Analysis of Stock Market Integration Among ASEAN Countries by Using Vector Error Correction Model (VECM) Approach

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Abstract

Globalization has driven the economy of countries to relate to each other. It brings relationships in the capital among countries in the world, especially in ASEAN region countries. This study aimed to analyze the integration of the stock market among countries in the ASEAN region. The stock market was analyzed are the Indonesia Stock Exchange, Malaysia Stock Exchange, Singapore Stock Exchange, Thailand Stock Exchange, Vietnam Stock Exchange, and Philippine Stock Exchange. This study using the Vector Error Correction Model (VECM) as the method. The result of this study shows that, in the long term Singapore Stock Index (STI), Malaysia Stock Index (KLSE), Philippines (PSEi), and Indonesia Stock Index (JKSE) are positively correlated. This means the change of stock index price in one country will affect other related countries in the long term. In the short term of VECM estimation, found the Vietnam Stock Index (VNI), Singapore Stock Exchange (STI), Philippine (PSEi) are positively correlated and negatively correlated with Thailand Stock Exchange (SET). For the managerial implication, the result of this study is expected as a reference or basis of consideration of investment decisions. This because long-term stock market movements are important because they impact international portfolio management and risk diversification.

Keywords: Integration, Capital Market, ASEAN, VAR/VECM

I.   INTRODUCTION

Globalization has changed everything in the world, especially in the economic sector. It changes the economic system of countries into an open economic system. The open system of a country's economy can make the country mutually integrated and mutually dependent on one another. Mutual integration between countries will make relations between countries are getting stronger and create obstacles in doing so, trade between countries will disappear, and capital mobility between countries will be smoother. However, in addition to providing many benefits, it will also have a negative impact. Namely, countries will quickly respond to the influence of countries experiencing a crisis. The stability of the country's economy is also determined by events that occurred both domestically and externally. Event volatility in other major countries to affect the condition of the nation's economy; in the end, it will have an impact on the stock price movement of capital market integration in a particular area.

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Usually, a strong country's economy can affect a weaker country's economy. As well in terms of investment. Today, investing activities are no longer limited by distance, time, and place. This is due to technological developments that make the capital market in the world able to integrate. With the integrated capital market in the world, investors can estimate the return that will be obtained in the capital market, where he invests capital with the integrated capital markets of other countries. In Asia, especially in ASEAN countries, the stock market in those countries are interesting for investors, due to the ASEAN countries mostly consist of developing countries and investment especially in the stock market in developing countries have a higher return than developed countries.
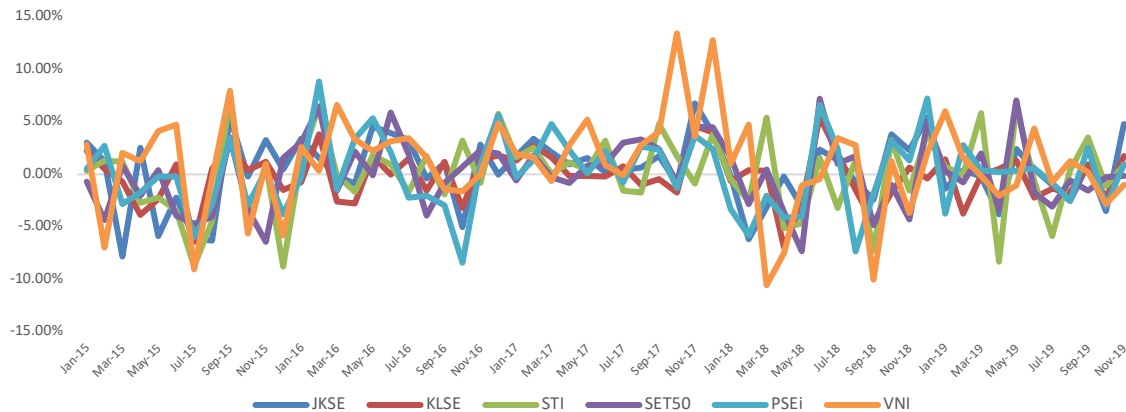

Figure 1. Stock Index Performance of ASEAN Countries

Integration in the capital market could lead to some advantages and disadvantages. The advantage of this integration makes the stock market more competitive; each county will attempt to facilitate investors in order to make investors interested to invest in their countries. Because it is important for countries due to capital market has big potential to gain funds. But on the investor's side, the integration of the capital market among counties could increase their systematic risk, risk, which can not be avoided through diversification.

II. LITERATURE REVIEW

Capital market is a market where bridging between those who needed long-term funds (company) and those (investors) who are needed investment instruments on financial products such as stocks, bonds, mutual funds, and others. On the other hand, stock markets are where government and industry can raise long-term capital, and investors can purchase and sell securities (Masoud, 2011). Not only government institutions but also private companies can raise log-term capital through the capital market. A stock market stock index is a statistical measurement, typically using weighted arithmetic mean, which reflecting all stocks or certain stock price movements. Movement in the stock index is driven by the movement of each stock in the index, but not all stocks in the index could affecting the stock index movement; only stock which has a large market cap could affect it. An equity index is a portfolio of stocks, chosen according to simple, predefined rules, and designed to capture a particular investment style (Broby, 2011). A composite stock index functioned to know the rate of market performance in terms of its price movements. It also reflects the level of return of stocks (Wauran & Tumbuan, 2017).

The integration in the capital market generally measures the integration of the global capital market from the perspective of price. A first approach is a direct approach, which involves the law of one price and price equality; a second approach is an indirect approach, which measures the level of price movement or the dependency between the capital market in the short-term and long-term. (Dhanaraj et al., 2013). A contagion Effect is a contagious event of an economic movement from

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one country or region to another country or region. According to Eichengreen, Andrew, and Charles (1996), The contagion effect can be caused by the existence of economic interdependence relationships such as macroeconomic similarities and relationships trade between countries. The second cause is more emphasis on the behavior of the originating investors from the asymmetry of information, collective behavior, and loss of trust without seeing the macro performance of the country concerned. Some studies have been conducted regarding the integration and contagious effect in the capital market. A study conducted by Robiyanto Robiyanto (2017) by using the Orthogonal Generalized Autoregressive Conditional Heteroscedasticity (OGARCH) approach found that the stock market in Indonesia, Malaysia, Thailand, and Singapore are integrated, but the Philippines stock market is not integrated. Another study also conducted by Neame and Raj, and Dhal by using the Johansen cointegration approach with daily and weekly data found that the GCC and Indian stock markets are integrated with other stock markets in the world. This means investing in the Indian Stock Market, offering international investors to diversify their portfolio risk. (Neame, 2002; Karim and Karim, 2008; Onour, 2009; Raj and Dhal, 2009).

This study analyzing whether the stock market among ASEAN countries are integrated and has a contagion effect potency by using a Vector Error Correction Model (VECM) approach. Vector Error Correction Model (VECM) is the restricted form of VAR due to the existence of non-stationary and cointegrated forms of data, which indicates a long-term relationship between variables in the VAR system. Vector Error Correction Model (VECM) is a model for analyzing time series data in a Vector Autoregressive (VAR) model, which is the stationary of the data at the first difference and has cointegration. Following is the general form of VAR, a model which is non-stationary variables:

$$Y_t = \mu + a_1 Y_{t-1} + a_2 Y_{t-2} + a_3 Y_{t-3} + \cdots + a_p Y_{t-p} + \varepsilon_t$$

Where Y_t is a vector containing the variable at a time -*t*, $a_1, a_2, a_3, \ldots, a_p$ is a parameter VAR (p), and Y_{t-p} is a vector containing the variable at time *t-p*. From Equation (1) can be formed the VECM   (equation as follows:

$$\Delta Y_t = \mu + a\beta' Y_{t-1} + \sum_{i=1}^{k} \Gamma_i \Delta Y_{t-1} + \varepsilon_t$$

Where, Δ is a differencing operator, with $\Delta y_t = y_t - {}_{at-1}$, Γ_i is a matrix coefficient   ($(p \, x \, p; j = 1,2,3, \ldots, k, \mu$ is a vector $(p \, x \, 1)$ which includes all determinant components in the system of equation, a, β stands for matrix $(p \, x \, r); 0 < r < p$ and r stand for the number of linear combinations of X_t which only effected by shock transistor $\beta' Y_{t-1}$: error correction term, namely the number of ballast inverting average on the cointegration vector on the data to $t - 1$, and a is a matrix of error correction coefficients.

III. RESEARCH METHODOLOGY

III.1. Data

Data used in this research is quantitative data, which is in the form of numbers and derived from secondary sources. The period of data used is from January 2015 to December 2019, which are including the historical data (the price of the stock index) of JKSE (Indonesia Composite Index), KLSE (Malaysia Composite Index), PSEi (Philippines Composite Index), SET (Thailand Composite Index), STI (Singapore Composite Index), VNI (Vietnam Composite Index). The stock price index of each country is transformed into a logarithmic (ln) form. The secondary data was obtained from investing.com, yahoo finance, related journal, and other relating literature.

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III.2. Sampling Method

The population in this research is all countries in ASEAN, which are there are ten countries included. But in this research only include six counties, that are Indonesia (JKSE), Malaysia (KLSE), Philippines (PSEi), Thailand (SET), Singapore (STI), Vietnam (VNI). The sampling method in this research is purposive sampling, which is set some criteria, (1) The country must have a stock market, (2) The stock market has established for long ago and has long performance in implementing domestic stock trading international stock trading, (3) Has complete data available on stock index price. By these criteria, then there are some countries that are not included, that are Myanmar, Laos, Brunei Darussalam, and Cambodia because the stock market in these countries is underdeveloped and not have complete data.

III.3 Methodology

A quantitative approach is used in this study due to the objective facts used as of how the reality of society is formed. Moreover, there are free values that can be measured and applying a statistical method for gathering the theory (Neuman, 2014). This research focusing on analyze a situation or a problem in order to explain the relationships between variables. The purpose of using an explanatory research model is to derive data and explain the relationships between stock Indexes in ASEAN countries. This research involved individual data observing (collecting) historical data from all global indices purposed in this proposal and also Jakarta Composite Index (JCI) in order to find out the relation between them.

This study using Vector Autoregression (VAR) and Vector Error Correction Model (VECM) method. The data processing in some stages in order to get the VAR/VECM model, which includes unit root testing, determining the optimum lag, VAR stability testing, cointegration testing, VECM, Impulse Response Function (IRF), and Variance Decomposition. Data processed by using E-Views 10 and Microsoft Excel.

IV. FINDING AND DISCUSSION

IV.1 Unit Root Test

The problem which often occurs in analyzing time series data is stationary. The stationary test is the most important step which analyzing the unit root existence among the data. This test is carried out So that the regression results do not produce false regressions (false regression). False regression is a regression that describes the relationship between two or more visible variables statistically significant when, in fact, it is not. Regression is spurious usually has a high R2 and a visible t-statistics significance, but the results cannot be interpreted properly in reality.

This study uses Augmented Dickey-Fuller (ADF) to test data stationarity. If data based on the ADF test is not stationary, the solution is to differentiate the process. Test the unit root of each variable in the research model based on the ADF test at a level. The test results can be seen below:

Table 1. Data Stationarity test result

Variable	Level			First Different		
	ADF Test Statistic	Critical Value 5%	Probability	ADF Test Statistic	Critical Value 5%	Probability
JKSE	-0.8631	-2.9117	0.7931	-7.0152	-2.9126	0.0000
KLSE	-1.9639	-2.9117	0.3017	-6.6150	-2.9135	0.0000
STI	-1.7033	-2.9126	0.4243	-9.5868	-2.9126	0.0000
SET	-1.2859	-2.9117	0.6306	-7.5985	-2.9126	0.0000
PSEi	-2.1940	-2.9117	0.2106	-6.9647	-2.9126	0.0000
VNI	-1.0038	-2.9117	0.7465	-6.4993	-2.9126	0.0000

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Source: Data Processed

Data are containing unit root at level or not stationer in the level stage. The value of probability at a level greater than a = 5% this means to accept the null hypothesis, that is, there is a unit root in the data or not stationer. While, from the first difference result, the probability value is less than a = 5%. It indicates that the data already stationed at the first difference and reject the null hypothesis.

IV.2 Optimum Lag Test

The optimum lag test is very important in the VAR model. The lag used in the VAR can be determined based on criteria for AIC, SC, or HQ. The optimum lag length test is very useful for eliminating autocorrelation problems in VAR systems so that with the use of optimal lag, it is hoped that problems will no longer arise autocorrelation. (Nugroho, 2009)

Table 2. Optimum Lag test result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2042.061	NA	8.90e+24	74.47493	74.69391	74.55961
1	-1818.009	391.0728	9.62e+21*	67.63667*	69.16955*	68.22945*
2	-1797.232	31.73147	1.75e+22	68.19025	71.03702	69.29112
3	-1749.673	62.25924*	1.30e+22	67.76992	71.93057	69.37888
4	-1712.557	40.49014	1.61e+22	67.72934	73.20388	69.84639
5	-1684.577	24.41904	3.42e+22	68.02097	74.80941	70.64611

Source: Data Processed

IV.3 VAR Stability Test

The stability of VAR needs to be tested first before carrying out a further analysis because if the VAR estimation results are combined with the correction model, unstable error, hence IRF (Impulse Response Function) and Variance Decomposition will be invalid (Setiawan, 2007 in Rusydiana, 2009). Following is the result of the VAR Stability test:

Table 3. VAR Stability test result

Root	Modulus
-0.092997 - 0.680712i	0.687035
-0.092997 + 0.680712i	0.687035
0.425498 - 0.429899i	0.604865
0.425498 + 0.429899i	0.604865
0.574614	0.574614
-0.554484 - 0.093160i	0.562256
-0.554484 + 0.093160i	0.562256
-0.513550 - 0.140668i	0.532467
-0.513550 + 0.140668i	0.532467
0.024742 - 0.352552i	0.353419
0.024742 + 0.352552i	0.353419
0.029317	0.029317

Source: Data Processed

It can be seen that there is no root containing the value of one or greater in each modulus value, which means the VAR model is stable.

IV.4 Cointegration Test

The purpose of the cointegration test is to find out whether there will be a balance in the long term. That is, there are limits to the movement and stability of the relationship between the variables

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in this study or not. In this research cointegration test was conducted by using Johansen's Cointegration Test. Below is the result of the cointegration test :

Table 4. Cointegration test result (Trance Statistic)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.599763	128.8427	95.75366	0.0000
At most 1 *	0.504997	76.64795	69.81889	0.0129
At most 2	0.307448	36.56609	47.85613	0.3683
At most 3	0.164157	15.62586	29.79707	0.7383
At most 4	0.065491	5.404936	15.49471	0.7644
At most 5	0.026725	1.544071	3.841466	0.2140

Source : Data Processed

Table 5. Cointegration test result (Max-Eigen Statistic)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.599763	52.19475	40.07757	0.0014
At most 1 *	0.504997	40.08186	33.87687	0.0080
At most 2	0.307448	20.94023	27.58434	0.2799
At most 3	0.164157	10.22092	21.13162	0.7236
At most 4	0.065491	3.860866	14.26460	0.8737
At most 5	0.026725	1.544071	3.841466	0.2140

Source: Data Processed

Can be seen, the results of trance statistic and maximum eigenvalue statistic show that there is one cointegrating equation among the variables in the ASEAN Stock index at 5% level of critical value, which means the set of cointegrated time series have an error-correction representation which is reflecting there is adjustment mechanism in the long-run.

IV.5 Granger Causality Test

Granger causality test was conducted in this study with the purpose of finding out the causality relationship between variables. Below is the result of the Granger causality test:

Table 6. Cointegration test result (Max-Eigen Statistic)

Null Hypothesis:	Obs	F-Statistic	Prob.
KLSE does not Granger Cause JKSE	58	2.61616	0.0825
JKSE does not Granger Cause KLSE		0.32087	0.7269
PSEI does not Granger Cause JKSE	58	1.71526	0.1898
JKSE does not Granger Cause PSEI		1.42095	0.2505
SET does not Granger Cause JKSE	58	1.10371	0.3391
JKSE does not Granger Cause SET		6.77962	0.0024
STI does not Granger Cause JKSE	58	2.42913	0.0979
JKSE does not Granger Cause STI		3.78592	0.029
VNI does not Granger Cause JKSE	58	0.53263	0.5902
JKSE does not Granger Cause VNI		5.92992	0.0047
PSEI does not Granger Cause KLSE	58	0.34591	0.7092
KLSE does not Granger Cause PSEI		0.52601	0.594
SET does not Granger Cause KLSE	58	0.01869	0.9815
KLSE does not Granger Cause SET		1.95483	0.1517
STI does not Granger Cause KLSE	58	0.36281	0.6974

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KLSE does not Granger Cause STI		1.83068	0.1703
VNI does not Granger Cause KLSE	58	1.79645	0.1758
KLSE does not Granger Cause VNI		0.42786	0.6541
SET does not Granger Cause PSEI	58	0.23105	0.7945
PSEI does not Granger Cause SET		2.13689	0.1281
STI does not Granger Cause PSEI	58	0.11795	0.889
PSEI does not Granger Cause STI		2.89940	0.0638
VNI does not Granger Cause PSEI	58	1.04423	0.3591
PSEI does not Granger Cause VNI		7.29873	0.0016
STI does not Granger Cause SET	58	0.58917	0.5584
SET does not Granger Cause STI		1.84111	0.1686
VNI does not Granger Cause SET	58	4.95237	0.0107
SET does not Granger Cause VNI		3.79401	0.0288
VNI does not Granger Cause STI	58	1.68674	0.1949
STI does not Granger Cause VNI		0.02251	0.9778

Source: Data Processed

A probability value less than a = 5% indicates that there is a causality relationship. If one variable has a probability value less than a = 5%, then there is a one-way causality relationship, and if both two variables have a probability value less than a = 5%, it indicates there is a two-way causality relationship.

IV.6 The Vector Error Correction Model (VECM) Estimation Result

After conducting several stages of testing, the model hints at VAR with test results shows there is one or more cointegration in the sets of variables, then the Vector Error Correction Model is suitable to apply. VECM estimation the resultant can only show a significant effect on lag, certainly both long term and short term in a way Comparing the estimated value t-hitung with the t-table value and based on t-test results, partially using a significant level of five percent with t table value of 2.000298.

This study found that, in the long term Singapore Stock Index (STI), Malaysia Stock Index (KLSE), Philippines (PSEi), and Indonesia Stock Index (JKSE) are positively correlated. This means the change of stock index price in one country will affect other related countries in the long term. This finding shows that the higher the index price will also increase the Indonesia Stock index price. The correlation between these countries occurs because there are linked to the economy in a related country.

In the short term of VECM estimation, found the Vietnam Stock Index (VNI), Singapore Stock Exchange (STI), Philippine (PSEi) are positively correlated and negatively correlated with Thailand Stock Exchange (SET). Shor-term effects are captured by the individual coefficients of the differentiated terms, which are capturing impact while the coefficient of the VECM variable containing information that the past values of variables could affect the current values of the observed variables. Also, the size and statistical significance of the coefficient of the error correction term measures the tendency of each variable to return to the equilibrium. Coefficient, which is significant, implies the past equilibrium errors play a role in determining the current outcomes that capture the long-run impact.

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IV.7 Impulse Response Function

IRF analysis will explain the impact of the shock on one variable on other variables, which in this analysis not only in a short time but can be analyzed for some future horizons as long-term information. Below is the result of the Impulse Response Function (IRF):
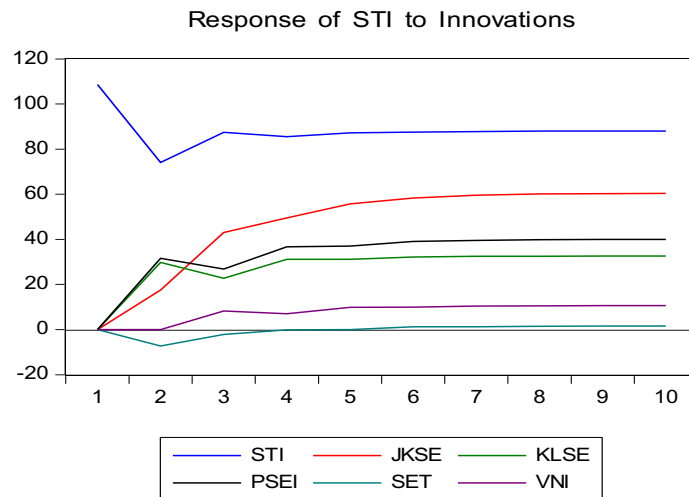

Figure 2. Impulse Response Function Result

The figure above explains the long-term dynamic response of JKSE, KLSE, PSEI, SET, and VNI, if there is a certain shock in STI equal to one standard error in each equation. Analysis of the impulse response function as well serves to see how long the effect lasts.

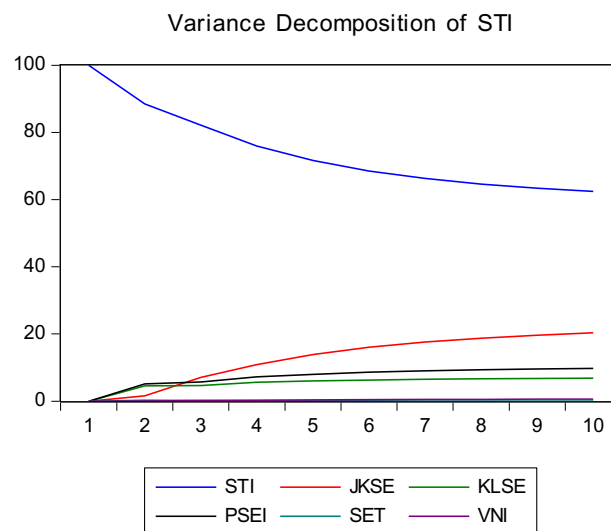## IV.8 Forecast Error Variance Decomposition

Figure 3. Variance Decomposition

Variance decomposition aims to measure the amount of contribution or composition of the influence of each independent variable on the variable dependents. Shows that the contribution to the diversity of the STI variable comes from the STI itself by 100% in the first period then decreased until the end of the period.

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V. CONCLUSION AND FURTHER RESEARCH

Based on the result of this study, it can be concluded that the study found that, in the long term Singapore Stock Index (STI), Malaysia Stock Index (KLSE), Philippines (PSEi), and Indonesia Stock Index (JKSE) are positively correlated. This means the change of stock index price in one country will affect other related countries in the long term. This finding shows that the higher the index price will also increase the Indonesia Stock index price. The correlation between these countries occurs because there are linked to the economy in a related country. In the short term of VECM estimation, found the Vietnam Stock Index (VNI), Singapore Stock Exchange (STI), Philippine (PSEi) are positively correlated and negatively correlated with Thailand Stock Exchange (SET). Shor-term effects are captured by the individual coefficients of the differentiated terms, which are capturing impact while the coefficient of the VECM variable containing information that the past values of variables could affect the current values of the observed variables.

The managerial implication of this study is expected to be a reference or basis of consideration of investment decisions. This because long-term stock market movements are important because they impact international portfolio management and risk diversification. For further research may add variables other than ASEAN countries in order to find out the opportunity of international investment and diversifying risk.

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