A Study on Weak-Form of Market Efficiency in Selected Asian Stock Markets

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Abstract

Efficiency of financial markets is one of the key elements indicating the performance of financial markets and the economy. In efficient markets, all transactions are done with the help of new information available about the economy, industries, and companies. Stock price movements are completely random, and are highly based on current information. The historical sequence of the prices will not provide any platform/base for the future. There might be no use of studying historical data of price changes to gain abnormal returns. The main aim of the present study was to investigate the behavior of the daily stock returns in five Asian countries, namely India, South Korea, Singapore, Hong Kong, and Japan. We employed both parametric and non-parametric tests to check the RWH (random walk hypothesis) to know the weak form of efficiency in the Asian stock markets. A common data set for all countries covering the time period from July 1997 to November 2013 was considered for the study. The results provided reasonable evidence to prove the existence of weak form of market efficiency in the selected Asian stock markets.

Keywords: **stock market efficiency, weak form of market efficiency, random walk hypothesis, Asian stock markets**

JEL Classification: G1, G10, G14, G15

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Are we able to predict the stock market prices? Researchers have been looking for answers to this question since years. Some studies have proven that the stock markets follow the random walk, in which successive price changes are independent of each other. In 1900, Louis Bachelier wrote a paper suggesting that security price fluctuations were random (Bachelier, 2006). Kendall (1943) suggested that stock price series are always wandering. Later, Fama (1965) stated that efficient markets fully reflect the available information and classified efficient markets into three categories, that is, weak, semi-strong, and strong form of market efficiency. All these forms testify markets being efficient on different levels of information.

Less developed and emerging markets are suitable only for the weak form of market efficiency. The main aim of the present study is to investigate the behavior of the stock market returns in selected Asian stock markets and to check the weak form of market efficiency of these markets. Although many conceptual and empirical studies have examined the weak form of market efficiency, the present study examines the nature of the stock markets which are more dynamic than ever before. The present study is confined to five major dynamic Asian countries namely India, South Korea, Singapore, Hong Kong, and Japan. Stock market indices of the above countries are Sensex (India), Kospi (South Korea), Strait Times (Singapore), Hang Sang (Hong Kong), and Nikkei (Japan)

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respectively. The time period for the present study is from July 1997 to November 2013. The same data set was chosen for all the said five countries.

Review of Literature

According to Osborne (1959) and Fama (1970), the concept of efficient markets has been in literature since 1960s. Many economists have researched on market efficiency and its nature. Fama (1965) tested the market efficiency of the Dow Jones Industrial average for the period from 1958 to 1962 (for a period of 5 years). He employed the serial correlation test and the runs test, and he did not find linear dependency in price changes ; however, he identified random walk (RW) in the stock market prices. Ko and Lee (1991) employed the serial correlation test to find market efficiency in the stock markets of Japan, Hong Kong, Korea, Singapore, Taiwan, and the USA. They selected the value of the weighted stock index from January 1981 to December 1988. They found a strong correlation among Japan, U.S., Hong Kong, and Singapore. However, little evidence was found in case of Taiwan and Korea. Urrutia (1995) employed the variance ratio test on monthly data from December 1975 to March 1991 to check the random walk hypothesis in four Latin American stock markets - Argentina, Brazil, Chili, and Mexico. Poshakwale (1996) used the daily data of Bombay Stock Exchange from January 1987 to October 1994 to test the weak form of efficiency in the Indian stock market. The results of the runs test and the autocorrelation rejected the weak form of market efficiency.

Islam and Khaled (2005) took the daily, weekly, and monthly index data from the Dhaka Stock Exchange from 1990 to 2001; they employed the unit root test, autocorrelation test, and variance ratio test to test the market weak-form of efficiency. They found evidence of weak form of efficiency before the 1996 stock market crash. Granger and Morgenstern (1964) found that there was weak form of efficiency in the New York Stock Exchange only in the short run. Venkatesan (2010) investigated the behavior of the Indian stock market (NSE) returns. The study results revealed that the return series was insignificantly different from zero, which is consistent with the random walk hypothesis. Li and Liu (2012) tested the random walk hypothesis using the variance ratio test in 34 MSCI countries of the World Economic Outlook Database -2010. They considered weekly data from January 5, 1988 to December 28, 2010. They found that 25 out of the 34 markets followed the random walk hypothesis. Ansari and Chen (2013) investigated the behavior of stock returns in 10 major Asia-Pacific countries (Australia, China, Hong Kong, Indonesia, Japan, Malaysia, Singapore, South Korea, and Taiwan). They considered the stock market closing prices covering the time period from January 2000 to December 2006. They employed the unit root test, serial correlation test, variance ratio test, and the random walk models BDS test. They found reasonable evidence to prove the existence of weak form of market efficiency. Jain and Jain (2013) employed both parametric and non - parametric tests on BSE and NSE of India. They considered the closing prices from April 1993 to March 2013. They concluded that the Indian stock markets held weak form of market efficiency.

Data and Methodology

The present empirical study is based on the daily closing prices of five Asian stock market indices, that is, Sensex (India), Kospi (South Korea), Nikkiei (Japan), Hang Seng (Hong Kong), and Strait Times (Singapore) for the time period from July 1, 1997 to November 30, 2013. Data was extracted from the website of Yahoo Finance (http://in.finance.yahoo.com/). Daily data is specified in terms of daily returns and was calculated with the first difference of the natural logarithm.

$$r_t = \log (p_t - p_{t-1}) \qquad (1)$$

where,

r_t represents the returns at time t,

p_t is the closing price at day t,

p_{t-1} is the closing price of the index at day t-1.

In order to test the weak form of market efficiency, we employed both parametric and non-parametric tests. Most traditional methods used to test market efficiency are the runs test and the serial correlation test. Another test to find the stationarity in series is the unit root test; we used runs test, serial correlation test, and the unit root test to check the market efficiency of the selected Asian stock markets. Runs test is a statistical method that examines whether a string of data is occurring randomly in a given data or not. It analyzes the occurrence of similar events in the stream of runs. This test is used to find the occurrence of event randomness. The formulas used for the runs test are as follows :

$$E(R) = \text{mean}\,\mu = \frac{2N_+ N_-}{N} + 1 \qquad (2)$$

$$\text{variance}\ \sigma^2 = \frac{2N_+ N_-(2N_+ N_- - N)}{N^2(N-1)}$$

where,
$E(R)$ is the average expected return

The following hypotheses will be tested in this paper :

- **H0**: The observed series is random.
- **H1:** The observed series is not random.

Autocorrelation or serial correlation is the test of serial dependency. It is the most common test for RWM in a form of estimates of serial correlation for stock price indices. Fama (1965), Moore (1964), Cootner (1962), and Kendal (1943) calculated the serial correlation. The auto correlation test examines whether the coefficient of correlation is significantly different from zero or is nearly zero. The former one indicates that there is an evidence of serial correlation, which indicates non randomness in series; the latter one implies the randomness of the series. Since the tested data are daily closing prices, so the lags selected for the test are 36.

$$R(\tau) = \frac{E[(X_t - \mu)(X_{t+\tau} - \mu)]}{\sigma^2} \qquad (3)$$

where,
E is the expected period value,
X_t is the value at day t,
X_{t+1} is the value at $t+1$,
μ is the mean of the series.

Testing the stationarity and non stationarity of the time series is one of the ways to test the market efficiency. This test is known as the unit root test. This is not a significant method to test the non stationarity in finance, economic time series as prices are normally not stationary. However, a brief analysis was made by using this test. The most commonly used tests in the unit root test are ADF (Augmented Dicky Fuller test), Phillips - Perron test, and KPSS test (Kwiatkowski - Phillips - Schmidt -Shin test). Presence of the unit root is the substantial evidence to prove the weak form of market efficiency. The following is the formula used to test ADF :

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta_{1\Delta} y_{t-1} + \ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \qquad (4)$$

where,
Δ is the first difference operator and ε_t is the zero mean white noise error term.

Table 1. Summary of the Descriptive Statistics of Daily Returns

Descriptive Statistics	INDIA (JULY 1ST 1997 to 30th JUNE 2005)	INDIA (JULY 1ST 2006 to NOV 29th 2013)	INDIA (JULY 1ST 1997 to NOV 29th 2013)
Observations	1981	2075	4056
Mean	0.000388	0.000650	0.000522
SD	0.016295	0.016765	0.165300
Skewness	-0.18297	0.348592	0.100211
Kurtosis	3.42266	8.351525	6.094230
Jarque-Bera	2073.6500	2130.6566	18329.3379
	SOUTH KOREA (JULY 1ST 1997 to 30th JUNE 2005)	**SOUTH KOREA (JULY 1ST 2006 to NOV 29th 2013)**	**SOUTH KOREA (JULY 1ST 1997 to NOV 29th 2013)**
Observations	1961	1839	4050
Mean	0.000427	0.000441	0.000434
SD	0.02375	0.014500	0.019532
Skewness	0.047839	0.012629	0.038580
Kurtosis	2.334512	7.096484	4.219120
Jarque-Bera	414.6796	870.2176	2764.9786
	SINGAPORE (JULY 1ST 1997 to 30th JUNE 2005)	**SINGAPORE (JULY 1ST 2006 to NOV 29th 2013)**	**SINGAPORE (JULY 1ST 1997 to NOV 29th 2013)**
Observations	2013	2128	4141
Mean	0.000168	0.000263	0.00021
SD	0.015091	0.012710	0.13814
Skewness	0.375184	-0.19429	0.16395
Kurtosis	7.644444	6.232519	7.754335
Jarque-Bera	2631.8351	2925.8616	7173.2923
	HONG KONG (JULY 1ST 1997 to 30th JUNE 2005)	**HONG KONG (JULY 1ST 2006 to NOV 29th 2013)**	**HONG KONG (JULY 1ST 1997 to NOV 29th 2013)**
Observations	1974	2121	4095
Mean	0.000143	0.000383	0.000267
SD	0.018467	0.16906	0.017671
Skewness	0.519208	0.31752	0.427275
Kurtosis	11.12835	9.186194	10.25689
Jarque-Bera	3361.4979	2304.1444	7322.9462
	JAPAN (JULY 1ST 1997 to 30th JUNE 2005)	**JAPAN (JULY 1ST 2006 to NOV 29th 2013)**	**JAPAN (JULY 1ST 1997 to NOV 29th 2013)**
Observations	1966	2067	4033
Mean	-0.000167	0.00274	0.000002
S.D	0.015174	0.016417	0.015823
Skewness	0.079084	-0.333626	-0.154069
Kurtosis	1.820831	7.978233	5.485812
Jarque-Bera	847.6562	1487.7714	2229.7906

Note : The numerical values were calculated after analyzing daily returns of indices of exchanges of various countries

The null hypothesis is :

➔ **H0:** y_t contains a unit root.

➔ **H1:** y_t does not contain a unit root.

If α_1 takes a negative value or any value near to or significantly different from zero ; in such cases, the series is considered stationary.

Table 2. Summary of Results of Runs Test

	Summary of runs test results from July 1997 to June 2005				
	India	**South Korea**	**Singapore**	**Hong Kong**	**Japan**
Observations	1981	1961	2013	1974	1966
Runs	900	931	958	1122	1001
Positive moves	1048	1024	998	990	963
Negative moves	933	937	1015	984	1003
Expected runs	988	980	1007	988	984
SD	22.17	22.09	22.42	22.21	22.154
Z VALUE	-3.976	-2.20	-2.42	6.033	0.7857
P. VALUE	0.0	0.013	0.013	1	0.7839
Market efficiency	Inefficient	Inefficient	Inefficient	Inefficient	**Efficient**
	Summary of runs test results from July 2005 to November 2013				
	India	**South Korea**	**Singapore**	**Hong Kong**	**Japan**
Observations	2075	2089	2128	2121	2068
Runs	979	1052	1122	1079	1102
Positive moves	1102	1127	1119	1093	1074
Negative moves	973	962	1009	1028	994
Expected runs	1034	1039	1062	1061	1033
SD	22.68	22.70	22.99	23.00	22.69
Z VALUE	-2.446	0.573	2.60	0.804	3.02
p- VALUE	0.0072	**0.716**	**0.99**	**0.789**	**0.9987**
Market efficiency	Inefficient	**Efficient**	Inefficient	**Efficient**	Inefficient
	Summary of runs test results from July 1997 to November 2013				
	India	**South Korea**	**Singapore**	**Hong Kong**	**Japan**
Observations	4056	4050	4141	4095	4033
Runs	1878	1983	2081	2066	2101
Positive moves	2149	2150	2117	2077	2036
Negative moves	1907	1900	2024	2018	1997
Expected runs	2022	2018	2070	2048	2017
SD	31.7260	31.694	32.16	31.9855	31.74
Z VALUE	-4.5319	-1.1132	0.327	0.56041	2.6361
p- VALUE	**0.0**	**0.13**	**0.628**	**0.712**	**0.9959**
Market efficiency	Inefficient	**Efficient**	**Efficient**	**Efficient**	Inefficient

Note : The numerical values were calculated after analyzing daily returns of indices of exchanges of various countries. Values extracted from https://in.finance.yahoo.com/

Table 3. Summary of Results of Autocorrelation of Daily Retunes

Leg	India		South Korea		Singapore		Hong Kong		Japan	
	AC [1]	B-L[11] Statistic	AC [1]	B-L[11] Statistic	AC [1]	B-L[11] Statistic	AC [1]	B-L[11] Statistic	AC [1]	B-L[11] Statistic
1	0.074	22.397	0.03	3.635	0.03	3.669	-0.008	0.294	-0.042	7.228
2	-0.011	22.895	-0.025	6.076	0.027	6.65	-0.029	3.768	-0.027	10.149
3	-0.033	27.327	-0.004	6.128	0.009	6.969	0.015	4.706	0.005	10.251
4	-0.02	28.911	-0.028	9.419	0.018	8.311	-0.006	4.834	-0.026	13.078
5	-0.039	34.94	-0.034	14.147	-0.004	8.383	-0.047	14.039	0.008	13.336
6	-0.032	39.18	-0.006	14.296	-0.037	14.178	0.012	14.631	-0.013	13.968
7	0.023	41.416	0.016	15.344	0.02	15.761	0.009	14.939	0.001	13.974
8	0.043	49.018	0.012	15.891	0	15.762	0.019	16.491	0.011	14.48
9	0.026	51.772	0.018	17.218	0.008	16.016	0.003	16.523	-0.009	14.809
10	0.014	52.533	0.005	17.338	0.037	21.741	-0.023	18.685	0.031	18.671
11	-0.054	64.29	0.003	17.364	-0.046	30.411	-0.016	19.789	0.005	18.763
12	0.023	66.479	0	17.364	0.031	34.515	0.034	24.41	0.005	18.873
13	0.016	67.489	0.007	17.584	0.042	41.926	0.046	33.207	0.002	18.887
14	0.042	74.561	-0.014	18.413	0.009	42.277	-0.038	39.027	-0.014	19.656
15	0.011	75.086	-0.016	19.502	-0.004	42.358	0.023	41.287	0.024	21.991
16	0.009	75.43	-0.008	19.783	-0.014	43.128	0.012	41.923	-0.048	31.514
17	0.043	82.918	0.007	20.004	0.041	49.985	-0.005	42.008	0.012	32.114
18	-0.009	83.233	0.007	20.207	-0.022	51.926	-0.039	48.259	0.02	33.664
19	-0.041	90.239	0.012	20.814	0.02	53.624	0.043	55.843	-0.007	33.841
20	-0.029	93.599	0.011	21.275	-0.014	54.405	0.015	56.775	-0.017	35.07
21	-0.009	93.906	0.018	22.591	-0.017	55.574	-0.002	56.799	-0.006	35.21
22	-0.001	93.912	-0.033	26.925	0.021	57.351	0.002	56.816	-0.015	36.111
23	-0.006	94.07	0.006	27.09	0.013	58.037	0.006	56.986	-0.022	38.016
24	-0.006	94.233	0	27.093	0.022	60.139	-0.015	57.925	0.033	42.526
25	0.014	95.011	-0.01	27.531	0.001	60.144	0.005	58.041	0.017	43.749
26	0	95.012	0.029	30.87	0.022	62.152	0.012	58.615	-0.015	44.651
27	-0.015	95.981	0.014	31.698	-0.003	62.195	0.000	58.616	0	44.651
28	0.013	96.635	-0.006	31.846	0.003	62.237	0.041	65.391	-0.003	44.687
29	-0.01	97.053	-0.037	37.505	0.012	62.789	-0.031	69.43	0.009	45.012
30	-0.023	99.176	0.019	39.034	-0.037	68.508	-0.048	79.024	-0.003	45.046
31	-0.023	101.285	-0.026	41.847	0.003	68.554	0.003	79.062	0.005	45.131
32	0.001	101.286	-0.013	42.494	0.005	68.639	0.000	79.062	-0.025	47.624
33	0.019	102.727	0.018	43.886	-0.016	69.759	-0.048	88.471	0.008	47.864
34	0.003	102.774	0.005	43.984	0	69.759	0.052	99.455	-0.003	47.891
35	-0.002	102.785	-0.011	44.492	-0.007	69.984	0.002	99.467	-0.031	51.859
36	-0.005	102.877	-0.001	44.498	-0.006	70.155	0.001	99.469	-0.002	51.881

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

AC[1]: Autocorrelation , B-L[11] : Box-Ljung Statistic, Note : The numerical values were calculated after analyzing daily returns of indices of exchanges of various countries. Values extracted from https://in.finance.yahoo.com/

Results and Discussion

We first analyzed some basic statistics like mean, standard deviation, skewness, kurtosis, and Jerqua - Bera from the daily returns of the selected five stock markets. Details of the results are furnished in the Table 1. For our convenience, the total period of research was considered from July 1997 to November 2013. The data was divided into two sub - periods; the first sub - period started from July 1997 to June 2005, and the second sub-period was from July 2005 to November 2013. As the table shows, with the exception of Japan's index Nikkei, all other markets yielded good average daily returns over the period. The returns varied from 0.000002 in case of Japan to 0.000522 in case of India. Other markets like South Korea, Singapore, and Hong Kong yielded 0.000434, 0.00021, and 0.000267 returns respectively. Critical value for skewness is 0. A positive value of the skewness indicates that the series is elongated in the right tail and a negative value indicates that it is elongated in the left tail. The critical value of the kurtosis is 3 ; a value greater than 3 indicates that the series in question is peaked relative to normal. A value less than 3 implies that the series is flat relative to normal. Values of both skewness and kurtosis of the data series indicates that the series is not normally distributed ; kurtosis values are the evidence that there is a leptokurtic distribution in the given series. So, the returns are not normally distributed. This is supported by a large value of the Jarque-Bera in the given series.

Runs test analysis of the data series relating to the five countries is furnished in the Table 2. Runs test was used to find out the series price movements that occurred by chance. Runs test is the non parametric test which does not require variables to be normally distributed in order to test them for interdependencies. Critical value of *Z* at 5% significance level is ±1.96 (Worthington & Higgs, 2003). When the expected number of runs are significantly different from the observed number of runs, it means that the market suffers from over or underreaction to information. This situation provides traders an opportunity to make excess returns from trading. *Z* value between -

Table 4. Summary of Results of Unit Root Test at Variance of First Difference

INDIA		SOUTH KOREA		SINGAPORE		HONG KONG		JAPAN	
ADF (without intercept)		ADF (without intercept)		ADF (without intercept)		ADF (without intercept)		ADF (without intercept)	
-37.3004		-37.0277		-35.8445		-37.1899		-37.7404	
H0:	Rejected	H0:	Rejected	H0:	Rejected	H0:	Rejected	H0:	Rejected
At 1%	-2.56	At 1%	-2.56	At 1%	-2.56	At 1%	-2.56	At 1%	-2.56
5%	-1.94	5%	-1.94	5%	-1.94	5%	-1.94	5%	-1.94
10%	-1.94	10%	-1.94	10%	-1.94	10%	-1.94	10%	-1.94
ADF (with intercept)		ADF (with intercept)		ADF (with intercept)		ADF (with intercept)		ADF (with intercept)	
-37.3320		-37.0371		-35.8399		-37.3320		-37.7383	
H0:	Rejected	H0:	Rejected	H0:	Rejected	H0:	Rejected	H0:	Rejected
At 1%	-3.43	At 1%	-3.43	At 1%	-3.43	At 1%	-3.43	At 1%	-3.43
5%	-2.86	5%	-2.86	5%	-2.86	5%	-2.86	5%	-2.86
10%	-2.57	10%	-2.57	10%	-2.57	10%	-2.57	10%	-2.57
Asymptotic critical values reference: Davidson, R. and MacKinnon, J. (1993).									
KPSS	0.0988	KPSS	0.0685	KPSS	0.0799	KPSS	0.0689	KPSS	0.2425
H0: Do Not Rejected		H0: Do Not Rejected		H0:Do Not Rejected		H0: Do Not Rejected		H0: Do Not Rejected	
10% 5% 1%		10% 5% 1%		10% 5% 1%		10% 5% 1%		10% 5% 1%	
0.347 0.463 0.739		0.347 0.463 0.739		0.347 0.463 0.739		0.347 0.463 0.739		0.347 0.463 0.739	

Note : The numerical values were calculated after analyzing daily returns of indices of exchanges of various countries. Values extracted from https://in.finance.yahoo.com/

1.96 to +1.96 is sufficient to prove the randomness in price series. This test was conducted on both the sub periods of the series as well as on the total data series. Randomness was tested from July 1997 to June 2005, from July 2006 to November 2013, and from July 1997 to November 2013.

From the test results of the first period, we found that except for Japan, for all other markets, the null hypothesis is rejected, that is, these are not weak form efficient in the period considered for the study. However, in case of the second period of the test, there was an evidence of randomness in cases of South Korea and Singapore. However, the overall period provides a strong evidence of randomness, that is, weak form of market efficiency in cases of Hong Kong and South Korea and considerable evidence in cases of Japan and Singapore. However, no evidence was found in India in any series of data.

Autocorrelation (serial correlation) is the test of serial dependency. Serial dependency is the most common test for RWH (random walk hypothesis). Autocorrelation tests the evidence whether the coefficients of correlation are significantly different from zero (Granger & Morgenstern, 1970). If there is any correlation in the residual series, it is likely the first - order serial correlation between E_t and E_{t-1}. As per this, we needed to correlate the same series between E_t and E_{t-n}, where n is the number of lags. For instance, for 16 lag correlations, the variables need to check the serial dependency between E_t and E_{t-16}. Fama (1965) tested the autocorrelation in Dow Jones Industrial average. He found the coefficient value to be 0.003, which is significantly near to zero. With this, he concluded that the market has a serial independence.

Kendal (1943), Moore (1964), and Cootner (1962) tested the serial correlation for the daily and weekly returns. Serial correlation for a large sample size (large time series) and high order serial correlation Ljung- Box statistics (Ljung & Box, 1978) were used. If the autocorrelation and partial correlation values at all lags are zero or nearly zero, there is no serial correlation, and the values of Ljung- Box statistics should be insignificantly large. We conducted the autocorrelation for the 36 lags for the entire data series. The details of the autocorrelation results are presented in the Table 3 for all the 36 lags along with the Ljung- Box statistics. The auto correlation coefficient column represents the values of the correlation coefficient for all the 36 lags. The values of this were significantly near to zero in all markets for some lags, and some of them are equal to zero. From this evidence, we can say that all the considered five Asian markets have no serial correlation. It implies that we cannot reject the null hypothesis (serial independence), and all markets are efficient markets, and the form of efficiency is weak-form of market efficiency. This is supported by the higher value of Ljung- Box statistics for all the sample countries.

Unit root testing is an important test to check whether the data is stationary or not. If there is no fixed level of price, then the time series is non stationary. It is a necessary, but not a significant condition for the random walk hypothesis. A series is said to be stationary if the mean and covariance of the series do not depend on time. To test the presence of the unit root, the Augmented Dickey Fuller (ADF) (Dickey & Fuller, 1979) test is a famous test that is used. We applied the ADF and KPSS test. Details of the unit root test are depicted in the Table 4, which shows the values of variance at first differences, and is measured in the series with $X_t - X_{t-1}$, where X_t is the closing price of the index at day t, X_{t-1} is the closing price at day t -1.

The test of unit root was performed on first difference of the data series on India, South Korea, Singapore, Hong Kong, and Japan. Mac Kinnon's critical values were used to determine the significance of the test statics. ADF test was made with intercept and without intercept. The ADF test rejected (see Table 4) the null hypothesis in all the five countries in both the cases of intercept. It indicates that all markets are weak form efficient. On the other hand, the null hypothesis of the KPSS has reverse assumptions (not rejected, see Table 4) that the series has no unit root. Daily returns of the stock index of the five countries shows that all were weak form efficient (null hypothesis is not rejected (KPSS test) in case of all the selected countries). Therefore, from the Table 4, we can conclude that all the countries have weak form of market efficiency.

Conclusion

This study examined the behavior of the daily returns to find the weak form efficient market in five Asian countries

using the stock market indices from July 1997 to November 2013. Runs test, autocorrelation test, and unit root test were employed to find the weak form of market efficiency. We found overwhelming evidence to prove the existence of weak form of market efficiency in all the said five countries. In the runs test, with the exception of India and Japan, all other countries satisfied the conditions of randomness. There was no linear dependency in price changes that were found using the test of autocorrelation (serial correlation) in any of the countries. Unit root test proved the market efficiency at first different in all markets. So all countries showed the weak form of market efficiency. Therefore, we can conclude that the performance of the financial markets act as an efficient channel to distribute capital resources throughout the economy that ultimately aids in the enhancement of a country's economy.

Implications

Studies on the efficient market hypothesis are very crucial to analyze the market performance. True value of the stocks can be determined based on different kinds of efficiencies in the market. This study can be used by the investors to understand the market and valuation of stocks so that they can take rational decisions for their investment holdings.

Limitations of the Study and Scope for Further Research

The present paper examined the existence of weak form of market efficiency in the selected Asian stock markets. This study is based on the concept that price movements of the stocks are fully reflected in all available information. A major limitation of the study is that it did not examine how the prices of the stocks moved with relation to the available information. This study has tested only whether the stock movements are random or not, the series is auto-correlated or not, and whether the series has unit root or not. However, the study did not create a link between the information and valuation of stocks. Future studies can carry out an in-depth analysis about how the price movements moved (and are related) in relation to the available information, and how the fair value of stocks are determined based on market efficiency.

References

Ansari, M., & Chen, J. C. (2013). Are Asia-Pacific markets efficient an empirical investigation. *Finance India, 27* (1), 61-76.

Bachelier, L. (2006). *Louis Bachelier's theory of speculation: The origin of the modern finance*. Princeton: Princeton University Press.

Cootner, P. H. (1962). Stock prices: Random vs. systematic changes. *Industrial Management Review, 3* (2), 34-105.

Davidson, R. & MacKinnon, J. (1993). *Estimation and inference in econometrics*. Oxford : Oxford University Press.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimates for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74* (366), 427-431.

Fama, E. F. (1965). Random walks in stock market prices. *Financial Analysts Journal, 21*(5), 55-59. DOI: http://dx.doi.org/10.2469/faj.v21.n5.55.

Fama, E.F. (1970). Efficient capital markets: A review of theory and empirical work. *The Journal of Finance, 25* (2), 383 - 417. DOI: 10.1111/j.1540-6261.1970.tb00518.x.

Fuller, W. (1976). *Introduction to statistical time series*. New York: John Wiley & Sons.

Granger, C. W. J., & Morgenstern, O. (1964). The random-walk hypothesis of stock market behavior. *International Review of Social Sciences, 17*(1), 1-30.

Granger, C. W. J., & Morgenstern, O. (1970). *Predictability of stock market prices* (1st ed.): Lexington: Heath Lexington Books.

Islam, A., & Khaled, M. (2005). Tests of weak-form efficiency of the Dhaka stock exchange. *Journal of Business Finance & Accounting, 32* (7-8), 1613-1624.

Jain, K., & Jain, P. (2013). Empirical Study of the weak form of EMH in Indian stock markets. *International Journal of Management and Social Sciences Research, 2* (11), 52-59.

Kendall, M. G. (1943). *The advanced theory of statistics* (Vol.1). London: Charles Griffin.

Ko, K. - S., & Lee, S. - B. (1991). A comparative analysis of the daily behavior of stock returns: Japan, the U.S, and the Asian NICs. *Journal of Business Finance and Accounting, 18* (2), 219-234. DOI: 10.1111/j.1468-5957.1991.tb00590.x.

Li, B., & Liu, B. (2012). A variance-ratio test of random walk in international Market. *Journal of Business Finance and Accounting, 29* (9 &10), 1275-1299.

Ljung, G.M., & Box, G.E.P. (1978). On a measure of lack of fit in time series models. *Biometrika, 65* (2), 297-303.

Moore, A. (1964). *A statistical analysis of common-stock prices* (Unpublished Ph.D. Dissertation). Graduate School of Business, University of Chicago, Chicago.

Osborne, M.F.M. (1959). Brownian motion in the stock market. *Operations Research, 7*(2), 145-173.

Poshakwale, S. (1996). Evidence on weak form efficiency and day of the week effect in the Indian stock market. *Finance India, 10* (3), 605-616.

Urrutia, J. L. (1995). Test of random walk and market efficiency for Latin American emerging equity markets. *The Journal of Financial Research, 18* (3), 299-309.

Vekatesan, K. (2010). *Testing random walk hypothesis of Indian stock market returns: Evidence from National Stock Exchange* (pp. 1-10). ICBI-University of Kelaniya, Sri Lanka.

Worthington, A. C., & Higgs, H. (2003). *Weak-form market efficiency in European emerging and developed stock markets* (Discussion Paper No 159). School of Economics and Finance, Queensland University of Technology, Australia.