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Ho Chi Minh Stock Exchange Market: Operations and Efficiency

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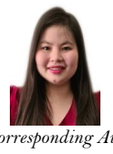

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Abstract

This paper presents an up-to-date account of market operations of the Ho Chi Minh Stock Exchange and examines its informational efficiency in recent years. The daily closing prices and rates of return of VN Index – the major market index of Ho Chi Minh Stock Exchange and 10 stocks chosen from different sectors are employed, from 2 January 2018 to 31 December 2019, to investigate the random walk hypothesis of market efficiency using the Lo-MacKinlay variance ratio test and Chow-Denning multiple variance ratio test. Our results show that the market index and individual sample stocks conform to the null hypothesis of a random walk type 3 model of a weak form market efficiency. The paper also presents the results of an Event Study to examine the semi-strong form market efficiency of the HOSE. The empirical results on this type indicate that there are significant abnormal returns and significant cumulative abnormal returns by trading the stocks around the events. These results are inconsistent with the requirements of a semi-strong form market efficiency, and it thus appears that further improvements in transmission of information and its speed within this market are needed to further improve the efficiency of this emerging market.

Keywords: Emerging stock markets, Market operation, Market efficiency, Ho Chi Minh stock exchange, Variance ratio test, Event study.
JEL Classification: C12; G14.

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Ethical: This study follows all ethical practices during writing.

Contents

Contribution of this paper to the literature
This paper presents an up-to-date account of market operations of the Ho Chi Minh Stock Exchange and examines its informational efficiency in recent years.

1. Introduction to Ho Chi Minh Stock Exchange and its Market Operations

Vietnam's stock exchange markets are currently one of the most dynamic emerging stock markets in Asia (Pham, Nguyen, & Vo, 2018). Ho Chi Minh Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX) are key platforms for trading listed stocks in Vietnam (Huong & Thuy, 2016) HOSE is the Vietnam's largest stock exchange, and it is the main market for trading stocks of large corporations. Since the initial milestones of establishing the Vietnamese stock market, there has been a significant enhancement and development of this stock market. The government has focused on regaining trust in the market and its operations, particularly since the global financial crisis in 2010. Restructuring of the securities market has been a primary strategic project of the Vietnamese government and the Ministry of Finance since 2012 (The Prime Minister, 2012).

From 2000 to 2019, listed value at HOSE jumped by VND 883,670 billion Figure 1. The market liquidity in 2019 remained stable. Average trading volume per session in 2019 was about 182.5 million shares, equivalent to average trading value of VND 4,128 billion per session (Ho Chi Minh Stock Exchange., 2019). Market capitalization at HOSE in 2019 peaked at nearly 3.28 trillion VND, which was over twice the market capitalization at HOSE in 2016 Figure 1. The market capitalization at HOSE accounted for more than 95% of equity market capitalization nationwide.

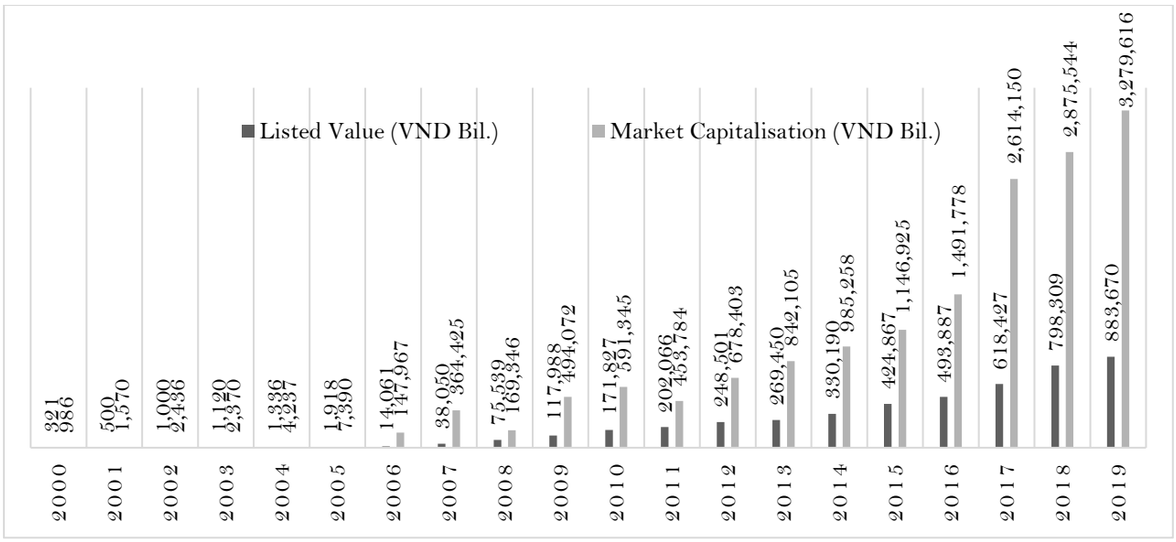

Figure-1. Listed value and market capitalization on HOSE from 2000 to 2019.
Source: Ho Chi Minh Stock Exchange. (2019).

The market capitalization at HOSE in 2018 was 2.87 equivalent to nearly 52% of the gross domestic product (GDP) of Vietnam (Ho Chi Minh Stock Exchange, 2018), Figure 2. It was slightly more than the ratio of Indonesia and China but far from the level reported in the Philippines, Malaysia, and Thailand in 2018 (The World Bank, 2019). The performance of HOSE could be explained by abundant liquidity and by positive market expectations on the state-owned enterprise equitization process (The World Bank, 2019). The market capitalization at HOSE in 2019 was equivalent to nearly 54% of the GDP of Vietnam in 2019, which rose by 2% compared to the market capitalization at HOSE in the previous year (Ho Chi Minh Stock Exchange., 2019).

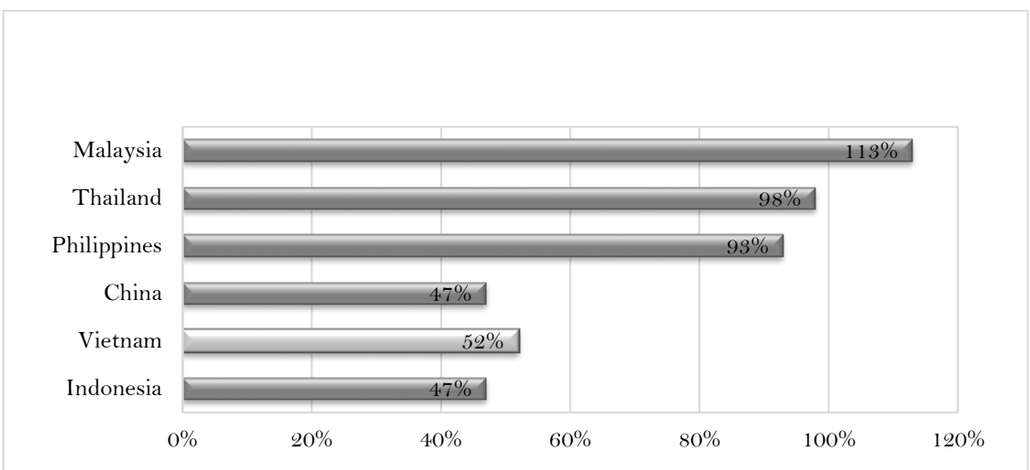

Figure-2. Market capitalization compared to regional peers (% of 2018 GDP).
Source: The World Bank (2019).

Further, the market liquidity of Vietnamese stock market was compared to regional peers in Figure 3. The Vietnamese stock market was more active, with a moderate turnover ratio of 40%, which was in the midrange to the ratios obtained by the other frontier and emerging markets in the region (The World Bank, 2019).

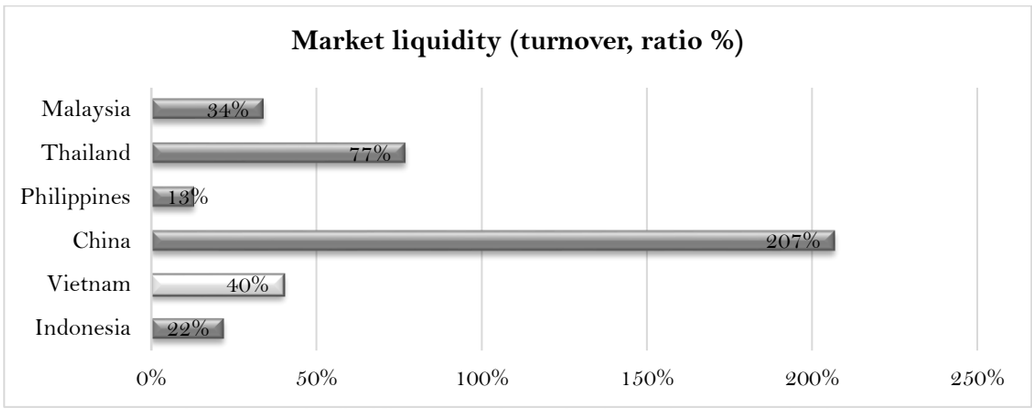

Figure-3. Market liquidity compared to regional peers (turnover, ratio %).
Source: The World Bank (2019).

As in 2019, the price to earnings ratio (P/E) of VN Index was 16.5 Table 1. Compared with P/E of other peer markets in Southeast Asia, P/E of VN Index was the lowest and below the average P/E of 19.12. Nonetheless, regarding the economic growth potential using OECD's GDP growth forecast in the period of 2019 – 2023, Vietnam is one of the economies which were predicted to obtain the greatest growth rate. Thus, HOSE stock market is expected to achieve a positive growth in the future to gradually narrow the gap with the other regional markets.

Table-1. P/E of VN Index and other indices in the Southeast Asia.

Market indices	Countries	Expected GDP 2019-2023 (%)	P/E	P/E forward 1 year
VN Index	Vietnam	6.5	16.5	16.8
PCOMP Index	Philippines	3.7	19.4	16.7
SET Index	Thailand	6.6	18.7	20.1
FBMKLCI Index	Malaysia	5.2	21.2	21.9
JCI Index	Indonesia	4.6	19.8	19
Average		5.32	19.12	18.9

Source: KB Securities Vietnam (2019); OECD (2019).

Additionally, the correlation between returns on equity (ROE) and price to book value (P/B) of Asian countries was presented in Figure 4. VN Index had a high ROE and high P/B index compared to the ratios of other Asian countries. Furthermore, Vietnam enhanced to become Southeast Asia's best-performing stock market in 2019 with a 12% gain for VN Index on HOSE (Preiss, 2019). Vietnam was the third-best performing market in the world over the past five years (Preiss, 2019). This provides a positive growth potential of the market in the future.

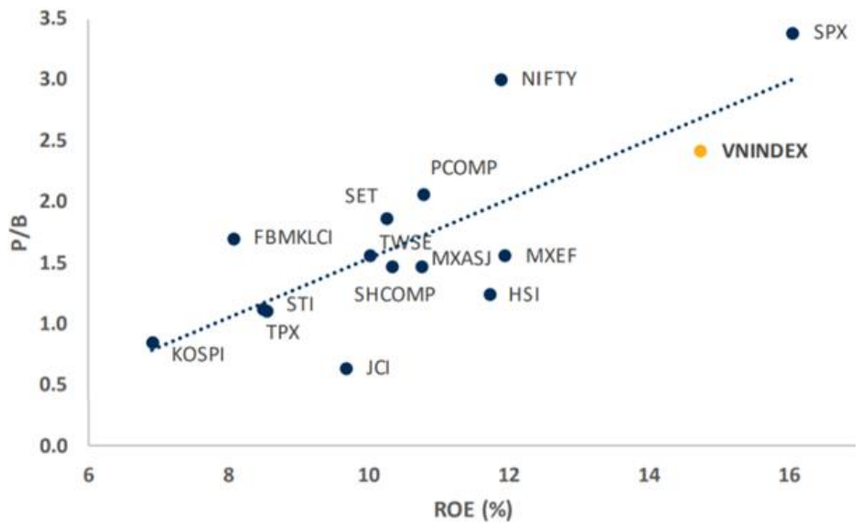

Figure-4. ROE – P/B of Asian countries.
Source: KB Securities Vietnam (2019).

As 31st December 2019, there were 378 listed company stocks on HOSE. 10 major sectors on HOSE include energy, materials, industrials, consumer discretionary, consumer staples, health care, financial, real estate, utilities and information technology. Article 6 of the Decree No.39/2018/ND-CP stated that classifications of enterprises could depend on number of employees participating in social insurance and total annual revenue or total capital of enterprises (The Government, 2018). Accordingly, 100% of companies listed on HOSE were large companies Figure 5.

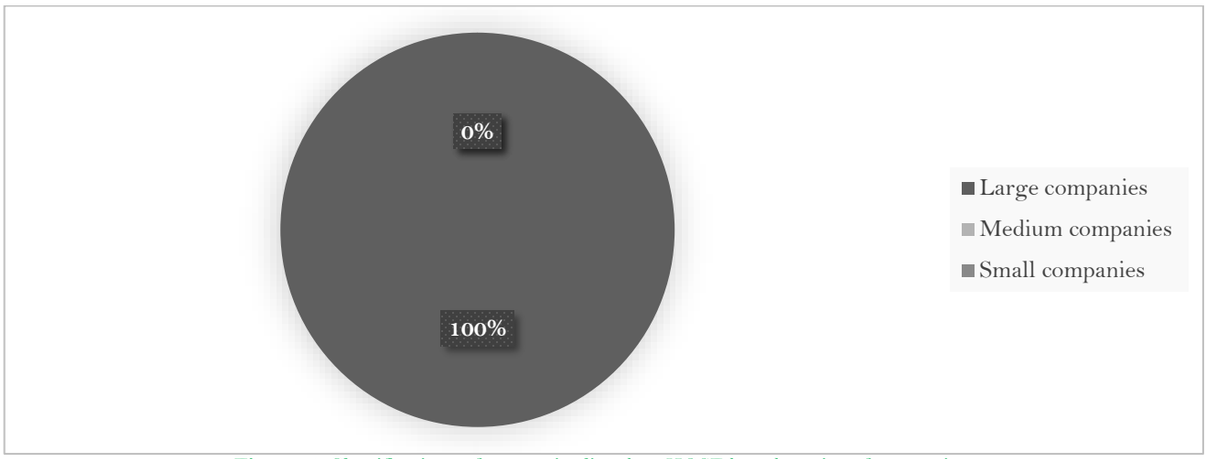

Figure-5. Classifications of companies listed on HOSE based on size of companies.

According to the Article 4 of Law on Enterprises No. 68/2014/QH13, the state-owned enterprises are redefined as those enterprises in which 100 percent of the charter capital are held by the State (The National Assembly, 2014). Based on the current law, 100% of companies listed on HOSE and HNX are not state-owned companies. However, under Article 141 of Law on Enterprises No. 68/2014/QH13, conditions for conducting the general meeting of shareholders were listed. It is stated that the general meeting of shareholders shall be conducted when the number of attending shareholders represents at least 51% of the total number of votes. Further, resolutions are passed if the number of shareholders represents at least 65% of the total votes of all attending shareholders agree. It is of concern whether the proportion of state stockholders, in the listed companies, is equal to or greater than 51% Figure 6. There are, currently, 20% of listed companies on HOSE in which the State owns at least 51% of the outstanding stocks.

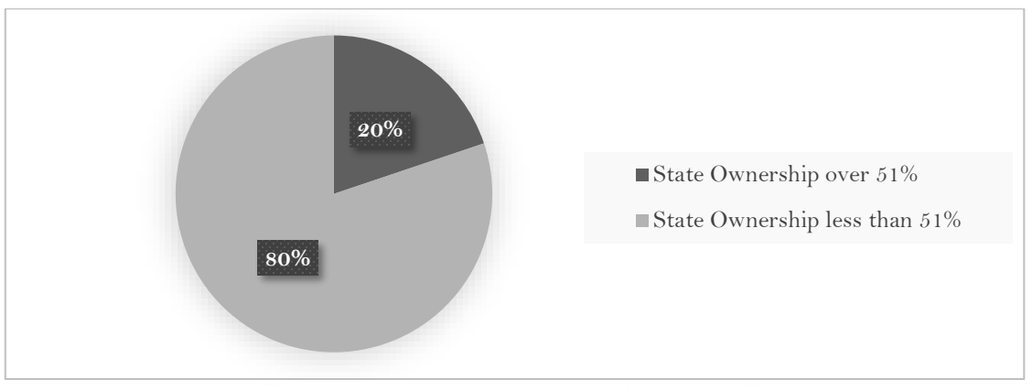

Figure-6. State ownership in companies listed on HOSE.

2. Literature Review

There has been a considerable growth in demand for investment funds in Vietnam, resulting in significant market activities of the Vietnamese stock exchanges in terms of both market capitalization and liquidity (Gupta, Yang, & Basu, 2014; Vo & Truong, 2018). The new listings of companies and participation of foreign investors have accelerated the HOSE market's development in recent years (Vo & Truong, 2018). Despite the rapid rise in the market activities in recent years, there appear to be only a limited number of studies on the key emerging market operations and efficiency.

Dong Loc, Lanjouw, and Lensink (2010) used weekly price series of VN Index and the five oldest stocks on the stock exchange to test for market efficiency. The results, obtained from the autocorrelation tests, run tests and variance ratio tests all failed to support the random walk hypothesis of a weak form market efficiency. These findings were consistent with those of Do, Le, and Nguyen (2015); Luu, Pham, and Pham (2016) and Shaik and Maheswaran (2017) whose detailed statistical investigations showed that the Vietnamese stock markets are not weak form efficient. Phan and Zhou (2014) and Gupta et al. (2014) however, indicated a gradual improvement towards market efficiency although overall the Vietnamese stock markets have remained inefficient over more than 10 operating years. Results under the assumption of homoscedastic and heteroscedasticity increments in these papers provided enough evidence to accept the random walk hypothesis in the third sub-period, which implies that the Vietnamese stock market was weak form efficient after the crisis.

Tran and Mai (2015) investigated the effects of dividend announcements on share prices in the Vietnamese stock market by an Event Study method. The data set included closing prices and adjusted closing prices of 233 companies listed on HOSE with totally 979 dividend announcements between 2008 and 2014 (Tran & Mai, 2015). There were three groups of dividend announcements in the study – dividend increases, dividend decreases and no change. It was indicated that the mean and median values of abnormal return from day -2 to day -1 in the dividend increase cluster were significantly positive. Moreover, abnormal trading volume was significantly different from zero from day 0 to day +5 in these three groups. It provided strong statistical evidence of information leakage or insider trading before the announcement date and the low transparency level of the stock market (Tran & Mai, 2015). Therefore, the market was not semi-strong efficient.

The empirical research of Tran., Nguyen, and Pham (2016) appraised semi-strong form efficiency in the Vietnamese stock market by analyzing the market reaction to dividend and earnings announcements. It involved

247 listed companies on HOSE from 2014 to 2015 (Tran. et al., 2016). The daily stock price of VN Index and each firm were used for 20 days around the publishing day from HOSE database and the data consisted of announcements of dividends and quarterly earnings of the companies. As a result, there was an insignificant reaction to the announcement day and in few days around it. Additionally, there were significant abnormal returns within 20 trading days surrounding the date of dividend and earnings announcements. The stock prices did not promptly and adequately reflect the new information and these announcements had a significant impact to the stock price in the event window of 20 days. In other words, the evidence did not support the requirements of a semi-strong form in the Vietnamese stock market (Tran. et al., 2016). Appendix 1 presents a summary of empirical studies related to the Vietnamese stock markets.

It is evident from this brief review of recent studies that there are clear gaps in the literature in two key areas. Firstly, there is little empirical evidence available on the status of this market efficiency after the changes of regulations in 2012. Secondly, there appears to exist little up to date information regarding this market's operations and activities in recent years. This paper aims to fill these gaps, its purpose is twofold:

1. To provide an up-to-date account of the recent operations of the Ho Chi Minh Stock Exchange (HOSE) Market under the new market regulations since 2012.

2. To test the efficiency of this market based on the random walk and an Event Study using recent data relating to market activities after imposition of the new market regulations in 2012.

The first point is provided in the first section of introduction to Ho Chi Minh Stock Exchange and its market operations, and the second gap is fulfilled in the following sections. The remainder of the work is organized as follows. Section 3 discusses the data and the empirical methodology of this study. Section 4 discusses the empirical results of the HOSE market efficiency. Finally, Section 5 discusses implications and conclusions of the study.

3. Data and the Empirical Methodology

To fulfill the gap and strive for the research objectives, the study examines the stock price behavior of Vietnam's HOSE overall stock price index (VN Index) and 10 companies, which are listed on HOSE and are selected randomly from 10 sectors. These are An Phat Bioplastics Joint Stock Company (AAA) from materials sector; Binh Duong Water Environment Joint Stock Company (BWE) from utilities sector; BIDV Securities Joint Stock Company (BSI) from financial sector; Dong A Plastic Group Joint Stock Company (DAG) from industrials; Digiworld Corp (DGW) from information technology sector; Binh Dinh Pharmaceutical and Medical Equipment Joint Stock Company (DBD) from health care sector; Danang Rubber Joint Stock Company (DRC) from consumer discretionary sector; Viet Nam National Petroleum Group (PLX) from energy sector; Saigon Beer – Alcohol – Beverage Corporation (SAB) from consumer staples sector; and Sai Gon Thuong Tin Real Estate Joint Stock Company (SCR) from real estate sector.

Daily stock prices for VN index and the above listed companies are collected for the period 2 January 2018 to 31 December 2019, generating 498 observations on the market index and each of the selected stocks. The testing procedures involve the following steps: (1) Variance ratio tests under the independently and identically distributed assumptions are performed without bias correction to test the homoscedastic random walk model. (2) Multiple variance ratio tests are performed by repeating the previous procedure but allowing for heteroscedasticity in the data and using bootstrapping to illustrate the statistical significance. The study also conducts Wright's rank variance ratio test to support the tests in step 1 and step 2. Wright (2000) proposed the VR tests that do not rely on asymptotic approximations and are done under homoscedasticity. (3) If the null hypothesis of a random walk model is not rejected in ALL cases, the study then performs Event Study analysis to test the semi-strong market form efficiency.

This study uses historical daily closing prices of VN Index and 10 selected companies from 10 different sectors for the period of January 2018 to December 2019. Combining all sample data together, the study uses 5478 observations. We start by implementing tests of random walks and weak-form market efficiency. We would then examine semi-strong form efficiency if the requirements of a weak form market efficiency are met, in all sample cases.

3.1. Weak Form Tests

To appraise the market efficiency, the random walk model is employed, defined as:

$$p_t = \mu + p_{t-1} + \varepsilon_t$$
$$\text{or } \Delta p_t = y_t = p_t - p_{t-1} = \mu + \varepsilon_t \quad (1)$$

where:

$\Delta p_t (y_t)$ is the continuously pounded rate of return for a stock at time t.

p_t and p_{t-1} are the natural logarithm of the stock price at time t and t-1.

μ is an unknown drift parameter.

ε_t is random disturbance term.

Equation 1 is used to examine whether the daily stock returns/movements are randomly distributed. The random walk implies uncorrelated residuals and hence uncorrelated returns, Δp_t.

The hypothesis to be tested is:

H_0: Vietnamese market indices and stock prices follow a random walk.

H_1: Vietnamese market indices or stock prices do not follow a random walk.

Campbell, Lo, and MacKinlay (1997) classified into three types of random walk. The random walk type 1 (RW1) allows for homoscedasticity and it is known as the homoscedastic Random Walk Hypothesis. Whereas the random walk type 2 (RW2) and random walk type 3 (RW3) allow for heteroscedasticity. The RW2 is used to test the assumption of unconditional heteroscedasticity in the random disturbances. The RW3 is more general, and it is used to examine the assumption of conditional heteroscedastic Random Walk Hypothesis. Besides that, RW1 is considered as a special case of RW2 and RW1 and RW2 are special cases of the RW3. The RW1 is the strongest form of random walk and the RW3 is the weakest form of random walk (Campbell et al., 1997). Thus, this study employs tests to examine RW1 and RW3. The statistical tests are conducted by using EViews 10.

Regarding the decision-making process used in this study, in order for the market to meet the requirements of the RW1 or RW3 the results obtained from these tests, in all cases, are required to show that null hypothesis is not rejected. The single variance ratio test by Lo and MacKinlay (1988) and multiple variance ratio test by Chow and Denning (1993) are two key tests, while other tests are also considered as supporting tests in this study. The single variance ratio test by Lo and MacKinlay (1988) is employed to test the individual null hypothesis of a random walk, while the multiple variance ratio test by Chow and Denning (1993) is used to examine the joint null hypothesis. This work requires all results of the Lo & MacKinlay's tests and Chow & Denning's tests to not be rejected under the null hypothesis of a RW1 or RW3 if the market meets the requirements of the RW1 or RW3.

3.2. Semi-Strong Form Tests

If the results of the above tests indicate that the null hypothesis is not to be rejected, in all sample cases, tests of semi-strong form market efficiency might be conducted via an Event Study. The event study gauges effects of a specific event on the stockholder wealth by examining an abnormal movement of stock prices around the event (Mann & Babbar, 2017). The abnormal returns refer to the difference between the actual returns after an event and the normal returns that a firm would have gained without the effects of such an event (Eryigit & Eryigit, 2019; Mann & Babbar, 2017). The event study has a variety of applications and contributions in accounting and finance research (MacKinlay, 1997).

The most popular model to estimate the normal behavior is a regression based on the actual return of the stock and the actual return of market index or industry index (Benninga, 2014). The paper collects and analyses the stock daily closing prices and rates of returns of VN Index – the major market index in HOSE, and DRC and BWE – two companies randomly selected from the chosen company stocks on HOSE. BWE is one of the newly listed company stocks while DRC is one of the existing listed company stocks.

The method has been used to investigate several specific firms and economy-wide events (Benninga, 2014). In this study, I randomly choose three event days on which there were huge daily changes in VN Index's closing prices and its rates of returns. The information is summarized in Table 2.

Table-2. Chosen events in event study based on VN Index.

No	Date	Daily returns	Event
1	05/02/18	-5.10%	Information from the Chairman of the State Securities Commission related to the roadmap of applying an increase of the initial margin and impact of volatility of the US stock market impacted investor sentiment.
2	03/07/18	-4.34%	Fears of an escalating trade war between the US and China and the problems of climbing exchange rates and lowering expected profits of listed companies.
3	11/10/18	-4.84%	Selloffs of European and American stocks due to concerns about rising US government bond yields and psychological effects of the escalating trade war on investors.

With randomly chosen securities and event dates, there should be no abnormal performance on average if the stock market has semi-strong form efficiency (Brown & Warner, 1985). Parametric t-test will be utilized to evaluate whether abnormal returns (ARs) and cumulative abnormal returns (CARs) are significantly different from zero. The parametric t-test in this work will be performed based on the studies of Brown and Warner (1985); MacKinlay (1997) and Eryigit and Eryigit (2019).

The abnormal return (AR) for a stock i on day t is calculated as below:

$$AR_{it} = y_{it} - (\alpha_i + \beta_i y_{mt}) \quad (2)$$

Where: y_{it} represents actual stock return on day t;

$\alpha_i + \beta_i y_{mt}$ represents return expected by the α, β and corresponding market return of the stock.

Equation 2 refers to investigating AR_{it} using the market return model. It assumes a linear relationship between market return, individual asset return, and constant variance.

The cumulative abnormal return (CAR) for a stock i on day t is calculated as:

$$CAR_{it} = CAR_{it-1} + AR_{it}$$

or $$CAR_{i,(\tau_2,\tau_3)} = \sum_{t=\tau_2}^{\tau_3} AR_{i,t} \quad (3)$$

According to MacKinlay (1997), abnormal returns need to be cumulated to analyze the general effect of the event. Abnormal returns would be cumulated based on time as Equation 3. Cumulating based on time reflects cumulative abnormal returns in the event window.

The hypotheses to be tested include:

H_0: The ARs and CARs are close to zero.

H_1: The ARs or CARs are greatly different from zero.

The parametric t-test in this study will be conducted in Excel. The alternative hypotheses indicate that ARs and CARs could be less or more than zero, so the tests are two-tailed. With a significant level of 5%, H_0 will not be rejected if the calculated t-value belongs to (-1.96; 1.96).

Within this framework, HOSE would be considered a semi-strong form efficient, if the null hypothesis that ARs and CARs are close to zero is not rejected, at a prespecified level of significance.

4. Empirical Results

4.1. Weak form Market Efficiency

The variance ratio tests are conducted using EViews statistical package to examine the random walk model and martingale hypothesis for the daily return data of the market index and 10 stock prices from 2 January 2018 to 31 December 2019. The default settings in this study are to compute the test for specified lists of "2 5 10 20 30" to investigate the data in the period of 2 working days, 5 working days, 10 working days, 20 working days and 30 working days. The detailed statistical results of VN Index are provided in Appendix 2. The procedure is similarly

carried out on data of chosen listed companies on HOSE. Table 3 summarizes the results of variance ratio tests on the logarithm of daily closing prices of the VN Index and the listed companies on HOSE. Statistical results of joint null hypothesis tests are presented in Appendix 3.

Table-3. Statistical results of VN Index and 10 companies listed on HOSE

No	Market index/ Company Code	Homoscedastic Random Walk Hypothesis			Conditional Heteroscedastic Random Walk Hypothesis		Wright's Rank Variance Ratio Tests		
		Individual Null Hypothesis	Joint Null Hypothesis		Individual Null Hypothesis	Joint Null Hypothesis	Individual Null Hypothesis	Joint Null Hypothesis	
		Lo & MacKinlay's Tests	Chow & Denning's Tests	Wald-type Tests	Lo & MacKinlay's Tests	Chow & Denning's Tests	Lo & MacKinlay's Tests	Chow & Denning's Tests	Wald-type Tests
1	VN Index	Reject	Reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
2	AAA	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
3	BWE	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
4	BSI	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
5	DAG	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
6	DGW	Not reject	Not reject	Not reject	Not reject	Not reject	Not reject	Not reject	Reject
7	DBD	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
8	DRC	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
9	PLX	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
10	SAB	Not reject	Not reject	Reject	Not reject	Not reject	Reject	Reject	Reject
11	SCR	Not reject	Not reject	Reject	Not reject	Not reject	Not reject	Not reject	Reject
No of rejected null		1	1	10	0	0	1	1	11

RW1 is the strictest form of a random walk. In the RW1, there are independently and identically distributed increments with mean 0 and varianceσ^2. When a stock market is weak-form efficient, any market indices or stock prices of any company listed on the market should meet the requirements of weak-form efficiency. The results of VN Index from the test of the homoscedastic random walk model consistently reject the joint and individual null hypothesis of a random walk under homoscedasticity based on the Chow-Denning test and Lo-MacKinlay test. Further, the Richardson-Smith Wald test statistic does not accept the joint null hypothesis in 10 cases. Therefore, it could strongly reject the null hypothesis of a RW1 under homoscedasticity.

The rejection of the random walk null hypothesis is supported by the Wright's rank variance ratio tests, which is also used to test the RW1 model. A rejection of the joint null hypothesis in the case of SAB leads to that the joint null hypothesis of a random walk is rejected on HOSE based on Chow-Denning test. Moreover, there is a rejection of the individual null hypothesis in the case of SAB based on Lo-MacKinlay test, so the individual null hypothesis of a random walk is unaccepted on HOSE. Additionally, the Richardson-Smith Wald test statistic does not accept the joint null hypothesis in 11 cases. Subsequently, there is a strong rejection of the null hypothesis of a RW1 based on all these tests.

In terms of the multiple variance ratio test, all the Chow-Denning's maximum $|z|$statistic values are less the critical value of 1.96 and their corresponding p-values are all more than the significant value of 0.05. Moreover, in the individual tests, the variance ratio statistics are not significantly and statistically different from 1.0, all absolute values of z-statistic are all less than the critical value of 1.96 and their appropriate bootstrap p-values are all greater than the significant level of 0.05. The joint null hypothesis and the individual null hypothesis of a martingale are not rejected under conditional heteroscedasticity. It indicates that the logarithm of the stock price series of VN Index and the selected listed companies on HOSE are almost certainly random and conform to the hypothesis of a RW3. Therefore, the null hypothesis of a martingale could not be rejected on the logarithms of VN Index and all chosen stocks on HOSE at a significant level of 5%. According to the martingale hypothesis, "the expected returns and price changes projected on the basis of information fully reflected in the current price are zero, the stock price sequence will follow a martingale" (Dong Loc et al., 2010). It intimates that there is no systematic price movement, and it could lead to an effective linear forecasting rule in the market.

4.2. Semi-Strong Form Market Efficiency

HOSE appears to meet the conditions of weak-form efficient market hypothesis, so semi-strong form efficient hypothesis will be assessed. In this work, the shortest time gap between announcement dates of any two chosen events impacting the market indices and stocks on HOSE is 70 days. Moreover, the estimation window is regarded as the period before the event window and the longest event window in this work is 21 days of (-10, +10). Thus, in this study, the estimation window will be 35 days until the day before the event window (-10; +10). In addition, there are two types of mistakes in a statistical hypothesis test (Stock & Watson, 2015). In the work, the significant level of type I is defined, and it is crucial to evaluate other smaller event windows to limit and minimize the possibility of occurring type II error. Therefore, this research also considers an event window (-5; +5) and (-1; +1) to understand the reaction of the stock prices to the information raised.

Table-4. Event 1 – ARs of DRC and BWE.

EVENT 1							
DRC				**BWE**			
Date in event study	**AR**	**t-statistics of AR**	**Significance**	**Date in event study**	**AR**	**t-statistics of AR**	**Significance**
-10	-1.942%	-0.633	NO	-10	1.418%	0.443	NO
-9	-0.731%	-0.239	NO	-9	0.020%	0.006	NO
-8	-2.823%	-0.921	NO	-8	-4.218%	-1.317	NO
-7	-5.069%	-1.653	NO	-7	-1.430%	-0.446	NO
-6	3.099%	1.011	NO	-6	6.375%	1.991	YES
-5	-0.096%	-0.031	NO	-5	1.225%	0.383	NO
-4	-1.230%	-0.401	NO	-4	-0.031%	-0.010	NO
-3	-3.026%	-0.987	NO	-3	-1.589%	-0.496	NO
-2	-1.046%	-0.341	NO	-2	-0.068%	-0.021	NO
-1	0.090%	0.029	NO	-1	-1.231%	-0.384	NO
0	-2.463%	-0.803	NO	0	-2.948%	-0.921	NO
1	2.441%	0.796	NO	1	0.150%	0.047	NO
2	-0.999%	-0.326	NO	2	1.594%	0.498	NO
3	0.159%	0.052	NO	3	-0.415%	-0.129	NO
4	-0.711%	-0.232	NO	4	0.395%	0.123	NO
5	1.550%	0.506	NO	5	1.264%	0.395	NO
6	-1.139%	-0.372	NO	6	-1.444%	-0.451	NO
7	-1.471%	-0.480	NO	7	-1.167%	-0.364	NO
8	-2.512%	-0.819	NO	8	-0.788%	-0.246	NO
9	-0.861%	-0.281	NO	9	0.713%	0.223	NO
10	-2.026%	-0.661	NO	10	1.127%	0.352	NO

ARs of DRC and BWE related to event 1 are provided in Table 4. On the event day, ARs under market-adjusted returns of DRC and BWE are -2.463% and -2.948%, respectively. These values are statistically insignificant at a significant level of 5%. However, on the day -6 in the event window of BWE, there is a huge abnormal return of 6.375% and its corresponding t-statistic value is 1.991. It is statistically significant at a significant level of 5%. It implies that significant ARs could be gained 6 days before the event day by exploiting the relevant information leakage. It leads to rejecting the null hypothesis that ARs are close to zero.

Table-5. Event 2 – ARs of DRC and BWE.

EVENT 2							
DRC				**BWE**			
Date in event study	**AR**	**t-statistics of AR**	**Significance**	**Date in event study**	**AR**	**t-statistics of AR**	**Significance**
-10	8.835%	1.178	NO	-10	-1.928%	-0.655	NO
-9	6.328%	0.844	NO	-9	-2.951%	-1.002	NO
-8	5.324%	0.710	NO	-8	1.542%	0.524	NO
-7	4.497%	0.600	NO	-7	7.599%	2.58	YES
-6	5.155%	0.687	NO	-6	0.773%	0.262	NO
-5	10.496%	1.399	NO	-5	-3.796%	-1.289	NO
-4	9.414%	1.255	NO	-4	0.318%	0.108	NO
-3	8.820%	1.176	NO	-3	2.766%	0.939	NO
-2	6.499%	0.866	NO	-2	0.801%	0.272	NO
-1	6.353%	0.847	NO	-1	0.021%	0.007	NO
0	3.907%	0.521	NO	0	0.838%	0.284	NO
1	0.421%	0.056	NO	1	1.062%	0.361	NO
2	1.746%	0.233	NO	2	0.951%	0.323	NO
3	-0.247%	-0.033	NO	3	-2.683%	-0.911	NO
4	-1.376%	-0.183	NO	4	3.061%	1.039	NO
5	0.047%	0.006	NO	5	0.859%	0.292	NO
6	-0.040%	-0.005	NO	6	0.042%	0.014	NO
7	0.241%	0.032	NO	7	1.096%	0.372	NO
8	0.907%	0.121	NO	8	3.229%	1.096	NO
9	5.762%	0.768	NO	9	1.728%	0.587	NO
10	6.440%	0.859	NO	10	1.951%	0.662	NO

Their daily ARs during the event window period related to the event 2 are manifested in Table 5. The ARs on the event day of DRC and BWE are 3.907% and 0.838%, respectively, but they are not significant at a significant level of 5%. The same holds good for the entire event window period of DRC as its ARs are not significant on any of the days. However, on the day -7 in the event window of BWE, there is a massive AR of 7.599% with the t-statistic value of 2.580. It indicates that the ARs of BWE could be obtained significantly 7 days before the event day. It causes a rejection of the null hypothesis that ARs are close to zero.

Table-6. Event 3 – ARs of DRC and BWE.

EVENT 3							
DRC				**BWE**			
Date in event study	**AR**	**t-statistics of AR**	**Significance**	**Date in event study**	**AR**	**t-statistics of AR**	**Significance**
-10	6.302%	0.695	NO	-10	-1.220%	-0.532	NO
-9	5.910%	0.652	NO	-9	2.154%	0.939	NO
-8	3.899%	0.43	NO	-8	-1.841%	-0.803	NO
-7	2.139%	0.236	NO	-7	-1.473%	-0.642	NO
-6	4.630%	0.51	NO	-6	3.951%	1.723	NO
-5	2.610%	0.288	NO	-5	-1.901%	-0.829	NO
-4	3.819%	0.421	NO	-4	-1.962%	-0.855	NO
-3	2.036%	0.224	NO	-3	-0.755%	-0.329	NO
-2	-1.205%	-0.133	NO	-2	0.885%	0.386	NO
-1	-1.670%	-0.184	NO	-1	-1.875%	-0.818	NO
0	2.079%	0.229	NO	0	-3.917%	-1.708	NO
1	-10.263%	-1.132	NO	1	2.245%	0.979	NO
2	-2.209%	-0.244	NO	2	-1.204%	-0.525	NO
3	-6.845%	-0.755	NO	3	1.037%	0.452	NO
4	-5.962%	-0.657	NO	4	1.057%	0.461	NO
5	-5.168%	-0.57	NO	5	-0.292%	-0.127	NO
6	-5.925%	-0.653	NO	6	-0.328%	-0.143	NO
7	-13.375%	-1.475	NO	7	0.177%	0.077	NO
8	-16.072%	-1.772	NO	8	0.790%	0.344	NO
9	-16.323%	-1.8	NO	9	-0.429%	-0.187	NO
10	-16.229%	-1.789	NO	10	-1.484%	-0.647	NO

The behavior of the ARs of DRC and BWE during the event window related to the event 3 is summarized in Table 6. The ARs of DRC and BWE are all insignificant at a significant level of 5%. Therefore, it is unable to reject the null hypothesis of no significant ARs.

The behavior of CARs around the events is presented in Table 7. The results of the CARs are investigated in different event windows of (-10; +10), (-5; +5) and (-1; +1). The CARs for the event 1 and 3 are mostly negative in these stated types of the event window, but they are all statistically insignificant. It reflects that the market reacts negatively and feels pessimistic to the information related to event 1 and 3, but its impact is not significant. Thus, there is a lack of evidence to reject the null hypothesis of no significant CARs in the case of event 1 and 3.

Table-7. CARs of DRC and BWE.

EVENT 1							
DRC				**BWE**			
Window	**CAR**	**t-statistics of CAR**	**Significance**	**Window**	**CAR**	**t-statistics of CAR**	**Significance**
(-10; +10)	-20.805%	-1.481	NO	(-10; +10)	-1.047%	-0.071	NO
(-5; +5)	-5.331%	-0.524	NO	(-5; +5)	-1.653%	-0.156	NO
(-1; +1)	0.068%	0.013	NO	(-1; +1)	-4.029%	-0.726	NO
EVENT 2							
DRC				**BWE**			
Window	CAR	t-statistics of CAR	Significance	Window	CAR	t-statistics of CAR	Significance
(-10; +10)	89.526%	2.604	YES	(-10; +10)	17.277%	1.280	NO
(-5; +5)	46.077%	1.852	NO	(-5; +5)	4.198%	0.430	NO
(-1; +1)	10.680%	0.822	NO	(-1; +1)	1.921%	0.377	NO
EVENT 3							
DRC				**BWE**			
Window	CAR	t-statistics of CAR	Significance	Window	CAR	t-statistics of CAR	Significance
(-10; +10)	-67.819%	-1.632	NO	(-10; +10)	-6.384%	-0.608	NO
(-5; +5)	-22.777%	-0.757	NO	(-5; +5)	-6.682%	-0.879	NO
(-1; +1)	-9.854%	-0.627	NO	(-1; +1)	-3.547%	-0.893	NO

On the other hand, the CARs of DRC and BWE for event 2 are all positive in all these different event windows. It denotes that the market reacts optimistically to the event. The CAR of DRC in the event window of (-10; +10) is 89.526% and its t-statistic value of 2.604 is much greater than the critical value of 1.96. It could be explained by the continuous positive ARs of DRC from day -10 to day +2 though the values are insignificant. This suggests that fears of an escalating trade war between the US and China and the issues of increasing exchange rates and reducing expected profits of listed companies have significant positive effects on its CAR in the event window (-10; +10). The significant CAR value of DRC in the event window (-10; +10) results in strongly rejecting the null hypothesis of no significant CARs.

In summary, the statistical results proved that ARs and CARs of DRC and BWE are greatly different from zero in some cases, so the null hypothesis of no significant ARs and CARs is vigorously rejected. It indicates that HOSE market is not semi-strong form efficient.

5. Implications and Conclusions

Our empirical investigation on HOSE reveals that VN Index and the stock prices of a sample of randomly selected companies, from 10 different listed sectors, all satisfy the requirements of a RW3. This finding implies that increments are uncorrelated, but they are clearly neither independent nor identically distributed because their squared increments are correlated. It suggests that HOSE is fairly efficient in the weak form and it would not be possible to accurately predict the price movement of VN Index and the selected listed companies on HOSE to earn consistent excess returns over a sustained period based on their historical price changes. This is a significantly statistical result as it might be taken to imply that recent policies designed to improve operations of this market and its efficiency have indeed been effective.

With regard to semi-strong form market efficiency, however, our results show that significant ARs could be gained 6 days or 7 days before the event day, but no significant ARs are on the event date. This emphasizes the fact that information is leaked to the market prior to the announcement day. As a result, the null hypothesis of no significant ARs cannot be accepted. Furthermore, according to the results of event 2, the CAR of DRC in the event window of (-10; +10) is 89.526% and its t-statistic value of 2.604 is much greater than the critical value of 1.96. It leads to the rejection of the null hypothesis that CARs are close to zero. The investors incur significant abnormal returns and significant CARs by trading the stocks. This finding implies that HOSE is not yet capable of accurately, and at the corresponding time, incorporating the publicly available information in the stock prices, and thus failing to satisfy the requirements of a semi-strong form market efficiency. To remedy this shortcoming in market operations, a range of new policies, designed to eliminate information leakages and enhance transmission of information, are needed if the efficiency of this key emerging market is to be further improved.

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Appendix

The joint and individual null hypothesis are rejected based on Chow-Denning test, Lo-MacKinlay test and Wald test under homoscedasticity Table A1, A2 & A3. Under heteroskedasticity, the joint and individual null hypothesis of a martingale could not be rejected based on Chow-Denning test and Lo-MacKinlay test (Table A1 & A2).

Table-A.1. Single variance ratio test on log P_t (VN Index).

Null Hypothesis: Log PT is a random walk				
Date: 03/31/20 Time: 14:17				
Sample: 1/02/2018 12/31/2019				
Included observations: 497 (after adjustments)				
Standard error estimates assume no heteroskedasticity				
Use biased variance estimates				
User-specified lags: 2 5 10 20 30				
Joint Tests		**Value**	**df**	**Probability**
Max |z| (at period 5)*		2.051586	497	0.1855
Wald (Chi-Square)		13.51411	5	0.0190
Individual Tests				
Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	1.000700	0.044856	0.015608	0.9875
5	1.201619	0.098275	2.051586	0.0402
10	1.170853	0.151452	1.128102	0.2593
20	1.038178	0.222931	0.171253	0.8640
30	0.992365	0.276593	-0.027605	0.9780
*Probability approximation using studentized maximum modulus with parameter value 5 and infinite degrees of freedom				
Test Details (Mean = -7.15338111347e-05)				
Period	Variance	Var. Ratio	Obs.	
1	0.00012	--	497	
2	0.00012	1.00070	496	
5	0.00015	1.20162	493	
10	0.00014	1.17085	488	
20	0.00013	1.03818	478	
30	0.00012	0.99236	468	

Table-A.2. Multiple variance ratio test on log P_t (VN Index).

Null Hypothesis: Log PT is a martingale				
Date: 03/31/20 Time: 14:17				
Sample: 1/02/2018 12/31/2019				
Included observations: 497 (after adjustments)				
Heteroskedasticity robust standard error estimates				
Use biased variance estimates				
User-specified lags: 2 5 10 20 30				
Joint Tests		**Value**	**df**	**Probability**
Max |z| (at period 5)*		1.390532	497	0.5925
Individual Tests				
Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	1.000700	0.067692	0.010342	0.9917
5	1.201619	0.144994	1.390532	0.1644
10	1.170853	0.214893	0.795062	0.4266
20	1.038178	0.304677	0.125305	0.9003
30	0.992365	0.367704	-0.020765	0.9834
*Probability approximation using studentized maximum modulus with parameter value 5 and infinite degrees of freedom				
Test Details (Mean = -7.15338111347e-05)				
Period	Variance	Var. Ratio	Obs.	
1	0.00012	--	497	
2	0.00012	1.00070	496	
5	0.00015	1.20162	493	
10	0.00014	1.17085	488	
20	0.00013	1.03818	478	
30	0.00012	0.99236	468	

Table-A.3. Rank variance ratio test on log P_t (VN Index).

Null Hypothesis: Log PT is a random walk
Date: 03/31/20 Time: 14:18
Sample: 1/02/2018 12/31/2019
Included observations: 497 (after adjustments)
Standard error estimates assume no heteroskedasticity
User-specified lags: 2 5 10 20 30
Test probabilities computed using permutation bootstrap: reps=5000,rng=kn, seed=1000

Joint Tests		**Value**	**df**	**Probability**
Max |z| (at period 5)		1.793294	497	0.1778
Wald (Chi-Square)		6.430104	5	0.2664
Individual Tests				
Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	1.019309	0.044856	0.430472	0.6778
5	1.176236	0.098275	1.793294	0.0674
10	1.194238	0.151452	1.282507	0.2010
20	1.167488	0.222931	0.751298	0.4838
30	1.096058	0.276593	0.347291	0.7580
Test Details (Mean = 0)				
Period	Variance	Var. Ratio	Obs.	
1	1.00000	--	497	
2	1.01931	1.01931	496	
5	1.17624	1.17624	493	
10	1.19424	1.19424	488	
20	1.16749	1.16749	478	
30	1.09606	1.09606	468	

This table summarizes the statistical test results in all joint null hypothesis tests. The probability approximation in Chow-Denning test is conducted using studentized maximum modulus with parameter value 5 and infinite degrees of freedom.

Appendix-3. Statistical results of joint null hypothesis tests.

No	**Market index/ Company Code**	**Homoscedastic Random Walk Hypothesis (RW1)**		**Conditional Heteroscedastic Random Walk Hypothesis (RW3)**	**Wright's Rank Variance Ratio Tests**	
		Joint Null Hypothesis		**Joint Null Hypothesis**	**Joint Null Hypothesis**	
		Chow & Denning's Tests (Max |z| at period m)	**Wald-type Tests (Chi-Square)**	**Chow & Denning's Tests (Max |z| at period m)**	**Chow & Denning's Tests (Max |z| at period m)**	**Wald-type Tests (Chi-Square)**
1	VN Index	2.051586	13.514110	1.390532	1.793294	6.43010
2	AAA	1.518724	4.396357	1.175483	1.347282	4.42633
3	BWE	0.728012	4.751010	0.688696	0.738522	4.96286
4	BSI	1.685831	5.940855	1.394067	1.935761	7.26802
5	DAG	1.328480	4.299466	1.172319	1.671795	7.91515
6	DGW	1.060222	1.772857	0.854374	1.223552	3.09841
7	DBD	0.891214	2.702539	0.663286	1.437285	3.03724
8	DRC	1.335389	4.690794	1.235332	1.450079	4.21442
9	PLX	1.509040	7.136878	1.076068	1.637842	4.17150
10	SAB	1.952080	4.402822	1.164296	2.037932	4.81433
11	SCR	1.269829	9.310069	0.908594	1.205051	3.82641
No of rejected null		1	10	0	1	11