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Co-integration and Co-movement Between Asian Stock Price Index and Jakarta Composite Index

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The profit from international diversification to eliminate risks has caused investors to spread their capital to different international stock exchanges. The dynamic relations among stock exchanges indicate the presence of one or two-way relations among the stock exchanges. This happens because of the interdependence and integration that takes place among stock exchanges, such as interdependence among Asian markets. This research aims to analyze and discuss co-integration and co-movement between Asian stock price index and Indonesia. The research design used Vector Error Correction Model. The results of this research prove that in the short-term, there is a relationship between Kuala Lumpur Composite Index, Stock Exchange of Thailand Index, and Hang Seng Index against Jakarta Composite Index. In the results of co-integration test, there are co-integration and co-movement between the capital markets of Malaysia, Thailand, South Korea, Japan, Singapore, and Hong Kong with Indonesia capital market.

Keywords: *Co-integration, Co-movement, interdependence, integration, Asian stock, Vector Error Correction Model*

JEL Classification: G1, G100

Introduction

The increasingly borderless world economy makes the capital market in Indonesia affected by the movement of large capital markets in the world. This linkage between countries is due to foreign investors controlling stocks listed on the Indonesia capital market (IDX). This makes foreign investors invest in stock exchanges around the world, causing a linkage between one stock exchange to another. This paper examines the short- and long-run linkages between Asian capital markets and Indonesia capital market.

Many researchers conducted research on Jakarta Composite Index (JCI) at the time of the global crisis in 2008 and before the global crisis. A research conducted by Utama and Artini (2015) proved that Dow Jones Index and Straits Times Index (STI) affected JCI, while FTSE Index and NIKKEI 225 Index did not affect JCI. On the contrary, a research conducted by Mansur (2005) proved that KOSPI Index, TAIEX Index, NIKKEI 225 Index and ASX Index had an effect on JCI, while Dow Jones Index, FTSE Index and Hang Seng Index did not affect JCI. Another research by Christa & Pratomo (2012) which examined the effect of the global stock exchange price index on JCI also proved that during 2008-2011, Nikkei 225 index influenced JCI.

A research from Click & Plummer (2005) which examined stock market integration in

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Table 1. Development of Jakarta Composite Index from 2009-2017

Period	Indonesia	
	JKSE	Growth Change (%)
2009	2,534.36	86.98
2010	3,703.51	46.13
2011	3,821.99	3.20
2012	4,316.69	12.94
2013	4,274.18	-0.98
2014	5,226.95	22.29
2015	4,593.01	-12.13
2016	5,296.71	15.32
2017	6,355.65	19.99

Source: Processed by authors from YahooFinance, (2019).

ASEAN-5 after the Asian crisis of 1997-1998, proved that the capital markets of Indonesia, Malaysia, Philippines, Singapore and Thailand in the 1997-1998 Asian financial crisis period were co-integrated in the long term based on both daily and weekly data. It was also supported by the research of Krisandi & Muharam (2013) which proved that during 1988-2011, the capital markets of Indonesia, Malaysia, Thailand, the Philippines and Singapore moved together in the long term. This result showed that the five capital markets had a long-term co-integration. Co-integration between countries could also be seen in the research of Puspitasari, Siregar & Andati (2015) which analyzed the co-integration of ASEAN stock exchange using the Vector Error Correction Model (VECM). The VECM proved that during 2009-2015, there was co-integration in long-term relationship within the ASEAN regions (Indonesia, Malaysia, Thailand and the Philippines).

However, it was in contrast to the results from Yang, Kolari & Min (2003) which examined long-term relationships and short-term dynamics between the United States, Japan, and ten Asian stock markets (including Indonesia, Korea, Malaysia, Thailand, Hong Kong, Singapore) in the 1997-1998 period of Asian financial crisis. It showed that in the long term, there was co-integration between these capital markets. These capital markets had strong co-integration during the 1997-1998 period of Asian financial crisis, whereas before the Asian financial crisis, it had smaller co-integration. Furthermore, Yang, Kolari & Min (2003) proved that Japan had little or no influence on the Asian markets prior to the Asian financial crisis, but it had more influence during the Asian financial crisis.

Due to the inconsistency and contradiction in the results of those research and global crisis (subprime mortgage) which have a negative impact on the index in various countries, especially Indonesia, the researchers are interested in conducting a research on the period after the global crisis to find out whether or not there is co-integration between Asian stock price index and JCI. This research is a development from Kasim's research (2010) which examined the effect of regional stock indexes on JCI.

After the global crisis in 2008, the condition of Indonesian capital market began to improve with an index growth of 86.98% in 2009. The development of Jakarta Composite Index after the 2008 global crisis can be seen in Table 1.

Literature Review

Co-movement among Capital Market

The same stocks can be sold in international stock exchanges such as Asian stock exchanges. The profit from international diversification to eliminate risks has caused investors to spread their capital to different international stock exchanges (Tang et al., 2019; Beck & Stanek, 2019; Almohamad, Mishra & Yu, 2018; Ben-Zion, Choi & Hauser, 1996; Madura & Soenen, 1992; Levy and Sarnat, 1970; and Grubel, 1986). Investors can decide where to buy the stocks either because of the expected return or of the volatility that takes place in many countries (Erb, Harvey & Viskanta, 1996 and Bailey & Lim, 1992).

The dynamic relations among stock ex-

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changes as stated in Patel (2013), Hung & Cheung (1995) and Wu & Su (1994) indicate the presence of one or two-way relations among the stock exchanges. This happens because of the interdependence and integration that take place among stock exchanges, such as interdependence among Central and Eastern European Countries (Beck & Stanek, 2019); Asian equity market (Patel, 2013); American, European and Asian indices using finance big data and Granger causality directed network (Tang et al., 2019); European and American stock exchanges (Schollhammer & Sand, 1985) or among Asian and Pacific markets (Chan, Cup & Pan, 1992). The earlier research have further proven the optimization as a result of international market integration (Subrahmanyan, 1975). Lee (1993) also saw the presence of market integration and price execution in NYSE for the listed stocks.

From the research stated above, only Harris et al's (1995) that analyzed the long-term balance using error correction model. The research was conducted to find out the influence of American regional stock exchanges (Midwest and Pacific) on the international stock exchange, which was New York stock exchange, whose trading was linked with its national network done by National Intermarket Trading System and Consolidated Tape.

Ben-Zion, Choi & Hauser (1996) with co-integration and causality study found out the profit potential on long-term portfolio which resulted from international market relation interdependence. The use of co-integration analysis was meant to cover the existing dimension and variables implying the use of no return price level. Different trading time among USA, Germany, Japan and England was given attention because the research used daily closing price.

Harris et al. (1995) and Ben-Zion, Choi & Hauser (1996) conducted research on interdependence among international stock exchanges in a long-term balance with price level. Stationary equilibrium co-integration among stock exchanges must be used as a substance for direct portfolio investment of long-term investors. The advantage of paying attention to the dimension of the existing variables has brought co-integration an important role. The non-existence of co-integration among stock exchanges will indicate the existence of long-term portfolio profit potential (Ben-Zion, Choi & Hauser, 1996: 1005).

The linkages between existing capital markets in the world are caused by increasingly borderless state of economy. The linkages between capital markets are due to foreign investors starting to invest their money in the stock exchanges in the world, causing capital markets (Hartanto, 2013) or money markets (Rahman & Shahari, 2017) among countries to be integrated.

Woo's (2010) research examined co-movement between ASEAN capital markets and proved that Malaysia, Indonesia and Singapore had stronger co-movement compared to other ASEAN countries. It was further supported by the research of Krisandi & Muharam (2013) which proved that during 1988-2011, the capital markets of Indonesia, Malaysia, Thailand, the Philippines and Singapore moved together in the long term. This result showed that the five capital markets had long-term co-integration. Co-integration between countries can also be seen in the research of Puspitasari, Siregar & Andati (2015) which analyzed the co-integration of the ASEAN stock exchange with the VECM, proving that during 2009-2015, there was co-integration in long-term relationships within the ASEAN region (Indonesia, Malaysia, Thailand and the Philippines). It was strengthened by Aminda & Desmintari's research (2018) which proved that Indonesia, Singapore, Malaysia, South Korea, Hong Kong and Japan are integrated in the long term.

Research Framework

Based on the previous studies, the researchers used six regional stock indexes which had a large influence on JCI. The six indexes are Kuala Lumpur Composite Index (Malaysia), Stock Exchange of Thailand (Thailand), Kospi (Korea), Nikkei 225 (Japan), Straits Times Index (Singapore) and Hang Seng Index (Hong Kong). This research employed VECM to test whether or not there is co-integration between

Figure 1. Research Framework

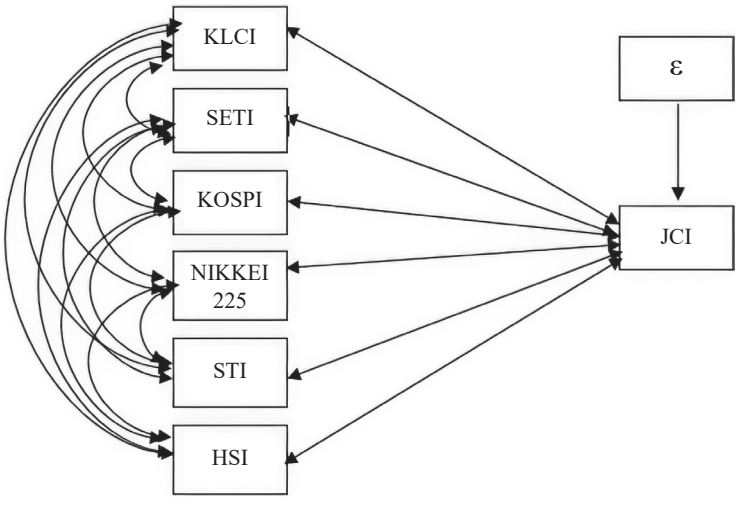

Table 2. Augmented Dickey Fuller Test Results

Variables	ADF Statistic		Test Critical Values		
	t-statistic	Probability	1%	5%	10%
JKSE	-25.06709	0.0000	-3.977745	-3.419432	-3.132308
KLSE	-23.80497	0.0000	-3.977745	-3.419432	-3.132308
SETI	-21.73412	0.0000	-3.977745	-3.419432	-3.132308
KS11	-22.14384	0.0000	-3.977745	-3.419432	-3.132308
N225	-20.76458	0.0000	-3.977745	-3.419432	-3.132308
STI	-21.12981	0.0000	-3.977745	-3.419432	-3.132308
HSI	-21.61307	0.0000	-3.977745	-3.419432	-3.132308

Source: Processed by authors from E-views calculation (2019)

the regional stock price index and JCI on Indonesia Stock Exchange. The research framework is shown in Figure 1.

Based on the framework of the research, it can be explained that KLCI index (Malaysia), SETI index (Thailand), KOSPI index (South Korea), NIKKEI index 225 (N225-Japan), Straits Times Index or STI index (Singapore), Hang Seng Index or HSI index (Hong Kong) are the independent variables, while JCI (Indonesia) is the dependent variable. Variables could interact among each other.

Research Method

This research used weekly time series data from January 2009 to December 2017 to obtain empirical evidence that was more in line with the condition after the 2008 global crisis. The weekly data collection was conducted to avoid incomplete or unavailable data due to stock exchange holiday factors or time differences among the countries.

Due to the availability of the time series data and the purpose of the research, which is finding co-integration and co-movement among stock exchanges, the Vector Error Correction Model (VECM) was fitted appropriate for this research. The several tests used in this research were unit root test, Granger causality test, Johansen's co-integration test, estimation of VECM, impulse response function and the variance decomposition.

Results and Discussions

Data Stationarity Test

In the stationarity test, the assumption must be fulfilled, meaning the result should not have a unit root problem. Augmented Dickey Fuller test was used to examine the unit root test. If the probability value is smaller than the value of α (5%), then H_0 is not supported or there is no unit root problem. Conversely, if the probability value is greater than the value of α, then H_0 is supported or there is a unit root. The test is shown in Table 2.

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Table 3. Optimal Lag Length Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	8497.333	NA	2.57e-25	-36.75469	**-36.69203***	**-36.73002***
1	8585.312	172.9128	**2.17e-25***	**-36.92343***	-36.42215	-36.72607
2	8618.972	65.13432	2.32e-25	-36.85702	-35.91712	-36.48698
3	8650.700	60.43259	2.50e-25	-36.78225	-35.40373	-36.23951
4	8688.489	70.83496	2.63e-25	-36.73372	-34.91658	-36.01830
5	8722.809	63.29205	2.81e-25	-36.67017	-34.41441	-35.78206
6	8743.433	37.40791	3.18e-25	-36.54733	-33.85295	-35.48653
7	8791.407	85.56387	3.20e-25	-36.54289	-33.40988	-35.30940
8	8839.476	**84.27729***	3.22e-25	-36.53886	-32.96723	-35.13268

Source: Processed by authors from E-views calculation (2019)

Based on the results, it can be concluded that all variables, namely JKSE, KLSE, SETI, KS11, N225, STI, and HSI do not have unit root problems. All values were smaller than their critical value, which means that the time series data are stationary at first difference.

Determination of Optimal Lag Length

There are several parameters used in this test, namely final prediction error, Akaike, Schwarz, and Hannan-Quinn information criteria. These criteria can be determined by selecting the criteria that have the least Final Prediction Error (FPE) or other criteria (Akaike, Schwarz, Hannan-Quin) among the several proposed lags. Based on Table 3, this research used lag 1 because it has the smallest value of Final Prediction Error (FPE). Therefore, the other tests used lag 1 as well. The results of the determination of lag length is shown in Table 3.

Granger Causality Test

Granger causality test can analyze whether each variable, namely JKSE, KLSE, SETI, KS11, N225, STI and HSI are related (feedback/bilateral causality) or unrelated (independence). If the probability value is smaller than $\alpha = 5\%$, then there is a significant relationship. Conversely, if the probability value is greater than $\alpha = 5\%$, then there is no significant relationship. The results show that there is a bilateral relationship between SETI and JKSE as well as between HSI and JKSE. In addition, there is a unidirectional relationship between KLSE and JKSE; KLSE and HIS; STI and SETI; and between STI and HSI. In conclusion, there is an independence relationship between KS11 and JKSE; N225 and JKSE; STI and JKSE; SETI and KLSE; KS11 and KLSE; N225 and KLSE; STI and KLSE; KS11 and SETI; N225 and SETI; HSI and SETI; N225 and KS11; STI and KS11; HSI and KS11; STI and N225; and between HSI and N225. Table 4 shows the results of Granger causality test.

The results are in line with Adisetiawan's (2017) finding that Hang Seng index had an effect on JCI, but are in contrast with Mansur's (2005) research which found that Hang Seng index had no effect on JCI. Hong Kong capital market is one of the capital markets with the largest market capital in Asia, so there is a possibility that Hong Kong capital market affects Indonesia capital market. In 2017, Indonesia collaborated with Hong Kong in order to increase investment and trading in the long term. This means that Hong Kong investors could invest in Indonesian exchanges, so that it could affect the index movement in the event of a shock.

Co-integration Test

Co-integration was tested to find out whether the entire variables in the research contained co-integration or not, in the long term. In this research, the co-integration test uses the Johansen's co-integration test method. If the value of the trace statistic and maximum eigenvalue is greater than the critical value with a significance level of 5%, then H_0 is not supported; meaning that all variables have co-integration in the long term. Conversely, if the value of the trace statistic and maximum eigenvalue is smaller than the critical value with a significance level of 5%,

Table 4. Granger Causality Test Results

Null Hypothesis	Probability
KLSE does not Granger Cause JKSE	0.0101
JKSE does not Granger Cause KLSE	0.8194
SETI does not Granger Cause JKSE	0.0089
JKSE does not Granger Cause SETI	0.0016
KS11 does not Granger Cause JKSE	0.0942
JKSE does not Granger Cause KS11	0.8129
N225 does not Granger Cause JKSE	0.1481
JKSE does not Granger Cause N225	0.5354
STI does not Granger Cause JKSE	0.0959
JKSE does not Granger Cause STI	0.8411
HSI does not Granger Cause JKSE	0.0151
JKSE does not Granger Cause HSI	0.0367
SETI does not Granger Cause KLSE	0.9067
KLSE does not Granger Cause SETI	0.1922
KS11 does not Granger Cause KLSE	0.3945
KLSE does not Granger Cause KS11	0.9516
N225 does not Granger Cause KLSE	0.5091
KLSE does not Granger Cause N225	0.4047
STI does not Granger Cause KLSE	0.2028
KLSE does not Granger Cause STI	0.7265
HSI does not Granger Cause KLSE	0.7919
KLSE does not Granger Cause HSI	0.0050
KS11 does not Granger Cause SETI	0.9665
SETI does not Granger Cause KS11	0.5644
N225 does not Granger Cause SETI	0.7703
SETI does not Granger Cause N225	0.6466
STI does not Granger Cause SETI	0.0411
SETI does not Granger Cause STI	0.4305
HSI does not Granger Cause SETI	0.8286
SETI does not Granger Cause HSI	0.3229
N225 does not Granger Cause KS11	0.9667
KS11 does not Granger Cause N225	0.1712
STI does not Granger Cause KS11	0.0739
KS11 does not Granger Cause STI	0.1049
HSI does not Granger Cause KS11	0.9292
KS11 does not Granger Cause HSI	0.2216
STI does not Granger Cause N225	0.6355
N225 does not Granger Cause STI	0.7383
HSI does not Granger Cause N225	0.7653
N225 does not Granger Cause HSI	0.4028
HSI does not Granger Cause STI	0.1092
STI does not Granger Cause HSI	3.E-07

Source: Processed by authors from E-views calculation, (2019).
Note: Bilateral relationship, a unidirectional relationship, and an independence relationship

then H_0 is supported; meaning that there is no co-integration in the long term.

Table 5 presents the analysis of both the trace statistic and max-eigenvalue statistic compared to the critical value. Based on the findings, the seven variables are all significant at the level of 5%. Therefore, all the variables are co-integrated to each other in the long term.

It can be concluded that the movement of JCI (Indonesia) has similarities to the movement (co-movement) of KLSE (Malaysia), SETI (Thailand), KOSPI (South Korea), NIKKEI225 (Japan), STI (Singapore) and HSI (Hong Kong). The results are supported by Adisetiawan's (2017) finding which proved that there is a long-term co-integration among the capital markets of Malaysia, Thailand, South Korea, Japan, Singapore and Hong Kong towards Indonesia. This finding is also supported by Santosa & Setyawan (2016) which proved that there is a co-integration between NIKKEI225, KOSPI, HSI, STI and KLCI with JCI during 1999-2013.

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Table 5. Co-integration Test Results

Null Hypothesis	Trace		Max-Eigenvalue	
	Trace Statistic	5% Critical Value	Max-Eigenvalue Statistic	5% Critical Value
r = 0 *	1506.949	150.5585	278.6903	50.59985
r = 1 *	1228.259	117.7082	258.4080	44.49720
r = 2 *	969.8508	88.80380	254.6636	38.33101
r = 3 *	715.1872	63.87610	201.7796	32.11832
r = 4 *	513.4076	42.91525	198.8781	25.82321
r = 5 *	314.5295	25.87211	172.1790	19.38704
r = 6 *	142.3506	12.51798	142.3506	12.51798

Source: Processed by authors from E-views calculation, (2019).
(*) all the variables are significant at α = 5%

Table 6. The VECM Estimation Test Results

Variables	Coefficient	Standard Error	t-statistic
Long-Term			
KLSE(-1)	0.796774	0.13175	6.04744*
SETI(-1)	-0.602145	0.08506	-7.07902*
KS11(-1)	-0.032029	0.09921	-0.32284
N225(-1)	0.076437	0.06542	1.16841
STI(-1)	0.558644	0.11813	4.72895*
HSI(-1)	-1.173625	0.08658	-13.5555*
Short-Term			
CointEq1	-0.450651	0.06600	-6.82800
D(JKSE(-1))	-0.351282	0.05633	-6.23626
D(KLSE(-1))	0.356460	0.07796	4.57212*
D(SETI(-1))	-0.130206	0.05529	-2.35477*
D(KS11(-1))	-0.091117	0.06218	-1.46535
D(N225(-1))	0.075995	0.04515	1.68320
D(STI(-1))	0.002216	0.06866	0.03228
D(HSI(-1))	-0.216512	0.05960	-3.63291*
C	2.38E-05	0.00129	0.01850

Source: Processed by authors from E-views calculation, (2019).
(*) significance at 5%.

Estimation of Vector Error Correction Model

The test results show that if the research variable has been proven to have a co-integration relationship, then VECM is used to determine the short-term trends of a variable towards its long-term value. In the results of data stationarity testing, it was found that the seven research variables were stationary at the level of the first difference, then further testing of the VECM model was carried out. If the t-statistic value is greater than the value of the critical value at the alpha level of 5% (1.96) with degree of freedom of *n-k* (470-7), it can be concluded that there is a long-term or short-term relationship to JCI.

Table 6 shows that in the long term, Kuala Lumpur Composite Index (Malaysia), Stock Exchange of Thailand (Thailand), Straits Times Index (Singapore) and Hang Seng Index (Hong Kong) have a relationship to Jakarta Composite Index (Indonesia) because the t-statistic value is greater than the 5% critical value of 1.96. Furthermore, Korean Composite Stock Price Index (South Korea) and Nikkei 225 (Japan) do not have a relationship to Jakarta Composite Index (Indonesia) in the long term because the t-statistical value is smaller than the 5% critical value of 1.96. Kuala Lumpur Composite Index (Malaysia) and Straits Times Index (Singapore) have a positive pattern of relations with Jakarta Composite Index, whereas Stock Exchange of Thailand (Thailand) and Hang Seng Index (Hong Kong) have a negative relationship pattern towards Jakarta Composite Index (Indonesia). Malaysia and Singapore have a positive relationship with Indonesia because bilateral cooperation between these countries is strong, so that these three countries influence each other in the long term. Thailand and Hong Kong have a negative relationship with Indonesia, which means that if a shock index falls in Thailand or Hong Kong, the investors will withdraw their

funds from the Thai or Hong Kong markets and diversify their funds into the Indonesian market, thereby reducing losses, and vice versa.

In the short-term, Kuala Lumpur Composite Index (Malaysia), Stock Exchange of Thailand (Thailand) and Hang Seng Index (Hong Kong) have a relationship with Jakarta Composite Index (Indonesia) because the t-statistic value is greater than the 5% critical value of 1.96. Korean Composite Stock Price Index (South Korea), Nikkei 225 (Japan) and Straits Times Index (Singapore) have a relationship to Jakarta Composite Index (Indonesia) because the t-statistic value is smaller than the 5% critical value of 1.96. Kuala Lumpur Composite Index (Malaysia) has a pattern of positive relationship with Jakarta Composite Index (Indonesia), while Stock Exchange of Thailand (Thailand) and Hang Seng Index (Hong Kong) have a negative pattern towards Jakarta Composite Index (Indonesia).

The results of this research are consistent with the findings of Puspitasari, Siregar & Andati (2015) that in the short term, STI (Singapore) has a negative effect on JCI. Furthermore, Puspitasari, Siregar & Andati (2015) explained that in ASEAN region, these two countries did have a fairly high capital structure so that the Indonesian capital market was influenced by the two countries. In the short term, Indonesia and Singapore are indeed unrelated, but in the long-term, Indonesia and Singapore are co-integrated to each other. This is because these two countries have established economic cooperation for a long period of time. This result is consistent with the research of Wicaksono & Yasa (2017), which found that Nikkei 225 had no relationship with JCI. This means that when there is a shock in Japan, Indonesia is not likely to be affected, or vice versa. From the analysis, it can be concluded that investors or other traders should pay attention to changes in Kuala Lumpur Composite Index (Malaysia), Stock Exchange of Thailand (Thailand) and Hang Seng Index (Hong Kong) in the short term. In the long term, investors or other traders should pay attention to the movements of Kuala Lumpur Composite Index (Malaysia), Stock Exchange of Thailand (Thailand), Straits Times Index (Singapore) and Hang Seng Index (Hong Kong).

Impulse Response Function Test

This test can find out the duration of the influence of the shock of a variable on another variable until the effect disappears or returns to the equilibrium point. Through this test, it can be seen how the positive or negative responses of a variable to other variables, usually in the short term, tend to move and change significantly and then tend to be stable until the end of the period in the long term.

In Figure 2, it can be seen that the greatest shock is caused by JKSE variable itself. The shock response of JKSE variable to the positive moving HSI variable rises above zero to the second period, then moves downward relative to the fourth period and then tends to be stable (stationary) until the final period.

The shock response of JKSE variable to the positive moving SETI variable rises above zero to the third period, then relatively moves down to the fourth period and then tends to be stable (stationary) from the sixth period to the end period.

The shock response of JKSE variable to the positive moving KLSE variable rises above zero to the second period, then fluctuates up to the fifth period and then tends to be stable (stationary) from the sixth period to the end period. The shock response of JKSE variable to the positive moving N225 variable rises above zero to the second period, then fluctuates up to the fifth period and then tends to be stable (stationary) from the sixth period to the final period. The shock response of JKSE variable to KS11 variable moves stable (stationary) to the second period, then moves positively up to the third period and then returns to stable (stationary) from the fourth period to the end period. The shock response of JKSE variable to the negative moving STI variable falls below zero to the second period, then fluctuates up to the fifth period but is still below zero and then tends to be stable (stationary) from the sixth period to the end period. The results of IRF is shown in Figure 2.

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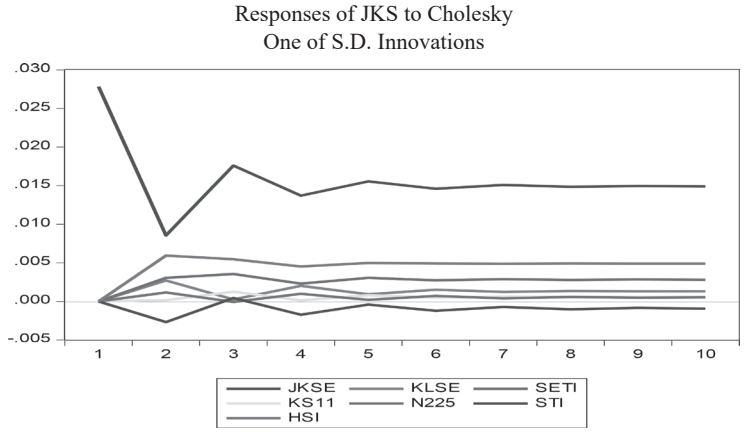
Figure 2. Responses of JKSE to



Variance Decomposition

Variance decomposition measures the influence when a shock occurs or after a shock occurs, both of the variables themselves and their effects on other variables. The following are the results of the variance decomposition test in 10 periods.

Firstly, it can be seen that JKSE variable is influenced by the variable itself by 100% in the first period, but the other six variables, namely KLSE, SETI, KS11, N225, STI and HSI cannot influence (zero) JKSE variable. Thus, in later periods, the effect of JKSE on JKSE itself was reduced to 88.49685% in the 10th period. The KLSE, KS11, N225 and STI variables can influence JKSE variable, but the amount is relatively insignificant because it is below 1%. Unlike JKSE, the other six variables in subsequent periods tend to increase until the 10th period. SETI and HSI variables can influence JKSE variables more when compared to KLSE, KS11, N225 and STI variables. This is shown by the percentage of SETI and HSI variance decomposition against JKSE which continues to increase until the 10th period, which are 2.490475% and 7.561057%, respectively.

Secondly, it can be seen that KLSE variables are influenced by the variables themselves of 78.80302% and JKSE variables of 21.19698% in the 1st period. However, other variables, namely SETI, KS11, N225, STI and HSI cannot influence (zero) KLSE variable. Thus, in subsequent periods, KLSE's influence on KLSE itself tend to increase to 83.39424% in the 10th period, while its effect on JKSE decreases to 15.01030% in the 10th period. SETI, KS11, N225 and STI variables can influence KLSE variable, but the amount is relatively insignificant because it is below 1%. JKSE and HSI variables can influence KLSE variables more when compared to KLSE, KS11, N225 and STI variables, although the results of JKSE can influence KLSE more than HSI variables that are still in the one-digit range. This is shown by the percentage of variance decomposition of JKSE and HSI against KLSE in the 10th period, which is 15.01030% and 1.218418%, respectively. Indonesia's influence (JKSE) is quite large for Malaysia (KLSE) because Malaysia is investing heavily in Indonesia which is quite large[1]. Therefore, if there is a shock in Indonesia, Malaysia will be affected.

Thirdly, it can be seen that SETI variables are influenced by the variables themselves at 62.50378% and by JKSE and KLSE variables at 32.57464% and 4.921577% in the first period. However, other variables; namely KS11, N225, STI and HSI cannot influence (zero) SETI variables at 51.45579% in the 10th period, while the effect on JKSE and KLSE increases until the 10th period. Thus, the influence of SETI on SETI itself tend to decrease in later periods. Variables N225, STI and HSI can influence SETI variable but the magnitude is relatively insignificant because it is below

[1] Malaysia is ranked eighth as the country that has a large direct investment in Indonesia, based on Badan Koordinasi Penanaman Modal (BKPM)

Table 7. Variance Decomposition Test Results

Variables	Period	JKSE	KLSE	SETI	KS11	N225	STI	HSI
JKSE	1	100	0	0	0	0	0	0
	2	93.35888	0.808277	1.027352	0.002268	0.147579	0.789358	3.866282
	3	91.71385	0.586987	1.737106	0.126396	0.106653	0.582962	5.146047
	4	90.68427	0.770040	1.835459	0.108709	0.155295	0.696303	5.749929
	5	90.12277	0.696121	2.071826	0.127494	0.132884	0.596694	6.252210
	6	89.55044	0.724066	2.183461	0.123776	0.142149	0.596647	6.679464
	7	89.23184	0.706396	2.295335	0.125758	0.132591	0.550464	6.957616
	8	88.92372	0.706460	2.368457	0.126133	0.132514	0.536765	7.205954
	9	88.69405	0.702105	2.439351	0.126287	0.128478	0.512283	7.397446
	10	88.49685	0.699081	2.490475	0.126884	0.126882	0.498771	7.561057
KLSE	1	21.19698	78.803020	0	0	0	0	0
	2	18.72976	80.667860	0.002136	0.006321	0.125217	0.006980	0.461729
	3	17.53882	81.109050	0.276918	0.092258	0.087212	0.004924	0.890821
	4	16.71100	81.921360	0.229521	0.084828	0.106184	0.004367	0.942736
	5	16.24677	82.271900	0.256539	0.100372	0.093207	0.004914	1.026295
	6	15.83284	82.650990	0.236715	0.086771	0.093520	0.004304	1.094862
	7	15.56263	82.892830	0.235408	0.085669	0.089110	0.004090	1.130264
	8	15.33579	83.098240	0.227900	0.077393	0.087516	0.003657	1.169504
	9	15.15613	83.262330	0.224425	0.074051	0.085447	0.003407	1.194215
	10	15.01030	83.394240	0.220592	0.069244	0.084069	0.003135	1.218418
SETI	1	32.57464	4.921577	62.503780	0	0	0	0
	2	37.04671	5.592036	55.345190	1.728178	0.036282	0.002752	0.248850
	3	37.01121	5.543551	55.808280	1.214552	0.026618	0.005836	0.389952
	4	38.63201	5.719589	53.696370	1.560037	0.032673	0.005051	0.354273
	5	38.94816	5.840656	53.396720	1.352225	0.029820	0.004547	0.427866
	6	39.68197	5.867695	52.599000	1.400302	0.031377	0.003937	0.415722
	7	39.94611	5.960434	52.301610	1.319403	0.030231	0.003565	0.438652
	8	40.32518	5.973280	51.917170	1.311955	0.030785	0.003201	0.438431
	9	40.53289	6.026503	51.684040	1.275861	0.030241	0.002963	0.447503
	10	40.75806	6.041712	51.455790	1.261221	0.030436	0.002723	0.450063
KS11	1	28.38323	5.668178	1.326157	64.622440	0	0	0
	2	30.15463	5.985392	1.358161	62.432700	0.064447	0.002951	0.001716
	3	30.17617	6.023190	1.180131	62.540270	0.044192	0.002029	0.034022
	4	30.81087	6.070935	1.230951	61.799190	0.056778	0.002036	0.029236
	5	30.92266	6.151437	1.180813	61.661230	0.048367	0.001768	0.033722
	6	31.19360	6.153533	1.188478	61.380570	0.049195	0.001698	0.032927
	7	31.29897	6.198844	1.172470	61.248550	0.046059	0.001553	0.033558
	8	31.43234	6.204291	1.170915	61.112120	0.045211	0.001517	0.033606
	9	31.51426	6.226858	1.164222	61.015680	0.043789	0.001426	0.033768
	10	31.59380	6.234846	1.161406	60.931730	0.042932	0.001395	0.033886
N225	1	13.98908	6.139196	1.636972	14.946520	63.288230	0	0
	2	13.75961	9.126526	1.629183	12.051810	63.397880	0.022047	0.012948
	3	13.99856	8.434416	1.461043	12.736420	63.330700	0.016723	0.022144
	4	13.89718	9.257970	1.547682	11.577440	63.668800	0.026078	0.024846
	5	13.98600	9.249947	1.478726	11.493070	63.748400	0.021711	0.022147
	6	13.97080	9.467954	1.504539	11.095910	63.917910	0.023426	0.019463
	7	14.00031	9.552701	1.481908	10.934260	63.993090	0.020692	0.017047
	8	14.00232	9.639276	1.485536	10.758380	64.078980	0.020346	0.015168
	9	14.01524	9.707293	1.477940	10.632060	64.134930	0.018885	0.013650
	10	14.01959	9.759292	1.476478	10.527460	64.186510	0.018258	0.012408
STI	1	33.03377	7.836849	2.735744	6.603531	6.991649	42.798450	0
	2	33.07528	8.610607	2.724283	6.718166	7.851031	40.794180	0.226458
	3	31.98709	8.615550	3.069956	6.742020	7.602512	41.778620	0.204255
	4	32.36145	8.803572	2.988800	6.822061	7.938177	40.842200	0.243747
	5	31.98988	8.929663	3.095938	6.806439	7.932233	41.005470	0.240376
	6	32.13256	8.973941	3.070445	6.858162	8.045786	40.662410	0.256699
	7	31.99518	9.061376	3.110800	6.854175	8.081843	40.638560	0.258061
	8	32.04003	9.085160	3.104690	6.878190	8.128995	40.497910	0.265022
	9	31.98508	9.135908	3.122502	6.882278	8.161997	40.444870	0.267369
	10	31.99432	9.156450	3.123260	6.893596	8.188636	40.372640	0.271102
HSI	1	29.03901	16.216250	1.863264	8.685241	3.126474	2.196912	38.872850
	2	35.82057	18.504560	2.193811	6.581052	3.369326	3.920684	29.609990
	3	42.79127	18.188470	1.899348	6.283112	3.271604	3.470139	24.096050
	4	44.19316	19.457030	1.624931	5.589978	3.495338	3.826054	21.813510
	5	46.62990	19.472350	1.514951	5.339652	3.453749	3.828293	19.761100
	6	47.74732	19.951720	1.394867	5.030103	3.547417	3.910140	18.418430
	7	48.88417	20.075080	1.322771	4.855917	3.544218	3.945016	17.372820
	8	49.63227	20.294100	1.254535	4.692626	3.584654	3.981637	16.560180
	9	50.30986	20.409090	1.206427	4.570628	3.592742	4.008747	15.902510
	10	50.82858	20.534400	1.163046	4.467676	3.612909	4.031081	15.362310

Source: Processed by authors from E-views calculation, (2019).

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1%. JKSE, KLSE and KS11 variables can influence SETI variables more when compared to N225, STI and HSI variables even though JKSE results influence SETI more than KLSE and KS11 variables which are still in the one-digit range. This is shown by the percentage of JKSE contributions to SETI in the 10th period at 40.75806%, while KLSE and KS11 variables are only able to contribute 6.041712% and 1.261221%, respectively. Indonesia (JKSE) has a big influence on Thailand (SETI) because Indonesia has established a long-term partnership with Thailand in 2009. Therefore, Indonesia will influence Thailand in the long-term.

Fourthly, it can be seen that KS11 variables can be influenced by the variables themselves at 64.62244%. However, other variables, namely N225, STI and HSI cannot influence (zero) KS11 variables in the first period. Thus, in subsequent periods, the influence of KS11 on KS11 itself tend to decline to 60.93173% in the 10th period. N225, STI and HSI variables can explain SETI variable, but the magnitude is relatively insignificant because it is below 1%. JKSE variable can influence KS11 variable more when compared to KLSE and SETI variables. This is shown by the percentage of JKSE contributions to KS11 in the 10th period at 31.59380%, while KLSE and SETI variables are only able to contribute 6.234846% and 1.161406%, respectively. Indonesia (JKSE) has a big influence on South Korea (KS11) because Indonesia is establishing an economic cooperation with South Korea in order to increase trade and investment. This caused the shock that occurred in Indonesia to affect the movement of shares in South Korea.

Fifthly, it can be seen that N225 variable is influenced by the variable itself at 63.28823%. However, other variables, namely STI and HSI cannot influence (zero) N225 variable in the first period. Thus, the influence of N225 on N225 itself tend to increase to 64.18651% in the 10th period in subsequent periods. STI and HSI variables can influence the SETI variable, but the magnitude is relatively insignificant because it is below 1%. JKSE and KS11 variables can influence N225 variable more when compared to KLSE and SETI variables. This is shown by the percentage of JKSE and KS11 contributions to N225 in the 10th period, which are 14.01959% and 10.52746%, respectively; while KLSE and SETI variables are only able to contribute 9.759292% and 1.476478%, respectively.

Sixthly, it can be seen that STI variables can be influenced by the variables themselves at 42.79845%, but the HSI variable cannot influence (zero) STI variable in the first period. Thus, the influence of STI on STI itself tend to decrease to 40.337264% in the 10th period. The HSI variable can influence STI variable, but the magnitude is relatively insignificant because it is below 1%. JKSE variable can influence STI variables more when compared to KLSE, SETI, KS11 and N225 variables. This is shown by the percentage of JKSE contributions to STI in the 10th period at 31.99432%, while KLSE, SETI, KS11 and N225 variables are only able to contribute at 9.156450%, 3.123260%, 6.893596% and 8.188636%, respectively. Indonesia's influence (JKSE) is great for Singapore (STI) because Singapore is the country that makes the largest direct investment in Indonesia[2]. This causes Indonesia and Singapore to influence each other.

Seventhly, it can be seen that HSI variable is influenced by the variable itself at 38.87285% in the first period. Thus, the influence of HSI on HSI itself decreases significantly to 15.363231% in the 10th period. SETI, KS11, N225 and STI variables can influence HSI variable, but the magnitude is relatively insignificant because it is below 1%. JKSE and KLSE variables increase significantly from the first to tenth periods so that they can influence HSI variables more. This is shown by the percentage of JKSE and KLSE contributions to HSI in the 10th period, which are 50.882858% and 20.53440%, respectively; while SETI, KS11, N225 and STI variables are only able to contribute 1.163046%, 4.467676%, 3.612909% and 4.031081%, respectively. Indonesia has a big influence on Hong Kong because Hong

[2] Singapore is the country that has the largest direct investment in Indonesia, based on Badan Koordinasi Penanaman Modal (BKPM).

Kong is one of the largest direct investment countries in Indonesia. Hong Kong capital market is also one of the capital markets with the largest market capital value in Asia. Therefore, Asian capital markets including Indonesia may be affected.

Conclusions

Based on the Granger causality test, there is a unidirectional relationship between KLSE (Malaysia) with JKSE (Indonesia), KLSE (Malaysia) with HSI (Hong Kong), STI (Singapore) with SETI (Thailand), and STI (Singapore) with HSI (Hong Kong). In addition, there is a bilateral relationship between JKSE (Indonesia) with SETI (Thailand) and JKSE (Indonesia) with HSI (Hong Kong).

All research variables have seven co-integration. This shows that in achieving the long-term balance, all variables will adjust to each other in the short term. The integration of the Indonesian capital market with the country began since Indonesia opened its cooperation with ASEAN countries so that the Indonesian capital market and other ASEAN countries capital markets mutually influence each other in the long term. Thus, the results of this research support the entire research hypothesis.

Based on the VECM estimation test, it can be concluded that KLSE (Malaysia), SETI (Thailand), STI (Singapore) and HSI (Hong Kong) have an influence on JKSE (Indonesia) in the long term. In the short term, KLSE (Malaysia), SETI (Thailand) and HSI (Hong Kong) have an influence on JKSE (Indonesia). Malaysia, Singapore and Hong Kong affect the capital market in Indonesia very strongly because these countries make huge investments in Indonesia. Malaysia, Singapore and Hong Kong are among the top ten countries that have the largest investment in Indonesia, with Singapore ranked first in terms of the total investment in Indonesia.

In the short and long term, if the stock index in Malaysia moves up, the stock index in Indonesia also moves up. In contrast, if the stock index in Indonesia moves up, the stock indexes in Thailand and Hong Kong move down because there is a pattern of negative relations. Based on the co-integration test, if the stock index in Indonesia moves up, the stock indexes in Malaysia, Thailand, South Korea, Japan, Singapore and Hong Kong will move up simultaneously. If the stock index in Indonesia moves down, the stock indexes in Malaysia, Thailand, South Korea, Japan, Singapore and Hong Kong will move down simultaneously as well.

From the impulse response function test, it can be concluded that the movements of KLSE (Malaysia), SETI (Thailand), KS11 (South Korea), N225 (Japan) and HSI (Hong Kong) were responded positively by JKSE (Indonesia). The STI (Singapore) variable movement was responded negatively by JKSE (Indonesia). Thus, if there is a shock of rising stock prices in Malaysia, Thailand, South Korea, Japan and Hong Kong, Indonesia will respond positively or rise, and vice versa. Similarly, if there is a shock of rising stock prices in Singapore, Indonesia tends to respond negatively or down, and vice versa.

Based on the variance decomposition, the contributions of JKSE, KLSE, SETI, KS11, N225, STI and HSI are most significantly affected by the variable itself in the first period. In contrast to HSI, the contribution of the variable itself decreased significantly in the long term and JKSE had a significant influence on HSI. This is in line with the results of the IRF testing where in subsequent periods, HSI tends to be smaller compared to JKSE. In the medium and long term, KLSE and N225 variables tend to increase in each period, whereas JKSE, SETI, KS11, STI and HSI variables tend to decrease in each period.

If there is a shock in Malaysia, Indonesia or Hong Kong tend to be affected, whereas if there is a shock in Indonesia or Hong Kong, Malaysia is not affected. Similarly, if there is a shock in Singapore, Thailand or Hong Kong tend to be affected, whereas if there is a shock in Thailand or Hong Kong, Singapore is not affected. In contrast, if there is a shock in Indonesia, Hong Kong or Thailand will tend to be affected. Similarly, if there is a shock in Hong Kong or Thailand, Indonesia is also affected.

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of the Subprime Mortgage global crisis, namely from 2009-2017. The purpose of this research is to obtain accurate results in current conditions after the 2008 global crisis. This research combines large capitalist capital markets and small capitalist capital markets, so that the speed of adjustment of large capital markets is not balanced with small capital markets.

Further research is expected to use all composite capital market index variables or all liquid capital market index variables such as LQ45 index (large or relatively equivalent capital market variables). Therefore, further researchers are expected to consider the speed of adjustment test to measure how fast the co-movement and co-integration of the capital markets.

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