Response Asymmetry in Spillover Volatility: An Empirical Study in the Indonesia and Singapore Stock Market

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Following the blueprint of the ASEAN integration 2015, the integration of the financial markets in this region will increase. This study investigates the existence of a volatility spillover from the Singaporean stock market into Indonesia, including its transmission pattern. Singapore, as an advanced country in the ASEAN region, has played an important role as the information leader in the market of this region, so that it is very possible that the shocks in the Singapore's stock market will be transmitted to another stock market in this region. Using TGARCH (1,1) model specification regarding the data of the daily return of the Indonesia market index (IHSG) for the period of January 2008 – August 2012, it is observed that the shock that took place in the Singapore stock market is immediately transmitted to the Indonesia stock market with two important asymmetric patterns. The transmission of the shock from the Singapore stock exchange becomes stronger when this market (1) experiences a negative return, and (2) is in the bearish phase.

Keywords: *Asymmetric volatility spillover, sign asymmetry, phase asymmetry*

Introduction

In 2015, when the ASEAN Economic Community (AEC) is achieved, ASEAN will have a single market in which a freer flow of goods, services, investment and the capital flow among the nations in this area will take place. Many empirical studies have shown that the development of the integration of the capital market has resulted that the movement of the prime indicator of the stock market in a certain country can be transmitted easily and immediately to another country's stock market (see for instance: Kanas, 1998; Rigobon and Sack, 2003; Savva et al., 2009; Ingyu, 2011). Facts have also shown that the global economic crisis of 2008, which at the beginning was initiated in the United States, within a short period has spread over to most of the hemisphere, especially to the developed countries which are economically and financially very integrated with the United States.

In Asia, many countries have endured the negative side of the crisis, although the degree of the side effect has more variance among the countries, depending on the domestic economic condition and the degree of the integration of the country with the world economy. Singapore is a country which was at the beginning the most seriously affected by this crisis. This is not surprising because Singapore is a country which is fully integrated with the global market with regard to the business and finance. As a consequence, the country's economy is very sensitive towards any economic shock initiated from outside. In the context of the ASEAN economic and financial integration, a shock that exists in a country can easily and quickly spread to other countries. Some people explained that

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this possibility include financial panic and rational channels. Corsetti et al. (1998) and Glick and Rose (1998) said that spreading is rational, and a turmoil can spread via, among others, a trade and financial relation. Another argument explained it from the side of the market behavior.

Singapore which is part of the group of developed countries in the ASEAN region plays an important role as the information leader in this regional market and therefore is very possible in creating a price and volatility spillover from the Singapore stock exchange into other markets in this region, including Indonesia. This article studies the asymmetry spillover volatilities between the Singapore and Indonesia stock exchange. Many empirical findings have shown that the spillover volatility among markets is asymmetric. Bae and Karolyi (1994) have found that volatility spillover from the United States to the Japanese stock market is greater after a negative return innovation (bad news) compared to after a positive return innovation (good news). Koutmos and Booth (1995) have also found the existence of the same asymmetry at the volatility transmission between New York, Tokyo, and the London stock exchanges. Kansas (1998) also found the asymmetric pattern at the volatility transmission between London, Frankfurt, and Paris stock exchanges. Other studies have analyzed the asymmetric pattern in the transmission of the volatility during the bull and bear market period. The result of these observations shows that volatility from one market into another market will be transmitted faster and stronger during the downward market movement phase.

Efforts to get a better understanding about international transmission in a shock and volatility return of stocks between markets will become important, especially when accompanying the economic and financial integration with an increasing intensity. The aim of this study is to examine whether there is an asymmetry in the spillover volatility from the Singapore stock exchange into the Indonesia stock exchange. Investigation towards the asymmetric response is important because a spillover that is asymmetric is a source of financial contagion

and of course it has an important implication towards the macro policy. It is very possible that in a certain phase, especially in the bull phase, the market in a certain country, especially in the emerging market, looks as if it is not related to the market of other countries which are more advanced. However, facts and some other empirical studies have shown that during the downward market phase trend (bear), emerging markets can become blown up by a flare up, originated from the developed market.

According to this writer's observation, although there are many studies which have studied spillover volatilities in these two markets, however, there are only a few which have paid attention to the asymmetry phenomena in its transmission, the asymmetry which is connected to the short term return behavior (sign asymmetry) as well as to the long term return behavior (phase asymmetry).

Literature Review

The integration of the international financial market has been developing as a consequence of the liberation process adopted by many countries, have created many empirical studies which have examined how a stock market fluctuation in a certain market will transmit it to another stock exchange. Many of these studies have concluded that the transmission process have asymmetric characteristics (Badhani, 2009; Bahng and Shin, 2003; Chen et al., 2003; Koutmos and Booth, 1995). Badhani (2009) has studied whether the Indian stock market has responded asymmetrically to the information that comes from the United States market. The result has proved that there is a significant asymmetry in the price and the volatility spillover. The Indian stock market has responded stronger after the negative return compared to the positive return in the United States market. However, the study did not find a significant difference in the spillover price effect and in the volatility during the bull and bear market phase. Using the multivariate EGARCH, Koutmos and Boothe (1995) have also found an asymmetry in the transmission volatility among the New York, London, and Tokyo stock exchanges.

According to Badhani (2009), the asymmetry phenomenon has been observed in the asset price in three aspects. *First*, the evidence of asymmetry found in the response volatility towards the price change. The volatility increases more after a negative shock compared with after the positive shock.

The *second* asymmetric proof is shown in the mean reversion of the asset's price. Some empirical studies have found that the negative change of the stock price will reverse faster compared with a positive change. Therefore, a positive return in general shows a positive autocorrelation, while a negative return shows a negative autocorrelation (Koutmos, 1998; Nam et al., 2001). Overreaction towards bad news and under reaction towards good news is often assumed as the origin of this asymmetry.

The *third* asymmetric form is found in some empirical studies, which have shown that the covariance and correlation among the return will increase during the bear market and will decline during the bull market (Lin et al., 1994; Ang and Bekaert, 2002; Das and Uppal, 2004; Capiello et al., 2006). In the context of the international equity market, this phenomenon is manifested in an asymmetric spillover return and volatility.

Analyzing an asymmetric response, such as in Badhani (2009), the writer has used two different frameworks regarding the time span of the price behavior in the leading market (in this case Singapore). *First*, the asymmetry is studied in the context of the price behavior in the short term. Does the market price/volatility in a certain country show an asymmetric response towards a positive or negative price innovation in other countries? Such an asymmetric response is called sign asymmetry or news asymmetry. A positive price innovation in the leading market in this context is called as good news and a negative price innovation is called bad news. *Second*, asymmetry is studied in the context of a long term price behavior (or trend). Does a market price / stock market volatility in a country show an asymmetric response during an increasing price trend (bull market) and a decreasing price trend (bear market)? An asymmetric response of this genre is called as a phase asymmetry. The bullish phase in a market is called good time, while a bear phase in the market is called as bad time.

The identification of the volatility spillover in this study will be conducted using the following method by Fabozzi et al. (2004). To model the spillover effect of the volatility of a certain market (A) towards another market (B), the lag squared error component which was produced by the mean equation model GARCH of market B will be included into the GARCH model for market A as an explanatory variable in the conditional variance equation. The result of this lag squared error estimation coefficient will then be examined to analyze the existence of the spillover effect.

Research Method

Data and its sources

To study the asymmetric response at the Indonesia stock exchange towards the Singapore stock exchange, the daily time series data at the closing of Jakarta composite index, and the FTSE Strait Times index (FSSTI index – Singapore) is used, with a sample period of January 3rd until August 15th 2012 with a total of 990 observations. The daily time series data for both indexes are collected from Bloomberg. For each index, the daily return is calculated as a change in the logarithm of the closing price in two chronological days: $R_t = \ln(S_t) - \ln(S_{t-1})$, with S_t as the closing index at day t.

Method of data analysis

In this study, the specification of the TGARCH model will be used to capture the asymmetric volatility phenomena. This specification is used because many results of these studies in the literature have shown that the univariate stock index return has the tendency towards a volatility clustering (time varying volatility) and it has also shown an asymmetric behavior. The volatility will increase following the negative return shock. Therefore, before a TGARCH model parameter estimation is conducted, the Lagrange Multiplier will be used to

Table 1. Identification result of bear and bull phase

Phase 1	Bear	January 3rd, 2008 - March 31st, 2008
Phase 2	Bull	April 1st, 2008 - June 6th, 2008
Phase 3	Bear	June 7th 2008 – March 20th, 2009
Phase 4	Bull	March 23rd, 2009 – February 2nd, 2011
Phase 5	Bear	February 3rd, 2011 – March 21st, 2011
Phase 6	Bull	March 22nd, 2011 – August 4th, 2011
Phase 7	Bear	August 5th, 2011 – August 15th, 2012

test the existence of the ARCH structure using the auxiliary least squares regression for the variable stock return towards the intercept.

It is known from the literature that the return data, besides showing the volatility clustering characteristics, also exhibits fat tails distribution probability, that is, it has a greater tendency to create an extreme occurrence. In general, this is signaled through the greater positive kurtosis excess value of more than 3. This kind of distribution is characterized as leptokurtic. All of these characteristics are different from the Gaussian (normal) distribution property. Therefore, the statistical descriptive regarding the whole of the above mentioned property will be studied in order to complete the reason for using the TGARCH specification in modeling the return volatility of the stock in the Indonesia stock exchange. In accordance to the finding of Hansen and Lunde (2001), the GARCH model with order (1,1) is the best model in predicting the return of assets volatility behavior. Therefore, TGARCH with order (1,1) will be used in this study to model the volatility return in the Indonesia stock exchange as well as the Singapore exchange.

Identifying the sign asymmetry pattern is done by dividing the return data of the FSSTI index in two series. The first series consist of data with positive return, and the second series consist of data with a negative return. For the time being, to identify the asymmetry phase, the distribution of the data in two series is based on the series data in the bull phase and bear phase. Both phases are identified visually from the FSSTI time series index plot which is based on the trend pattern as occurred in the market. To identify the pattern of the asymmetry phase, the researcher has divided the data into two series, that is, the data series of the bull phase and the bear phase. The grouping of the data into two phases is based on the monthly candlestick

which appears on the FSSTI chart. If the candle of a certain month has become lower low than the candle of the previous month, it means that the data is in the bear phase. Whereas, if the candle in this month is a high, and it becomes higher compared to the candle of the previous month, it means that the date is in the bull phase. However, if the candle does create a new high or a newer low, it means that the data will be categorized as following the next phase (if the candle for the following month creates a new low, it means that it enters the bear phase, and vice versa). The lowest or the highest point at each phase will become the border point between moving from the bull phase into the bear phase. Table 1 presents the identification result for the bear and bull phase.

The structure of mean and variance equation of TGARCH (1,1) for the sign asymmetry pattern:

$$R_t = \eta + \sum_{i=1}^{r} \theta_i R_{t-1} + \varepsilon_t + \sum_{j=1}^{s} \phi_j \mu_{t-j} \qquad 1)$$

$$\varepsilon_\tau | \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \delta \varepsilon_{t-1}^2 D_{t-1} + \beta h_{t-1} + \phi_1 SINRS_t + \phi_2 SINRS_t D_t^* \qquad 2)$$

with:

R_t: IHSG return

$$D_{t-1} = \begin{cases} 1 & if\ \varepsilon_{t-1} < 0 \\ 0 & if\ \varepsilon_{t-1} > 0 \end{cases} \qquad D_{t-1}^* = \begin{cases} 1 & if\ SIN_t < 0 \\ 0 & if\ SIN_t > 0 \end{cases}$$

The above mean equation is following the ARMA (r,s), in which R is the daily return of the index market (IHSG), ε_t is the stochastic error, Ω_{t-1} is the whole information at t-1, h_t is the conditional variance return which function is explained in the equation (2). This equation is used to detect whether the volatility return in the Indonesia stock exchange shows a different response when the Singapore market has a negative return and a positive return during the
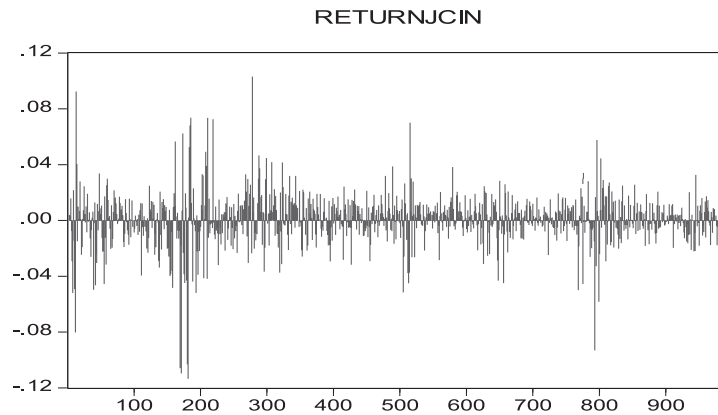
Figure 1. Return of IHSG

previous business day. The parameter in equation (2) has to fulfill: $\alpha_0 > 0$; $\alpha_1, \beta > 0$. The dummy variable (D_{t-1}) in above mentioned model represents the price innovation with a positive or negative characteristic, which has occurred in the Indonesian stock exchange. Therefore, the parameter shows the asymmetric influence from the domestic shocks which have a positive and negative characteristic towards the return of the IHSG. Whereas D^*_{t-1} represents the positive of negative price innovations which have taken place at the Singapore stock exchange.

SINRS is a quadratic value of the standardized residual resulted from the mean equation at the TGARCH (1,1) model for the stock's daily return in the Singapore stock exchange. This variable is a shock which takes place in the Singapore market, so that the ϕ_1 parameter in the equation (2) shows the volatility spillover from the Singapore stock exchange into Indonesia which is accompanied by the positive return in Singapore; ϕ_2 shows the difference in the negative return effect in the Singapore stock exchange towards the volatility spillover; hence, $\phi_1 + \phi_2$ is the volatility spillover from the Singapore stock exchange to Indonesia which has accompanied the negative return event at the Singapore stock exchange. The significance of the ϕ_2 parameter is that there is an asymmetric spillover volatility from the Singapore stock exchange into Indonesia. The δ parameter is called a leverage term. If δ is positive and significant, the shock which has a negative feature in the Indonesia stock exchange will have a greater effect towards the volatility (that is $\alpha + \delta$), compared with a positive shock effect towards the volatility (as big as α).

The TGARCH specification (1,1) for the phase asymmetry pattern is shown as follows:

$$R_t = \eta + \sum_{i=1}^{r} \theta_i R_{t-1} + \varepsilon_t + \sum_{j=1}^{s} \phi_j \mu_{t-j} \qquad \varepsilon_t | \Omega_{t-1} \sim N(0,h_t)$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \delta \varepsilon_{t-1}^2 D_{t-1} + \beta h_{t-1} + \phi_1 SINRS_t \\ + \phi_2 SINRS_t D_t^{\#} \qquad\qquad 3)$$

with:

$$D_{t-1} = \begin{cases} 1 & if \ \varepsilon_{t-1} < 0 \\ 0 & if \ \varepsilon_{t-1} > 0 \end{cases}$$

$$D_t^{\#} = \begin{cases} 1 & if \ market \ in \ the \ bear \ phase \\ 0 & if \ market \ in \ the \ bull \ phase \end{cases}$$

Equation (3) is used to detect whether the volatility return of the Indonesia stock exchange has shown a different response when the Singapore market is in a bull (good time) and bear (bad time) phase. In this variance equation, the ϕ_1 parameter shows the volatility spillover from the Singapore stock exchange into Indonesia during the bull phase at the Singapore stock exchange, while $\phi_1 + \phi_2$ is the volatility spillover from the Singapore stock exchange into Indonesia during the bear phase in Singapore. Hence, ϕ_2 shows the asymmetry in the volatility spillover. The significance of the parameter ϕ_2 shows that there is an asymmetric spillover volatility from the Singapore stock exchange into Indonesia during the bear and bull phase.

The estimation of the parameter in the above mentioned model has been done by using the Maximum Likelihood Procedure with the help of the software Eviews 7.1.
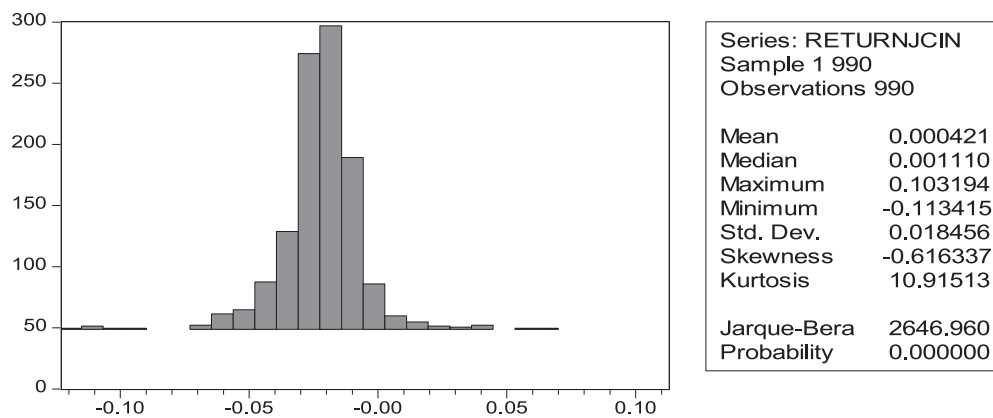
Series: RETURNJCIN	
Sample 1 990	
Observations 990	
Mean	0.000421
Median	0.001110
Maximum	0.103194
Minimum	-0.113415
Std. Dev.	0.018456
Skewness	-0.616337
Kurtosis	10.91513
Jarque-Bera	2646.960
Probability	0.000000

Figure 2. Descriptive statistics of the IHSG return data

Table 2. Variance residual return test of the IHSG

Heteroskedasticity test: ARCH

F-statistic	66.9879	Prob. $F(1,987)$	0.0000
Obs*R-squared	62.8575	Prob. Chi-Square(1)	0.0000

Note: since prob. Chi-Square (0.0000) is less than the alpha 5%, we reject the null of no ARCH effect.

Result and Discussion

As has been discussed in the previous part, the modeling of the return volatility is done with the GARCH model estimation which is the right specification model for data's that have a time varying volatility characteristic and have also a non normal distribution. Figure 1 shows the time series data for the Indonesia stock exchange. It can be seen that the stock return has shown that there is a quick change from one period into another period. It further shows that there is a time gap in which a great change is followed by a next great change, and that there is also a period in which a small change will be followed by a small next change. In this situation, the data series looks as if it shows that there is a time varying volatility or a volatility clustering.

Kurtosis, skewness, and Jarque-Bera normality statistics as shown in Figure 2 indicate that the characteristics of the data return of the IHSG follow the result of the findings as mentioned in many literature, the distribution probability is fat tails in nature as signaled by the positive kurtosis excess value which is greater than 3, and is a non normal distribution.

The test of the existence of the ARCH effect in Table 2 also shows that there is an ARCH effect in the residual return of the IHSG at the 5% significance level.

Many tests and observations on the characteristics of the data return are employed in this study. To accommodate the possibility of the asymmetry phenomena, sign as well as phase asymmetry, the specification of TGARCH is used in this study to catch the data characteristics and the asymmetry phenomena.

Estimation of the mean equation model in which the specification is aimed in equation (1), demands the determination of the optimal order for the autoregressive process and its moving average. Table 3 shows the result of the diagnostic test (with the residual analysis using lag 15) and other model criteria. The diagnostic test result, using the residual analysis shows that with a significant alpha= 5%, only the ARMA (3,1) specification model has a residual which is characterized as white noise, until the observed lag residual does not show the autocorrelation symptoms. ARMA (3,1) has also produced the greatest Adjusted R^2 and the smallest AIC. Therefore, the best model for the mean equation is the model with the ARMA (3,1) specification.

When analyzing the asymmetric response towards the shock coming from the Singapore stock exchange, TGARCH (1,1) as an extension of the GARCH model is modified by inserting two asymmetric patterns, that are, the sign asymmetry and the phase asymmetry at their relevant variance equations. The result of

Tabel 3. Diagnostic test and some other criteria to choose a model

Model	Q-Stat	Adjusted R^2	AIC	SIC
AR(1)	144.58 (23.68)	0.1734	-4.7793	-4.7694
MA(1)	231.68 (50.06)	0.4255	-5.1430	-5.1331
ARMA(1,1)	28.43 (22.36)	0.4342	-5.1573	-5.1424
ARMA(1,2)	47.96 (21.03)	0.4281	-5.1466	-5.1318
ARMA(2,1)	31.32 (21.03)	0.4340	-5.1560	-5.1361
ARMA(2,2)	28.09 (19.68)	0.4347	-5.1565	-5.1367
ARMA(3,1)	16.62 (19.68)	0.4378	-5.1600	-5.1353

Note: Q-stat is used to test the autocorrelation residual up to lag 15, which follows the chi-squared distribution with a degree of freedom is the lag, less the amount of ARMA order. The number in the brackets is the critical value Q at the significant level 5%.

Table 4. Sign asymmetry

	Coefficient	z-statistic	Prob.
Mean equation			
Constant (η)	0.0014	3.564208	0.0004
AR-1 (θ_1)	0.4868	2.352944	0.0186
AR-2 (θ_2)	-0.0399	-1.134216	0.2567
AR-3 (θ_3)	-0.0687	-2.832373	0.0046
MA-1 (ϕ)	-0.4210	-2.017983	0.0436
Variance equation			
Constant (α_0)	2.19E-05	3.7992	0.0001
ARCH effect (α_1)	0.0595	2.4585	0.0140
Asymmetry (negative return shock – domestic market) – (δ)	0.3518	5.0536	0.0000
GARCH effect (β)	0.2588	6.3827	0.0000
Volatility spillover (ϕ_1)	7.98E-05	7.7176	0.0000
Asymmetry volatility spillover (negative return shock) – (ϕ_2)	7.73E-05	4.0850	0.0000

Source: Data processing result
Response of the return volatility of the Indonesia stock exchange towards the positive and negative shock from the Singapore stock exchange

Table 5. Residual variance test result
Heteroskedasticity test: ARCH

F-statistic	0.0872	Prob. $F(1,984)$	0.7679
Obs*R-squared	0.0873	Prob. Chi-Square(1)	0.7676

Note: since prob. Chi-Square (0.7676) is greater than the alpha 5%, we do not reject the null of no ARCH effect.

the parametric estimation is shown in the Table 4 (for the sign asymmetry pattern) and Table 6 (for the phase asymmetry pattern).

The test of the variance residual as shown in Table 5 on the residual obtained from the Table 4 model has shown that the residual from the model has a homoskedastic characteristic. The positive and significant β parameter value at the variance equation indicates that the news effect towards the volatility return of the stock has a persistent characteristic during the analysis period of January 3rd 2008 until August 15th 2012. In this equation it is also shown the significance of the ϕ_1 parameter, which shows that there is a proof that there is a significant volatility spillover phenomenon, that is, that shock/ volatility return as happened in the Singapore stock exchange will immediately transmitted to the Indonesia stock exchange. This finding

is in accordance to the study results by Lestano (2010), who has shown the existence of the spillover volatility from the Singapore stock exchange into the Indonesia stock exchange and it confirms the expectation that a stock exchange with an established financial system has spillover volatility to a country with a non established financial system. The variance equation at this study has also put two possible asymmetry phenomena, that is the difference effect of a negative or positive shock return which happen in the domestic (Indonesia) and the difference between the negative and positive shock return of the Singapore stock exchange. Both asymmetric effects, in which each is shown by the parameters δ and ϕ_2, are positive and statistically significant. The significance of parameter ϕ_2 shows that transmission of the shock/volatility return from the Singapore stock exchange to

Table 6. Phase asymmetry

	Coefficient	z-statistic	Prob.
Mean equation			
Constant (η)	0.0010	2.6469	0.0081
AR-1 (θ_1)	0.4479	2.2776	0.0228
AR-2 (θ_2)	-0.0468	-1.3683	0.1712
AR-3 (θ_3)	-0.0714	-3.0707	0.0021
MA-1 (ϕ)	-0.3736	-1.8663	0.0620
Variance equation			
Constant (α_0)	2.49E-05	4.0198	0.0001
ARCH effect (α_1)	0.0328	1.3705	0.1705
Asymmetry (negative shock return – domestic market) – (δ)	0.4285	5.4999	0.0000
GARCH effect(β)	0.2288	5.6273	0.0000
Volatility spillover (ϕ_1)	8.93E-05	8.5615	0.0000
Asymmetric volatility spillover (during the bear phase) – (ϕ_2)	8.65E-05	4.7948	0.0000

Source: data processing result
Response of the return volatility of the Indonesia stock market towards the shock from the Singapore stock exchange during the bear and the bull

Table 7. Variance residual test results

Heteroskedasticity test: ARCH

F-statistic	0.0057	Prob. $F(1,984)$	0.9396
Obs*R-squared	0.0058	Prob. Chi-Square(1)	0.9395

Note: since prob. Chi-Square (0.9395) is greater than the alpha 5%, we do not reject the null of no ARCH effect.

the Indonesia stock exchange becomes stronger when the Singapore stock exchange is experiencing a negative return (compared with when the Singapore market experienced a positive return). The second asymmetry phenomenon is shown by the parameter δ which is also significant. This shows that the volatility return in the Indonesia stock exchange shows a different/asymmetry response towards the shock change which happened at the previous period. The negative shock in the Indonesia stock exchange tends to have a greater volatility effect compared to the positive shock, or in other words, the volatility has increased more after the negative shock (the decrease of the price/return) compared with after the positive shock. Looking at the amount of the estimation parameter (δ) and (ϕ_1) it can be seen that although a significant volatility transmission phenomenon has taken place from the Singapore stock exchange to Indonesia, however, the influence of the shock that has happened in the domestic market has a greater influence towards the volatility return of the IHSG compared to the shock which happened in the Singapore stock exchange.

Result of the test of Table 7 shows that the residual variance obtained from the Table 5

equation is homoskedastic. A shown in Table 3, the variance equation at Table 5 has indicated that the news effect towards the volatility return of the stock has a persistent character during the period of analysis (shown by the significant β parameter). The result of the model estimation to identify the asymmetric phase character has also shown an important finding. The significance of the ϕ_1 and ϕ_2 parameters indicate that the shock as experienced at the Singapore stock exchange will be immediately transmitted to the Indonesian stock exchange, and the transmission of volatility spillover will be stronger when the Singapore stock exchange is in a downward phase (bear).

This finding has strengthened previous studies which have analyzed the asymmetric pattern at the volatility transmission during the bear and bull markets. The volatility from one market into another market is stronger and faster transmitted during the downward market movement phase. This phenomenon is called financial contagion. King and Wadhwani (1990) in their study have proven that such a contagion is observed during the financial crisis period of 1987, whereas Edward and Susmel (2001) and Bae et al. (2003) have proved it during the Asian and Russian crisis.

In the increasing financial market integration, a better understanding about the international transmission in the shock and volatility of the return of the stock between markets will become more important. The existence of a significant spillover volatility have brought some important implications. *First*, the correlation between both markets will be strengthened in its return as well as in its volatility. *Second*, the correlation and the price/volatility's spillover at the end will have an important implication for the portfolio manager, especially for those who have stressed the importance of the benefit of diversification. This benefit will not be provided as expected, because the financial market of the two nations will become more related to each other. Especially, during the downwards turn phase, the correlation becomes closer because it has discovered a significant proof of the asymmetry volatility. During this phase, where the spillover becomes stronger, the usefulness of the diversification of the international portfolio will decrease more. *Third*, especially, the stronger volatility transmitted when the market is at the downwards trend will cause an increase in the asymmetry information. Volatility and uncertainty about asset values undoubtedly are closely correlated. Instruments whose fundamental values change quickly are difficult to value because trader must be certain that they have all available information when they form their value estimates. Since it is harder for traders to be fully informed about volatile instruments, asymmetric information problems are probably become greater. When the asymmetric information problem is particularly severe, spread may be so wide that no trading occurs. Dealers will not make markets because the losses they expect from trading with well informed trader are greater than their potential trading revenue. When this happens, market has failed. Market failure explains why business is not interested in financing their operation by issuing publicly traded equity (Harris, 2003). *Fourth*, the asymmetry phenomenon (time varying) of the spillover volatility also automatically implicates that the investor is facing an investment opportunity set which have also a time varying characteristic. Of course, like Badhani (2009)

said, the next implication will be the need to develop a new approach to solve the choice of the dynamic portfolio for the investor facing an investment opportunity set which has a time varying character.

Conclusion

This research studies the asymmetry in the spillover volatility of the Singapore and Indonesia stock exchange during the analysis period of January 2008 – August 2012. Specification of the ARMA-TGARCH (1,1) model was developed to investigate the asymmetry pattern in the short term return behavior (sign asymmetry) as well as in the long term return behavior (phase asymmetry). The important empiric finding in this study is that the shock happened in the Singapore stock exchange will be immediately transmitted to the Indonesian stock exchange. Two important asymmetric patterns detected are: (1) the transmission of the shock/volatility return from the Singapore stock exchange to the Indonesian stock exchange will be stronger when the Singapore stock exchange is experiencing a negative return (a form of sign asymmetry) compared with when the Singapore market experiencing a positive return; and (2) the transmission of the shock will also be stronger whenever the Singapore stock exchange is in the declining phase and trend (bear), and this is called the phase asymmetry.

The important implication of this asymmetry volatility spillover phenomenon is the need of a fast and responsive macro policy when the external market enters the declining phase (bear), because during this phase, the tremor will be transmitted immediately to the Indonesian stock exchange with a stronger intensity. For the global investor, this asymmetry pattern will also have an implication, that the efforts to diversify the portfolio between stocks markets of the countries will have a lower usefulness when the market is experiencing a declining trend phase. Moreover, stronger volatility transmitted when the market is in the downwards trend will cause an increase in the asymmetry information. It is harder for traders to be fully informed about volatile instruments. When the

asymmetric information problem is particularly severe, spread may be so wide that no trading occurs and market becomes illiquid. Market failure explains why businesses are not interested in financing their operation by issuing publicly traded equity. The asymmetry phenomena (time varying) of the spillover volatility also implicates that the new approach to solve the portfolio choice needs to be developed. This is because the investor will face a time varying investment opportunity set as an implication of time varying spillover volatility.

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