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The Dynamic Relationship Between Trading Volume, Stock Return, and Volatility-Domestic and Cross-Country : South Asian Markets

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Abstract

This paper examines the contemporaneous and dynamic relationships among trading volumes, stock returns and return volatility for three emerging markets in Southeast Asia, which are Malaysia, Indonesia and Singapore. Tests on both intra- and inter-market relationships between the variables are conducted to determine whether they are interrelated within the same market and across the markets. The paper also applies GARCH technique to model the volatility of returns for the three stock markets of concern. The study finds strong evidence of asymmetry in the relationship between the stock returns and trading volume; whereby returns are significant in predicting their future dynamics, as well as, the trading volume. However, trading volume has a very limited power on the future dynamics of stock returns. The study also finds bidirectional causality between trading volume and volatility of returns in Malaysia and Singapore. In particular, Singapore market can be perceived as the focal stock exchange that has cross-market relationships with its other two neighbors.

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INTRODUCTION

Trading volume is an independent variable and can be useful in confirming price action and measuring the strength of a market move (Pring, 2006). It is a common knowledge among traders that if price moves up or down, the perceived strength of that move depends on the volume for that period. There are studies that show using volume to analyze stocks (assets) can bolster profits and reduce risk (Mitchell, 2011). Volume is defined as the number of shares traded. Assuming that investors are rational, the sale and purchase of assets are mainly driven by news and information. Two of the most widely cited theories (Mixture of Distribution Hypothesis and Sequential Information Arrival Hypothesis) both contend that trading volume is a variable that captures information and hence, factor-in investors' collective reaction to news into the stock price (Asghar, 2011). After all, what moves prices is the relative enthusiasm of buyers or sellers in response to given information (Pring, 2006).

Granger and Morgenstern (1963) was one of the first authors who showed how investors could extract information about the future payoff of a security from its price. Numerous studies seek to extend the model by incorporating both price and trading volume into the equation. For example, several empirical studies support the idea that trading volume contains information about future returns. Such popular landmark studies include Epps and Epps (1976), Copeland (1976), Karpoff (1987), Lamoureux and Lastrapes (1990), Gallant, Rossi and Tauchen (1992), Campbell, Grossman and Wang (1993), Blume, Easley and O'Hara (1994), Wang (1994) and Lee and Rui (2002).

More attention had been drawn to tap on this issue since Karpoff (1987) pointed out four importance of investigating the relationship between trading volume and security's prices. According to him, such study is important: (1) to provide insights into the structure of financial markets; (2) for event study; (3) for the debate over the empirical distribution of speculative prices; and (4) for research into futures markets. Besides uncovering the relation between price and volume, the price volatility of financial asset is the key for risk management, which serves as the basis for investing decisions and indicators of the healthiness of financial market (Dan, Yuan & Zhong, 2013). Therefore, it is also important to study how trading volume impacts volatility of return, besides price changes. This study seeks to draw the attention towards emerging markets, particularly Southeast Asia due to several factors. In the past decades, a large number of countries have reformed their markets to be more open to foreign investment, transparent and thoroughly regulated. Emerging markets especially in Southeast Asia have received huge capital inflows and become an important alternative for investors who seek for international diversification.

According to Michelfelder and Pandya (2005), the correlations of equity returns between emerging and developed countries are low. The information flow in the markets is also not equivalent due to the significant institutional differences. Hence, it is possible to reduce portfolio risk by participating in emerging markets. As a matter of proof, Harvey (1995) showed that adding portfolio of emerging markets to a diversified developed markets portfolio would reduce total risk by six percentage points. Hence, these findings demonstrate that the emerging markets should become important destinations for international portfolio diversification; thus requiring more theoretical and empirical understanding. As the intended result, this study could provide a closed solution where investors may possibly infer information about the future trading signals from (1) the market return, (2) return volatility and (3) trading volume. Besides, cross-country comparison and inter-market influence will also be learnt which will help to infer decisions on regional portfolio diversification.

Problem statement

In addition to that, most from the already few studies conducted in emerging markets (such as Choudhry, 1996; Sabri, 2004; and Michelfelder and Pandya, 2005) contend that there are differences in the volume-return-volatility link between mature and emerging markets. Therefore, one cannot imply the results found in the developed markets to hold in the emerging markets. Due to their varying characteristics, isolated studies have to be conducted in the emerging markets to understand the behavior of volume as an agent of information flow towards stock returns and volatility in their own unique landscape.

The body of literature lacks studies that look into the dynamic relationships of volume-return-volatility by way of cross-country comparison. This issue is considered as imperative based on the "contagion theory" of "spillover effect" proposed by King and Wadhani (1990) in which traders in one market may draw inferences about stock price in their own market by observing price movements in another. For example, Lee and Rui (2002) find that the US trading volume contains predictive power for UK and Japanese trading volumes whereas Choi, Yoon and Kang (2013) find evidence of causality between volume, return and volatility in Japan, Korea, Hong Kong, and China.

The research questions for this study are:

i. Are there any contemporaneous and dynamic cause-and-effect relationships between trading volume and stock market returns in the Southeast Asian equity markets?
ii. Does trading volume influence return volatility of the concerned stock indices?

iii. Is the stock market return and return volatility in one market influenced by the volume of another market in Southeast Asia?

The main objectives of this study are to investigate the relationships between trading volume, stock market returns and returns volatility in Southeast Asian equity markets.
The specific objectives are:

i. To examine the contemporaneous and dynamic causal relationships between trading volume and stock indices returns in each of the Southeast Asian markets.
ii. To determine the dynamic relationship between trading volume and return volatility in each of the Southeast Asian stock markets.
iii. To investigate any cross-market influence between trading volume to stock returns and trading volume to return volatility in the region.

LITERATURE REVIEW

Efficient Market Hypothesis (EMH) describes the behavior of prices in stock markets (Park & Irwin, 2007). According to Jensen (1978), an efficient market is "*the one where it is impossible to make economic profits by trading based on the respective information*". The EMH theory pertains to this study since the analysis of the predictive power of trading volume is basically an effort to find ways to predict the future prices (and return) and to beat the market be making a proactive strategy in investment. Thus, the researcher is implying that the stock markets in Southeast Asia might be imperfect and not fully efficient; or showing a weak or semi-strong EMH.

The dynamics between trading volume, stock returns and the volatility of stock market returns can be explained by two basic approaches. The first group of approach suggests that differences in investor opinions and expectations are the source of changes in trading volume, price change and volatility (Admati & Pfleiderer, 1988; Harris & Raviv, 1993; Wang, 1994; He & Wang, 1995). The second group of approach suggests that it is the manner in which information arrives at the market which determines the relationship between the three variables. The two most cited theories under the second group are the Sequential Information Arrival Hypothesis (SIAH) and the Mixture of Distribution Hypothesis (MDH).

Copeland (1976) proposes the SIAH, which is, later extended by Morse (1980) and Jennings, Starks and Fellingham (1981). According to the theory, a positive bidirectional causality relationship exists between absolute values of price changes and volume. SIAH assumes that all traders receive new information in a sequence. In other words, new information that reaches the market does not reach all participants simultaneously, but to one at a time. As information is distributed sequentially from one group to another, traders revise their positions every time new information arrives and the final equilibrium is only established after a sequence of transitional equilibriums. Therefore, due to the series of multidirectional information flow, SIAH suggests that there should be a bidirectional lead-lag relation between volume and volatility. Lagged values of volume may contain the information that is useful to predict current price returns and, vice versa (Celik, 2013).

In contrary to that, the Mixture of Distribution Models (MDH) is championed by Clark (1973), Epps and Epps (1976), and Harris (1986). The theory states that price changes and trading volume relations occur due to a mixture of distribution. Epps and Epps (1976) use trading volume to measure the level of market disagreement as traders revise their reservation prices based on the arrival of new information into the market. As market disagreement widens, the resulting revisions in reservation price, in turn, will increase the level of trading volume. Since all traders simultaneously receive new information and that the price and volume change simultaneously, hence it should be impossible to use past return data to forecast volume.

Relationship between trading volume and stock market returns

Blume *et al.* (1994) investigate and develop a model that links trading volume to stock price behavior. In their model, the aggregate supply is fixed, while the demand side changes as traders receive various signals about fundamental values of assets. In their analysis, trading volume indicates the quality or precision of information in past price movements. They suggest that investors who consider some measurement of past volume in their technical analysis can obtain additional profits and perform better than those who only rely on price measures. Podobnik, Horvatic, Petersen and Stanley (2009) investigate the possible relations between the two variables by analyzing the properties of the logarithmic volume-price changes. Using de-trended cross-correlation analysis on daily data of the New York Stock Exchange (NYSE), Standard and Poor's (S&P) 500 Index and 28 other financial indices all around the world, they propose that the underlying processes for logarithmic price change and logarithmic volume change are

similar.

Smirlock and Starks (1988) applied the Granger causality technique to examine the lagged relationship between absolute price changes and volume in equity markets and investigate the implications of this relationship for the microstructure of these markets. Their results indicate that there is a significant unidirectional causal relationship running from absolute price changes to volume at the firm level. In addition, Bauer and Nieuwland (1995) investigate this issue by using daily stock return and volumes for 30 stocks listed in Frankfurt stock market. However, they find that trading volume has exploratory power to predict stock returns and is valuable as a proxy for information arrival.

Campbell *et al.* (1993) present a model, which postulates that price changes accompanied by high volume tend to be reversed, while prices changes on days with low volume tend to stay in the current direction. Blume *et al.* (1994) finds that volume is a valuable information in technical analysis. This is also supported by Wang (1994), shows that volume may provide information about future returns via a model based on information asymmetry. Chordia and Swaminathan (2000) use VAR tests with pairs of high and low volume portfolio return to analyze daily and weekly stock return as well as average trading volume covering long period from 1963 to 1996. Their findings show that daily or weekly returns of stocks with high volume lead daily or weekly return of stocks with low volume. There is a tendency for high volume stock to respond rapidly and low volume stock to respond slowly to new market information.

Pisedtasalasai and Gunasekarage (2007) examine the causal and dynamic relations among stock returns, return volatility and trading volume for five emerging markets in the region, which are Indonesia, Malaysia, Singapore, Thailand and the Philippines. They find strong evidence of asymmetry in the relationship between the stock returns and trading volume; whereby there is significant causality running from stock returns to trading volume for Indonesia, Malaysia, Singapore and Thailand while significant causal effect from trading volume to stock returns was detected only for Singapore. In the Philippines however, none of such causality exist.

However, there are researchers who find bidirectional relationship between the two variables. Ratner and Leal (2001) examine the Latin American and Asian developing financial markets and find a positive contemporaneous relation between return and volume in these countries except India. Moosa and Al-Loughani (1995) studied four emerging Asian stock markets (Malaysia, the Philippines, Singapore, and Thailand), they also find bi-directional causality between volume and returns.

Some conclusions can be drawn from the literatures. Firstly, these past studied have found some relationship between trading volume and stock price changes (returns), despite bearing different magnitudes in various markets. Nevertheless, most studies lend support that price changes (return) may have positive contemporaneous relationship with trading volume. Secondly, the studies that look on the causality relationship aspect may have inconclusive evidence. While the studies have found causality running between trading volume and stock returns, the direction can be either uni- or bi-directional. Therefore, stock returns may positively cause trading volume, but still, the opposite might not necessarily hold true. This relation will obtain further evidence from this study.

Relationship between trading volume and volatility of stock returns

In a dynamic content, an important issue would be whether information about trading volume is useful in improving forecasts of price changes (returns) and the volatility of the return. In terms of the causal relation between volume and volatility, Lee and Rui (2002) examine the two variables in and across three advanced markets (New York, London and Tokyo Stock Exchange). Upon employing Vector Autoregressive (VAR) analysis, they fail to prove the causal relationship between volume and return in the same market. However, they find evidences for inter-related positive feedback between trading volume and stock return among the three markets. Their findings show causal relationship running from the New York market variables (trading volume, stock return and return volatility) onto London and Tokyo markets variables. These findings lend support for spillover effect where information from one market is transmitted to another, thereby affecting its returns and volatility.

Pisedtasalasai and Gunasekarage (2007) examine relations among stock returns, return volatility and trading volume for five emerging markets in Southeast Asia. The GARCH test yield evidence that the trading volume of some markets seems to contain information that is useful in predicting future dynamics of return volatility. Similarly, in Kuala Lumpur Stock Exchange (KLSE), Ahmed, Hassan and Nasir (2005) have concluded that current volatility can be explained by past volatility that tends to persist over time. These findings are also consistent with those of Najand and Yung (1991), Foster (1995) and Huang and Yang (2001) but in contrary to the earlier findings by Lamoureux and Lastrapes (1990) in the developed markets. Subsequently, using data from the same market (KLSE), Tan and Tay (2011) employ GARCH model to test for contemporaneous correlation between trading volumes and return volatility of the KLCI index. However, they find that including trading volume in the conditional variance (return volatility) equation leads to a reduction of volatility persistence, which is inconsistent with Ahmed *et al.* (2005).

In the European market, Naka and Oral (2013) examines volatility of stock returns and trading volume by

employing GARCH and TGARCH models in Istanbul stock exchange national-100 Index. The results suggest that stable distributions clearly outperform the Gaussian case. The results also indicate that the trading volume significantly contributes to the volatility, and indicate the strong leverage effects on volatility in the market. Again, this is also consistent with the results found by other researchers in other emerging markets.

It is quite clear that studies have shown that the relationship between trading volume and volatility will most probably be a positive one. This finding is quite consistently obtained from many emerging and developed markets. It is also possible to obtain bidirectional causality relationship from the two variables, even though it is not the motive of the study. Nevertheless, one may conjecture that the same findings may hold in the Southeast Asian equity markets; hence, the fourth hypothesis is developed based on this notion.

Review on cross-country, inter-variable spillover effects

From the view of international capital asset pricing model, the findings that stock returns in different countries are correlated to different degree is not a new phenomenon. In an attempt to explain why, King and Wadhani (1990) proposed a "contagion theory", where they proposed that a "mistake' in one market is transmitted to another. Traders in one market draw inferences about shocks to their local stock price fundamentals by observing price movements in other markets. The study on inter-market relationship is valuable to the literature especially in today's environment where information is widely accessible and national markets are becoming increasingly competitive. According to Lee and Rui (2012), there is some overlapping trading period and multiple listings of the same securities across different markets. Moreover, many of the markets within the same region often carry the same characteristics such as level of economic development, socio-economic advancement and time zone. Therefore, studying international markets inter-relationship may allow researchers to learn more from the continuous trading and uninterrupted transmission of information, particularly in their effect towards volume, stock prices and return volatility.

In this sense, some studies on national equity markets have focused on the correlation of return between different markets. One of the earliest studies, Agmon (1972, 1974) finds that these return correlations are insignificant or unstable. A later study by Jaffe and Westerfield (1985) find contradictory result, where the correlations among national markets are positive and significant. Similarly, Eun and Shim (1989) find significant cross-country interactions using Vector Autoregression (VAR) technique. They also conclude that the US market has an influential role against the rest of the markets under study. Copeland and Copeland (1998) go deeper into the issue to explore the contemporaneous and lead-lag relations of market returns and find a strong contemporaneous relationship among regional exchanges that open at the same time. Consistent with Eun and Shim (1989), they also reveal that the U.S. leads the European and the Pacific markets by one day. These findings all lend support to the view that financial market variable in various countries may be interconnected to some extent.

Besides the co-movement of returns among markets, researchers are also interested to determine whether there are any spillover effects in volatility among the regional markets. For example, Hamao, Masulis and Ng (1990) found spillover effects from the US and the UK stock markets to the Japanese market. They contend that the spillover effect of information by trading volume of one country to volume in another is a rare subject of discussion in the literature and call for more empirical studies.

Lee and Rui (2002) find a positive feedback relationship between trading volume and return volatility in all three markets. They find that the US trading volume contains predictive power for UK and Japanese volumes. Michelfelder and Pandya (2005) compare the volatility of stock returns and predictability in two mature markets (Japan and United States) against seven emerging equity markets (India, Hong Kong, South Korea, Malaysia, Singapore and Taiwan). Using EGARCH, the study finds that emerging markets have higher volatility but lower persistence of shocks as compared to the two mature markets. They also have greater impact on volatility of stock returns during non-trading days than mature markets. In addition, the VAR test shows that US shocks are rapidly transmitted to the rest of the world, implying dependency of emerging markets returns towards the returns on mature markets.

Choi *et al.* (2013) provide evidence on the domestic and cross-country relationships between trading volume, return and volatility in four Asian stock markets. The study employs Granger causality and GARCH to model the relationship and finds evidence that financial market variables across the countries are interrelated. One of the principal discoveries is that Hong Kong financial market variables, in particular trading volume, have extensive predictive power for the variables of Japan and Korea. Japanese stock market, on the other hand, is substantially influenced by variables of Korea, Hong Kong, and China.

Several conclusions can be made from the literatures discussed above. Firstly, multiple researchers have found the existence of inter-relationships between financial market variables across countries. Secondly, trading volume may have the power to predict return and volatility in other markets. Thirdly, the number of studies in this field is still quite scarce, and almost all from the already few literatures are concentrating on mature markets. It would be interesting to replicate the studies into financial markets in other parts of the

world.

RESEARCH METHODOLOGY

Two conceptual frameworks are henceforth presented. Figure 1 presents the framework for the domestic cases, where separate estimations will take place for each country's financial market variables of concern. On the other hand, figure 2 presents the framework for cross-country relationships, where the study seeks to test whether trading volume in one market of concern has predictive power on stock returns and return volatility in another two markets.

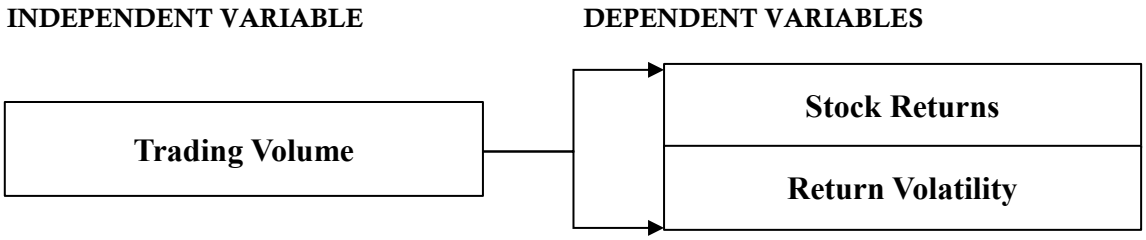
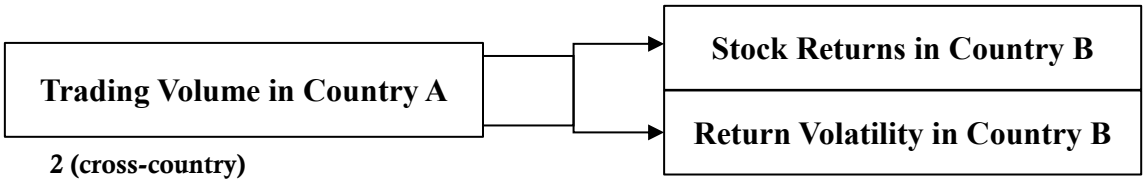


Figure 1 : Conceptual framework 1 (domestic)



2 (cross-country)

There are two dependent variables in this study, which are stock market returns and volatility of the returns. Stock market return is defined as the rate of change (gain or lose) in the price of the concerned stock market indices. The time-series daily index returns are calculated using the logarithmic of daily difference of the market index value as follows:

$$Stock\ returns = ln\ (P_t - P_{t-1}) * 100$$

Where $P_t - P_{t-1}$ are closing daily prices of the stock market indices at time t and t-1. This definition and derivation of stock market return are the same in both domestic and cross-country cases.

Volatility refers to the rate of fluctuation in the share prices, which in this study is derived from time series of past market index prices. Being measured using variance, volatility is a measure for deviation of price of over time. In other words, it refers to the amount of uncertainty or risk about the size of changes in the stock's value.

A higher volatility means that a stock's (index) value can potentially be spread out over a larger range. This means that the price can change dramatically over a short time period in either direction. A lower volatility means that a security's value does not fluctuate dramatically, but changes in value at a steady pace over a period of time. The measures of stock return volatility in both domestic and cross-country cases are the same.

The independent variable of concern in this study is trading volume, which is defined as the number of shares that changed hand during a particular trading period. This definition of trading volume is following Chen, Firth and Rui (2001) where volume is regarded as a measure of how much of a given financial asset (in this case; stocks) has been traded in a given period of time. In this study, trading volume be expressed in a natural logarithm form in order to ensure its stationarity.

Based on the discussion from the literatures, these following hypotheses are to be tested:

H_1: There is positive contemporaneous relationship between trading volume and stock market returns in the Southeast Asian equity markets.

H_2: There are causal relationships between trading volume and stock market returns in the Southeast Asian equity markets.

H_3: There is a relationship between trading volume and stock market volatility in the Southeast Asian equity

markets.

H_4: There are inter-market causality relationships between trading volume and stock market returns among the Southeast Asian stock markets.

H_5: There are inter-market causality relationships between trading volume and stock market volatility among the Southeast Asian stock markets.

Data collection methods

In a research involving stock market performance, profitability, volatility and such, previous researchers have stressed on the importance of using the highest-frequency data as possible. It is because the stock market often shows high volatility that can be best captured by the use of intraday or daily data. Hence, this study will employ daily time-series data on stock index prices and trading volume from the three Southeast Asian stock markets (Malaysia, Indonesia and Singapore). Each country is represented by only one broad-based index, which captures the overall performance of the stocks listed in them. The indices are FTSE-Bursa Malaysia Kuala Lumpur Composite Index (KLCI) for Malaysia, the FTSE Straits Times Index (STI) for Singapore and the Jakarta Stock Exchange Composite Index (JCI) for Indonesia. All three indices are broad-based market capitalization weighted index of a specified number of constituent stocks designed to measure the overall performance of the respective stock exchanges.

This study requires raw data on the daily closing prices and trading volume for the respective stock indices. The necessary datasets are sourced from DataStream database and cross-compared or verified using data coming from Yahoo Finance website. The period extends from January 2000 until the end of December 2014, totaling of 15 years and span over approximately 3,600 observations per country. For the purpose of cross-country analysis, the data is initially screened where figures on dates that are not matched by both markets in comparison will be eliminated. The data had undergone a series of tests. Initially, some preliminary steps are taken onto the data to test for optimum parameters or fitness of the data. The steps are as follows:

Trend and unit root tests

Previous studies such as Chen *et al.* (2001) document evidence of both linear and non-linear trends in time series of trading volume information. The Granger causality test that are employed in this study assumes that the variables are stationary. Therefore, it is important to test for stationarity of the stock return and volume data. Following Lee and Rui (2002), the researcher examined the linear and non-linear time trend in trading volume by estimating the following regression:

$$V_t = \alpha + \beta t + \chi t^2 + \varepsilon_t \quad (1)$$

Where, V_t is the raw trading volume data while t and t^2, respectively are linear and quadratic time trends.

To test for a unit root (or the difference stationarity process), the researcher had employed both Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979) and the Phillip-Perron (PP) test proposed by Phillip and Perron (1988). The tests are undertaken onto both the returns and the detrended trading volume data. The model estimation is as follows:

a) Augmented Dickey-Fuller regression

$$\Delta x_t = \rho_0 + \rho x_{t-1} + \sum_{i-1}^{n} \delta \, \Delta x_{t-1} \quad (2)$$

b) Phillip-Perron regression

$$X_t = \alpha_0 + \alpha x_{t-1} + \mu_t \quad (3)$$

The differences between the two unit root tests are in terms of their treatment of any "nuisance" serial correlation. The PP test tends to be more robust to a wide range of serial correlation and time-dependent heteroskedasticity, thus is employed for robustness check. In these tests, the null hypotheses stating that the series are nonstationary: $\rho = 0$ and $\alpha = 1$, is interpreted based on the reading on t-statistics.

Contemporaneous volume – return relationships

The tests underlined in this section are dedicated to examine the first hypothesis of a positive contemporaneous relationship between trading volume and stock returns. In the past, many researchers employed various techniques to test such relationships. Following Lee and Rui (2002), the relationships are tested using an instrumental variable estimator as a Newey-West regression estimator to avoid problem of simultaneity bias. Another advantage of the technique is that it produces heteroskedasticity-consistent estimates by correcting the covariance matrix of the consistent instrumental estimator.

In addition to the Newey-West regression model, a GARCH model is incorporated to include heteroskedasticity and can be extended to include other effects on conditional variances. This model offers considerable flexibility in robust modeling of stock returns, which is done upon obtaining positive contemporaneous results between trading volume and stock returns from the Newey-West regression.

Therefore, to test whether the positive contemporaneous relationship still exist after controlling for non-normality of error distribution, the following GARCH (1,1) model will be estimated:

$$R_t = b_0 + b_1 V_1 + \varepsilon_t,$$
$$\varepsilon_t \mid (\varepsilon_{t-1}, \varepsilon_{t-2}, \ldots) \sim N(0, h_t), \quad (4)$$
$$h_t = a_0 + a_1 \varepsilon^2_{t-1} + a_2 h_{t-1}$$

Dynamic causal volume – return – volatility relationships

The techniques to be discussed under this section seek to test the second and fourth hypotheses of the causal relationships between trading volume, stock market returns and volatility of returns; in each of the Southeast Asian equity markets and by way of cross-country relations. Thus, these tests apply in both domestic and cross-country cases. The only difference between the two is that in the former, the variables in the same country are regressed, whereas the latter involve variables from a pair of different countries. As a bidirectional test, the procedure tests whether trading volume precedes stock returns, vice versa, which is the main agenda behind Granger's (1969) test of causality. In this test, if an event 'x' occurs before an event 'y', then it can be concluded that 'x' causes 'y'. If prediction of 'y' using past 'x' is more accurate than the prediction without using past 'x' in the mean square error sense, 'x' is said to Granger-cause 'y'.

The following bivariate autoregression is used to test for causality between each pair among trading volume, stock returns and returns' volatility:

$$x_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i x_{t-1} + \sum_{i=1}^{n} \beta_i y_{t-1} + \varepsilon_t,$$
$$y_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i x_{t-1} + \sum_{i=1}^{n} \delta y_{t-1} + \eta_t, \quad (5)$$

In the first causality equation, if after the regression, beta (β_i) coefficients are statistically significant, it can be said that unidirectional causality relationship exists between the two variables (i.e.: return cause volume). The significance of the relationship will be determined based on the accompanying p-value of t-statistic, where a t-stat reading that rejects the hypothesis that $\beta_i = 0$ for all 'i' will mean that return causes trading volume. Similarly, in the second equation, if causality runs from volume to returns, then the γ_i coefficient will be mutually different from zero. If both β_i and γ_i are statistically different from zero, then it will be concluded that there is a feedback relation (bidirectional causality) between returns and trading volume.

Volatility modeling

The methods described here seek to achieve the fifth objective. Many methods are developed by the past researchers to formulate a measure of volatility because of a special feature of volatility that it is not directly observable. This study applies a GARCH (1,1) model with modification to include a student's t-distribution as an alternative to the standard Gaussian distribution. Student's t-distributions is a rich class of probability distributions that allows skewness and heavy tails, which are apparently present in economics and financial data especially stock returns. To support that, Naka and Oral (2013) find that the usage of GARCH and TGARCH models with stable distribution assumption provide better goodness of fit over the traditional Gaussian models.

Therefore, the model specification will be based on the one set by Naka and Oral (2013). The researcher imposes stability conditions to estimate the GARCH model so that these processes will have strictly stationary solutions. The estimated model is then fitted into the following equation:

$$\sigma^2{}_t = \gamma + \alpha U^2{}_{t-1} + \beta \sigma^2{}_{t-1} + \varepsilon \quad (6)$$

where; γ is the constant coefficient representing long-term volatility, αis the coefficient for $U^2{}_{t-1}$which is the lagged squared return and β is the coefficient for$\sigma^2{}_{t-1}$ which represents the lagged variance. The best fit for the model in terms of lag length is determined using Akaike Information Criterion (AIC) and Log Likelihood (Log LL). A model is considered best fitted when it has a small AIC and high Log LL. On the significance of variables, the GARCH estimation result will be interpreted based on the t-statistics to determine whether the three components of GARCH (long-term volatility, lagged squared return and lagged variance) do have significant impact on the overall volatility (variance) of the stock return.

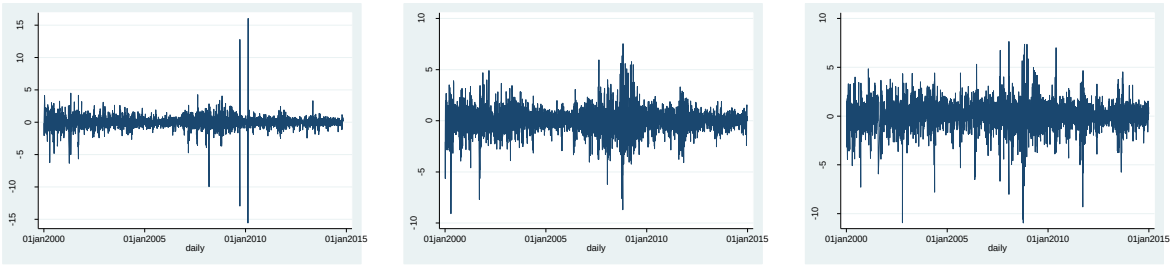
DATA ANALYSIS AND FINDINGS

Unit root tests

	P-values					
	Malaysia		Singapore		Indonesia	
	ADF	Phillip-Perron	ADF	Phillip-Perron	ADF	Phillip-Perron
Index Return	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Trading Volume	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000
Logged Trading Volume	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 1: Results of unit root test

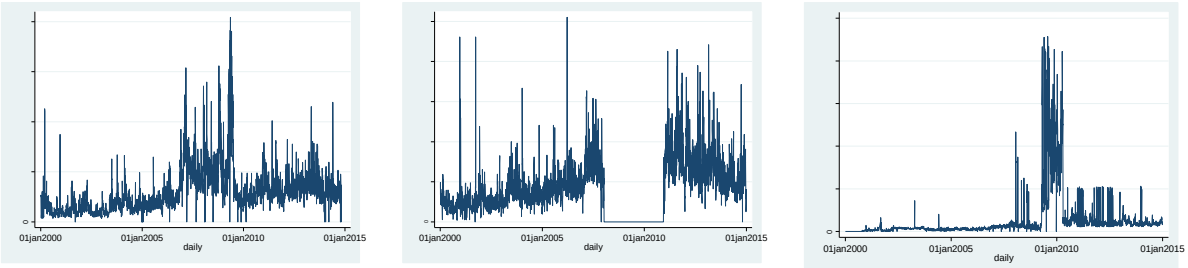
The unit root test is conducted to test for stationarity of the data. Based on table 1 above, the index return data is stationary in original form under both Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) measures as 0.0000 p-values are recorded for all countries. This observation can be seen more clearly from the line charts below (figure 3), where the stock returns for all countries do not exhibit any upward or downward trends as the plots move sideways. Therefore, the dataset is stationary, and there is no unit root; as suggested by the ADF and PP statistics. This heteroskedastic property is as expected from any financial return series.



Malaysia Singapore Indonesia

Figure 3 : Line charts for stock market return

However, problems were detected when it comes to trading volumes as all of them fail to record significant p-values under ADF measure. This fact is supported by the figure 4 as the volume data in their original form, do exhibit observable patterns and are unstable across time. The trading volumes tend to spike during a certain period and remain low during another, which suggests evidence for volatility clustering.



Malaysia Singapore Indonesia

Figure 4 : Line charts for trading volume (original form)

To circumvent this problem, the volume data is transformed into logged form to provide for more consistency and stability. This resulted in stationary data as evidenced by the 0.0000 p-values under both ADF and PP statistics in table 1. Figure 5 below supports this point, as the logged trading volume data plot is now behaving in more stable and stationary manner. Thus, the data is now fit to be used for the subsequent data analysis processes.

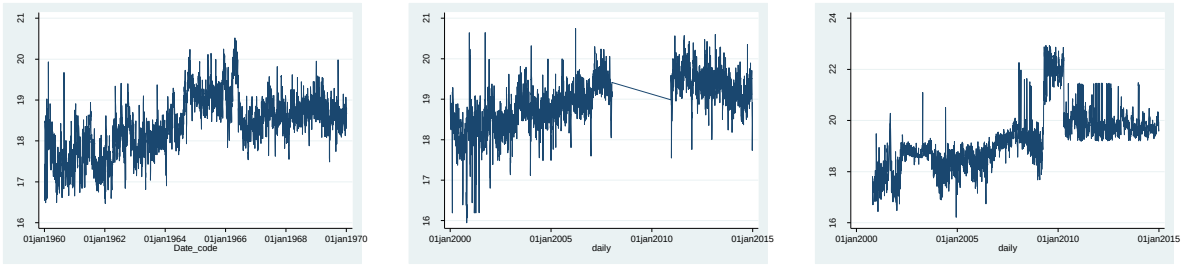


Figure 5 : Line charts for trading volume (logged form)

Contemporaneous relationships

The following tests are conducted for the first hypothesis. Firstly, a Newey-West regression technique is applied to take into consideration of the heteroskedastic nature of the stock return data. The Newey-West regression is performed with zero lag, in order to consider only the contemporaneous (current-time) relationships between trading volume to stock return, instead of considering the effect of past trading volume in predicting the dependent variable. The results are presented in table 2:

	Malaysia	**Singapore**	**Indonesia**
Number of observations	3622	3028	3345
F-stat	4.66	3.68	4.10
Prob. > F-stat	0.0310	0.0552	0.0430
Constant coefficient	-1.0666	-1.2467	-0.7692
(p-value)	(0.035)	(0.057)	(0.064)
Logged Trading Volume's coefficient	0.0598	0.6667	0.0436
(P-value)	(0.031)	(0.055)	(0.043)

Table 2 : Newey-West regression result for contemporaneous relationship

The F-statistic indicates that the model for Malaysia and Indonesia are well-specified; which is supported by the significant p-values (0.031 for Malaysia and 0.043 for Indonesia). Singapore, however, fail to make the cut as the recorded p-value of F-stat is 0.0552, slightly higher than 0.05 significance level. However, this value is still acceptable since it is not too far from 0.05. In terms of individual significance of the independent variable, the trading volume is found to be significantly related to stock returns in Malaysia and Indonesia in 95% confidence interval as the countries recorded p-values of t-statistics of 0.031 and 0.043 respectively. Both p-values are significantly lower than 0.05, hence the null hypothesis for both countries are successfully rejected. Thus, it can be said that trading volumes have positive predictive power over stock returns in both of the two countries.

Since trading volumes in all countries had shown significant positive association to the stock market return, the analysis is taken a bit further to consider the effects of conditional variances and establish more rigor into the findings. This is undertaken by running the following GARCH (1,1) estimations.

GARCH (1,1) model

On top of the Newey-West regression, GARCH (1,1) test for contemporaneous relationships is undertaken in order to include other effects on conditional variances into the estimation. This model has the advantage of offering considerable flexibility in robust modeling of stock returns, hence is used to complement the earlier findings. The results are presented in table 3 below:

Z-statistics	**Malaysia**	**Singapore**	**Indonesia**
Constant (θ)	-2.195087	-1.887198	-0.3355161
(p-values)	(0.0000)	(0.0001)	(0.3250)
Trading Volume (ω)	0.122139	0.1023116	0.024855
(p-values)	(0.0000)	(0.0250)	(0.1600)

Table 3 : GARCH (1,1) regression result for contemporaneous relationship

Trading volume is found to have a positive contemporaneous relationship to the Malaysian stock market return that is similar to the results found from the Newey-West regression. The relationship is significant at 1%, since a p-value of 0.000 is obtained and hence the null hypothesis is rejected. For the sake of forecasting, the 0.1221 omega coefficient carries the implication that any 1% increase in trading volume will increase the Malaysian stock market return by 0.1221%, ceteris paribus.

For Singapore, the result shows that a positive dynamic relationship does exist between trading volume and stock market return in the market, also corroborating to the results found in Newey-west regression earlier. The null hypothesis is successfully rejected as the calculated p-value is significant at 0.025. The elasticity coefficients imply that on average, any 1% increase in trading volume will add to the stock index return by 0.10%, all else being equal. Nevertheless, the effect is minimal since the value of coefficient is quite small.

In contrary to the previous results, the Indonesian market, however, exhibit no significant contemporaneous relationship between trading volume and stock market as the independent variable failed to register a significant p-value ($p = 0.16 > 0.05$). Unlike the other two markets, the null hypothesis for the Indonesian case is failed to be rejected and hence, slightly contradictory to the findings in Newey-West technique. This also indicates the presence of heteroskedasticity in the Indonesian dataset, which is greatly constrained and penalized by the GARCH (1,1) method.

Hence, several overall conclusions can be drawn out of the findings from these two techniques. Firstly, trading volume in all markets are significant in explaining stock market returns under both methods, with exception to the Indonesian case. Secondly, it can be generally deduced that trading volume has positive relationship with stock market returns, hence, an increase in trading volume will increase stock return. Thirdly, the effect or elasticity of return to changes in trading volume is very small; and fourthly, there has to be a large change in trading volume before it can result in moderate level of change in stock returns. These findings will be further elaborated in chapter five, alongside with other important findings of the study.

Granger causality tests

This series of tests are intended to check on the validity of hypotheses number two and three. Lag length for each Granger causality estimates were obtained from the regression. The lag is chosen based on the AIC, HQIC and SBIC, depending on which lag received the most asterisks from the three measures. To simplify the task, decision is also made based on the p-value of each lag, where the highest lag with significant p-value (less than 0.05) is chosen. Table 4 below summarizes the Granger causality test results for each pairs of volume and returns. Panel 1 highlights the causality running from trading volumes to stock returns and vice versa within the same markets while panel 2 of table 4 contains the results of causality among and between the two variables in different markets.

Null Hypotheses	Obs	P> chi-sq	Lags	R-sq	Prob. > F – stat.
Panel 1: Between local trading volumes and returns for each countries					
LVOL_KLCI does not G-Cause RETURN_KLCI	2,489	0.0000	10	0.0245	0.228
RETURN_KLCI does not G- Cause LVOL_KLCI		0.0000		0.8280	0.056*
LVOL_STI does not G-Cause RETURN_STI	2662	0.0221	6	0.6828	0.344
RETURN_STI does not G- Cause LVOL_STI		0.0000		0.0088	0.368
LVOL_JCI does not G-Cause RETURN_JCI	2104	0.0000	10	0.8550	0.387
RETURN_JCI does not G-Cause LVOL_JCI		0.0000		0.0295	0.502
Panel 2: Between cross-country trading volumes and returns					
LVOL_KLCI does not G-Cause RETURN_STI	2227	0.0000	10	0.8207	0.847
RETURN_STI does not G- Cause LVOL_KLCI		0.0032		0.0183	0.168
LVOL_KLCI does not G-Cause RETURN_JCI	2001	0.0000	8	0.8344	0.848
RETURN_JCI does not G-Cause LVOL_KLCI		0.0634		0.0125	0.850
LVOL_STI does not G-Cause RETURN_KLCI	1454	0.0000	15	0.6867	0.025**
RETURN_KLCI does not G-Cause LVOL_STI		0.0000		0.0753	0.139
LVOL_STI does not G-Cause RETURN_JCI	1904	0.0000	7	0.6886	0.226
RETURN_JCI does not G-Cause LVOL_STI		0.0014		0.0181	0.841
LVOL_JCI does not G-Cause RETURN_KLCI	1595	0.0000	10	0.8615	0.666
RETURN_KLCI does not G-Cause LVOL_JCI		0.0000		0.0351	0.293
LVOL_JCI does not G-Cause RETURN_STI	1001	0.0000	19	0.8769	0.051**
RETURN_STI does not G-Cause LVOL_JCI		0.0000		0.0918	0.418

****Represents the causal relationship being significant at 1%.*
***Represents the causal relationship being significant at 5%.*
**Represents the causal relationship being significant at 10%.*

Table 4: Pairwise Granger Causality Tests (between volume and return)

In terms of causality running between trading volumes in each country and the stock market returns, it can be concluded that not much relationship is going on. In Malaysia, the trading volume is not significant in causing the stock market return as the p-value is recorded at 0.228, higher than 0.05 significance level. However, the KLCI market return is significant at 10% level in Granger-causing its trading volume, as a p-value of 0.056 is recorded.In sum, there is a significant unidirectional causality relationship running from return to volume hence the null hypothesis that return does not Granger cause volume is successfully rejected, while the opposite null hypothesis is failed to be rejected.

Looking at the results in panel 2, the Malaysian market trading volume also fails to Granger-cause stock returns in Singapore and Indonesia. These are evident by the insignificant p-values of 0.847 and 0.848 recorded in each markets respectively. The null hypotheses that trading volume in Malaysia Granger-cause stock market return in Singapore and Indonesia are thus, failed to be rejected. The opposite is also holding true. The stock market returns in both Singapore and Indonesia also found not to significantly Granger-cause the Malaysian trading volume, as they both recorded p-values of 0.168 and 0.850 respectively. Hence, both of the null hypothesis associating stock market returns in Singapore and Indonesia to Granger-cause trading volume in Malaysia failed to be rejected. In conclusion, the Malaysian trading volume has no significant causality relationship with all of the Malaysian, Singapore and Indonesian stock market returns. In the opposite way, there is also no causality from Singapore and Indonesian stock returns to the Malaysian market trading volume. The Malaysian stock return is the only variable found as significant in Granger-causing its own trading volume, hence suggesting only a unidirectional causality relationship.

For Singapore (refer to panel 1), no causality is found between trading volume and stock return. This is

because both causality tests running from trading volume to stock return, vice versa recorded insignificant p-value readings of 0.344 and 0.368 respectively. However, in panel 2, there is an evidence that the Singaporean trading volume causes foreign stock returns, as a p-value of 0.025 is recorded from Singaporean trading volume to the return of KLCI. This pair is significant at 5% level, which also means that the null hypothesis is successfully rejected. The trading volume in Singapore may cause changes in stock market returns in Malaysia, nevertheless, the opposite causality is insignificant at p-value of 0.139. Lastly, there is also no causality between Singaporean trading volume and Indonesian stock market return. Insignificant p-values of 0.226 and 0.841 are recorded for the volume-return and return-volume pairs respectively. In conclusion, trading volume in Singapore is only related to the Malaysian stock return (with unidirectional causality); while no stock returns in any country can Granger-cause the Singaporean trading volume.

For the case of Indonesian trading volume, the variable is found not to Granger-cause the Jakarta Composite Index, as a p-value of 0.387 is obtained for the pair. The same goes to the other way around, as it recorded an insignificant p-value of 0.502. Both of the null hypothesis are thus, failed to be rejected. Trading volume in Indonesia is also found not to be having any Granger-causality relationship with the Malaysian stock market return as p-values of 0.666 is recorded for causality from volume to return and 0.293 for return to volume, thus both null hypotheses are failed to be rejected. However, trading volume of the Indonesian market is found to Granger-cause the STI return at roughly 5% level, successfully rejecting the null hypothesis. On the other way around, Singapore stock market return does not Granger-cause Indonesian trading volume, based on the 0.418 p-value thus, the null hypothesis is failed to be rejected. In conclusion, just like Singapore trading volume, the Indonesian volume does not Granger-cause its own stock market return, but is associated to the returns in other stock markets instead.

In sum, there are only three significant pairs observed from the causality analysis thus far. It is interesting to note that (1) the Malaysian returns can Granger-cause its own volume but not the other way around; (2) the Singapore trading volume can Granger-cause KLCI return; and (3) Indonesian trading volume has a causality relationship with STI returns. Some inter-market relationships can be observed from the results as trading volume in one country may explain the variation of returns in other markets.

To continue with the analysis, table 5 below shows the results of pairwise Granger causality tests among and between each countries' trading volume.

Null Hypotheses:	Obs	Prob. > Chi-sq	Lags	R-sq	Prob. > F – stat.
LVOL_STI does not G-Cause LVOL_KLCI	1106	0.000	20	0.6826	0.000***
LVOL_KLCI does not G-Cause LVOL_STI		0.000		0.7935	0.062*
LVOL_JCI does not G-Cause LVOL_KLCI	1432	0.000	11	0.8593	0.400
LVOL_KLCI does not Granger Cause LVOL_JCI		0.000		0.8318	0.206
LVOL_JCI does not G-Cause LVOL_STI	1155	0.000	13	0.7625	0.000***
LVOL_STI does not G-Cause LVOL_JCI		0.000		0.6490	0.000***

****Represents the causal relationship being significant at 1%.*
***Represents the causal relationship being significant at 5%.*
**Represents the causal relationship being significant at 10%.*

Table 5 : Pairwise Granger Causality Tests (between volume of each market)

STI and KLCI volumes are found to bi-directionally Granger-cause one another. Singaporean trading volume records a p-value of 0.000 against the Malaysian trading volume; significant at 1% level, hence rejecting the null hypothesis. The same goes to the other way around, where Malaysian volume is significant at 10% level to cause Singapore volume as a p-value of 0.062 is recorded. Similarly, a significant at 99% level bidirectional causality is detected as running between Singapore and Indonesian trading volumes. Both of the null hypotheses are rejected at once here, indicating that volumes in both of the markets do cause one another and move in the same direction. However, the Indonesian and Malaysian trading volume showed no causality at all in any direction as indicated by the 0.400 and 0.206 p-values. Hence, it can be concluded here that Singapore trading volume is Granger-caused by and Granger-causing both Malaysian and Indonesian volumes, but the Malaysian and Indonesian volumes do not interact with one another. Arguably, almost all of the trading volumes exhibit strong causality between one another as evidenced by the high R-square values. Moderate to strong explanatory powers were recorded between the pairs of variables in each markets, indicating that trading volumes in different neighboring markets do move in almost the same pattern through time.

Lastly, table 6 below concludes the causality tests by summarizing the Granger-causality tests results for the pairs of inter-market returns.

Null Hypotheses:	Obs	Prob. > Chi-sq	Lags	R-sq	Prob. > F – stat.
RETURN_STI does not G-Cause RETURN_KLCI	2901	0.000	5	0.0218	0.000***
RETURN_KLCI does not G-Cause RETURN_STI		0.000		0.0088	0.010***
RETURN_JCI does not G-Cause RETURN_KLCI	2531	0.000	5	0.0289	0.000***
RETURN_KLCI does not G-Cause RETURN_JCI		0.000		0.0140	0.718
RETURN_JCI does not G-Cause RETURN_STI	3386	0.000	1	0.0193	0.479
RETURN_STI does not G-Cause RETURN_JCI		0.000		0.0010	0.000***

****Represents the causal relationship being significant at 1%.*
***Represents the causal relationship being significant at 5%.*
**Represents the causal relationship being significant at 10%.*

Table 6 : Pairwise Granger Causality Tests (between returns of each market)

The results suggest bidirectional causality between KLCI and STI returns, as indicated by 0.000 p-value for the case of STI returns to KLCI returns, and 0.01 for the case of KLCI to STI. Both of the pairwise causality is significant at 99%, indicating rejection on both of the null hypotheses. Nevertheless, the R-square values are very small and almost negligible as STI return can only explain 2.18% of KLCI return while KLCI return can only explain STI return by 0.88%. Return of KLCI is also caused by JCI return at 1% significance level; hence, the null hypothesis is rejected. However, the opposite causality from Indonesian to Malaysian market return does not take place as a p-value of 0.718 is recorded. Only a unidirectional relationship is observed between the pair. The R-square value for this pair is also very small at 2.89%.

Similarly, a unidirectional causality is recorded running from Singaporean return to Indonesian return at 1% level while the opposite causality is insignificant due to the p-value of 0.479. Thus, only the null hypothesis for the case of STI return to JCI return is rejected while the reverse is failed to be rejected. Just like the other two markets, the R-square indicates that Singapore return can only explain the variation of Indonesian return by less than 1%. Therefore, even though the causality is present, the strength of association between the pairs of stock market returns is still questionable. It is to be noted here that all of the tests are considered well-specified due to the fact that none of the pair exhibit insignificant p-value reading on the chi-square distribution except two which are the causality from Singapore return to Indonesian return and Indonesian return to Malaysian volume. With at least 1,000 observations taken into consideration in each pair of variables, these results are considered valid and reliable. This point will be further validated by the following test results accompanying the Granger-causality estimation in Stata. The series of tests involved are Lagrangian Multiplier test for autocorrelation, Jarque-Bera test for skewness and kurtosis (normality) and Eigenvalue stability condition tests.

Causality between trading volume and volatility of stock returns

The following table 7 contains the Granger-causality results for the pairs of trading volume and volatility of stock returns for both local and cross-country cases.

Null Hypotheses	Obs	P > chi-sq	Lags	R-sq	Prob. > F – stat
Panel 1: Between local trading volumes and volatility of returns for each countries					
LVOL_KLCI does not G-Cause VARIANCE_KLCI	3451	0.000	8	0.1052	0.000***
VARIANCE _KLCI does not G-Cause LVOL_KLCI		0.000		0.8256	0.000***
LVOL_STI does not G-Cause VARIANCE _STI	2967	0.000	9	0.8222	0.052**
VARIANCE _STI does not G-Cause LVOL_STI		0.000		0.6857	0.000***
LVOL_JCI does not G-Cause VARIANCE _JCI	3171	0.000	9	0.8410	0.888
VARIANCE _JCI does not G-Cause LVOL_JCI		0.000		0.8590	0.148
Panel 2: Between cross-country trading volumes and volatility of stock returns					
LVOL_KLCI does not G-Cause VARIANCE _STI	3400	0.000	10	0.8984	0.020**
VARIANCE _STI does not G-Cause LVOL_KLCI		0.000		0.8255	0.844
LVOL_KLCI does not G-Cause VARIANCE _JCI	3171	0.000	9	0.2628	0.878
VARIANCE _JCI does not G-Cause LVOL_KLCI		0.000		0.8586	0.818
LVOL_STI does not G-Cause VARIANCE _KLCI	2862	0.000	9	0.0763	0.000***
VARIANCE _KLCI does not G-Cause LVOL_STI		0.000		0.6876	0.467
LVOL_STI does not G-Cause VARIANCE _JCI	2862	0.000	9	0.8258	0.991
VARIANCE _JCI does not G-Cause LVOL_STI		0.000		0.6882	0.798
LVOL_JCI does not G-Cause VARIANCE _KLCI	3171	0.000	9	0.2628	0.878
VARIANCE _KLCI does not G-Cause LVOL_JCI		0.000		0.8586	0.818
LVOL_JCI does not G-Cause VARIANCE _STI	3148	0.000	9	0.8958	0.528
VARIANCE _STI does not G-Cause LVOL_JCI		0.000		0.8602	0.000***

***Represents the causal relationship being significant at 1%.
**Represents the causal relationship being significant at 5%.
*Represents the causal relationship being significant at 10%.

Table 7 : Pairwise Granger Causality Tests (between volume and volatility)

The analysis will begin by observing the results that are presented in panel 1 of the above table 7. The p-value of chi-square results suggests that all estimations are well-fitted. The results also suggest for a bidirectional causality relationship between trading volume and variance (volatility) of stock returns in the Malaysian stock market, as evidenced by the 0.000 p-values. A weak predictive power is documented running from volume to volatility (by 10.52%), but a strong relationship is seen running the other way around which is by 82.56%. The same conclusion can be drawn from the Singaporean case, whereby both parts of the causality registered significant results at 5% and 1%. Thus, there are also bidirectional causality relationships between volume and volatility in the Singapore market. The strength of association is high, since volume can explain volatility by 82%, while volatility explains volume by 68.5% in the market. However, Indonesian market failed to register any significant reading of p-value to justify a causality relationship going on. Therefore, it can be concluded that there is no causality relationship between volume and return volatility in the Indonesian market.

Panel 2 of table 7 summarizes the Granger-causality results for the cross-country pairs of variables. Similarly, the models are well-fitted as evidenced by the significant chi-square values. The Malaysian trading volume is found not to Granger-cause or be Granger-caused by volatilities of JCI since both of the p-values are insignificant. However, a significant unidirectional cause-and-effect relationship is observed running from KLCI volume to STI's return volatility. Likewise, the STI trading volume is also not associated at all to the Indonesian market's return volatility, since both of the pairs did not produce any significant p-value readings. The only causality is seen running from Singaporean's trading volume to the Malaysian return, which is significant at 1% level. However, the association is not as strong since a very small R-square value of 0.0763 is recorded, suggesting that the Singapore market volume can only explain 7.63% of the Malaysian market return volatility. Finally, the Indonesian trading volume is not associated with the Malaysian stock return volatility, since the pairs failed to produce any significant readings on p-value. It also cannot Granger-cause the Singaporean volatility, as evident by the 0.528 p-value. However, the Singapore return volatility

does have a significant causality relationship with the Indonesian volume, and this association is strong at 86.02%.

As the general conclusion from these inter-market Granger-causality test results, the volumes of KLCI and STI have the power to cause the volatility in each other's stock returns, but not to the JCI. In relation to the local volume-volatility relationship, both Malaysian and Singapore variables are able to significantly Granger-cause each other. This implies that the volume and volatility of returns in the two markets are interrelated to one another. However, the opposite is true for the Indonesian case, where the trading volume and volatility are not causing each other at all. These results highlight the weak association contained in the Indonesian stock market variables in relation to its own and other markets' variables.

CONCLUSION

The first objective of the study is to examine the contemporaneous and dynamic relationships between trading volume and stock indices returns in Malaysia, Singapore and Indonesia. This objective is realized using three methodologies, which are Newey-West and GARCH (1,1) regressions for contemporaneous relationship and Granger causality for dynamic relationship.

Firstly, on the contemporaneous relationship, there are significant positive relationships between trading volume and stock returns in all countries of concern. More precisely, the Newey-West test reveals that the trading volume in Malaysia and Indonesia are significant at 5%, while Singapore's is marginally significant at 10%. The GARCH (1,1) test results echoes the earlier findings, but also point that the Indonesian trading volume is insignificant in explaining the stock returns. In sum, these results suggests that trading volume does influence the movements of stock returns in Southeast Asia, and higher volume tends to be associated to higher stock returns; albeit in very small elasticity. Therefore, investors may use this indicator as a signal for profit-making situation and to avoid going long on common stocks during times when trading volumes are in a falling trend. Several overall conclusions can be pinched out of the findings from these two techniques. Firstly, trading volume in all markets is significant in explaining stock market returns under both methods, with exception to the Indonesian case. Secondly, it can be generally inferred that trading volume has positive relationship with stock market return, hence, an increase in trading volume will increase stock return. Thus, the null hypothesis number 1 is successfully rejected. Thirdly, the effect or elasticity of return to changes in trading volume is very small; and fourthly, there has to be a large change in trading volume before it can result in moderate level of change in stock returns.

This positive association between volume and return is in accordance to the results of most of the past studies. As the Wall Street adage states, "it takes volume to move prices", the academic world is pleased that volume movement causes price changes in similar direction. Some of the past studies that share the same finding in the emerging markets are Moosa and Al-Loughani (1995) who finds that the relation of price-volume in Southeast Asian is contemporaneous, lagged and positive; and Ratner and Leal (2001) who find a positive contemporaneous relation between return and volume in the Latin and Asian financial markets. The positive relationships are as expected since the increase in trading volume represents the growing demand and interest in the market (from the market participants) which, tends to make the price moves more abruptly. The buying and selling activities made by traders influences the price to move up and down and since more traders are actively buying and selling, the price changes will be more aggressive. This finding is consistent with Lamoureux and Lastrapes (1990) in USA, Dan *et al.* (2013) in China and Naka and Oral (2013) in Turkey.

Secondly, on the dynamic relationship, the Granger causality shows that none of the local trading volumes is significant in explaining the variation in the respective countries stock market returns. The same goes for the other way around, except for the KLCI return which is significant at 10% level in Granger-causing its trading return. In other words, only a unidirectional causality running from return to volume is observed, indicating a rejection of null hypothesis number 2. Even though this result is supportive to the one found by Léon (2007) in Africa, it is rather in contrary to this paper's results on the contemporaneous relationship; which suggest a strong explanatory power borne by trading volume onto stock returns. It is also in contrary to Moosa and Al-Loughani (1995) who find bidirectional relationships between the same two variables in the same markets. However, when taken together, trading volume does contain some information that is useful in predicting future dynamic of stock market returns in Southeast Asia.

The second objective of this study is to seek to determine the dynamic relationship between trading volumes and return volatility in each of the Southeast Asian stock markets. This objective is achieved by administering the pair wise Granger-causality tests between two pairs of variables within the same markets. As a general conclusion, volumes and volatility are able to significantly Granger-cause each other in the stock markets of Malaysian and Singapore, which calls for the rejection of null hypothesis number 3. This implies that the volume and volatility of returns within the two markets are internally interrelated to one another. Trading volume will cause fluctuation in share price and hence, return whereas in reverse, volatility

of return will affect the number of shares being traded in the exchange. This finding corroborates the Sequential Information Arrival Hypothesis (SIAH) which suggests that information are relayed into the stock market participants in stages, hence there tend to be multiple transitional equilibrium points established before the true equilibrium point is met. Therefore, there are many opportunity for the two variables to be intertwined by the forces in the market, and hence, it explains why the two variables may interrelate with one another.

However, the opposite is true for the Indonesian case, where the trading volume and volatility are not causing each other at all. These results highlight the weak association contained in the Indonesian stock market variables in relation to its own market variables. Given the high degree of fluctuation in share volume and return in the market (as described in descriptive statistics), there must be other variables that can explain this phenomenon.

Along with the second objective, comes the requirement to model the volatility of the respective countries' stock market returns, which becomes the third objective of the study. The objective is achieved by running the GARCH (1,1) model.

The results expose that only Singapore market's long-term volatility is significant in influencing its overall volatility of stock return. However, the observed relationship is negative, which implies that that the long-term volatility is negatively factored into the current volatility. In other words, the stock return's volatility moves in opposite way from the long-term variance. The lagged square returns (representing the adjustment to past shocks) are found to be significantly explaining the variation in stock return volatility in all countries. The alpha value ranges from 0.61 to 0.96, which means that the stock markets return in Southeast Asia are sensitive to their own past return series. Since the coefficients are positive, traders are advised to use the past return as an indicator for future volatility of returns. For example, if today's stock return is positive, one can expect that tomorrow's return will be volatile whereas if today's return is negative, the next trading day will be most likely be characterized by small changes in stock prices.

The shock in past returns is the variable that carries the most weights in influencing the three markets' volatility of return. Singapore stock returns, in particular is the one that is most sensitive to its past returns since the rate of decay is very slow and the effect is likely to persist in longer period as compared to the other two markets. In other words, Singapore market has the highest volatility and persistence than Malaysia and Indonesia. This is in contrary to Michelfelder and Pandya (2005), which suggest that emerging markets have higher volatility but lower persistence of shocks as compared to the more mature markets. The lagged variance (representing adjustment to past volatility) is also found to be significant in all three countries. However, the lagged variances are less influential as compared to the squared return in explaining the return volatility. This implies that the current volatility of return is influenced by the past volatility. For the matter of forecasting, if today's volatility increases, the future volatility is more likely to slightly increase as well.

In terms of decay effect, all of the stock market returns volatility dissipates only slowly going into the future. Any momentum created by shocks in today's rate today is likely to continue going into the far future especially in Singapore. This carries significant impact especially in knowing to what extent does the momentum created by a shock, say, a financial crisis or major macroeconomic event will pose onto the stock market's performance in the countries. For Singapore in particular, the trend will be likely to persist for a longer time as compared to Indonesia and Malaysia. The good implication about this observation is that any large price increase will bring about larger swing in the future; which amplifies profitability, but so does large price falls; which can amplify losses. Therefore, even though it is more risky to invest in the Singaporean market as compared to Malaysia and Indonesia, the incentive from assuming the added risks may also be handsomely rewarding. In addition to that, the volatility of stock market returns in all three markets tends to adjust to past volatility in moderate pace. This means that past variances are moderately factored into the return volatility and the effect will die in a short time.

In overall, these results are in accordance to those found by Pisedtasalasai and Gunasekarage (2007) who studied the same markets and found that the volume in some markets contain information that is useful in predicting future dynamics of return volatility. The same view is shared by Ahmed *et al.* (2005) who concluded that the current volatility in Southeast Asian stock market could be explained by past volatility that tends to persist over time. Other earlier studies by Najand and Yung (1991), Foster (1995), and Huang and Yang (2001) also reside behind the same view.

Objective number four is dedicated to investigate any cross-market interaction between trading volume and stock returns, and between trading volume and return volatility in the region. This objective is realized with the aid of the pairwise Granger causality test. Between one market stock returns and trading volumes in another, the results revealed that not much significant relationship is going on between the three countries. Only two pairs of variables are significant, which are: Singapore's trading volumes onto Malaysian stock returns, and Indonesia's trading volumes onto Singapore's returns. The rest of the pairs are recorded insignificant results. The findings suggest that there exist some explanatory power in trading volumes of

Singapore and Indonesia in affecting the return in another market. This finding also lend support to the contagion effect theory proposed by King and Wadhani (1990) in which traders draw inferences by observing variables from another stock market, leading the variables to link up to some extent.

In terms of inter-market relationships between volumes in two different markets, there seems to be more positive results. Bidirectional causality relationships exist between Singapore and Malaysian trading volumes, as well as between Singapore and Indonesian trading volumes. The Malaysian and Indonesian trading volume, on the other hand, failed to register any significant result. This finding suggests a strong association stemming from Singapore to the other two markets where volumes in Singapore tend to Granger-cause those of Malaysia and Indonesia. All in all, the null hypothesis number 4 is also successfully rejected. As the implication, traders may aim to look at the Singapore's volume movements and use it to infer a prediction into the other two markets. Looking on the theoretical aspect, this finding is also supporting King and Wadhani's contagion theory mentioned earlier. More interesting results are obtained from the pairs of inter-market returns. In contrary to the results found by Mitchelfelder and Pandya (2005) who posit that developing countries' stock returns are not linked to one another, this study had proved otherwise. The Singapore market return is associated bi-directionally to Malaysian return, and uni-directionally to Indonesian return. Again, this suggests a strong association between Singapore returns to its neighbors. The Malaysian and Indonesian market returns tend to be affected to what is happening in Singapore, perhaps because the Singaporean market is more advanced, more developed and is one of the major financial centers in the world. On the other hand, Indonesian market return is able to Granger-cause those in Malaysia but Malaysian returns could not return the favor.

On the causality between trading volume and return volatility in cross market perspective, the volumes of KLCI and STI have the power to cause the volatility in each other's stock returns, but not to the JCI. This implies a mutually strong inter-variable causality relationship between Malaysian and Singaporean markets, as well as a weak relationship possessed by the Indonesian market variables onto the other two markets. It also means that the investors in Malaysia and Singapore may infer trading decisions by looking at the trends in each other's variables, hence supporting for a rejection on null hypothesis number 5. On the other hand, investors in Indonesia may find it not useful to look into volatility data of the neighboring two markets. Despite the mixed findings, these evidences are enough to conclude that the stock market returns in neighboring countries in Southeast Asia are interrelated to some extent, with Singapore being the center of gravity that binds them up together. These findings also lend support to the contagion theory or spillover effect. Indeed, the financial variables in different markets may be related to one another and hence, one may infer trading decisions in one market by referring to the trends in another. This is also consistent with Lee and Rui (2012) who suggest that markets with overlapping trading period may share many characteristics in the stock market variables movement. Sabri (2008) also stand behind the same argument as he found that the volume-stock price movements in Arab stock markets are significantly integrated.

The fifth and final objective of the study is to find evidence supporting either Mixture of Distribution Hypothesis (MDH) or the Sequential Information Arrival Hypothesis (SIAH) in the three stock markets. This objective can be realized by looking at the findings that have been discussed thus far. Both theories concern about the flow of information to the stock market, with trading volume being a proxy that implies the information movement within the market. Copeland (1976) developed the SIAH model which essentially contends for a positive bidirectional relationships between return and volume. On the other hand, Clark (1973) posits a positive unidirectional causal relationship running from trading volume to stock returns in his MDH theory.

This study finds only a unidirectional relationship between Malaysian market's return and volume. In addition to that, Singapore's trading volumes are also able to Granger-cause Malaysian return while Indonesian volumes are also able to cause the Singapore's return. Therefore, it is quite clear that the study lends support to the Mixture of Distribution Hypothesis. In this theory, trading volume represents a mixture of disagreement among market participants about future movement of stock prices and as they revise the prices of their market orders, this will increase the level of trading volumes. In turn, the market return will be affected. This finding is consistent to those of Ahmed and Nasir (2005), Pisedtasalasai and Gunasekarage (2008) and Tan and Tay (2011), among all who studied the interactions between volume and stock returns in the same Southeast Asian markets. In concurrence to this study, all of them also found that trading volumes contain information that is useful in predicting future returns and volatility.

Nonetheless, another interesting finding to mention is in terms of the relationships between the pairs of local volume to its return volatility. This study found evidence that the two variables are bi-directionally causing one another in Malaysian and Singaporean markets. Taking these findings into account, a support on the SIAH is established. This asymmetric information model hypothesizes that new information reaches one market participants at a time, instead of simultaneously. This normally happens in markets which are characterized by high number of individual investors and less efficient; which fits the character of the Southeast Asian markets. Due to the sequence of information flow, lagged volatility may have the ability to

predict current trading volume and, vice versa. The same finding echoes through many other developing exchanges such as in Brazil (De Medeiros & Van Doornik, 2006), Middle East (Sabri, 2008) and Africa (Léon, 2007).

Limitations of the study

A study is only as relevant as the samples that make up its findings. Therefore, the fact that this study only employs datasets from three Southeast Asian countries is an issue that can be addressed in the future by expanding the sample size. The inclusion of more entities into the dataset could help to improve the rigor of the findings as well as enrich the academic world. Secondly, the study is only concentrating on the developing stock exchanges in Southeast Asia, while there are numerous other markets that share the same characteristics and may be very well fit into consideration. In addition, the focus on samples coming from a nearby region will involve the inclusion of regional risks into the picture. Adverse conditions coming from political, economic and environmental aspects of the region may exogenously influence the variables and distort the overall findings.

Another issue to mention is the sample period that covers daily data from year 2000 to 2014. A major economic crisis had happened in between of this period, hence may actually affect the findings.

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