The Impact of COVID-19 Pandemic toward Asian Pacific Stock Markets during Year 2020: An Empirical Study of Logarithmic Returns and Duration Dependence Test Model

Sethapong Watanapalachaikul*
Faculty of Business Administration, Rajapruk University*

Abstract

COVID-19 pandemic had significant economic implications, not only the cost of managing people's health but also seriously affecting global economy. The global stock markets plunged during the first three months of this pandemic. This research attempted to discuss upon movement of major Asian Pacific markets during the COVID-19 outbreak during January-December 2020. This empirical research identified and compared stock speculation/ bubble of seven major Asian Pacific stock markets by using econometric models.

The leading stock exchanges in the Asian Pacific region were chosen, which ranked by Statista. These countries are Japan, China, India, Australia, Korea, Singapore and Thailand. Daily closing index prices were gathered during January to December 2020. This research utilized logarithmic return model and the duration dependence test method to calculate the results. Microsoft Excel and Statistica programs were used for model creation and generating results.

The results show that Korea Stock Market was the best performer during the year 2020 follow by Japan, India and China. They yielded positive logarithmic returns by the use of daily index prices. Whereas Australia, Thailand and Singapore stock markets yielded negative logarithmic returns. Duration dependence test results show no evidence of rational speculative activities/bubbles in the stock markets of Japan, Korea, India, Australia and Singapore. On the other hand, there were evidence of rational speculative bubbles in China and Thailand stock markets.

Keywords: COVID-19 Pandemic, Asian Pacific Stock Markets, Logarithmic Returns, Duration Dependence Test Model.

Introduction

COVID-19 is a crisis, a pandemic that not only affects pandemic and public health but also has a serious impact on world economy and financial markets. Significantly reduced incomes, increased unemployment and disruptions in the service, manufacturing, and transport industries are the result of mitigation measures adopted in many countries. It is clear that most governments were rapidly assessing the risk of the COVID-19 outbreak and were

Received: 2020-02-:07 Revised: 2020-04-20: Accepted: 2020-04-27

responding to the crisis. As the pandemic is unlikely to disappear in the foreseeable future, proactive international action is necessary to save lives as well as protect economic wealth. COVID-19 affected all financial and stock markets, especially during the first 12 months of the coronavirus pandemic outbreak.

Research Questions

How severe COVID-19 pandemic affecting returns in Asian Pacific stock exchanges during January to December 2020? Were there any existence of stocks speculation (or speculative bubble) in the Asian Pacific primary stock exchanges during COVID-19 pandemic, January to December 2020 by using an econometric model, a duration dependence test model?

Research Objectives

To explore and comment on the returns of Asian Pacific primary stock exchanges during COVID-19 pandemic, January to December 2020. To identify and compare stocks speculation of seven Asian Pacific primary stock exchanges during COVID-19 pandemic during January to December 2020 by using an econometric model, a duration dependence test model.

Literature Review

Efficient Market Hypothesis

The efficient market hypothesis is a statement about: (1) the theory that stock prices reflect the true value of stocks; (2) the absence of arbitrage opportunities in an economy populated by rational, profit-maximizing agents; and (3) the hypothesis that market prices always fully reflect available information (Fama 1970). An efficient market is defined with respect to an information set Φ_t if it is impossible to earn economic profits by trading on the basis of Φ_t. A general notation describing how investors generate price expectations for stocks could be explained as:

$$E(p_{j,t+1} \mid \Phi_t) = [1 + E(r_{j,t+1} \mid \Phi_t)]p_{jt}$$

where E is the expected value operator, $p_{j,t+1}$ is the price of security *j* at time *t+1*, $r_{j,t+1}$ is the return on security *j* during period *t+1*, and Φ_t is the set of information available to investors at time *t*. The left-hand side of the formula $E(p_{j,t+1} \mid \Phi_t)$ denotes the expected end-of-period price on stock *j*, given the information available at the beginning of the period Φ_t. On the right-hand side, $1 + E(r_{j,t+1} \mid \Phi_t)$ denotes the expected return over the forthcoming time period of stocks having the same amount of risk as stock *j*.

Under the efficient market hypothesis (EMH), investors cannot earn abnormal profits on the available information set Φ_t other than by chance. The level of over value or under value of a particular stock is defined as:

$$x_{j,t+1} = p_{j,t+1} - E(p_{j,t+1} | \Phi_t)$$

where $x_{j,t+1}$ indicates the extent to which the actual price for security *j* at the end of the period differs from the price expected by investors based on the information available Φ_t. As a result, in an efficient market it must be true that:

$$E(x_{j,t+1} | \Phi_t) = 0$$

This implies that the information is always impounded in stock prices. Therefore the rational expectations of the returns for a particular stock according to the EMH may be represented as:

$$P_{t+1} = E_t P_{t+1} + \varepsilon_{t+1}$$

where P_t is the stock price; and ε_{t+1} is the forecast error. $P_{t+1} - E_t P_{t+1}$ should therefore be zero on average and should be uncorrelated with any information Φ_t . Also $E(x_{j,t+1} | \Phi_t) = 0$ when the random variable (good or bad news), the expected value of the forecast error, is zero:

$$E_t \varepsilon_{t+1} = E_t (P_{t+1} - E_t P_{t+1}) = E_t P_{t+1} - E_t P_{t+1} = 0$$

Underlying the efficient market hypothesis, it is opportune to mention that expected stock returns are entirely consistent with randomness in security returns. This position is supported by the law of iterated expectations. The expectation difference equation can be solved forward by repeatedly substituting out future prices and using the law of iterated expectations:

$$E_t [E_t + I_t (X)] = E_t(X)$$

Non-parametric testing of market efficiency is based on the premise of no arbitrage opportunities, i.e., that opportunities for earning unusual returns do not exist (Fama 1970, Jensen 1978).

Speculation, Bubble, and the Economy

West (1987) believed that a price bubble can occur in a generation where the current market price is subject to a forecasted future price change. Under rational expectations, the model often does not represent the expectation of the agent. Uncertainty arises from an attempt to correct two external variables from one equilibrium market condition. As a result, arbitrary expectations and responses to manual price changes may drive real price dynamics independent of market fundamentals, creating a speculation. It is also noted that earlier literature was attributed to a large number of hysterical sprints and panic, rather than rational behavior, however, Stratman (1988) considered it a predictable event. It is an event that the pricing plan ends. He also noted asset prices must reflect market fundamentals in dependent terms. Information about current and expected future returns on assets. West (1987) pointed out that most stock speculation contained elements of absurdity and that such speculation was more theoretically difficult to deal with. They therefore pay more attention to the rational analysis of speculative bubbles. Their model is considered to be a market clearing behavior, and it implies that private and data disclosed by asset prices are held voluntarily and there is no incentive to allocate portfolios. With further assumptions including common and current datasets, an efficient or unconditional market can derive from it. West's model explained the expectation of future variables influences current decisions and did not have a specific solution. As a result, the market price can deviate from the present value of the asset without violating the non-speculative conditions. If a deviation occurs, the model's structure implies that it can be expected to grow over time and become a bubble.

McQueen and Thorley (1994) acknowledged that current share prices are based on projections of future results and the expected return on these prices, which are subject to change as new information becomes available and not based on current dividends observed. Therefore, a small change in the forecast could lead to a large shift in the base price. However, basic knowledge cannot be observed directly and requires a proxy that is believed to provide basic information, although it can only provide a rough guide to the behavior of fundamentals. When the market crashed in October 1987, critics pointed to proxies and claimed that the stock was undervalued before it crashed.

Binswanger (1999, p. 116) stated excessive stock speculation was "a thought of as having a negative overall impact on the economy. They are supposed to create additional price risk and increase the instability of the economy". In recent years, there have been a number of empirical studies attempting to identify rational stocks speculation in stock prices and returns. West (1987) found evidence of speculative bubble in stock prices and returns. On the other hand, Stratman (1988) showed empirical evidence to prove the absence of speculation in stock prices. Surprisingly, Harman and Zuehlke (2001) found both existence and non-existence of speculation on the New York Stock Exchange by applying different empirical models, resulting in contradicting conclusions. Binswager (1999) considered three different hypotheses: 1) The efficient market hypothesis; 2) The irrational bubble hypothesis; and 3) The rational bubble hypothesis.

Stock Speculation and Financial Market Behaviour

Speculation in the stock market arise when stock prices are not at levels consistent with economic fundamentals or stocks are over-valued in comparison with real economic speculation. Speculation (b_t) can be written in the form of:

$$b_t = p_t - f_t$$

where p_t is the stock price at time t, and f_t is the fundamental value.

Speculation cause stock price to be more volatile and overvalued, which creates stock market instability and inefficiency. Generally when the stock price diverges from economic fundamentals speculation will emerge due to excessive optimism with respect to fundamentals. In some cases, investors might recognize excess in stock prices compared with economic fundamentals, and they might find an arbitrage opportunity and believe that the excess will continue. However, in the long term, it is quite impossible that such rises in stock prices can be sustained beyond levels consistent with economic fundamentals. Therefore, when stock prices are inflated by speculation, sooner or later, there will be an inevitable collapse or bursting of the speculation.

Stocks speculation are often used by behavioral finance theorists in an attempt to identify behaviour of investors who act irrationally, such as when 'herding' occurs (Cuthbertson 1996). Statman (1988) identifies irrational behaviour of investors as: 1) trading for both cognitive and emotional reasons; 2) trading because they think they have information when they have nothing but noise; and 3) trading because it brings personal satisfaction.

The speculation literature assumes that stock prices can diverge from economic fundamentals and that speculation will emerge due to excessive optimism with respect to these fundamentals, making changes in stock prices unforecastable. Therefore, investors cannot beat the market in order to earn extraordinary gain. In some cases, a minority of investors (called noise traders) might not trade in a fully rational way (when their stocks are known to be overvalued relative to fundamentals) and therefore sustain the presence of significant speculation in share prices.

Duration Dependence Test

Many approaches have been developed to identify the existence of speculation in stock prices and returns. One of the earlier and most popular approaches is the unit-root process where the unit-root process is tested on stationarity or nonstationarity of the residuals between asset prices and market fundamentals. This process has been criticized by Harman and Zuehlke (2001) for having serious drawbacks in detecting speculation. They found that the unit root process could not identify speculation correctly when the market price contains collapsible speculation, so that the hypothesis of a speculation is not equivalent to the hypothesis of a unit root by conducting a Monte Carlo simulation.

Other approaches include the Duration Dependence Test, Weibull Hazard Model and Simulation Time Series Analysis. The Duration Dependence test and Weibull Hazard model are more widely accepted, because of their robustness in testing for rational stocks speculation. However, the use of time series simulation is considered to be in the early stages of model development, and hence, this approach is not yet fully accepted. Two classical models of rational stocks speculation are rational expectation model and a stochastic process (Islam and Watanapalachaikul 2004).

Methodology

This research follows Miskolczi (2017) logarithmic return model, and the duration dependence test method used in Islam and Watanapalachaikul (2004) study. To calculate the logarithmic result, Microsoft Excel program was used for constructing both index and logarithmic returns. For duration dependence test model analysis of daily stock prices in Asian Pacific region, Statistica program was used to find estimation and analysis of duration dependence test by using appropriate calculation and functions to ensure its reliability in estimation.

Population, Data and Scope of Research

This research chose to study the leading stock exchanges in the Asian Pacific region, which were ranked by domestic market capitalization in 2019 from Statista (2020). These 7 stock exchanges are Japan, China, India, Australia, Korea, Singapore and Thailand Stock Market. All daily closing prices of the stock exchanges were gathered during the study period from January 2020 to December 2020. The scope of this research will limit to primary Asian Pacific stock exchanges. Daily closing stock indices were gathered from various Internet sources such as Yahoo Finance, Market Watch, Statista and CNN Business.

Research Models

Logarithmic Return

We adopted Miskolczi (2017) logarithmic return model as follows:

$$GrR^{S}_{[0,T]}[n] = \prod_{i=1}^{n}\left(1 + R^{S}_{[t_{i-1},t_i]}[1]\right) = (1+R)^n = \left(1 + \frac{R^{*}_{[0,T]}[1]}{n}\right)^n$$

Since t_0 and t_n are the 0[th] and the last time points respectively, it can be written as

$$GrR^{S}_{[0,T]}[n] = \frac{1}{P_0}\prod_{i=1}^{n-1}\frac{P_{t_i}}{P_{t_i}}P_T = \frac{P_T}{P_0}$$

given that $\frac{P_T}{P_0} = \lim_{n}\left(1 + \frac{R^{*}_{[0,T]}[1]}{n}\right)^n$

Now, the length of the $[t_{i-1}, t_i]$ subintervals could become smaller overtime. Therefore, the number of equidistant subintervals of [0,*T*] could be followed by the exponential function that

$$\frac{P_T}{P_0} = e^{R^{*}_{[0,T]}[1]}$$

By applying approximation of the logarithm that $(1 + x) \approx x$, we could calculate the stock return:

$$R^L_{[t_{i-1},t_i]}[1] = ln\left(\frac{P_{t_i}}{P_{t_i-1}}\right) \approx \frac{P_{t_i}}{P_{t_i-1}} - 1 = R^S_{[t_{i-1},t_i]}[1]$$

given that $R^S_{[t_{i-1},t_i]}[1] \approx 0$

Duration Dependence Test Model

The model constructs by utilizing discrete log logistic model that could be formulated as:

$$\ln L(\alpha,\beta) = \sum_{i=1}^{N} \{J_i \ln[g(t_i)] + (1 - J_i)\ln[1 - G(t_i)]\}$$

where α is the shape parameter of the lognormal distribution, β is the duration elasticity of the hazard function, J_i is a duration of the process or time to exit from a state, g_t is the discrete density function for duration, and G_t is the corresponding distribution function. The discrete density and distribution functions for duration are related as:

$$G(t_i) = \sum_{k=1}^{t_i} g(k)$$

However, if the law of conditional probability is applied and the density for completed duration is:

$$g(k) = h(k)\prod_{m=0}^{k-1}[1 - h(m)]$$

In addition, the logistic distribution function ψ evaluated at a linear transformation of log-duration could be described as:

$$h(k) = \psi[\alpha + \beta\ln(k)] = \{1 + \exp[-\alpha - \beta\ln(k)]\}^{-1}$$

The Weibull Hazard function:

$$S(t) = \exp(-\alpha t^{bt+1})$$

where S(*t*) is the probability of survival in a state to at least time (*t*) and the corresponding Hazard function is:

$$h(t) = \alpha(\beta + 1)t^{\beta}$$

where α is the shape parameter of the Weibull distribution, and β is the duration elasticity of the hazard function. The fundamental assumption of the Weibull Hazard model is a linear relationship between the log of the hazard function and the log of duration, where:

$$\ln[h(t)] = \ln[\alpha(\beta + 1] + \beta\ln(t)$$

To demonstrate the existence of rational speculative activities using the Duration Dependence, the daily closing stock indices of Asian Pacific stock markets were obtained. The corresponding sequence of runs is determined by the length of the runs, which is the number of consecutive periods.

It is hypothesized that stock speculation exists when the rate of return of the stock price between the period *t-1* and *t* is growing faster than the fundamental price. According to the rational expectation theory, we hypothesize that:

$$E_t P_t = P_t + b_t$$

Therefore, the gap between the expected return and the real return is considered to be caused by an activity.

If the conditional distribution of prices is normal, then there will always be a positive probability of obtaining a negative price (violation of limited liability).

$$p_t + q = k + \delta E_t p_{t+1} + (1-\delta) E_t d_{t+1}$$

and

$$\lim_{k \to \infty} \delta^k E_t p_{t+k} = 0$$

If the transversality condition does not hold, the logarithm of the price has the following form:

$$p_t = f_t + b_t$$

where b_t is a speculative activity (bubble) generated by extraneous events, and f_t is the market fundamental given by:

$$f_t = \eta + (1-\delta)\sum_{j=0}^{\infty} \delta^j E_t d_{t+1+j}$$

and:

$$E_t b_{t+1} = \frac{1}{\delta} b_t$$

The second type of activity is a stochastic process where the next period activities grow with a random error. Rational speculative activities are b_t, and u_{t+1} is an error term which can either be additive or multiplicative. Addictive random errors are defined as: $b_{t+1} = \lambda_{t+1} b_t + u_{t+1}$ where λ_{t+1} is the random variable such that the expected value of λ_t, $E\lambda_t$ is 1+*r*. In addition, activities with multiplicative random error are defined as:

$$b_{t+1} = \lambda_{t+1}(b_t u_{t+1})$$

The rational activities with a multiplicative error must satisfy sub-martingale and non-negativity conditions. The sub-martingale condition assumes that $E_{t-1}(b_t) = (1+r)b_{t-1}$. The

Non-negativity is achieved by assuming that $\lambda_t = \exp(\Theta_t)$ and $u_t = \exp(U_t)$, where $\Theta_t \sim IIN(\ln(1+r) - \frac{\sigma_\theta^2}{2}, \sigma_\theta^2)$ and $U_t \sim IIN(-\frac{\sigma_\theta^2}{2}, -\sigma_\theta^2)$

Testing of Model Validity

Duration dependence test for the hazard function is performed by replacing equation $\ln[h(t)] = \ln[\alpha(\beta+1] + \beta \ln(t)$ to $\ln L(\alpha, \beta) = \sum_{i=1}^{N} \{J_i \ln[g(t_i)] + (1-J_i)\ln[1-G(t_i)]\}$ and adding the maximum recording probability function associated with α and β. The dependent variable is 1 if run ends, or 0 if the run never ends during the next period, the independent variable is the logarithmic of the current length of run. Logarithmic returns were used for a sample approximation of the Hazard rate and β. If the estimation β is negative and differs significantly from zero for positive runs, in conjunction with an insignificant estimate of β for negative runs, is considered evidence of speculative activities or speculative bubbles.

Empirical Results

There are two parts. The first part, we apply Miskolczi (2017) logarithmic return model to compare the performance of the Asian Pacific stock markets. The second part involves the test of the duration dependence, which modeled by Islam and Watanapalachaikul (2004) to find any existence of rational speculative activities/bubbles in the stock market. Microsoft Excel and Statistica software program were used to find logarithmic returns and testing the existence of duration dependence consecutively.

Logarithmic Returns

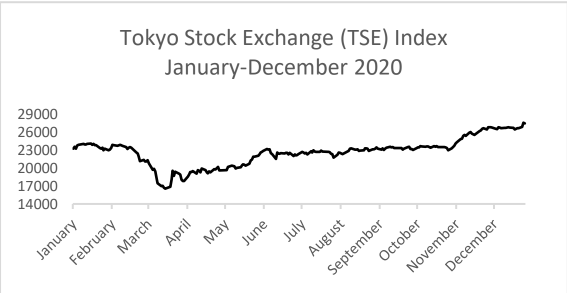
The two main objectives of a stock index are representation and comparison. Indices are often used as a benchmark by which investors and portfolio managers can measure investment performance. Stock indices represent a broad market trend or a segment of the market. In a simple term, the logarithmic return of a record is a logarithmic calculation of the return on investment. The logarithmic formula could be explained as:

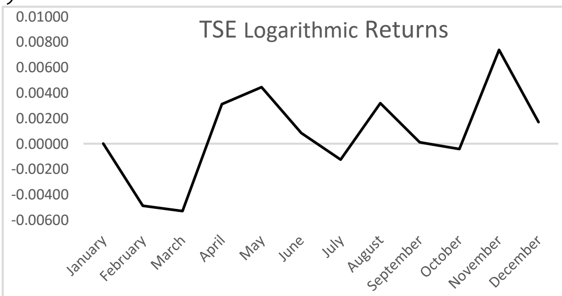
$$R^L_{[t_{i-1},t_i]}[1] = \ln\left(\frac{P_{t_i}}{P_{t_i-1}}\right) \approx \frac{P_{t_i}}{P_{t_i-1}} - 1 = R^S_{[t_{i-1},t_i]}[1]$$

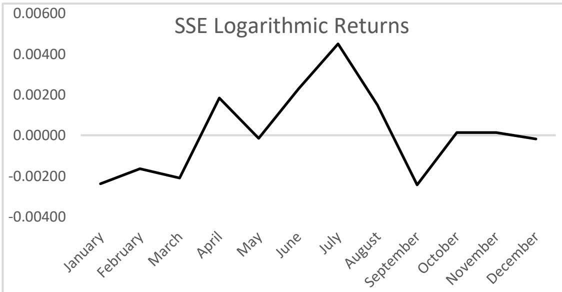
Logarithmic calculation gives a clearer picture of the return than the arithmetic formula that others used to calculate returns on a daily basis. Larger positive or negative logarithmic values (i.e. closer to 0.1 or -0.1) indicate larger positive or negative returns respectively.

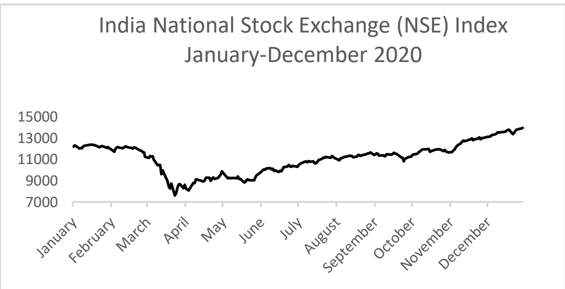
Tokyo Stock Exchange experienced tremendous drop in the index price during February and March, recording a nearly 20% drop in the market value. The index increased gradually after April and reaching the record high in December, see figures. The cumulative negative returns over February and March was -0.0048 and -0.0053 respectively, which was very significant as well as the result on November. It is worth to notice months that have significance log returns, which are February, March, May and November.

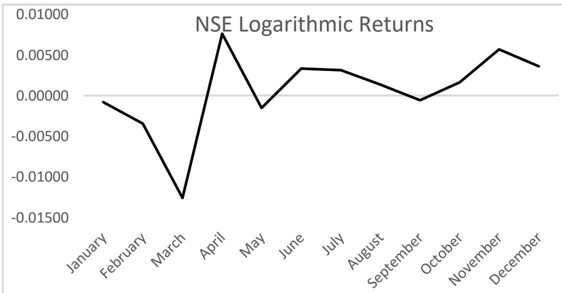
Shanghai Stock Exchange (SSE) performance ranked fourth of all stock markets in Asian Pacific Region. The value of the stock markets dropped from January to April, then there was an upward trend until December. The cumulative positive returns during was 0.00450 during July, which was very significant. SSE performed very well after March. The rapid growth began during April until early August. However, the abnormal positive log returns is detected in the month of July. Then the market tended to be very stable until December.

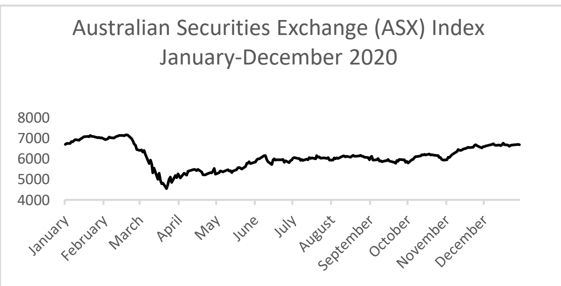


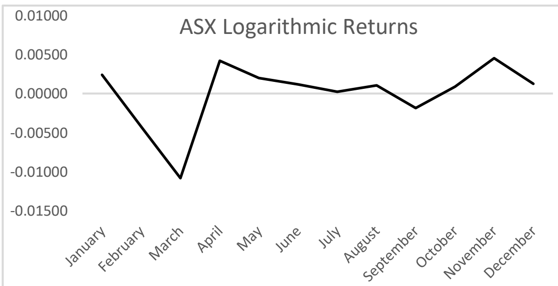


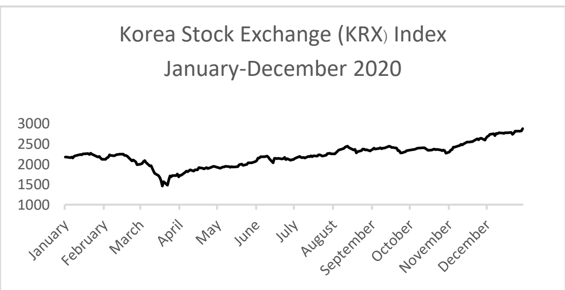


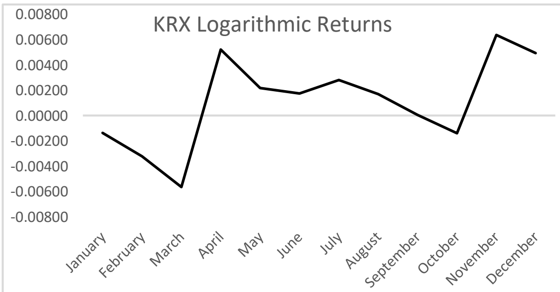












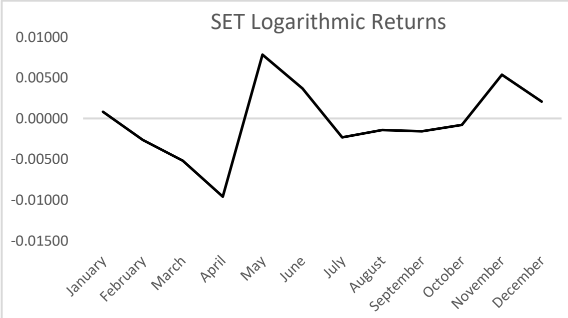


Table 1 Ranking of Asian Pacific Stock Markets by Logarithmic Returns for the Year 2020

Countries	Logarithmic Returns
Korea	0.2784
Japan	0.1678
India	0.1342
China	0.0910
Australia	-0.0012
Thailand	-0.0692
Singapore	-0.1326

India National Stock Exchange (NSE) experienced huge drop in the index price during February until April. The index increased gradually after April and reaching the new high in December. The cumulative negative returns over February and March was -0.0035 and -0.0126 respectively. In addition, a significant cumulative positive returns was April and November. NSE experienced great stock market crash during February to March, which had a negative index returns of -22.77. However, the market has recovered and gradually increased since March. During November, there was a jump in the index return as well as cumulative log returns.

Australian Securities Exchange (ASX) performance ranked fifth in term of stock market performance in Asian Pacific Region. The value of the stock markets dropped over 20% during February to March and had not fully recovered until December 2020. There were 9 months of positive log returns and 3 months of negative log returns, which were February, March and September. Comparing to other stock markets in Asian Pacific region, ASX index prices recovered from the pandemic was not fast but had a steady increase the index price overtime. ASX was the least volatile stock market in Asian Pacific region as well.

Korea Stock Exchange performance could be viewed as the best performing stocks in Asian Pacific Region in term of index prices recovery after March stock price slump. In December 2020, the stock price rose to a new high since December last year. According to the result of logarithmic returns of KRX, there were 8 months of positive log returns and 4 months of negative log returns, which were January, February, March and October. The overall stock market had recovered steadily since March, with minor drop in log returns in October.

Singapore Exchange Limited (SGX) index had not been recovered well after the pandemic since March among other Asian Pacific stock exchanges. In December 2020, the index price was still closed lower than the same period last year. There were 5 months of positive log returns and 7 months of negative log returns. The stock market performance was among the lowest in the Asian Pacific countries. There were more negative cumulative returns than positive cumulative returns.

Stock Exchange of Thailand (SET) experienced up and down cycle in a "W" shape and throughout the year it had not recovered after March stock price slump. In December 2020, the index price closed lower than December 2019. SET index had suffered a significant drop in stock prices since March with higher volatility comparing to other countries in the region. The negative log returns during March and April were worth noticing (-0.00519 and -0.0096) as well as positive log returns during November and December.

In conclusion, the logarithmic results show that Korea Stock Market was the best performer during the year 2020 follow by Japan, India and China. They yielded positive logarithmic returns by the use of daily index prices. Whereas Australia, Thailand and Singapore stock markets yielded negative logarithmic returns, see Table 1.

Duration Dependence Test Results

Table 2 presents the duration dependence test of the logarithmic returns of Tokyo Stock Exchange for runs of daily cumulative returns for the full sample period during January to December 2020. For the duration dependence test result, there are 22 positive runs and 24 negative runs. The longest positive run lasts 6 days. Hence, the longest negative runs tend to be longer, which lasts 9 days. The run counts of the logarithmic returns suggest positive runs tend to be more common in daily abnormal returns.

Table 2 Tokyo Stock Exchange (TSE), Duration dependence test model for runs of daily logarithmic index returns (January–December 2020)

Run Length	Positive runs		Negative runs	
	Actual run counts Total = 22	Sample hazard rates	Actual run counts Total = 24	Sample hazard rates
1	11	0.3438	8	0.4345
2	4	0.4700	6	0.5122
3	5	0.5364	1	0.5567
4	1	0.6490	4	0.1767
5	0	0.0000	3	0.7000
6	1	1.0000	0	0.0000
7			0	0.0000
8			0	0.0000
9			2	1.0000
Log-Return test				
α	-0.231		0.189	
β	0.130		-0.067	
LRT of H0: $\beta = 0$	0.10		0.04	
(*p*-value)	(0.89)		(0.53)	

According to the result, the hazard rates $h(t) = \alpha(\beta+1)t^{\beta}$ associated with a positive run length of 2 days is 0.4700. It could be explained that if a positive run exists for more than two consecutive days, there is a 47.00% probability that the speculative activities/speculative bubbles could be detected and collapse in the next day. And if a positive run length of 3 days is 0.5364. It could be explained that if a positive run exists for more than three consecutive days, there is a 53.64% probability that the upward trend could be stopped by the next day.

On the other hand, the hazard rates $h(t) = \alpha(\beta+1)t^{\beta}$ associated with a negative run length of 5 days is 0.7000. It could be explained that if a negative run exists for more than five consecutive days, there is a 70.00% probability that stock price will adjust itself and close higher on the following day. In any case, McQueen and Thorley (1994) suggest that speculative activities do not generate duration dependence in runs of negative abnormal returns.

According to Islam and Watanapalachaikul (2004), rational speculative bubbles would be detected if the hazard rates generate a decreasing function in runs of positive abnormal returns. The result shows that Tokyo Stock Exchange had positive runs up to fourth consecutive days, all generate an increasing function in runs. The maximum likelihood estimates of the logarithmic function parameters (α = -0.231) and (β = 0.130). This could explain that the probability of ending a run of positive logarithmic returns increases with the length of run. The positive β coefficient for the positive runs suggests positive duration dependence that is not consistent with rational speculative activities/bubbles. In addition, the negative logarithmic return exhibit negative β coefficient (β = -0.067), which is also inconsistent with rational speculative activities/bubbles.

The likelihood ratio test (LRT) of β=0 is asymptotically distributed χ^2 with one degree of freedom, where $LRT = -2\, log_e\left(\frac{L_S(\hat{\theta})}{L_g(\hat{\theta})}\right)$. The results show the confidence intervals (*p* value) are based on the LRT, which is the probability of obtaining the value of LRT higher under the null hypothesis of no bubble (β = 0). The LRT of the null hypothesis of no duration dependence or constant hazard is rejected at 89% significance level with LRT of 0.10. Therefore, the study shows no detection of speculative activities/bubbles in the Tokyo Stock Exchange during the COVID-19 pandemic from January to December 2020.

Shanghai Stock Exchange, for the duration dependence test result, there are 33 positive runs and 25 negative runs. The longest positive run lasts 8 days while the longest negative runs lasts 9 days. The actual hazard rate tend to decrease with run length for positive runs. The sample hazard rate for run length one is 0.84, showing that of the 33 runs of positive logarithmic returns in Shanghai Stock Exchange, there are 15 runs that last at least one day or a 44% probability that a positive logarithmic returns lasting for one day could revert to negative logarithmic returns in the next consecutive day. Then, of the remaining 18 runs, 5 runs will have a 37.88% probability end in the third day. The hazard rate continues to decrease at run length four, five to eight. The positive runs reveal declining hazard rates with run length. While the negative run shows relatively similar hazard rates with run length. The pattern of decreasing hazard rate in positive runs for Shanghai Stock Exchange is consistent with the rational speculative activities/bubbles prediction.

India National Stock Exchange for runs of daily logarithmic returns during January to December 2020. There are 38 positive runs and 33 negative runs. The longest positive run lasts 8 days. On the other hand, the longest negative runs tend to be shorter, which lasts only 6 days. The run counts of the logarithmic returns suggest positive runs tend to be more common in daily abnormal returns. The pattern of increasing hazard rate in positive runs for NSE reject the null hypothesis of the existence of rational speculative activities/bubbles theory. The LRT of the null hypothesis of no duration dependence or constant hazard rate is rejected at 65% significance level with LRT of 0.10. Therefore, the null hypothesis of no speculative activities/bubbles is rejected for NSE during the COVID-19 pandemic from January to December 2020. The result confirms that no speculative activities/bubbles persist in India National Stock Exchange during the study period.

Australian Securities Exchange, for the duration dependence test result, there are 34 positive runs and 32 negative runs. The longest positive run lasts 9 days while the longest negative runs lasts 6 days. The probability of ending a run of positive logarithmic returns increases with the length of run on the two, three, four, and five runs consecutively (0.4122, 0.5567, 0.5767, 0.7000). The positive β coefficient for the positive runs suggests positive duration dependence that is not consistent with rational speculative activities/bubbles.

For Korea Stock Exchange, the positive runs reveal increasing hazard rates with run length. The pattern of increasing hazard rate in positive runs for KRX is consistent with the rejection of null hypothesis of rational speculative activities/bubbles. Therefore, no evidence of rational speculative activities/bubbles was found in the KRX during the study period.

Singapore Exchange Limited (SGX), we found that the actual hazard rate increases with run length for positive runs. The sample hazard rate for run length one is 0.3425, showing that of the 29 runs of positive logarithmic returns in SGX, there are 19 runs that last at least one day or a 34.25% probability that a positive logarithmic returns lasting for one day could revert to negative logarithmic returns in the following consecutive day. The probability of ending a run of positive logarithmic returns increases with the length of run on the two, three, four, and five runs consecutively (0.3567, 0.4568, 0.4454, 0, 0.7200). The positive β coefficient for the positive runs suggests positive duration dependence that reject the null hypothesis of no rational speculative activities/bubbles.

Stock Exchange of Thailand (SET), the LRT of the null hypothesis of no duration dependence or constant hazard rate is rejected at 75% significance level with LRT of 0.20.

Therefore, the null hypothesis of no speculative activities/bubbles is not rejected for Stock Exchange of Thailand during the COVID-19 pandemic from January to December 2020. In conclusion, speculative activities/bubbles were detected or found in the Stock Exchange of Thailand during the study period.

Therefore, according to the duration dependence test results, there was no evidence of rational speculative activities/bubbles in the stock markets of Japan, Korea, India, Australia and Singapore. On the other hand, there was evidence of rational speculative bubble in China and Thailand stock markets.

Conclusions and Discussion

This empirical research also attempted to identify and compare stock speculation/ bubble of seven major Asian Pacific stock markets by using econometric models during the study period. We studied the leading stock exchanges in the Asian Pacific region, which were ranked by Statista such as Japan, China, India, Australia, Korea, Singapore and Thailand. Daily closing index prices were gathered during January 2020 to December 2020. This research utilized logarithmic return model and the duration dependence test method to calculate the results. Microsoft Excel and Statistica programs were used for model creation and generating results.

The results show that Korea Stock Market was the best performer during the year 2020 follow by Japan, India and China, which ranked second, third and fourth consecutively. These four stock markets yielded positive logarithmic/accumulated returns by the use of daily index prices. Whereas Australia, Thailand and Singapore stock markets yielded negative logarithmic returns, which were ranked fifth, sixth, and seventh consecutively.

Duration dependence test results show no evidence of rational speculative activities/ bubbles in the stock markets of Japan, Korea, India, Australia and Singapore. On the other hand, there was evidence of rational speculative bubbles in China and Thailand stock markets.

While it might not make a big difference between using logarithmic and simple returns, using logarithmic return/cumulative returns is considered a better approach to stock analysis such as portfolio optimization and risk management as in Cuthbertson K. (1996), and Islam and Watanapalachaikul (2004). According to the results, we found that COVID-19 pandemic had seriously affected all stock markets especially during the first three months of the outbreak. For overview of the stock markets in Asian Pacific region, the results of logarithmic returns during March record the lowest stock indices with significant negative log returns. Most of the stock markets had recovered their index prices especially during April with a significant rebound of the index prices and the upward trend continue until December 2020.

All Asian Pacific stock markets had been severely affected by the COVID-19 pandemic especially during the first three months of the outbreak. The stock markets had depreciated more than 10 percent, especially India and Australia stock markets had plunged more than 20% of the index prices during March. After March most of the Asian Pacific markets had recovered and gradually recovered the index prices. At the end of the year 2020, most of the stock markets had their index prices closed higher than at the start of the year 2020 except Australia, Singapore and Thailand that had their index prices closed lower than the same time previous year.

According to the result, we found positive abnormal logarithmic returns for the China stock market, Shanghai Stock Exchange, during July for unknown reason. Reuters (2021) reported the largest number of new stock investors in five years in July, as millions of individuals rushed into a buoyant share market, boosting trading turnover and brokerage earnings in to China stock market. The number of new investors in mainland Chinese shares totaled 2.4 million in July 2020, the most since June 2015, the peak of China's massive stock bubble that later burst. This result is corresponding to the duration dependence test finding of an evidence of rational speculative activities/bubbles existed in Shanghai Stock Exchange. In addition, Thailand stock market, Stock Exchange of Thailand, also had positive abnormal logarithmic returns during April and November.

The results of the duration dependence tests show an evidence to support the existence of speculative activities/bubbles in the China and Thailand stock markets. However, the tests did not show any evidence of rational speculative activities/bubbles in Japan, India, Australia, Korea and Singapore stock markets. The duration dependence test results of this research are similar with Islam and Watanapalachaikul (2004), and Binswnger (1999) but contradict Stratman (1988) who employed specification and cointegration tests. Stratman's cointegration test bases on expectations of future streams of dividends, utilizing linear rational expectation model of stock price and assumes that the expected real return of stock equals a constant required real rate of return, but does not account for volatility of stock prices. In addition, the problem of specification test arises from observing rational bubbles separately from the market fundamentals of the asset pricing. Therefore, the duration dependence test as in Islam and Watanapalachaikul (2004) is considered more reliable in obtaining robust results.

Implementation and Recommendation

The results of duration dependence test model indicate the detection of rational speculative activities/bubbles depends not only the choice of the test but also on the data frequency and the end dates of the data set. Hence, converting the rational speculation tests into recursive tests could help improve the detection of rational speculative activities/bubbles. This research could be useful as a warning mechanism to stock market investors to detect any bubbles before they deflate, which allows some investors to avoid the impending correction in stock prices.

References

Binswanger M. (1999). **Stock Markets. Speculative Bubbles and Economic Growth**. UK: Edward Elgar Publishing.

Cuthbertson K. (1996). **Quantitative Financial Economics: Stocks**. Bonds. and Foreign Exchange. London: John Wiley and Sons.

Fama, E. F. (1970). **Efficient Capital Markets: A Review of Theory and Empirical Work**. Journal of Finance. vol. 25. pp. 383-417.

Harman YS. and Zuehlke. TW. (2001). **Testing for Rational Bubbles with a Generalized Weibull Hazard**. Working Paper. Department of Finance. Oxford: Miami University.

Islam S. and Watanapalachaikul S. (2004). **Empirical Finance**. Heidelberg: Springer.

Jensen, M. (1978). **Some Anomalous Evidence Regarding Market Efficiency**, Journal of Financial Economics, vol. 12, pp. 33-56.

McQueen G. and Thorley S. (1994). **Bubbles. Stock Returns. and Duration Dependence**. Journal of Financial and Quantitative Analysis. vol. 29. pp. 196-197.

Miskolczi Panna. (2017). **Note on Simple and Logarithmic Return**. Debrecen: Center Print Publishing House.

Statista. (2020). **Leading stock exchanges in the Asian Pacific region in 2019**. [Online]. Retrieved September, 20, 2020, from https://www.statista.com/statistics/710680

Statman M. (1988). **Investor Psychology and Market Inefficiencies**. Equity Market and Valuation Methods. California: The Institute of Chartered Financial Analysts.

West KD. (1987). **A Specification Test for Speculative Bubbles**. Quarterly Journal of Economics. vol. 102. pp. 553-580.