean returns are zero or almost zero for all the portfolios-SENSEX, BSE 200 and Nifty, during the study period. The distribution of daily returns tends to be leptokurtic with long tails and many mean centric observations. All the indices give negative returns on Fridays and all the values of the days descriptive statistics very closely coincides sending strong evidence as to the weekend effect. The standard deviation of the portfolio increased with the degree of diversification. i.e, highest standard deviation for BSE 200 and lowest for Sensex. This is neither surprising nor contrary to the expectations. The portfolio construction is neither random nor based on Markowitz selectivity criterion. Standard deviation of all the indices returns is highest for Mondays. Further, it also reveals that Mondays' standard deviation of SENSEX, BSE 200 and Nifty are more than their respective average of 'all days' standard deviation during the study period. For all the indices, Wednesday registered the highest positive returns. For SENSEX and BSE 200, Thursday and Friday registered negative returns while for Nifty Friday showed negative returns. However, for SENSEX, Nifty and BSE 200 Friday showed the lowest returns. All the indices appear to be most attractive on Mondays

from the view point of mean returns and standard deviations. Considering the Kurtosis and the range figures, SENSEX relatively shows some semblance of normality. Wide variations are observed across the weekdays within and among the indices.

To test whether the differences in the mean returns across the weekdays are statistically significant, 'H' statistic is computed. The critical value of 'H' is abnormally higher than the critical value of all the indices. Thus, the null hypothesis is rejected. This provides evidence to the presence of regularity in common stock returns in India during the study period.

Pattern of Deviation

By employing multiple comparison procedure, it is possible to find out which pair shows significant deviation from one another and uncover the general pattern of high low tendencies in the data. For a given overall level of significance level of ¤ decide τ_{μ}, ×$_{v,}$ if

$$\left|R_{\mu} - R_{v}\right| \geq Z\left(\alpha / K(K-1)\right)^{\left(N(N+1)/12\right)^{1/2}} \left[\frac{1}{n_{\mu}} + \frac{1}{n_{v}}\right]^{1/2}$$

Where :

μ = 1, 2.. .K-1

ν = μ+1... .K

K = 5

N = total number of daily returns

n = number of daily means in the μ^{th} and v^{th} column

R = average rank sum of the μ^{th} and i^{th} column

$Z\left(\alpha / K(K-1)\right)$ = the upper percentage point of the unit normal distribution for a given significance level whose value for 99 percent confidence level is 2.575.

The required calculations are presented in the table 4 and 5

The Table 5 shows that Monday-Tuesday, Monday-Friday and Wednesday-Friday sets have positive deviations for all the indices. However, Monday-Friday sets for all the indices have the highest positive deviation. Tuesday-Wednesday-sets also have positive deviations although very low, for all the indices. Thus, in general, Indian stock market exhibits regularities in the equity returns and have scope for questioning its market efficiency.

Testing for statistical significance : Homeoskedasticity

Whether volatility in stock returns is equal across all five days of the week or does it exhibit statistically significant differences is tested with the help of Modified Levene test. This statistic is distributed as F-statistic with (j-j, N-j) degrees of freedom. The computed value of Levene test statistics for SENSEX, BSE 200 and Nifty is presented in Table 4.6.

At 4 degrees of freedom, the critical values are 1.94 at 10 per cent, 2.37 at five percent and 3.32 at one per cent level of significance. Comparing the computed values of the test statistics, 5.1 (for Sensex), 5.21 (for Nifty) and 4.91 (for BSE 200), with the critical values, the hypothesis of homeoskedasticity is rejected. This means that there is significant difference in volatility pattern across days of the week. This means that for SENSEX, BSE 200 and Nifty, there is day of the week effect in the volatility of daily returns, volatility being highest at the beginning of the week (Monday) and lowest at the end of the week (Friday).

Implication for Market Efficiency

Through pair-wise multiple comparison procedure, it is observed that Monday-Tuesday, Monday-Friday, and Wednesday-Friday have positive deviations for all the indices. These observations must consequently lead us to

designing a trading strategy exploiting the possibility of making abnormal returns. A comparison of annual rates of returns generated by a passive strategy of 'by and hold' and various active strategies of 'buying Monday and selling Thursday' or 'buying Monday and selling Friday' or 'buying Wednesday and selling Friday' is presented in Table 6. For all the indices, mean returns of the active strategies turned out to be lower than the 'buy and hold' strategy for the study period. If transaction cost is taken into account, this would further reduce, even wipe out the profit the investor could have earned through the active strategy mentioned above. The active strategy is of little use because the study period is characterized by a highly volatile economic environment and the fact that the indices underwent frequent shuffling and reshuffling unconnected to the principles of diversification. Broca (1992) also found the returns resulting from pursuing a trading strategy based on the observed regularity of returns being less than a naive 'buy and hold strategy' in spite of his strong evidence as to the Wednesday having the lowest returns and Fridays the highest. However this does not mean that knowledge of persistent stock market behaviour pattern on week days have no value whatsoever. An individual can increase the expected return to his investment by altering the timing of routinely scheduled transactions.

Conclusion

In this study, an attempt has being made to analyse the presence of day of the week effect in stock returns and volatility. Using the log returns data on SENSEX BSE 200 and Nifty for a period from January 1st 1997 to June 30th 2005, comprising a total of 2139 observations for each of the indices, the analysis provides evidence as to the presence of day of the week effect in stock returns and volatility. It confirms the evidence of earlier studies i.e., the leptokurtic distribution of equity returns, presence of highest variation on Monday (weekend effect) and regularities of returns across the indices. An examination of daily returns of these indices during this period shows evidence of significant variation according to the day of the week. This contradicts the random walk hypothesis as a descriptive model for common stock price movements in India. Wednesdays showing consistently highest returns and Fridays showing consistently negative returns for all the indices evidences the regularity of returns. Through a pair wise comparison procedure, it is found that Monday-Tuesday, Monday-Friday and Wednesday-Friday have highest positive deviations for all the indices. But a simple trading strategy designed to exploit these empirical regularities could not outperform a naïve 'buy and hold' policy over the study period. A benefit, however, accruing to investors from knowledge of the variations is that by altering the timing of routinely scheduled transactions, they could increase the expected returns to investments.

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Table 1
BSE SENSEX Day-wise Summary Statistics on Daily Returns

	Monday	Tuesday	Wednesday	Thursday	Friday	All Days
Mean	0.0002	-0.0005	0.0011	0.0003	-0.0007	0.00008
Median	0.0009	0.0000	0.0008	0.0005	-0.0002	0.00048
Standard Deviation	0.0909	0.00917	0.00778	0.00566	0.00609	0.02392
Skewness	-3.310	-2.192	5.897	-0.325	-0.227	-0.0314
Kurtosis	26.166	74.584	78.330	2.988	1.997	36.813
Range	0.12	0.20	0.13	0.05	0.005	0.11
Number of Observations	429	428	429	428	425	2139
'H' value					27.8407	

Table 2
BSE 200 Day-wise Summary Statistics on Daily Returns

	Monday	Tuesday	Wednesday	Thursday	Friday	All Days
Mean	0.0005	-0.0002	0.0008	0.0003	-0.0004	0.0002
Median	0.0016	0.0000	0.0007	0.0007	0.0002	0.0006
Standard Deviation	0.00993	0.00834	0.00597	0.00570	0.00613	0.0072
Skewness	-5.251	7.771	0.107	-0.484	-0.339	0.5544
Kurtosis	61.064	125.849	3.536	2.784	1.738	38.9942
Range	0.016	0.016	0.06	0.05	0.05	0.096
Number of Observations	429	428	429	428	425	2139
'H' value					33.2423	

Table 3
S&P CNX Nifty Day-Wise Summary Statistics on Daily Returns

	Monday	Tuesday	Wednesday	Thursday	Friday	All Days
Mean	0.0011	0.0007	0.0032	0.0012	-0.0001	0.0012
Median	-0.0001	-0.0001	0.0012	0.0008	0.0004	0.0004
Standard Deviation	0.03093	0.00534	0.03596	0.03636	0.00557	0.02283
Skewness	19.238	-0.611	20.089	-20.089	-0.279	3.656
Kurtosis	388.796	2.348	409.632	411.513	1.188	242.695
Range	0.68	0.05	0.76	0.76	0.04	0.428
Number of Observations	429	428	429	428	425	21.39
'H' value					17.3631	

Table 4
Actual and Expected Multiple Comparison Values

	$\lvert R_\mu - R_v \rvert$			$Z\left(\frac{\alpha}{K(K-1)}\right)\left(\frac{N(N+1)}{12}\right)^{1/2}\left[\frac{1}{n_\mu}+\frac{1}{n_v}\right]^{1/2}$			
	SENSEX	BSE 200	NIFTY	Z	$\left(\frac{\alpha}{K(K-1)}\right)$	$\left(\frac{N(N+1)}{12}\right)^{1/2}$	$\left[\frac{1}{n_\mu}+\frac{1}{n_v}\right]^{1/2}$
Monday-Tuesday	113.664	110.961	98.263	2.575	507.662	0.08892	96.817
Monday-Wednesday	7.267	6.274	4.336	2.575	507.662	0.08892	96.389
Monday-Thursday	19.773	37.221	32.221	2.575	507.662	0.08892	96.719
Monday-Friday	120.831	144.269	137.669	2.575	507.662	0.08815	97.293
Tuesday-Wednesday	109.296	105.266	108.26	2.575	507.662	0.08832	97.289
Tuesday-Thursday	98.263	99.226	86.261	2.575	507.662	0.08871	96.271
Tuesday-Friday	8.412	44.26	20.226	2.575	507.662	0.08819	97.289
Wednesday-Thursday	19.263	39.591	16.226	2.575	507.662	0.08839	96.279
Wednesday-Friday	123.229	143.932	101.226	2.575	507.662	0.08879	97.881
Thursday-Friday	102.669	110.667	61.226	2.575	507.662	0.00891	96.718

Table 5
Deviation of Actual From Expected Average Risk Difference

	SENSEX	BSE 200	NIFTY
Monday-Friday	16.847	14.144	1.446
Monday-Wednesday	-89.122	-90.115	-92.052
Monday-Thursday	-77.006	-59.498	-64.498
Monday-Friday	23.538	46.971	40.376
Tuesday-Wednesday	12.007	7.977	10.971
Tuesday-Thursday	1.992	2.955	-10.01
Tuesday-Friday	-88.877	-53.029	-77.063
Wednesday-Thursday	-77.016	-56.688	-80.053
Wednesday-Friday	16.382	46.051	25..348
Thursday-Friday	5.951	13.949	-35.492

Table 6
Trading Strategy Annual Returns Generated

	SENSEX	BSE 200	Nifty
Monday-Thursday	22.93	7.67	31.77
Monday-Friday	20.63	9.49	29.92
Wednesday-Friday	27.91	11.73	35.27
Buy and hold	17.26	4.97	27.82

Table 7
Modified Levene's Test Values

Index	
BSE SENSEX	5.1
BSE 200	4.91
S&P CNX Nifty	5.21