IJER © Serials Publications
13(8), 2016: 3719-3728
ISSN: 0972-9380

CO-MOVEMENT OF THE INDONESIAN STOCK EXCHANGE WITH THE WORLD'S MAJOR STOCK EXCHANGES

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Abstract: *This study examined the association Indonesian stock market with world stock markets, especially the stock markets of developed countries, namely, Hong Kong (Han Seng), London (FTSE-100), USA (NASDAQ), Singapore (SGX), and Tokyo (Nikkei-125). The goal in this study is to assess the presence of co-mevement and causality Indonesian stock market with stock markets of developed countries. The data used is the index price (closing price) daily, JKSE, NASDAQ, FTSE-100, NIKKEI-225, SGX, and Hang Seng. To test the relationship Indonesia stock market with stock markets of developed countries using Granger Causality Test.*

The test results showed that the Indonesian stock market interact strongly against the world's major stock markets. This is proved by the evidence of the nature of kointegratif five major world capital markets with the Indonesian stock market. Indonesia stock market and China's stock market have an unique relationship patterns. Individual test results also found a unique relationship between the Indonesian stock market with China's stock market (Hang Seng), which the Chinese stock market as a bridge between the world's stock market with stock market Indonesia

JEL Classifications: G10, G15

Keywords: *co-movement, Co-Integration, Causality, unique relationship patterns*

BACKGROUND TO THE RESEARCH

The world economy experienced two periods of deep crisis in less than a decade. The first crisis was experienced by the US economy in 2008 preceded by the collapse of the banking sectors. When the US economy had not shown a recovery, in 2009 the European economy showed the symptoms of crisis. The financial crisis of the European economy was started with the increasing budget deficits of Greece, Ireland and Portugal. The budget deficits resulted in a growing ratio of debt to GDP. The ineffectiveness of fiscal policy and the limited fiscal space made the European economy worse. The worse European financial crisis raises fears that it will spread into the economy of other countries, particularly the Asian economies.

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Based on several studies (Bappenas, 2011), the Indonesian economy was not directly affected by the crisis in Europe and the United States. The direct effect of the global crisis on the economy of Indonesia was relatively small. However, the indirect effect that may occur is relatively great. Indonesia's economic flaming was not significantly affected by the economic turnmoil in America and Europe, but it came from the turmoil of China's economy. China's economy is affected by the economies of Europe and America. China's financial markets, which refers to the Hong Kong stock exchange, are considered a paradoxical phenomenon. Based on the study of Nishimura and Men (2010), China's stock exchange is not rational for the Chinese stock exchange has a significant effect on the movement of stocks in the G-5 states. It is seen as an initial entry of the Chinese economy in the trap of speculative bubble in the second half of 2006. The studies on the co-movement volatility on the stock exchanges of ASEAN (Oh, *et al.*, 2010) provide an interesting picture. Globalization which is closely related to the ASEAN economy turns out to show its effect on the stock exchange of ASEAN. There is a strong evidence that the ASEAN stock exchanges had the increase in co-movement to the international market.

Indonesia as a member of the ASEAN countries and the developing country requires substantial funding to drive the engine of the economy. The development of foreign investments in Indonesia has increased sharply since the first quarter of 2004 (Figure 1). The FDI developments will impact on financial markets, so there is an idea that if the real sectors increase, it can be reflected in financial market developments. This is where the actual economic openness begins through financial markets.

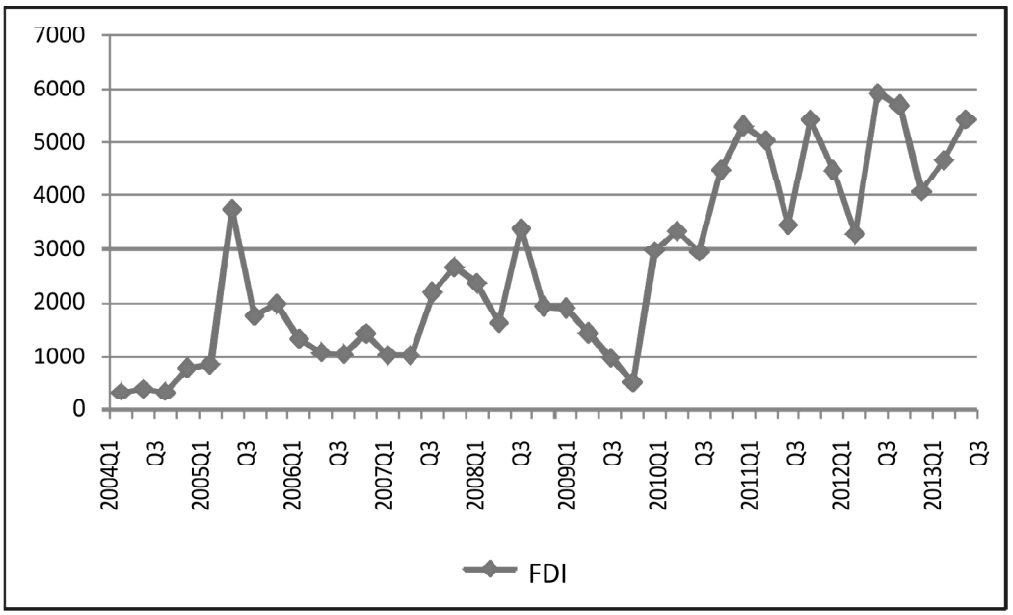

Figure 1: FDI Indonesian Development (USD million)

When there is an attempt to get foreign investment, the government should liberalize the financial markets. Financial market developments will largely depend on the response of the community, both domestically and internationally. The study aim to build a model that concerning the openness of Indonesian financial markets against major world markets, represented by five important financial markets; NASDAQ, FTSE-100, NIKKEI-225, SGX, and Hang Seng.

RELEVANT LITERATURE

Indonesia has a relatively open economy. The economic relation between Indonesia and many countries, particularly the developed countries in the group of the Organisation of Economic Development Countries (OECD), is increasing. It will have an impact on transaction activities, of goods and services, and the capital will also increase. The associations between the factors are described in figure 2.

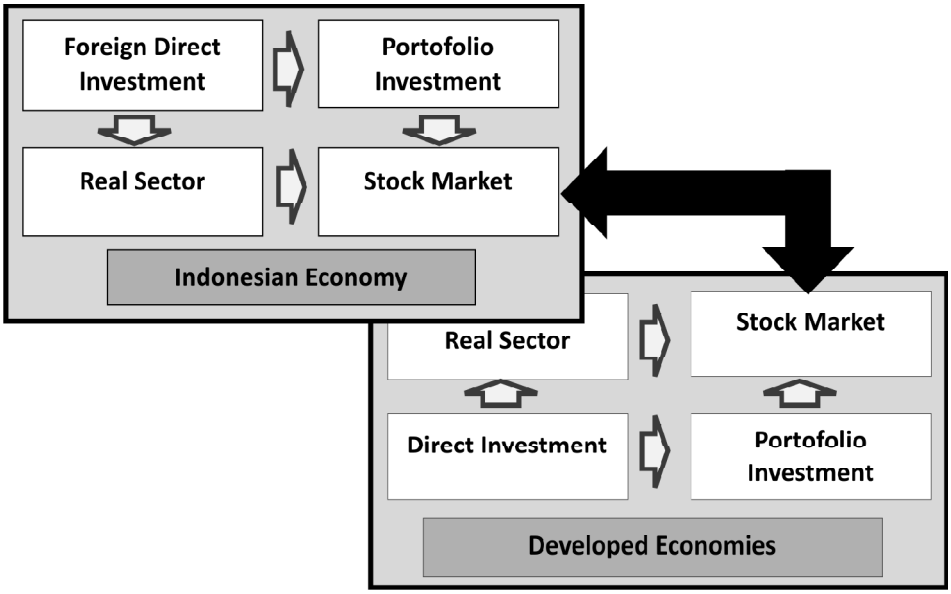

Figure 2: Interaction between Economy

From the viewpoints above, it can be understood that the movement in one stock exchange may have an impact on the stock exchanges of other countries. It is surely based on the assumption of equality in international economic relations. When the State's economy is not comparable, there is a tendency that the stock exchange turmoil in developed countries may have more pronounced impact on developing economies. The recent movements of stock prices were the focus of the research attention. Co-movement is a term with the concept which is often debated. However, in general, co-movement has the definition of asset movement spread into various assets in the same

period. Correlation method is not an appropriate method to describe the concept of co-movement (Baur, 2003). Bbukti showed that in times of crisis co-movement tends to increase. Baur (2003) emphasized that the negative co-movement rarely happened.

The studies related to co-movement are Huang, Yang, and Hu (2000), Chen, Firm, and Rui (2000), and Li, Butt and Rehman (2011) with the conclusions that co-movement does not occur. The research of Huang, Yang, and Hu (2000) used the stock exchanges in the US, Japan, Hongkong, and Taiwan in the period 1992-1997, while Chen, Firm, Rui (2000) used the object of the financial markets in Brazil, Mexico, Chile, Argentina, Colombia, Venezuela from 1995 to 2000. The other study conducted by Modi, et.al. (2010) used the objects of observation of Brazil, Mexico, USA, London, Hong Kong, and India in the year 1997-2008. Ali, Butt, and Rehman (2011) used the object of observation of China, Indonesia, Taiwan, Singapore, Malaysia, Japan, the US, and UK stock exchanges.

Variable Stationary Test

The main problem faced by the time series data is the ability to meet the assumption of stationary. The terminology of stationary refers to stationary point process or more popular with stochastic process. The stationary process in time series data is recognized as weak stationary having three (3) components, i.e.:

1. Mean : $E(Y_t) = m$ (1a)
2. Variance : $\text{var}(Y_t) = E(Y_t - m)^2 = s^2$ (1b)
3. Covariance : $g_k = E[(Y_t - m)(Y_{t+k} - m)]$ (1c)

If the data has stationary nature, the mean, variance and covariance will be the same regardless of the size of the data; it is called time invariant.

Stationary nature is important in maintaining the generalization of analytical results. Conversely, if the stationary nature is not met, the analysis will be casuistic. In other words, nonstationary time series data has different means or different variation, or both are different all the time.

Time series data has the stationary property on the degree of one or I (1) meaning that the data has the unit root of degree one (1) or integrated on degree one (Banerjee et al, 2003). Generally, it is symbolized by I (d). Mathematically, it can be formulated as follows:

$$Y_t - Y_{t-1} = (1 - L)\, Y_t = \epsilon_t \quad (2)$$

The study used the Augmented Dickey-Fuller (ADF) as a technique for testing the data stationary. It was started from the model of Dickey-Fuller stationary test based on the equation of:

$$\Delta y_t = \alpha y_{t-1} + \varepsilon_t \;\; ; \alpha = \rho - 1 \; ; \quad (3)$$

The hypothesis applied to the equation was:

H0 : $\alpha = 0$

Ha : $\alpha < 1$

a value was evaluated by using:

$$t_\alpha = \frac{\hat{\alpha}}{se\,(\hat{\alpha})} \tag{3a}$$

Based on the information above, it can be concluded that the testing using t-distribution does not show the consistency of the results. Therefore MacKinnon (1996) conducted a modification to the standard Dickey-Fuller test.

Dickey-Fuller's standard unit-root only has validity if the data is in the process of AR (1). When the data is in a higher order, the assumption of white-noise for disturber error is violated. Therefore, the process of the standard Dickey-Fuller test is improved into the Augmented Dickey-Fuller (ADF). The construction of ADF test used the parametric correction factor to high order by applying the assumption that the relevant data follows the pattern of AR (p) and the lag operator on data change is added. Mathematically, it is formulated as follows:

$$\Delta y_t = \alpha y_{t-1} + \beta_1 \Delta y_{t-1} + \cdots + \beta_p \Delta y_{t-p} + v_t \tag{4}$$

In addition to the advantages in terms of operator lag for looser autoregressive, it is found that ADF is also asymptotic to the existence of moving average process (Said and Dickey, 1984).

Cointegration: Johansen Method

The idea of cointegration was introduced by Granger in 1983, and, together with Engle, he deepened the cointegration conception in 1987. The thought of Engle and Granger was then deepened by Johansen and Juselius in the perspective of vector autoregressive model.

In the viewpoint of economics, the concept of cointegration is widely used as a tool to analyze long-term relationships. Cointegration interpretation requires a through understanding of economic problems because cointegration is constructed from mathematical studies. However, Johansen's cointegration was recommended by Lütkepohl (2007: p. 25), and the use was compared with other cointegration approaches.

The application of cointegration was started after the time series data had the testing of unit roots and was assumed to be integrated in the same degree. Johansen's cointegration applied in this study was a multivariate cointegration. Technically, Johansen's cointegration used the Maximum Likelihood approach which determines the number of cointegration vector of time series data in non-stationary (QMS, 2007: p. 363).

Engle and Granger (1987) state that it is possible to build cointegration from two or more variables which are not stationary. When the variables have a linear

combination, the variables are cointegrated and can be interpreted as a long-term relationship.

Johansen's cointegration test is built on the cointegration of VAR, i.e.:

$$Y_t = \alpha_1 Y_{t-1} + \cdots + \alpha_z Y_{t-z} + \beta X_t + \varepsilon_t \quad (5)$$

Y_t is the variable which is not stationary at degree one, I (1), X_t variable is a variable with deterministic trend, and ε_t is innovation variable. The equation (3.16) can be written in the form of the first degree.

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{z-1} \Gamma_i \Delta Y_{t-i} + \beta X_t + \varepsilon_t \quad (6)$$

Description: $\Pi = \sum_{i=1}^{z} \alpha_i - I \; ; \quad \Gamma_i = -\sum_{j=i+1}^{z} \alpha_j$

Theoretically, there are five decisions that can be made in the testing of Johansen's cointegration (QMS, 2007: p. 365), i.e.:

1. If variable Y_t has no deterministic trend and the cointegration equation has no intercept.

   $H_2(r): \Pi Y_{t-1} + \beta X_t = ab' Y_{t-1};$

   The first case is executed when there is a confidence that all associated variables have the mean of zero.

2. If variable Y_t has no deterministic trend and the cointegration equation has intercept

   $H_1^*(r): \Pi Y_{t-1} + \beta X_t = a(b' Y_{t-1} + \rho_0)$

3. If variable Y_t has a linear trend, but the cointegration equation has intercept.

   $H_1^*(r): \Pi Y_{t-1} + \beta X_t = a(b' Y_{t-1} + \rho_0) + a_\perp \gamma_0$

4. If variable Y_t and the cointegration equation has a linear trend

   $H^*(r): \Pi Y_{t-1} + \beta X_t = a(b' Y_{t-1} + \rho_0 + \rho_1 t) + a_\perp \gamma_0$

5. If variable Y_t has a quadratic trends and the cointegration equation has a linear trend

   $H^*(r): \Pi Y_{t-1} + \beta X_t = a(b' Y_{t-1} + \rho_0 + \rho_1 t) + a_\perp (\gamma_0 + \gamma_1 t)$

Description: $a_\perp$ is the determinant out of the cointegration relationship. If the determinant out of and in the equation have cointegration, the decomposition is not uniquely identified. To determine the level of slackness in the Johansen's procedure, the criteria of Roots of Characteristic Polynomial was used, which is also the detection of lag specifications for Vector Error Correction.

Johansen has two different tests; Trace test and Maximum Eigenvalue test. Trace test is a combined test of H_0: there is no cointegration in the pair of variables conducted

(H_0: r = 0) and Ha: there is cointegration (H_a: r ≥ 1). Maximum Eigenvalue test tests each value of eigenvalue separately, with H_0: there is no cointegration in the pair of variables conducted and H_a: there is cointegration (H_0: r = 0).

Granger Causality

The Granger causality of two stationary variables will involve the VAR model estimation.

$$\Delta y_t = c + \sum_{i=1}^{n} b_i \Delta y_{t-i} + \sum_{i=1}^{n} d_i \Delta x_{t-i} + \varepsilon_t \quad (7)$$

$$\Delta x_t = f + \sum_{i=1}^{n} g_i \Delta y_{t-i} + \sum_{i=1}^{n} h_i \Delta x_{t-i} + \mu_t \quad (8)$$

The Granger Causality approach is to answer the question of whether the variable of y or x currently can be explained by the past condition. The important statement in the technique of Granger causality is Granger Causes. Noteworthy, Granger causality does not have the implications on the association of effects.

DISCUSSION

The unit root test was conducted to the stock prices in the form of index figures of each stock exchange, that is, the Jakarta Stock Exchange (JSX) measured through LQ45, Singapore Stock Exchange (SGX), the Nikkei Stock Exchange (Nikkei-125), NASDAQ (NSD), and the Financial Times Stock Exchange (FTSE-100). The stationary test results indicate that all of the stock price variables were not stationary in the order of zero (I (0)), but they were stationary in the order of one (I (1)). The results will have the consequences on the application of co integration at the degree one as well as on the application of Granger causality.

Table 1
Root ADF Unit Test

VARIABEL	*I(0)*			*I(1)*		
	Intercept	*Intercept +Trend*	*None*	*Intercept*	*Intercept +Trend*	*None*
ADF T-TEST 1%	-3.461	-4.002	-2.576	-3.461	-4.002	-2.576
Jakarta Stock Exchange (JKX)	-1.695	-2.687	-0.566	-12.812	-12.784	-12.834
Hang Seng Stock Exchange (HSX)	-1.617	-1.726	0.299	-13.085	-13.079	-13.112
Nikkei 225 (NIK)	-3.225	-3.346	0.214	-14.196	-14.002	-14.220
NASDAQ (NSD)	-0.566	-2.963	1.507	-14.241	-14.232	-14.129
Financial Times Stock Exchange (FTSE)	-2.265	-2.490	0.371	-13.607	-13.575	-13.623
Singapore Stock Excgange (SGX)	-1.704	-2.545	-0.407	-12.114	-12.094	-12.134

The application of Johansen's Cointegration in the order I (1) was conducted by including the series of d (JKX), d (HSX), d (NIK), d (NSD), d (FTSE), and d (SGX). The results were as follows: The analysis results were seen by comparing between the trace statistic and the critical value of 1% which indicate that there is a cointegration at all the cointegration hypotheses which were constructed. The nature of the cointegration occurred in all assumptions which were built. It conveyed the idea that

all six stock exchanges observed influenced each other in the six forms of equation. Based on the cointegration study, it could be concluded that the six stock exchanges showed the phenomenon of co-movement.

Table 2
Johansen Cointegration

HYPOTHESIZED	*EIGENVALUE*	*TRACE STATISTIC*	*CRITICAL VALUE*	
Trend assumption- No deterministic trend			**5%**	**1%**
None	0.362878	302.0392	82.49	90.45
At most-1	0.266928	209.1758	59.46	66.52
At Most-2	0.204074	145.2105	39.89	45.58
At Most-3	0.185920	98.19116	24.31	29.75
At Most-4	0.154768	55.81753	12.53	16.31
At Most-5	0.097705	21.17973	3.84	6.51

Included observations: 206 after adjusting endpoints
Trend assumption: No deterministic trend (restricted constant)
Series: D(JKX) D(HSX) D(NIK) D(NSD) D(FTSE) D(SGX)
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	*Trace Eigenvalue Statistic*		*5 % CV*	*1 % CV*
None **	0.364601	309.0716	102.14	111.01
At most 1 **	0.286770	215.6503	76.07	84.45
At most 2 **	0.204098	146.0324	53.12	60.16
At most 3 **	0.186471	99.00695	34.91	41.07
At most 4 **	0.155347	56.49393	19.96	24.60
At most 5 **	0.100047	21.71509	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 6 cointegrating equation(s) at both 5% and 1% levels

Included observations: 206 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: D(JKX) D(HSX) D(NIK) D(NSD) D(FTSE) D(SGX)
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	*Trace Eigenvalue Statistic*		*5% CV*	*1% CV*
None **	0.364577	309.0067	94.15	103.18
At most 1 **	0.286770	215.5931	68.52	76.07
At most 2 **	0.204031	145.9752	47.21	54.46
At most 3 **	0.186370	98.96695	29.68	35.65
At most 4 **	0.155310	56.47958	15.41	20.04
At most 5 **	0.100024	21.70975	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 6 cointegrating equation(s) at both 5% and 1% levels

Granger causality is essentially only the relation between the current variable by variable past. Granger calculation is based on bivariate relationships.

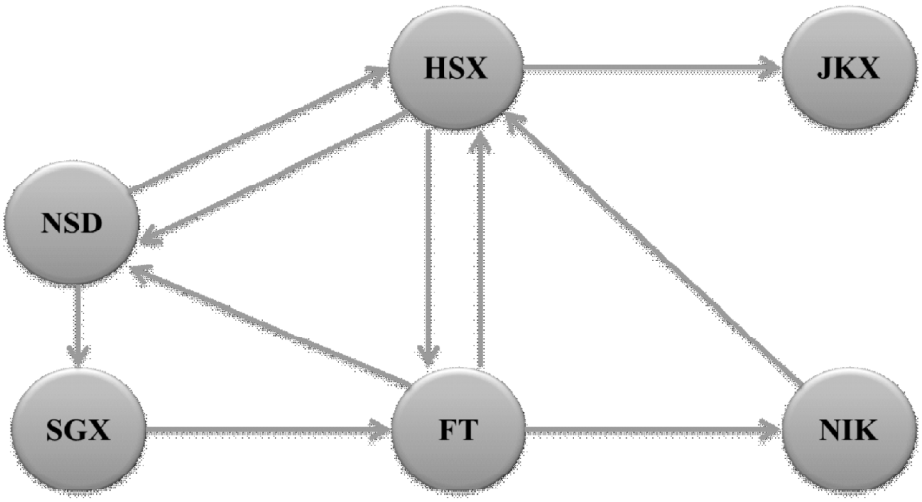

Figure 3: Granger Causality

Based on the calculation results of the Granger causality, it shows that Hang Seng, NASDAQ, and FTSE were the stock exchanges which were very sensitive to the presence of other stock exchanges. Viewing from the perspective of the Indonesian stock exchange, the stock exchange of Hong Kong (Hang Seng) is a door for the effects of international economy.

These results are similar to the report of Bappenas (the National Development Planning Agency) (2011) which states that, in the sector of international trade, the Chinese economy is the entrance to the effects of the American economy to Asia. The Chinese economy has the most dominant trading relationship with the United States economy. Therefore, it is logical that the seepage of the economic problems in the United States will first enter into the Chinese economy.

CONCLUSION

The increase of economic relationship with many countries, particularly developed countries included in the group of the Organisation of Economic Countries Development (OECD) has encouraged the increasing openness of the Indonesian economy. It could be observed from the increased transaction activities of goods and services as well as capital. The increased economic activities subsequently had the impact on financial markets. It could be seen from the strong interaction of the Indonesian stock exchange against the world's major stock exchanges. It was proved by the evidence of the cointegrative nature of five major world capital markets with the Indonesian stock exchange. When it was viewed individually, the stock exchange

of Hong Kong (Hang Seng) was the stock exchange as a bridge between the world's stock exchanges and the Indonesian stock exchange.

RESEARCH RECOMMENDATIONS

1. It should be investigated whether the factor of real sector in international trade relations is the driving factor of the relationship between the stock exchanges.
2. It should be more detailed in the search for the factors that allow the description of transmission mechanism in stock exchange.

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