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TESTING THE WEAK FORM EFFICIENCY OF VIETNAMESE STOCK MARKET DURING 2010 - 2016

Master's Thesis in Finance

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ABSTRACT

After the financial crisis considerably affected the economy of developed countries, investors started to pay attention towards fast developing emerging markets.

The study focuses on examining the presence of the weak-form efficiency for the Vietnamese stock market from 2010 to 2016. Using the relationship between the Efficient Market Hypothesis and the Random Walk Theory, three approaches are applied for the test of the independence of daily stock returns of Vietnamese stock index (VNI) and 10 representative stocks listed in Ho Chi Minh stock exchange (HOSE), namely: autocorrelation tests, runs tests and variance ratio tests.

Collected data includes above stock returns from January 2010 to September 2016 and is divided into two cycles (January 2010 – January 2014 and January 2014 – September 2016). Although autocorrelation tests and runs tests show efficient sign of some stock returns in the second subsample, variance ratio tests reject the null hypothesis of random walk theory and market efficiency. As a result, the weak form efficiency of EMH does not hold for the Vietnamese stock market in the period of over more than 5 years 2010 – 2016.

KEYWORDS: efficient market hypothesis, random walk theory, Vietnamese stock market

1. INTRODUCTION

Recently, stock market has been the most controversial concern in economic progress in general and financial theories in particular. This affair, especially debates around Efficient Market Hypothesis (EMH), has drawn great attention from market analysts. In an efficient market, there would be no undervaluation or overvaluation for the assets, thus, the risks and returns for the investment can easily be determined (Fontaine and Nguyen, 2006). According to the first empirical research about EMH of Fama (1970), a stock market is efficient if the stock prices fully reflect all available information and EMH can be tested by three approaches, namely the Fair Game model, the Submartingale model, and the Random Walk Theory. Fama (1970) states that the level of efficiency for stock market is classified into three forms: weak form, semi-strong form and strong form. The first form is widely concerned by many empirical researches while the tests of the other two forms are relatively rare.

In the beginning, the studies on EMH mostly focused on developed market such as US market (Fama and French (1989), Campbell (1987), …), UK market (Hudson et al. (1996)) or Australian market (Worthington and Higgs (2009), …) However, after the financial crisis, investors in developed markets had to deal with the problem of "flight to quality", results in the attraction to invest more in emerging stock markets to diversify their portfolios (Arshad et al., 2016). Since then, there was more and more investigation in this type of stock market: Laurence et al. (1997) about China stock market, Gilmore and McManus (2001) about Czech Republic, Hungary and Poland stock markets, Asiri (2008) about India stock market, Hamid et al. (2010) about stock markets of Pakistan, India, Sri Lanka, China, Korea, Hong Kong, Indonesia, Malaysia, …

Vietnamese stock market has almost same features to typical emerging and thin trading market such as: asymmetric information, great amount of inactive stocks, inadequate legal framework or irrational investors. After more than 16 years of operation, Ho Chi Minh

stock exchange (HOSE) has been growth rapidly with 307 stocks, with total capitalization of 1.14 quadrillion VND (equal to 27.3% GDP 2015) (Nguyen & Nguyen, 2016). Almost all the blue chips in banking, real estate, oil and gas, manufacturing are listed in this stock market. As of December 2014, VN Index increased by 8.12% while VN30 Index increased by 39.46%, marked the highest growth rate in Southeast Asia (HOSE 2014 annual report). According to Nguyen & Nguyen (2016), from 2010, important regulations and projects has been submitted for approval. Some could be named as Development Strategies for Vietnam's securities market in period 2011 – 2020, the plan of restructuring and reforming the stock market in 2012, anti-crisis project, the proposal on foreign portfolio investment management and establishment of the derivatives market and derivatives products. Therefore, researching on the efficiency of Vietnamese stock market from 2010 to 2016 would be useful and informational to readers.

1.1. Purpose and contribution of the study

Aiming to have a closer look at stock market in Vietnam, this master thesis focuses on testing whether the Vietnamese stock market is efficient in weak form or not. It is stated by Wong and Kong (1984) that if the results prove that the weak form of EMH cannot hold, testing other forms of EMH such as semi-strong or strong form is unnecessary.

Since there have not been many researches about the degree of efficiency for the stock market in Vietnam until now, the study conducts the tests of randomness for sample of data and examines the availability of random walk theory in Vietnamese stock market, considered as the essential proposition in testing the weak form of EMH. This is the main contribution of the thesis to academic financial literature.

1.2. Hypotheses

The hypotheses used for testing the random walk theory could be defined as below:

H_0: The random walk theory / weak form of EMH hold in Vietnamese stock market.

H_1: Vietnamese stock market does not conform to the random walk theory / is not in a weak form of EMH.

The null hypothesis of a random walk is examined using statistical tests, namely autocorrelation test, variance ratio test, and run test. It is impossible to predict the future movement of stock prices if a random walk process exists. On the contrary, if the set of tests rejects the existence of a random walk, the stock price could be predicted. As a result, the weak form of EMH does not hold in Vietnamese stock market.

1.3.Thesis Structure

The following chapters of the thesis are provided as follows. Chapter 2 contains theoretical background of the thesis, including the theory of market efficiency and random walk theory. Chapter 3 presents the literature review of previous main studies on testing market efficiency in different stock markets. Chapter 4 describes the data collection, testing model and methodology for the research. Empirical results obtained from statistic tests then are given and analyzed in chapter 5. Finally, chapter 6 concludes and suggests limitation and possible direction for further researches.

2. THEORETICAL BACKGROUND

2.1. The Efficient Market Hypothesis (EMH)

The concept of market efficiency was first proposed by Bachelier (1900) and then developed with important evidence by Fama in 1970. Market efficiency is seen as the level that stock prices react to new published information. A stock market is efficient when stock prices reflect all available information. Therefore, it is impossible to create abnormal return if the trading is based on available information (Dimson and Mussavian, 1998). Due to the restriction in the market size, the irrational investors and the trading costs or the mechanism of government, the level of efficiency in emerging stock market seems to be lower than that of developed stock market.

The idea of market efficiency is very important for market participants. In an efficient market, investors are unable to make choice and find an edge. They can only earn the abnormal returns by taking advantages of anomalies. The idea is equally important to firm manager. As the information is provided promptly and immediately, firm securities could be evaluated accurately as its present and prospect value.

2.2. Three forms of market efficiency

Fama (1970) classified EMH into three types according to the information characterization: “weak”, “semi-strong” and “strong”.

2.2.1. The weak form of EMH

The lowest level of information efficiency is called weak form of EMH. A market is determined as weak form efficiency if current prices fully reflect all past information including historical trading prices, transaction volume or short interest. The past price is meaningless to predict the future price fluctuation. Therefore, using only past value data will not generate abnormal profits.

2.2.2. The semi-strong form of EMH

In the market that is efficient in the semi-strong form of EHM, current prices reflect all released available information related to prospect of company such as capital information, balance sheet, interest rates, dividends, accounting data, annual wages, etc. Returns cannot be made just by analyzing any published information because market prices will be adjusted immediately to the news revealed by such information.

2.2.3. The strong form of EMH

The last form of EMH approves that current prices reflect all information regarding to the firm, including both publicly released and unreleased data. Therefore, even obtaining inside information cannot create abnormal returns.

2.3. Random Walk model

Fama (1970) suggested three methods for testing stock market: the Fair Game model, the Submartingale model and the Random Walk model. The Random Walk model is an extension of Fair Game model and provides the detail of the stochastic process generating returns. Therefore, he concluded that Random Walk model is more powerful than the Fair Game model in testing the EMH.

In an efficient market, prices change accordingly to new information. As the information arrives randomly, stock prices also fluctuate unpredictably. Based on the Random Walk Hypothesis by Kendal (1953), Fama (1970) built the equation for Random Walk model:

(1) $$P_{t+1} = P_t + \varepsilon_{t+1}$$

In which: P_{t+1} is the stock price at time t+1;

P_t is the stock price at time t;

ε_{t+1} is the random error with zero mean and finite variance.

The formula above implies that the change in stock prices (ε_{t+1}= P_{t+1} - P_t) is the unpredictable value and does not depend on the previous value of stock.

2.4. Testing weak form efficiency of stock market

In general, three levels of EMH have different corresponding tests. According to Fama (1991), tests of strong form address a question around private information. Meanwhile, the semi-strong tests examine how quickly the stock prices respond to new released information. Tests for weak form concern to the predictability of return in the future through the return obtained in the past.

The tests for weak form of EMH can be categorized in two main types: statistical tests for independence and trading tests (Fama, 1991). Statistical tests investigate the independence of stock returns in term of testing the presence of Random Walk process in stock market, e.g., the serial correlation test, runs test or unit roots test. Trading tests check whether trading rules that market participants following are available in the market or not, e.g. the tests for Calendar effects or the filter rules.

Moreover, it could be said that in the weak form of EMH, current stock prices reflect all information contained in the historical price movements. Hence, if the movement of stock value follows the random walk, the future value of stock is independent to the past value and the past data cannot be used to predict the future stock prices. Consequently, tests for random walk theory are used in the sense of examining the weak form of market efficiency.

Examining the serial correlations between the past returns and future returns could be seen as the main objective in testing Random Walk theory in stock market. For the empirical test, the frequency of time series data need to be collected in the form daily, weekly, monthly or yearly (Chang and Ting, 2000).

There are various approaches to test the randomness of stock returns. Box and Pierce (1970) use the Q-test to test the autocorrelation, which is developed to LB-test by Ljung and Box (1978) afterwards. Following these tests, if the autocorrelations are nearly zero then the stock prices movements are independent to each other and follow the random walk and vice versa. Lo and MacKinlay (1989) examined the correlation among the serial return, using the Variance Ratio Test. The test based on the idea that if the stock returns wander, the variance of its q-differences could become q-times the variance of the first ones. This test can also be used to explore negative serial correlation on long-horizon profits. The test became more reliable in testing the randomness of stock prices and has been developed by many researchers such as Chow and Denning (1993) and Wright (2000). Another popular test is runs test which check whether the serial of stock profits in fairly close intervals are independent to each other or not. Campbell et al. (1997) defined a “run” of a sequence is a

segment including consecutive equal elements of price changes. Besides, there are many different tests proposed such as Unit Root Test which is initially proposed by Dickey and Fuller (1979) or Portmanteau test provided by Box and Pierce (1970).

3. LITERATURE REVIEW

3.1. Evidence in Developed Markets

US market was studied by many researchers such as Pencek and Kohers (1990), Rodriguez et al. (2014) with different periods and the results given was mostly consistent: this market is weak form efficient. Pencek and Kohers (1990) study 3 main US stock exchanges: American Stock Exchange (AMEX), New York Stock Exchange (NYSE) and OTC market. The testing results suggest that AMEX and NYSE are equally weakly efficient while OTC market has lower lever of pricing efficiency. After researching US market stock returns in the period 1929 – 2014, Rodriguez et al. (2014) conclude that the level of market efficiency is not consistent over time and changes following economics and social shocks. Moreover, the longer period examined, the higher predictability stock market returns can be.

Worthington and Higgs (2004) analyzed sixteen European developed markets from December 31, 1987 to May 28, 2003 and found that the random walk hypothesis cannot be rejected in those markets. While Germany, Ireland, Portugal, Sweden and the United Kingdom satisfy most of the condition of the random walk theory, French, Finland, the Netherlands, Norway and Spain only meet some requirements of the theory. They used various methods including serial correlation, runs, unit root and multiple variance ratio tests. Borgers (2010) examined the weak form market efficiency in stock market indexes of France, Germany, UK, Greece, Portugal and Spain in the period from 1993 to 2007. The serial correlation test, runs test, augmented Dickey-Fuller test and multiple variance ratio test proves that monthly prices and profits follows the random walk while daily returns are not normally distributed. The efficient market hypothesis cannot be rejected for France, UK, Germany and Spain market while in Greece and Portugal, the hypothesis is rejected. The author also stated that in the last period after 2003, some random walk criteria was seen in the two markets.

Lima and Tabak (2004) used the variance ratio test and multiple variance ratio test and found that the random walk hypothesis cannot be rejected for Hongkong equity market but is rejected for Singapore market. Nisar and Hanif (2012) also tested the EMH in Developed markets in Asia Pacific including Japan, China, Korea, Hongkong, Australia, Pakistan and India using runs test and variance ratio test. They showed that three out of seven markets do not follow the random walk (China, Pakistan and India) while the others are weak form of efficient markets. The writers recommended to the policy makers and regulatory bodies of stock markets that market efficiency is important for all stock market, therefore a massive audit and information technology should be developed, while decreasing the transaction cost.

3.2.Evidence in Emerging Markets

Smith and Ryoo (2003) examined the random walk hypothesis for five European emerging stock markets, Greece, Hungary, Poland, Portugal and Turkey using variance ratio test from 1991 to 1998. The result showed that only in Istanbul market, the stock price index followed a random walk. The hypothesis is rejected in four other markets. It is explained that liquidity is an important factor to market efficiency, as Istanbul market has greater liquidity than the other four markets. Meanwhile, Worthington and Higgs (2004) found that Hungary market satisfies requirements of the random walk theory in daily stock returns. Their researching time was from 1994 to 2003, which is longer and more recent than the study of Smith and Ryoo (2003). Worthington and Higgs (2004) stated that Hungary market is the most institutionally mature of total four European emerging markets, including Czech Republic, Hungary, Poland and Russia.

Employing a serial correlation test, an Augmented Dickey-Fuller test and Lo and Mckinlay (1988) variance ratio test, Shaker (2013) investigated if the Finnish and Swedish stock market indices follow a random walk. All three tests show the results that both the OMX

Stockholm 30 and OMX Helsinki 25, during the period 2003 to 2012, does not follow a random walk. Therefore, both stock markets are not efficient in the weak form.

Sanyal et al. (2014) tested the EMH in 10 emerging stock markets: India, China, Indonesia, Sri Lanka, Pakistan, Russia, Brazil, Turkey, Mexico and Hongkong. The study uses runs test, unit root test, autocorrelation and variance ratio tests and concluded that only Hongkong stock market is weak form efficient. It is suggested that forecasting prices in an inefficient market is possible, as the prices do not follow the random walk. The reasons for market inefficiency in emerging markets is also provided in this paper, which is the transmission of market information, the dependence in developed economics and the lag in trading time between those markets and US market.

Fontaine and Nguyen (2006) investigated the weak form market efficiency in eight emerging stock markets: Argentina, Brazil, Chile, Colombia, Malaysia, Mexico, Thailand and Venezuela. The authors realized that some of these markets are weak form efficient during the entire period (Argentina, Thailand) or at least in a small sub-period (Mexico, Venezuela). They stated that the world market risk has a large effect to the expected returns in each country. Moreover, transaction cost and investment restriction in emerging countries are factors that directly link to market efficiency. This conclusion is consistent with other studies.

The weak form efficient market hypothesis was also rejected for the Ghana stock exchange (Ayentimi et al., 2013). They used data of weekly stock prices from 2007 to 2012 and test the hypothesis with test of normality, Kolmogorov-Smirnow Goodness of fit test and runs test. It is also indicated that in order for the market to be efficient, the transaction cost must be reduced. The efforts should come from the Securities and Exchange Commission, listed companies and individual investors.

3.3. Previous tests for weak form of EMH in Vietnam

Truong et al. (2010) investigated Vietnamese stock market in the relationship with EMH. They used the weekly prices of market index (VNI) and five oldest stocks listed (SAM, REE, TMS, LAP, HAP) from 2000 to 2004. After series of tests including autocorrelation tests, runs tests, variance ratio tests, they summarized that Vietnamese stock market is inefficient in weak form. However, autocorrelation test, runs test failed to reject the null hypothesis of randomness for REE and HAF, respectively. The period studied in this research is the first period when the market starts to operate. In the first two years, the stock exchange only opened three sessions per weeks with only about 32 listed companies until the end of 2005. Therefore, the result is reasonable.

Moreover, when testing the market efficiency in the ASEAN region using numbers of test such as unit root tests, variance ratio tests, nonparametric tests and cointegration tests using daily frequency data of VNINDEX from January 2000 to April 2011, Guidi and Gupta (2013) reject the EMH for the stock market of Vietnam. The authors also explained that part of the result was a consequence of the policy of the country, specifically underdeveloped legal and information system. The consequences are large information cost and resources allocation cost in the country. Therefore, if the legal and regulatory framework are transparency, the speed of information flow will improve, the result could change in this market.

Using data of weekly returns of VNINDEX and daily prices of five representative stocks from July 28th 2000 to July 28th 2013, Phan and Zhou (2013) employed autocorrelation tests, runs tests and variance ratio tests and found the similar results for testing weak form market efficiency of Vietnamese stock market. However, when they divided the sample into three periods (2000 – 2003, 2003 – 2009 and 2009 – 2013), the evidence supported for the random walk theory in this market in the third cycle. They concluded that a significant improvement can be seen in the efficiency of Vietnamese stock market. It is also the consequent of investors' behavior which became more professional.

4. DATA AND RESEARCH METHODOLOGY

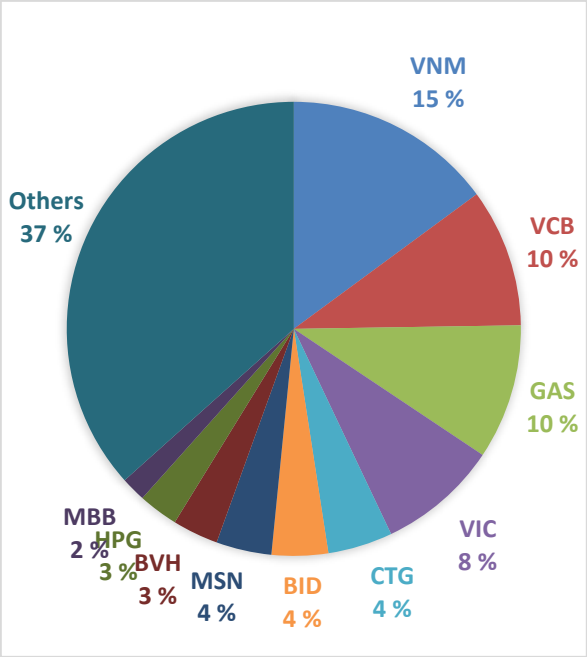
4.1. Data and statistic description

4.1.1. Data

The time series data used in this study including daily closing prices of the main market index of Vietnam (VNINDEX) and other ten outstanding statistical stocks listed on Ho Chi Minh stock exchange (HOSE) for weekdays. Specifically, 10 individual stocks selected are: BID, BVH, CTG, GAS, HPG, MBB, MSN, VCB, VIC, VNM. The daily data is collected from January 01 2010 to September 23 2016. All the indices come from DataStream Database and are dominated in Vietnam Dong (VND).

There are over 300 stocks listed on HOSE, each stock has different level of influence to the market index, depending on their characters such as authorized stock and market capitalization. Therefore, chosen stocks should be considered as representatives for the market index. In other words, those stock must have decisive effects to the entire market, i.e. if the stock prices rise, the market index will see a relatively significant increase and vice versa. Market capitalization is one important factor in choosing the stock. For instance, the market value of Vietnam Dairy Products JSC (VNM) has market capitalization of 203202.9 billion VND by 23 September 2016, made up for approximately 14.9% of total market capitalization. It indicated that if the stock of this company goes up or down roughly 7.5%, VN-Index will also grow or decline 1% respectively. For this reason, ten stocks selected have greatest market capitalization in the market.

Figure 1. Vietnamese stock market capitalization (23 Sep 2016).

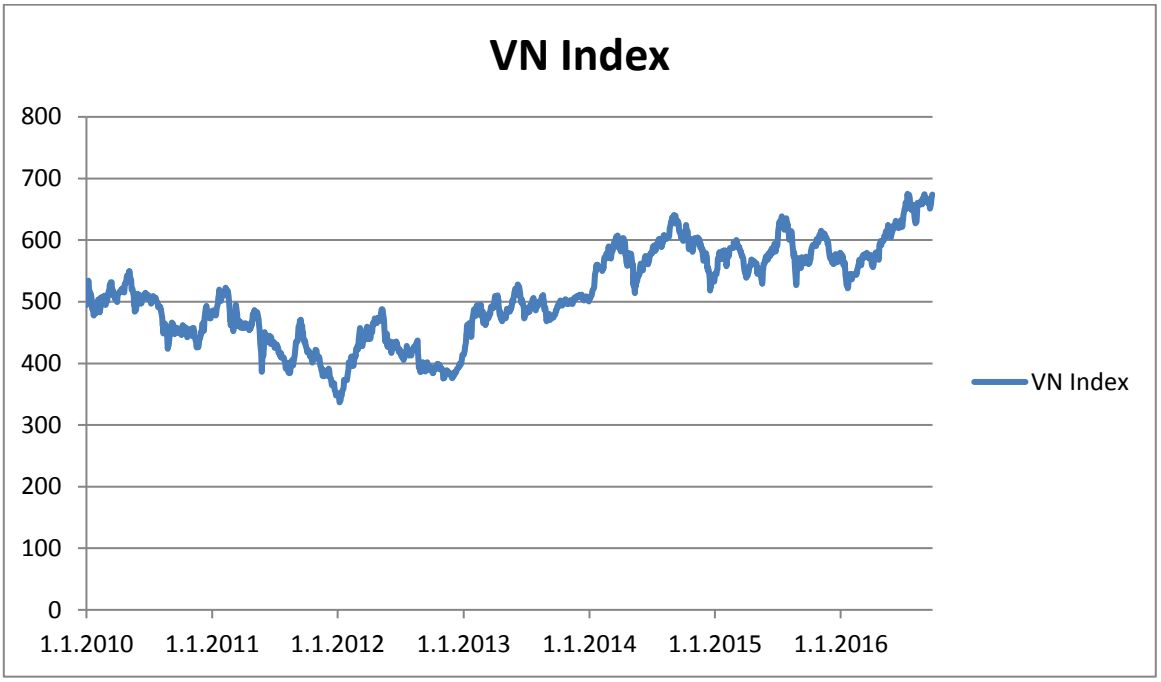


Stocks	Market Capitalization (billion VND)	Percentage
	1364150	100%
VNM	203202.9	14.90 %
VCB	134376.6	9.85 %
GAS	131255.7	9.62 %
VIC	116982.3	8.58 %
CTG	62925.49	4.61 %
BID	54870.34	4.02 %
MSN	53681.36	3.94 %
BVH	44502.82	3.26 %
HPG	38682.93	2.84 %
MBB	24059.9	1.76 %
Others		36.62 %

4.1.2. Statistical description of data

VNINDEX is built based on all capitalization-weighted stock indexes listed on HOSE. It is created in July 28th 2000 with the original value of 100 points and the market capitalization of approximately US 1.1 billion. The index includes 45 listed stocks and one fund, is considered as the commonwealth of Vietnamese stock market. The upward and downward trends of the VNINDEX explain the situation of the whole economy. As of September 23 2016, VNINDEX reached 674.09 points. The movement of VNINDEX is explained in more details in the figure bellow.

Figure 2. Fluctuation of VNINDEX over the period from 01.01.2010 to 23.09.2016.



After the financial crisis in 2008 – 2009, VNINDEX value moved smoothly over more than 5 years from January 2010 to September 2016. Over the period, Vietnamese government has applied many macroeconomic policies that stimulate economic growth such as Trans-Pacific Partnership Agreement, Free Trade Agreement and boosting foreign ownership. This study will test Vietnamese stock market over 2 periods: the first period from 1 January 2010 to 24 January 2014 and the second period from 27 January 2014 to 23 September 2016. Of which, the second period includes three stocks that was released later, however, had relatively large market capitalization (MBB, GAS and BID).

In addition, in order to test the weak form of EMH in Vietnam stock market, the daily stock returns of VNINDEX and 10 key stocks will be considered on basis of means, median, maximum, minimum, standard deviation (SD), skewness (S), kurtosis (K) and Jarque-Bera. Skewness, Kurtosis and Jarque-Bera is defined below.

Skewness is referred as a measure of the lack of symmetry of the sample data in the variable distribution and can be defined as:

(2) $$S=\frac{1}{N}\frac{\sum_{i=1}^{N}(Y_i-\overline{Y})^3}{SD^3}$$

Where $\overline{Y}$ is the mean;

SD is the standard deviation;

N is the number of data points.

Kurtosis aims to measure whether the data are peaked or in flatness to a normal distribution and the formula for kurtosis is:

(3) $$K=\frac{1}{N}\frac{\sum_{i=1}^{N}(Y_i-\overline{Y})^4}{SD^4}$$

According to Brooks (2008), S is zero and K equals 3 in normal distribution case.

Jarque-Bera is an asymptotic test to check normality in the residuals (Jarque-Bera, 1987). It can be defined as:

(4) $$\text{Jarque} - \text{Bera} = \frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4}\right)$$

Description statistics for the daily data of VNINDEX and 10 representative stocks of Vietnamese stock market are represented in the following tables.

Table 1. Descriptive statistics for daily returns of VNINDEX and 7 individual stocks

(1^{st} cycle: 1/1/2010 – 24/1/2014).

Stocks	Observation	Mean	Median	Maximum	Minimum	SD	S	K	Jarque - Bera
VNINDEX	1060	0.000117	0.00000	0.044047	-0.047871	0.012255	-0.258062	4.149073	70.08160
VNM	1060	0.001367	0.00000	0.053635	-0.064539	0.015168	0.273737	5.566904	304.2519
VCB	1060	-0.000107	0.00000	0.056863	-0.080969	0.020188	0.013090	3.857242	32.48675
VIC	1060	0.000840	0.00000	0.064967	-0.058872	0.020532	-0.034502	3.634322	17.98137
CTG	1060	1.78e-05	0.00000	0.063479	-0.093960	0.020251	0.097473	4.185122	63.71118
MSN	1060	0.000984	0.00000	0.065724	-0.067613	0.023257	0.067689	3.204500	2.656505
BVH	1060	0.000443	0.00000	0.067329	-0.069514	0.028716	0.047591	2.478913	12.39279
HPG	1060	0.000426	0.00000	0.068169	-0.070363	0.021588	0.048830	3.621726	17.49355

Table 2. Descriptive statistics for daily returns of VNINDEX and 10 individual stocks (2^{nd} cycle: 27/1/2014 – 23/09/2016).

Stocks	Observation	Mean	Median	Maximum	Minimum	SD	S	K	Jarque - Bera
VNINDEX	695	0.000266	0.000000	0.037784	-0.060512	0.010205	-0.650106	6.780728	465.0758
VNM	695	0.000767	0.00000	0.067606	-0.069698	0.013996	0.180464	6.270132	313.4459
VCB	695	0.001002	0.00000	0.067404	-0.072291	0.020018	0.119779	5.048682	123.2028
GAS	695	-0.000203	0.00000	0.067823	-0.073098	0.021980	0.044461	4.970385	112.6573
VIC	695	0.000559	0.000000	0.065788	-0.065251	0.015926	0.373486	5.684987	224.9929
BID	695	-0.000161	0.000000	0.067711	-0.072512	0.020511	0.283509	5.586434	203.0312
CTG	695	0.000000	0.000000	0.066285	-0.071991	0.016731	0.501506	6.389288	361.7853
MSN	695	-0.000449	0.00000	0.067003	-0.071733	0.017181	0.203869	5.768325	226.7401
BVH	695	0.000507	0.00000	0.068218	-0.072288	0.024586	0.194741	3.893099	27.49077
HPG	695	0.000969	0.00000	0.067421	-0.072489	0.019393	0.323458	4.363244	65.93628
MBB	695	0.00195	0.00000	0.062903	-0.064595	0.013256	0.183565	6.771554	415.8243

As can be seen from the statistic above, most of the means and all of the median value of daily data of Vietnamese market indices are positive, which leads to a rise in expected stock value.

Meanwhile, the values of S and K of VNINDEX is negative and different to 3, respectively, which indicates that the daily return distribution is negative skewed and most distribution is concentrated on the left side of the mean. Other indices, except for VIC, have positive S, thus, is positive skewed and most distribution is concentrated on the right side of the mean. It could be noticed that the values of Jarque-Bera statistic exceeds the critical values for significant level of 1%. It can be concluded that daily returns do not follow a normal distribution. As a result, beside parametric tests, non-parametric tests such as the runs test should be conducted to analyze the market efficiency.

Daily return is transformed by the natural logarithmic equation as following:

(5) $$R_t = \ln(P_t) - \ln(P_{t-1}) = \Delta \ln(P_t)$$

Where: R_t is the daily return;

P_t is the closing stock price at time t;

$P_{t-1}$is the closing stock price at time t-1

It can be seen from the table above that the medians of daily data of Vietnamese market indices are mostly positively close to zero. The mean of VNINDEX is negative, which prove that there were significant influences of the global financial crisis to Vietnamese stock market. It can also be noticed that the second period has higher mean with lower Standard Deviation. The negative skewness of most of the sample indicates that most distribution is concentrated on the left side of the mean. The kurtosis of all stock returns is greater than 3, meaning that the distribution is high peak and fat tail. The value of Jarque-Bera statistic shows that the returns of all stocks are not normally distributed at significance level of 1%. Therefore, it is reasonable to use a non-parametric test to examine the weak form efficiency of Vietnamese stock market.

4.2.Methodology

4.2.1. Autocorrelation test

Autocorrelation tests, also referred as the “serial correlation” or “lagged correlation” test, is considered as the primary and most popular approach for testing the random walk theory for stock market. Statistically, the term of correlation is defined as a mathematical tool for finding the repeating patterns between a given time and a lagged value of it over continuous time span. Therefore, if the stock returns are uncorrelated at all leads and lags, the stock markets will be said to conform to the random walk theory.

According to Campbell et al. (1997), the model of statistic test for autocorrelation could be represented as below:

(6) $$\rho_k = \frac{\sum_{t=1}^{N-k}(r_t-\overline{r})(r_{t+k}-\overline{r})}{\sum_{t=1}^{N-k}(r_t-\overline{r})^2}$$

Where ρ_k is the autocorrelation coefficient for lag k ($-1 \leq \rho_k \leq 1$);

N is the sample date size;

r_t and r_{t+k} are the stock returns at time t and (t+k), respectively;

$\overline{r}$ is the sample mean of returns;

k is the lag length.

If the autocorrelation coefficient ρ_k differs from zero, the weak form of EMH will not hold.

The null hypothesis in this case is

H_0: $\rho_k = 0$

Against H_1: $\rho_k \neq 0$

Based on the Portmanteau Q*(m) statistic by Box and Pierce (1970), Ljung and Box (1978) proposed the Q-statistic as given below:

(7) $$Q_{LB} = N(N+2)\sum_{k-1}^{m} \frac{{\rho_k}^2}{N-k} \sim \chi_m^2$$

Where ρ_k is the k^{th} estimated autocorrelation coefficient;

m is the maximum lag length

Ljung-Box Q-statistics is conducted to test for the autocorrelation at multiple lags joint. The null and alternative hypothesis is stated as following:

H_0: $\rho_0 = \rho_1 = \rho_2 = \ldots = \rho_k = 0$

Against

H_1: $\rho_0 \neq \rho_1 \neq \rho_2 \neq \ldots \neq \rho_k \neq 0$

Where k € $\{1, N\}$

If Q_{LB} is higher than chi-square, the null hypothesis H_0 is rejected, the random walk theory does not hold in the stock market.

In addition, it should be noticed that the choice of maximum lag length m is important to the result of the test (Campbell et al., 1997). Tsay (2010) suggested that the value of m ≈ ln(N) in order to avoid missing higher order autocorrelation as well as effect of higher order autocorrelation to outcome of the test. As a result, the value of m could be around 10 or 15 in the case of seasonal autocorrelation.

4.2.2. Runs test

Runs test can be used as a popular non-parametric tool to test the random process in return series. Campbell et al. (1997) pointed out that the term of "run" in a sequence is a segment including adjacent equal factors of price changes. If stock returns conform to randomness process, the actual amount of runs (R) would be close to the expected number of runs (m).

According to Campbell (1997), the changes in stock value can be categorized into three forms: plus (prices increase), minus (prices decrease) and no change (prices maintain). The null hypothesis that confirms the presence of random walk theory in stock market can be tested by investigating the series of prices changes which have the same characteristic.

Expected number of runs is calculated as:

(8) $$M = \frac{N(N+1)-\sum_{i=1}^{3} n_i^2}{N}$$

Where N is the sample data size

n_i is the number of observations in each form which denoted as i

If the size of observations is too large (N>30), the expected number of runs M then seems to normally distributed with the standard error as

(9) $$\sigma_m = \left[\frac{\sum_{i=1}^{3} n_i^2\left[\sum_{i=1}^{3} n_i^2+N(N+1)\right]-2N\sum_{i=1}^{3} n_i^3-N^3}{N^2(N-1)}\right]^{0,5}$$

Under the null hypothesis that the independence is exist between stock returns, the Z-statistics can be conducted as:

(10) $$Z = \frac{R \pm 0,5-m}{\sigma_m}\text{ , } Z \sim N(0,1)$$

Where 0,5 is the continuity adjustment, which is negative if R ≤ m and positive if R > m.

The value Z-statistics will be negative (positive) in the case that the actual number of runs (R) is less (more) than the expected value (m). Both of two cases indicate that the serial correlation between stock returns exists, which violates the Radom Walk Hypothesis (Abraham et al., 2002). On the other hand, at the 5% significance level, if critical value of Z-statistic is higher than 1,96 then the null hypothesis that there is randomness in the series of stock returns or the weak form efficient is rejected.

4.2.3. Variance ratio test

Gilmore and McNanus (2003) indicated that the autocorrelation test is not a sufficient condition for a random walk. Therefore, Variance ratio (VR) test is proposed in this study. The test could be seen as the most powerful and popular approach for testing the independence among stock returns. Lo and MacKinlay built this test in 1988 based on the assumption that the changes in stock returns under random walk theory are linear in the sample interval. VR test exploits the fact that if the logarithm value of time series conforms the randomness, the variance of its q-differences corresponding grows to q time of its first differences. For example, if the random walk theory is hold in a stock market which trades for 5 sessions per week, the variance of the weekly series should be 5 times the variance of the daily series.

In order to test the independences in stock returns, the case of nq+1 observations can be concerned and Lo and MacKinlay (1988) proposed the following single test:

(11) $$VR\ (q) = \frac{Var\ (R_t - R_{t-q})}{Var\ (R_t - R_{t-1})} = \frac{\sigma^2(q)}{\sigma^2(1)}$$

Where VR(q) is the variance ratio of q-difference

$\sigma^2(q)$ is the $\frac{1}{q}$ times of the variance of the q-difference

$\sigma^2(1)$ is the first difference

Under the null hypothesis of confirming the availability of pure randomness, the variance ratio VR(q) should be equal to 1. If VR(q) is different to 1, it is indicated that there is a positive (negative) correlation between stock returns. The conclusion is the random walk theory does not hold.

$\sigma^2(q)$ can be determined as:

(12) $$\sigma^2(q) = \frac{1}{m}\sum_{t=q}^{nq}(R_t - R_{t-q} - q\mu)^2$$

Or: (13) $$\sigma^2(q) = \frac{1}{nq-1}\sum_{t=q}^{nq}(R_t - R_{t-q} - \mu)^2$$

Where: (14) $$m = q\,(nq - q + 1)\,(1 - \frac{q}{nq})$$

(15) $$\mu = \frac{1}{nq}\,(R_{nq} - R_0)$$

Moreover, Lo and MacKinlay (1988) also examined the null hypothesis under both assumptions of homoscedasticity and heteroscedasticity by conducting two asymptotic distributions as below:

(16) $$Z_q = \frac{VR(q)-1}{[\phi(q)]^{0,5}} \sim N(0,1)$$

and (17) $$Z_q^* = \frac{VR(q)-1}{[\phi^*(q)]^{0,5}} \sim N(0,1)$$

Where: Z_q is the standard test statistic

Z_q^* is the robust test statistic

$\phi(q), \phi^*(q)$ are standard error of variance ratio under the assumption of homoscedasticity and heteroscedasticity.

(18) $$\phi(q) = \frac{2(2q-1)(q-1)}{3q(nq)}$$

(19) $$\phi^*(q) = \sum_{j=1}^{q-1} \left(\frac{2(1-j)}{q}\right)^2 \delta(j)$$

(20) $$\delta(j) = \frac{\sum_{t=j+1}^{nq}(R_t - R_{t-1} - \mu)^2 (R_{t-j} - R_{t-j-1} - \mu)^2}{\left[\sum_{t=1}^{nq}(R_t - R_{t-1} - \mu)^2\right]^2}$$

Where $\delta(j)$ is the heteroscedasticity-consistent estimator;

μ is the average value of stock returns.

Campbell et al. (1997) also suggested that the variance ratio tests are used for lags of 1, 4, 8 and 16.

Kim (2006) also researched a variance ratio test with the usage of wild bootstrap. This methodology will also be presented in this thesis, by computing both individual and joint VR test statistics. Kim's wild bootstrap includes three following stages:

1. Form a bootstrap sample of T observations $x_t^* = \eta_t x_t$ (t = 1, …, T) where η_t is a random sequence with zero mean and variance equal one.
2. Chow and Denning (1993) developed joint variance ration tests which defined heteroskedastic test statistic as:

   (21) $$\text{CD} = \sqrt{T} \max_{1 \le i \le m} |z_2(q_i)|$$

   The second step of Kim's bootstrap caculates CD^* from the sample generated in stage 1.
3. Repeat 1. and 2. Sufficiently many times in order to form a bootstrap distribution of the test statistic CD^*.

5. EMPIRICAL RESULT

This section will provide the empirical findings obtained from three tests mentioned in the methodology part: (1) Autocorrelation Test, (2) Runs Test, (3) Variance Ratio Test.

5.1.Autocorrelation test

Firstly, in order to test the weak form of EMH, the autocorrelation tests with 15 lags will be employed to detect the correlation between series of daily stock returns of VNINDEX and 10 representative stocks.

Table 3 illustrates the results from autocorrelation test for return series in first period. It can be seen from table 3 that the autocorrelation coefficient at lag one of CTG (0.06) is lowest and of MSN (0.236) is highest. All the coefficient is positively significant at lag one for daily stock returns of all indexes. For higher order autocorrelation, CTG shows insignificant autocorrelation coefficient in all lags, except for lag 6 and 7 (negatively significant). On the other hand, at lag 10, the other series show consistently positive autocorrelation, except for VNINDEX and VIC (negatively significant). While positive autocorrelation coefficient demonstrates that returns are predictability in short horizon, which is against hypothesis of market efficiency; negative autocorrelation coefficient suggests mean reversion in returns. Negative autocorrelation coefficient can also be seen in lower lags of all the return indexes. To be concluded, most of the testing series has the significant autocorrelation coefficient (AC), thus does not follow the randomness process (except for CTG).

The Ljung-Box Q-statistics indicate possibility of dependence in the first and higher order of the return indexes. The Ljung-Box Q-statistic shows that most of the coefficients are significant (except for CTG), which rejects the absence of auto-correlation in stock returns.

Table 3. Results of autocorrelation tests for daily stock returns (1st period).

Lag		1	2	3	4	5	6	7	8	9	10
	AC	0.151	0.039	0.028	0.035	-0.046	-0.064	0.065	0.026	-0.058	-0.004
	Q-stat	24.364 (***)	26.011 (***)	26.826 (***)	28.157 (***)	30.379 (***)	34.754 (***)	39.213 (***)	39.913 (***)	43.462 (***)	43.478 (***)
	AC	0.080	-0.026	-0.046	-0.029	-0.024	-0.045	0.042	-0.001	-0.034	0.001
	Q-stat	6.77408 (***)	7.4781 (**)	9.7403 (**)	10.618 (**)	11.237 (**)	13.387 (**)	15.272 (**)	15.273 (*)	16.526 (*)	16.527 (*)
	AC	0.062	-0.039	-0.035	0.032	-0.092	-0.066	0.070	0.040	-0.040	0.054
	Q-stat	4.0484 (**)	5.6878 (*)	7.0140 (*)	8.1309 (*)	17.228 (***)	21.943 (***)	27.112 (***)	28.794 (***)	30.494 (***)	33.630 (***)
	AC	0.125	-0.005	-0.034	0.025	-0.037	-0.013	0.035	-0.002	-0.021	-0.045
	Q-stat	16.593 (***)	16.616 (***)	17.877 (***)	18.557 (***)	20.016 (***)	20.208 (***)	21.531 (***)	21.536 (***)	21.988 (***)	24.155 (***)
	AC	0.060	-0.004	-0.033	0.007	0.000	-0.081	-0.002	0.004	0.016	0.005
	Q-stat	3.8841 (**)	3.9001	5.0499	5.1074	5.1074	12.153 (*)	12.156 (*)	12.171	12.445	12.471
	AC	0.236	0.016	0.002	-0.013	-0.065	-0.042	0.027	-0.018	-0.043	0.018
	Q-stat	59.305 (***)	59.587 (***)	59.590 (***)	59.757 (***)	64.262 (***)	66.189 (***)	66.978 (***)	67.342 (***)	69.347 (***)	69.689 (***)
	AC	0.188	0.013	0.018	0.045	0.029	0.004	0.050	-0.022	-0.057	0.053
	Q-stat	37.417 (***)	37.595 (***)	37.944 (***)	40.135 (***)	41.003 (***)	41.024 (***)	43.698 (***)	44.230 (***)	47.694 (***)	50.658 (***)
	AC	0.106	0.043	-0.004	0.012	-0.040	-0.080	-0.007	0.023	-0.027	0.011
	Q-stat	12.055 (***)	14.009 (***)	14.030 (***)	14.178 (***)	15.869 (***)	22.735 (***)	22.784 (***)	23.327 (***)	24.089 (***)	24.220 (***)

****, ** and * indicate statistical significance at the 1%, 5% and 10% levels*

On the other hand, table 4 indicates results of autocorrelation tests on 2nd cycle. At lag one, the autocorrelation coefficient of GAS (0.158) is highest and of VNM (-0.045) is lowest. Except for GAS and BID, all the coefficient is insignificant at lag one. For higher lag, VNINDEX shows negative significant coefficient at lag 4 and 5, positive significant coefficient at lag 2; VCB shows positive significant coefficient at lag 10; GAS shows significant coefficient at all lags; BID shows positive significant coefficient at lag 10, negative significant coefficient at lags 2 and 3; MSN shows positive significant coefficient at lags 6 and 8, negative significant coefficient at lag 9.

The test result of the Ljung-Box Q-statistic cannot reject the null hypothesis about the absence of autocorrelation in stock returns (except for GAS). To be extended, the null hypothesis of no autocorrelation is strongly rejected at 1% significant level for GAS. Meanwhile, the extent of rejection is less pronounced for VNINDEX, VCB, BID, MSN. For the remaining stocks, the null hypothesis cannot be rejected. This result can be explained from the reason that Vietnamese stock market is developing rapidly and gradually succeeds in dealing with problems of an emerging and thin market.

To summarize it, according the results of autocorrelation tests for daily returns of VNINDEX and 10 major stocks, it can be said that null hypothesis of absence of autocorrelation is rejected in the first period from 1 January 2010 to 24 January 2014. This result is consistent with previous findings of Truong et al. (2010) and Guidi and Gupta (2013). However, the null hypothesis cannot be rejected in the second period from 27 January 2014 to 23 September 2016 for most of the return indexes, except for GAS.

Table 4. Results of autocorrelation tests for daily stock returns (2nd cycle).

Lag		1	2	3	4	5	6	7	8	9	10
	AC	0.042	0.071	0.013	-0.084	-0.006	-0.017	0.019	0.032	-0.002	0.038
	Q-stat	1.2195	4.7533 (*)	4.8725	9.8067 (**)	9.8351 (*)	10.033	10.298	11.001	11.003	12.038
	AC	-0.045	0.036	0.001	-0.029	0.041	0.010	0.002	-0.020	0.020	-0.075
	Q-stat	1.4333	2.3559	2.3574	2.9621	4.1676	4.2339	4.2374	4.5058	4.7757	8.7424
	AC	0.002	-0.025	0.010	-0.080	-0.043	0.015	0.012	-0.017	0.024	0.114
	Q-stat	0.0029	0.4249	0.5016	4.9458	6.2584	6.4200	6.5257	6.7224	7.1307	16.297 (*)
	AC	0.158	0.070	0.007	-0.012	-0.037	-0.049	0.041	0.036	-0.030	0.047
	Q-stat	17.456 (***)	20.907 (***)	20.940 (***)	21.042 (***)	21.980 (***)	23.644 (***)	24.837 (***)	25.726 (***)	26.369 (***)	27.927 (***)
	AC	-0.000	-0.017	-0.010	-0.015	-0.048	-0.009	-0.039	0.025	0.075	-0.012
	Q-stat	0.0001	0.1980	0.2651	0.4142	2.0138	2.0674	3.1252	3.5704	7.5795	7.6807
	AC	0.076	-0.032	-0.049	-0.002	0.055	-0.038	-0.008	-0.029	0.053	0.084
	Q-stat	4.0075 (**)	4.7287 (*)	6.4336 (*)	6.4371	8.5373	9.5395	9.5840	10.165	12.154	17.146 (*)
	AC	0.020	-0.032	-0.050	-0.080	-0.023	-0.012	0.013	-0.023	0.013	0.132
	Q-stat	0.2840	0.9906	2.7722	7.2782	7.6395	7.7429	7.8609	8.2302	8.3570	20.673
	AC	0.004	-0.053	-0.043	-0.071	-0.057	0.048	-0.020	0.061	-0.040	-0.018
	Q-stat	0.0086	1.9696	3.2857	6.7711	9.0150	10.633 (*)	10.916	13.564 (*)	14.711 (*)	14.950
	AC	0.012	0.031	0.036	0.036	0.015	-0.055	0.050	0.033	0.039	-0.032
	Q-stat	0.0967	0.7576	1.6697	2.5811	2.7344	4.8802	6.6653	7.4467	8.4951	9.2105
	AC	0.038	-0.056	-0.036	-0.024	-0.044	-0.004	-0.036	-0.028	-0.041	0.009
	Q-stat	1.0265	3.2503	4.1577	4.5762	5.9523	5.9619	6.8981	7.4397	8.6043	8.6594
	AC	-0.002	-0.063	-0.023	-0.051	0.022	-0.082	0.048	-0.016	0.044	0.058
	Q-stat	0.0034	2.7454	3.1301	4.9848	5.3344	10.091	11.718	11.903	13.275	15.672

****, ** and * indicate statistical significance at the 1%, 5% and 10% levels*

5.2.Runs test

Table 5. Results of Runs tests for daily stock returns.

Variables	1st cycle			2nd cycle		
	Observation (N)	Number of runs (R)	Z-statistic	Observation (N)	Number of runs (R)	Z-statistic
VNINDEX	1060	487	-2.69896(***)	695	320	-2.15241(**)
VNM	1060	451	-2.4026(***)	695	304	-0.35149
VCB	1060	508	-1.03588	695	335	-0.45548
VIC	1060	461	-2.43266(***)	695	318	-0.68644
CTG	1060	482	-0.82802	695	342	0.4602
MSN	1060	439	-3.93120(***)	695	306	-1.91365(**)
BVH	1060	480	-2.39432(***)	695	331	-0.69683
HPG	1060	470	-2.42677(***)	695	315	-1.52008(*)
GAS				695	320	-1.40673(*)
BID				695	338	-0.19955
MBB				695	304	-0.46565

****, ** and * indicate statistical significance at the 1%, 5% and 10% levels*

The results of the runs test for daily stock returns of Vietnamese stock market is presented in Table 5. In the first cycle, Z-statistic is significant at 1% level in most of the cases (except for VCB and CTG), rejecting the existence of a random walk. Besides, the significant negative value of Z-statistics shows that their actual runs are significantly smaller than their corresponding expected runs. The negative Z-values also report positive serial autocorrelation, which is consistent to the results of autocorrelation tests.

Meanwhile, in the second cycle, Z-statistic of VNINDEX and MSN is significant at 5% level and Z-statistic of HPG and GAS is significant at 10% level. The Z-statistic of the remaining stocks are insignificant. Therefore, except for VNINDEX, MSN, HPG and GAS, Z-statistic is not significant in test results of 2nd cycle, which proves that the null hypothesis of a random walk cannot be rejected.

In a word, given the results from the runs test, the null hypothesis of random walk theory is rejected for the market returns in the first period, except for VCB and CTG. On the other hand, in second period, the random walk theory falls to reject for most stocks (VNM, VCB, VIC, CTG, BVH, BID, MBB). While the serial correlation test cannot reject the null hypothesis of random walk theory for CTG in the first period and only strongly rejects the null hypothesis of random walk theory for GAS in the second period, the results from the two tests are slightly different.

5.3.Variance ratio test

Table 6. Results of Variance ratio tests for daily stock returns (1st cycle).

Variables	Number n*q of base bservations	Number q of base observation aggregated to form variance ratio			
		2	4	8	16
VNI					
VR(q)		0.565967	0.284926	0.143584	0.075921
Z(q)		-14.12443(***)	-12.43842(***)	-9.421686(***)	-6.831814(***)
Z*(q)		-10.30530(***)	-9.4355(***)	-7.49380(***)	-5.725916(***)
VNM					
VR(q)		0.556619	0.279492	0.135941	0.068364
Z(q)		-14.42864(***)	-12.53293(***)	-9.505768(***)	-6.88769(***)
Z*(q)		-8.981279(***)	-8.040334(***)	-6.407890(***)	-4.899791(***)
VCB					
VR(q)		0.554953	0.258608	0.128791	0.068246
Z(q)		-14.48284(***)	-12.89619(***)	-9.584429(***)	-6.888559(***)
Z*(q)		-10.25457(***)	-9.555272(***)	-7.445116(***)	-5.707342(***)
VIC					
VR(q)		0.574888	0.278797	0.143918	0.074023
Z(q)		-13.83413(***)	-12.54502(***)	-9.418018(***)	-6.845849(***)
Z*(q)		-10.12408(***)	-9.558523(***)	-7.510189(***)	-5.748423(***)
CTG					
VR(q)		0.534762	0.264584	0.133661	0.070631
Z(q)		-15.13992(***)	-12.79225(***)	-9.53085(***)	-6.870928(***)
Z*(q)		-10.82976(***)	-9.60142(***)	-7.598310(***)	-5.830938(***)
MSN					
VR(q)		0.644394	0.331628	0.166347	0.088569
Z(q)		-11.57223(***)	-11.62605(***)	-9.171264(***)	-6.738308(***)
Z*(q)		-9.547547(***)	-9.747569(***)	-8.070876(***)	-6.191383(***)

BVH	1060				
VR(q)		0.60811	0.294331	0.157844	0.077380
Z(q)		-12.75299(***)	-12.27482(***)	-9.264812(***)	-6.821031(***)
Z*(q)		-10.71346(***)	-10.40823(***)	-7.963095(***)	-6.052518(***)
HPG					
VR(q)		0.532771	0.273894	0.134994	0.06943
Z(q)		-15.20471(***)	-12.63031(***)	-9.516186(***)	-6.879803(***)
Z*(q)		-10.72182(***)	-9.438673(***)	-7.575909(***)	-5.816451(***)

****, ** and * indicate statistical significance at the 1%, 5% and 10% levels*

The results of the variance ratio tests for Vietnamese stock market in two periods is illustrated in Table 6 and Table 7. VR(q) is the variance ratio of the return indexes, Z(q) and Z*(q) are the statistics of the variance ratio under the assumption of homoscedasticity and heteroscedasticity, respectively. The variance ratio test for each stock returns is run for different lags of q (2, 4, 8 and 16 days).

According to the test results, the null hypothesis of random walk theory/weak form of EMH is strongly rejected at 1% significant level for series of daily returns of all stocks. Specifically, the empirical results confirm that test statistics Z under the assumption of homoscedasticity and heteroscedasticity are significant at all values of q. The estimated values of VR(q) are smaller than 1 for all cases, showing negative auto-correlation for daily holding period returns. This result is similar to findings of previous paper about market efficiency in Vietnamese stock market.

Table 7. Results of Variance ratio tests for daily stock returns (2nd cycle).

Variables	Number n*q of base observations	Number q of base observation aggregated to form variance ratio			
		2	4	8	16
VNI					
VR(q)		0.486043	0.285022	0.128635	0.065269
Z(q)		-13.53963(***)	-10.06789(***)	-7.760254(***)	-5.594298(***)
Z*(q)		-5.919563(***)	-4.807937(***)	-4.217555(***)	-3.581749(***)
VNM					
VR(q)		0.462173	0.248168	0.123614	0.058170
Z(q)		-14.16844(***)	-10.58684(***)	-7.804964(***)	-5.636782(***)
Z*(q)		-7.718025(***)	-6.266068(***)	-5.178933(***)	-4.226607(***)
VCB					
VR(q)		0.51482	0.272626	0.129101	0.061480
Z(q)		-12.78153(***)	-10.24244(***)	-7.756103(***)	-5.616971(***)
Z*(q)		-8.190171(***)	-7.128858(***)	-5.899974(***)	-4.610062(***)
VIC					
VR(q)		0.509633	0.255253	0.122511	0.062798
Z(q)		-12.91818(***)	-10.48707(***)	-7.814789(***)	-5.609083(***)
Z*(q)		-8.701515(***)	-7.638298(***)	-6.220309(***)	-4.80993(***)
CTG					
VR(q)		0.528042	0.277996	0.132981	0.067494
Z(q)		-12.43320(***)	-10.16683(***)	-7.721548(***)	-5.58098(***)
Z*(q)		-7.696199(***)	-6.893016(***)	-5.582425(***)	-4.311869(***)
MSN					
VR(q)		0.529827	0.270236	0.118742	0.064742
Z(q)		-12.38619(***)	-10.2761(***)	-7.848353(***)	-5.597453(***)
Z*(q)		-7.950403(***)	-7.279009(***)	-6.130990(***)	-4.687038(***)
BVH					

VR(q)		0.491057	0.245383	0.123890	0.066729
Z(q)		-13.40754(***)	-10.62607(***)	-7.802510(***)	-5.585561(***)
Z*(q)		-8.555034(***)	-7.208686(***)	-5.668743(***)	-4.360995(***)
HPG					
VR(q)		0.550745	0.268569	0.136099	0.060540
Z(q)		-11.83512(***)	-10.29957(***)	-7.693777(***)	-5.622600(***)
Z*(q)		-8.133531(***)	-7.593639(***)	-6.125122(***)	-4.832898(***)
GAS					
VR(q)		0.553851	0.302535	0.145773	0.075580
Z(q)		-11.75330(***)	-9.821279(***)	-7.607627(***)	-5.532586(***)
Z*(q)		-7.598556(***)	-6.760790(***)	-5.778596(***)	-4.573765(***)
BID					
VR(q)		0.560028	0.273382	0.141869	0.075746
Z(q)		-11.59057(***)	-10.23179(***)	-7.642391(***)	-5.531594(***)
Z*(q)		-8.036640(***)	-7.265699(***)	-5.584392(***)	-4.286232(***)
MBB					
VR(q)		0.531673	0.264549	0.129303	0.059967
Z(q)		-12.33754(***)	-10.35618(***)	-7.754307(***)	-5.626032(***)
Z*(q)		-7.362143(***)	-6.673687(***)	-5.439113(***)	-4.340236(***)

****, ** and * indicate statistical significance at the 1%, 5% and 10% levels*

Kim's wild bootstrap show no differences to Lo and MacKinlay variance ratio test when the null hypothesis is rejected at 1% level for all lags.

Overall, based on the empirical findings above, the null hypothesis of random walk theory and the weak form efficiency of EMH is rejected for the Vietnamese market index VNINDEX and almost all representative stocks. However, the evidences from the autocorrelation test and runs test for daily series of some stock returns fall to reject the randomness in the series.

5.4. Explanation of tests results

The result of rejection of the null hypothesis about weak form efficiency for Vietnamese stock market is consistent to many studies with similar condition. The evidence of inefficient market is presented in the study of Smith and Ryoo (2003) on the market of Greece, Hungary, Poland and Portugal or Guidi and Gupta (2013) on the market of Vietnam from January 2000 to April 2011. Since the market is characterized by representative features of emerging and thin markets, the efficiency of stock market performance is affected.

Particularly, serial correlation could be caused by non-synchronous or infrequent stock trading between small-capitalized companies and large-capitalized companies. Furthermore, most companies have insufficient corporate governance system, which leads to many problems such as asymmetric information, inexplicit accounting system, insider trading and market manipulation. Last, but not least, the State Securities Commission of Vietnam (SSC) do not have a mechanism with strict management for the market.

The background of stock market should also be looked carefully. Most of the listing firms in Vietnamese stock exchange are originally state-owned companies, which affects the shareholding structure. Although the companies went privatization, many major securities are still owned by Vietnamese government and are decided not to be traded. Those stocks become low liquidity securities and influence the efficiency of the market.

On the other hand, overcoming the global financial crisis in 2007 – 2008, Vietnamese economy sees a great potential with considerable growth rate. Upgraded corporate governance mechanism also promises positive changes in market efficiency of Vietnamese stock market in the future.

To summarize, with market imperfection in an emerging market, the result of inefficient in weak form of Vietnamese stock market is not a surprising finding.

6. CONCLUSION

This chapter is aimed to provide a final remark and explanation for empirical results obtained from three tests above. The limitation of the thesis is also discussed after that. Lastly, some recommendations are presented for further studies.

6.1. Summary of the tests results.

The study provides an inside into Vietnamese stock market and investigates the weak form efficiency of this stock market from 1 January 2010 to 23 September 2016 (nearly 6 years of operation).

The data for the test is collected from Data Stream, including daily returns of Vietnamese market index VNI and 10 representative stocks. Due to the differences in publishing day of individual stocks, full data is divided into two periods: 1st period from 1 January 2010 to 24 January 2014 and 2nd period from 27 January 2014 to 23 September 2016. Autocorrelation test, runs test and variance ratio test are applied on the study. According to results obtained from these tests, the null hypothesis is rejected, indicating that the random walk theory/ the weak form efficiency does not exist in the stock market of Vietnam.

Specifically, from the autocorrelation test, in the first period, Q-statistics of VNI are highly significant at all lags from 1 to 10, suggesting that daily returns of VNI is linear independent. However, in the second period, Q-statistics of VNI is only significant at lags 2, 4 and 5. Therefore, the random walk theory cannot be rejected strongly at this period. Similar concluded could be seen in all individual stock indexes, except for GAS.

Moreover, the findings from the runs test indicate that the availability of the randomness process is rejected for the market index and some individual stocks (MSN, HPG) in both

two periods. On the other hand, except for MSN, HPG, GAS, for all the other individual stocks, random walk theory cannot be rejected in the second period.

In order to provide a clear conclusion for the efficiency theory of Vietnamese stock market, Lo and MacKinlay's variance ratio test is applied. The outcomes obtained from this test under both homoscedasticity and heteroscedasticity fail to support the null hypothesis for daily stock returns of VNI and all other individual stocks indices in both two periods. As the variance-ratio test could be seen as the most powerful and popular test for the independence among stock returns, the conclusion from this test has important position.

Given the results above, to summarize, this research points out that Vietnamese stock market is not efficient in the weak form of EMH.

6.2. Thesis limitation and further suggestion

This study mainly focuses on the literature of market efficiency, which includes the weak form efficiency of the Efficient Market Hypothesis or the Random Walk Theory. In fact, market efficiency is a huge field that requires deeper investigation. As only the statistic tests for weak form efficiency of the stock market using time series data of stock indexes are applied and other tests such as technical trading rules or adjusting transaction cost are not included, the research method is restricted. Meanwhile, the corrected daily stock returns are not applied in the thesis. Possible bias in empirical findings might happen due to this problem. Above limitation could be seen in the study.

Further research could be done by using weekly or monthly data of the indices to investigate the efficiency of Vietnamese stock market. Alternatively, not only statistic methods but other technical tests could be used to test the hypothesis. Finally, investigating some calendar anomalies could be an effective way to examine the efficiency of the market.

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