Int. Journal of Economics and Management 11 (S1) : 183 – 195 (2017)

PERTANIKA JOURNALS

IJEM

International Journal of Economics and Management

Journal homepage: http://www.econ.upm.edu.my/ijem

Asymmetric Spillover effect in Indonesian Stock Market

DAVID KALUGE

Faculty of Economics and Business, Brawijaya University Indonesia

ABSTRACT

Investors are faced with many investment choices and when the market falls, they adjust their portfolios so as to gain maximum profits from their investments. Investors then sell stocks of unfavorable sectors and buy stocks of more profitable sectors. In the global stock market, spillovers occur when there is an economic downturn or a financial crisis. Some studies have noted this spillover effect among intra stock markets among Asian countries. In this study, the VAR-ASYMX was applied on data taken from the Jakarta Stock Exchange (BEI) and the Wall Street Journal (WSJ) in the timeline between 4th of March, 2013 to 1st of July, 2016. This study aims to understand how certain sectors transmit the shock or volatility experienced onto other sectors in the market. Results show that spillover effects, in terms of changes in mean of prices as well as volatility of prices, occurred in many business sectors. However, the spillover impact coverage of one sector is different from that of another sector. For instance, some sectors experienced shock after one day of the crisis while other sectors took two days or longer. The spillover affect certain domestic sectors which then affect other sectors while certain sectors were not affected by the spillover because they had no linkages at all. The same result applies to the mean and volatility of prices spillover. In the latter, risks were transferred from foreign markets as well as domestic markets onto other domestic sectors in the Indonesian data. In looking at the asymmetric responses of domestic sectors towards the shock transferred by foreign markets, it was found that many sectors reacted more severely when prices drop than when prices escalate. In this regard, policy makers should pay more attention to price drops in the stock markets of Malaysia (KLSE), South Korea KOSPI (KS11), and China-Hongkong Hangseng (HIS) so as to prevent a severe outcome of the crisis.

*Corresponding author: Email : davidk@ub.ac.id

Keywords: : Spillover, Asymmetric, Intra Stock Market Spillover, Shock Transmission, Volatility Transfer.

JEL Classification: G11, G1.

BACKGROUND

One of the strongest topics which concerns policy makers in financial markets is the spillover effect. Financial markets are markets that are very liquid and vulnerable, globally. Due to these characteristics, a financial shock that occurs in one corner of the world can easily affect other markets worldwide, to some extent. The explained dynamics can happen across time in a continuous manner. In this regard, policy makers and investors with concerns about stock prices behavior and the stability of stock market, continuously observe for any occurrence of a serious event all over the world. More specifically, attention is paid more to the markets of countries that have tight financial connections with other neighbouring countries. The shock occurring in those countries could easily be transferred to the financial markets of other countries around the world. Undeniably, serious events that occur in some countries can propel investors to adjust their portfolios optimally. This means that there will be fluctuations in the domestic financial market. If the fluctuation is relatively small, it could be placed under control. However, if it is too big to handle, it can push the market into a crisis.

There are many studies (Booth, Martikainen *et al.* 1997, Beirne, Caporale *et al.* 2010, Awartani & Maghyereh, 2013, Calice, Chen *et al.* 2013, Apergis & Voliotis 2015, Fernández-Rodríguez, Gómez-Puig *et al.* 2015) looking at this topic but most concern international markets and their spillover effects. Other studies tend to focus on Islamic asset markets (Majdoub & Mansour, 2014, Aloui, Hammoudeh *et al.* 2015). In trading markets, the spillover effect is sometimes linked to a crisis or extreme world events (Awartani & Maghyereh 2013, Apostolakis & Papadopoulos 2015, Du & He 2015, Apostolakis 2016). Other aspects related to this topic which are important for researchers are the asymmetric responses (Alsubaie & Najand 2009, Jin 2015, Baruník, Kočenda *et al.* 2016, Chakraborty & Kakani 2016) and time-varying parameters (Alsubaie & Najand 2009, Tamakoshi & Hamori 2016). There were also many different points of views as a result of the many studies. Nonetheless, there was hardly any study looking at the dynamics of certain intra-stock markets. By knowing the dynamics of sectoral indices, the way they transmit variability across (inter) sectors, policy makers can learn to anticipate stock market instability and investors can thus, escape from potential loss. This study aims to answer the question of how certain sectors transmit their shock or volatility onto other business sectors in the market.

THEORETICAL DISCUSSION

Not long after the Asian crisis, Masson (1998), in his study, claimed that there were three types of transferring crisis. First, all crises have similar characteristics due to a common cause of those crisis, for instance a political decision in one industrial economy is followed by a political

decision in another industrial economy, with both happening in almost the same time, This is because all countries experiencing a crisis are in the same situation. This phenomenon is called "monsoonal effect" and the term can be attributed to Masson and Mussa (1995) (see also Masson, 1998).

Second, a crisis in one industrial market can affect the macro-economic fundamentals of other markets due to business linkages among the countries. This type of effect is classified as "spillover effect" (Masson, 1998). This phenomenon has been emphasized by Dornbusch, Park *et al.* (2000) who say that if the transfer of shock exists due to normal interdependence among economics who share economic and business linkages, it cannot be categorized as contagion but as spillover.

The third is the transferring of crisis not because of economic reasoning but due to behavioral aspect or market sentiment. This case is sometime known as "Contagious Effect". Goldstein (1998) explains that the channel of contagion operates through changes in expectations but not through the change in values of a country's fundamentals.

Financial Asset Prices Correlation

The transferring of shocks among markets can be indicated by a change in asset prices. Thus, empirical correlation among asset prices can be used to show the effect. The increase in correlation shows the increase of the inter-connection among markets. Some studies claim contagion for such a situation.

Studies such as those conducted by Calvo and Reinhart (1996), Frankel and Schmukler (1996) and Baig and Goldfajn (1998) found evidence of the increase in co-movement in asset prices for Asian and Latin America's emerging markets in the periods before and after a crisis. However, the increase in co-movement in asset prices is not absolutely accepted as contagion.

A study conducted by Rigobon (1999) expanded on previous studies by including some current issues. He found that there was an increase in correlation after a financial crisis. However, Arias, Hausman and Rigobon (1998) who also did the same study, found limited evidence of contagion (see also Dornbusch, Park *et al.*, 2000).

A significant increase in correlation among different countries does not necessarily mean that contagion exists. The presence of a correlation only is not enough proof of contagion because markets also have economic linkages such as international trade, international investment and sector linkages and so….is not necessarily due to market sentiment. This type of relationship is called spillover, especially spillover in the mean.

Spillover Effect in Volatility

Volatility can be used to test for risk transfer. Volatility in a country's market can be induced similarly in other countries' markets. As a turbulence, volatility is close to investors' panic hence, it can be considered as being close to the phenomenon of contagion. However, it may not necessarily happen. Turbulence in one sector can be easily transferred to other related or linked sectors, either forward or backward. Park and Song (1999) tested the phenomenon of

spillover effects among foreign exchange markets in East Asian countries during the crisis period. They observed that there was a spillover effect.

Sensitivity to Risk

The shock that can act as a factor for change in other markets could be seen as a factor for potential gain or loss. Investors normally react just between the extremes; they seek gain and avoid loss, as pendulums swing to the right and left. If investors are neutral to the risk, their actions should be fair and so symmetric to the right and the left. This behavior could be deemed as a normal density function. If the curve shape skewed to the right or left, it means that the behavior is not neutral. It could be at risk loving or risk aversion. This behavior should be of interest to policy makers because it does not just concern the shape but also the magnitude. Having knowledge of the type of sensitivity is necessary in the event of anticipating the impact of a certain type of shock that could attack and hurt the market.

This study deals with the indices of sectors in the Indonesian stock market. All sectors have certain linkages among themselves. Thus, a shock in one sector will be reacted by sectors of other linkages. Besides the linkages, investors, especially those from domestic markets, based on their macro-economic knowledge, often adjusted their portfolios by selling the unfavorable stocks and buying more favorable ones. The substitution process existing among the stocks represents the phenomenon of spillover effects intra stock market.

METHOD

Variables

Based on the theoretical arguments, some groups of variables were adopted for the purpose of this study. The first are those variables related to investment choices (represented by Y-matrix). All indices of the sectors available in the analyzed market are of interest to this research. The dynamics of the indices could show the dynamics of the investment decisions taken by investors as a response to the market. The second is the group of variables representing external intervention (X-matrix) i.e. the indices of world markets.

The Y-matrix is composed by nine (9) elements made up of sectors in the stock market namely, the agriculture (JKAGRI), Basic Industry (JKBIND), Consumption (JKCONS), Finance (JKFINA), Infrastructure (JKINFA), Mining (JKMING), Miscellaneous (JKMISC), Property (JKPROP), and Trading (JKTRAD) sectors.

The X-matrix is structured by world stock market indices including the Stock Market of Malaysia (KLSE), South Korea KOSPI (KS11), Japan Nikkei (N225), Singapore Straight Time (STI), London (FTSE), China-Hongkong Hangseng (HIS), and the US NASDAQ (IXIC).

All variables were measured in terms of abnormal returns. The time lag is used to capture time-lagged impact in the process. In capturing the asymmetrical response against shocks from abroad, a Dummy variable (D) is used to differentiate the situation of good (jumping up returns) from the bad (returns drop). This variable is important in capturing the asymmetric

spillover effect (Kaluge & Puspita, 2015). The data used in the study were gathered from the Jakarta Stock Exchange (BEI) and Wall Street Journal (WSJ) on a daily basis during the time line of between 4th of March, 2013 to 1st of July, 2016.

Model

The model applied consists of 2 blocks: block of price behavior and volatility behavior. The model deals with many variables and equations which can be expressed in the state of space form as indicated below:

Price Fluctuation: The basic model of this study is Vector Auto Regression with asymmetric Impact of X factors (VAR-ASYMX) (see equation (1.1) and (1.4))

$$Y_t = A_0 + A_1 Y_{t-1} + B_1 (I + \emptyset D_t) X_t + E_t \tag{1.1}$$

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_k \end{bmatrix}; X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_m \end{bmatrix}; E = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_k \end{bmatrix}$$

$$A_{0;} = \begin{bmatrix} a_{01} \\ a_{02} \\ \vdots \\ a_{0k} \end{bmatrix}; A_1 = \begin{pmatrix} a_{11} & \cdots & a_{1k} \\ \vdots & \ddots & \vdots \\ a_{k1} & \cdots & a_{kk} \end{pmatrix}; B = \begin{pmatrix} b_{11} & \cdots & b_{1m} \\ \vdots & \ddots & \vdots \\ b_{k1} & \cdots & b_{km} \end{pmatrix}; (1+\phi D) = \begin{pmatrix} 1+\phi D_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & 1+\phi D_m \end{pmatrix}$$

Where

$$D_i \begin{cases} = 0 \text{ for Prices drop} \\ = 1 \quad \text{otherwise} \end{cases};$$
$$k = 1, 2..., 9 \text{ (number of sectors)}$$
$$m = 1, 2..., 7 \text{ (number of global Indices)} \tag{1.2}$$

$$Y = [JKAGRI\ JKBIND\ JK\ CONS\ JKFINA\ JKINFA\ JKMING\ JKMISC\ JKPROP\ JKTRAD]$$
$$X = [\ KLSE\ KS11\ JT1\ FTSE\ HSI\ 1XIC\ ] \tag{1.4}$$

A and B are matrices of parameters. A is the parameter matrix representing the spillover effect noted intra stock market while B is the parameter matrix for the contagious effect coming from external shocks. E and U are error terms.

Volatility Price Transfer

$$Y_t^v = A_{v0} + A_{v1}Y^v{}_{t-1} + B_{v1}(1+\phi_v D_t)X^v{}_t + U_t \quad (1.4)$$

Subscript v indicates variability; The X and Y are based on abnormal returns as explained below:

Abnormal return in range can be defined as returns lying outside the normal range of daily stock prices movement. Therefore, it can be written as (see equations (1.5) to (1.7):

Return is written: $R = \frac{p_t - p_{t-1}}{p_{t-1}}$ (1.5)

Abnormal Return in Point (AR): $AR = R - \widehat{R}$ (1.6)

Here; $\widehat{R}$ is the expected return.

Abnormal Return in range (x) (see in Kaluge and Puspita 2015):

$$x\begin{cases} = AR \;\; if \;\; U \le R \le L \\ = 0 \qquad otherwise \end{cases} \quad (1.7)$$

Where U is upper bound of the normal range and L is Lower bound.

RESULT AND DISCUSSION

Mean Price Spillover

The Vector Auto Regression Y with Asymmetric Effect of X factors is written as Equation (1.1) and it yields the results as noted in Table 1.

Table 1: Result from Mean Prices Spillover Model

	JKAGRI	JKBIND	JKCONS	JKFINA	JKINFA	JKMING	JKMISC	JKPROP	JKTRAD
$JKAGRI_{t-1}$	0.089 **	-0.042	-0.129	-0.065	0.047	0.004	-0.023	-0.071	-0.025
$JKAGRI_{t-2}$	-0.036	-0.021	-1.402	0.025	-0.024	-0.020	0.046	0.027	0.026
$JKBIND_{t-1}$	0.111 **	-0.015	1.853 **	0.072	0.088	-0.032	0.216 ***	-0.036	0.052
$JKBIND_{t-2}$	0.017	0.094	-1.945 **	0.131 ***	0.045	0.036	-0.037	0.186 ***	0.035
$JKCONS_{t-1}$	-0.001	-0.002	-0.054 *	-0.001	0.001	0.001	-0.001	-0.001	0.001
$JKCONS_{t-2}$	-0.001	-0.002	-0.022	-0.002	-0.001	0.001	0.001	0.001	0.001
$JKFINA_{t-1}$	-0.044	0.162 **	-0.811	0.074	0.248 **	0.065	0.273 ***	0.029	0.24 ***
$JKFINA_{t-2}$	0.008	-0.079	-2.428 **	-0.117 **	0.132	-0.010	-0.001	0.067	0.154 *
$JKINFA_{t-1}$	-0.009	0.024	-0.021	0.057	-0.393 ***	-0.051	-0.175 ***	0.011	-0.312 ***
$JKINFA_{t-2}$	0.036	0.040	-0.583	0.029	-0.082	0.07 *	0.121 *	-0.084 *	-0.026
$JKMING_{t-1}$	0.042	0.075	-0.629	0.069	0.118	0.144 ***	0.069	0.017	0.188 ***
$JKMING_{t-2}$	0.034	-0.043	0.538	-0.082 *	-0.057	-0.046	-0.051	-0.072	-0.028

Table 1 : (Cont.)

JKMISC $_{t-1}$	0.005	0.035	1.247 **	0.018	0.046	0.032	-0.064	0.103 ***	0.051
JKMISC $_{t-2}$	-0.022	-0.054 *	9.021 ***	-0.05 *	-0.010	-0.013	-0.095 ***	-0.047	-0.030
JKPROP $_{t-1}$	-0.085 *	-0.036	-1.997 ***	-0.058	-0.102	-0.08 **	-0.066	0.070	-0.030
JKPROP $_{t-2}$	-0.065	-0.047	-1.913 **	-0.024	-0.096	-0.033	-0.033	-0.144 ***	-0.069
JKTRAD $_{t-1}$	0.002	-0.056	-0.789	-0.058	-0.104	0.082	-0.209 ***	-0.005	-0.130
JKTRAD $_{t-2}$	-0.067	-0.058	0.208	-0.008	-0.102	-0.048	0.061	0.182 ***	-0.126
C	0.001	-0.001	0.029	-0.001	0.001	0.001	-0.001	-0.001	0.001
KLSE	0.188 **##	0.152	0.028	-0.043	0.31 *##	0.041	0.187	-0.019	0.205
KS11	0.129 *##	0.110	-0.519	0.108	0.032	-0.097	0.051	-0.045	-0.136
N225	0.013	-0.037	-0.867	0.001	0.039	0.022	0.011	0.012	0.015
STI	-0.028	-0.087	-1.516	-0.086	0.030	-0.017	-0.095	0.003	0.055
FTSE	0.055	0.024	0.627	-0.012	-0.006	0.010	0.040	0.057	-0.019
HSI	0.037	0.067	0.929	-0.006	0.088	0.101 ***##	0.154 **	0.097 *##	0.074
IXIC	0.009	0.072	-0.096	0.043	-0.087	0.014	0.039	0.025	-0.036
R-squared	0.051498	0.058492	0.357658	0.052098	0.191163	0.048592	0.35879	0.084563	0.236056
Adj. R-squared	0.02098	0.028199	0.33699	0.0216	0.165139	0.01798	0.338159	0.055109	0.211476
Sum sq. resids	1626.132	1993.472	493686.5	1467.784	6360.763	1203.862	2875.967	1745.477	3771.658
S.E. equation	1.446663	1.601749	25.20665	1.374423	2.861173	1.244738	1.923895	1.49881	2.203209
F-statistic	1.687456	1.930871	17.30541	1.70821	7.345541	1.587366	17.39083	2.871011	9.603631
Log likelihood	-1422.708	-1504.483	-3717.56	-1381.574	-1970.332	-1301.989	-1651.637	-1451.144	-1760.494
Akaike AIC	3.608239	3.811912	9.323935	3.505788	4.972183	3.307569	4.178424	3.679063	4.44955
Schwarz SC	3.760041	3.963715	9.475738	3.657591	5.123985	3.459372	4.330226	3.830865	4.601352
Mean dependent	9.09E-18	-2.63E-17	-6.16E-16	4.62E-17	-2.25E-17	-1.16E-17	5.74E-17	-4.29E-17	6.86E-17
S.D. dependent	1.462081	1.624822	30.95674	1.389512	3.131388	1.256081	2.364855	1.541898	2.481123

Note : * significant at 0.1 level;
** significant at 0.05 level;
*** significant at 0.01 level;
significant asymmetric effect

The spillover effect is seen in the impact on price changes or spillover Effect in mean. A shock in prices in one market could be transferred to prices in other markets. The spillover effect could be measured in terms of change in value or change in price mean. Based on this measurement, it is found that the Basic Industry sector has a "mean" transfer to the Agriculture, Consumption, and Miscellaneous sectors. If the price index of the Basic Industry jumps up, it will be followed by an increase in the price index of the Agriculture, Consumption, and Miscellaneous sectors one day after the shock. The same effect of the Basic Industry sector occurs in the Finance sector on the second day after the shock. The effect on the Consumption sector is very short because it will have the reverse effect as more selling actions are done by the actors.

If the shock happens in the Finance sector, it will affect the change in the price indices of the Basic Industry, Infrastructure, Trading, and Miscellaneous sectors but these in turn, will cause a reverse effect in the Consumption sector. The Infrastructure sector impacts the spillover effect onto the Trading sector. The price drop or price escalate in the Infrastructure sector will

drive the prices up in the Trading and Property sector in the opposite direction. The same story exists in the Mining sector. The shock in prices noted in the Mining sector has an effect on the Trading sector in the same direction. The shock in the Property sector will be reacted by the prices in the Consumption sector in the opposite direction. This assumes that there is a substitution effect from Consumption on Property; selling stock of firms in the Consumption sector and buying stocks in the Property sector. Finally, it is also noted that the shock in the Trading sector will affect the Property sector positively and the Miscellaneous sector, negatively.

International spillover effect also happens in the Indonesian stock market. The Agriculture sector will significantly react towards the shock in price indices of stock markets in Malaysia (KLSE) and South Korea (KS11). This sector follows the price direction of both markets. The prices of the Infrastructure sector in Indonesia follow those in Malaysia while the stock market in China/Shanghai (HIS) dictates the prices in the Indonesian sectors of Mining, Property, and Miscellaneous. In the case of Indonesia, the spillover effect of China's stock market has no impact on Indonesia's Trading sector.

In terms of asymmetrical responses, almost all sectors that have significant responses to foreign market tend to be biased to price drops. If the prices fall, the reaction against it is more serious than if the prices escalate at the same magnitude. This result is similar to what has been found by Booth, Martikainen *et al.* (1997) who noted the price and volatility spillover in the Scandinavian market. They claimed that volatility transmission is asymmetric with spillovers being more pronounced for bad news than good.

Volatility Price Spillover

Volatility Price Spillover uses the Velocity Risk Transfer Model which is actually a Vector Auto Regression Yv with Asymmetric Effect of Xv factors. It is written as Equation (1.4) with the following result:

Table 2 Result from Volatility Spillover Model

	JKAGRI	JKBIND	JKCONS	JKFINA	JKINFA	JKMING	JKMISC	JKPROP	JKTRAD
$JKAGRI_{t-1}$	0.067 *	0.119 ***	29.718	0.06	-0.086	-0.006	0.058	0.184 ***	-0.036
$JKAGRI_{t-2}$	0.072 *	-0.042	41.519	-0.052	-0.173	-0.022	-0.042	-0.047	-0.133
$JKBIND_{t-1}$	0.032	0.054	64.669	0.11 ***	-0.167	0.104 ***	0.364 ***	0.068	-0.078
$JKBIND_{t-2}$	0.051	0.125 ***	-92.764 **	0.042	-0.514	0.101 ***	0.109	0.097 *	-0.288
$JKCONS_{t-1}$	-0.001	-0.001	0.003	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
$JKCONS_{t-2}$	-0.001	0.001	0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
$JKFINA_{t-1}$	-0.002	0.143 **	96.219 *	0.072	-0.47	0.053	0.126	0.107	-0.3
$JKFINA_{t-2}$	-0.185 ***	-0.093	-391.828 ***	-0.058	0.748	-0.084 **	-0.089	0.05	0.45
$JKINFA_{t-1}$	-0.067 *	-0.087 *	-148.436 ***	0.07 *	-0.634	0.004	0.137 **	-0.067	-0.326
$JKINFA_{t-2}$	-0.078 ***	-0.089 ***	355.93 ***	-0.013	-0.019	-0.068 ***	0.359 ***	-0.122 ***	-0.054
$JKMING_{t-1}$	0.017	-0.108 *	0.428	-0.144 ***	-0.409	0.006	-0.168 **	-0.129 **	-0.238
$JKMING_{t-2}$	0.324 ***	0.09	17.869	0.03	-0.604	0.019	0.112	0.067	-0.363
$JKMISC_{t-1}$	-0.04 **	-0.033	-168.578 ***	-0.034 *	0.571	-0.052 ***	-0.214 ***	-0.067 ***	0.352
$JKMISC_{t-2}$	-0.001	-0.001	701.911 ***	-0.002	-0.006	-0.002	-0.005	-0.005	-0.002
$JKPROP_{t-1}$	0.043	0.082 *	-22.278	0.078 **	-0.326	-0.021	-0.042	0.02	-0.149

Table 2 : (Cont.)

$JKPROP_{t-2}$	0.071 *	0.002	-43.109	-0.005	-0.234	-0.018	-0.072	-0.04	-0.134
$JKTRAD_{t-1}$	0.12 *	0.155 *	265.017 ***	-0.125 *	1.708	-0.007	-0.046	0.119	1.021
$JKTRAD_{t-2}$	0.133 ***	0.148 ***	-633.34 ***	0.044	-0.465	0.131 ***	-0.288 ***	0.216 ***	-0.232
C	0.809 ***	1.21 ***	-1019.98 ***	1.269 ***	12.836	1.369 ***	2.447 ***	1.749 ***	7.206
KLSE	0.846 ***##	0.789 ***##	20.636	0.195	5.546	0.061	0.083	0.004	3.039
KS11	0.168	0.539 ***##	286.212 *##	0.3 *##	-1.691	0.251 **##	0.059	0.268	-0.705
N225	-0. 011	-0.032	-6.177	0.007	-0.253	0.002	0.01	-0.008	-0.172
STI	-0.129	-0.005	-216.89	0.168	-0.53	-0.047	0.285	-0.048	-0.207
FTSE	0.092	0.014	53.042	-0.095	-1.719	-0.061	0.016	-0.098	-0.988
HSI	0.027	-0.043	-41.749	-0.059	-0.955	-0.049	0.048	-0.146 *##	-0.568
IXIC	0.036	0.098	-184.711 *##	0.184 *##	-0.012	-0.028	0.252	0.1	-0.003
R-squared	0.145	0.114	0.970	0.076	0.096	0.060	0.974	0.087	0.163
Adj. R-squared	0.117	0.086	0.969	0.046	0.067	0.030	0.973	0.057	0.136
S.E. equation	4.650	5.406	4738.759	4.499	181.682	3.531	7.004	5.480	101.688
F-statistic	5.260	4.012	991.215	2.542	3.313	1.982	1154.473	2.956	6.066
Log likelihood	-2360.271	-2481.319	-7922.408	-2333.73	-5303.60	-2139.148	-2689.16	-2492.132	-4837.581
Akaike AIC	5.943	6.245	19.797	5.877	13.274	5.393	6.763	6.272	12.114

Note: * significant at 0.1 level;
** significant at 0.05 level;
*** Significant at 0.01 level;
significant asymmetric effect

The Agricultural sector (JKAGRI) has volatility spillover on the Basic Industry and Property sectors (the effect arises one day after). However, the Basic Industry and Property sectors have no variance spillover on the Agriculture sector, except for the Property sector, at a 2-day lag. The Basic Industry sector has variance spillover on the Financial and Mining sectors and others, one day after, and on the Consumption, Mining, and Property sectors, 2 days after. Interestingly, the result shows that 2 days after the shock in the Basic Industry sector, the Consumption sector tends to be calmed down. The Consumption sector has no transfer of volatility. It tends to just absorb the impact.

The Finance sector has significant impact on the disturbance in the Consumption sector at a one and two day lag after the case. The result also shows that the variance in the Agriculture and Basic Industry, Mining, and Property sectors tend to have an adverse impact two days after the incidence. The volatility seen in the Mining sector can only be transferred to the Agriculture sector. The turbulence seen in the Property sector will impact on the variance in the Finance sector and some on the Agriculture sector. In addition, the Trading sector has linkages to many sectors. Thus, the shock in terms of volatility seen in this sector, will be transferred to the Agriculture, Basic Industry, Consumption, Mining, and Property sectors.

In terms of international volatility transference, the Agriculture and Basic Industry sectors have volatility transfer that is experienced by the Malaysian Stock market (KLSE). The impact is more magnitude in significance if the turbulence is related to the fall of the index. For instance, the Kospi (KS11) index of South Korea has a volatility spillover on the Basic Industry, Consumption, and Mining sectors. Thus, a similar effect of asymmetry exists. Actors will react more if the price drops so the turbulence becomes more severe.

This study also found that the Nasdaq (IXIC) … has significant linkages with the financial sectors of the Indonesian market. Hence, the shock or volatility experienced in the US market will easily impact on the volatility of the financial sectors in Indonesia. Nonetheless, China has no volatility spillover on Indonesia. This finding is quite similar to the findings of Allen, Amram *et al.* (2013) who noted the volatility spillovers from the Chinese stock market onto the economies of its neighbors. They located some evidences of volatility spillovers which happened across these markets in the pre-GFC periods, but there was little evidence to suggest that there was a spillover effect from China onto related markets during the GFC.

Volatility transfer occurs at several sectors. If there is a volatility in the Agriculture (JKAGRI) sector, it will spillover onto the JKBIND and JKPROP sectors at a one-day lag. The Basic Industry (JKBIND) spillovers affect the JKFINA, JKMING, and JKMISC sectors within a one-day lag and the JKCONS (which is negatively affected), JKMING, and JKPROP sectors within a two-day lag. These findings are in line with the results found by Aityan, Ivanov-Schitz *et al.* (2010) who observed that "Next-Day Correlations" (NDCs) among the US stock market and markets in the Asian regions are significant.

Congruence of Response between Volatility and Mean

The question asked is whether the existence of volatility spillover stand hand in hand with mean spillover. From this study, it is found that not all sectors experience both effects. Some sectors have no effect while others have just one effect and this could be either mean spillover or volatility spillover; the rest of the sectors have both effects.

The sectors which appear to experience both types of spillover effect are the Basic Industry sector which impacts the Miscellaneous (one-day after) sector then onto the Consumption and Property (both are two-day after) sectors. The Finance sector spillover affects the Basic Industry (one-day after) sector then onto the Consumption (two-day after) sector. The Infrastructure sector has a spillover effect onto the Miscellaneous (one-day after) sector and then onto the Mining, Property, and Miscellaneous (two-day after) sectors. The same exists for the spillover effect from the Trading sector onto the Property sector.

In the context of international spillover effects, the simultaneous existence of both types of effect which happened due to the shock of the Malaysian (KLSE) phenomenon created spillover effects for the Agriculture sector in Indonesia while the shock experienced in China (HSI) affected the Property sector in the Indonesian stock market. Other studies of the CIVETS (Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa) indicate that the contemporaneous spillover effects are generally low. However, the CIVETS stock markets may show higher degrees of co-movements in times. The structure of the causality shows that the presence of intra-regional and inter-regional return and volatility spillover are interdependent effects (Korkmaz, Çevik *et al.* 2012).

CONCLUSION

Spillover effects exist among sectors in intra- Indonesian stock markets. The effects occurring among the sectors are not balanced. This means that some sectors create a spillover effect onto other sectors, but the impact on other sectors may not necessarily affect the respective sectors in the same way. Spillover effects also occur as a result of the shock noted in foreign capital markets which can create a spillover effect onto domestic sectors in the Indonesian stock market.

Spillover effects, in terms of change in mean prices, happen in many sectors. There are different coverage for spillover impact. Some sectors which experience shock affects only one or two other sectors whereas certain sectors may not have any effect on other sectors whilst certain sectors may even have no spillover effect at all. The same story exists when the spillover effect is measured by the disturbance or counted by variance. In terms of volatility spillover, it appears that shocks from foreign markets can creep into domestic market sectors and the risks may also be transferred among the domestic sectors in the Indonesian stock market.

Even though there are two types of spillover effect, and that both happen in the Indonesian stock market, it should be kept in mind that, in the relationship between two sectors, it is not necessary that both types of spillover effect will happen simultaneously. Using the daily closing prices of sectoral indices, this study offers results which show that the spillover effects arise mostly one-day after the shock and fewer sectors two-day after shock.

In terms of asymmetric responses of domestic sectors toward the shock in foreign markets, it is found that many sectors react more seriously when prices drop than when prices escalate. Thus, if the asymmetric approach is neglected and the symmetric one is used, the result will surely be underestimated in relation to price drops.

REFERENCES

Aityan, S. K., Ivanov-Schitz, A. K., & Izotov, S. S. (2010). "Time-shift asymmetric correlation analysis of global stock markets." *Journal of International Financial Markets, Institutions and Money,* Vol. 20 No. 5, pp. 590-605.

Allen, D. E., Amram, R., & McAleer, M. (2013). "Volatility spillovers from the Chinese stock market to economic neighbours." *Mathematics and Computers in Simulation,* Vol. 94, pp. 238-257.

Aloui, C., Hammoudeh, S., & ben Hamida, H. (2015). "Global factors driving structural changes in the co-movement between sharia stocks and sukuk in the Gulf Cooperation Council countries." *The North American Journal of Economics and Finance,* Vol. 31, pp. 311-329.

Alsubaie, A., & Najand, M. (2009). "Trading volume, time-varying conditional volatility, and asymmetric volatility spillover in the Saudi stock market." *Journal of Multinational Financial Management,* Vol. 19 pp. 2, pp. 139-159.

Apergis, N., & Voliotis, D. (2015). "Spillover effects between lit and dark stock markets: Evidence from a panel of London Stock Exchange transactions." *International Review of Financial Analysis*, Vol. 41, pp. 101-106.

Apostolakis, G. (2016). "Spreading crisis: Evidence of financial stress spillovers in the Asian financial markets." *International Review of Economics & Finance*, Vol. 43, pp. 542-551.

Apostolakis, G., & Papadopoulos, A. P. (2015). "Financial stress spillovers across the banking, securities and foreign exchange markets." *Journal of Financial Stability*, Vol. 19, pp. 1-21.

Arias, E. F., Hausmann, R., & Rigobon, R. (1998). "Contagion on Bond Markets: Preliminary Notes." *Massachusetts Institute of Technology, Sloan School of Management, Cambridge, Mass. Processed*.

Awartani, B., & Maghyereh, A. I. (2013). "Dynamic spillovers between oil and stock markets in the Gulf Cooperation Council Countries." *Energy Economics,* Vol. 36, pp. 28-42.

Baig, T., & Goldfajn, I. (1999). "Financial market contagion in the Asian crisis." *IMF staff papers*, Vol. 46 No. 2, pp. 167-195.

Baruník, J., Kočenda, E., & Vácha, L. (2016). "Asymmetric connectedness on the US stock market: Bad and good volatility spillovers." *Journal of Financial Markets,* Vol. 27, pp. 55-78.

Beirne, J., Caporale, G. M., Schulze-Ghattas, M., & Spagnolo, N. (2010). "Global and regional spillovers in emerging stock markets: A multivariate GARCH-in-mean analysis." *Emerging Markets Review*, Vol. 11 No. 3, pp. 250-260.

Booth, G. G., Martikainen, T., & Tse, Y. (1997). "Price and volatility spillovers in Scandinavian stock markets." *Journal of Banking & Finance,* Vol. 21 No. 6, pp. 811-823.

Calice, G., Chen, J., & Williams, J. (2013). "Liquidity spillovers in sovereign bond and CDS markets: An analysis of the Eurozone sovereign debt crisis." *Journal of Economic Behavior & Organization,* Vol. 85, pp. 122-143.

Calvo, S. G., & Reinhart, C. M. (1996). "Capital flows to Latin America: is there evidence of contagion effects?" *World Bank Policy Research Working Paper*, (1619).

Chakraborty, S., & Kakani, R. K. (2016). "Institutional investment, equity volume and volatility spillover: Causalities and asymmetries." *Journal of International Financial Markets*, *Institutions and Money.*

Dornbusch, R., Park, Y. C., & Claessens, S. (2000). "Contagion: How it spreads and how it can be stopped." *World Bank Research Observer,* Vol. 15 No. 2, pp. 177-197.

Du, L., & He, Y. (2015). "Extreme risk spillovers between crude oil and stock markets." *Energy Economics,* Vol. 51, pp. 455-465.

Fernández-Rodríguez, F., Gómez-Puig, M., & Sosvilla-Rivero, S. (2015). "Volatility spillovers in EMU sovereign bond markets." *International Review of Economics & Finance,* Vol. 39, pp. 337-352.

Frankel, J. A., & Schmukler, S. L. (1996). "Country fund discounts and the Mexican crisis of December 1994: did local residents turn pessimistic before international investors?." *Open Economies Review,* Vol. 7 No. 1, pp. 511-534.

Goldstein, M. (1998). *The Asian financial crisis: Causes, cures, and systemic implications (*Vol. 55). Peterson Institute.

Jin, X. (2015). "Asymmetry in return and volatility spillover between China's interbank and exchange T-bond markets." *International Review of Economics & Finance,* Vol. 37, pp. 340-353.

Kaluge, D., & Puspita, W. (2015). "Asymmetric Reaction Towards Financial Shocks in ASEAN Countries." *Procedia-Social and Behavioral Sciences,* Vol. 211, pp. 519-527.

Korkmaz, T., Çevik, E. İ., & Atukeren, E. (2012). "Return and volatility spillovers among CIVETS stock markets." *Emerging Markets Review,* Vol. 13 No. 2, pp. 230-252.

Majdoub, J., & Mansour, W. (2014). “Islamic equity market integration and volatility spillover between emerging and US stock markets.” *The North American Journal of Economics and Finance,* Vol. 29, pp. 452-470.

Masson, P. R. (1998). Contagion: monsoonal effects, spillovers, and jumps between multiple equilibria.

Masson, P. R., & Mussa, M. (1995). *The Role of the IMF: Financing and its Interactions with Adjustment and Surveillance* (Vol. 50). International Monetary Fund.

Park, Y. C., & Song, C. Y. (2001). Financial contagion in the East Asian crisis: With special reference to the Republic of Korea. In *International financial contagion* (pp. 241-265). Springer US.

Rigobon, R. (1999). *On the measurement of the international propagation of shocks* (No. w7354). National bureau of economic research.

Tamakoshi, G., & Hamori, S. (2016). “Time-varying co-movements and volatility spillovers among financial sector CDS indexes in the UK.” *Research in International Business and Finance*, Vol. 36, pp. 288-296.