A TEST ON MARKET EFFICIENCY OF BSE PSU: A CRITICAL STUDY

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Abstract
Indian economy dramatically changed in last twenty years and this drastic change brought a revolution in Indian economy. Public sector companies have undergone major industrial reforms since conception of liberalization in India. Investment in public sector undertakings directly affects the market capitalization of these companies which is important for the financial health of companies. Investors are expected to adopt innovative investment strategies while investing, for this market efficiency to be judged. Weak form of Efficient Market Hypothesis says that price changes in stock market are always random and independent to each other. It implies that technical analysis cannot be used to earn excess return.The main objective of the study is to analyze the weak form efficiency of S & P BSE PSU Indexby employing the Unit Root Test, Autocorrelation and Run Test to comment on randomness of price changes, So that one take financial decisions accordingly.

Introduction
Indian Public Sector is a very important cog in Indian economy. Indian PSUs proved torchbearers in development of this country.The public sector is expected to provide specially for the further development of industries of basic and strategic importance or in the nature of public utility services. (Indian Planning Commission) Public sector undertakings need to be rejuvenated to prevent drain of national asset. PSUs are playing a very important role to channelize savings in to investment. The government is trying to change its culture and bring efficiency by improving the financial health of these companies. There is a need of massive investment so that these PSUs can fulfill the desired goal. Thus Indian PSUs can be judged for its efficiency by judging its market efficiency in the stock market because stock market plays very important role in channelizing the investment. A stock market is said to be well functioned if the stock price movements are random.Thisrandomness, which forms the theoretical basis of the weak-form efficientmarket hypothesis, states that successive stock prices or returns areindependently and identically distributed; that past stock prices have nopredictive content to forecast future stock prices. (Fama 1995). Market efficiency has been the central paradigm of the financial market. This study was conducted with the objective of examining the role of public sector undertakings in the economic development of the country.The investors do analysis of various sectors of the capitalmarket to select better stocks of the better sector forinvestment. The investor tries to identify the best stock in the best sector where excess return is possible. There are three aspects that wouldgenerally affect the performance of a company's stockin the stock market. The first aspect is the performanceof the individual company. The second is the performances of the sector to which the company belongs to. The third is the performance of the market as a whole and an integrated entity. BSE PSU is one of the core indexes of Bombay Stock Exchange. The present study examines the weak form efficient market theory in 15 selected PSU companies which are part of BSE PSU Index.

S & P BSE PSU Index
BSE Limited launched "S&P BSE PSU Index" on 4 June 2001. This index consists of major Public Sector Undertakings listed on BSE. The S&P BSE PSU Index is displayed on-line on the BOLT trading terminals nationwide.The Base Date for the S&P BSE PSU Index is 1st February 1999, the date when the S&P BSE 500 was launched. Being a subset of S&P BSE 500, the S&P BSE PSU Index ensures a reasonable history of how the Central Government wealth fluctuated on the bourses. The Base Value for the S&P BSE PSU Index has been set at 1000 to ensure adequacy in terms of daily index movement.For consideration of scrips for inclusion in S&P BSE PSU index, Public Sector Undertaking refers to any undertaking wherein the Central Government holding is equal to or more than 51%. Since S&P BSE PSU index is a subset of S&P BSE-500 index, scrips that form part of S&P BSE-500 index automatically get included in S&P BSE PSU index.PSUs or Public Sector Undertakings are among the largest and most profitable organizations in India. As on 31 May 2016, of the total of 290 Central Public Sector Enterprises (CPSEs) and subsidiaries of CPSEs, only 50 are listed.

Literature Review
Gupta and Basuanalyzed the Weak form efficiency of BSE and NSEby using the ADP, PP and KPSS Test and concluded that both these markets are not efficient in weak form and support the theory that markets in emerging markets are not efficient.

Sharma and Seth investigated the weak form efficiency of BSE and NSE in pre and post financial crisis and their result shows that Indian stock market do not follow random walk in pre and post period further they concluded that Indian markets were not affected by financial crisis.

Pinto, Ajaya and Menezes analyzed equity future market in National Stock Exchange using Run test, Autocorrelation and found that most of the futures follow the random walk.

Jaganthan(2014) studied market efficiency of BSE with the help of parametric and nonparametric test(LO McKinley Variance Test, Ljung Box Test and Run Test) his results clearly shows that random walk does not exist in BSE therefore excess return can be generated.

Zabiulla (2012) examined weak form efficiency in BSE and his analysis by Run test, Autocorrelation and Unit Root Test concluded that stock market is informationally inefficient in weak form.

Nalini (2015) empirically tested random walk hypothesis in selected stock listed in BSE using Run Test methodology and concluded that price movements in the share price are random in behavior which implies that historical prices cannot be used for predicting the future prices.

Objective of the Study
- To study whether the share prices of companies listed in BSE PSU are stationary or not?
- To investigate whether share prices of companies are correlated with its own values at different lags?
- To test the validity of random walk hypothesis in BSE PSU companies.

Research Methodology
Hypothesis of the Study
The study will test three hypotheses
Ho: Share prices of S & P BSE PSUCompanies are not stationary.
Ho: There is no significant relationship between the stock prices and its own valuesat different lags.
Ho: BSE PSUs does not follow a random walk means price movement of share prices are affected by the past prices.

Sample Selection
The study focuses on finding out the randomness of successive price changes of companies which are part of S & P BSE PSU Index.The data used in this study consisted of the daily closing prices of 15 selected companies of BSE PSUs for the sample period of ten years from April 2006 to March 2016.

Sources of Data
The present study is based on secondary data. All information regarding market price of stock, daily return of stock were obtained from www.bseindia.com, www.moneycontrol.comin.finance.yahoo.com. Other relevant information was alsocollected from the books and journal.

Tools Used for the Analysis
Unit Root Test
Unit root is used to test the stationarity of timeseries data and to find out whether a time seriesvariable is non-stationary or not. The most popular unit root test for checking thestationarity is Augmented Dickey-Fuller (ADF) test. ADF test has been applied to check the null hypothesis of a unit root. If the series is nonstationaryand the first difference of the series isstationary, the series contains a unit root. It has been examined through software E-views. The results of ADF for Unit Root have been presented in Appendices.

Autocorrelation Function
Serial correlation test measures thecorrelation coefficient between a series of returns and lagged returns in thesame series, whether the correlation coefficients are significantly differentfrom zero.In an efficient market,existence of zero autocorrelation forms the nullhypothesis.It has been examined through software E-views. The result of Autocorrelation has been presented in Appendices.

Run Test
Run test is another very important statistical tool for testing the random walk or statistical independence. It is also known as Wald-Wolfowitz Test. The important feature of run test is that if returns are not normally distributed even then it can be used. Run test is a non-parametric test which is applicable here as a test of randomness for the sequence of return. It has been examined through software SPSS 20. The result of Run test has been presented in Appendices.

Analysis and Interpretation
Unit Root Test
Unit Root examines whether the series is stationary or non-stationary. If the series is non-stationary in level form and stationary in first difference form then it is expected that the series has unit root problem means series is not stationary. The null hypothesis of the study is that series containsunit root. Here ADF test has been employed in order to test the stationarity. If we do the ADF test at level then intercept and trend both should be considered but for the first difference only intercept should be considered. The results shows that series of all the individual stock returns are stationary at the level of 1%, 5% and 10% level because the absolute test statistics is more than the critical value(absolute value) then we reject the null hypothesis, the same thing also can be concluded with the help of p value, if the p value is less than 5 percent we can reject the null hypothesis and accept the alternative. Here p value in all the stocks is less than 5 percent. Thus the first hypothesis that share prices of BSE PSUs are not stationary is rejected. It suggests that market does not have characteristic of efficient market in weak form.

Autocorrelation
The autocorrelation has been used to examine the randomness of the stock returns. If autocorrelation has zero value or close to zero value it means that prices changes in consecutive period are not correlated with each other if vice-versa it implies that series has autocorrelation. If returns have positive and statistically significant autocorrelation it suggests that price moment exist in the market which can be utilized for gaining abnormal returns. Table 3 presents the results of autocorrelation test up to 10 lags. Out of 15 PSUs 7 earned significant value in all the 10 lags. These PSUs are BEL, BHEL, ENGINEERSIN, IOC, NATIONALUM, SAIL, GAIL.The analysis of NTPC, NEYVELILIG reveals that values are not significant up to 5 and 6 lags respectively but becomes significant in subsequent lags.It implies that returns are serially and significantly correlated. Thus the null hypothesis that there is no significant relationship between the stock prices and its own values at different lags has been rejected. In aggregate all the 15 PSUs stock returns do not walk randomly means values are not close to zero. From the above analysisit can be concluded that BSE PSU index is not efficient in weak form.

Run Test
Run Test is a non-parametric test and independent of normality and constant and variance of data. It is used to examine the serial dependencies. Here the null hypothesis is that series does not follow random walk. The calculated value of Run Test (Z) has been compared with the critical value at 5% level of significance. The study finds that value of Z of all the 15 companies falling within the acceptance region because values are less than the critical value 1.96 at 5% levelof significance.So the null hypothesis that series does not follow the random walk has been accepted. The result shows that price movement in BSE PSUs are not random in behavior. It implies that historical prices can be tapped for gaining abnormal profit means BSE PSU is inefficient market in weak form.

Conclusion
The research paper examined the weak form efficiency of EMH in S & P BSE PSU Index. On the basis of empirical results we can conclude that BSE PSU Index is still not efficient in weak form which implies that by using technical analysis one can beat the market because returns does not follow the random walk. The ADF, Autocorrelation and Run Test gave the same results that price prediction is possible by observing the past trends. These results support the common notion that the equity markets in the emerging economies are not efficient.If the price movements are independent it will reflect the efficient and transparent stock price movements.

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Appendices

Table 1: Descriptive Statistics

PSUs	N	Mean	Median	Max.	Min.	S.D	Skewness	Kurtosis	Jb	Prob.
BEL	2480	0.039493	-0.05159	18.28888	-67.4154	2.621261	-6.53917	182.0555	3330633	0.000
BHEL	2480	-0.04679	-0.02547	21.63523	-80.3775	3.201591	-7.67284	186.5797	3506822	0.000
BPCL	2480	0.066417	-0.04993	18.02101	-50.7262	2.635882	-2.44443	60.18275	340356	0.000
CONCOR	2480	0.024036	0.014012	14.25945	-48.2227	2.283375	-4.66646	101.3706	1008934	0.000
ENGINEERSIN	2480	0.006322	-0.14124	19.99885	-80.0017	3.247296	-5.13506	155.5055	2414218	0.000
GAIL	2480	0.031769	-0.03977	14.38115	-35.757	2.318268	-1.33724	29.1387	71339.76	0.000
HINDPETROLTD	2480	0.069722	0	18.00655	-12.6065	2.610988	0.403067	6.71535	1493.547	0.000
IOC	2480	0.017681	-0.03735	16.31654	-50.9262	2.503976	-3.06471	75.31681	544286.8	0.000
MTNL	2480	-0.04871	-0.26286	19.92188	-18.8825	3.047126	0.672177	8.927098	3816.903	0.000
NATIONALUM	2480	-0.01443	-0.08724	14.84428	-77.374	3.16052	-5.78692	149.967	2245770	0.000
NEYVELILIG	2480	0.043414	-0.05697	19.48217	-28.4977	3.029197	0.361454	13.08117	10555.76	0.000
NTPC	2480	0.018198	-0.02341	13.72649	-14.1515	2.005383	0.129391	8.447203	3073.029	0.000
ONGC	2480	-0.01895	-0.03974	16.02805	-76.3957	2.752315	-9.10071	249.236	6299558	0.000
SAIL	2480	0.016795	0	18.6018	-14.3881	2.974558	0.310126	6.397974	1232.864	0.000
SCI	2480	0.003552	-0.04885	17.83659	-33.7238	2.903496	-0.08241	15.71884	16718.92	0.000

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Table 2: Run Test (Results Using Mean)

PSUS	Test Value	Cases<Test Value	Cases>Test Value	Total Cases	No. of Runs	Z Values	Asymp. Sig.
BEL	0.039492883	1300	1180	2480	1205	-1.332587873	0.182667087
BHEL	-0.046793303	1224	1256	2480	1202	-1.558560322	0.11910048
BPCL	0.066416527	1296	1184	2480	1274	1.430086051	0.152692323
CONCOR	0.023847375	1253	1226	2480	1231	-0.375820293	0.7070505
ENGINEERSIN	0.006321828	1345	1135	2480	1195	-1.501398574	0.133252503
GAIL	0.031768878	1286	1194	2480	1251	0.470885545	0.637722471
HINDPETROLTD	0.069721974	1267	1213	2480	1254	0.54607243	0.58501615
IOC	0.017681442	1273	1207	2480	1234	-0.246080327	0.805620052
MTNL	-0.048711644	1320	1160	2480	1211	-1.001919851	0.316382304
NATIONALUM	-0.014427025	1273	1207	2480	1219	-0.849043583	0.395857041
NEYVELILIG	0.043413702	1295	1185	2480	1215	-0.948269037	0.342992509
NTPC	0.0181978	1263	1217	2480	1272	1.262812423	0.206656599
ONGC	-0.018950887	1251	1229	2480	1238	-0.116596663	0.907179682
SAIL	0.016795254	1257	1223	2480	1207	-1.356641457	0.174895162
SCI	0.003551933	1294	1186	2480	1197	-1.676156991	0.093707446

Table 3: Autocorrelation

PSUs	LAG	1	2	3	4	5	6	7	8	9	10
BEL	AC	0.047	0.005	-0.044	-0.032	0.029	-0.043	-0.018	0.025	0.04	0.035
	Prob.	0.018	0.06	0.015	0.011	0.01	0.003	0.004	0.005	0.002	0.001
BHEL	AC	0.075	-0.02	-0.028	-0.023	-0.006	-0.043	0.029	0.022	0.005	0.007
	Prob.	0	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.002	0.003
BPCL	AC	0.002	0.013	-0.011	-0.011	-0.015	-0.005	0.002	0.003	-0.025	0.027
	Prob.	0.934	0.815	0.875	0.907	0.903	0.949	0.977	0.989	0.954	0.887
CONCOR	AC	0.011	-0.002	0.019	-0.038	-0.012	-0.023	0.01	-0.031	-0.05	0.018
	Prob.	0.567	0.843	0.742	0.31	0.398	0.373	0.461	0.337	0.086	0.099
ENGINEERSIN	AC	0.072	0.019	0.032	-0.008	0.049	-0.012	0.034	0.006	0.023	0.008
	Prob.	0	0.001	0.001	0.002	0	0.001	0.001	0.001	0.001	0.002
GAIL	AC	-0.041	-0.031	0.001	-0.037	-0.043	-0.027	0.043	0.019	-0.007	0.015
	Prob.	0.043	0.038	0.008	0.041	0.012	0.012	0.004	0.005	0.009	0.012
HINDPETROLTD	AC	0.016	0.011	0.003	-0.037	-0.021	-0.038	0.03	-0.006	0.007	0.028
	Prob.	0.419	0.625	0.81	0.365	0.369	0.177	0.129	0.185	0.247	0.202
IOC	AC	0.09	0.016	0.016	-0.033	-0.024	-0.028	0.013	-0.021	0.027	0.006
	Prob.	0	0	0	0	0	0	0	0	0	0.001
MTNL	AC	0.024	0.033	-0.018	0.033	-0.015	-0.006	0.05	0.057	-0.003	0.041
	Prob.	0.227	0.122	0.171	0.1	0.141	0.211	0.041	0.004	0.007	0.003
NATIONALUM	AC	0.057	0.031	-0.037	-0.003	0.025	-0.006	0.035	0.002	0.001	0.009
	Prob.	0.004	0.005	0.003	0.008	0.009	0.017	0.01	0.017	0.029	0.044
NEYVELILIG	AC	0.026	0.005	-0.036	-0.017	-0.001	-0.026	0.054	0.032	0.014	0.006
	Prob.	0.196	0.421	0.173	0.225	0.34	0.292	0.043	0.03	0.041	0.061
NTPC	AC	0.008	-0.031	-0.023	-0.01	-0.036	-0.071	0.02	0.032	0.009	-0.013
	Prob.	0.705	0.289	0.286	0.399	0.202	0.003	0.004	0.003	0.005	0.008
ONGC	AC	0.024	-0.011	-0.039	-0.009	-0.029	-0.038	0.002	0.021	-0.015	-0.013
	Prob.	0.23	0.416	0.142	0.225	0.167	0.075	0.119	0.126	0.153	0.191
SAIL	AC	0.047	-0.018	-0.01	-0.036	-0.019	-0.047	0.024	0.066	0.051	-0.01
	Prob.	0.02	0.045	0.091	0.045	0.06	0.013	0.014	0	0	0
SCI	AC	0.037	0.035	-0.018	-0.024	-0.029	-0.01	0.026	0.032	0.016	0.05
	Prob.	0.069	0.043	0.068	0.072	0.057	0.088	0.079	0.054	0.069	0.014

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Table4: Unit Root Test
Critical Value of Augmented Dicky Fuller Test (Level 0) (Intercept and Trend)

PSUs	LAG	Critical Value	PROB.	1%	5%	10%
BEL	0	-47.45677	0.000	-3.961746	-3.411621	-3.127681
BHEL	0	-46.18927	0.000	-3.961746	-3.411621	-3.127681
BPCL	0	-49.68506	0.000	-3.961746	-3.411621	-3.127681
CONCOR	0	-49.19196	0.000	-3.961746	-3.411621	-3.127681
ENGINEERSIN	0	-46.29977	0.000	-3.961746	-3.411621	-3.127681
GAIL	0	-51.82454	0.000	-3.961746	-3.411621	-3.127681
HINDPETROLTD	0	-48.97566	0.000	-3.961746	-3.411621	-3.127681
IOC	0	-45.49493	0.000	-3.961746	-3.411621	-3.127681
MTNL	0	-48.57446	0.000	-3.961746	-3.411621	-3.127681
NATIONALUM	0	-46.98379	0.000	-3.961746	-3.411621	-3.127681
NEYVELILIG	0	-48.49951	0.000	-3.961746	-3.411621	-3.127681
NTPC	0	-49.39703	0.000	-3.961746	-3.411621	-3.127681
ONGC	0	-48.57384	0.000	-3.961746	-3.411621	-3.127681
SAIL	0	-47.53541	0.000	-3.961746	-3.411621	-3.127681
SCI	0	-47.97421	0.000	-3.961746	-3.411621	-3.127681

Critical value of Augmented Dicky fuller Test (First Difference) (Intercept)

PSUs	LAG	Critical Value	PROB.	1%	5%	10%
BEL	17	-21.45514	0.000	-3.432813	-2.862514	-2.567334
BHEL	16	-21.38855	0.000	-3.432812	-2.862514	-2.567333
BPCL	15	-22.70699	0.000	-3.432811	-2.862513	-2.567333
CONCOR	17	-22.24555	0.000	-3.432813	-2.862514	-2.567334
ENGINEERSIN	11	-24.67042	0.000	-3.432807	-2.862511	-2.567332
GAIL	15	-22.06614	0.000	-3.432811	-2.862513	-2.567333
HINDPETROLTD	14	-22.97252	0.000	-3.43281	-2.862513	-2.567333
IOC	13	-23.77692	0.000	-3.432809	-2.862512	-2.567333
MTNL	15	-21.1396	0.000	-3.432811	-2.862513	-2.567333
NATIONALUM	15	-21.6657	0.000	-3.432811	-2.862513	-2.567333
NEYVELILIG	19	-19.65494	0.000	-3.432815	-2.862515	-2.567334
NTPC	15	-23.47428	0.000	-3.432811	-2.862513	-2.567333
ONGC	15	-22.7173	0.000	-3.432811	-2.862513	-2.567333
SAIL	15	-22.45463	0.000	-3.432811	-2.862513	-2.567333
SCI	14	-22.79517	0.000	-3.43281	-2.862513	-2.567333

- BEL - Bharat Electronics Ltd.
- BHEL - Bharat Heavy Electricals Ltd.
- BPCL - Bharat Petroleum Corporation Ltd.
- CONCOR - Container Corporation of India Ltd.
- ENGINERSIN - Engineers India Ltd.
- GAIL - GAIL (India) Ltd.
- HINDPETROLTD - Hindustan Petroleum Corporation Ltd.
- IOC - Indian Oil Corporation
- MTNL - Mahanagar Telephone Nigam Ltd.
- NATIONALUM - National Aluminum Company Ltd.
- NEYVELILIG - Neyveli Lignite corporation Ltd.
- NTPC - National Thermal Power Corporation
- ONGC - Oil and Natural Gas Corporation Ltd.
- SAIL - Steel Authority of India Ltd.
- SCI - Shipping Corporation of India Ltd.