Calendar Anomalies in Indian Stock Market

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Introduction

The Efficient Market Hypothesis (EMH) assumes that stock prices adjust rapidly to the arrival of new information, and thus, current prices fully reflect all available information. Fama (1970) formalized the theory, organized the empirical evidence, and divided the EMH into three subhypotheses depending on the information set involved. The weak-form EMH states that current stock prices fully reflect all historical market information such as: prices, trading volumes, and any market oriented information. The semistrong-form EMH asserts that prices fully reflect not only the historical information but also all public information including non-market information, such as earning and dividend announcements, economic and political news. Finally the strong-form EMH contends that stock prices reflect all information from historical, public, and private sources, so that no one investor can realize abnormal rate of return.

Till the late seventies, empirical studies bolstered the view that capital markets are informational efficient. Academician and researcher on the concept of informational efficiency of capital markets developed various theoretical security valuation models. However the late seventies and eighties produced the evidences questioning the validity and illuminated the various anomalies related to the capital market efficiency. These studies demonstrated the possible trading strategies, seasonal anomalies and persistence of technical analysis yielding abnormal returns using the historical data and publicly available information. Some of the studies have documented seasonal anomalies (weekend effect; where stocks exhibit significantly lower returns over the period between Friday's close and Monday's close, January effects; where returns are unusually high during the month of January as compared to any other month and Monthly effects) in stock returns across the globe (see for example Fama (1965), French (1980), Lakonishok and Levi (1982), Smirlock and Starks (1986), Lakonishok and Smidt (1988), Wang, Li and Erickson (1997), Kamara (1997), Mehdian and Perry (2001), Gultekin and Gultekin (1983), Kim (1989), Jaffe, Westerfield and Ma (1989), Solnik and Basquest (1990), Dubois and Louvet (1996) and Mehdian and Perry (1999)). The empirical evidences regarding calendar anomalies in Indian stock market were documented by Chaudhary (1991), the study reported negative and highest returns on Monday and Friday respectively during the period June 1988 to January 1990. Broca (1992) exhibited unequivocal evidence as to day-of-the-week effect in Indian equity market. Poshakwale (1996) found the positive mean returns for all the day except Monday and Wednesday by analyzing BSE National Index between January 1987 and October 1994. Arumugam (1998) examined the day-of-the-week effect using longer time horizon (1979 to 1997) through dummy variable regression model. The study reported that Friday returns were significantly positive during 1986 to 1997 while Monday returns were significantly negative in the bear phase. Panday (2002) reported the monthly effects in stock returns in India by using the Sensex monthly returns data from April 1991 to March 2002. Karmakar and Chakraborty (2004) conducted an exhaustive study of stock market anomalies by analysing the Economics Times index for the period of fifteen years (January 1981 to December 1985).

The study confirmed the presence of Friday effect, the monthly effect, the turn of the month effect and holiday effect in Indian stock markets.

Sharma (2004) tried to explore the presence of seasonality in Indian stock market returns during the post-liberalization period (1996 to 2002). The study provided evidence as to presence of seasonality across the days of week, presence of highest variance on Mondays, weekend effects and regularity of returns across the indices. Bodla and Jindal (2006) reported the prevalence of the turn of the month effect and semi monthly effects in Indian stock market by using the Nifty 50 index during the period 1998 to 2002. The evidence of equity market anomalies documented by above-mentioned studies contradicts the prediction of the efficient market hypothesis (EMH), at least in its weak form, because the predictable movements in asset prices provide investors with opportunities to generate abnormal returns. In addition, stock market anomalies may result from an inefficient flow of information in financial markets, which is a violation of an underlying assumption of the EMH. It would be pertinent to reexamine the conclusions drawn by the earlier

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studies by considering the post equity market reforms period (2002-2006). By 2001, reforms brought Indian stock markets up to par with the global standards for virtually every aspect of its equity market microstructure. The 'open outcry'system that restricted trading to the floors of stock exchanges in India's metropolises was replaced by screen-based, electronic order-book systems that instantaneously linked traders across the country through the world's first satellite trading system. Virtually all trading took place on a dematerialized basis through a central depository. The deeply flawed account period settlement system was replaced by a T+2 rolling settlement that is one of the most efficient systems in the world, and badla or carry-forward trading gave way to a rapidly developing derivatives market. As a consequence of these changes, the total value of transactions in securities has grown dramatically over the last ten years from Rs 1.7 billion in 1994–95 to Rs 50.8 billion in 2003–04. The market experienced the bull phase (2002-2006) due to above-mentioned fundamental reforms, changes in economic scenario in India, heavy flows from foreign institutional investors and growing participation of retail investors in equity market. This study is an endeavor to explore the Indian stock market's informational efficiency in its weak form in the context of calendar anomalies especially in respect of the day of week effect and month of year effect, keeping the above considerations in view. The study is organized in three sections as follows: Section II addresses the data and methodology; Section III discusses the empirical results and useful conclusions.

Data and Methodology

BSE Sensex, the leading indicator of the performance of Indian economy and stock market fluctuations in India comprising of 30 most liquid individual stocks is considered most appropriate for the study of stock market anomalies like this one. Nevertheless, we have used the BSE 100 index to check the regularity of stock returns. The Prowess database provides the information regarding the daily closing values of above-mentioned two indices for the period from January 1st 1996 to December 31st 2006 comprising a total 2721 observations for each of two indices. The data for this whole period is divided into two sub-periods: the pre-reform period, January 1996 to December 2001 and the post-reform period, January 2002 to December 2006. This bifurcation of study period provides an opportunity to investigate the seasonality during post-reform period in Indian stock market which experienced the upswings due to growing economic growth rate, wider participation of foreign institutional investors and retail investors in the market. The continuously compounded annual rate of return is a well-accepted approach for measuring daily returns. The natural log of daily index value is the measure of daily return used for this study. Following is the formula.

$$R_t = ln\left[\frac{I_t}{I_{t-1}}\right]$$

Where in:

I_t is index value at end of period t.
I_{t-1} is index value at end of previous period t-1.
ln is natural log.

The study attempts to uncover the possible presence of calendar anomalies in the Indian stock market using the daily returns on BSE indices. The present study intends to test the following null hypotheses regarding day-of-the-week effect, month-of-the-year effect and turn of the month effect:

H_{01} Mean daily returns across all the five days are equal.
H_{02} Mean returns of all the months of year do not exhibit statistically significant differences.

In the seasonality literature, it appears that the researcher tends to perform parametric test on any data set without first checking the data's distributional properties which makes the testing results highly suspicious. In order to generate evidences on soundness of methodology to test the seasonality, the present study used both parametric and nonparametric approach to test the hypotheses. In the parametric approach, One-way analysis of variance (ANOVA) has been used. Analysis of variance is used to test the hypothesis that several means are equal. The formula for calculating the analysis of variance statistics F is as under:

$$F = \frac{MS - between - sample}{MS - within - sample}$$

$MS - between - sample$ = Mean square deviation between observations

$MS - within - sample$ = Mean square deviation within observations

The Kruskall-Wallis, a nonparametric test has also been used to test the equality of several means. The formula for calculating the Kruskall-Wallis test statistics H is as under:

$$H = \left[\frac{12}{N(N+1)} x \sum \frac{R_j^2}{n} \right] - 3(N+1)$$

R_j = sum of the ranks in the jth column

n = number of cases in the jth column

N = sum of the observation in all the columns

Empirical Results and Discussions

Day of the Week Effect

One of the empirical findings reported in efficiency literature is that sample distribution of daily common stock returns varies by day-of-the-week. To investigate the day-of-the-week effect, the study has measured the average returns for various days-of-the-weeks for different periods. Table 1 exhibit the summary statistics of days of the week returns during the whole study period and the two sub- periods for the two indices, in addition it also assimilates the F- statistics and H- statistics. The results for the whole period indicate that except Friday, the mean returns were positive for all the days in case of BSE Sensex. The average return for the Tuesday was lowest whereas Wednesday had highest and statistically significant return (Table 1 a, and Figure 1 a). In case of BSE 100, all the days of the week demonstrated positive returns except the Tuesday. Similar to BSE Sensex, the average return on Wednesday was the significant highest. To test whether the differences in mean returns across the weekdays are statistically significant, the study incorporated both parametric (ANOVA) and non-parametric (Kruskall-Wallis test) approach. As it can be noted form the Table 1 (a) that F- statistics for BSE Sensex (1.31049) and BSE 100 (0.32531) could not provide credence to reject the hypothesis of the equality of mean return for days of weeks during the whole study period. The H- statistics for the two indices could also not produce evidences in the favour of alternative hypothesis that there are significant differences in mean returns of weekdays. The summary statistics presented in Table 1 (b) for first sub-period (1996-2001) revealed that Friday mean returns were negative for both the indices and even statistically significant for BSE Sensex. It is curious to note that mean returns on Wednesday for the indices were highest. It is worthy to note that the non-parametric approach H-statistics for BSE Sensex (16.857) and BSE 100 (14.125) rejected the null hypothesis of equality of mean returns across the days of the week while the parametric approach F-statistics rejected the null hypothesis only in case of BSE Sensex. The summary statistics documented in Table 1 (c) for the second sub-period (2002-2006) exhibited that the both the indices yielded highest and significant mean returns on Friday and lowest mean returns on Monday. Interestingly, both the indices produced positive returns for all the days of week during the second sub-period. Both the F-statistics and H- statistics could not reject the null hypothesis of equality of mean returns across days of the week. On the whole, both parametric and non-parametric tests have not documented any seasonality regarding the days of the week in Indian bourses during the whole study period. However during the first period (1996-2001) the study demonstrated the instances of significant difference in daily common stock's return.

Month of the Year Effect

The January effect is another pervasive and well-documented anomaly in the stock markets. Numerous studies have validated that the average return on January has been unusually high and this phenomenon is referred to as January effect. The present study investigated the monthly seasonal pattern by using the monthly average return. Table 2 presents the summary statistics of month of the year returns during the whole study.

Table : 1 Summary Statistics of BSE Sensex and BSE 100 Returns for Day of the Week

(a) Year 1996-2006

BSE Sensex	Monday	Tuesday	Wednesday	Thursday	Friday	BSE 100	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	0.00092	0.00036	0.00145*	0.00042	-0.00069	Mean	0.00043	-0.00016	0.00137*	0.00066	0.00029
SD	0.01856	0.01507	0.01516	0.01560	0.01620	SD	0.03234	0.01584	0.01567	0.01547	0.02930
t-statistics	1.15536	0.55206	2.23621	0.63156	-0.98193	t-statistics	0.31220	-0.23044	2.03677	0.99673	0.22709
Observations	543	547	546	549	536	Observations	543	547	546	549	536
F-statistics	1.31049	H-statistics	5.384			F-statistics	0.32531	H-statistics	6.185		
Df (v1,v2)	4,2716	Df	4			Df (v1,v2)	4,2716	Df	4		
Significance	0.26365					Significance	0.86113				

(b) Year 1996-2001

BSE Sensex	Monday	Tuesday	Wednesday	Thursday	Friday	BSE 100	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	0.00146	0.00005	0.00170	0.00003	- 0.00352**	Mean	0.00044	-0.00082	0.00147	0.00049	-0.00178
SD	0.02097	0.01583	0.01816	0.01711	0.01754	SD	0.04159	0.01842	0.01784	0.01685	0.03773
t-statistics	1.19062	0.05292	1.60997	0.03019	-3.39657	t-statistics	0.18203	-0.76394	1.41901	0.50605	-0.79700
Observations	293	296	297	297	286	Observations	293	296	297	297	286
F-statistics	3.87790	H-statistics	16.857			F-statistics	0.57614	H-statistics	14.125		
df(v1, v2)	4,1464	Df	4			df(v1, v2)	4,1464	Df	4		
Significance	0.00386					Significance	0.67997				

(c) Year 2002-2006

BSE Sensex	Monday	Tuesday	Wednesday	Thursday	Friday	BSE 100	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	0.00029	0.00072	0.00116	0.00088	0.00256**	Mean	0.00042	0.00062	0.00124	0.00085	0.00265**
SD	0.01528	0.01292	0.01111	0.01364	0.01386	SD	0.01577	0.01319	0.01165	0.01386	0.01432
t-statistics	0.29945	0.88034	1.64454	1.02576	2.91516	t-statistics	0.42397	0.74554	1.68354	0.98450	2.92666
Observations	250	253	249	250	250	Observations	250	253	249	250	250
F-statistics	1.03035	H-statistics	3.673			F-statistics	1.04015	H-statistics	4.568		
df(v1, v2)	4,1247	Df	4			df(v1, v2)	4,1247	Df	4		
Significance	0.39027					Significance	0.38516				

(1) SD = Standard Deviation. (2) F-statistics is based on one-way ANOVA and H-statistics is based on Kruskall-Wallis test. (3) Df = degree of freedom, v1 = between sample, v2 = within sample. (4) * Significant at 5 % level, ** Significant at 1% level. (5) Critical value of H- statistics at 1 % and 5 % level of significance are 13.277 and 9.488 respectively.

Figure:1(a) BSESensex and BSE100 Returns for the Days of the Week (1996-2006)

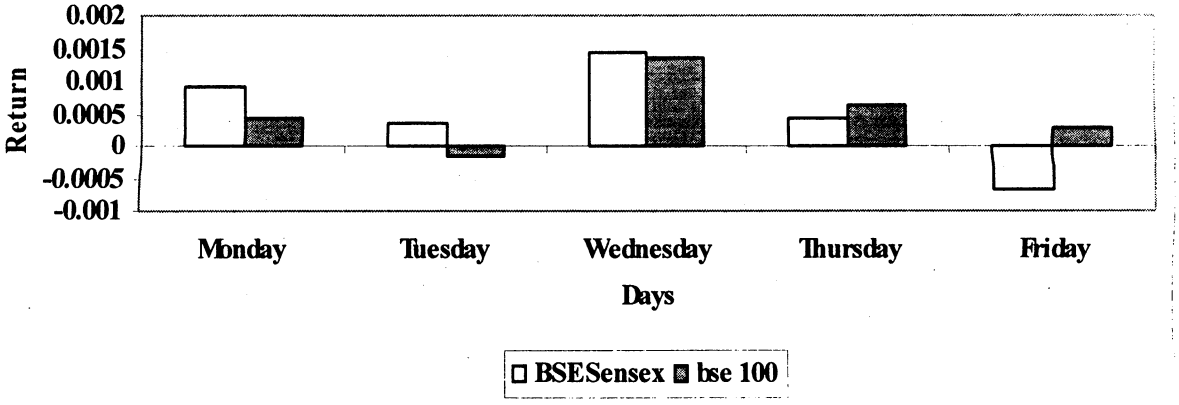


Figure:1(b) BSESensex and BSE100 Returns for the Days of the Week (1996-2001)

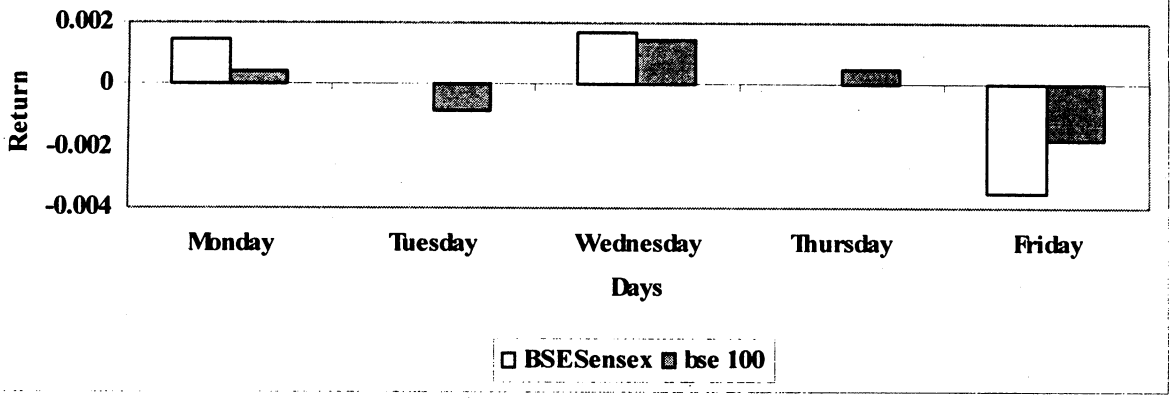
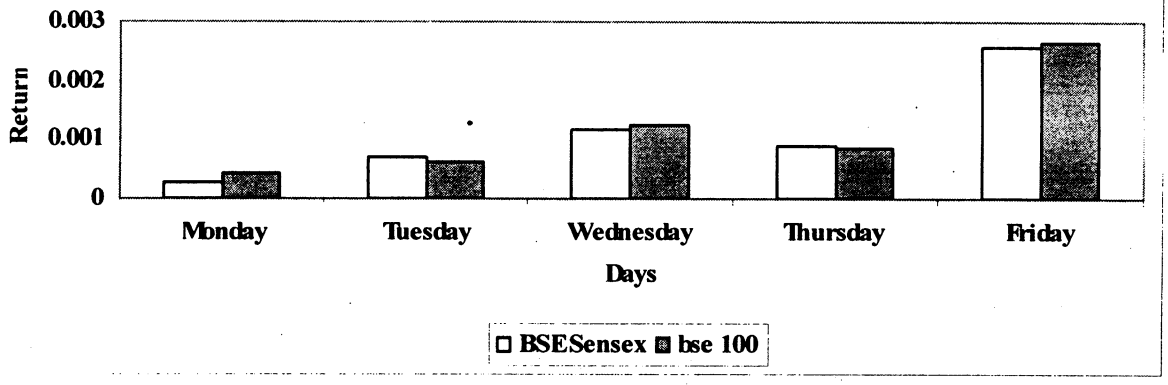


Figure:1(c) BSESensex and BSE100 Returns for the Days of the Week (2002-2006)



period and the two study periods for the two indices; in addition it also contains the F- statistics and H-statistics. The results for the whole period indicate that in case of BSE Sensex, the return for the February, December and November were significantly positive while mean returns for all the months tend to zero (Table 2 (a), and Figure 2 (a). Among the three months, return for February was the highest, followed by December and November. The similar results were noted for BSE 100 index where the return for December was highest among the three months. To test whether the differences in mean returns across the months are statistically significant, the study applied both parametric (ANOVA) and non-parametric (Kruskall-Wallis test) approach. As it can be noted form the Table 2 (a) that F- statistics for BSE Sensex (1.4085) and BSE 100 (0.78048) were not significant at 1% level of significance and could not provide credence to reject the hypothesis of the equality of mean return for months of the year during the whole study period.

The H- statistics for the two indices could also not produce evidences in the favour of alternative hypothesis that there are significant differences in mean returns of months of the year. On the whole both parametric and non-parametric tests could not document monthly seasonal patterns in Indian bourses during the whole study period. It can be observed from the figure 2 (b) and the summary statistics presented in Table 2 (b) for the first sub-period (1996-2001) that the mean return for February was highest for both the indices. On inspection of t-statistics, it is curious to note that mean returns of all the months for the indices were tend to zero. It is worthy to note that the non- parametric approach H- statistics for BSE Sensex (9.520) and BSE 100 (11.375) and F-statistics for BSE Sensex (0.97611) and BSE 100 (0.43142) were not significant at 1% level of significance, consequently rejected the alternative hypothesis of significant differences in mean returns across the month of the year. The summary statistics documented in Table 2 (c) for the second sub-period (2002-2006) and figure 2 (c) exhibited that the both the indices yielded significant and

positive mean returns in the months of November, December and August and the returns for remaining all the months were tend to be zero. The study noted that among three months the return on November was highest, followed by December and August. The study indicated that F-statistics in case of BSE Sensex (1.84019) and BSE 100 (1.63105) were significant at 4 % and 8 % level of significance respectively.

Table 2

Summary Statistics of BSE Sensex and BSE 100 Returns for Month of the Year

(a) Year 1996-2006

	BSE Sensex			BSE 100			
	Mean	SD	t-statistics	Mean	SD	t-statistics	Obs.
Jan	0.00046	0.01619	0.43046	0.00066	0.02023	0.49759	230
Feb	0.00246	0.01599	2.27557*	0.00238	0.01636	2.14505*	218
Mar	-0.00105	0.01756	-0.89687	-0.00070	0.01820	-0.57710	225
Apr	0.00025	0.01981	0.18286	-0.00051	0.05946	-0.12538	216
May	-0.00087	0.02059	-0.64074	-0.00079	0.02106	-0.57100	232
Jun	0.00146	0.01756	1.27715	0.00110	0.01770	0.95888	237
Jul	-0.00004	0.01497	-0.04087	0.00005	0.01457	0.05575	243
Aug	0.00078	0.01220	0.97239	0.00143	0.01224	1.77602	230
Sep	-0.00025	0.01577	-0.25177	-0.00052	0.01561	-0.50530	229
Oct	-0.00091	0.01572	-0.86770	-0.00085	0.01584	-0.80414	224
Nov	0.00192	0.01258	2.27921*	0.00211	0.01250	2.51361*	222
Dec	0.00245	0.01287	2.88860**	0.00287	0.01343	3.24079**	230
F-statistics	1.408573	H-statistics	11.725	F-Statistics	0.78048	H-Statistics	15.757
Df(v1, v2)	11,2724	Df (k-1)	11	df (v1, v2)	11,2724	Df (k-1)	11
Significance	0.16173	Crit. Value	24.275	Significance	0.66004	Crit. Value	24.275

(b) Year 1996-2001

	BSE Sensex			BSE 100			
	Mean	SD	t-statistics	Mean	SD	t-statistics	Obs.
Jan	0.00091	0.01859	0.54432	0.00146	0.02404	0.67196	123
Feb	0.00306	0.01890	1.77346	0.00299	0.01898	1.72449	120
Mar	-0.00151	0.02151	-0.76780	-0.00122	0.02266	-0.58706	119
Apr	0.00058	0.02452	0.25051	-0.00142	0.08129	-0.18535	113
May	0.00016	0.01904	0.09418	-0.00006	0.01955	-0.03545	123
Jun	0.00052	0.01754	0.33380	0.00035	0.01780	0.22100	127
Jul	-0.00082	0.01663	-0.56954	-0.00055	0.01616	-0.39125	133
Aug	-0.00088	0.01383	-0.70304	-0.00013	0.01344	-0.11076	122
Sep	-0.00241	0.01759	-1.51415	-0.00259	0.01777	-1.61051	122
Oct	-0.00209	0.01850	-1.23367	-0.00176	0.01879	-1.02011	119
Nov	0.00047	0.01495	0.34541	0.00069	0.01509	0.50136	120
Dec	0.00211	0.01475	1.57308	0.00268	0.01534	1.91830	121
F-statistics	0.97611	H-statistics	9.520	F-statistics	0.43142	H-statistics	11.375
Df(v1, v2)	11,150	Df (k-1)	11	df (v1, v2)	11,1450	Df (k-1)	11
Significance	0.46607	Crit. Value	24.275	Significance	0.94255	Crit. Valu	

(c) Year 2002-2006

	BSE Sensex			BSE 100			
	Mean	SD	t-statistics	Mean	SD	t-statistics	Obs.
Jan	0.00003	0.01308	0.02680	-0.00019	0.01487	-0.13062	105
Feb	0.00146	0.01141	1.24946	0.00141	0.01249	1.10856	96
Mar	-0.00092	0.01137	-0.82708	-0.00043	0.01104	-0.39484	104
Apr	-0.00054	0.01291	-0.41756	-0.00032	0.01279	-0.25071	99
May	-0.00221	0.02240	-1.01825	-0.00178	0.02289	-0.80212	107
Jun	0.00230	0.01766	1.35291	0.00176	0.01772	1.02956	108
Jul	0.00094	0.01266	0.77234	0.00079	0.01240	0.66157	108
Aug	0.00274	0.00982	2.87453**	0.00324	0.01060	3.14871**	106
Sep	0.00210	0.01149	1.87462	0.00182	0.01248	1.49859	105
Oct	0.00058	0.01182	0.49435	0.00027	0.01173	0.23251	103
Nov	0.00375	0.00883	4.24515**	0.00387	0.00832	4.65051**	100
Dec	0.00289	0.01038	2.88080**	0.00313	0.01081	2.99132**	107
F-statistics	1.84019	H-statistics	19.463	F-statistics	1.63105	H-statistics	20.711
Df(v1, v2)	11,1236	Df (k-1)	11	df (v1, v2)	11,1236	Df (k-1)	11
Significance	0.04331	Crit. Value	24.275	Significance	0.08447	Crit. Value	24.275

(1) SD = Standard Deviation. (2) F-statistics is based on one-way ANOVA and H-statistics is based on Kruskall-Wallis test. (3) Df = degree of freedom, v1 = between sample, v2 = within sample. (4) * Significant at 5 % level, ** Significant at 1% level. (5) Critical value of H- statistics at 1 % and 5 % level of significance are 24.725 and 19.675 respectively.

Figure:2(a) BSESensex and BSE100 Returns for the Month of the Year (1996-2006)

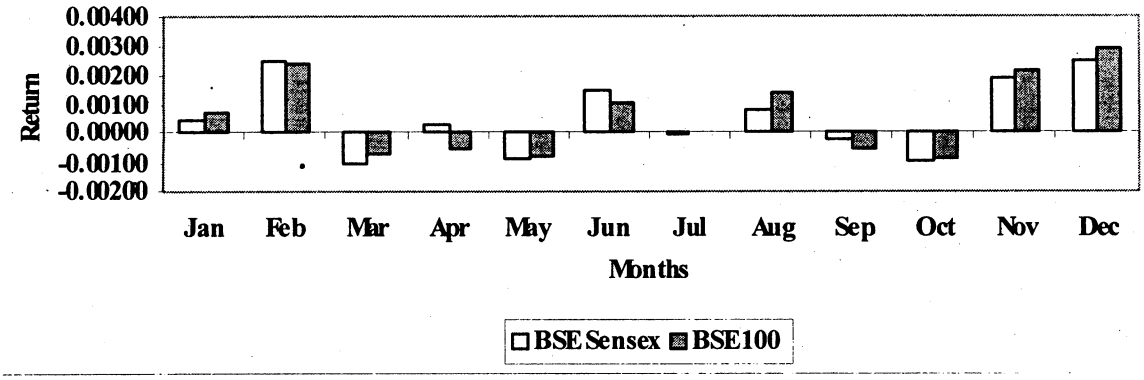


Figure:2(b) BSESensex and BSE100 Returns for the Month of the Year (1996-2001)

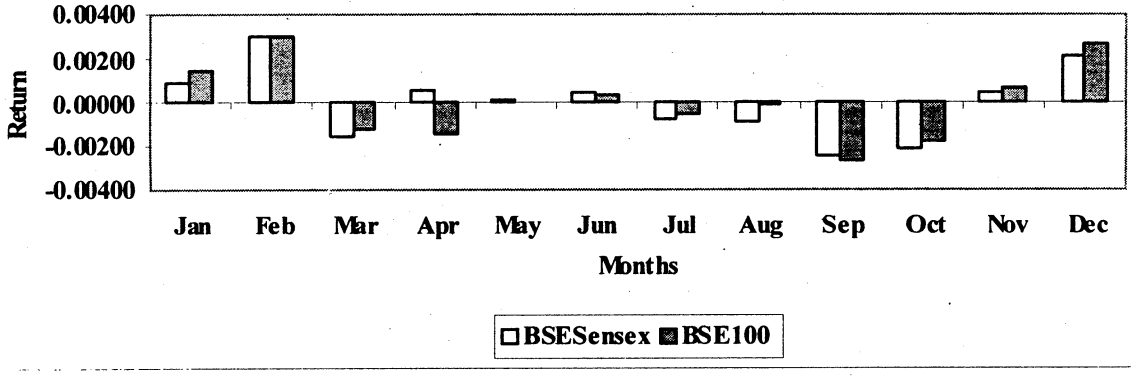
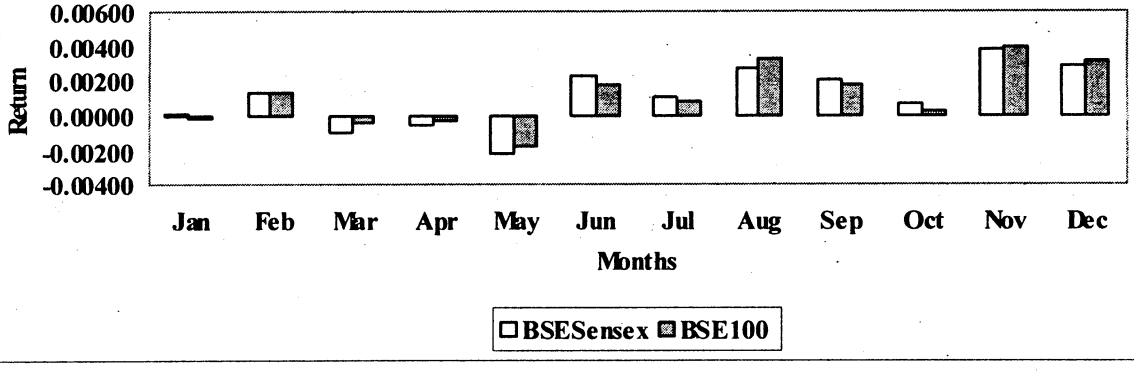


Figure:2(c) BSESensex and BSE100 Returns for the Month of the Year (2002-2006)



Further the non-parametric H-statistics in case of BSE Sensex (19.463) and BSE 100 (20.711) were found to be significant at 6 % and 5 % level of significance. Thus the study on the basis of parametric and

non-parametric approach rejected the null hypothesis of equality of return across the month of the year during the sub-period January 2002 to December 2006. On the whole, both parametric and non-parametric tests have not documented any seasonality regarding the month of the year in Indian bourses during the whole study period and first sub-period (1996-2001). However during the second sub-period (2002-2006) the study reported inequality in average monthly common stock's return.

Conclusion

The present study is an endeavor to explore the Indian stock market's informational efficiency in its weak form in the context of calendar anomalies especially in respect of the day of week effect and month of year effect. In this attempt to find seasonality in Indian stock market, the study used the daily closing value of BSE Sensex and BSE 100 indices for the period during January 1996 to December 2006. The study is bifurcated into two sub-periods. One important thing that distinguished this study from earlier studies is that it incorporated both the parametric and non-parametric approach to check any seasonal pattern in common stock returns. The findings regarding the day of the week reported no significant differences in sample distribution of daily common stock returns during the whole study period and second sub-period (2002-2006). It is curious to note the empirical findings reported the day of the week effect during the first study the pre-reform period (1996-2001) and exhibited the effects of stock market reforms. Regarding the month of the year effect, the study has not reported any anomaly regarding the average monthly return during the whole study period and first sub-period (1996-2001). Interestingly in the post-reform period (2002-2006), the study exhibited evidences in favor of alternative hypothesis that the average monthly returns are not equal. On the whole, the study documented the day of the week effect and month of the year effect during the per-reform period (1996-2001) and post-reform period (2002-2006) respectively. The study adds to existing market efficiency literature that both the parametric and non-parametric approaches yield similar results regarding examination of seasonality in common stock return.

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