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Abstract

The aim of this paper is to investigate the Efficient Market Hypothesis (EMH) for Association of South-East Asian Nations (ASEAN) stock markets for the period January 2000 through April 2011. We test whether these markets are efficient individually and collectively using number of statistical tests. We reject the EMH for the stock markets of Indonesia, Malaysia, the Philippines and Vietnam. This study finds stock markets in Singapore and Thailand are weak form efficient. We also find that collectively these markets do not follow the same trend; this means that prices from one market are not predictable in terms of information in another. Findings of this study are of importance for policy makers of these countries who attempt to introduce regulations to make their financial markets more attractive for investors from other countries.

Keywords: ASEAN, efficient market hypothesis, variance ratio, cointegration

JEL Classification: **G12, G14, G22.**

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1. Introduction

Market efficiency has important bearing for investors who seek to identify assets to invest in the equity markets. If the equity market is efficient, attempts to find miss-priced assets to make excess returns do not yield any benefits. In efficient markets, prices of the assets will reflect the best estimate of agents in the market regarding the expected risk and the expected return of the assets accounting for the information known about the asset at the time. Therefore there will be no undervalued assets offering higher than expected returns or overvalued assets offering lower than expected return. All assets in the market will be appropriately priced offering optimal reward to risk. However, if the markets were not efficient investors can enhance their risk-adjusted returns by identifying mispriced assets. Efficient market hypothesis (EMH hereafter) can be argued to provide dual function; first as a theoretical and predictive model of the operations of the financial markets. Second function it may serve is as an instrument for impression management campaign to convince more people to invest their savings in the equity markets (Will 2006).

Objective of this paper is to investigate the random walk hypothesis (RWH) for a selected sample of countries which are members of the Association of Southeast Asian Nations (ASEAN). There are specific reasons to consider ASEAN member countries for this study. ASEAN as an economic block is gaining its own identity and researchers and policymakers are considering these markets as a group of economies in their studies of market integration and financial market development (see for example Hill and Menon (2010), Acharya (2009). At the 2010 ASEAN Finance Ministers Meeting was decided a roadmap for Financial integration with the ultimate goal of greater economic integration among ASEAN countries by 2015. A key step in this process is the development of capital markets with a long-term goal of achieving higher cross-border integration among them. A necessary condition for investors from all member states to have an incentive to allocate capitals across ASEAN stock markets is the market efficiency, in other words security prices should fully reflect all available information.[1] A series of reforms have been introduced in ASEAN financial markets by local regulatory bodies starting in the 1990s[2]. Some studies have attributed premature

[1] Fama (1970) subdivided the efficient market hypothesis into three categories. The weak form assumes that all information contained in historical prices is fully reflected in current prices. The semi strong hypothesis assumes that publicly information is fully reflected in current stock prices. The strong-form hypothesis assumes that all information, public or private, is fully reflected in security prices.

[2] Singapore has introduced significant reforms since 1998 with the aims of making the financial sector more opened to foreign competition and introducing new regulatory and supervisory practices in line with international best practices (IMF, 2004). During the 1990s the Malaysian government launched a programme of financial liberalization allowing foreign investors to acquire equity in domestic firms and also reducing the tax rate on their profits. In the Philippines a first wave of reforms started in the late 1980s, however at the beginning of the 1990s the government took more robust measures (such as interest rate deregulation and liberalization of the foreign exchange market) with the aim of raising market competition. In the early 1990s the Thai government implemented several measure of financial liberalization

capital account liberalization as one of the main causes of the 1997 Asian Crisis. Based on the experience of Asian crisis, some ASEAN countries introduced efficient domestic regulatory framework in order to better monitor financial sector activities.[3] During the 2000s, ASEAN equity markets have experienced a rapid growth in the number of listed companies, capitalization and liquidity. This rapid growth and the reform of the regulatory systems can contribute to reduce the systematic divergence of stock prices from the fundamentals resulting in more efficient markets.

The implications of market efficiency in stock markets for issues in corporate finance are well documented. An efficient market is supposed to provide the 'correct' signals for the allocation of real resources (i.e. fixed investment). On the other side if share prices do not reflect fundamentals then abnormally low share prices may restrict a firm from raising capital through the market and embarking on a viable investment project. The aim of this paper is to contribute to the existing literature in the area of emerging stock markets, by considering the issue of efficiency related to a group of both well-defined emerging countries and member of a regional economic organisation. The rest of the paper is structured as follows. The next section presents a brief review of the literature. Section 3 outlines the methodologies employed and section 4 describes our data sources. Section 5 presents the empirical findings and Section 6 discusses some policy implications followed by conclusions in Section 7.

2. Brief review of literature

The efficiency of Asian stock markets has been of interest in last decade. Overall past studies on Asian stock markets provide mixed results. A number of studies (Darrat and Zhong, 2000; Karemera and Ojah, 1999; Chang and Ting, 2000; Buguk and Brorsen, 2003; Chang et al. 2004; Hoque et al., 2007; Fifield and Jetty, 2008; Lagorde and Lucey, 2008; Hung, 2009) have analysed the RWH for Asian stock markets. Results can be summarised as follows. Firstly, Asian stock markets show a certain degree of predictability especially when daily data are considered. However, applying the conventional VR test in cases when data is not normally distributed may lead to high acceptance rates of the null hypothesis of random walk. In order to overcome this problem, some authors have preferred using the multiple variance ratio (MVR) tests. Use of MVR provides more

based on the reduction of restrictions on capital account transaction and relaxing exchange controls. Greater financial and capital account liberalization in Singapore took place especially after the 1997 Asian crisis, with the main aim to allow non-resident financial institutions to participate more actively to the development of the local stock market.

[3] In Thailand the financial institutions supervision is managed by the Bank of Thailand (BoT), in Singapore by the Monetary Authority of Singapore (MAS), in Indonesia by the Bank of Indonesia (BoI) and the Indonesian Capital Market and Financial Institutions Supervisory Agency, in Malaysia by the Central Bank of Malaysia (BNM). In the Philippines by the Central Bank and other three agencies. In Vietnam by both State Bank of Vietnam (SBV) and .Ministry of Finance.

robust results given that it also considers the presence of heteroskedasticity. However, as pointed out by some authors (Charles and Darnè, 2009), splitting a sample of data in sub-periods and applying the MVR test to each sub-sample may lead to different results (i.e random walk hypothesis may be found only on recent periods). This may be explained with the evolving efficiency of the stock markets, due to the relaxation on restrictions on both domestic and foreign investors. A few papers (see for example Abdmoulah, 2010) have investigated the phenomenon of evolving efficiency due to technical difficulties in implementing such methodologies of analysis. To deal with data non-normality, a more powerful test was introduced by Wright (2000). Using non-parametric test of Wright (2000) some authors (Kim and Shamsuddin, 2008; Charles and Darnè, 2009) find higher rate of rejection of the RWH.

Financial markets in ASEAN region can still not be characterised as developed. These markets are not sufficiently developed as measured using different indicators of market deepening (Gupta and Donleavy; 2009). Regulatory framework is weak these markets as reported in Clark and Tunaru (2005) so we will consider recent evidence on governance indicator and rule of law in our discussions of results and conclusion.

It is evident from the review of the literature that a mix of different results has been achieved by using different methodologies. However it seems evident that the ongoing liberalisation processes and removal of restrictions to trading activity may have played their role in affecting the results of a large number of tests employed. Our study extends the empirical literature in three ways. Firstly we focus our study on stock markets within a specific economic area that is the ASEAN. Secondly we perform our analysis on a quite recent period of time. Our results can contribute to the understanding by identifying clearly which stock markets may be considered not efficient and, consequently, more attention must be given by policy makers in these markets through appropriate new initiatives.

3. Methodology

In this paper we employ a number of tests (i.e., unit root tests, variance ratio tests, non-parametric tests and cointegration test) in order to investigate whether ASEAN stock markets are efficient individually and collectively.

3.1 Augmented Dickey-Fuller (ADF) test

The presence of a unit root in a time series suggests support for the random walk hypothesis. The ADF unit root test (Dickey and Fuller, 1979), is carried out by estimating the following equation:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots + \beta_p \Delta y_{t-p} + \upsilon_t \quad (1)$$

where y_t is a series that follows as AR(p) process, x_t are optional exogenous repressors[4], α and δ are parameters to be estimated and v_t are assumed to be white noise. The null hypothesis is the presence of a unit root, so not rejecting that hypothesis means the series follows a random walk.

The null and alternative hypotheses can be written as $H_o: \alpha = 0$ and $H_o: \alpha < 0$ and evaluated using the conventional *t*-ratio for α ,that is $t_\alpha = \hat{\alpha}/(se(\hat{\alpha})$, where $\hat{\alpha}$ is the estimate of α, and $se(\hat{\alpha})$ is the coefficient standard error.

3.2 Kwiatkowsky, Phillips, Schmidt, and Shin test

An alternative unit root test is the KPSS Test (Kwiatkowski et al., 2002) which is specifically designed to test the null hypothesis of stationarity against the alternative of a unit root. Rejecting the null hypothesis suggests support for the random walk hypothesis. The KPSS test statistic is based on the residuals from the OLS regression of y_t on the exogenous variables x_t, that is:

$$y_t = x_t'\delta + u_t \quad (2)$$

An LM statistic[5] is computed using residuals of the above equation in order to test the null hypothesis of stationarity..

3.3 Variance-Ratio (VR) test

As pointed out by Gilmore and McManus (2003), a unit root is a necessary but not sufficient condition for a random walk. The reason is that unit root process can have predictable elements, but a random walk for stock prices means that returns must be uncorrelated. Hence we test for the random walk hypothesis through the VR test (Lo and MacKinlay, 1988) which is based on the assumption that the variance of a random walk term increases linearly with time. This approach has gained popularity and has become the standard tool in random-walk testing. The VR test is as follows:

$$VR(q) = \frac{\sigma^2(q)}{\sigma^2(1)} \quad (3)$$

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[4] These may consist of a constant, or a constant and trend.

[5] This statistic s defined as $LM = \sum_t S(t)^2 / (T^2 f_o)$ where f_o, i san estimator of the residual spectrum and $S(t)$ is a cumulative residual function.

where $\sigma^2(q)$ is the unbiased estimator of 1/q of the variance of the *q-th* difference and $\sigma^2(1)$ is the variance of the first difference. Under the assumption of homoskedasticity increments, a standard normal statistic z(q) is calculated as follows:

$$z(q) = \frac{VR(q)-1}{\sqrt{v(q)}} \sim N(0,1) \tag{4}$$

where $v(q) = [2(2q-1)(q-1)]/3q(nq)$. A second test statistic z*(q) is developed under the assumption hypothesis of heteroskedasticity increments and expressed as follows:

$$z^*(q) = \frac{VR(q)-1}{\sqrt{v^*(q)}} \sim N(0,1) \tag{5}$$

where

$$v^*(q) = \sum_{k=1}^{q-1}\left[\frac{2(q-k)}{q}\right]^2 \phi(k) \tag{6}$$

and

$$\phi(k) = \frac{\sum_{t=k+1}^{nq}(p_t - p_{t-1} - \hat{\mu})^2 (p_{t-k} - p_{t-k-1} - \hat{\mu})^2}{[\sum_{t=1}^{nq}(p_t - p_{t-1} - \hat{\mu})^2]^2} \tag{7}$$

Both the $Z(q)$ and $Z^*(q)$ statistics test the null hypothesis that $VR(q) = 1$ or the chosen index follows a random walk. When the random walk hypothesis is rejected and $VR(q) > 1$, returns are positively serially correlated.

3.4 Multiple Variance-Ratio tests

Chow and Denning (1993) proposed a multiple variance ratio (MVR) test where a set of variance ratios is tested against one, that is the null hypothesis $V(q_i) = 1$ for $i = 1, \ldots, n$ is tested against the alternative that $V(q_i) \neq 1$for some *i*. Chow and Denning's test statistic is $MV_1 = \sqrt{T} \max_{1 \le i \le n} |z(q_i)|$ where $z(q_i)$is defined in the previous eq (4). The null hypothesis is rejected at the α level of significance if the MV_1 is greater than the $(1 - [\alpha^*/2])^{th}$ percentile of the standard normal distribution, where $\alpha^* = 1 - (1-\alpha)^{1/n}$. The heteroskedasticity-robust version can be written as $MV_2 = \sqrt{T}\max|z^*(q_i)|$, where $z^*(q_i)$ is defined in eq. (5), and it has the same critical values as

MV_1. Chow and Denning (1993) controlled the size of the MV ratio test by comparing the calculated values of the standardized test statistics, either $z(q)$ or $z^*(q)$ with the Standardized Maximum Modulus (SMM) critical values. If the maximum absolute value of, say *z(q)* is greater than the SMM critical value then the random walk hypothesis is rejected. SMM distribution has a critical value of 2.491 for the 5 percent level of significance.

3.5 Wright Test

Wright (2000) proposed the use of ranks of differences in place of the differences used in the Lo and MacKinlay test. Wright (2000) demonstrated that this nonparametric variance ratio tests based on ranks (R_1 and R_2) can be more powerful than the tests suggested by Lo and MacKinlay and are more appropriate when the distribution of returns is not normal. The test statistics based on ranks are as follows:

$$R_1(k) = \left(\frac{\frac{1}{Tk}\sum_{t=k}^{T}(r_{1t} + \ldots + r_{1t-k+1})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{1t}^2} - 1 \right) \times \phi(k)^{-1/2} \quad (8)$$

and

$$R_2(k) = \left(\frac{\frac{1}{Tk}\sum_{t=k}^{T}(r_{2t} + \ldots + r_{2t-k+1})^2}{\frac{1}{T}\sum_{t=1}^{T} r_{2t}^2} - 1 \right) \times \phi(k)^{-1/2} \quad (9)$$

where $r_{1t} = (r(y_t) - (T+1)/2)) / \sqrt{[(T-1)(T+1)]/12}$, $r_{2t} = \Phi^{-1}(r(y_t)/(T+1))$, T are observations of first differences of variables y_t (stock prices), ϕ_t is the asymptotic variance, $r(y_t)$ is the rank of y_t among $y_1, \ldots, y_T$, and Φ^{-1} is the inverse of the standard normal cumulative distribution function.

3.6 Runs test

The Runs test is a non-parametric test that used in order to examine whether successive price changes are independent. A run is usually defined as a sequence of consecutive price changes with the same sign. The non-parametric run test is applicable as a test of randomness for the sequence of returns[6]. Thus if a series of returns is random, the observed number of runs (R) in the series should

[6] In this randomness test the null hypothesis is that a set of observations can be considered random.

be close to the expected number of the runs (m). Accordingly, the null hypothesis for this test is for temporal independence (or weak-form efficiency) in the series of returns. The expected number of runs (m) can be computed using the following equation:

$$m = \frac{N(N+1) - \sum_{i=1}^{3} n_i^2}{N} \tag{10}$$

where *N* denotes the number of observations (price changes or returns), *i* the sign of plus, minus, and no change, n_i is the total numbers of changes of each category of signs. For a larger number of observations $(N > 30)$, the expected number of runs is approximately normally distributed with a standard deviation σ_m of runs computed as follows:

$$\sigma_m = \left[\frac{\sum_{i=1}^{3} \left[n_i^2 + N(N+1) \right] - 2N \sum_{i=1}^{3} n_i^3 - N^3}{N^2 (N-1)} \right]^{1/2} \tag{11}$$

The standard normal Z-statistic used in order to conduct a run test can be computed as follows:

$$Z = \frac{R - m \pm 0.5}{\sigma_m} \sim N(0,1) \tag{12}$$

where 0.5 is the continuity adjustment, which is positive if $\mathbf{R} \leq \mathbf{m}$ and negative if $\mathbf{R} \geq \mathbf{m}$. As pointed out by Abraham et al. (2002), when actual number of runs exceed (fall below) the expected runs, a positive (negative) Z values is obtained. A negative Z value indicates a positive serial correlation, whereas a positive Z value indicates a negative serial correlation. At the 5% significance level, a Z value greater than 1.96 indicate non-randomenss.

4. Data and descriptive statistics

Due to data availability we consider only six ASEAN countries.[7] Data used in this work are daily prices[8] for stock market indices in local currency obtained from *Thomson Datastream* during the period 4 January 2000 to 29 April 2011. Mean equity market returns are positive for all stock markets (Table 3). The highest daily return was 16.177% for the Philippines, while the lowest -

[7] That is Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam.

[8] We use daily data for a period of 11 years based on findings of Beckev (2003) that when investigating EMH it is better to use high frequency data for a long period of time rather than lower frequency data for small periods of time which may bias the results.

17.089 for Thailand. The kurtosis values of all index returns are higher than three indicating that returns' distribution are fat-tailed. The skewness values are in general negative indicating that the asymmetric tail extends more towards negative values than positive ones. The Jarque-Bera statistics clearly rejects the null hypothesis of a normal distribution for all stock returns.

Table 3 – Summary statistics of data on returns[a]

	No Obs	Mean	Maximum	Minimum	St. Dev.	Skewness	Kurtosis	Jarque-Bera test	p-value
Indonesia	2954	0.058	7.623	-10.954	1.463	-0.641	9.286	5066.64	0.00
Malaysia	2954	0.020	4.502	-9.978	0.905	-0.886	12.944	12558.45	0.00
Philippines	2954	0.023	16.177	-13.088	1.380	0.511	19.692	34425.41	0.00
Singapore	2954	0.006	7.530	-8.695	1.289	-0.246	7.694	1742.23	0.00
Thailand	1565	0.033	11.320	-17.089	1.611	-1.076	18.389	15746.71	0.00
Vietnam	2805	0.055	6.656	-7.655	1.668	-0.229	5.708	881.75	0.00

Notes. [a]Each return series is calculated as $r_t = [\ln(p_t) - \ln(p_{t-1})] \times 100$, where p_t and p_{t-1} represent the index price at time *t* and *t-1*, respectively.

5. Empirical finding and interpretation

5.1 Unit Root test

The presence of a unit root in the ASEAN stock markets returns was tested using both the ADF and KPSS tests. The ADF test rejects the hull hypothesis of a unit root in both constant and constant and trend models (Table 4). The KPSS test does not reject the null hypothesis of stationarity in both constant and constant and trend models (table 5). Both ADF and KPSS tests clearly indicate that ASEAN stock markets returns do not follow a random walk process.

Table 4: ADF unit root tests

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
Model						
Constant	-48.308***	-46.433***	-47.705***	-53.153***	-26.292***	-21.718***
Constant and Trend	-48.351***	-46.449***	-47.751***	-53.176***	-26.307***	-21.747***

Notes. The table presents the results of the Augmented-Dickey Fuller (ADF) unit root test which was applied to the stock market returns. Critical values for Model in level are -3.432 (1%) and -2.862 (5%) hile for the model with constant and trend are -3.961(1%) and -3.411(5%). ***** reject the null hypothesis at 1% and 5% respectively.

Table 5: KPSS unit root tests

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
Model						
Constant	0.343	0.170	0.370	0.268	0.214	0.173
Constant and Trend	0.155*	0.069	0.126	0.132	0.127	0.09

Notes. The table presents the results of KPSS unit root test which was applied to the stock market returns. The null hypothesis for the KPSS test is stationarity against the alternative of a unit root. Critical values for Model with constant are 0.739(1%) and 0.463(5%) while for the model with constant and trend are 0.216(1%) and 0.146(5%). The null hypothesis of stationarity is rejected if the test statistics exceeds the critical values. ***** reject the null hypothesis at 1% and 5% respectively. The critical values are based upon the asymptotic results presented in Kwiatkowski et al. (1992).

5.2 Variance ratio tests

Table 6 shows the VR test results computed for lags 2, 4, 8, days, with the one-day return used as a base[9].

Results show that the hypothesis that the variance ratio test is one can be rejected for most of the stock market considered based on the homoscedasticity assumption. The variance ratio test also indicates the presence of positive serial correlation in daily returns across the intervals considered. Because of would be an error if one were to reject the random walk hypothesis based on these results which are biased as a result of heteroskedasticity in the return series, we report also the Z-statistic adjusted for this violation of homoscedasticity, although results remain the same. In conclusion the random walk hypothesis is rejected for all markets but Singapore and Thailand.

Table 6 - Variance Ratios for daily returns (QUESTA TABELLA RIPORTA I VALORI PER ASEAN)

Number of days, q, in holding period	2	4	6	8
Indonesia				
VR(q)	1.117	1.202	1.233	1.233
Z(q)	6.388**	5.889**	5.141**	5.141**
Z*(q)	4.096**	3.671**	3.243**	3.243**
Malaysia				
VR(q)	1.156	1.281	1.350	1.383
Z(q)	8.502**	8.187**	7.702**	7.043**
Z*(q)	5.580**	5.093**	4.763**	4.424**
Philippines				
VR(q)	1.129	1.182	1.169	1.146
Z(q)	7.053**	5.312**	3.730**	2.696**
Z*(q)	5.591**	3.767**	2.542**	1.836
Singapore				
VR(q)	1.022	1.042	1.079	1.085
Z(q)	1.220	1.225	1.752	1.561
Z*(q)	0.841	0.789	1.110	0.986
Thailand				
VR(q)	0.978	1.051	1.066	1.036
Z(q)	-0.868	1.094	1.065	0.488
Z*(q)	-0.333	0.465	0.489	0.237
Vietnam				
VR(q)	1.239	1.462	1.647	1.802
Z(q)	12.689**	13.099**	13.869**	14.364**
Z*(q)	8.400**	8.292**	8.744**	9.074**

Notes. The variance ratios are reported in the main rows, with the homoschedasticity Z(q) and heteroschedasticity-robust test statistics Z*(q) given respectively in (.) and in [.]. Under the random walk null hypothesis, the value of the variance ratio test is 1 and the test statistic have a standard normal distribution (asymptotically). Test statistics marked with asterisks indicate that the corresponding variance ratios are statistically different from 1 at the 5% level of significance.

[9] The number of lag periods has been limited to eight for the daily data since the power of the VR test decline as q become large relative to the data set.

Results for Chow and Denning's (1993) tests are reported in Table 7. We can see that, at the 5% level of significance null for Chow and Denning's homoskedastic and heteroskedastic are rejected for all markets except Singapore and Thailand. Findings suggest that only stock markets of Singapore and Thailand follow a random walk process.

Table 7 – Multiple variance ratio tests

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
MV_1	6.494**	8.445**	7.094**	0.987	0.886	12.69**8
MV_2	4.165**	5.543**	5.612**	0.682	0.340	8.406**

Notes. MV_1 is the homoskedastic and MV_2 is the heteroskedastic-robust version of the Chow-Denning test. ** reject the null hypothesis at the 5% level of significance. The critical value for the Chow-Denning test are 3.089(1%), 2.68(5%) and 2.310(10%) respectively.

Rank based variance ratio test (Wright, 2000) results are summarized in Table 8. The rank-based test results show that R_1 and R_2 are significant for all countries with the exception of Singapore. We also found that any serial dependence is positive given that all rejections are in the right tail of the null distribution. Also S_1 rejects the null hypothesis for all stock markets returns except two markets (Singapore and Thailand) and all values of $k \geq 2$ at the 5% level. We therefore conclude that both the rank- and signed-based variance-ratio test confirm only two ASEAN stock markets are weak-form efficient

Table 8 – Wright Non-Parametric Variance Ratio Tests using ranks and Signs

	Number of lags (k)			
	k=2	k=5	k=10	k=30
Indonesia				
R_1	5.86**	4.40**	2.6-1**	2.24**
R_2	6.15**	4.75**	2.79**	2.75**
S_1	4.51**	3.17**	1.86	0.67
Malaysia				
R_1	7.62**	7.64**	6.41**	5.61**
R_2	8.51**	8.19**	6.53**	5.01**
S_1	4.62**	5.03**	5.09**	4.85**
Philippines				
R_1	7.19**	5.49**	3.32**	3.06**
R_2	7.81**	5.89**	3.58**	3.32**
S_1	4.73**	3.27**	1.42	1.54
Singapore				
R_1	-0.41	0.50	0.99	1.34
R_2	0.36	0.94	1.08	1.20
S_1	-1.64	-0.62	0.51	1.13
Thailand				
R_1	1.26	1.90	1.33	2.42**
R_2	0.89	1.82	1.04	1.81
S_1	1.04	0.68	0.43	1.64
Vietnam				
R_1	13.71**	14.93**	17.51**	19.64**
R_2	13.60**	14.46**	16.45**	18.37**
S_1	9.37**	11.84**	14.87**	16.91**

Notes. ***/**/** indicate significance at 1%, 5%, and 10% respectively.

5.3 Runs Test

As pointed out by Abraham et al. (2002) the non-parametric runs test is considered more appropriate than the parametric autocorrelation test since observed returns do not follow the normal distribution. Results of the runs test (Table 9) indicate that the null hypothesis of randomness is rejected for all stock markets returns with the exception of Singapore and Thailand.

Table 9 – Runs test results for ASEAN stock markets returns

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
Observation	2954	2954	2954	2954	1565	2805
n (+)	1515	1478	1405	1461	758	1279
n (-)	1236	1310	1382	1383	707	1237
n (0)	203	166	167	110	100	289
Expected runs (m)	1477.826	1477.372	1472.269	1477.610	781.299	1377.352
Actual runs (R)	1455	1458	1435	1602	832	1296
Standard errors	27.167	27.154	27.065	27.163	19.718	25.982
Z-statistics	-3.94**	-4.75**	-4.63**	1.59	-1.05	-9.05**

Notes. If the Z-statistic is greater than or equal to ± 1.96 in absolute level, then we reject the null hypothesis at 5% level of significance. **Indicates rejection of the null hypothesis that successive price changes are independent

6. Policy implications

Most of the ASEAN stock markets do not follow a random walk. Are these results consistent with the empirical literature analysing efficiency of stock markets? Chan et al. (1997) analysed the EMH for a sample of 18 developed and emerging stock markets. They found that these markets are individually efficient. However authors applied only a unit root test to monthly series without using other tests in order to check the robustness of their results. Further those authors by using the cointegration analysis find that some of these stock markets (grouped using different criteria such as membership of international economic organisations or closed geographic proximity) share a long-run relationship (i.e. they are cointegrated). Overall their results indicate that stock markets taken either individually or collectively may show different results in terms of efficiency. Our results contradict earlier findings (i.e. most of the markets are not individually efficient. However our results are based on daily observations and a number of statistical tests were employed in order to check the robustness of the results. Further we focused on a sample of emerging stock markets while Chan et al. (1997) considered mainly developed stock markets. Our results seem to contradict Chan et al (1997) but are not strictly comparable as we look at emerging stock markets where as Chan et al (1997) study is based on the developed markets using monthly data. Further we use daily data. That explanation may be consistent with the findings of Gilmore and McManus (2003). Using daily data, these authors find that Central European stock markets are not efficient individually.

There are significant implications of the market efficiency for investors who seek to maximise their risk-adjusted returns and look their optimal portfolios globally. Two main consequences may affect those ASEAN countries which do not match with the EMH. Firstly, deviations from efficiency may offer profit opportunities to better informed investors at the expenses of less-informed investors. Secondly, deviations from EMH would result in a large cost that will be borne by these countries (i.e inefficient resource allocation). Policy makers have a task on their hands in terms of mitigating the costs of inefficient markets. This could be assisted by introducing further reforms for improving legal and regulatory framework as well as increasing standards of transparency and internal controls. Underdeveloped legal and information systems have an effect on the price discovery process, and may slow down the speed at which new information can be incorporated into asset prices. Using two rough indicators namely regulatory quality and rule of law[10] (Table 11) we can see that most of the ASEAN countries characterized by inefficient stocks market have low values for both indicators. Although we did not test whether these indicators are related with market efficiency, we may conjecture that both indicators may have a role in explaining the reasons some ASEAN stock markets are not efficient.

7. Conclusions

Efficiency of the emerging markets has been of concern for international investors and academics. Since market efficiency provides a theoretical model for financial market operations and is used in the asset pricing models, understanding of the market efficiency is of import for academics. Understanding of the market efficiency for policy makers is important as notion of market efficiency serves as an instrument for impression management for regulators in terms of building positive sentiment for potential investors. Stock markets assists in reallocation of resources in an economy and investors are conscious of market efficiency in their investment decision making.

Our study finds that stock markets in Indonesia, Malaysia, the Philippines and Vietnam are not weak form efficient. Stock markets of Singapore and Thailand are found to be weak form efficient. Implications of these findings are that an investor who wishes to identify miss-priced assets by looking at the past prices within the economy is able to do so. However, an investor who seeks to identify miss-pricing in a market by looking at the past prices in another market is not able to do so as these markets are not sufficiently integrated. Our findings are different to some of earlier studies. We provide insight into these markets by testing their market efficiency individually using daily

[10] Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. While the rule of law indicator captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police and the courts (Kaufmann et al., 2010).

frequency data. Results of earlier studies that have used weekly, monthly and quarterly data have been different as the speed of flow of information and price adjustments in the developing countries may have been slower than expected. With the improvement in legal and regulatory framework and transparency the flow of information may improve resulting in much speedier price discovery in these markets. This may result in more efficient markets in this region.

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