

Stock-market efficiency in thin-trading markets: the case of the Vietnamese stock market

Truong Dong Loc^a, Ger Lanjouw^{b,*} and Robert Lensink^c

^a*School of Economics and Business Administration (SEBA), Can Tho University, Vietnam*

^b*Faculty of Economics and Business, Department of International Economics and Business, University of Groningen, The Netherlands*

^c*Faculty of Economics and Business, Department of Finance, University of Groningen, The Netherlands*

This article reviews developments in the Stock Trading Centre (STC) in Ho Chi Minh City, Vietnam, the main stock market in the country, since its start in 2000. It presents information about developments in the number of stocks traded, trading activity and stock-price developments. This article focuses on the question whether the market is weak-form efficient. An important element of the investigation concerns the possible bias of the results caused by the thin trading that characterizes the STC. Stock-market returns are corrected for this. The main conclusion is that the STC is not efficient in the weak form.

1. Introduction

A growing number of articles examine whether stock markets in emerging markets behave in line with the Efficient-Market Hypothesis (EMH). Some of these studies reject the hypothesis that the stock markets in question are weak-form efficient.¹ For instance, Wheeler *et al.* (2002) fail to find support for weak-form efficiency in the case of the Warsaw Stock Exchange. Similarly, Grieb and Reyes (1999) reject the hypothesis of market efficiency for all stock-market indexes and most individual stocks in Brazil and Mexico. In addition, Karemera *et al.* (1999) find that stock-return series in Brazil, Chile and Mexico in general are not weak-form efficient; equally Mookerjee and Yu (1999), Groenewold *et al.* (2003)

and Lima and Tabak (2004) document that the stock markets in China are not weak-form efficient, and Abeysekera (2001) and Abraham *et al.* (2002) reject the hypothesis of weak-form efficiency for stock markets in Sri Lanka, Kuwait, Saudi Arabia and Bahrain.

Other studies, however, provide evidence that stock markets in some emerging market economies are efficient. Dockery and Vergari (1997) document that the Budapest Stock Exchange is efficient in the weak form. In addition, studies by Karemera *et al.* (1999) and Buguk and Brorsen (2003) support the null hypothesis of weak-form market efficiency for the stock market in Turkey. For Africa, Dickinson and Muragu (1994), and Olowe (1999) find that the Nairobi and Nigerian stock exchanges are efficient

*Corresponding author. E-mail: g.j.lanjouw@rug.nl

¹ According to the weak form of the EMH, a market is efficient if current prices fully reflect all information contained in past prices (Fama, 1970). It implies that past prices cannot be used as a predictive tool for future stock price movements and hence it is not possible for a trader to make abnormal returns by only using the past history of prices.

in the weak form. Seddighi and Nian (2004) document that the Shanghai Stock Exchange is weak-form efficient for the period from 4 January 2000 to 31 December 2000. Fawson *et al.* (1996), Alam *et al.* (1999) and Chang and Ting (2000) support the hypothesis that the Taiwanese stock market is efficient in the weak form. Similarly, the null hypothesis of market efficiency cannot be rejected for the Hong Kong stock market (Alam *et al.*, 1999; Cheung and Coutts, 2001; Karemera *et al.*, 1999; Lima and Tabak, 2004). In addition, it is documented that stock markets in the ASEAN region (Indonesia, Malaysia, Thailand and Singapore) behave in line with the weak form of the EMH (Barnes, 1986; Alam *et al.*, 1999; Karemera *et al.*, 1999). With respect to the southern part of Asia, Sharma and Kennedy (1977) and Alam *et al.* (1999) provide evidence supporting the hypothesis of market efficiency for the Bombay (India) and Dhaka (Bangladesh) Stock Exchange. Thus, results regarding market efficiency are mixed and country dependent.

While studies on stock markets in emerging markets are widely available, so far not any study has focused on Vietnam. This is unfortunate, since the Vietnamese stock market, although still characterized by low capitalization and thin trading, is rapidly developing. The Vietnamese stock market also is an interesting case since Vietnam is one of the world's few remaining communist countries and insight into the functioning of a typically capitalist institution like a stock market within such a country could give new perspectives on the possible co-existence of elements of different ways of organizing economic and political systems. The main Vietnamese stock market, formally known as the Securities Trading Centre (STC), located in Ho Chi Minh City, was launched on 28 July 2000. At the opening trading session, only two stocks with a total market capitalization of VND 444 000 million (about USD 28.20 million) were traded at the market. Over 5 years of operation (until the end of 2005), the number of listed companies has increased to 32, with a total market capitalization of VND 6 337 480 million (about USD 402.38 million).

This article aims to have a closer look at the stock market in Vietnam. We describe, in detail, the organization of the Vietnamese stock market and its development. We focus on whether the Vietnamese stock market is weak-form efficient. The reason behind this is that if the evidence would fail to support the weak-form of market efficiency, it is not

necessary to examine the EMH for the more demanding degrees of the semi-strong and strong form (Wong and Kwong, 1984). As such testing for weak-form efficiency is a logical first step in investigating market efficiency in a certain stock market. To test for market efficiency we apply autocorrelation tests, runs tests and variance-ratio tests. The data used for these tests consists of observed weekly returns of the market index and five individual stocks listed on the market. A special feature of the analysis is that we correct the data for thin (infrequent) trading, which is a prominent characteristic of the Vietnamese stock market.

The remainder of this article is organized as follows: Section II provides an overall description of the organization and operation of the Vietnamese stock market; Section III summarizes the performance of the market over the period from 28 July 2000 to 31 December 2005; Section IV describes the data we have used;² Section V explains the tests that we use for examining the weak form of market efficiency; Section VI presents the results; Section VII concludes.

II. Organization and Operation of the Stock Market

The State Securities Commission (SSC), officially established in November 1996, is responsible for the organization, development and supervision of the country's securities market. Before February 2004, the SSC had operated as an organ under the direct responsibility of the Prime Minister. However, the Prime Minister decided, on 19 February 2004, to hand over the task of managing the SSC to the Ministry of Finance. The SSC is responsible for four security-trading centres: the Ho Chi Minh City (HCMC) Stock-Trading Centre (STC), the Hanoi Stock Trading Centre, the Securities Information Technology Centre and the Centre for Securities Research and Training. In this article we concentrate on the HCMC STC, being the main stock market in the country.

As of 31 December 2005, 13 securities companies (Table 1) have been licensed, with a total registered capital of VND 605 750 million (USD 38.47 million). Securities companies can be established either as joint-stock or as limited-liability companies. The main business of the securities companies is

² There is a discrepancy between the time span of the data used in the more descriptive Sections II and III, where we like to mention the latest available data, and in the later sections of this article, the formal empirical testing is reported (data period 2000–2004).

Table 1. Securities companies in Vietnam

Name of company	Capital (VND bil.)	Ownership	Trading at the STC since	Estimated market share* in Jan '04 (%)
Bao Viet Securities Co.	43	100% owned by Bao Viet Insurance; a state-owned insurance company	28 July 2000	21.1
Bank for Investment & Development of Vietnam Securities Co.	100	100% owned by Bank for Investment & Development of Vietnam; a state-owned bank	28 July 2000	12.4
Asia Commercial Bank Securities Co.	43	100% owned by Asia Commercial Bank, a joint stock bank	28 July 2000	14.4
Thang Long Securities Co.	43	100% owned by Military Bank, a joint stock bank	28 July 2000	5.4
First Securities Co.	43	Privately owned joint stock company	28 July 2000	5.5
Saigon Securities Incorporation	20	Privately owned joint stock company	28 July 2000	23.2
Industry Commerce Bank Securities Co.	55	100% owned by Industry Commerce Bank, a state-owned bank	16 November 2000	7.5
Bank for Agriculture & Rural Development Securities Co.	100	100% owned by Bank for Agriculture & Rural Development, a state-owned bank	05 November 2001	2.5
Vietcombank Securities Co.	60	100% owned by Bank for Foreign Trade of Vietnam; a state-owned bank	21 June 2002	5.7
Mekong Securities Co.	6	Institutions: 30% Individuals: 70%	02 April 2003	0.5
Ho Chi Minh Securities Co.	50	State: 28.8% Institutions: 57.2% Individuals: 14.0%	02 May 2003	1.7
Eastern Asia Bank Securities Co.	21	100% owned by Eastern Asia Commercial Joint Stock Bank	15 September 2004	n/a
Hai Phong Securities Joint Stock Co.	21.75	State: 46% Others: 52%	29 October 2003	n/a

Source: Dragon Capital Group's website, www.dragoncapital.com

*Market shares are calculated based on order-matching transactions.

brokerage, own-account trading,³ securities investment portfolio management, underwriting, and financial and securities investment advice. In order to receive a license for the securities business, the company should have a business plan that is in line with the objectives of Vietnam's socio-economic development and growth of the securities industry; it should have adequate technical facilities for securities-business activities; it should have a certain minimum level of legal capital, dependent on the type of securities business; it should have a director, vice-director and practitioners who are qualified for

being granted the securities practitioner certificate by the SSC.

A company has to fulfil some qualifications before it can be listed at the Vietnamese stock market. The main requirements are a minimum capital of VND 5 billion (USD 0.32 million) and having been profitable in the last two consecutive years before the year of applying for listing. Furthermore, members of the firm's Board of Directors, Board of Management, and Board of Supervisors have to hold at least 50% of their shares for 3 years from the date of listing, and

³ Own-account trading is defined as buying and selling activities of securities for the securities companies' own account.

there should be at least 50 outside investors, holding 20% of the firm's equity at minimum.

Companies that want to be listed are required to submit certain documents to the SSC, including financial statements approved by the accepted auditing organization, the firm's charter and a prospectus containing information similar to that required by regulatory bodies in developed countries. Within 45 days from the date of receiving a full and complete set of application documents, the SSC will decide about granting the listing license to the firm.

Before 15 April 2003 foreign companies were not permitted to act as joint-stock companies, so they are ineligible to apply for admission to be listed at the STC. Recently the Ministry of Planning and Investment has conducted a pilot scheme that converts foreign-invested companies into joint-stock companies for the purpose of listing. The criteria for listing of foreign-invested joint-stock companies are mostly equivalent to those applicable to domestic joint-stock companies. At the end of 2004, 20 foreign-invested companies have applied for conversion into joint-stock companies.

Listed companies are required to disclose all information that is important for investors' investment decisions. The information under this obligation can be classified into two categories: regular and irregular information. Regular information includes quarterly, semi-annual and annual financial statements. Within 10 days from the date of completing annual financial statements, listed companies have to disclose their audited financial information in three consecutive issues of a national newspaper or a local newspaper at the location of the head office of the company or on the bulletin of the STC. Quarterly and semi-annual financial statements listed companies have to be disclosed within five days from the date of completion via the bulletin of the STC. Irregular information consists of any information related to events that happen irregularly and could affect investors' decisions.⁴

All listed securities are required to be traded via the STC in Ho Chi Minh City. All securities listed at the STC should be denominated in Vietnamese Dong

(VND) with a standardized par value for each of VND 10 000. For the first period from 28 July 2000 to 1 March 2002, trading sessions have been conducted on Monday, Wednesday and Friday, from 8:00 a.m. to 10:00 a.m. From the beginning of January 2001, the trading sessions were shortened to one hour, from 9:00 a.m. to 10:00 a.m. From 1 March 2002, the market trades daily with two order-matching sessions at 9:20 a.m. and 10:30 a.m. At the STC securities, transactions are executed through a fully-computerized trading system, the Automatic Order-Matching and Put-Through Trading System. The system performs the order-matching process according to price-then-time priority, without human intervention. After securities brokerage companies electronically send buy or sell orders from their offices to the STC's mainframe computer, the system automatically executes an order-queuing process and arranges the orders according to a price-then-time priority. This procedure means that orders are first grouped by price, with the best price (highest price for buying and lowest price for selling) taking precedence. Then, within each price group, orders are arranged according to time. The trading price of a given stock is determined at a specified time (currently at 9:20 a.m. and 10:30 a.m. daily) and at the price that generates the greatest trading volumes of the stock. In case of having two or more price levels that create the same trading volumes, the price closest to the previous trading session's closing price is chosen as the trading price.

Put-through trading is a method for securities trading at the STC that allows brokers to deal directly with each other, either on behalf of their clients or for themselves. The dealing price is negotiated between the two brokers and hence the executed price may not be the same as that of securities traded in the market on that day. Following the conclusion of negotiations and trading, dealers are required to send details of the negotiation results to the STC's mainframe for recording purposes.

Foreign investors (institutions and individuals) can buy or sell shares at the STC through securities companies. However, their ownership in a

⁴The listed companies are required to disclose information within 24 h if, e.g., a significant change in conditions of its business activities occurs; if it suffers from a loss equivalent to or more than 10% of its equity; if there is a change in the firm's business strategy or other important decisions on business activities are taken, such as major investments in other firms or in fixed assets; and if the company falls into bankruptcy, or makes a decision on corporate merger, acquisition, split or dissolution. A company also has to disclose information if it signs a loan agreement or issues bonds, which is worth 30% or more of its equity; if it changes the Chairperson of the Board of Directors, or more than one-third of the members of the Board of Directors, or its Director (General Director); if a share split occurs, if it issues bonus shares or shares for paying dividends, which is worth more than 10% of the equity and if it applies for de-listing. Finally, the disclosure obligation concerns the suspicion of involvement in criminal acts, like violation of tax laws, of directors, supervisors, managers or the chief accountant.

listed firm is limited to 30% of the firm's equity. Foreign investors who wish to participate in the STC are required to register through a licensed custodian who holds securities on behalf of foreign investors. Currently, three foreign banks (the Hong Kong and Shanghai Banking Corporation, Deutsche Bank AG and Standard Chartered Bank) are licensed by the SSC to provide custodian services for foreign investors. Moreover, foreign securities business institutions are allowed to buy shares of Vietnamese securities firms and/or investment funds, or contribute capital to establish a joint-venture securities firm and/or investment fund with Vietnamese partners. However, the proportion of capital contributed by foreign partners in a joint venture is maximized at 49% of the firms' chartered capital.

III. The Performance of the Vietnamese Stock Market

The Vietnamese stock market was launched on 28 July 2000 with just two firms listed, Refrigeration Electrical Engineering Joint Stock Company (REE) and Saigon Cable and Telecommunication Material Joint Stock Company (SACOM). The growth of the number of listed companies has been rather slow. At the end of 2000 still only five joint-stock companies were listed, to be joined by only five more in 2001. In 2002, 10 more companies are listed. By the end of 2005, a total of 32 joint-stock companies have been given permission to float their shares on the STC (Table 2). All of the listed firms (except North Kinh Do Food Joint-Stock Company and Kinh Do Corporation) are former state-owned enterprises (SOEs) that were previously restructured by equitization, the Vietnamese version of privatization (e.g. Truong *et al.*, 2006). Out of the listed firms 20 operate in the manufacturing sector, while the rest belongs to the trading and services sector.

Table 3 presents information on key indicators of the development of the STC over the period from the opening year (2000) through 30 December 2005. During this period market capitalization has increased significantly and continuously, from VND 444 000 million (USD 28.20 million) at the first trading session (28 July 2000) to VND 2 650 197 million (USD 168.32 million) at year-end 2002, and to VND 6 337 480 million (USD 396.06 million) on 30 December 2005. Moreover, the data in Table 3 reveal that the market capitalization-to-GDP ratio

has been negligible although it rose year by year. It goes up to 0.55% in 2004 from 0.24% in 2000.

Trading at the market also is still rather thin. Trading value at the STC has been tiny; during the first year of trading the average daily trading value is only VND 1385 million (USD 0.09 million). It rises significantly in 2001 to VND 6128 million (USD 0.39 million). Specifically, daily trading extraordinarily peaks on 11 June 2001 at VND 30 459 million (USD 1.93 million). However, daily trading value remarkably declines in the two consecutive following years (2002 and 2003) before temporarily moving upwards in the first half of 2004 and, later, in the second half of 2005. The developments in daily trading value over the period from 28 July 2000 to 30 December 2005 are shown in Fig. 1. Another indicator of the thinness of trading at the STC is the trading-value-to-GDP ratio. This ratio has been negligible, although it rose considerably in 2004, after a continuous decline over the period 2000–2003. Low market capitalization and commensurately small trading volumes make the Vietnamese stock market the smallest in the Southeast Asian region.

During the year following the STC's opening, the prices of all listed shares moved-up daily. Consequently, VN-INDEX considerably and continuously rose, moving from the initial base level of 100 to the record level of 571.04 on 25 June 2001. The main reason to explain the steep ascent of stock prices is the existence of an acute imbalance between supply of and demand for shares.⁵ Since then, however, despite the government's great efforts in creating commodities for the market by stimulating joint-stock companies to have their stocks listed at the STC, the market index fell substantially. In fact, VN-INDEX has slipped-down from the top of 571.04 to a bottom of 130.9 on 24 October 2003. After falling to the bottom, VN-INDEX has recovered and remained fairly stable at a level above 200 since January 2004. As of 30 December 2005 VN-INDEX stood at 307.50 points. The time pattern of VN-INDEX over the period from the STC's opening date to 30 December 2005 is graphically shown in Fig. 2.

IV. Data Description

The data used in this study consist of weekly price series of the market index (VN-INDEX) and the five oldest stocks listed at the STC, to wit REE, SAM,

⁵ As of 25 June 2001, only six joint-stock companies with a total capital of VND 360 044 million (USD 22.87 million) had their stocks listed at the STC.

Table 2. Companies listed at the STC (as of 31 December 2005)

No.	Date of listing	Company	Code	Sector	Number of outstanding common shares	Share price at IPO (1000 VND)	Share price at 31 December 2005 (1000 VND)
1	28 July 2000	Refrigeration Electrical Engineering Company	REE	Manufacturing	15 000 000	16.0	34.4
2	28 July 2000	Cable and Telecommunications Material Company	SAM	Manufacturing	12 000 000	17.0	47.0
3	04 August 2000	Hai Phong Paper Joint Stock Company	HAP	Manufacturing	2 008 000	16.0	22.8
4	04 August 2000	Transimex Joint Stock Company	TMS	Transportation	3 300 000	14.0	43.4
5	15 December 2000	Long An Food Processing Export Company	LAF	Manufacturing	1 930 082	17.0	20.3
6	12 July 2001	Saigon Hotel Corporation	SGH	Hotel	1 766 300	25.2	18.0
7	18 October 2001	Halong Canned Food Joint Stock Company	CAN	Manufacturing	3 500 000	27.1	17.2
8	26 November 2001	Da Nang Plastics Joint Stock Company	DPC	Manufacturing	1 587 280	35.0	12.2
9	17 December 2001	Bien Hoa Confectionery Company	BBC	Manufacturing	5 600 000	27.0	21.9
10	26 December 2001	Saigon Beverages Joint Stock Company	TRI	Manufacturing	3 790 300	29.0	28.0
11	02 January 2002	Binh Thanh Import-Export Production & Trade Joint Stock Company	GIL	Trade	1 700 000	38.0	32.0
12	17 January 2002	Binh Trieu Construction and Engineering Joint Stock Company	BTC	Manufacturing	1 261 345	21.9	8.1
13	11 April 2002	Bim Son Packaging Company	BPC	Manufacturing	3 800 000	25.0	16.2
14	18 April 2002	Chau Thoi Concrete Corporation	BT6	Construction	5 882 690	23.9	31.0
15	22 April 2002	General Forwarding & Agency Corporation	GMD	Transportation	20 000 000	42.5	69.5
16	02 May 2002	An Giang Fisheries Import & Export Joint Stock Company	AGF	Manufacturing	4 179 130	30.0	42.0
17	09 May 2002	Savimex Corporation	SAV	Manufacturing	4 500 000	25.0	31.0
18	29 August 2002	Seafood Joint Stock Company No. 4	TS4	Manufacturing	1 500 000	16.0	26.0
19	19 August 2002	Khanh Hoi Import Export Joint Stock Company	KHA	Trade	3 350 000	21.5	21.3
20	18 December 2002	Hanoi P&T Construction and Installation Joint Stock Company	HAS	Construction	1 200 000	21.5	32.8
21	12 February 2003	VTC Telecommunications Joint Stock Company	VTC	Manufacturing	1 797 740	21.0	32.9
22	04 November 2003	Petroleum Mechanical Joint Stock Company	PMS	Manufacturing	3 200 000	14.5	14.4
23	15 March 2004	Bach Tuyet Cotton Corporation	BBT	Manufacturing	6 840 000	21.6	11.0
24	14 April 2004	Hoa An Joint Stock Company	DHA	Manufacturing	3 500 000	38.5	43.0
25	21 September 2004	Saigon Fuel Joint Stock Company	SFC	Trade	1 700 000	22.8	28.5
26	12 December 2005	Kinh Do Corporation	KDC	Manufacturing	25 000 000	59.0	54.0
27	01 March 2005	Southern Seed Joint-Stock Corporation	SSC	Agriculture	6 000 000	30.8	44.0
28	21 March 2005	HaNoi Maritime Holding Company	MHC	Transportation	6 705 640	19.0	23.3
29	11 July 2005	Phuong Nam Culture Joint-Stock Corporation	PNC	Trade	2 000 000	16.0	16.6
30	20 July 2005	Thien Nam Trading Import Export Corporation	TNA	Trade	1 300 000	30.0	31.0
31	12 December 2005	Kinh Do Corporation	KDC	Manufacturing	25 000 000	59.0	54.0
32	16 December 2005	Nhi-Hiep Brike-Tile Joint Stock Company	NHC	Manufacturing	1 336 061	23.0	24.5

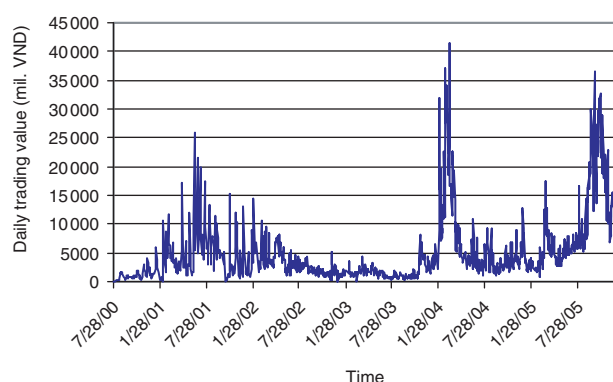
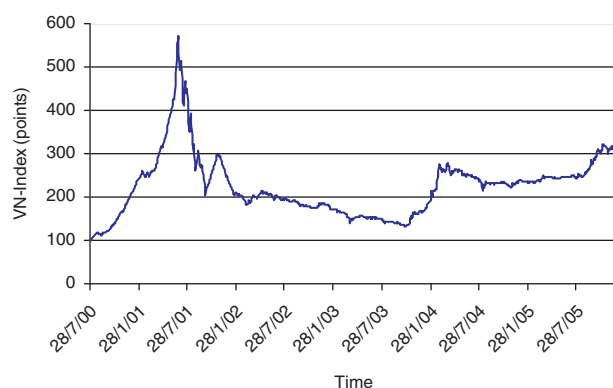
Source: The State Securities Commission's website (www.ssc.gov.vn).

Table 3. Key development indicators for the STC over the period 2000–2005

Indicators	2000	2001	2002	2003	2004	2005
Number of listed companies	5	10	20	23	26	32
Market capitalization (bil. VND)	1048.76	1661.10	2650.20	2514.29	3945.31	6337.48
Market capitalization on GDP (%)	0.24	0.34	0.49	0.42	0.55	na
Yearly trading value (bil. VND)	91.40	925.38	762.77	422.50	1692.99	2435.64
Trading value on GDP (%)	0.02	0.19	0.14	0.07	0.24	na
Average daily trading value (bil. VND)	1.39	6.13	3.23	1.71	6.80	9.82
VN-INDEX	206.83	235.40	183.33	166.94	239.29	307.50
Percentage change in VN-INDEX (%)	–	+13.8	–22.1	–8.9	+43.3	+28.5

Source: Own calculation on the basis of data obtained from the Bank for Investment & Development of Vietnam Securities. Company's website, www.bsc.com.vn

Notes: All figures refer to the end of the year indicated. na: not available.

**Fig. 1.** Daily trading value over the period 28 July 2000 to 30 December 2005**Fig. 2.** VN-INDEX changes over the period 28 July 2000 to 30 December 2005

HAP, TMS and LAF.⁶ We have also applied the same methodology to daily data, but since the results were similar, we have not presented them here to save space. VN-INDEX is a composite index calculated from prices of all common stocks traded at the STC. Specifically, it is a market-capitalization-weighted price index which compares the current market value

of all listed common shares to their value on the base date of 28 July 2000 when the first trading session took place.

The data used in our empirical tests refer to the period 28 July 2000 (the day of the first trading session of the stock exchange) to 31 December 2004. They come from the Bank for Investment and Development of Vietnam Securities Co.'s website (www.bsc.com.vn). A natural-logarithm transformation is performed on these data. To generate a time series of continuously compounded returns, weekly returns are computed as follows:

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

where p_t and p_{t-1} are the stock prices at time t and $t-1$.

The weekly returns are calculated as the natural logarithm of the index and the stock prices from Wednesday's closing price minus the natural logarithm of the previous Wednesday's close. If the following Wednesday price is not available, then the Thursday price (or Tuesday if Thursday is not available) is used. If both Tuesday and Thursday prices are not available, the return for that week is reported as missing. The choice of Wednesday prices aims to avoid the effects of weekend trading and to minimize the number of holidays (Huber, 1997).

Descriptive statistics for the weekly returns of VN-INDEX and the individual stocks are presented in Table 4.

V. Methodology

According to Fama (1970) market efficiency implies that successive price changes of a stock are independently and identically distributed. Thus, past price

⁶The full firm names corresponding to the abbreviated firm names are given in Table 2.

Table 4. Descriptive statistics for VN-INDEX and individual stock returns

	VN-INDEX	REE	SAM	HAP	TMS	LAF
Observations	225	225	225	224	224	205
Mean	0.0016	0.0007	0.0014	0.0007	0.0016	0.0013
Median	0.0003	0.0000	0.0011	0.0011	0.0000	0.0000
Maximum	0.0840	0.0834	0.0853	0.1718	0.2850	0.1567
Minimum	-0.0894	-0.1774	-0.1768	-0.2553	-0.3010	-0.1467
SD	0.0189	0.0259	0.0240	0.0365	0.0376	0.0283
Skewness	-0.4	-1.5	-2.0	-3.1	-0.97	-0.1
Kurtosis	8.0	13.6	17.8	26.4	36.97	11.0
Jarque-Bera	239.9 ^a	1129.9 ^a	2201.8 ^a	5485.9 ^a	10808.3 ^a	543.5 ^a

Note: ^aIndicates that the null hypothesis of normality is rejected at the 1% significant level.

movements or trends of a stock or a stock market cannot be used to predict their future movement. We use several tests to examine market efficiency in the weak form, which form focuses on the information conveyed by past prices. We first use parametric autocorrelation tests to examine whether the consecutive stocks returns are independent. However, the results of the Jarque-Bera test (presented in Table 4), indicate that stock returns are not normally distributed. Therefore we also use a nonparametric test to investigate market efficiency. More specifically, we use the runs test. Furthermore the variance-ratio test, proposed by Lo and MacKinlay (1988), is conducted to examine whether uncorrelated increments exist in the series, under the assumption of homoscedastic and heteroscedastic random walks.

Autocorrelation tests

The first approach to detect whether stock returns show a random walk summarized here is the autocorrelation test. Autocorrelation measures the relationship between the current stock return and its value in the previous period. It is calculated as:

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

where ρ_k is the serial correlation coefficient of stock returns of lag k , N is the number of observations, r_t is the stock return over period t , r_{t+k} is the stock return over period $t+k$, \bar{r} is the sample mean of stock returns and k is the lag of the period.

The autocorrelation test aims to determine whether the serial-correlation coefficients are significantly different from zero. Statistically, the hypothesis of weak-form efficiency should be rejected if stock returns (price changes) are serially correlated (ρ_k is significantly different from zero).

To test the joint hypothesis that all autocorrelations are simultaneously equal to zero, the

Ljung-Box portmanteau statistic (Q) is used. The Ljung-Box Q -statistics are given by:

$$Q_{LB} = N(N+2) \sum_{j=1}^k \frac{\rho_j^2}{N-j}$$

where ρ_j is the j th autocorrelation and N is the number of observations. Under the null hypothesis of zero autocorrelation at the first k autocorrelations ($\rho_1 = \rho_2 = \rho_3 = \dots = \rho_k = 0$), the Q -statistic is distributed as chi-squared with degrees of freedom equal to the number of autocorrelations (k).

Runs test

The runs test is a nonparametric test that is designed to examine whether or not an observed sequence is random. The test is based on the premise that if a series of data is random, the observed number of runs in the series should be close to the expected number of the runs. A run can be defined as a sequence of consecutive price changes with the same sign. Therefore, price changes of stocks can be categorized into three kinds of runs: an upward run (prices go up), a downward run (prices go down) and a flat run (prices do not change). Under the null hypothesis of independence in share-price changes (share returns), the total expected number of runs (m) can be estimated as:

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

where N is the total number of observations (price changes or returns) and n_i is the number of price changes (returns) in each category ($N = \sum_{i=1}^3 n_i$). For a large number of observations ($N > 30$), the sampling distribution of m is approximately normal and the standard error of $m(\sigma_m)$ is given by:

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

The standard normal Z -statistics that can be used to test whether the actual number of runs is consistent with the hypothesis of independence is given by:

$$Z = \frac{R \pm 0.5 - m}{\sigma_m}$$

where R is the actual number of runs, m is the expected number of runs and 0.5 is the continuity adjustment (Wallis and Roberts, 1956) in which the sign of the continuity adjustment is negative (-0.5) if $R \geq m$, and positive otherwise. Since there is evidence of dependence among share returns when R is too small or too large, the test is a two-tailed one.

Variance-ratio test

The variance-ratio test, proposed by Lo and MacKinlay (1988), is demonstrated to be more reliable and at least as powerful as the unit-root test (Lo and MacKinlay, 1988; Liu and He, 1991). The test is based on the assumption that the variance of increments in the random-walk series is linear in the sample interval. Specifically, if a series follows a random-walk process, the variance of its q -differences would be q times the variance of its first differences.

$$\text{Var}(p_t - p_{t-q}) = q \text{Var}(p_t - p_{t-1})$$

where q is any positive integer. The variance ratio, $VR(q)$, is then determined as follows:

$$VR(q) = \frac{(1/q) \text{Var}(p_t - p_{t-q})}{\text{Var}(p_t - p_{t-1})} = \frac{\sigma^2(q)}{\sigma^2(1)}$$

For a sample size of $nq + 1$ observations (p_0, p_1, \dots, p_{nq}), the formulas for computing $\sigma^2(q)$ and $\sigma^2(1)$ are given in the following equations:

$$\sigma^2(q) = \frac{\sum_{t=q}^{nq} (p_t - p_{t-q} - q\hat{\mu})^2}{h}$$

where

$$h = q(nq + 1 - q) \left(1 - \frac{q}{nq}\right)$$

and

$$\hat{\mu} = \frac{1}{nq} \sum_{t=1}^{nq} (p_t - p_{t-1}) = \frac{1}{nq} (p_{nq} - p_0)$$

$$\sigma^2(1) = \frac{\sum_{t=1}^{nq} (p_t - p_{t-1} - \hat{\mu})^2}{(nq - 1)}$$

Under the assumption of homoscedastic and heteroscedastic increments, respectively, two

standard normal test-statistics, $Z(q)$ and $Z^*(q)$, developed by Lo and MacKinlay (1988), are calculated by the following equations:

$$Z(q) = \frac{VR(q) - 1}{[\phi(q)]^{1/2}} \approx N(0, 1)$$

$$Z^*(q) = \frac{VR(q) - 1}{[\phi^*(q)]^{1/2}} \approx N(0, 1)$$

where $\phi(q)$ is the asymptotic variance of the variance ratio under the assumption of homoscedasticity, and $\phi^*(q)$ is the asymptotic variance of the variance ratio under the assumption of heteroscedasticity:

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

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

where $\hat{\delta}(j)$ is the heteroscedasticity – consistent estimator, computed as follows:

$$\hat{\delta}(j) = \frac{\sum_{t=j+1}^{nq} (p_t - p_{t-1} - \hat{\mu})^2 (p_{t-j} - p_{t-j-1} - \hat{\mu})^2}{\left[\sum_{t=1}^{nq} (p_t - p_{t-1} - \hat{\mu})^2 \right]^2}$$

Estimating the true returns: correcting for thin trading

As mentioned above, the Vietnamese stock market is characterized by thin and infrequent trading. Many studies have pointed out that thin or infrequent trading can cause a serious bias regarding the results on market efficiency (Cohen *et al.*, 1978; Lo and MacKinlay, 1990; Stoll and Whaley, 1990; Miller *et al.*, 1994). The problem is that the absence of a price change between two moments may be interpreted as being caused by the absence of a price reaction to new information and consequently as a sign that the market is inefficient, whereas it may simply be caused by the absence of any trade due to the trading taking place infrequently.

To deal with the problem of thin trading, the methodology proposed by Miller *et al.* (1994) is employed in this study. To remove the effect of thin trading the model basically suggests that a moving-average model which reflects the number of nontrading days should be estimated, after which returns are adjusted accordingly. However, due to difficulties in determining nontrading days, Miller *et al.* (1994) show that it is equivalent to achieve the non-trading adjustment by estimating an AR(1) model.

Specifically, the model can be stated in the following equation:

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \varepsilon_t$$

Then, using the residuals from the above equation, adjusted returns are computed as follows:

$$R_t^{Adj} = \frac{\varepsilon_t}{1 - \alpha_1}$$

where R_t^{Adj} is the adjusted return for thin trading at time t .

It is important to note here that the above model assumes the nontrading adjustment to be constant over time. The assumption may be correct for developed markets, but it is not likely to be the case for emerging markets (Antoniou and Ergul, 1997). Therefore, in this study the equation is recursively estimated on a yearly basis.

All tests are conducted with both observed and corrected data. The results of these tests are discussed in the following section.

VI. Empirical Findings

Autocorrelation tests

To test the weak form of market efficiency for the Vietnamese stock market, first the autocorrelation tests with 12 lags are performed for weekly returns of the VN-Index and five individual stocks. The results of these tests are summarized in Tables 5 and 6.

The estimation results show that autocorrelation coefficients of the observed weekly index returns

are significant with a positive sign at the 1st, 2nd, 3rd, 4th and 5th lags. Additionally, based on the Q -statistics, the null hypothesis of absence of autocorrelation in the index returns for all lags selected is strongly rejected at the 1% significance level. Furthermore, results of the autocorrelation tests on observed weekly returns for the individual stocks show significant autocorrelation coefficients for each individual stock-returns series. Specifically, significant autocorrelation coefficients are found at the 1st, 2nd and 4th lag for REE; at the 1st, 2nd, 4th and 5th lag for SAM; at the 1st and 2nd lag for HAP; at the 1st, 2nd, 3rd, 4th, 5th and 7th lag for TMS; and at the 1st, 2nd, 3rd and 5th lag for LAF. The Q -statistics fail to support the joint null hypothesis that all autocorrelation coefficients from lag 1 to 12 are equal to zero for the observed return series of all individual stocks.

The results of the autocorrelation tests for the corrected returns indicate that the random-walk hypothesis is still rejected for the market index and all selected individual stocks, except REE.

Runs test

To investigate weak-form efficiency of the Vietnamese stock market, the nonparametric runs test is also used in this study. The runs test is considered more appropriate than the parametric autocorrelation test, since the observed series do not follow a normal distribution. Results of the runs tests for weekly returns of the index and the selected individual stocks are reported in Table 7. The results indicate that the null hypothesis of independence among stock returns is rejected for the market index and all selected individual stocks, except HAP.

Table 5. Results of autocorrelation tests for the observed weekly-return data

Lag	VN-INDEX		REE		SAM		HAP		TMS		LAF	
	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.
1	0.328 ^a	24.554 ^a	0.266 ^a	16.090 ^a	0.175 ^a	6.986 ^a	-0.188 ^a	8.016 ^a	0.200 ^a	9.106 ^a	0.164 ^b	5.588 ^b
2	0.250 ^a	38.905 ^a	0.177 ^a	23.271 ^a	0.144 ^b	11.712 ^a	0.310 ^a	29.971 ^a	0.246 ^a	22.922 ^a	0.219 ^a	15.633 ^a
3	0.155 ^b	44.434 ^a	0.120	26.589 ^a	0.040	12.085 ^a	-0.066	30.968 ^a	0.178 ^a	30.196 ^a	0.215 ^a	25.379 ^a
4	0.206 ^a	54.280 ^a	0.201 ^a	35.946 ^a	0.172 ^a	18.921 ^a	0.063	31.883 ^a	0.151 ^b	35.418 ^a	0.097	27.372 ^a
5	0.239 ^a	67.540 ^a	0.118	39.169 ^a	0.170 ^b	25.666 ^a	0.090	33.762 ^a	0.232 ^a	47.884 ^a	0.226 ^a	38.241 ^a
6	0.075	68.838 ^a	0.077	40.550 ^a	-0.039	26.029 ^a	0.015	33.817 ^a	0.088	49.692 ^a	0.128	41.709 ^a
7	0.089	70.685 ^a	0.066	41.577 ^a	0.064	26.993 ^a	-0.002	33.818 ^a	0.136 ^b	54.008 ^a	0.009	41.727 ^a
8	-0.013	70.725 ^a	0.096	43.739 ^a	-0.031	27.214 ^a	0.008	33.833 ^a	0.078	55.431 ^a	-0.083	43.212 ^a
9	0.098	72.993 ^a	-0.034	44.020 ^a	0.105	29.817 ^a	0.068	34.936 ^a	0.059	56.246 ^a	0.094	45.123 ^a
10	-0.077	74.391 ^a	0.016	44.082 ^a	-0.091	31.773 ^a	-0.002	34.937 ^a	0.027	56.419 ^a	-0.097	47.192 ^a
11	0.069	75.516 ^a	-0.007	44.093 ^a	0.018	31.850 ^a	0.061	35.809 ^a	0.051	57.037 ^a	0.022	47.297 ^a
12	0.031	75.741 ^a	0.006	44.103 ^a	-0.007	31.861 ^a	0.048	36.369 ^a	0.047	57.561 ^a	0.021	47.393 ^a

Note: ^{a,b} Significant at the 1 and 5% levels, respectively.

However, when corrected returns are used, the results of the runs test reveal that the null hypothesis cannot be rejected for HAP, but it is to be rejected for REE and LAF. For the remaining series the rejection of the null hypothesis is unchanged, but the extent is less pronounced as compared with the results for the observed weekly data.

Variance-ratio tests

This study employs variance-ratio tests for both null hypotheses, namely the homoscedastic- and heteroscedastic-increments random walk. In addition, the variance ratio is calculated for intervals (q) of 2, 4, 8, 16 and 32 observations. The results of the variance-ratio tests are reported in Tables 8 and 9.

The estimation results again confirm that the null hypothesis of random-walk behaviour under the assumption of homoscedasticity is strongly rejected for all series and for all values of q . Indeed, all Z -statistics are greater than the conventional critical value (1.96 for the 5% level). In addition, the heteroscedasticity-consistent variance-ratio test provides consistent evidence that the null hypothesis of random-walk behaviour cannot be accepted for any of the observed weekly return series. Specifically, a comparison of Z^* -statistics to the conventional critical value reveals that the random-walk hypothesis is rejected at $q=2, 4, 8$ and 16 for TMS and REE, and at $q=2, 4$ and 8 for VN-INDEX and LAF. In the case of HAP the evidence against the null hypothesis under the assumption of heteroscedasticity is weak because only two rejections ($q=2$ and $q=4$) are reported.

Table 6. Results of autocorrelation tests for the corrected weekly return data

Lag	VN-INDEX		REE		SAM		HAP		TMS		LAF	
	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.	AC	Q -stat.
1	-0.055	0.687	-0.033	0.244	-0.005	0.005	-0.010	0.022	-0.079	1.406	-0.046	0.448
2	0.143 ^b	5.377	0.055	0.939	0.069	1.095	0.238 ^a	12.863 ^a	0.165 ^b	7.578 ^b	0.181 ^a	7.270 ^b
3	0.017	5.442	0.047	1.455	-0.022	1.209	0.025	13.006 ^a	0.058	8.345 ^b	0.165 ^b	12.927 ^a
4	0.099	7.707	0.100	3.761	0.162 ^b	7.213	-0.011	13.035 ^b	-0.008	8.360	-0.004	12.930 ^b
5	0.178 ^a	15.016 ^a	0.081	5.265	0.162 ^b	13.305 ^b	0.089	14.846 ^b	0.243 ^a	21.917 ^a	0.211 ^a	22.340 ^a
6	-0.040	15.386 ^b	0.008	5.280	-0.107	15.944 ^b	0.016	14.904 ^b	-0.011	21.945 ^a	0.062	23.152 ^a
7	0.093	17.410 ^b	0.051	5.881	0.056	16.662 ^b	-0.053	15.569 ^b	0.147 ^b	26.992 ^a	0.026	23.300 ^a
8	-0.104	19.948 ^b	0.006	5.889	-0.053	17.320 ^b	-0.006	15.576 ^b	-0.080	28.496 ^a	-0.171 ^b	29.549 ^a
9	0.144 ^b	24.800 ^a	0.001	5.889	0.139 ^b	21.887 ^a	0.051	16.175	0.110	31.308 ^a	0.131	33.260 ^a
10	-0.170 ^b	31.648 ^a	-0.044	6.345	-0.128	25.769 ^a	-0.018	16.249	-0.098	33.548 ^a	-0.139 ^b	37.422 ^a
11	0.107	34.366 ^a	0.018	6.425	0.024	25.911 ^a	0.069	17.392	0.075	34.865 ^a	0.024	37.546 ^a
12	-0.055	34.438 ^a	0.003	6.427	-0.000	25.911 ^b	0.045	17.872	0.123	38.488 ^a	0.045	37.986 ^a

Note: ^{a,b} Significant at the 1 and 5% levels, respectively.

Table 7. Results of the runs test for VN-Index and selected individual stocks

Variables	Obs. (N)	Actual runs (R)	Expected runs (m)	Z -statistics
<i>Observed weekly returns</i>				
VN-INDEX	225	81	113	-4.27 ^a
REE	225	111	135	-3.35 ^a
SAM	225	100	125	-3.52 ^a
HAP	224	123	131	-1.09
TMS	224	103	129	-3.67 ^a
LAF	205	105	124	-2.76 ^a
<i>Corrected weekly returns</i>				
VN-INDEX	224	95	113	-2.34 ^b
REE	224	103	113	-1.24
SAM	224	92	113	-2.71 ^a
HAP	223	86	104	-2.50 ^b
TMS	223	92	112	-2.59 ^a
LAF	204	93	103	-1.33

Note: ^{a,b} Significant at the 1 and 5% levels, respectively.

Table 8. Variance-ratio test results for the observed weekly-return data

Variables	Number nq of base observations	Number q of base observations aggregated to form variance ratio				
		2	4	8	16	32
VN-INDEX	224					
$VR(q)$		0.56	0.30	0.20	0.10	0.06
$Z(q)$		-6.56 ^a	-5.59 ^a	-4.05 ^a	-3.05 ^a	-2.21 ^b
$Z^*(q)$		-2.92 ^a	-2.80 ^a	-2.19 ^b	-1.71	-1.39
REE	224					
$VR(q)$		0.58	0.31	0.19	0.11	0.06
$Z(q)$		-6.23 ^a	-5.49 ^a	-4.09 ^a	-3.01 ^a	-2.20 ^b
$Z^*(q)$		-3.11 ^a	-3.16 ^a	-2.68 ^a	-2.14 ^b	-1.76
SAM	224					
$VR(q)$		0.52	0.25	0.17	0.08	0.05
$Z(q)$		-7.14 ^a	-5.97 ^a	-4.18 ^a	-3.11 ^a	-2.22 ^b
$Z^*(q)$		-3.26 ^a	-2.89 ^a	-2.16 ^b	-1.71	-1.38
HAP	223					
$VR(q)$		0.36	0.18	0.10	0.06	0.03
$Z(q)$		-9.59 ^a	-6.57 ^a	-4.55 ^a	-3.19 ^a	-2.26 ^b
$Z^*(q)$		-2.63 ^a	-2.17 ^b	-1.95	-1.80	-1.60
TMS	223					
$VR(q)$		0.52	0.31	0.18	0.10	0.06
$Z(q)$		-7.20 ^a	-5.46 ^a	-4.11 ^a	-3.05 ^a	-2.20 ^b
$Z^*(q)$		-3.91 ^a	-3.32 ^b	-2.75 ^a	-2.22 ^b	-1.79
LAF	204					
$VR(q)$		0.47	0.27	0.17	0.08	0.05
$Z(q)$		-7.55 ^a	-5.55 ^a	-4.01 ^a	-2.98 ^a	-2.14 ^b
$Z^*(q)$		-3.80 ^a	-3.05 ^a	-2.29 ^b	-1.83	-1.51

Note: ^{a,b} Significant at the 1 and 5% levels, respectively.

Furthermore, when corrected returns are employed, similar results are obtained from the tests. Specifically, the null hypothesis of random-walk behaviour under the assumption of homoscedasticity is strongly rejected for all series and for all values of q , while under the assumption of heteroscedasticity the null hypothesis cannot be accepted for all series for some values of q . The rejection of the null hypothesis is less pronounced for VN-INDEX, REE, TMS and LAF, but more pronounced for SAM and HAP as compared to the results for the observed weekly returns.

VII. Conclusions

This article provides a detailed description of the stock market in Vietnam and also examines whether the Vietnamese stock market is weak-form efficient. The weak form of market efficiency for the market

index and five selected individual stocks is tested by using weekly return data for the period from 28 July 2000 to 31 December 2004. We apply three tests: the autocorrelation test, the runs test and the variance-ratio test. To deal with the problem of thin or infrequent trading, which could seriously bias the results, the observed returns are corrected by using the methodology proposed by Miller *et al.* (1994). The results obtained from the autocorrelation tests indicate that the null hypothesis of random-walk behaviour is conclusively rejected for the market index and four out of five selected individual stocks, even in the case that the returns are corrected for thin trading. In addition, the runs test provides evidence to reject the random-walk hypothesis for observed weekly returns of the market index and all selected individual stocks (except for HAP). However, when corrected returns are used, the results given by the runs tests fail to reject the random-walk hypothesis for REE and LAF. The results of Lo and MacKinley's variance-ratio test under both homoscedasticity and heteroscedasticity assumptions for

Table 9. Variance-ratio test results for the corrected weekly return data

Variables	Number nq of base observations	Number q of base observations aggregated to form variance ratio				
		2	4	8	16	32
VN-INDEX	223					
$VR(q)$		0.41	0.22	0.14	0.06	0.04
$Z(q)$		-8.82 ^a	-6.24 ^a	-4.35 ^a	-3.18 ^a	-2.25 ^b
$Z^*(q)$		-3.33 ^a	-2.69 ^a	-2.08 ^b	-1.63	-1.32
REE	223					
$VR(q)$		0.45	0.23	0.13	0.07	0.04
$Z(q)$		-8.14 ^a	-6.17 ^a	-4.38 ^a	-3.14 ^a	-2.25 ^b
$Z^*(q)$		-3.11 ^a	-2.75 ^a	-2.24 ^b	-1.80	-1.52
SAM	223					
$VR(q)$		0.46	0.21	0.14	0.07	0.04
$Z(q)$		-7.99 ^a	-6.33 ^a	-4.34 ^a	-3.16 ^a	-2.24 ^b
$Z^*(q)$		3.68 ^a	3.14 ^a	2.35 ^b	1.85	1.49
HAP	222					
$VR(q)$		0.45	0.20	0.11	0.06	0.04
$Z(q)$		-8.18 ^a	-6.35 ^a	-4.46 ^a	-3.16 ^a	-2.25 ^b
$Z^*(q)$		-3.21 ^a	-2.96 ^a	-2.51 ^b	-2.15 ^b	-1.81
TMS	222					
$VR(q)$		0.38	0.24	0.13	0.06	0.04
$Z(q)$		-9.21 ^a	-6.03 ^a	-4.38 ^a	-3.18 ^a	-2.24 ^b
$Z^*(q)$		-3.05 ^a	-2.34 ^b	-1.96 ^b	-1.60	-1.30
LAF	203					
$VR(q)$		0.39	0.24	0.15	0.07	0.04
$Z(q)$		-8.62 ^a	-5.76 ^a	-4.11 ^a	-3.02 ^a	-2.15 ^b
$Z^*(q)$		-3.34 ^a	-2.48 ^b	-1.85	-1.48	-1.24

Note: ^{a,b} Significant at the 1 and 5% levels, respectively.

both observed and corrected returns fail to support the random-walk hypothesis for the market index and all selected individual stocks.

In summary the predominant outcome of this study is that the Vietnamese stock market is inefficient in the weak form, even in case, corrections are made for the thin trading that characterizes the market.

References

- Abeysekera, S. P. (2001) Efficient markets hypothesis and the emerging capital market in Sri Lanka: evidence from the Colombo Stock Exchange – a note, *Journal of Business Finance and Accounting*, **28**, 249–61.
- Abraham, A., Seyyed, F. J. and Alsakran, S. A. (2002) Testing the random walk behaviour and efficiency of the Gulf stock markets, *The Financial Review*, **37**, 469–80.
- Alam, M. I., Hasan, T. and Kadapakkam, P.-R. (1999) An application of variance-ratio test of five Asian stock markets, *Review of Pacific Basin Financial Markets and Policies*, **2**, 301–15.
- Antoniou, A. and Ergul, N. (1997) Market efficiency, thin trading and non-linear behaviour: evidence from an emerging market, *European Financial Management*, **3**, 175–90.
- Barnes, P. (1986) Thin trading and stock market efficiency: the case of the Kuala Lumpur Stock Exchange, *Journal of Business Finance and Accounting*, **13**, 609–17.
- Buguk, C. and Brorsen, B. W. (2003) Testing weak-form efficiency: evidence from the Istanbul Stock Exchange, *International Review of Financial Analysis*, **12**, 579–90.
- Chang, K. P. and Ting, K. S. (2000) A variance ratio test of the random walk hypothesis for Taiwan's stock market, *Applied Financial Economics*, **10**, 525–32.
- Cheung, K.-C. and Coutts, J. A. (2001) A note on weak form market efficiency in security prices: evidence from the Hong Kong Stock Exchange, *Applied Economics Letters*, **8**, 407–10.
- Cohen, K. J., Maier, S. F., Schwartz, R. A. and Whitcomb, D. K. (1978) The returns generation process, returns variance, and the effect of thinness in securities markets, *The Journal of Finance*, **33**, 149–67.
- Dickinson, J. P. and Muragu, K. (1994) Market efficiency in developing countries: a case study of the Nairobi Stock Exchange, *Journal of Business Finance and Accounting*, **21**, 133–50.
- Dockery, E. and Vergari, F. (1997) Testing the random walk hypothesis: evidence for the Budapest Stock Exchange, *Applied Economics Letters*, **4**, 627–29.
- Fama, E. F. (1970) Efficient capital markets: a review of theory and empirical work, *The Journal of Finance*, **25**, 383–417.

- Fawson, C., Glover, T. F., Fang, W. and Chang, T. (1996) The weak-form efficiency of the Taiwan Share Market, *Applied Economics Letters*, **3**, 663–67.
- Grieb, T. and Reyes, M. G. (1999) Random walk tests for Latin American equity indexes and individual firms, *The Journal of Financial Research*, **22**, 371–83.
- Groenewold, N., Tang, S. H. K. and Wu, Y. (2003) The efficiency of the Chinese stock market and the role of the banks, *Journal of Asian Economics*, **14**, 593–609.
- Huber, P. (1997) Stock market returns in thin markets: evidence from the Vienna Stock Exchange, *Applied Financial Economics*, **7**, 493–98.
- Karemera, D., Ojah, K. and Cole, J. A. (1999) Random walks and market efficiency tests: evidence from emerging equity markets, *Review of Quantitative Finance and Accounting*, **13**, 171–88.
- Lima, E. J. A. and Tabak, B. M. (2004) Tests of the random walk hypothesis for equity markets: evidence from China, Hong Kong and Singapore, *Applied Economics Letters*, **11**, 255–8.
- Liu, C. Y. and He, J. (1991) A variance-ratio test of random walks in foreign exchange rates, *The Journal of Finance*, **46**, 773–85.
- Lo, A. W. and MacKinlay, A. C. (1988) Stock market prices do not follow random walk: evidence from a simple specification test, *The Review of Financial Studies*, **1**, 41–66.
- Lo, A. W. and MacKinlay, A. C. (1990) Data-snooping in tests of financial asset pricing models, *The Review of Financial Studies*, **3**, 431–67.
- Miller, M. H., Muthuswamy, J. and Whaley, R. E. (1994) Mean reversion of Standard & Poor's 500 Index basis changes: arbitrage-induced or statistical illusion?, *The Journal of Finance*, **49**, 479–513.
- Mookerjee, R. and Yu, Q. (1999) An empirical analysis of the equity markets in China, *Review of Financial Economics*, **8**, 41–60.
- Olowe, R. A. (1999) Weak form efficiency of the Nigerian stock market: further evidence, *African Development Review*, **11**, 54–68.
- Seddighi, H. R. and Nian, W. (2004) The Chinese stock exchange market: operations and efficiency, *Applied Financial Economics*, **14**, 785–97.
- Sharma, J. L. and Kennedy, R. E. (1977) A comparative analysis of stock price behaviour on the Bombay, London, and New York stock exchanges, *Journal of Financial and Quantitative Analysis*, **12**, 391–413.
- Stoll, H. R. and Whaley, R. E. (1990) The dynamics of stock index and stock index futures returns, *Journal of Financial and Quantitative Analysis*, **25**, 441–68.
- Truong, D. L., Lanjouw, G. J. and Lensink, B. W. (2006) The impact of privatization on firm performance in a transition economy: the case of Vietnam, *Economics of Transition*, **14**, 349–89.
- Wallis, W. A. and Roberts, H. V. (1956) *Statistics: A New Approach*, The Free Press of Glencoe, Glencoe (Ill).
- Wheeler, F. P., Neale, B., Kowalski, T. and Letza, S. R. (2002) The efficiency of the Warsaw Stock Exchange: the first few years 1991–1996, *The Poznan University of Economics Review*, **2**, 37–56.
- Wong, K. A. and Kwong, K. S. (1984) The behaviour of Hong Kong stock prices, *Applied Economics*, **16**, 905–17.

Copyright of Applied Economics is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.