An Empirical Study About Testing Weak Form of Market Efficiency:– A Case Study of BSE And NYSE

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Abstracts

The research work presented here is about testing weak form of market efficiency of Indian stock market and USA stock market. The hypothesis about randomness of stock indices movement in both the markets was tested using Runs test, for this monthly index data for the period from April 2008 to March 2017 were collected. The null hypothesis about independent movement of stock indices for both the markets was tested at 5% significance level. The test result supported the acceptance of null hypothesis – both the markets were found efficient in weak form during the period of the study.

Keywords : Efficient market, Runs test, Stock index

Efficient Market Hypothesis - Introduction

A market is said to be efficient in which share prices follow an independent path, this happens because of the following :

- Large number of investors in the market

- Free flow of information to all the investors

- Every investor is capable to interpret the information

- Every kind of price sensitive information is discounted in the prices immediately

- No one is in a position to influence the market unduly

When a market is efficient then each price of a share is independent of the previous price, the prices are influenced by the equilibrium of demand and supply. A market can be either identified as an efficient or inefficient. The market efficiency totally depends upon the facilities, full disclosure, transparency and regulatory provision

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governing the market. India market was an inefficient market in the past because of the various factors like, lack of transparency, manual trading system, delay in the settlement of trades, no protection to investors, especially small investors, etc.

Forms of Market Efficiency

As per the fundamentals of efficient market hypothesis a market might be in any of the following form of efficiency

Weak form of efficiency: A market is considered efficient in weak form only when each subsequent price is independent of the previous price. The prices always make a random walk, and get affected only by the demand and supply position. If a market reflects such form of efficiency, then 'Technical Analysis' cannot benefit the investors in making investment decisions. Under technical analysis it is presumed that past price trends and traded volumes affect the price trend in the future, the study of past trends can help in predicting near future price trends. (For detailed study of technical analysis refer to the chapter on technical analysis of this book)

Semi-strong form of efficiency: A level of efficient market in which companies, industrial houses and government follow the principle of full disclosure and transparency. Every kind of price sensitive information is made available in the market as soon as it is generated. The effect of this is that such information gets reflected in the prices immediately and influences the prices only during the shorter time span, it has no subsequent effect on the prices. If a market has such form of efficiency, then, even the 'Fundamental Analysis' cannot benefit. Fundamental analysis is the study of fundamental factors about economy, industries and companies for investment decisions. (for detailed study of fundamental analysis refer to chapter on fundamental analysis of this book)

Strong form of efficiency: Market is considered to be efficient in strong form, when an insider is not able gain from the information. A strong form of efficiency is achieved only when high level of disclosure standards and transparency the end of company is maintained; it may be obligatory or voluntary. Such as strict restriction and check on insider trading, this can be achieved through immediate, regular and full disclosure by companies; this does not give any chance for insiders to gain from insider information.

According to the efficient market hypothesis it can be concluded that share prices follow an independent movement because of the market efficiency. Provisions of full disclosure and transparency do not provide any one to exercise undue influence on the market. Presence of large number of investors having capability to interpret the information in right direction, make the prices to move independently. In an efficient market neither fundamental analysis nor technical analysis can help indecision making, it is the demand and supply position which influences the price movement. In a high degree of efficiency of market even an insider cannot achieve undue gains.

Efficient Market Hypothesis (EMH) is based on the fundamentals that markets are efficient and prices make an independent movement in these markets. Each price of an individual share is independent of the previous price, the implication of this is that price of a moment does not affect the price of another moment, this type of movement

of prices is called as random walk of prices, therefore this hypothesis is also called random market hypothesis. According to this hypothesis prices get affected by the demand and supply position. Prices reflect equilibrium position of the demand and supply, these show a wide fluctuation, only on account of a disequilibrium in the demand and supply position. Runs test helps in finding out whether a particular movement is random or not to test weak form of market efficiency runs test was used and it was concluded that both the markets are efficient in weak form.

Literature Review

To carry out the empirical testing of different statistical tools in the field of portfolio management previous studies on similar topic were studies. These studies helped in shaping the scope of the ensuing study particularly the application of RUNS test in testing efficiency of capital market. Abstracts of the studies reviewed is presented below.

Sarkar, Chakrabarti, and Sen (2007) report that shocks in Dow Jones, Jakarta stock index has profound effect on the BSE Sensex. The study concluded that these three markets have re-coupling effect. They also established the fact that prior to 1991-92 BSE Sensex maintained de-coupling with these markets but in the new millennium it has moved towards re-coupling.

Study by **Harri Toivonen (2005)** on modeling, valuation and risk management of stock market derivatives. This study concluded that both long-term trends and short-term fluctuations in share prices have important consequences for global economic growth. On the supply side for shares in a market of many developing countries still continue to rely heavily on macro economic aggregates same is true about the demand for the shares also.

Padhi (2005) reports the trend of volatility in the case of aggregate indices and five selected sectors such as electrical, machinery, mining, non-metallic and power plant sector. Under the study a correlation was tested between aggregate index value and sector wise index values. It was concluded that majority of the sector specific indices have high degree of correlation with the aggregate index value.

In a study by **Gorton, Gary, B., and Rouwenhorst, Geert, K (2004)** focused on the simple properties of options and futures market as an asset class. It concluded that fully collateralized option and futures markets historically have offered the same return as U.S. equities market. This study concluded that options and futures market returns are positively correlated with inflation, unexpected inflation, and changes in expected inflation.

Chaudhury S K (2003) examine the interdependence of the three major stock markets in south Asia stock market indices namely India, Taiwan, and Singapore by employing bivariate and multivariate co-integration analysis to model the linkage among the stock markets. Under the study it was concluded that there was no co-integration among these markets for the period from January 1994 to November 2002.

Narayanaswamy R (2002) found out that the response time of stock prices to unanticipated news lasted about two hours after which they tended to reverse. According to the study it was concluded that such tendency of price movement reflects high level of transparency and full disclosure in the market. This type of market is considered as efficient not only in weak form but also efficient in strong form also.

Dilbagh S B (**2002**) reported that 63.5% of extreme volatility increases and 53.4% of decreases are associated with extraordinary reported news items. These extraordinary news items are from systematic and non-systematic factors both. Systematic factors are like national and international events, natural calamities; macroeconomic aggregate and non-systematic factors are company or industry specific like merger and acquisition, announcement of bonus or split of the company.

Research Methodology

The research was empirical in nature to test the weak form efficiency of the Indian stock market and of US stock market, monthly stock market index data of BSE Sensex and NYSE Composite were collected for the period from April 2008 to March 2017. By using these data for both the markets the hypothesis about randomness of both the stock market indices was tested.

To test the weak form of market efficiency of Indian stock market and USA stock market following hypothesis was formulated:

H01: "BSE Sensex movement each time is independent of the previous time period's index movement"

Ha1: "BSE Sensex movement each time is not independent of the previous time period's index movement"

H02: "NYSE Composite Index movement each time is independent of the previous time period's index movement"

Ha2: "NYSE Composite Index movement each time is not independent of the previous time period's index movement"

Both the hypothesis were tested using Runs test at 5% significance level.

Table # 01 Showing Monthly Index Data and Calculation of Runs

(Source for index values: www.bseindia.com and www.nyse.com, runs values calculated)

Month	BSE Sensex	Sign	Runs	NYSE Composite	Sign	Runs	Month	BSE SENSEX	Sign	Runs	NYSE Composite	Sign	Runs
Apr-08	4905			6210			Oct-12	5672	+		6693	+	
May-08	4253	+	1	6311	+	1	Nov-12	6234	+		7006	+	
Jun-08	4675	+		6430	+		Dec-12	6603	+		7250	+	
Jul-08	4647	-	2	6400	-	2	Jan-13	6556	-	24	7090	-	26
Aug-08	4330	-		6740	+	3	Feb-13	6714	+	25	7321	+	27
Sep-08	4417	+	3	6630	-	4	Mar-13	6493	-	26	7167	-	28
Oct-08	3820	-	4	6660	+	5	Apr-13	6154	-		7008	-	
Nov-08	3928	+	5	6300	-	6	May-13	6715	+	27	7009	+	29
Dec-08	4081	+		6560	+	7	Jun-13	7194	+		7134	+	
Jan-09	4168	+		6644	+		Jul-13	7635	+		7217	+	
Feb-09	4310	+		6271	-	8	Aug-13	7805	+		7477	+	
Mar-09	3808	-	6	5890	-		Sep-13	8634	+		7496	+	
Apr-09	3487	-		6344	+	9	Oct-13	7892	-	28	7633	+	
May-09	3614	+	7	6423	+		Nov-13	8789	+	29	7433	-	30
Jun-09	3440	+	8	6220	-	10	Dec-13	9398	+		7645	+	31
Jul-09	3347	-		6178	-		Jan-14	9920	+		7754	+	
Aug-09	3305	-		5880	-		Feb-14	10370	+		8106	+	
Sep-09	2918	-		5440	-		Mar-14	11280	+		8060	-	32
Oct-09	3164	+	9	5464	+	11	Apr-14	12043	+		8233	+	33
Nov-09	3175	+		5792	+		May-14	10399	-	30	8471	+	
Dec-09	3314	+		5812	+		Jun-14	10609	+	31	8189	-	34
Jan-10	3353	+		5790	-	12	Jul-14	10744	+		8169	-	
Feb-10	3529	+		5742	-		Aug-14	11699	+		8242	+	35
Mar-10	3581	+		6004	+	13	Sep-14	12454	+		8388	+	
Apr-10	3338	-	10	5742	-	14	Oct-14	12961	+		8470	+	
May-10	3125	-		5708	-		Nov-14	13696	+		8775	+	
Jun-10	3245	+	11	5337	-		Dec-14	13787	+		8969	+	
Jul-10	2988	-	12	4914	-		Jan-15	14091	+		9139	+	
Aug-10	3181	+	13	4955	+	15	Feb-15	12938	-	32	9255	+	
Sep-10	2992	-	14	4454	-	16	Mar-15	13072	+	33	9124	-	36
Oct-10	2950	-		4729	+	17							

Month	Value	+/-	Run	Value	+/-	Run
Nov-10	3228	+	15	4953	+	
Dec-10	3378	+		5000	+	
Jan-11	3250	-	16	4869	-	18
Feb-1	3284	+	17	4717	-	
Mar-11	3048	-	18	4730	+	19
Apr-11	2959	-		5132	+	
May-11	3181	+	19	5436	+	
Jun-11	3607	+		5506	+	
Jul-11	3793	+		5559	+	
Aug-11	4244	+		5661	+	
Sep-11	4453	+		5644	-	20
Oct-11	4906	+		5959	+	21
Nov-11	5045	+		6073	+	
Dec-11	5839	+		6440	+	
Jan-12	5696	-	20	6552	+	
Feb-12	5667	-		6692	+	
Mar-12	5591	-		6599	-	22
Apr-12	5655	+	21	6439	-	
May-12	4760	-	22	6485	+	23
Jun-12	4795	+	23	6603	+	
Jul-12	5170	+		6403	-	24
Aug-12	5192	+		6454	+	25
Sep-12	5584	+		6570	+	
Apr-15	13872	+		9262	+	37
May-15	14544	+		9628	+	
Jun-15	14651	+		9979	+	
Jul-15	15551	+		9873	-	38
Aug-15	15329	-	34	9554	-	
Sep-15	17291	+	35	9597	+	39
Oct-15	19838	+		10039	+	
Nov-15	19363	-	36	10312	+	
Dec-15	20287	+	37	9857	-	40
Jan-16	17649	-	38	9740	-	
Feb-16	17579	-		8963	-	
Mar-16	15644	-		8797	-	
Apr-16	17287	+	39	9299	+	41
May-16	16415	-	40	9401	+	
Jun-16	13461	-		8660	-	42
Jul-16	14355	+	41	8438	-	
Aug-16	14565	+		8382	-	
Sep-16	12860	-	42	7532	-	
Oct-16	9788	-		6061	-	
Nov-16	9092	-		5599	-	
Dec-16	9647	+	43	5757	+	43
Jan-17	9424	-	44	5195	-	44
Feb-17	8891	-		4617	-	
Mar-17	9708	+	45	4978	+	45

The above table shows index values for the period from April 2008 to March 2017 and runs for both the indices.

Empirical Testing Using Runs Test – A Tool For Testing Weak Form Of Market Efficiency

Runs test is used to test whether a market is in weak form of efficiency or not, if price movement passes this test, then market is considered to be efficient in weak form of efficiency. It is carried as follows:

- Month end index values for BSE Sensex and NYSE Composite index were collected for the period from April, 2008 to March, 2017.

- A Null hypothesis about the independence of market index movement was assumed. The null hypothesis assumed was as follows:

H0 : "Index movement each time is independent of the previous time period's index movement"

Ha : The alternate hypothesis was "Index movement each time is not independent of the previous time period's index movement"

- Number of 'runs' in the collected index data were identified. A 'run' means occurrence of a particular index movement followed or preceded by another kind of occurrence. Like increasing (+) index value and decreasing (-) index value are two types of 'runs. The total number of runs were counted at the end.

- Number of + signs and – signs were counted separately as n_1 and n_2 respectively.

- Mean 'runs' was calculated using the formulae

$$\mu r = \frac{2n1n2}{n1 + n2} + 1$$

- Standard deviation of 'runs'

$$\sigma r = \sqrt{\frac{2\,n1n2\,(2\,n1n2 - n1 - n2)}{(n1 + n2\,)2\,(n1 + n2 - 1\,)}}$$

n_1 = number of '+' signs, n_2 = number of '-' signs, μr = Mean value of runs calculated on the basis of n_1 and n_2, σ_r = Standard deviation of runs from the mean value of runs.

With the help of mean (μr) runs and standard deviation (σ_r) of runs upper limit and lower limit of expected/observed number of runs was calculated. These upper and lower limits were set by using a significance level. In the study a significance level of 5% has been taken to arrive at the upper and lower limit of observed runs. At 5% significance level value for area under normal curve value is 1.96. The upper and lower limits were calculated as follows:

Upper limit = μr + 1.96* σ_r

Lower limit = μr - 1.96* σ_r

The criterion for decision about acceptance or rejection of null hypothesis under runs test is to make an observation whether number of observed runs fall within the upper and lower limits calculated as above or not. If observed number of runs fall within the upper and lower limits then the null hypothesis of independence is accepted and it is concluded that the market has week form of efficiency i.e. prices/index make an independent movement in the market without getting affected by the previous price/index movement. If observed number of runs fall outside the limits calculated above then null hypothesis is rejected and it is concluded that the market is not efficient in weak form i.e., each price/index movement is not independent of the previous price/index movement.

RUNS TEST AND TEST OF MARKET EFFICIENCY (EFFICIENT MARKET HYPOTHESIS)

Test of Market Efficiency – Testing Weak Form of Market Efficiency[2]

Market efficiency level can be tested with the help of quantitative as well qualitative measurements. Quantitative methods like 'RUNS Test' and qualitative test is through the method of 'Observation about the disclosure and transparency measurements' are used to test market efficiency. RUNS test used to test week form of market efficiency where qualitative tests are used to test semi-strong and strong form of market efficiency.

Hypothesis

H_0: The movement of index value is independent of the previous index value.

H_a: The movement of index value is not independent of the previous index values.

Table # 2 Different Parameter under runs test for BSE Sensex

Observed Runs	45
+ SIGN (n_1)	68
- SIGN (n_2)	39
u_r	50.57
σ_r	4.77
Upper Limit	59.92
Lower Limit	41.22

As observed number of runs are 45 which fall within the upper and lower limit of runs therefore null hypothesis of independence of index movement is accepted and it is concluded that the Indian stock market is efficient in weak form.

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[2] Index value is also referred as price of the whole market hence index value and price of the market are synonyms of each other.

Table # 3   Different Parameter under runs test for NYSE Composite Index

Observed Runs	45
+ SIGN (n_1)	63
- SIGN (n_2)	44
u_r	52.81
σ_r	4.98
Upper Limit	62.57
Lower Limit	43.05

As observed number of runs are 45 which fall within the upper and lower limit of runs therefore null hypothesis of independence of index movement is accepted and it is concluded that the USA stock market is efficient in weak form.

Conclusion About RUNS test

Runs test was used to test the weak form efficiency of both of these markets. Runs test is used to test whether the share prices/index values make an independent movement in the short run or not. The null hypothesis was taken as that the index value makes a random movement and each price does not get affected by the index value preceding it on the same stock exchange. The test result of run test at 5% significance level revealed that for both the indices observed number of runs were 45 each. Statistically calculated upper and lower limit of runs for BSE Sensex was 59.92 and 41.22 respectively this shows that null hypothesis of random walk hypothesis is to be accepted and it was concluded that the movement of prices and index in BSE was random for the period from April 2008 to March 2017. Similarly upper and lower limit of runs for NYSE composite index was 62.57 and 43.05 respectively which shows that observed number of runs i.e., 45 was within the range and null hypothesis of random walk was accepted.

Hence null hypothesis – the movement of index value is independent of previous index value is accepted. It was concluded that in both the markets prices (index is the representative of whole market) make a random walk and both the markets were found efficient in weak form during this period i.e., each individual index did not get affected by the previous index movement.

CONCLUSION

The empirical testing as discussed in the paper shows that different statistical tools find a very frequent application in the field of portfolio management. By using these tools, a portfolio planner can make efficient and effective investment decision. By using the test like RUNS test one can assess the efficiency level of market. If a market is efficient in weak form, then technical analysis cannot help the investors in making extra gains by using tools of technical analysis. These statistical tools are having strong predictive capabilities if analysed in right direction and at right time.

REFERENCES

Brown, Stephen J., William N. Goetzmann, Stephen A. Ross, 1995 : "Testing Market Efficiency", The Journal of Finance, 853-873

Chan, Kam C., Benton E. Gup and Ming-Shiun Pan, 1997 : "International Stock Market Efficiency and Integration – A Study of Eighteen Nations", Journal of Business Finance & Accounting, 803-813.

Chopra Navin, Josef Lakonishok and Jay R. Ritter, 1992,:"Measuring Abnormal Performance – Do stocks Overreact?", Journal of Financial Economics, 235-268

Chaudhury S K (2003), "Short Run Behavior of Industrial Share Price Indices: An Empirical Study of Returns, Volatility and Covariance Structure", Prajanan, Vol. XX, Apr-Jun, No. 2, p. 99-113.

Dilbagh S B (**2002**), "Indian Stock Market Seasonality: A Note", Indian Economic Journal, Vol 39, No. 2, (Oct-Dec), p. 110-119.

Dimson Elroy and Massoud Mussavian, 2000: "Market Efficiency", The Current State of Business Disciplines, Publisher : Spellbound Pubns. Pvt. Ltd.

Gorton, Gary, B., and Rouwenhorst, Geert, K (2004), " Facts and Fantasies about Options and Futures," International Journal of Management, Vol. 10, No. 2, (July), p. 151-156.

Hall Stephen and Giovanni URGA, 2002: "Testing for Ongoing Efficiency in The Russian Stock Market", Journal of Finance & Accounting.

Harri Toivonen (2005), "Modeling, Valuation and Risk Management of Commodity Derivatives" Annual Issue of ICFAI, December 2005, p. 27-34

Levy Moshe, 2001: "Market Efficiency, the Pareto Wealth Distribution and the Distribution of Stock Returns, Journal of Accounting and Finance.

Narayanaswamy R (2002), "Capital Market Efficiency and Financial Reporting", IIMB Management Review, Vol. 4 No. 2, p. 55-69

Padhi (2005), " Comparison of Aggregate Indices and Sector specific Indices", Chartered Secretary, Vol 351, No. 6 (Jun), p.423.

Richardson Mathew and Tom Smith, 1991: "Test of Financial Models in The Presence of Overlapping Observations", The Review of Financial Studies, 227-254

Sarkar, Chakrabarti, and Sen (2007), "A Study on Volatility and Re-coupling of Select Stock Markets of Asia", Indian Journal of Finance, Mumbai, Oct. 2008, p.110-115

Yue Wei T. Alok R. Chaturvedi and Shailendra Mehta, 2000: " Is More Information Better ? The Effect of Traders' Irrational Behaviour on An Artificial Stock Market", Proceedings of The Twenty First International Conference on Information Systems (ICIS), December 2000.

Zhang Yi-Cheng, 1999,: " Toward a Theory of Marginally Efficient Markets", Physica A : Statistical Mechanics and Its Applications, 269.