TEST OF WEAK FORM OF EFFICIENCY IN EMERGING MARKETS: A SOUTH ASIAN EVIDENCE

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Abstract

This study examines the weak form of efficiency of three South Asian markets named as Dhaka Stock Exchange (DSE), Bombay Stock Exchange (BSE) and Karachi Stock Exchange (KSE) for a period between January 2000 to June 2010. Data used in the study is monthly closing values of the indices of the said exchanges. The study uses autocorrelation test, unit root tests, co-integration test and Granger causality test to examine the efficiency of the markets. Empirical result reveals that the returns do not follow normal distribution and the distributions are leptokurtic. Autocorrelation and unit root tests imply that the data series are stationary. Johansen co-integration test indicates that there is common stochastic trend shared by the markets. Granger causality test implies that the knowledge of the past return behavior in one market is unlikely to improve forecasts of returns of another market with some exceptions. So tests result implies that the markets are not weak form of efficient.

บทคัดย่อ

การศึกษานี้ตรวจสอบความมีประสิทธิภาพระดับต่ำของตลาดเอเชียใต้ 3 ตลาด ได้แก่ ตลาดหลักทรัพย์ดักกา (Dhaka Stock Exchange - DSE) ตลาดหลักทรัพย์บอมเบย์ (Bombay Stock Exchange - BSE) และตลาดหลักทรัพย์การาจี (Karachi Stock Exchange - KSE) ในช่วงเวลาตั้งแต่เดือนมกราคม 2543 ถึงเดือนมิถุนายน 2553 ข้อมูลที่ใช้ในการศึกษาครั้งนี้ได้แก่มูลค่าปิดแต่ละเดือนของดรรชีตลาดหลักทรัพย์ดังกล่าว การศึกษานี้ใช้การทดสอบสหสัมพันธ์ของตัวรบกวน การทดสอบ ความนิ่งของข้อมูลการทดสอบการร่วมกันของข้อมูล และการทดสอบความเป็นเหตุเป็นผลระหว่างตัวแปรเพื่อตรวจสอบระดับความมีประสิทธิภาพของตลาด หลักฐานเชิงประจักษ์แสดงให้เห็นว่าผลตอบแทนไม่ได้มีกระจายแบบปกติและมีการกระจายแบบโด่งสูง การทดสอบสหสัมพันธ์ของตัวรบกวนและความนิ่งของ

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ข้อมูลบ่งชี้ว่าอนุกรมข้อมูลมีความนิ่ง การทดสอบการร่วมกันของข้อมูลชี้ให้เห็นว่าตลาดมีแนวโน้มการแกว่งตัวที่เหมือนกัน การทดสอบความเป็นเหตุเป็นผลระหว่างตัวแปรบ่งชี้ว่าความรู้เกี่ยวกับการเคลื่อนไหวของผลตอบแทนในอดีตของตลาดหนึ่งไม่มีความน่าจะเป็นที่จะทำนายผลตอบแทนของตลาดอื่นได้ดีขึ้น ดังนั้นผลการทดสอบบ่งชี้ว่าตลาดไม่ได้มีประสิทธิภาพในระดับต่ำ

INTRODUCTION

In this age of globalization, more attentions are being drawn to the globalization of securities markets throughout the world. It is not only important for the investors but also interesting to the academicians to examine the implications of investing in the international equity markets. As Efficiency of financial market has important implications on the implementation of economic policy, it has been tested extensively in the South Asian countries like the rest of the world. But almost all of the studies focusing South Asian countries shed light on individual market [e.g. Mobarek, Mollah and Bhuyan (2008), Rahman, Uddin and Salat (2008), Nath (2002), Gupta and Basu (2007), Abeysekera (2001) Hameed and Ashraf (2009)] rather than examining long-term relationship among the markets. Thus, this paper is an attempt to examine weak form efficiency of three South Asian markets and to examine the integration of the markets as existence of cointegrartion will pave the way to make arbitrage profit.

Analysis of the South Asian markets is important for another reason. South Asian governments have implemented a wide range of deregulation policies in the financial markets as a movement towards the accomplishment of market economy in the last decade. Deregulation policies aim to enhance competitiveness, liberalization and internationalization in the financial market. The governments are still providing top priority to the deregulation policies as the countries are still experiencing negative trade balance. But the governments are also cautious regarding deregulations as they also have to fight against inflation and international terrorism which may be the by product of deregulation. As one of the objectives of deregulation is to bring efficiency in the financial market, it is interesting to examine the efficiency of the markets during the period.

DSE, BSE and KSE are prime stock exchanges in south Asia and playing a pivotal role in developing the respective economy as well as contributing to the development of the region. A stock market mobilizes the savings and invests it for development purposes. Stock market also helps the investors to create a diversified portfolio investment by the way reduce the risk and reduce the cost of the fund. So it is very important to examine the efficiency of these markets from academic, investor and regulatory point of view.

LITERATURE REVIEW

Although the controversy relating to the random walk behavior of stock prices started after the submission of Ph.D thesis of Bachelier

(1900), the issue is still an unsettled vicinity of finance literature. Many studies focused developed market of United States and Europe. Cootner (1962) and Stevenson and Bear (1970) investigated the behavior of security prices in US markets and found very weak indication of randomness. Fama (1966) showed that security returns do not conform to normal distribution. Lo and MacKinlay (1988) and Dorfman (1993) examined US indices and found that Random Walk Hypothesis is strongly rejected. Brown and Easton (1989) made an attempt to study the efficiency of London Stock Exchange. They used serial correlation, runs test and found that the London market was efficient in the historical time period. Chen (1996) conducted a study in FSPCOM and FSDXP using autocorrelation, spectral analysis and filter techniques studied the price. He concluded the non-existence of random walk.

A good number of studies have been conducted to examine the efficiency of African emerging stock markets. Parkinson (1987) studied the presence of the weak-form efficiency in the Nairobi Stock Exchange. He concluded that random walk hypothesis is rejected for these data in Nairobi Stock Exchange. Dickinson and Muragu (1994) also tested the existence of weak-form efficiency in Nairobi Stock Exchange. They contradicted with Parkinson (1987) and found that Nairobi Stock Exchange is weak form of efficient. Olowe (2002) examined weak form efficiency of the Nigerian stock market. He used correlation analysis and monthly stock returns data over the period January 1981-December 1992. The results conclude that the Nigerian stock market appears to be efficient in the weak form. Appiah-Kusi and Menyah (2003) examined the weak-form efficiency of eleven African stock markets. The result of the study reveals that the markets in Egypt, Kenya, Mauritius, Morocco, and Zimbabwe are weak form of efficient but rest of the six markets are not weak form of efficient. Akinkugbe (2005) investigated weak and semi-strong form of efficiency of the stock markets in Botswana. Autocorrelation test show that there is no serial correlation in the return series and the results of unit root tests implies that the market is weak form of efficient.

A large number of studies are also available on Middle Eastern countries of Asia. Abraham et al. (2002) did a similar study and investigated the weak-form efficiency in three major Gulf stock markets including Kuwait, Saudi Arabia, and Bahrain. They concluded that none of the markets are weak form of efficient. Hassan et al. (2003) also examined the weak form of efficiency of Kuwait stock market (KSE). The result of the study does not support the evidence of weak form of efficiency in the market. Buguk and Brorsen (2003) made an attempt to test the random-walk version of the efficient market hypothesis for the Istanbul Stock Exchange (ISE) using its composite, industrial and financial index weekly closing prices. They found that all three series are a random walk, but a non-parametric test provides some evidence against a random walk. Tas and Dursonoglu (2005) also examined the efficiency of Istanbul Stock Exchange (ISE) but they concluded that the tests reject random walk hypothesis in ISE. Moustafa (2004) examined the behavior of stock prices in United Arab Emirates (UAE) stock market. The study concluded that the returns of 40 stocks out of the 43 are random at a 5% level of significance that means the empirical study supports the weak-form EMH of UAE stock market. Marashdeh and Shrestha (2008) investigated whether the stock price index in the United Arab Emirates Securities Market meets the criterion of weak-form market efficiency. The study reveals that the Emirates Securities Market data contains unit root and follow a random walk, which suggests that the market meets the criterion of weak-form market efficiency. Omran and Farrar (2006) investigated the efficiency of the emerging stock markets and the validity of the random walk hypothesis (RWH) and tests for calendar effects in five major Middle Eastern emerging markets by applying a range of statistical and econometrics techniques. The study reject the RWH for all markets and suggest that the stock returns in these countries exhibit calendar effects. Asiri (2008) measured the behaviour of stock prices in the Bahrain Stock Exchange (BSE). The study found that Random walk with no drift and trend is confirmed for all daily stock prices and each individual sector.

Most of the studies conducted in developing and in the less developed markets of Latin America concluded that stock price does not follow random walk and markets are not weak form of efficient. Harvey (1995) investigated volatility and returns predictability of six Latin American, eight Asian, three European and two African emerging stock markets. He found the presence of strong serial correlation in the stock returns which means that stock returns are more predictable. Ojah and Karemera (1999) examined random walk for the four Latin American markets such as Argentina, Brazil, Chile, and Mexico. The study found that only stock prices of Argentina follow random walk. Karemera et al. (1999) also studied the random walk hypothesis for fifteen emerging stock markets. The result reveals that with U.S. dollar based data, 10 of the 15 emerging stock markets are consistent with the random walk hypothesis under the multiple variance ratios, while 5 of the 15 are consistent with the random walk hypothesis under the single variance ratio.

Most of the studies conducted to investigate the efficiency of emerging markets of South Asia also concluded that the markets are not weak form of efficient. Mobarek and Keasey (2000), Ahmed (2002), Kader and Rahman (2004), Mobarek, Mollah and Bhuyan (2008), Rahman, Uddin and Salat (2008) and Mohiddin, Rahman and Uddin (2008) examined the behavior of stock price movement in Dhaka Stock Exchange (DSE) in Bangladesh and concluded that DSE is not weak form of efficient. Hasan, Islam and Baher (2000) studied equity return of DSE and showed that DSE equity return show positive skewness, excess Kurtosis and deviation from normality. Rahman, Salat and Bhuiyan (2004) did a similar study in DSE but contradicted with Mobarek and Keasey (2000) and said that DSE general index follow random walk and the market is efficient in weak form. Islam and Khaled (2005) found Conflicting evidence on weak form efficiency of the Dhaka Stock Market from the use of monthly versus daily data, structural changes after the 1996 market crash, and the use of tests with or without heteroscedasticity adjustment. Reddy (1997), Pant and Bishnoi (2001), Nath (2002) and Gupta and Basu (2007) studied the efficiency of Indian stock market. They found no evidence of efficiency in Indian stock market. Abeysekera (2001) used the serial correlation test, runs test and unit root tests to examine the weak form of efficiency of the Colombo Stock Exchange (CSE) in Sri Lanka. The result of serial correlation test, runs test and unit root tests reject the random walk hypothesis thus the market is not weak form of efficient. Hameed and Ashraf (2009) tested weak-form efficiency for Pakistani stock market using daily closing prices. They found that returns series exhibit persistence and volatility clustering. In their study weak-form efficiency and mean variance hypothesis is rejected.

Data and Methodology

Data used in the study includes monthly closing values of Dhaka Stock Exchange (DSE) general index, Karachi Stock Exchange (KSE) all share index and Bombay Stock Exchange (BSE) 500 index for a sample period from January 2000 to June 2010. Data have been collected from International Financial Statistics (IFS), websites of respective stock exchanges and from DSE library.

After collecting data, monthly returns were calculated using continuously compounded return formula. Monthly returns were calculated using following formula.

$$R_{Nt} = ln\left(\frac{P_{nt}}{P_{nt-1}}\right) \quad or$$

$$R_{Nt} = ln(P_{nt}) - ln(P_{nt-1}) \qquad (1)$$

Where,

R_{Nt} = Return on closing index price,
P_{nt} = Current closing index price,
P_{nt-1} = Previous period closing index price,
ln = Natural log

Test of normality: After calculating return series, the study moves to test the normality of data series. In this regard Jarque-Bera (JB) test of normality is used. The JB test of normality is an asymptotic test. It is also based on the OLS residuals. This test first computes the skewness and kurtosis measures of the OLS residuals and uses the following test statistic:

$$JB = n\left(\frac{S^2}{6} + \frac{(K-3)^2}{24}\right) \qquad (2)$$

Where n = sample size, S = skewness coefficient and K = kurtosis coefficient. For a normally distributed variable, S = 0 and K = 3. Therefore, the JB test of normality is a test of joint hypothesis that S and K are 0 and 3, respectively.

Autocorrelation Function: To test the non stationery or randomness of a data series the study use autocorrelation function (ACF). ACF plot the value of autocorrelation at successive lags against the length of the lag. Autocorrelation coefficient as suggested by Fama (1965) at lag k, is denoted by ρk, is defined as

$$\rho k = \frac{yk}{yo} \qquad (3)$$

To test the statistical significance of autocorrelation coefficient we test the joint hypothesis that all the ρk up to certain lags are simultaneously equal to zero. This can be done by using the Ljung-Box (LB) statistic developed by Ljung and Box (1978), which is defined as

$$LB = n(n+2)\sum_{k-1}^{m}\left(\frac{\rho^2 k}{n-k}\right) \qquad (4)$$

Where, n = sample size and m = lag length

Unit Root Test: To test the presence (absence) of unit root in the return series we use several unit root test, such as, Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988), GLS-detrended Dickey-Fuller (Eliot, Rothenberg and Stock, 1996) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) unit root test. The methodologies of these tests are explained one by one.

Augmented Dickey-Fuller (1979) test is obtained by the following regression

$$\Delta Y_t = \beta_1 + \beta_2 t = \delta Y_{t-1} + \alpha_i \sum_{i-1}^{m} \Delta Y_{t-1} + \varepsilon_t \qquad (5)$$

where Δ is the difference operator, β, δ and α are the coefficients to be estimated, Y is the variable whose time series properties are examined and ε is the white-noise error term.

The DFGLS test involves estimating the standard ADF test equation, (5), after substituting the GLS detrended Y_t^d for the original Y_t:

$$\Delta Y^d_t = \beta_1 + \beta_2 t = \delta Y^d_{t-1} + \alpha_i \sum_{i-1}^{m} \Delta Y^d_{t-1} + \varepsilon_t \qquad (6)$$

Phillips and Perron (1988) propose an alternative (nonparametric) method of controlling for serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test equation and modifies the t-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the statistic

$$\xi_\alpha = t_\alpha \left(\frac{y_0}{f_0}\right) - \frac{T(f_0 - y_0)(se(\bar{\alpha}))}{2f^{\frac{1}{2}}{}_0 s} \qquad (7)$$

Where, α is the estimate, and t_α the t ratio α, $se(\alpha)$ is the coefficient standard error, and s is the standard error of the test regression. In addition y_0 is a consistent estimate of the error variance. The remaining term f_0, is an estimator of the residual spectrum at frequency zero.

The KPSS (1992) test differs from the other unit root test that the series Y_t is assumed to be stationary under the null. The KPSS static is based on the residuals from the OLS regression of Y_t on the exogenous variables x_t:

$$Y_t = x'_t\delta + \varepsilon_t \qquad (8)$$

Cointegration test

It is also useful to determine whether the South Asian markets are jointly efficient or whether one or more markets could contain information important in forming forecasts of the others, indicating market inefficiency. For this purpose we employ the Johansen procedure (Johansen, 1988; Johansen and Juselius, 1990) to test for the possibility of a cointegrating relationship among the markets.

The Johansen procedure relies on the relationship between the rank of a matrix and its characteristic roots. Let be a vector of n time series variables, each of which is integrated of order (1), and assume that can be modeled by a vector autoregression (VAR):

$$Y_t = Y_{t-1} + ... + a_p Y_{t-p} + \varepsilon_t \qquad (9)$$

Rewrite the VAR as

$$\Delta Y_t = \quad \Pi Y_{t-1} + \Sigma\Gamma\Delta Y_{t-1} + \varepsilon_t \qquad (10)$$

where Π a_i - I and Γ_{t-i} + ε_t.Under the assumption that each series Y_t is nonstationary, the rank of Π will be less than n. In the event that the rank of Π is zero, we can model the system as a standard VAR in first differences.

The tests used to determine the rank of Π are the trace test and the maximum eigen-value test:

$$\lambda_{tyace}(r) = -\, n\, \Sigma \ln(1 - \lambda_i) \qquad (11)$$

$$\lambda_{max}(r; r+1) = -\, n \ln(1 - \lambda_{n+1}) \qquad (12)$$

where the estimated values of the characteristic roots (eigen values) obtained from the estimated Π matrix, r is the number of cointegrating vectors, and n = the number of usable observations. The trace statistic tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r against a general alternative. The λ_{max} statistic uses the null that there are exactly r versus r+1 cointegrating vectors.

Granger Causality test

We also use a test of Granger causality using the return series without an error-correction term. The Granger method (Granger, 1969) seeks to determine how much of a variable, Y, can be explained by past values of Y and whether adding lagged values of another variable, X, can improve the explanation. Y is said to be "Granger-caused" by X if X helps predict Y, that is, if the coefficients on the lagged X's statistically significant, as measured by an F test. The Granger test takes the form:

$$Y_t = \alpha_0 + \Sigma\, \alpha_i Y_{y-i} + \Sigma \beta_j X_{t-j} + \varepsilon_t \quad (13)$$

$$X_t = \alpha_0 + \Sigma a_i X_{t-i} + \Sigma b_j Y_{t-j} + \mu_t \quad (14)$$

Empirical Results

Table 1 represents descriptive statistics of the log returns series of the indices. DSE has the highest mean return (0.015809), whereas BSE has the lowest mean return (0.009237). Standard deviations of returns range from 0.066352 to 0.094140, which indicates that the returns in the markets are somewhat similarly volatile. BSE has the lowest mean return and highest standard deviation indicates that investment in BSE is most risky among the three markets. On the other hand, DSE has the highest mean return and lowest standard deviation indicates that investment in DSE is least risky among the three markets.

Table 1: Descriptive statistics of log return series

	BSE	DSE	KSE
Mean 0.009237	0.015809	0.015290	
Median	0.027595	0.012715	0.015357
Maximum	0.287626	0.023009	0.210056
Minimum	-0.316158	-0.221654	-0.411577
Standard deviation	0.094140	0.066352	0.091144
Skewness	-0.730207	0.081388	-1.503676
Kurtosis	4.218699	4.323466	8.103126
Jarque-bera	17.034920	8.371688	112.567700
Probability	0.000200	0.015209	0.000000

Skewness coefficients show that BSE and KSE returns are negatively skewed and DSE returns are positively skewed. Negative skewness coefficients of BSE and KSE retuns indicate that there is a greater probability of decrease in returns than rises. Positive skewness coefficient of DSE indicates that there is greater probability of increase in returns than decrease which make the investment most attractive in DSE although all the skewness coefficients are low. If we look into the Kurtosis we can see that Kurtosis is positive and high in all the three markets reveals that the distributions are leptokurtic. Finally the Jarque-Bera test which is used to measure normality of a data series proves that DSE, BSE and KSE returns do not follow normal distribution as the null hypothesis of normality is rejected at 5-percent significance level for all the three markets.

Table-2 shows auto-correlation (AC) coefficient and Ljung-Box Q-statistics of log return series of all the three markets. From the

Table 2: Auto-correlation test results of log return series

Lag	BSE log return series		DSE log return series		KSE log return series	
	AC	t-statistic	AC	t-statistic	AC	t-statistic
1	0.136*	2.1533	0.023	0.0608	0.228*	4.1714
2	-0.034	2.2883	-0.052	0.3831	-0.018	4.1972
3	0.087*	3.19	0.095*	1.4402	1.4402*	1.4402
4	0.148*	5.7909	0.009	1.4509	0.092*	5.0217
5	0.038	5.9621	0.113*	2.9858	0.08*	5.5649
6	0.04	6.1548	0.08*	3.7539	-0.018	5.5932
7	0.001	6.1551	-0.015	3.783	-0.014	5.61
8	-0.027	6.2457	-0.162*	7.0206	0.029	5.6819
9	-0.023	6.3097	0.079*	7.7926	0.118*	6.9291
10	0.027	6.3983	0.009	7.8032	-0.003	6.9299
11	0.035	6.5557	-0.023	7.8721	0.026	6.9911
12	0.083*	7.45	-0.015	7.9025	0.044	7.1753
13	0.031	7.5735	-0.143*	10.575	-0.001	7.1753
14	0.034	7.7236	-0.04	10.785	-0.002	7.1756
15	-0.005	7.7271	-0.069*	11.424	-0.057	7.4922
16	0.097*	8.9874	-0.043	11.675	-0.044	7.6844
17	0.01	9.0017	-0.114*	13.438	-0.004	7.686
18	0.001	9.0018	-0.126*	15.595	0.033	7.7964
19	-0.013	9.0249	-0.116*	17.458	0.119*	9.2696
20	-0.008	9.0335	-0.103*	18.953	0.08*	9.9572
21	0.042	9.2873	-0.01	18.967	-0.021	10.007
22	0.027	9.3925	-0.16*	22.611	0.014	10.028
23	-0.049	9.7366	0.015*	22.642	0.023	10.085
24	0.079*	10.653	0.074*	23.452	-0.065*	10.574
25	0.037	10.858	0.019	23.507	-0.013	10.593
26	-0.043	11.134	0.001	23.507	0.048	10.867
27	-0.027	11.248	-0.034	23.678	0.022	10.925
28	0.006	11.254	0.016	23.719	-0.031	11.048
29	-0.052	11.666	0.023	23.804	0.026	11.135
30	-0.005	11.669	0.074*	24.653	0.051	11.468

* Significant autocorrelation at two standard error limit

table it is clearly evident that there is significant positive auto-correlation and significant negative auto-correlation at different lags for the three markets. The presence of non-zero autocorrelation in the markets return series suggest that there may be some relationship among the past returns and the present returns in the three markets. The findings suggest that market returns in DSE, BSE and KSE are predictable based on past information. So the markets are not weak form of efficient. The presence of positive auto-correlation paves the way to the investors to earn superior return than the market average by following market timing strategy.

Table 3 exhibits unit root test results of log return series. We can see that incase of ADF, DFGLS and PP unit root test computed test statistic exceed the critical values at 1% , 5% and 10% significance level in absolute term for the markets. Thus the null hypothesis of a unit root is rejected. The results clearly indicate that monthly log return series of the markets are stationary data series and do not contain a unit root. In other words, the return series do not follow random walk. In case of KPSS unit root test computed test statistic is smaller than the critical values 1%, 5% and 10% significance level. Thus the null hypothesis of data stationary is accepted. The result is consistent with other unit root test. So the results of unit root tests confirm the findings of auto-correlation correlation test that the market is not weak form of efficient as the data series are stationary and do not follow random walk.

The results for Johansen co-integration test between log return series are reported in table 4. Form the table it is evident that, incase of BSE and DSE the computed trace statistic is higher than their corresponding critical values at 5% level indicate that the null hypoth-

Table 3: Unit root test result of log return series

Particulars		BSE log return series		DSE log return series		KSE log return series	
		Constant	constant & linear trend	Constant	constant & linear trend	Constant	constant & linear trend
Test Statistic	ADF	-9.2281*	-9.2863*	-10.1569*	-10.1162*	-6.8336*	-7.4661*
	DF-GLS	-2.8024*	-8.0796*	-10.1235*	-9.9707*	-5.9776*	-6.6253*
	PP	-9.3340*	-9.3966*	-10.1498*	-10.108*1	-6.7965*	-7.4169*
	KPSS	0.1841*	0.1344*	0.0566*	0.0503*	0.7385*	0.0593*
1% Critical Value	ADF	-3.4897	-4.0420	-3.4897	-4.0420	-3.5191	-4.0834
	DF-GLS	-2.5864	-3.5656	-2.5858	-3.5656	-2.5957	-3.6712
	PP	-3.4897	-4.0420	-3.4897	-4.0420	-3.5191	-4.0834
	KPSS	0.7390	0.2160	0.7390	0.2160	0.7390	0.2160
5% Critical Value	ADF	-2.8874	-3.4504	-2.8874	-3.4504	-2.9001	-3.4700
	DF-GLS	-1.9438	-3.0180	-1.9437	-3.0180	-1.9451	-3.1068
	PP	-2.8874	-3.4504	-2.8874	-3.4504	-2.9001	-3.4700
	KPSS	0.4630	0.1460	0.4630	0.1460	0.4630	0.1460

Notes: *indicates stationarity at 1% level, **indicates stationarity at 5% level, ***indicates stationarity at 10% level. Lag length for ADF tests have been decided on the basis of SIC. Maximum Bandwidth for PP and KPSS tests have been decided on the basis of Newey-West (1994). The DF, ADF and PP tests are based on the null hypothesis of unit roots while the KPSS test assumes the null hypothesis of stationarity.

esis of no co-integration can be rejected. In particular, the result indicates that there is two cointegrating equation at 5% significant level. But if we look in the maximum eigen value test we can see that maximum eigen value test indicates no cointegrating equation between the return series. So trace test and maximum eigen value test result contradict. But the result of trace test should be more emphasized as trace statistic considers all of the smallest eigen values, it holds more power than the maximum eigenvalue statistic (Kasa, 1992).The presence of cointegration between the return series indicate that there is common stochastic trend shared by the markets and that returns from one market is predictable in terms of information in another market. The result of Johansen cointegration test reveals that the markets are not weak form of efficient.

Table 4 also exhibits cointegration test result between log return series of DSE and KSE. The result is similar to that of BSE and DSE and indicate that there is cointegrating relationship between the log return series of DSE and KSE which again reveals that the markets are not weak form of efficient as one market is predictable on the basis of information of another market. Johansen cointegration test reveals that there is cointegration between the return series of two markets. So there is a long term co-movement between the stock prices of these two markets which also against the efficiency of the markets. Table 4 also shows cointegration test result among the log return series of BSE, DSE and KSE. The trace test and maximum eigen value test both indicate there is one cointegrating equation among the markets. So both the test concludes that there is cointegration exists among the return series of the markets. Presence cointegration indicates that share prices of one market can be forecasted on the basis of the information of other markets. So the markets are not weak form of efficient.

With the existence of a co-integrating relationship among the return series, the study

Table 4: Cointegration test result between log return series

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical	Prob.**	Max-Eigen	0.05 Critical	Prob.**
Cointegration test result between log return series of BSE and DSE							
None*	0.145333	27.84327	18.39771	0.0018	16.96069	17.14769	0.05
At most 1*	0.095854	10.88258	3.841466	0.001	10.88258	3.841466	0.00
Cointegration test result between log return series of DSE and KSE							
None*	0.201212	22.87997	18.39771	0.011	16.1755	17.1477	0.06
At most 1*	0.088914	6.704468	3.841466	0.0096	6.70447	3.84147	0.00
Cointegration test result between log return series of BSE and KSE							
None*	0.289691	34.10531	18.39771	0.0001	24.62796	17.14769	0.00
At most 1*	0.123335	9.477347	3.841466	0.0021	9.477347	3.841466	0.00
Cointegration test result between log return series of BSE, DSE and DSE							
None*	0.288396	40.80033	35.0109	0.0108	24.4968	24.252	0.04
At most 1	0.131106	16.30353	18.39771	0.0958	10.1184	17.1477	0.38
At most 2*	0.082318	6.185114	3.841466	0.0129	6.18511	3.84147	0.01

*denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values turns to a test of Granger causality, using log return series of the indices without an error-correction term. Table 5 represents the result of Granger-Causality tests among the return series without an error correction term. The table shows a lack of causality in either direction between KSE and DSE as F-statistic is statistically insignificant at 5-percent and 1-percent level in both the cases. So we can accept the null hypothesis that KSE does not cause DSE and DSE does not cause KSE. The table also reveals lack of causality from DSE to BSE and from KSE to BSE. But the test produces significant evidence for causality from BSE to DSE and BSE to KSE as F statistics are significant at 5-percent significance level. Therefore it appears that Granger causality runs one-way from BSE to DSE and BSE to KSE, not the other way .This implies that the knowledge of the past return behavior in one market is unlikely to improve forecasts of returns of another market except for some evidence of causality running from BSE to DSE and BSE to KSE. Thus the existence of one way causal relationship between BSE to DSE and BSE to KSE also proves that the markets are not weak form of efficient.

CONCLUSION

The study used an array of statistical and econometric tools to test the random walk hypothesis in DSE, BSE and KSE. The study shows that random walk hypothesis is rejected for all the three markets which proves that the markets are not weak forms of efficient and the markets are cointegrated. The result is consistent with the general impression about the emerging markets that the emerging markets are not informationally efficient. The finding of the study is consistent with some studies conducted in emerging markets [e.g. Mobarek, Mollah and Bhuyan (2008), Rahman, Uddin and Salat (2008), Nath (2002), Gupta and Basu (2007), Abeysekera (2001) Hameed and Ashraf (2009)]. However, the study also contradicts with some studies on emerging markets [e.g. Dickinson and Muragu (1994), Olowe (2002), Buguk and Brorsen (2003), Moustafa (2004), Rahman, Salat and Bhuiyan (2004), Akinkugbe (2005)].

The rejection of the random-walk model for the markets may be possibly explained by some points. One possible expla-

Table 5: Granger-Causality tests result

Null Hypothesis:	F-Statistic	Probability
KSE does not Granger Cause DSE	0.88213	0.41845
DSE does not Granger Cause KSE	1.31805	0.27422
BSE does not Granger Cause DSE	3.08928**	0.04966
DSE does not Granger Cause BSE	0.31452	0.73082
BSE does not Granger Cause KSE	5.90704**	0.00426
KSE does not Granger Cause BSE	2.26582	0.11130

Note: **indicates significant at the 5 percent level. The Granger Causality test is applied here to the log returns of the index series pair wise. Since this test is highly sensitive to the lag orders of the right hand side variables, the Akaike criterion was used to determine the optimal lag length, which was two in each case.

nation may be non synchronous trading in the markets. Market returns may be predictable to some extant due to infrequent trading if new information is not instantly reflected in the stock prices and high percentage of stock remains inactive. Another possible explanation may be market imperfections that interfere with the rapid processing of information. The inefficiency of the markets also may be due to less number of securities listed, poor institutional frame work, poor disclosure practice and lack of regulatory monitoring. So the test results and the possible explanations indicate that new regulations and practices have to be gradually introduced in the markets. The regulators should strictly monitor the market to build up investors' confidence. Investors also should have full access to all information to make a good investment decision. Thus the regulators should take necessary steps to discriminate information to the investors. Regulators should ease and relax the listing process so that more companies can be listed with the exchanges.

The results have several implications to investors, issuers and policy makers. Rejection of random walk hypothesis indicates that future security prices are predictable on the basis of past prices which provides an opportunity to the informed investors for predicting the future prices and earning abnormal returns by manipulating information. The findings are also helpful for regulators and policy makers. As refusal of random walk hypothesis indicates inefficiency of the market, it informs the regulators and policy markers that appropriate measures should be taken to bring informational and operational efficiency in the market. The outcome of the study is also useful to the issuers in the way that they can predict the future prices of their own securities in the market and can take corrective actions to main stable price of the securities which increase their fund raising ability.

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