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Evidence on Weak Form Efficiency and Day of the Week Effect in the Indian Stock Market

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ABSTRACT

Stock market efficiency is an important concept, for understanding the working of the capital markets particularly in emerging stock market such as India. The efficiency of the emerging markets assumes greater importance as the trend of investments is accelerating in these markets as a result of regulatory reforms and removal of other barriers for the international equity investments. There is enough evidence on market efficiency and day of the week effect in the developed markets, however, the same is not true for the emerging stock markets. This study provides empirical evidence on weak form efficiency and the day of the week effect in Bombay Stock Exchange over a period of 1987-1994. The results provide evidence of day of the week effect and that the stock market is not weak form efficient. The day of the week effect observed on the BSE pose interesting buy and hold strategy issues.

Introduction

STOCK MARKET EFFICIENCY is an important concept, in terms of an understanding of the working of the capital markets. The efficiency of the emerging markets assumes greater importance as the trend of investments is accelerating in these markets as a result of regulatory reforms and removal of other barriers for the international equity investments. The term *market efficiency* is used to explain the relationship between information and share prices in the capital market literature. Fama (1970 and 1991) provides the formal definition of "Market Efficiency". He classifies market efficiency into three categories namely, *weakform, semi strongform and strongform.* In its weak form, market efficiency hypothesis (EMH) states that the stock returns are serially un-correlated and have a constant mean. In other words, a market is considered weak form efficient if current prices fully reflect all information contained in historical prices, which implies that no investor can devise a trading rule based solely on past price patterns to earn abnormal returns. A market is semi strong efficient if stock prices instantaneously reflect any new publicly available information and Strong form efficient if prices reflect all types of information whether available publicly or privately.

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Market Efficiency has an influence on the investment strategy of an investor because if securities markets are efficient trying to pick winners will be a waste of time. Since in an efficient market, the prices of securities will reflect the market's best estimate of their expected return and risk, taking into account all that is known about them. Therefore, there will be no undervalued securities offering higher than deserved expected returns, given their risk. So, in an efficient market, an investment strategy concentrating simply on the overall risk and return characteristics of the portfolio will be more sensible. If however, markets are not efficient, and excess returns can be made by correctly picking winners, then it will pay investors to spend time finding these undervalued securities (Rutterford, 1983 pp. 282).

The day of the week effect refers to the existence of a pattern on the part of stock returns, whereby these returns are linked to the particular day of the week. Such relationship has been verified mainly in the USA. The last trading days of the week, particularly Friday, are characterised by the positive and substantially positive returns, while Monday, the first trading day of the week, differs from other days, even producing negative returns (Cross, 1973; Lakonishok and Levi, 1982; Rogalski 1984; Keim and Stambaugh, 1984; Harris, 1986). Once again the day of the week effect in emerging stock market have not been extensively researched. The presence of such an effect would mean that equity returns are not independent of the day of the week, an evidence against random walk theory.

Studies on testing of market efficiency of Asian emerging stock markets are also surprisingly few. Chan, Gup, and Pan (1992), show that there is no evidence that the stock prices in major Asian Markets and U.S. markets are weak form efficient individually and collectively in the long run. Dickinson and Muragu (1994) provide evidence of market efficiency in Nairobi Stock Exchange. They conclude that small market such as Nairobi Stock Exchange provides empirical results consistent with weak-form efficiency. Cheung, Wong and Ho (1993) report inefficiency of stock markets of Korea and Taiwan on the basis of weak theoretical form of Capital Asset Pricing Model in both the markets. Groenewold and Kang (1993) have conducted weak and semi-strong efficiency tests of Australian stock market by using aggregate share price indexes and find the data consistent with the weak form efficiency. Ho, Richard and Cheung (1994) study the seasonal pattern in volatility of Asian Stock Markets. Using Levene (1960) test, they report that there exist day-of-the-week variations in volatility in most of the emerging Asian markets. Barnes (1986) tests the weak form market efficiency of the Kuala Lumpur Stock Exchange and concludes that the stock exchange exhibited a surprisingly high degree efficiency, inspite of thinness of the market.

This research study examines weak-form efficiency and the day of the week effect on the Bombay Stock Exchange using daily BSE national index data for the period 1987 to 1994. The next section explains the theory of efficient markets. Hypotheses and the data used in the study are described in section 3. Market characteristics of Indian stock market are given in section 4. Descriptive statistics, non-parametric tests, analysis and results are given in sections 5 and 6. Day of the effect is described in section 7 and finally in section 8 main conclusions of the study are given.

Efficient Markets Theory

The efficient market hypothesis is inextricably related to the *random walk theory. The* idea that security prices might follow random was put forward by Bachelier[1] in 1900. The random walk is used to refer to successive price changes which are independent of each other. In other words, tomorrow's price change (and therefore, tomorrow's price) cannot be predicted by looking at today's price change, P_{t+1} - P_t is independent of p_t- p_{t-1}. There should be no trends in price changes. Proofs of the random walk theory can take several forms. As with all tests of theories involving future expected prices or returns, past actual prices or returns are used for the tests. So for the random walk theory, sets of share price changes are tested for serial independence. Random walk theory for share prices reflects a securities market where new information is rapidly incorporated into prices and where abnormal returns or'excess' returns cannot be made from spotting trends or from trading on new information.

That share prices appear to follow a random walk is an interesting result and proving it or attempting to disprove it occupied significant proportion of research in 1970's. But what remained to be shown was why share prices followed a random walk. There was plenty of evidence, but a formal theory was missing. What was needed was a model of share price behaviour to explain the random walk. The gap was filled by more general model based on the concept of efficiency of the markets in which shares are traded - *the efficient market hypothesis (EMH).*

According to EMH, the ability of investor to pick winners and make excess returns using new information is directly related to the speed and efficiency of a market at absorbing that information. So, efficiency is considered in terms of the 'fair game' concept. A market is regarded as efficient with respect to a particular set of information if investors using that information are faced with fair game, that is, they receive on average the return expected for the risk involved and make no consistent abnormal returns. This can be expressed in the following way. If ϕ_t is defined to be a particular set of information concerning security j available at time t, then any abnormal return achieved at time t+1 on security j can be written εj,t+l = where εj, t+1= (E(Rj,t+1)/ ϕ_t). The equation shows that the excess returns will be the difference between the return actually achieved and the return expected given the risk. The solidus/simply means that the returns are achieved or expected knowing information ϕ_t at time t. The EMH does not say that investors will never beat the market and will never make large profits. In other words, εj,t+l can be large and positive and sometimes negative, with the result that the sum of the excess returns over a number of periods of time will average zero $\varepsilon_{j,t+1} = 0$.

1. Bachelier, L., 1900, Th'eorie de la sp'eculation, Gauthiers-Villars

The fair game for investors is an outcome of a market being efficient. If a market is efficient, then investing is a fair game. This fair game concepts is useful in that it allows the different levels of the EMH to be tested.

Hypotheses and Data

Hypotheses

1. The null hypothesis is that prices on India stock market follow random walk.
2. That the Indian Stock Market is efficient in weak form i.e., first order autocorrelations are not present.
3. There is no difference in the returns between the days of the week. The market is also efficient in terms of autocorrelations coefficient up to five lags or weeks demonstrating no day of the week effect.

Data

The study use daily prices of the Bombay Stock Exchange National Index (BSENI) from 2nd January 1987 to 31st October, 1994. The Index values in local currency are taken from Data Stream International. In order to compare the performance with a World Portfolio, Morgan Stanley World Dollar Index is used and, therefore, index values are converted into US Dollar by using daily quotations of exchange rates of the Indian Rupee to the U.S dollar.

Indian Stock Market

Bombay Stock Exchange (BSE) is perhaps one of the oldest stock exchanges in Asia. The BSE was established in 1875 with the formation of "Native Share & Share Broker Association". The BSE has more than 628 members and account for more than 65% trading volume with over 70% of listed capital in India. Trading volume exceeds 215000 transactions with a turnover of $130 million per day. The market capitalisation of the 1900 stocks on which data is available, is about US$115 billion, on May 6th, 1994. Indian stock markets have also demonstrated remarkable stability and resilience in general and BSE in particular. According to a special report in Euromoney (Sept., 1994), average annual price fluctuations of ordinary shares on BSE have been quite stable, at about 25. 1% during the past 10 years. This compares favourably with figures from the London Stock Exchange (22%) and the New York Stock Exchange (23.9%). The Indian stock market largely remained unaffected during the world stock market crash in Oct. 1987. See Figure 1 for the behaviour of BSE national index (converted in to US$) as compared to Morgan Stanley World Dollar Index and Table 1 for the major market characteristics of BSE.

There are three main indices on the BSE, Bombay Stock Exchange Sensitive Index (SENSEX), Economic Times Ordinary Share Price Index (ET), and Bombay Stock Exchange National Index (BSENI). The BSE Sensitive Index includes 30 companies and is meant to capture the market leaders. The Economic Times Ordinary Share Index includes 72 companies. Recently another share index, BSE 200 has been launched by Bombay Stock Exchange for exclusive use of the brokers who deal in Bombay only. The BSENI is the most commonly used index and considered as the most representative of all three. See Table 2 for the description of the BSENI.

Figure 1

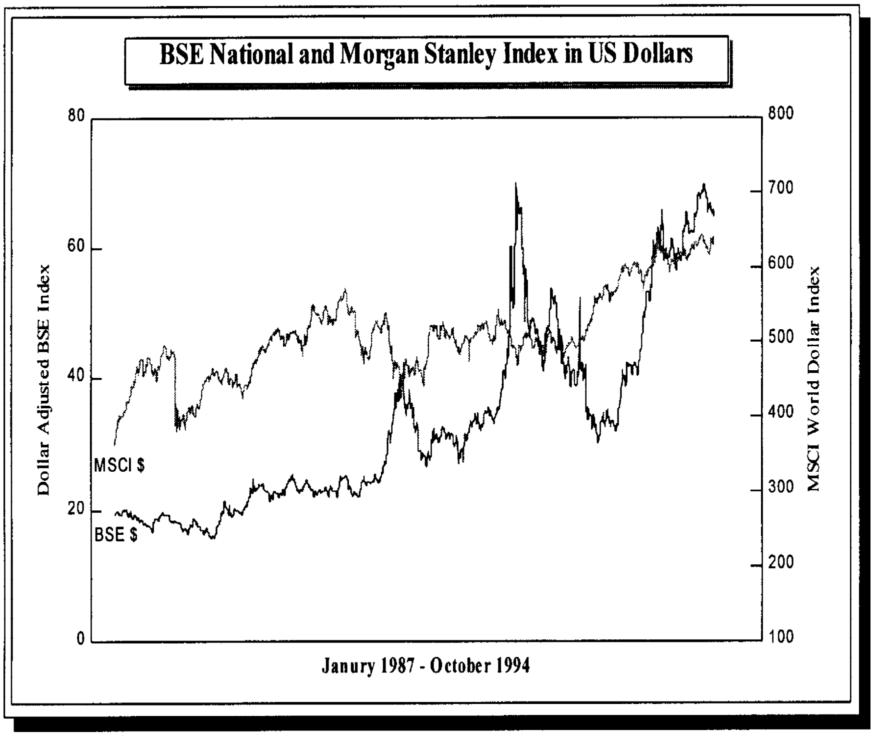


Table 1

Major Market Characteristics of Indian Capital Market	
Market Capitalisation (USDb)	126.80
Daily Turnover (USDm)	3160.00
Trading Volume (USDb)	675.2 (93)
New Issue Volume (USDb)	94.78 (93)
Trading System	Open outcry auction system.
Settlement and Transfer System	T+14 for A list securities. T+7 for B list. Clearing house of BSE handles settlement. Transfer carried out through transfer deeds.
Regulatory Agency	Securities and Exchange Board of India (SEBI) is authorised to regulate the functions of stock exchanges and implement disclosure norms.
Derivatives Market	Trading of Index Futures on BSE likely to be introduced by the end of 1994.

Source: Euromoney, September, 1994

Table 2

Bombay Stock Exchange National Index (BSENI)	
Base Period	1978-70 = 100
Stock Exchanges Covered	Bombay
Number of Scrips	100.00
Method of Compilation	The Index for a day is calculated as the percentage of aggregate market value of the equity stocks of all companies in the sample on that day to the average market value of the equity stocks of the same companies during the base period. In case where a scrip is actively quoted on more than one exchange, the average price of that scrip on these exchanges is used in the compilation of the index.
Weighting System	The price of each component share in the Index is weighted by the number of shares outstanding so that it will influence the index in proportion to its respective market importance.
Criteria for Selection of Scrips	Selection of Scrips is on the basis of their market activities and adequate representation of the various Industry groups.
Dividend Adjustments	None
Bonus Adjustments	The new weighting factor will be the number of equity shares outstanding after the bonus issue has been effective.
Rights Issue adjustments	The new weighting factor will be the number of equity shares outstanding after the rights issue, and an offsetting or proportionate adjustments is made of the base year average.

Descriptive Statistics

Frequency Distribution

One of the basic assumptions underlying the random walk theory and, therefore, EMH is that if the stock prices are random then its distribution should be normal. Any normal distribution is an advantage because we need only two summary measures, mean and variance, to describe the entire distribution. The normality of distribution is also one of the basic assumptions underlying the capital asset pricing models.

The Histograms of the index is computed and curve for normal distributions have been fitted in order to ascertain whether the distribution of index values fits the normal distribution. A distribution that is not symmetric but has more cases, or more of a tail toward one end of the distribution than the other is called *skewed.* If the tail is toward larger values, the distribution is positively skewed or skewed to the right. If the tail is toward smaller values, the distribution is *negatively skewed or skewed* to the left. *Kurtosis* indicates the extent to which, for a given standard deviation, observations cluster around a central point. If cases within a distribution cluster more than those in the normal distribution (that is the distribution is more peaked), the distribution is called *leptokurtic.* If cases cluster less than in the normal distribution (that is, it is flatter), the distribution is termed *platokurtic.* Values for *skeweness and Kurtosis are* 0 if the observed distribution is exactly normal.

As can be seen from Figure 2, that the frequency distribution is not normal. The distribution is positively skewed and with a value of -0.530 *kurtosis.* The descriptive statistics are given in Table 3. The results indicate that the distribution is not normal and, therefore, the prices on BSE do not follow random walk.

Figure 2

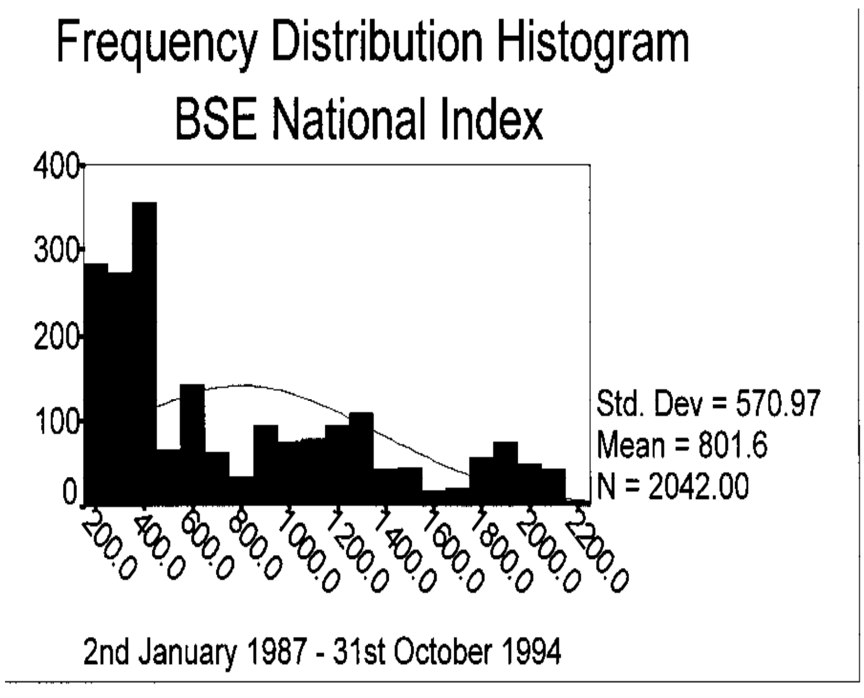


Table 3

Descriptive Statistics

Mean	801.61	Std Deviation	570.97
Variance	326,008.81	Kurtosis	-0.53
S.E. Kurt	0.11	Skewness	0.84
S.E. Skew	0.05	Range	1968.61
Minimum	207.87	Maximum	2176.48

To confirm this non-parametric tests are used which will provide further evidence whether the distribution conforms to a normal distribution or not.

Non-Parametric Tests

Kolmogorov Smirnov Goodness of Fit Test

To test whether the observed distribution fit theoretical normal or uniform distribution we use non-parametric test. Kolmogorov Smirnov Goodness of Fitness Test (KS) is a non-parametric test and is used to determine how well a random sample of data fits a particular distribution (uniform, normal, poisson). It is based on comparison of the sample's cumulative distribution against the standard cumulative function for each distribution. The Kolmogorov-Smirnov one sample goodness of fit test compares the cumulative distribution function for a variable with a uniform or normal distributions and tests whether the distributions are homogeneous. We use both normal and uniform parameters to test distribution.

The Kolmogorov Smirnov Goodness of Fit Test (KS) shows 0.0000 probability for the Z at the 5 percent level of significance, in case of normal as well as uniform distribution. The results clearly indicate that the frequency distribution of the daily values of BSENI does not fit either normal or uniform distribution. Table 4 show the results of the KS Test.

Table 4

Kolmogorov Smirnov Goodness of Fit Test

	Absolute	Positive	Negative	K-S Z	Z-Tailed P
Normal	0.18	0.18	-0.15	8.30	0.00
Uniform	0.33	0.33	0.00	15.06	0.00

Tests For Serial Dependence

Runs Test

We use the Wald-Wolfowitz Runs Test for the randomness of the series. Runs testing is a strong test for randomness in investigating serial dependence in share price movements and compares the expected number of runs from a random process with the observed number of runs. The test is non-parametric and is independent of the normality and constant variance of data. A run is defined as a series of identical signs that are preceded or are followed by a different sign or no sign at all. That is given a sequence of observations, the runs test examines whether the value of one observation influences the values taken by later observations. If there is no influence (the observations are independent), the sequence is considered random. It is assumed that the sample proportion of positive, negative and zero price changes are good estimates of the population's proportions. Runs test shows the cutting point, the number of runs, the number of cases below the cutting point, the number of cases greater than or equal to the cutting point, and the test statistics Z with its observed significance level. The total number of runs is a measure of randomness, since too many or too few runs, suggest dependence between observations.

The results of the runs test are given in Table 6. The runs test converts the total number of runs into a Z statistic. As can be seen that the total number of runs are just 14 with a zero observed significance level. Therefore, the hypothesis that the series is random is rejected.

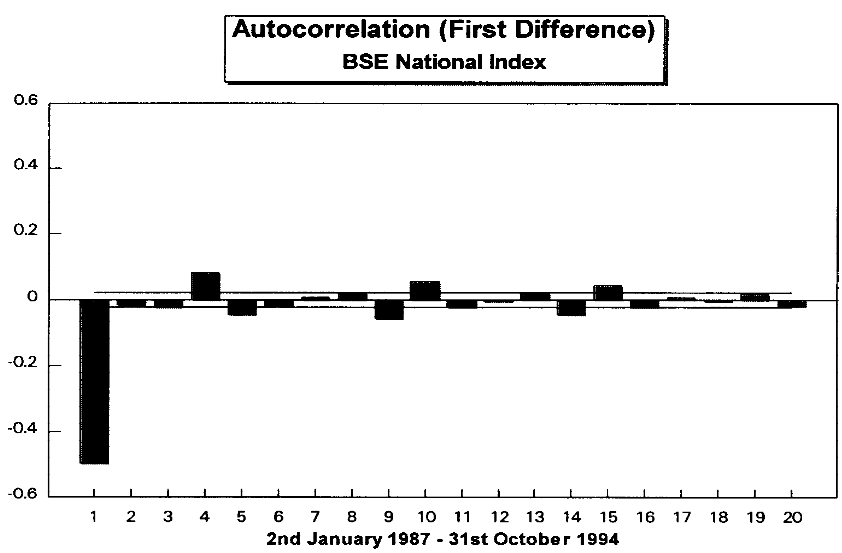
Table 5

	Cases	Test value (Median)	Runs	Z	2-Tailed P
LT Median	l,019.00	593.12	14.00	-44.62	0.00
GE Median	l,023.00				
Total	2,042.00				

Serial Correlation Coefficients Test

For testing the Efficient Market Hypothesis (EMH) in the weak form, Serial Correlation Coefficient Test is widely used. The Serial Correlation Coefficient measures the relationship between the values of a random variable at time t and its value in the previous period. The population serial correlation (Pa) coefficient is estimated using the sample serial correlation coefficient (Ra). For complete independence Pa = 0, a significant test may be performed on the variation of Ra from 0. Here confidence intervals of two and three standard errors are used. Autocorrelations are reliable measures for testing of dependence/independence of random variables in a series. If no autocorrelations are found in a series then the series is considered random. We transform the series by taking the first difference and compute the autocorrelations. The autocorrelation coefficients have been computed for the transformed index in order to establish whether information is obtained even with transformation of the higher order.

Figure 3



By referring to the Figure 3 it is evident that information available is available at several lags. There is significant negative autocorrelation on the first lag. The autocorrelations on the 9th and 10th lags may be ascribed to the two week settlement period (a week comprise of five working days), followed at the Bombay Stock Exchange. On BSE the year is divided into two week settlement periods. All transactions entered into a particular settlement period are to be settled at the end of the period. Settlement period is normally a fortnight but at times can extend beyond a fortnight. The evidence of presence autocorrelation coefficients in the transformed series on the 1st, 4th, 9th, 10th 14th and the 15th lags suggest that there is serial dependence between the values. Therefore, the null hypothesis that there are no first order autocorrelations present in the series is rejected.

Day of the Week Effect

The series of returns on BSENI are also tested for 'day of the week effect'. If there is no day of the effect then the mean found at the end of each day of the week would be same. The Table 6 shows the mean returns and the standard deviation for each day of week.

Table 6

Weekend Effect in the Daily $ Returns of BSENI

	Monday	Tuesday	Wednesday	Thursday	Friday
Mean Return	-0.09	0.10	-0.04	0.13	0.28
Standard Deviation	2.22	1.79	1.36	1.78	2.21
Range Maximum	20.64	12.90	9.37	27.33	10.65
Range Minimum	-15.58	-9.76	-7.14	-6.11	-19.27

As can be seen that the mean returns except for the Monday and Wednesday are positive. It can also be seen that the standard deviation is larger for the first and the last days of the week, which is almost similar to the evidence from other countries. The hypothesis used is that because Monday closing price entails the events of three days, the standard deviation should be higher compared to that of other days, while only significantly higher dispersion for this day would also indicate the effects of risk in determining daily returns (Jacobs and Levy, 1988). In case of BSE the high level of dispersion for Monday seems to point out the risk effect on daily returns. There are also a few markets where the standard deviation for Monday is smaller than that for other days (Solnik and Bousquet, 1990). In most of these studies it is implicitly assumed, along with the standard deviation for Monday and low one for Friday, that Monday returns are low or negative as compared to Friday returns - which seems also to be the cause for the BSE excepting that standard deviation on Friday is not low. The day of the week effect seems to conform to the familiar pattern observed in other stock markets, according to which the market has a tendency to end each week strong and start weak on Monday with the exception of negative returns on Wednesday. From the results it is evident that there is weekend (Friday) effect on the returns from

BSENI which supports the presence of first order autocorrelation and provides the indication of non-random nature of stock prices in the BSE.

Findings and Conclusions

The assumption that stock prices are random is basic to the efficient market hypothesis and capital asset pricing models. This study has presented evidence concentrating on the weak form efficiency and on the day of week effect in the Bombay Stock Exchange under the consideration that variance is time dependent. Moving from its traditional functioning to that required by the opening of the capital markets, the BSE has presented different patterns of stock returns and supports the validity of day of the week effect. The frequency distribution of the prices in BSE do not follow a normal or uniform distribution which is also confirmed by the non-parametric KS Test. The results of runs test and serial correlation coefficients tests indicate non-random nature of the series and, therefore, violation of weak form efficiency in the BSE. The other null hypothesis that there is no difference between the returns achieved on different days of the week is also rejected as there is clear evidence that the average returns are different on each day of the week. The weekend effect is evident as the returns achieved on Fridays are significantly higher compared to rest of the days of the week. However, the results presented in the study are not adjusted for transaction costs. Nor have the results been adjusted for non-synchroneous trading which may influence the serial correlation coefficients.

The implication of rejection of weak form efficiency for investors is that they cannot adopt a 'fair return for risk' strategy, by holding a well diversified portfolio while investing in the Indian stock market. What will be the appropriate investment strategy for an international investor for investing in Indian market and how efficiency/inefficiency will influence his choice of investments are the issues worth researching. Also the day of the week effect observed on the BSE pose interesting buy and hold strategy issues.

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