Weak Form Efficiency of Selected Asian Stock Exchanges

Sultan Singh
Professor, Department of Business Administration, Chaudhary Devi Lal University, Sirsa

Kumari Sapna
Assistant Professor, JCD Institute of Business Management, Sirsa

Abstract

The concept of efficient market hypothesis is important to better understand the functioning 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. This paper examines the weak form of the efficient market hypothesis for the selected Asian stock exchanges. The study used the daily, weekly and monthly observations over a period of 1st Jan. 2003 to 31st December 2011. The required data regarding closing prices of selected indexes has been collected from the yahoo finance website. In order to determine the validity of weak form efficiency of the Asian stock exchanges, auto-correlation, Box-Ljung statistics and runs test has been applied. The study concludes that Hangseng stock exchange follow random walk behaviour on the basis of runs test results but BSE and STI do not follow random behavior in case of daily prices. The study concludes that BSE and Hangseng is found to be weak form efficient.

Key Words: Weak form, Runs Test, Auto-correlation, BSE, STI

Introduction

After 1991, liberalization, privatization and globalization have made huge flow of funds for investment in stock market which gave a momentum reform to NSE and BSE. After that, significance of stock market's role in the development of economy is being realized in India. And the result was the integration of emerging markets with the developed markets. With the increase in flow of investments into emerging markets, academics and practitioners are paying increased attention to the emerging markets resulting in a better understanding of these markets. Innumerable studies have been conducted on random walk behaviour yet a popular topic for research because of regular changes in market conditions. For this dynamic stage in capital markets of India it is necessary to assess the level of efficiency of the equity markets in India in order to establish its longer term role in the process of economic development. Therefore, the recent study has been conducted in order to analyze the randomness behaviour of other Asian stock exchanges with Indian stock market.

Review of Literature

In the process of continuous evaluation of the performance of stock markets, the various academicians, scholars and administrators have made several studies on weak form efficiency but in different periods and in different perspectives. A brief review of some of the relevant study is as under:

Sarma (2004) examined the Indian stock market's efficiency in the 'weak form' in the context of calendar anomalies, especially in respect of the weekend effect. Daily returns generated by the SENSEX, NATEX, and BSE-200 during 1st January 1996 to 10th August 2002 comprising a total of 1,667 observations for each of the indices are considered for testing the seasonality. This study employed the daily mean index value for generating the daily returns to relax the implied assumption of the earlier studies by considering the closing values of the indices that trading is done at the closing values. A non-parametric test Kruskall-Wallis test is employed for testing the seasonality in the Indian stock market returns. It is found that the Monday-Friday set for all the indices has the highest positive deviation thereby indicating the presence of opportunity to make consistent abnormal returns through a trading strategy of buying on Mondays and selling on Fridays which is found to be beneficial in case of SENSEX alone during the period under study while for the others - NATEX and BSE200 - a passive 'buy and hold' strategy is more effective.

Elango and Hussein (2008) tested for market efficiency across the seven stock markets in the GCC (Gulf Co-operation Council) countries using daily indices between October 2001 and October 2006 with the help of Kolmogorov - Smirnov test. It was found that all the above seven markets reject the null hypothesis that the returns follow a normal distribution. Again, based on runs test for randomness, the hypothesis pertaining to random walk and weak-form efficiency of the GCC markets is rejected for all the seven markets during the period under study. This conclusion corroborates with the findings of the past studies carried out in GCC context and the developing and underdeveloped markets.

Mittal and Jain (2009) tested the weak form of efficiency and the efficient market hypothesis on Indian stock market in the form of random walk, during the period of 2007-2008 based on closing prices and daily returns on the Indian stock market three representative indices: S&P CNX 500, CNX 100, and BSE 200. Three types of anomalies namely Monday Effect, Friday Effect and Day of the week effect were examined and found that none of the above anomalies exist in the Indian stock market as informational efficient. Serial correlation and run test also support the random walk theory and market efficiency hypothesis.

Srinivasan (2010) examined the random walk hypothesis to determine the validity of weak-form efficiency for two major stock markets in India by using daily observations over the span from 1st July 1997 to 31st August 2010, comprising a total of 3244 observations. The random walk hypothesis is examined using unit root tests namely, Augmented Dickey-Fuller (1979) test and the Phillips-Perron (1988) test and concluded that the null hypothesis of unit root is convincingly rejected in the case of stock market returns of two major indices, viz. S&P CNX NIFTY and the SENSEX. The empirical results do not support the validity of weak-form efficiency for stock market returns of Indian stock exchanges.

Venkatesan (2010) investigated the random walk behaviour of stock market returns in India. The naïve random walk model was estimated using Ordinary Least Squares (OLS) method over the period 1st January, 2008 to 31st December, 2009. The study revealed that the return series is insignificantly different from zero, which is consistent with the random walk hypothesis, therefore suggested that the Indian stock market is found to be efficient and supports the random walk behaviour.

Hamid and Suleman and Shah and Akash (2010) tested the weak-form market efficiency of the stock market returns of Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesia, Malaysia, Philippine, Singapore, Thailand, Taiwan, Japan and Australia. Monthly observations are taken for the period January 2004 to December 2009. Autocorrelation, Ljung-Box Q-statistic Test, Runs Test, Unit Root Test and the Variance Ratio were used to test the hypothesis that the stock market follows a random walk. Monthly returns are not normally distributed because they are negatively skewed and leptokurtic. It was concluded that the monthly prices do not follow random walks in all the countries of the Asian-Pacific region.

Gupta and Yang (2011) tested the weak form efficiency for the two major equity markets (BSE and NSE) in India for the period 1997 to 2011. Results of market efficiency are mixed as: for quarterly data, all three methods ADF, PP and KPSS tests support the weak form efficiency for later sample period 2007 to 2011, but slight conflict for earlier period 1997 to 2007 as only PP test shows weak form inefficiency; for monthly data, all three test method are consistent on the weak form efficiency for the period 2007 to 2011 and not efficient for earlier period 1997-2007. For daily and weekly data, all three test methods reject weak form efficiency during all sample periods.

Khan and Ikram and Mehtab (2011) investigated the market efficiency of Indian Capital Market in its weak form based on the indices of two major stock exchanges of India viz. NSE and BSE. The efficiency is tested using the daily closing values of the indices of NSE and BSE over the period of 1st April 2000 to 31st March 2010 by employing runs test, which is a non parametric

test. Based on the result of runs test, alternate hypothesis is rejected , which proves that Indian capital market neither follow random walk model, nor is a weak form efficient.

Spate and Ansari (2011) studied on 200 secondary shares of BSE forming part of BSE – 200 index using daily closing prices for ten years. Weak form market efficiency is tested utilizing autocorrelation analysis, Ljung-Box Q (LBQ) statistics and Runs test. The results signify that trading strategies based on historical prices cannot be used to gain abnormal profits consistently.

Hussain and Hamid and Akash and Khan (2011) studied the day of the week effect as a stock market anomaly on the equity market practices in Pakistan. The modus-operandi applicable in this research consists of daily stock prices concerned to KSE-100 Index, for the period January 2006 to December 2010. It was concluded that Tuesday returns are quite significant and positive. Hence, it is inferred that there exists day effect in Pakistani stock market. The returns of Tuesday, on an average, are greater in comparison to rest of the days. The regression analysis is performed to meet the thrust of this study.

Irfan and Saleem and Irfan (2011) examined the performance of Karachi Stock Exchange (KSE) of Pakistan via non- parametric approaches by taking weekly open and closing prices of KSE-100 indexes for the period of 1st January 1999 to 31st August 2009. Several non-parametric approaches including Kolmogorov-Smirnov test (Lilliefors test), Ryan-Joiner test (Shapiro-Wilk), Anderson-Darling test, Phillips Perron (PP) unit root test and Runs test are used to test the conviction of the KSE stock market. All non-parametric tests informed that both return series do not follow the assumption of normality and randomness, which means rejecting the hypothesis of weak form of efficiency. Generally, results from the observed analysis strongly recommend that the Karachi Stock Market of Pakistan is not efficient.

Various studies have been conducted on random walk behavior of Indian stock market as well as other stock exchanges. Most of the studies used runs test, auto-correlation and ADF test to determine the validity of weak form efficiency. But only a few studies have been found on random walk behavior of Asian stock exchanges using daily and weekly closing prices both. Therefore, the present study is conducted to study on random walk behaviour of selected Asian stock exchanges for a period of 9 years i.e. 1st Jan. 2003 to 31st Dec. 2011 by using daily, weekly and monthly closing prices.

Objectives of the Study:

The present study is conducted to achieve the following objectives:

1. To determine the validity of the weak form of efficiency of selected Asian stock exchanges.
2. To study the randomness behaviour of selected Asian stock exchanges.

Research Hypotheses:

H_{01}: The selected Asian stock exchanges are found efficient in weak form.

H_{02}: The stock returns in Asian stock exchanges follow random behaviour.

Research Methodology:

The present study is of descriptive in nature and is based on secondary data. All the stock exchanges of Asian countries have been considered for the study. But the adjusted closing values of the indexes for the time period 1st Jan. 2003 to 31st March 2011 was available for BSE Sensex, Taiwan, Nikkei, HangSeng, Korea. The data regarding daily, weekly and monthly closing values for the indexes has been collected from Yahoo Finance. To determine the stock returns for daily, weekly and monthly, natural logarithm has been computed in order to generate a time series of continuously compounded returns with the help of the following formula:

$$R_t = LN (P_t/P_{t-1})$$

Where,

P_t and p_{t-1}= Stock prices at the time t and t-1.

The study period has been bifurcated into three sub-periods for daily and weekly observations which is 1st Jan 2003 to 31st Dec. 2005 (first sub-period), 1st Jan. 2006 to 31st Dec. 2008 (second sub-period) and 1st Jan. 2009 to 31st Dec. 2011 (third sub-period). Further, to test the random behaviour of the stock exchanges non-parametric i.e. runs test, auto-correlation and the Box-Ljung Statistics has been applied.

Results and Discussions

Table-1 shows the number of runs for daily market return during various sub-periods under study. The maximum and minimum number of runs has been found for Hangseng and BSE-Sensex respectively during first sub-period. However the number of runs has been found significant for BSE-Sensex and Strait Times Index at 5 per cent and 1 per cent level respectively whereas in case of Jakarta index, it is found significant at 10 per cent level under same sub-period. During second sub-period, BSE Index and Kuala Lumpur prices have not behaved randomly because these two values has been found significant at the level of 5 per cent and 1 per cent respectively. The maximum number of runs has been found in Nikkei and the minimum number of runs has been found in Kuala Lumpur.

The maximum and least number of runs has been found in Nikkei and Taiwan Index respectively during third sub-period. The daily market prices have been found dependent to each other for the Nifty and Taiwan Index at 10 per cent and 1 per cent level. The daily return using index values

has not been found significant for rest of other indexes under study. During overall period of study i.e. 2003-11, the results showed that index prices are dependent to successive prices for the BSE-Sensex, Jakarta, Kualampur and Strait Times Index at 1 per cent level, whereas it is found significant at 10 per cent level in case of Nifty and Nikkei Index.

Table-2 depicts the results of runs test for weekly prices of various indexes during the sub-periods and overall study period. During first sub-period, the maximum and minimum number of runs has been found for Nikkei and Taiwan Index. The weekly index prices have been found dependent in case of BSE-Sensex and Taiwan Index at 10 per cent and 5 per cent level respectively. Successive price changes have been found significant for weekly returns during the second sub-period in case of BSE-Sensex and Nifty at 5 per cent and 10 per cent level as evident from the table-2. Further, the maximum number of runs has been found for BSE-Sensex during third sub-period. Surprisingly, the number of runs has not been found significant for any of the index under study. Therefore, the null hypothesis i.e. index prices follow random behaviour, can be accepted. Similar results have been also found during the overall period of study i.e. 2003-11.

As exhibited in the table-3, the number of runs for monthly returns has been found equal for Jakarta, Korea, Kualampur and Nikkei Index during the first sub-period. The expected number of runs differs significantly from the observed number of runs in case of Nifty at 1 per cent level. During the second sub-period, the number of runs occurred for fifteen times in case of BSE-Sensex, HangSeng, Jakarta, Korea and Taiwan Index. The expected numbers of runs have been found significant in case of Kuala Lumpur and Strait Times Index at 10 per cent level. Large variations among number of runs have been observed during the third sub-period but z-value has not been found significant for any of the index under study. Contrary to the results of last sub-period, small variations among runs occurred has been observed during the overall period of study i.e. 2003-11 but expected number of runs have not been found significant during this period.

Table-4 depicts the Box-Jung Statistics (LBQ) for daily, weekly and monthly adjusted closing values during each sub-period. The LBQ statistic is often used as a test of whether a time series is white noise. LBQ-Statistics has been found significant in case of daily closing values during the first and second sub-periods at 1 per cent and 5 per cent level whereas for weekly closing value it is found significant only for third sub-period at 5 per cent level for BSE-Sensex. In case of HangSeng Index, it is found significant only during second sub-period for daily closing values whereas, in case of weekly and monthly closing values, LBQ-Statistics has not been found significant for any sub-period except BSE-Sensex during third sub-period. Further, it is found significant for Taiwan, Nifty and Kualalmpur Stock Exchanges during the third sub-period at 10

per cent and 1 per cent level respectively. In case of second sub-period for daily closing values, LBQ-Statistics has been found significant for all indexes at various level of significance except Korea Stock Exchange. On the other hand, it has been found significant during 1st sub-period for all the stock exchanges at various levels of significance except Nifty and Taiwan.

Table-5 shows the auto co-relation for daily market return during the first sub-period. To test the independency between successive price changes, serial correlation technique is used. Daily market return has been found significant at the level of 1 per cent in case of Jakarta, Korea BSE, NIKKEI, STI and Kuala Lumpur stock exchange whereas, returns of other stock exchanges i.e. HangSeng, Nifty, Taiwan has been found significant at the level of 5 per cent.

Table-6 reveals the results of auto co-relation for the second sub-period. If no autocorrelations are found in a series then the series is considered random. As per results, daily market return for indexes like BSE, Korea, Nifty, STI and Taiwan are found significant at the level of 5 per cent while in case of Nikkei, Hangseng, Jakarta, Kuala Lumpur has been found significant at the level of 1 per cent. Similar results have been observed from the table 7 consisting daily market returns for the third sub-period. Returns for indexes like BSE, Hangseng, Jakarta, STI are found significant at the level of 5 per cent and Nifty, Kuala Lumpur Taiwan are found significant at the level of 1 per cent. Table-8 reveals no significance during the overall period of study on daily basis. It shows the random behavior of index prices. Therefore, it can be said that stock prices behave randomly during 2003-11.

Table-9 represents the results of auto co-relation performed on weekly returns using index values during the first sub-period which reveals the indexes like BSE, Korea, STI are found significant at the level of 5 per cent and the rest of the indexes like HangSeng, Jakarta, Kuala Lumpur, Nifty, Nikkei, Taiwan showing no significance or random behavior.

During the second sub-period, results exhibited in table-10 presents the fact that returns of the indexes like BSE, Jakarta, Nikkei, Taiwan has been found significant at 5 per cent level and the rest of the indexes like Hangseng, Kuala Lumpur, Nifty, Korea and STI showing no significance or random behavior. Again, similar results have been found for the third sub- period as depicts from the Table-11. The weekly market return of the indexes like BSE, Hangseng, Jakarta, Korea, Nifty, Nikkei and Taiwan are found significant at the 5 per cent and the rest of the indexes like Kuala Lumpur and STI showing no significance of the returns. Table-12 depicts the results of weekly return for the overall period of study which shows random behavior of weekly returns because of insignificant values.

Table-13 describes that the monthly returns for the first sub-period have been found significant for the indexes like BSE, Nifty at the level of 5 per cent and returns for the rest of the indexes

like Hangseng, Jakarta, Korea, Kuala Lumpur, Nikkei, STI and Taiwan have not been found significant. During the second sub-period, returns have been found significant only in case of STI, Taiwan at the level of 5 per cent which is revealed from the Table-14.

Table-15 illustrates the auto correlation occurred during the third sub-period for monthly returns which reveals that the returns of the Korea index is found significant at the level of 5 per cent, whereas it is not found significant in case of BSE, Nifty, Hangseng, Jakarta, Kuala Lumpur, Nikkei, STI and Taiwan showing no significance or random behavior. During the overall period of study i.e. 2003-11, monthly returns have not been found significant for any of the index as is evident in Table-16. Therefore, it can be said that stock prices behave randomly during the period under study.

Conclusion

To sum up, Hangseng stock exchange follow random walk behaviour on the basis the results of runs test, but BSE and STI do not follow random behaviour in case of daily prices. In case of monthly price changes, BSE has been found weak form efficient. Further, the results of auto-correlation and Box-Ljung test revealed that all stock exchanges under study follow random walk behaviour in case of monthly and weekly prices except BSE (weekly prices) during the third sub-period and also during the overall study period. The study concludes that BSE and Hangseng is found to be weak form efficient.

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Table-1: Number of Runs (Daily) for Different Indexes

		2003-05		2006-08		2009-11		2003-11	
Sr. No.	Index	Number of Runs	Z value	Number of Runs	Z value	Number of Runs	Z value	Number of Runs	Z value
1	BSE	341	-2.307**	338	-2.234**	366	-.256	677	-3.248***
2	HANGSENG	382	.712	375	.106	379	.001	771	1.183
3	JAKARTA	343	-1.701*	345	-1.467	360	-.575	682	-2.611***
4	KORIA	361	-.825	369	.270	386	.914	721	-.866
5	KUALALUMPUR	352	-1.361	326	-3.113***	359	-.952	680	-3.116***
6	NIFTY	377	.628	379	.900	391	1.833*	772	1.893*
7	NIKKEI	377	-.171	390	1.548	398	1.057	784	1.779*
8	STI	356	-2.576***	356	-1.084	366	.378	709	-2.753***
9	TAIWAN	374	.045	373	.561	336	-.563***	755	.720

Source: Yahoo Finance

*Significant at 10 per cent level, ** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-2: Number of Runs (Weekly) for different Indexes

		2003-05		2006-08		2009-11		2003-11	
Sr. No.	Index	Number of Runs	Z value	Number of Runs	Z value	Number of Runs	Z value	Number of Runs	Z value
1	BSE	68	-1.653*	65	-1.960**	87	1.294	219	-1.321
2	HANGSENG	76	-.450	85	.947	77	-.313	236	.130
3	JAKARTA	73	-.801	73	-.403	86	1.384	232	.276
4	KOREA	80	.418	77	-.256	80	.236	225	-.660
5	KUALALUMPUR	75	-.504	71	-1.013	83	.721	229	-.482
6	NIFTY	70	-1.328	67	-1.770*	83	.997	223	-.704
7	NIKKEI	87	1.629	75	-.354	72	-1.077	225	-.668
8	STI	79	.000	71	-.908	79	.019	238	.478
9	TAIWAN	65	-1.992**	75	-.076	83	.938	226	-.216

Source: Yahoo Finance

*Significant at 10 per cent level, ** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-3: Number of Runs (Monthly) for Different Indexes

		2003-05		2006-08		2009-11		2003-11	
Sr. No.	INDEX	Number of Runs	Z value	Number of Runs	Z value	Number of Runs	Z-value	Number of Runs	Z value
1	BSE-Sensex	16	-.829	**15**	**-.573**	23	1.564	55	.004
2	HENGSENG	23	1.184	**15**	**-.776**	18	-.169	52	-.230
3	JAKARTA	18	-.169	**15**	**-1.044**	21	.528	58	.895
4	KOREA	18	-.151	**15**	**-.930**	22	.845	51	-.720
5	KUALALUMPUR	18	-.151	**13**	**-1.643***	16	-.829	55	.234
6	NIFTY	10	-2.836***	**17**	**.000**	23	1.564	59	.835
7	NIKKEI	18	-.169	**17**	**-.041**	56	.252	56	.252
8	STI	14	-1.508	**11**	**-1.675***	51	-.430	51	-.430
9	TAIWAN	19	.000	**15**	**-.776**	53	-.331	53	-.331

Source: Yahoo Finance

*Significant at 10 per cent level, ** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-4: Box- Ljung Statistics for Daily, Weekly and Monthly during Each Segment

		Daily			Weekly			Monthly		
Sr. No	**Index**	**2003-05**	**2006-08**	**2009-11**	**2003-05**	**2006-08**	**2009-11**	**2003-05**	**2006-08**	**2009-11**
1	BSE	41.495***	26.703**	17.268	17.703	18.996	31.444**	14.848	7.937	8.793
2	HANGSENG	16.311	46.075***	13.492	9.455	11.073	15.515	12.757	16.85	7.933
3	JAKARTA	30.953**	65.277***	17.291	4.266	15.118	19.53	5.895	13.846	11.073
4	KOREA	28.137**	17.319	13.988	15.501	14.998	20.279	12.592	16.242	21.831
5	KUALALUMPUR	36.132***	30.401**	142.394***	10.674	8.572	10.08	14.002	20.29	9.045
6	NIFTY	13.481	27.803**	23.689*	15.519	15.133	22.619	17.654	9.058	7.438
7	NIKKEI	27.818**	35.765***	17.789	13.441	15.769	12.929	17.664	8.473	13.285
8	STI	56.691***	24.64*	14.037	19.884	10.572	15.44	10.86	15.957	6.292
9	TAIWAN	19.459	33.578***	23.593*	17.128	19.063	16.81	9.38	16.399	9.214

Source: Data Compiled Obtained from Yahoo Finance

*Significant at 10 per cent level, ** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-5: Results of Autocorrelation on Daily Prices during 2003-05

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.078**	0.074**	0.16***	0.038	0.151***	0.026	0.054	0.104**	0.05
2	-0.121***	-0.011	-0.062	-0.04	0.052	-0.021	-0.006	-0.113***	-0.016
3	0.056	-0.002	-0.01	0	0.03	0.021	0.035	0.056	0.005
4	0.115***	-0.053	0.061	-0.055	0.053	-0.026	-0.039	0.093**	-0.013
5	-0.039	-0.004	0.052	0.002	0.01	-0.051	0.005	-0.059	0.021
6	-0.069	0.038	0.014	0.048	0.012	0.032	-0.089**	-0.032	-0.039
7	0.002	0.009	-0.019	-0.071	0.015	-0.017	-0.003	-0.041	0.03
8	-0.028	-0.05	-0.048	-0.017	0.055	-0.091**	0.031	-0.047	0.043
9	0.032	-0.062	-0.027	-0.037	0	-0.04	-0.032	0.036	-0.047
10	0.063	0.004	0.014	-0.007	0.006	0.028	-0.007	0.126***	-0.036
11	0.025	0.01	0.002	0.025	-0.037	0.014	-0.018	0.021	0.048
12	-0.032	0.05	-0.012	0.019	0.012	0.017	-0.032	-0.06	-0.002
13	0.009	0	-0.027	0.071	-0.101**	0.019	-0.114***	0.02	0
14	0.032	-0.052	-0.016	-0.053	0.003	0.014	-0.07	0.04	0
15	-0.044	-0.008	-0.035	-0.115***	-0.057	-0.006	-0.017	-0.02	-0.099**
16	-0.04	-0.002	-0.012	0.005	0.025	-0.019	-0.033	-0.065	-0.05

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-6: Results of Autocorrelation on Daily Prices during 2006-08

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.073	-0.074**	0.155***	0.024	0.114***	-0.053	-0.041	0.031	0.031
2	-0.037	0.019	0.061	0.018	-0.01	-0.048	0.066	-0.013	0.075**
3	-0.023	-0.077**	-0.019	0.005	0.075**	-0.037	-0.053	-0.013	-0.017
4	-0.048	0.001	0.001	-0.038	0.01	-0.009	0.004	-0.021	-0.053
5	-0.021	-0.052	-0.078**	-0.071	-0.037	-0.025	0.029	-0.057	-0.078**
6	-0.03	0.024	-0.032	0.052	-0.055	-0.047	-0.059	-0.022	-0.067
7	0.004	0.007	-0.037	-0.053	0.042	0.051	0.028	0.024	0.017
8	0.1**	0.079**	-0.052	-0.028	0.009	0.001	0.014	0.088**	0.055
9	-0.022	-0.067	-0.071	0.032	0	-0.051	0.04	-0.013	-0.01
10	-0.008	-0.085**	-0.026	0.002	0.018	0.066	0.06	-0.036	0.005
11	-0.042	0.009	0.053	-0.035	0.052	0.067	-0.118***	-0.055	0.07
12	0.036	0.041	0.05	-0.02	0.029	0.014	0.067	0.063	0.001
13	0.072**	0.114***	0.144***	0.078**	-0.048	-0.036	0.061	0.076**	0.069
14	0.077**	-0.078**	0.101**	-0.023	0.058	-0.008	0.04	0.035	0.103**
15	0.011	0.076**	0.041	0.001	-0.068	0.026	-0.018	0.056	-0.032
16	-0.002	0.026	0.067	0.007	-0.037	-0.107**	-0.063	0.018	0.012

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-7: Results of Autocorrelation on Daily Prices during 2009-11

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.066	0.004	0.015	0.005	-0.395***	-0.03	0.043	0.042	0.111***
2	-0.024	0.006	0.026	-0.052	0.013	0.02	0.028	-0.023	-0.063
3	-0.028	0.02	-0.081**	-0.012	-0.02	-0.016	0.023	-0.025	-0.016
4	0.022	-0.055	-0.065	-0.024	0.019	-0.025	-0.038	0.033	-0.022
5	-0.05	0.012	0.007	0	0.026	-0.075	0.005	-0.049	0.017
6	-0.042	-0.004	-0.042	-0.044	-0.006	0.111***	0.02	-0.054	-0.042
7	0.023	0.056	0.051	0.065	-0.002	-0.053	0.039	0.023	0.025
8	0.05	-0.029	0.021	0.031	0	0.001	-0.047	0.035	0.034
9	0.08**	0.012	0.042	0.008	-0.015	-0.012	0.03	0.075**	-0.014
10	0.035	-0.077**	0.022	-0.007	-0.007	-0.002	0.011	0.016	-0.002
11	0.006	-0.026	-0.03	0.002	0.014	-0.062	-0.07	-0.022	-0.028
12	-0.031	-0.021	0.045	0.021	0.028	0.037	0.046	-0.025	-0.028
13	-0.026	0.016	0.012	-0.051	0	0.044	-0.023	-0.01	0.073**
14	0.01	-0.041	0.037	-0.055	0.003	0.032	0.064	0.027	0.044
15	-0.005	0.008	-0.003	-0.028	-0.013	0.02	0.017	-0.004	-0.035
16	0.021	0.029	-0.002	-0.031	-0.177***	0.019	-0.033	0.018	0.014

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-8: Results of Autocorrelation on Daily Prices during 2003-11

S.N.	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTI	NIKKEI	STI	TAIWAN
1	0.075**	-0.05	0.158***	0.031	0.125***	-0.029	-0.017	0.054**	0.039
2	-0.06**	0.014	0.025	-0.003	0.008	-0.038	0.051	-0.042	0.041
3	0.001	-0.065**	-0.015	0.004	0.064**	-0.018	-0.03	0.009	-0.008
4	0	-0.008	0.021	-0.043	0.023	-0.012	-0.004	0.015	-0.036
5	-0.024	-0.044	-0.036	-0.041	-0.023	-0.03	0.026	-0.057**	-0.038
6	-0.038	0.026	-0.016	0.052**	-0.036	-0.022	-0.064**	-0.025	-0.054**
7	0.006	0.007	-0.03	-0.058**	0.035	0.036	0.023	0.005	0.023
8	0.065**	0.058**	-0.049	-0.022	0.023	-0.019	0.02	0.048	0.052**
9	-0.005	-0.066**	-0.055**	0.007	0	-0.046	0.024	0.002	-0.023
10	0.014	-0.069**	-0.013	0.001	0.016	0.056**	0.046	0.015	-0.009
11	-0.022	0.01	0.038	-0.011	0.027	0.056**	-0.092***	-0.031	0.063**
12	0.018	0.042	0.033	-0.003	0.025	0.02	0.045	0.027	0.003
13	0.055**	0.096**	0.094***	0.077**	-0.062**	-0.021	0.021	0.06**	0.042
14	0.066**	-0.073**	0.066**	-0.034	0.043	0	0.016	0.039	0.064**
15	-0.004	0.062**	0.018	-0.042	-0.064**	0.016	-0.016	0.034	-0.056**
16	-0.013	0.023	0.045	0.008	-0.019	-0.085***	-0.054**	-0.004	-0.012

Table-9: Results of Autocorrelation on weekly Prices during 2003-05

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.161**	-0.056	0.088	-0.131	0.04	0.107	-0.054	0.024	-0.009
2	0.085	0.027	-0.013	-0.061	0.114	0.073	-0.024	-0.175**	0.007
3	0.009	-0.026	-0.031	0.012	-0.042	-0.014	0.014	-0.127	-0.157
4	0.03	0.025	0.045	0.16**	-0.108	0.028	0.14	0.081	0.005
5	0.034	-0.007	-0.043	-0.037	0.088	0.076	-0.008	0.107	0.082
6	-0.005	0.089	-0.013	-0.089	-0.101	-0.028	-0.073	-0.009	0.016
7	-0.088	0.032	0.027	0.137	0.036	-0.103	0.063	-0.073	0.102
8	0.11	0.035	-0.039	0.042	-0.055	0.099	-0.018	-0.062	-0.065
9	0.177**	-0.098	-0.075	0.002	-0.003	0.143	-0.012	-0.035	-0.084
10	-0.034	0.06	-0.025	-0.044	-0.04	-0.025	-0.08	0.074	-0.031
11	0.025	0.047	0.04	0.003	-0.035	0.029	0.094	0.117	0.083
12	0.013	-0.018	0.042	0.022	-0.064	0.005	0.09	0.02	0.083
13	0.027	-0.025	0.009	-0.106	0.018	0.042	-0.071	-0.064	-0.035
14	0.106	-0.016	0.029	-0.06	-0.034	0.131	0.127	-0.132	-0.079
15	-0.038	0.099	-0.012	-0.002	-0.046	-0.051	0.015	0.054	-0.11
16	-0.069	-0.118	-0.022	0.022	-0.065	-0.068	-0.053	0.019	-0.124

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-10: Results of Autocorrelation on Weekly Prices during 2006-08

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.012	-0.012	-0.024	-0.113	0.067	0.02	-0.111	0.02	-0.078
2	0.188**	0.138	0.008	0.058	0.085	0.127	0.199**	0.141	0.14
3	0.01	0.007	0.206**	-0.024	0.018	0.042	-0.1	-0.005	0.181**
4	0.043	0.041	0.034	-0.015	0.034	0.043	0.006	0.047	-0.012
5	0.044	0.12	0.084	-0.011	0.073	0.021	-0.008	0.104	0.143
6	0.061	0.024	0.087	0.069	0.039	0.04	0.063	0.081	0.014
7	-0.08	-0.034	-0.091	0.112	0.058	-0.064	-0.02	0.036	0.087
8	-0.07	-0.079	0.057	-0.102	-0.032	-0.095	0.001	-0.044	-0.096
9	0.061	0.065	0.018	0.064	0.054	0.09	0.045	0.089	0.018
10	-0.139	-0.027	-0.1	-0.129	0.018	-0.146	-0.041	-0.042	-0.049
11	-0.048	-0.032	0.047	-0.011	0.064	-0.075	-0.149	-0.019	0.095
12	-0.085	-0.057	0.023	-0.016	0.016	-0.069	-0.03	-0.041	0.046
13	0.06	0.059	0.052	-0.009	0.061	0.015	-0.023	0	0
14	0.002	0.098	0.079	0.13	0.096	-0.002	0.039	0.091	0.088
15	0.146	-0.002	-0.017	-0.032	0.073	0.116	0.025	0.031	-0.003
16	0.038	-0.029	-0.009	0.072	0.032	0.03	0.028	0.015	0.011

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-11: Results of Autocorrelation on Weekly Prices during 2009-11

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	-0.026	0.003	-0.177**	0.024	0.06	-0.011	0.021	-0.007	-0.023
2	0.186**	-0.019	0.115	0.09	0.105	0.113	0.004	0.124	0.146
3	-0.108	-0.085	0.055	-0.18**	-0.09	-0.08	-0.038	-0.045	-0.101
4	0.061	0.009	-0.111	-0.002	0.011	0.023	-0.031	-0.02	0.043
5	-0.127	-0.011	0.189**	-0.035	-0.057	-0.105	-0.084	0.044	0.009
6	0.086	0.018	-0.079	-0.029	0.07	0.046	-0.021	-0.018	-0.018
7	0.003	0.142	0.043	-0.056	0.055	0.035	-0.015	0.076	0.041
8	0.207**	0.175**	0.082	0.02	0.088	0.204**	0.071	0.113	0.111
9	-0.035	-0.113	-0.043	-0.008	-0.023	-0.058	-0.074	-0.087	0.042
10	-0.005	-0.036	-0.021	-0.135	0	0.007	-0.093	-0.017	0
11	-0.139	-0.066	-0.051	-0.096	-0.083	-0.171**	0.072	-0.145	-0.108
12	-0.031	-0.061	-0.004	0.025	0.033	0.08	0.049	0.059	0.041
13	0.032	0.07	0.047	0.139	-0.008	-0.041	0.077	-0.002	0.008
14	0.045	0.081	0.045	0.151	0.022	0.057	0	0.107	0.158**
15	-0.008	-0.005	0.045	0.059	0.023	0.082	-0.157**	-0.028	-0.031
16	0.216**	0.011	-0.028	0.018	0.097	0.108	-0.089	0.092	0.112

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-12: Results of Autocorrelation on Weekly Prices during 2003-11

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTI	NIKKEI	STI	TAIWAN
1	0.027	-0.018	-0.036	-0.077	0.069	0.028	-0.048	0.017	-0.037
2	0.178***	0.059	0.039	0.035	0.095**	0.12**	0.106**	0.087	0.111**
3	-0.032	-0.028	0.125**	-0.043	-0.016	-0.009	-0.054	-0.031	0.006
4	0.063	0.03	0.004	0.045	0.006	0.045	0.019	0.04	0.017
5	-0.026	0.037	0.087	-0.032	0.037	-0.015	-0.022	0.08	0.081
6	0.065	0.017	0.034	0.009	0.025	0.036	0.03	0.045	0.008
7	-0.046	0.038	-0.031	0.085	0.062	-0.038	0	0.034	0.101**
8	0.079	0.056	0.045	-0.017	-0.004	0.057	0.023	0.02	-0.02
9	0.058	-0.012	-0.002	0.035	0.03	0.06	0.018	0.023	0.018
10	-0.08	-0.017	-0.058	-0.112**	-0.002	-0.082	-0.052	-0.016	-0.023
11	-0.053	-0.058	0.005	-0.061	-0.006	-0.066	-0.047	-0.048	0.021
12	-0.045	-0.048	0.035	0.014	0.012	0.001	0.036	0.032	0.063
13	0.105**	0.106**	0.054	0.06	0.052	0.054	0.06	0.048	0.027
14	0.058	0.099**	0.091	0.104**	0.083	0.064	0.078	0.073	0.087
15	0.11**	0.067	0.033	0.002	0.051	0.104**	0.035	0.066	-0.054
16	0.059	-0.042	-0.03	0.004	0.025	0.024	-0.033	0.019	0.012

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-13: Results of Autocorrelation on Monthly Prices during 2003-05

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.05	0.034	0.003	-0.137	-0.063	0.039	0.131	0.204	-0.017
2	0.151	0.025	0.026	0.157	-0.013	0.109	0.194	0.175	0.001
3	0.002	0.113	-0.125	-0.129	-0.16	0.051	0.082	-0.182	-0.156
4	-0.038	-0.13	0.063	-0.057	-0.088	-0.021	-0.204	-0.152	-0.084
5	-0.331**	-0.108	-0.1	-0.15	0.172	-0.371**	-0.236	-0.128	-0.076
6	-0.069	-0.172	-0.128	0.134	-0.277	-0.054	0.106	-0.001	0.074
7	-0.178	-0.108	-0.019	-0.131	-0.002	-0.199	-0.109	-0.044	0.158
8	-0.192	-0.26	-0.073	-0.04	0.131	-0.183	0.111	-0.051	-0.15
9	-0.183	0.091	-0.125	-0.071	0.187	-0.213	0.027	-0.223	0.026
10	0.04	-0.028	0.052	0.171	-0.071	0.054	0.017	-0.13	-0.157
11	0.011	-0.171	-0.119	-0.11	-0.086	0.046	-0.094	-0.095	-0.18
12	0.045	0.195	-0.057	-0.121	-0.156	0.019	-0.117	0.016	-0.004
13	0.086	0.151	0.016	0.026	0.147	0.123	-0.239	0.051	0.118
14	0.21	-0.016	0.157	-0.142	-0.077	0.238	-0.198	0.065	-0.04
15	-0.014	0.026	0.046	0.138	-0.04	-0.042	-0.154	0.062	0.07
16	-0.067	0.028	0.001	0.148	0.133	-0.046	-0.096	0.042	0.117

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-14: Results of Autocorrelation on Monthly Prices during 2006-08

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.166	0.252	0.319	0.084	0.286	0.127	0.204	0.359**	0.269
2	-0.024	0.147	0.009	0.199	0.268	-0.022	-0.048	0.193	0.177
3	-0.015	-0.053	0.089	0.039	0.247	-0.101	-0.065	0.046	0.036
4	0.156	0.082	0.027	0.018	0.18	0.156	0.041	0.038	0.085
5	0.158	0.003	0.035	0.114	0.128	0.196	-0.12	0.102	0.069
6	-0.11	-0.055	0.118	-0.234	0.119	-0.125	-0.129	-0.031	-0.031
7	0.15	0.121	0.29	0.178	0.289	0.136	0.145	0.108	-0.017
8	-0.022	0.033	0.038	-0.079	0.054	-0.054	0.089	0.082	0.146
9	0.131	0.263	-0.038	0.175	0.011	0.161	0.141	0.265	0.067
10	0.04	0.148	-0.004	0.106	-0.054	-0.007	0.081	0.098	0.315**
11	-0.065	-0.027	-0.117	0.034	-0.014	-0.058	0.052	0.076	-0.024
12	-0.138	-0.238	-0.15	-0.077	-0.139	-0.166	-0.068	-0.122	-0.16
13	-0.07	-0.23	-0.025	-0.174	-0.034	-0.078	-0.105	-0.158	-0.138
14	-0.067	-0.084	0.09	-0.078	0.026	-0.021	0.116	-0.004	-0.074
15	0.032	-0.083	-0.049	-0.198	-0.066	0.012	0.028	-0.017	-0.082
16	-0.044	-0.063	-0.17	-0.178	-0.214	-0.03	-0.08	-0.13	-0.163

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-15: Results of Autocorrelation on Monthly Prices during 2009-11

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.106	0.025	0.114	-0.084	0.052	0.032	0.006	0.08	0.022
2	-0.012	0.173	-0.042	-0.263	0.016	0.016	-0.03	0.065	0.093
3	0.108	0.071	0.174	0.339**	0.135	0.079	0.041	0.046	0.106
4	0.082	-0.089	-0.131	0.128	-0.104	0.134	-0.201	0.077	0.002
5	-0.182	0.058	-0.141	-0.227	0.037	-0.211	-0.161	-0.15	0.048
6	0.16	-0.064	-0.011	0.083	0.019	0.193	-0.182	0.038	-0.003
7	0.097	0.036	-0.008	-0.03	-0.005	0.05	0.079	0.133	0.102
8	-0.148	-0.213	0.131	-0.092	-0.065	-0.021	0.068	-0.075	-0.159
9	-0.018	-0.064	0.08	0.103	0.057	-0.035	0.156	0.06	0.063
10	0.06	-0.041	-0.057	-0.184	-0.082	0.026	-0.003	-0.083	-0.049
11	-0.058	-0.052	-0.101	-0.084	-0.031	-0.056	0	0.025	-0.226
12	0.089	-0.006	0.099	0.159	-0.044	0.062	-0.098	0.002	0.112
13	0.031	-0.022	-0.074	-0.052	-0.181	0.021	-0.155	-0.061	-0.024
14	-0.136	-0.061	-0.117	-0.201	0.135	-0.112	-0.178	-0.075	-0.13
15	0.089	0.133	0.239	0.217	0.224	0.075	0.064	0.154	0.038
16	0.114	0.157	0.063	0.075	0.075	0.114	0.203	0.1	0.149

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level

Table-16: Results of Autocorrelation on monthly Prices during 2003-11

SN	BSE	HANGSENG	JAKARTA	KOREA	KUALALUMPUR	NIFTY	NIKKEI	STI	TAIWAN
1	0.141	0.144	0.227**	0.007	0.157	0.095	0.168	0.267**	0.127
2	0.051	0.151	0.025	0.071	0.153	0.046	0.057	0.177	0.143
3	0.082	0.066	0.126	0.093	0.126	0.039	0.142	0.079	0.055
4	0.156	0.062	0.087	0.109	0.054	0.17	0.064	0.14	0.031
5	-0.082	0.022	-0.082	-0.134	0.147	-0.088	-0.157	-0.012	-0.054
6	-0.134	-0.173	-0.094	-0.113	-0.095	-0.116	-0.162	-0.119	-0.134
7	-0.025	-0.042	0.04	0.018	0.065	-0.066	0.021	-0.077	-0.01
8	-0.114	-0.164	-0.057	-0.102	-0.038	-0.067	0.022	-0.083	-0.135
9	0.012	0.023	-0.111	-0.006	-0.029	-0.003	0.043	0.014	0.017
10	-0.019	0.007	-0.038	-0.031	-0.16	-0.025	0.039	-0.07	-0.035
11	-0.126	-0.121	-0.142	-0.04	-0.121	-0.124	0.074	-0.006	-0.165
12	-0.017	-0.088	-0.093	0	-0.146	-0.037	0.029	-0.031	-0.003
13	0.004	-0.119	-0.064	-0.068	-0.129	0.006	0.012	-0.075	-0.049
14	-0.072	-0.065	0.033	-0.173	-0.017	-0.047	-0.082	-0.074	-0.097
15	0.022	0.014	-0.012	0.06	-0.023	-0.016	0.021	0.065	-0.044
16	-0.002	-0.096	-0.07	-0.045	-0.063	0.013	0.003	-0.104	-0.04

Source: Yahoo Finance

** Significant at 5 per cent level, ***Significant at 1 per cent level