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TESTING THE WEAK FORM OF EFFICIENCY OF THE INDIAN STOCK MARKET: AN EMPIRICAL STUDY OF NSE AND BSE INDICES

Dr. Sahaj Wadhwa*
Ms. Deepika Dewan**

ABSTRACT

Prior literature available on the efficient market hypothesis (EMH) over the last few decades is quite indecisive as some studies supported the efficient market hypothesis, and other studies harshly rejected it. The present study aims at testing of weak form of Efficient Market Hypothesis confined to Indian context only. For examining the presence of the weak-form market efficiency in the Indian stock market, 5 BSE market indices and 5 NSE market indices were chosen where closing price of all the indices were studies for the purpose of analysis. The tools used in present study are: (1) Descriptive statistics, (2) Runs test, (3) Unit root test to check the stationarity of time series, (4) ACF and PCAF and. The empirical findings of the study shows that The Indian stock market was found to be weak form efficient, which confirmed that the historical information had no impact on the current prices and could not be used for predicting the future prices. The findings from this study provide a few lines for future research. One of the major research implications is that this anomalies in the statistical results that have come by different academicians in the finance area need to be explained by future researchers. Another practical implication is that the investment brokers and retail investors should exercise caution before selecting their investment portfolios. Another important implication is to understand that financial literacy plays a vital role in investment decisions. Therefore, in addition to the technical analysis of the stock market, the analysts need to consider the level of financial literacy, information access, and subjective market efficiency of the Indian stock market before taking any investment decisions.

***KEYWORDS**: Efficient Market Hypothesis, Unit Root, ADF Test, Autocorrelation, Indian Stock Market, Market Returns.*

Introduction

Market efficiency refers to ability of stock market to process all the available information and reflect the same in stock prices. If market if not efficient then stocks that outperform market will create a positive wave of sentiments among investors on the other hand underperform stock will make market more tense. Apparently, stocks that underperform at any given point in market had been more sensitive to new information (Lulia, 2009). The concept of pure market efficiency has always been a subject matter of academic debates. But testing of stock market efficiency is important for individual as well as institutional investors.

* Assistant Professor, Department of Commerce, Delhi University, Delhi, India.
** Assistant Professor, Department of Commerce, Bharati College, Delhi University, Delhi, India.

Samuelson (1965) and Fama (1970) indicates that the EMH supposes that share price adjust rapidly to the appearance of new information, and thus, current prices fully reflect all available information and should follow a random walk process (Awad and Daraghma, 2009). The levels of market efficiency was provided by Fama (1971), who argued that markets could be efficient at three levels, based upon what information was reflected in prices. Fama made modifications in his previous work and brought some evidence proving the efficiency of the market. He has changed the title of the three forms of efficiency later in his research work and enlarged the scope of information to be considered while testing the efficiency of the stock markets. Fama renamed weak form efficiency to test for return predictability, semi-strong to event studies and strong form to tests for private information in 1970. In the layman language, EMH theory describes that the performance of stock prices is entirely free from its historical performance; no-one can predict the prices of stocks by considering the past data and earns abnormal profits. Any information that will impact the stock prices is available in the market and everyone has equal option to access the same. The objective of the present study is confined to the testing of weak form of Efficient Market hypothesis only in the Indian context. It tests if Indian stock market indices movements show presence of random walk. Also, examines if Indian stock market indices represents presence of weak form efficiency. The paper examines return series of BSE and NSE broad market indices.

Data and Methodology

To test and examine the presence of the weak-form market efficiency in the Indian stock market, 5 BSE market indices and 5 NSE market indices have been chosen and covering the study period from 01st July 2018 to 30th June 2023. The selected indices are BSE 50, BSE 100, BSE 200, BSE NEXT 50, BSE SMALL CAP 250, NIFTY50, NIFTY 100, NIFTY 200, NIFTY NEXT 50, NIFTY SMALL CAP 100. For the purpose of analysis closing price of all the indices have been taken of the respective indices form the official website of NSE and BSE.

To examine the research objectives following tools and techniques have been used

Techniques	Objective
Descriptive Statistics	To observe the distribution of data
Run test	To check the market efficiency
Unit root test	To check the stationary
ACF and PCAF	To check market form of efficiency

Descriptive Statistics

Table 1 indicates the statistical description of the daily stock prices returns traded on all 10 indices during the study period from01st July 2018 to 30th June 2023. The values of descriptive statistics like Mean, Median, Maximum, Minimum, Standard Deviation, Skewness, Kurtosis and Jarque Bera are mentioned. In case of random model normality of series is a prerequisite. Therefore, following hypothesis has been proposed to test the normal distribution of data.

H_0: Data is normally distributed

H_1: Data is not normally distributed

Table 1: Descriptive Statistics

Particulars	BSE 50	BSE 100	BSE 200	BSE NEXT 50	BSE SMALL CAP 250
Mean	0.000479	0.000471	0.000478	0.000425	0.000481
Median	0.001034	0.001054	0.00123	0.002011	0.002165
Max	0.085109	0.081427	0.078046	0.060767	0.051217
Min	-0.14028	-0.138806	-0.138278	-0.129358	-0.130396
Std deviation	0.012315	0.012182	0.012044	0.012918	0.01282
Skewness	-1.557239	-1.609993	-1.694154	-1.403094	-1.851504
kurtosses	23.98161	23.42214	23.65245	14.44072	16.37729
Jarque Bora	23077.56	22012.75	22557.21	7146.382	9890.086
Prob	0	0	0	0	0
Observations	1231	1237	1237	1237	1233

Particulars	NIFTY 50	NIFTY 100	NIFTY 200	NIFTY NEXT 50	NIFTY SMALL CAP 100
Mean	0.000504	0.00044	0.000459	0.00022	0.00036
Median	0.000616	0.0007	0.000924	0.00158	0.00214
Max	0.220228	0.21652	0.216539	0.0619	0.20806
Min	-0.139038	-0.137	-0.13744	-0.1237	-0.1415
Std deviation	0.014084	0.01379	0.01378	0.01244	0.01545
Skewness	2.211169	2.16897	2.126085	-1.4669	0.70838
kurtosses	65.27651	66.2917	66.38104	15.8142	38.9907
Jarque Bora	189698.8	195699	195877.1	8402.95	63137.1
Prob	0	0	0	0	0
Observations	1169	1169	1168	1169	1169

To check the normality of the data, the Skewness, Kurtosis and Jarque Bera values were calculated. The Jarque-Bera test is a goodness-of-fit test that checks presence of skewness and kurtoses in data that are similar to a normal distribution. Jarque-Bera test statistic is always positive, and if it is not close to zero, it shows that the sample data do not have a normal distribution.

The data was observed to be positively skewed with skewness for all indices except three indices viz. NIFTY 50, Nifty 100 and NIFTY Small Cap 100 which are negatively skewed. The p-value of the Jarque Bera test is less than the significant value of 0.05; provides sufficient evidence not to accept the Null hypothesis.

Therefore it can be concluded that the basic assumption of normality of market efficiency is not followed by Indian Stock Market as the data series are not found normally distributed.

Run Test

To test the efficiency in market and efficient market hypothesis, Runs Test has been performed. Runs Test is a nonparametric test, which is used to test the randomness of the series which auto correlation fails to do.

Runs Test is a traditional method which ignores the properties of distribution and used to check the randomness in market. In runs test we consider a series of price changes over a certain period of time. A run exist when two consecutive changes are the same (i.e. increase, increase and decrease, decrease). When price changes in a different direction, such as increase, decrease or vice versa, the run ends and a new run may begin.

To test for independence, following has been calculated:

- Total Number of Runs: (N) Number of Positive Price Changes: (n1) Number of Negative Price Changes: (n2)

Once we get the value of N, n1 and n2 following by using the given formula:

Mean,μ(r) : $\frac{2n_1n_2}{N} + 1$

Standard Deviation, σ(r) = $\frac{1}{N}\sqrt{\frac{2n_1n_2(2n_1n_2 - N)}{N-1}}$

$N = n_1 + n_2$

- **Level of Significance**: To test the weak form of efficiency of the stock market, the Runs Test is applied at 5% significance level where z=1.96

The actual number of runs is converted into Z statistics through the Runs test. The Z statistics define the probable difference in the observed and expected number of runs.

$$Z = \frac{R - \mu_R}{\sigma_R}$$

Upper limit and Lower Limit

- Lower limit :{ μ-1.96*(σ)}
- Upper limit :{ μ+1.96*(σ)}

The series is considered to be randomly distributed; if the calculated Z value is lying in between +/- 1.96 or it is asymptotic, significant value is found to be significant. To confirm the randomness or the random walk of Indian stock market, the following hypothesis was constructed:

H_0: Indian stock market is efficient

H_1: Indian stock market is not efficient

Table 2: Run Test Analysis

Particulars	BSE 50	BSE 100	BSE 200	BSE NEXT 50	BSE SMALL CAP 250
Positive runs(n1)	272	276	273	277	253
Negative Runs(n2)	271	275	272	276	252
Total Runs (N)	543	551	545	553	505
Expected Number of Runs(u)	610.9398863	612.16343	611.736246	599.7750809	596.998377
standard deviation	17.37713489	17.3767394	17.3287279	17.02422238	16.9727183
upper limit	644.9990707	646.22184	645.700553	633.1425568	630.264904
lower limit	576.8807019	578.105021	577.771939	566.407605	563.731849
z value	-3.90972889	-3.51984506	-3.85119129	-2.7475605	-5.4203679
p value	0.9999538	0.9997841	0.99994123	0.996997978	0.99999
Particulars	**NIFTY 50**	**NIFTY 100**	**NIFTY 200**	**NIFTY NEXT 50**	**NIFTY SMALL CAP 100**
Positive runs(n1)	260	259	258	259	251
Negative Runs(n2)	259	258	258	258	250
Total Runs (N)	519	517	516	517	501
Expected Number of Runs(u)	581.1582549	580.328767	578.754717	574.2465753	569.332763
standard deviation	16.96822583	16.9512087	16.9196291	16.77308935	16.6220602
upper limit	614.4159775	613.553136	611.91719	607.1218305	601.912001
lower limit	547.9005323	547.104398	545.592244	541.3713202	536.753525
z value	-3.66321474	-3.73594405	-3.70898894	-3.41300128	-4.11096833
p value	0.999875465	0.99990649	0.99989596	0.999678742	0.9999803

Table 2 shows result of Runs Test. It is clear that in none of the indices observed number of runs doesn't falls within the upper and the lower limit, so we can conclude that that the prices are not independent at 5% level of significance

Therefore, we have sufficient to accept the null hypothesis that the markets are efficient.

Unit Root Test

EMH assumes that share prices in stock market follow a random walk process without a drift. Therefore, it does not provide any opportunity to speculators to speculate the stock market. The stock prices for the next period are random and unpredictable from the past prices. A unit root is an essential condition for a random walk. The market can said to be weak form efficient, if the stock prices follow a unit root. Alternatively, the stock prices are stationary by nature. The random walk model does not say, however, the past information is of no value in assessing distributions of future returns. Indeed since return distributions are assumed to be stationary through time, past returns are the best source of such information. The random walk model does say, however, that the sequence (or the order) of the past returns is of no consequence in assessing distributions of future returns (Fama, 1970). To check whether the data has a unit root or not, the test ADF was employed.

The hypothesis was created as:

H_0: Observed series has unit root

H_1: Observed series does not have unit root

Table 3 shows the results of ADF test at level and **Table 4** shows ADF result at first difference. The t-statistics along with its p values are given in the following tables from 1st July 2018 to 30thJune, 2023.

Table 3: Results of ADF at Level

Particulars	T Value	1%	5%	10%	PROB
BSE 50	-0.39725	-3.43545	-2.863679	-2.567959	0.9072
BSE 100	-0.35986	-3.43543	-2.86367	-2.567954	0.9133
BSE 200	-0.32801	-3.43543	-2.863674	-2.56795	0.9183
BSE NEXT 50	-0.34484	-3.43543	-2.86367	-2.567954	0.9157
BSE SMALL CAP 250	-0.00104	-3.43545	-2.863679	-2.567959	0.9573
NIFTY 50	-1.83086	-3.44323	-2.867112	-2.5698	0.3654
NIFTY 100	-0.64232	-3.43573	-2.863805	-2.568027	0.8585
NIFTY 200	-1.77582	-3.44323	-2.867112	-2.5698	0.3925
NIFTY NEXT 50	-1.96129	-3.44323	-2.867112	-2.5698	0.3042
NIFTY SMALL CAP 100	-2.0503	-3.44336	-2.867171	-2.569831	0.2653

The negative t-statistic value was observed for all indices as indicated in the above table. ADF test was performed at 1%, 5% and 10% level of significance. In all cases calculated p-value is found to be greater than the significant values. Hence, it accepted the Null hypothesis constructed to check the unit root. The series was observed non - stationary during the study period. Thereby, the results exhibited the random walk process and the Indian stock market as weak form efficient.

To convert series from non-stationary to stationary ADF test was again performed at first difference. The results of the same are indicated in Table 2. The p-value shows that series becomes stationary at first level difference.

Table 4: Results at first difference

Particulars	T VALUE	1%	5%	10%	PROB
BSE 50	-34.8513	-3.43545	-2.86368	-2.56796	0
BSE 100	-34.7917	-3.43543	-2.86367	-2.56796	0
BSE 200	-34.4059	-3.43543	-2.86367	-2.56796	0
BSE NEXT 50	-33.9777	-3.43543	-2.86367	-2.56796	0
BSE SMALL CAP 250	-29.7472	-3.43545	-2.86368	-2.56796	0
NIFTY 50	-8.54825	-3.44339	-2.86718	-2.56984	0
NIFTY 100	-33.6506	-3.43574	-2.86381	-2.56803	0
NIFTY 200	-8.48084	-3.44339	-2.86718	-2.56984	0
NIFTY NEXT 50	-20.8685	-3.44325	-2.86712	-2.56981	0
NIFTY SMALL CAP 100	-6.89091	-3.44336	-2.86717	-2.56983	0

Auto Correlation and Partial Auto Correlation Test

Weak form of efficiency also indicates that there is no correlation between successive prices, i.e. the study of historical prices of a particular security cannot consistently be used to achieve excess returns. It also shows that undervalued or overvalued stock can be recognized with the help of technical analysis. To test linear dependence or independence of random variables in the series, autocorrelation can be considered as a reliable measure. If no autocorrelation is found in the series, the series is considered to be random (Arora, 2013). Autocorrelation test is mostly used to check the serial dependency in the data which helps in examining the weak form of capital market efficiency. It examines the correlation between the return series and lagged series. Besides this, it also measures whether the correlation coefficients are significantly equal to Zero or not over the different lags.

Null hypothesis to check the autocorrelation in the series is given below, as:

H_0: Indian Stock Market is not weak form efficient

H_1: Indian stock market is weak form efficient

Results of ACF AND PCAF at Level

If the calculated p-values are lesser than the critical value of 0.05 then the stock markets are considered to be weak form efficient. For all indices, the entire autocorrelation coefficients are equal to zero. If this situation persists in the market, the past information is not helpful for ascertaining future consequences. From the table, it can be seen that the autocorrelation value for all 36 lags was found zero.

Overall, the results confirmed the randomness in stock returns. The Indian stock market was found to be weak form efficient, which confirmed that the historical information had no impact on the current prices and could not be used for predicting the future prices.

For indices BSE Small Cap and NIFTY Small Cap ACF and PCAF at first and second difference is an inefficient market form.

The research findings of this study have several implications for the stakeholders, including the stockbrokers and investors. First, the results reported in this study portrayed that the stock market in India exhibited the weak-form inefficient; the investment brokers and investors should exercise caution before selecting their investment portfolios.

Firstly, India, being a thickly populated developing country, there is a wide variety of investors with varying financial requirements. Some investors seek a long-term return on their investment, whereas some prefer to have secured returns every month. Some investors are risk-takers, whereas some are risk-avoiders. Since people with different portfolio requirements influence the stock market, behavioural finance scholars suggest examining the effect of personality factors on investment behaviour. For example, some researchers documented that the personality characteristics of individuals have a significant impact on investment behaviour (Isidore and Christie, 2017; Sadiq and Khan, 2019).

Secondly, financial literacy plays a vital role in investment decisions. Therefore, in addition to the technical analysis of the stock market, the analysts need to consider the level of financial literacy, information access, and subjective Market efficiency of the Indian stock market.

Although theoretically, rational decision-making considers identifying multiple available alternatives and choosing suitable options, it is not possible in reality because of information asymmetry and market anomalies (Sitkin and Weingart, 1995), and investors make decisions based on the available information. Therefore, failure to consider the market anomalies may result in flawed decision-making.

Therefore, it is concluded that the Indian stock market, based on the results from the study, is a weak-form inefficient. Despite the onslaught against the EMH over the last two decades, the puzzling set of stock market anomalies could be considered chance events; some supporters argue that it is hard to find profit even if the market is highly volatile (Roll, 1994). Lack of finding support for EMH may be considered as a shortcoming of the basic model. It would not be an exaggeration that the EMH has not lost its charisma and is expected to be on the agenda of financial economists.

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