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Volatility Spillovers across Commodity and Stock Markets among ASEAN Countries

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ABSTRACT

The financial liberalization and opening of economies have increased volatility of international markets, hence has generated increasing interest in the study of market volatility. Meanwhile, in recent years, commodity markets have experienced a rapid growth in liquidity and an influx of investors who are attracted to commodities as investment alternatives and also as a means to support economic activity via the hedging of risks. Since gold and crude oil are the main representatives of the large commodity markets and with the the rising trend of world commodity prices, thus it is of fundamental practical significance to analyze how volatility and shocks are transmitted among these markets. Thus, this study employs the EGARCH and MEGARCH model to examine the spillover effect of oil and gold volatility on ASEAN-5 stock returns volatility over the 2000 to 2013 period. The results show that the impact of oil price on the mean equation of all stock market index are positive and significant; indicating that any increase in the crude oil price will increase the return of market index. However, the estimated values in the variance equation are statistically significant only for the case of Malaysia and Singapore but not for Indonesia, Thailand and Philippines. This finding indicates that one of the channels of stock market fluctuations in Malaysia and Singapore is the volatility of the crude oil price, in which any turbulence in the oil market can affect these two stock markets. In addition, hedging effect does not hold for the case of Malaysia and Singapore with regards to oil price risk. In contrast, for Indonesia, Philippines and Thailand, stock market can provide a good hedge against the oil market fluctuations. In regards to the gold prices, the volatility of the gold market has a significant effect on the volatility of Kuala Lumpur and Singapore stock markets only but not so for the other markets. Therefore, it can be concluded that for the case of Indonesia, Philippines and Thailand investment in the gold market can be a good hedge against the stock price fluctuations; nevertheless, in the case of Malaysia and Singapore investment on the gold market cannot hedge the volatility of stock market. On the strength of these results, we advocate the use of gold as a safe haven for a well-diversified portfolio only for Indonesia, Philippines and Thailand.

Key words: Volatility spillovers, oil and gold prices, ASEAN stock market

INTRODUCTION

The rising trend of commodity prices such as gold and oil prices over the last half decade coupled with the increasingly volatile of international financial markets has motivated interest to study the financialization of commodities and market volatility. The price of Brent traded at $23.95 per barrel in January 2000 and reached a high of $108.09 per barrel in December 2011 (Energy Information Administration) is one of the many evidences that highlight such phenomenon. Understanding the price behavior of commodity prices and the volatility transmission mechanism between these markets and the stock exchanges are crucial for each participant, including governments, traders, portfolio managers and investors. For instance, the findings will illustrate several important implications for portfolio hedgers in making optimal portfolio allocations, risk managers in managing risks and forecasting future volatility in both equity and commodity markets. As for investors, the results may provide a better picture of the exposure to commodity price risk specifically oil and gold price risk when investing in the ASEAN stock markets.

Studies such as Malik and Hammoudeh (2007), Malik and Ewing (2009) and Arouri *et al*. (2011), have examined the interactions between oil and stock markets. They provided evidence that not only oil price is a determinant but also a predictor of stock returns. In contrast, studies by Park and Ratti (2008) who examine the effect of the shocks that occurred in oil prices on stock exchange returns in USA and European countries using data from 1986 to 2005 found that the oil price shocks had a strong effect on stock returns with the exception of USA, thus, the link between these two markets is still not conclusive and warrants for further research.

For commodities market, besides oil, gold is another important commodity that may influence stock returns. As evidenced by Baur and McDermott (2010), gold is both a hedge and a safe haven for major European stock markets and the US. They also argue that gold may act as a stabilizing force for the financial system by reducing losses in the face of extreme negative market shocks. In addition, they also report that gold was a strong safe haven for most developed markets during the peak of the recent Global Financial Crisis (GFC). On the contrary, the conclusions of Mensi et al. (2013) who document significant transmission among the US stock index and commodity markets reflecting that gold could not be considered as a safe haven asset. Hence, it is argued that gold market and stock market have an evident tradeoff which in some countries such relation has been captured and in some other it is not statistically confirmed.

In this study, we consider the literature on equity market volatility and their link to oil and gold market by testing the hypothesis that volatility spillover from the oil market and the gold market to the equity market is statistically significant. We rely on EGARCH and MEGARCH model to test these hypotheses for selected ASEAN stock markets namely, Indonesia, Singapore, Malaysia, the Philippines and Thailand. Our study use monthly data for the period January 2000 to January 2013. The literature closest to our study is by Creti et al. (2013) who examine the links between price returns for commodities including oil and gold and stock returns. However their study focus on testing for correlations among the variables and rely on dynamic conditional correlation (DCC) GARCH methodology using data on the United States.

This paper is structured as follows: Section 2 presents recent empirical studies. Section 3 specifies the data and methodology. Discussions on the empirical results are described in Section 4, and Section 5 provides the conclusions and economic implications of the results.

LITERATURE REVIEW

The increasing trend of commodity prices and their important roles on economic development have trigger attention among researchers and practitioners. Among the main issues raised are the interactions among commodities and the financialization of the commodities. Two most popular commodities being examined are oil and gold from energy and precious metal commodity group respectively.

Interactions between stock markets and oil prices have been examined among others by Malik and Hammoudeh (2007), Park and Ratti (2008), Malik and Ewing (2009), Arouri *et al*. (2011, 2012), Sadorsky (2012) and Awartani and Maghyereh (2013). The link between oil prices and stock market could be explained from the discounted valuation model, in which the price of financial assets such as stock is the discounted future cash flow of the firm. As part of production input, changes in oil price may affect the cash flow of the firm and hence affect the stock returns. Examining data for US stock markets, most of these studies document that volatility spillover is from the oil market to equity markets except for some cases. For instance, Malik and Hammoudeh (2007) examine the volatility and shock transmission mechanism between the US equity, global crude oil market, and Gulf equity markets (Saudi Arabia, Kuwait and Bahrain) and find that, in all cases, volatility spillover is from the oil market to equity markets except in the case of Saudi Arabia, where volatility spillover is from the equity market to the oil market. Similar findings on Gulf equity markets are documented by a more recent study Awartani and Maghyereh (2013) during the period from 2004 to 2012 in which information flow from oil returns and volatilities to the Gulf Cooperation Council stock exchanges is found to be important. Meanwhile, studies on volatility spillovers have employed several approaches, for instance Malik and Ewing (2009), Arouri *et al*. (2011, 2012) and Sadorsky (2012) have employed the family of GARCH model specifically bivariate GARCH, generalised VAR-GARCH and multvariate GARCH respectively, in testing for volatility spillovers between oil and stock returns. They find significant evidence of transmission of shocks and volatility between oil prices and stock returns. Using data from January 1998 to December 2009 for Europe and the US, Arouri *et al*. (2011) discover a uni-directional volatility spillover, from oil markets to stock markets in Europe, but bi-directional in the US. On the other hand, Park and Ratti (2008) looked into the effect of the shocks that occurred in oil prices on stock exchange returns in USA and 13 other European countries using VAR model and the data between 1986 and 2005. They find that the oil price shocks had a strong effect on stock returns with the exception of USA. From this literature, we observe that oil price volatility spillover exists and mostly emerges from the oil market and affects the equity market. Yet, they do not consider the important role of gold on the stock returns.

Recently, studies such as Mensi et al. (2013), take into consideration the claim by Baur and McDermott (2010) on the role of gold as a safe haven asset or a refugee. According to them, in order for gold to be a safe haven asset, it must hold its value in adverse market conditions, hence offers investors the opportunity to protect wealth in the event of negative market conditions. Mensi et al. (2013) have documented that for return and volatility spillover, they find significant transmission among the US stock index and commodity markets. Specifically, employing the VAR-GARCH model, the past shocks and volatility of the stock index strongly influenced the oil and gold markets. Another study by Sumner et al. (2013), examine the relationship among financial markets and gold in the United States. Different from previous approach, they employ a spillover index methodology to examine whether gold returns and volatilities can predict U.S. stock market movements or vice versa. For the sample period from January 1970 until April 2009, they find that return spillovers appear muted. The lack of any substantial relationship between gold and stocks raises the question whether gold price movements can be used as a predictor for stocks and bond prices. On contrary such findings support the role of gold as a safe haven asset. Another related study is by Creti et al. (2013) who examine the links between commodities returns and stock returns on US data over a period of January 2001 to November 2011. Employing the DCC GARCH approach, the results how that the correlations between the returns evolve through time and are highly volatile, emphasizing the links between these variables and hence underlining the financialization of commodity markets.

As highlighted above, the relationship between oil, gold prices and stock returns is not conclusive, moreover, the literature on stock and commodity market linkages shows that price transmission between stock and commodity prices is extensively examined using different econometric techniques. It is now well known that stock and commodity markets are recently characterized by more volatile dynamics that call for deeper analyses of volatility spillover between these markets.

DATA AND METHODOLOGY

Data

The objective of this study is to examine the effect of oil and gold price fluctuations on the volatility of ASEAN-5 stock markets, namely Malaysia, Singapore, Philippines, Indonesia and Thailand. Composite index of each market, as the main indicator of the selected stock market, is utilized for this purpose. For oil price, the price of OPEC oil-basket is adopted in the current research following Juncal & Fernando (2003) who states that most of the accomplished studies on the impact of oil price fluctuations on the stock market volatilities have used the OPEC crude oil price quoted in USD. For the gold price, data of gold bullion are collected from the London precious metal stock market. Similar measures were used by most recent studies on gold prices among others Masih et al. (2011), Arouri et al. (2011), Sumner et al., (2013) and Thuraisami (2012). Monthly data are used in this study, collected from Thompson-Reuters Data Stream and the study period spans from January 2000 to January 2013. The return of every ASEAN-5 stock market is computed using equation (1).

$$R_t = \log\left({P_t}/{P_{t-1}} \right) \qquad (1)$$

Where, R_t represents return at time t, and P_t and P_{t-1} represent value of index in the current and previous period correspondingly.

Methodology

In order to examine the effect of oil price volatility on the stock market volatility we employed the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) model. The model is applied in cases where data exhibit evidence on non-stationarity, where an initial differencing step (corresponding to the "integrated" part of the model) can be applied to remove the non-stationarity to ensure the results of estimation is not spurious. In doing so, we test for unit root for all variables employing the augmented Dickey-Fuller (ADF) and Zivot-Andrews (ZA). The use of ZA unit root test beside the traditional unit root test ADF motivated from the fact that the results from the ADF testing can be misleading when the time series data have structural break or level shift characteristics. Therefore, in order to test for robustness, ZA test is used, which not only is capable to capture the breakpoint(s) in the time series but also to check whether the time series is stationary or nonstationary even in the presence of structural break. Next, in order to identify the correct distribution function for the error terms' distribution, kernel density function is employed.

Augmented Dickey-Fuller (ADF) unit root test

In the ADF unit root test, null hypothesis that a time series (Y_t) is integrated of order one; I(1), is tested against the alternative of I(0) by the assumption of dynamics in the data have an Autoregressive Moving Average structure (ARMA). The ADF test is based on estimating equation (2).

$$Y_t = \beta D_t + \delta Y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

Where D_t represents a vector of deterministic terms (constant, trend and etc) and p represents the order of lag difference terms. Under the null hypothesis, Y_t is I(1) which implies that δ is equal to one that is the case on nonstationarity. In contrast, if the estimated value for the coefficient of δ is not statistically different from zero, then it can concluded that the time series is stationary, that is the case of I(0).

Zivot – Andrews unit root test (ZA)

One disadvantage of ADF is that it ignores the structural break properties of the time series under consideration. Zivot and Andrews (1992) have suggested a procedure to check whether a series is stationary by the inclusion of break in the time series. In other words, in their suggested method breakpoint can be captured if there exists and its effect will be considered in the stationarity checking. The recommended procedure is as specified in equation (3).

$$y_t = \mu + \beta_t + \delta y_{t-1} + \gamma DU_t + \theta DT_t + \sum_{i=1}^{k} \eta_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

Where, *DU* and *DT* are dummy variables, introduced to capture the timing of structural break in the time series. In this procedure, the timing of break will be chosen at a point that minimizes one-side t-statistic of $\delta = 1$. By revealing the breakpoint, DU = 1 if t > time of break, and it would be zero otherwise. Likewise, DT = t if t > time of break, and it is zero otherwise. For more details, see Zivot & Andrews (1992).

After unit root testing, through a univariate framework, testing for the existence of the volatility in the ASEAN-5 stock markets will be investigated by employing EGARCH model. Results of this step represents whether there exist asymmetry effect (or leverage effect) in the ASEAN-5 data generating process. For the next step, based on a multivariate framework, crude oil price will be included in the EGARCH model in order to detect magnitude of volatility. If oil price volatility intensifies the volatility of ASEAN-5 stock markets, then it can be concluded that the oil price volatility positively affects the selected markets and there exists spillover effect. In addition, through EGARCH model which is empowered to capture the asymmetric effect of the financial markets, any increase in the volatility of the selected stock markets not only provides evidence on intensifying impact of the oil price volatility on the ASEAN-5 stock markets but also it represents information about the negative impact of oil price shocks on the stock market, which is more than the effect of positive shocks with the same magnitude. In following, preliminary analyses such as unit root tests and kernel density function investigation will introduce at first; and secondly, the ARCH and EGARCH models will be explained. Finally, empirical findings of this study will be reported.

Autoregressive Conditional Heteroscedasticity (ARCH)

ARCH models are used to characterize and model observed time series. They are used whenever there is reason to believe that, at any point in a series, the terms will have a characteristic size, or variance. In particular ARCH models assume the variance of the current error term or innovation to be a function of the actual sizes of the previous time periods' error terms: often the variance is related to the squares of the previous innovations (Engle, 1982). ARCH models are employed commonly in modeling financial time series that exhibit time-varying volatility clustering, i.e. periods of swings followed by periods of relative calm. ARCH model is introduced by Engle (1982) and claims that the conditional variance structure follows the squared of moving average form of residuals of the previous periods, resembling the squared moving average component. Therefore, it can be represented by equation (4).

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \beta_i u_{t-i}^2 \qquad (4)$$

Where conditional variance of σ^2 at time t depends on the squared error term in the previous periods $\sum_{i=1}^{p} \beta_i u_{t-i}^2$.

Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH)

EGARCH model initially developed by Nelson (1991) who proposed there exist an asymmetric effects between positive and negative asset returns. The specification for conditional variance is represented in equation (5) that is reported as follow:

$$\log \ \sigma_t^2 \ = \omega + \sum_{i=1}^{p} \alpha_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \sum_{k=1}^{r} \gamma_k \left(\frac{\varepsilon_{t-k}}{\sigma_{t-k}} \right) + \sum_{j=1}^{q} \beta_j \log \ \sigma_{t-j}^2 \qquad (5)$$

Where γ_k stands for capturing the asymmetric behavior of an asset return. EGARCH is capable of capturing the most important stylized features of stock market volatility, namely volatility-clustering, negative correlation with return, logarithm normality and under certain specifications, long memory. In addition, another privilege of EGARCH model is its ability to capture the "leverage" effect cited by Black and Fischer (1976). Means that shocks (i.e. bad news) have different influence, for instance impact of a negative shock or bad news on the volatility of an asset return is higher than the positive shock or good news with the same magnitude. Furthermore, the logarithm form of the conditional variance implies that the leverage effect has an exponential form hence the variance is non-negative. The presence of the leverage effect can be examined by the hypothesis that γ_k p 0 , if $\gamma_k \neq 0$ then the impact is asymmetric.

Volatility of gold and oil price firstly are captured by a simple structure of ARIMA-ARCH model and secondly through applying ARIMA-EGARCH model volatility and degree of asymmetry of ASEAN-5 are measured through a univariate model. After proving existence of volatility and asymmetric effect in the ASEAN-5 composite indices series, oil price and gold price are gradually added to the EGARCH model to capture spillover effect in the ASEAN-5 stock markets.

FINDINGS

Table 1 provides some descriptive statistics of the ASEAN-5 stock series. The skewness coefficients show that all return series are negatively-skewed. Meanwhile, that fact that all the kurtosis coefficients of stock returns exceed 3 indicates the high leptokurtic properties.

Corresponding plots of prices and return time series are presented in Figure 1. As it can be observed, some upward and downward trends exist in the movements of the price indices, implying that the mean and variance of these time series are not constant during the period under studied, hence the series can be nonstationary. Nevertheless, the return series, do not exhibit any deterministic trend and their fluctuations are around the origin line, indicating a stationary process. Yet, these graphical inferences are not sufficient and reliable enough to say about the stationarity level, thus a robust unit root tests such as ADF or ZA are required. Results of the ADF and ZA unit root tests are reported in Table 2. From Table 2, results from the ADF test show that the composite indices of ASEAN-5 stock markets are nonstationary in the level form (or price index) but the computed return series are stationary. In other words, the estimated t-statistics are not significant for the price indices, indicating that the null hypothesis of ADF test cannot be accepted and the price series is nonstationary. However the computed t-statistics of the return series are highly significant indicating that the return series are stationary. These findings from ADF test are supported by the results of the ZA unit root test. Thus, with regard to the outcomes of both unit root tests, it can be confirmed that the price series are nonstationary but the return series are stationary even at the presence of structural break in the time series. Therefore, due to the stationarity of the return series, these series will be used in the modeling.

Next, before testing for the ARCH and EGARCH models, the correct distribution function should be selected for the residuals. In doing so, the kernel density function is employed and the results of this plot are depicted in Figure 1. Beside the distribution form of the selected time series, kernel density plot show two theoretical distribution function namely Normal distribution and Student's-t distribution function. Referring to the left panel of Figure 1, kernel density of Student's-t distribution provide more fitted plot with the KLCI return series as compared to the Normal distribution function. Similar procedure is repeated for the other variables and the results indicate that the kernel density of the first difference form of crude oil and gold price are better fit with the Students-t distribution rather than the Normal distribution function. Therefore, for the modeling purposes, Student's-t distribution will be selected. Thus to sum up, it is found that composite indices of ASEAN-5 stock markets, crude oil price and gold bullion price indices are nonstationary in their level form, however they are stationary at first difference. In addition, results of the kernel density suggest that Student's-t distribution would be more appropriate function for the error term.

After obtaining a priori about the probable form of residuals distribution function, next the existence of volatility will be examined not only on the crude oil and gold bullion prices, but also on the composite index of all ASEAN-5 countries. For this purpose, ARCH (1) structure is applied for crude oil and gold bullion prices and consequently the EGARCH model will be used for each of the ASEAN-5 stock markets not only in order to capture the existence of volatility clustering in such markets, but also to capture the asymmetric effect in each market. The result for ARCH (1) is presented in Table 3.

In ARCH (1) model, the autoregressive and moving average (ARMA) component are taken into account in the mean equation in order to overcome the problem of serial-correlation, since the inclusion of such components reduce chances of dependency of residuals, as shown in Table 7. With regards to the outcome of each ARMA-ARCH model, and especially due to the significance of squared form of residuals, it can be concluded that enough evidence on the existence of time-varying volatility clustering phenomenon in the crude oil and gold price time series. The results of the diagnostic tests, such as heteroscedasticity and serial-correlation are reported in Table 7. Therefore, up to this point it is proven that the oil and gold prices are experiencing the volatility clustering phenomena; hence we can proceed to examine the impact of these variables on the volatility of ASEAN-5 stock markets. In doing so, first, we need to proof that ASEAN-5 stock markets are also experiencing the volatility clustering phenomena, second, to proof the existence of asymmetric effect in these markets and finally through a stepwise addition of both crude oil and gold prices, changes in the asymmetric effect coefficient could be observed. Such procedures are in line with Mohammad et.al, (2011) and Alok et.al, (2007) who suggest that any increase in the absolute value of such coefficient is interpreted as a rise in market volatility. For this purpose, exponential form of generalized autoregressive heteroscedasticity (EGARCH) is employed and the results are presented in Table 4. For the EGARCH, in order to check whether our developed models are statistically significant and reliable, we use Ljung-Box serial-correlation and ARCH-heteroscedasticity on the residuals and the results show that the developed EGARCH models for the ASEAN-5 stock markets are valid (the results could be requested from the author). With regard to the EGARCH model, the estimated coefficient for $\left(\varepsilon_{t-k} / \sigma_{t-k} \right)$ represents the existence of asymmetric behavior in response of variable (or time series) under studied, shown by γ_k in Equation (5). The negative and significant value of this coefficient indicates the existence of asymmetric effect in that market and therefore "bad news" will affect the market and make it more volatile than the "good news" of the same magnitude. Thus, the estimated γ_k coefficient for stock markets of Kuala Lumpur, Indonesia and Singapore are accepted but for Philippines and Thailand, this coefficient is not statistically reliable in the 5% level of significant. Therefore, referring to the estimated coefficients for the ARCH effect in the EGARCH equation, the presence of volatility in all of the ASEAN-5 markets is confirmed and the asymmetric response of Malaysia, Indonesia and Singapore stock markets is proven. In this regard, not only we have figured out that there exist volatility clustering in the selected markets but also it is demonstrated that the response of Malaysia, Indonesia and Singapore stock markets to the negative shocks and positive shocks of the same magnitude are different and negative shocks make these markets more volatile.

For the next step, crude oil price will be included to the EGARCH model and changes in the behavior of corresponding coefficient of asymmetric effect (γ_k) will be observed. By doing so, not only the effect of oil price on the return of ASEAN-5 stock markets will be examined, but also the impact of oil price volatility on the volatility of ASEAN-5 stock markets can be detected. The inclusion of oil price variable in the EGARCH equation will yield a multi-EGARCH or MEGARCH and the results are reported in Table 5. From the Table, it is shown that the impact of oil price on the mean equation of Kuala Lumpur stock market index is positive and significant; indicating that any increase in the crude oil price will increase the return of KLCI. Similar findings are also observed in other countries namely Singapore, Indonesia, Thailand and Philippines. Moreover, the estimated values in the variance equation, the γ_k is statistically significant for the case of Malaysia and Singapore but not for Indonesia, Thailand and Philippines. This finding indicates that one of the channels of Kuala Lumpur stock market fluctuations is the volatility of the crude oil price that is either experienced in the case of Singapore stock market. Therefore, any turbulence in the oil market can affect KLSE and stock market of Singapore; however, such impact for these two cases is not experienced for the rest of ASEAN-5 countries, namely Indonesia, Thailand and Philippines. This finding shows that, for the case of Indonesia, Philippines and Thailand, stock market can provide a good hedge against the oil market fluctuations. However, such hedging effect does not hold for the case of Malaysia and Singapore. Results of diagnostic tests of serial-correlation and heteroscedasticity confirm on the validation of the models (the results could be requested from the author).

With regard to the inclusion of gold prices to the EGARCH model, the results are reported in Table 6. Some notable findings from Table 6 are, firstly, gold price is not significant in any of the mean equations which show that there is no strong and significant relationship between gold price and ASEAN-5 stock markets. In other words, changes of the gold price could not affect the return of stock markets in ASEAN-5 countries during the period of this study. Secondly, in the variance equation, computed coefficient of the γ_k , is significant only in the case of Malaysia and Singapore stock markets hence provide evidence that the volatility of the gold market has a significant effect on the volatility of Kuala Lumpur and Singapore stock markets. However, such impact is not presence for the other markets. Therefore, it can be concluded that for the case of Indonesia, Philippines and Thailand investment in the gold market can be a good hedge against the stock price fluctuations; nevertheless, in the case of Malaysia and Singapore investment on the gold market cannot hedge the volatility of stock market. The results of the diagnostic tests on the residuals of EGARCH model with the inclusion of gold price reflect the validity of the developed model (the results could be requested from the author). With regards to the return equation of the KLCI, the absolute of the estimated value for coefficient γ_k of 0.4152 has increased to 0.4257 after the inclusion of oil volatility to the model, a 2.5% rise in the volatility of Kuala Lumpur stock market. The same pattern is observed for Singapore, in which around 2.7% rise in the volatility of Singapore stock market. Likewise, the inclusion of gold price in the EGARCH model of KLCI show 1.6% increase in the volatility of KLCI and 2.89% increase in the case of Singapore. In comparison, the impact of oil price and gold price volatility on the stock market is stronger for Singapore than Malaysia. The results for Malaysia and Singapore do not support previous studies that provide evidence on the role of gold as a safe haven asset such as Baur and Mc Dermott (2010).

CONCLUSION

This study examines the influence of oil and gold price volatility on the volatility of the ASEAN-5 stock markets. Applying ARCH and MEGARCH model on monthly data stock returns, crude oil and gold prices from January 2000 to January 2013, the findings of this study partly supported previous studies on the importance of oil and gold price fluctuations on stock markets activities and provide evidence on the significant influence of oil price volatilities on the Kuala Lumpur and Singapore stock market's volatility. Thus, indicating that oil price innovations and especially its negative shocks intensified the fluctuations of KLCI and Singapore stock markets and increased risk of investment in these markets. Regarding the impact of gold price fluctuations on the ASEAN-5 stock markets, we found evidence that the spillover effect holds for Malaysia and Singapore but not in other countries Findings of this study among others can benefit financial managers in the portfolio construction in the presence of oil and gold price fluctuations. This information can be helpful for formulating short term and long term investment strategies. For instance, investment a portion of investors' capital on gold as one of the elements of a hypothetical portfolio basket would not be advisable in the case of Malaysia and Singapore. Moreover, it can be concluded that for the case of Indonesia, Philippines and Thailand investment in the gold market can be a good hedge against the stock price fluctuations; nevertheless, in the case of Malaysia and Singapore investment on the gold market cannot hedge the volatility of stock market. On the strength of these results, we advocate the use of gold as a safe haven for a well-diversified portfolio only for Indonesia, Philippines and Thailand.

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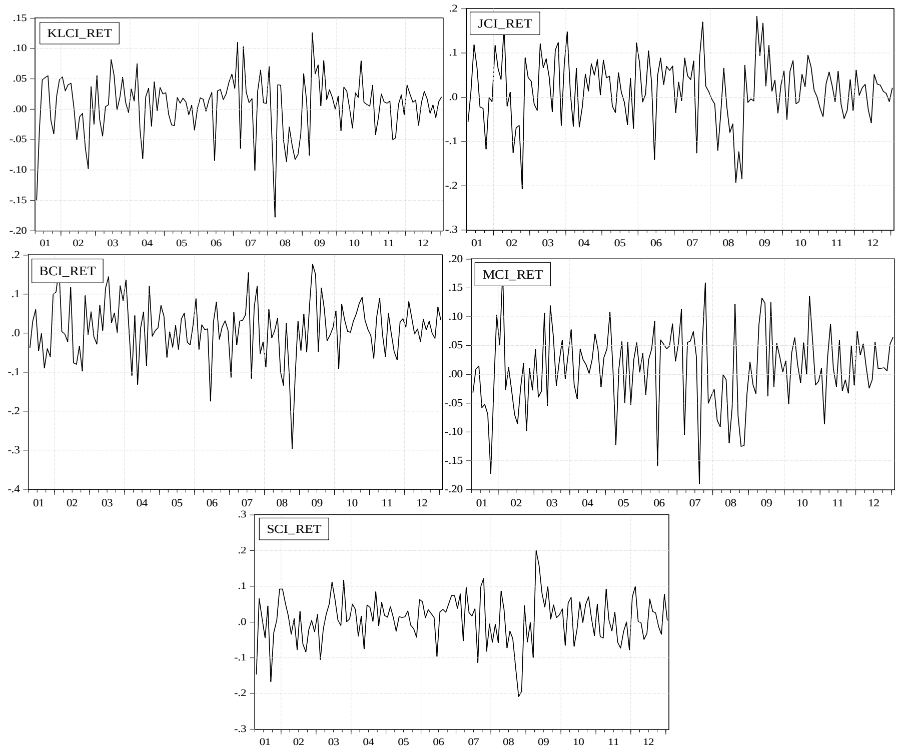
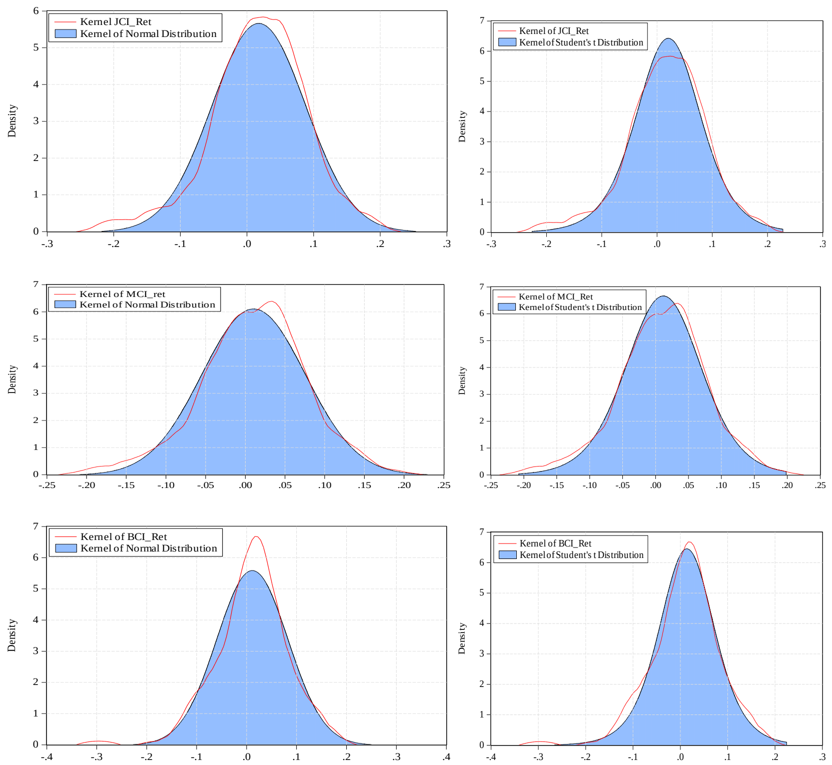


FIGURE 1: Plots of ASEAN-5 Computed Return Series



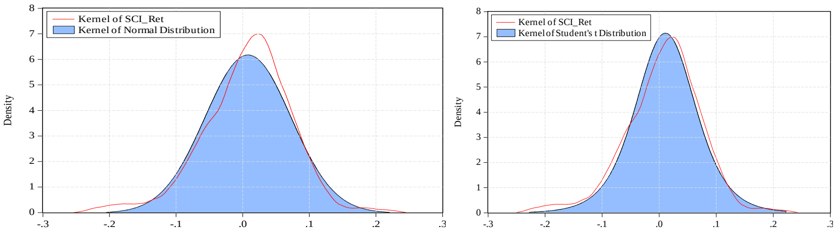


FIGURE 2: Plots of Kernel Density Function

TABLE 1: Descriptive Statistic of ASEAN-5 Stock Returns

	KLCI_RET	JCI_RET	SCI_RET	MCI_RET	BCI_RET
Mean	0.0038	0.0118	0.0042	0.0068	0.0065
Median	0.0115	0.0139	0.0122	0.0105	0.0109
Maximum	0.1259	0.1827	0.2003	0.1788	0.1848
Minimum	-0.1776	-0.2072	-0.2084	-0.1901	-0.2962
Std. Dev.	0.0466	0.0715	0.0657	0.0679	0.0771
Skewness	-0.6773	-0.3916	-0.4606	-0.3331	-0.5013
Kurtosis	4.3844	3.4225	3.7462	3.2276	4.2045
Jarque-Bera	24.386	5.1493	9.1367	3.2231	15.967
Probability	(0.0000)	(0.0761)	(0.0103)	(0.1995)	(0.0003)

TABLE 2: Results of the ADF and ZA Unit Root Tests

Variables	**Test on the level form**				**Test on the return form**			
	ADF		**ZA**		**ADF**		**ZA**	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept
KLCI	0.0547	-2.7062	-4.1287	-4.5252	-11.1991***	-11.3490***	-10.4409***	-10.5093***
JCI	0.6382	-2.7419	-3.0803	-4.0849	-9.9754***	-9.9948***	-10.0714***	-10.1904***
SCI	-0.9319	-3.3053	-4.5079	-4.4438	-5.5689**	-5.6004**	-10.2890***	-10.2968***
MCI	1.5264	-1.5423	-2.3246	-4.1586	-9.3300***	-9.7782***	-11.6910***	-11.6476***
BCI	-0.0417	-1.8401	-3.4012	-5.5941	-4.4948**	-4.5796**	-11.0821***	-11.0697***
Oil-Price	-1.5854	-1.6178	-6.0021	-6.2432	-9.6366***	-9.6124***	-10.9966***	-9.6134***
Gold-Price	1.4864	-1.5001	-3.1863	-2.7027	-4.4354**	-4.9950**	-14.581***	-14.5409***

Notes: *, **, *** denote significance at the 10%, 5%, and 1% level respectively

TABLE 3: Oil and Gold Price Volatility Modeling

Variable	**Mean Equation**			**Variance Equation**	
	Constant	*AR(1)*	*MA(1)*	*Constant*	u_{t-1}^2
Δ(log(Oil-Price))	*0.0169* *(0.0086)*	*-0.8788* *(0.0722)*	*0.9607* *(0.0468)*	*0.0066* *(0.0010)*	*0.3010* *(0.1531)*
Δ(log(Gold-Price))	*0.0142* *(0.0033)*	*-0.1980* *(0.0752)*	*-0.7318* *(0.1363)*	*0.0004* *(0.0001)*	*-0.0661* *(0.0281)*

Note: Δ representing the first difference form and reported values in parentheses are standard error

TABLE 4: Results of EGARCH modeling on the Return of ASEAN-5 Composite Indices

Return on ASEAN-5 Composite Indices	**Mean Equation**			**Variance Equation**			
	Constant	*AR(1)*	*MA(1)*	*Constant*	$\left\lvert \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right\rvert$	$\left(\frac{\varepsilon_{t-k}}{\sigma_{t-k}} \right)$	σ_{t-j}^2
KLCI-ret	*0.0042* *(0.0039)*	*0.1484* *(0.0683)*	-	*-10.8425* *(0.5376)*	*0.2881* *(0.1308)*	*-0.4154* *(0.1049)*	*-0.6897* *(0.0866)*
JCI-ret	*0.0160* *(0.0074)*	*0.2001* *(0.0821)*	-	*-5.3785* *(0.2127)*	*-0.0205* *(0.2515)*	*-0.2739* *(0.1488)*	-
MCI-ret	*0.0132* *(0.0016)*	*0.09015* *(0.0317)*	*-0.9881* *(0.0058)*	*-1.0563* *(0.5948)*	*0.3727* *(0.1761)*	*-0.2721* *(0.0841)*	*0.8636* *(0.0.958)*
SCI-ret	*0.0031* *(0.0066)*	*0.7545* *(0.1121)*	*-0.6539* *(0.1418)*	*-6.5647* *(2.0251)*	*0.6298* *(0.2235)*	*-0.3486* *(0.1399)*	*-0.0751* *(0.3507)*
BCI-ret	*0.0087* *(0.0066)*	*0.1126* *(0.1189)*	-	*-5.6760* *(0.1736)*	*0.4531* *(0.1847)*	*-0.2492* *(0.1066)*	*0.0055* *(0.4034)*

Note: Δ representing the first difference form and reported values in parentheses are standard error

TABLE 5: Results of MEGARCH Modeling by Inclusion of Oil Price Volatility

Return on ASEAN-5 Composite Indices	**Mean Equation**				**Variance Equation**			
	Constant	*Δ(Oil-p)*	*AR(1)*	*MA(1)*	*Constant*	$\left\lvert \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right\rvert$	$\left(\frac{\varepsilon_{t-k}}{\sigma_{t-k}} \right)$	σ_{t-j}^2
KLCI-ret	*0.0052* *(0.0038)*	*0.0021* *(0.0005)*	*-0.4078* *(0.1921)*	*0.5432* *(0.1625)*	*-9.6773* *(1.0652)*	*0.4605* *(0.1725)*	*-0.4257* *(0.0977)*	*-0.4448* *(0.1715)*
JCI-ret	*0.0114* *(0.0059)*	*0.0037* *(0.0008)*	*0.1182* *(0.0992)*	-	*-0.2715* *(0.3425)*	*0.2687* *(0.1486)*	*-0.0429* *(0.0782)*	*0.9911* *(0.0519)*
MCI-ret	*0.01163* *(0.0018)*	*0.0029* *(0.0010)*	*0.9045* *(0.0313)*	*-0.9882* *(0.0067)*	*-1.0395* *(0.5930)*	*0.3975* *(0.1653)*	*0.0378* *(0.0798)*	*0.8707* *(0.0912)*
SCI-ret	*0.0031* *(0.0066)*	*0.0028* *(0.0008)*	*0.7419* *(0.1367)*	*-0.6598* *(0.1679)*	*-6.4945* *(2.9648)*	*0.4613* *(0.2158)*	*-0.3581* *(0.1335)*	*-0.0723* *(0.5153)*
BCI-ret	*0.0114* *(0.0062)*	*0.0029* *(0.0009)*	*0.0457* *(0.1032)*	-	*-0.7297* *(0.8552)*	*0.1822* *(0.1193)*	*-0.0179* *(0.0741)*	*0.8913* *(0.1445)*

Note: Δ representing the first difference form and reported values in parentheses are standard error

TABLE 6: Results of MEGARCH Modeling by Inclusion of Gold Price Volatility

Return on ASEAN-5 Composite Indices	**Mean Equation**				**Variance Equation**			
	Constant	*Δ(Gold-p)*	*AR(1)*	*MA(1)*	*Constant*	$\left\|\frac{\varepsilon_{t-i}}{\sigma_{t-i}}\right\|$	$\left(\frac{\varepsilon_{t-k}}{\sigma_{t-k}}\right)$	σ^2_{t-j}
KLCI-ret	*0.0054* *(0.0041)*	*-0.0001* *(0.0003)*	*-0.2702* *(0.1823)*	*0.4659* *(0.1563)*	*-10.5405* *(0.7447)*	*0.3393* *(0.1412)*	*-0.4189* *(0.1127)*	*-0.6079* *(0.1188)*
JCI-ret	*0.0121* *(0.0064)*	*0.0007* *(0.0021)*	*0.0719* *(0.984)*	-	*-0.4241* *(0.4255)*	*0.2861* *(0.1682)*	*-0.0901* *(0.0699)*	*0.9652* *(0.0673)*
MCI-ret	*0.0117* *(0.0021)*	*0.0004* *(0.0071)*	*0.9021* *(0.0321)*	*-0.9886* *(0.0061)*	*-0.9530* *(0.5261)*	*0.3671* *(0.1687)*	*0.0273* *(0.0825)*	*0.8821* *(0.0855)*
SCI-ret	*0.0026* *(0.0006)*	*0.0009* *(0.0041)*	*0.7485* *(0.1143)*	*-0.6453* *(0.1458)*	*-6.7184* *(2.0137)*	*0.6246* *(0.2314)*	*-0.3685* *(0.1489)*	*-0.1028* *(0.3515)*
BCI-ret	*0.0084* *(0.0069)*	*0.0003* *(0.0011)*	*0.4223* *(0.6177)*	*-0.3284* *(0.6542)*	*-4.777* *(2.7511)*	*0.4298* *(0.2108)*	*-0.0151* *(0.1386)*	*0.1715* *(0.4989)*

Note: Δ representing the first difference form and reported values in parentheses are standard error

TABLE 7: Results of Diagnostic Tests - Oil and Gold Price (ARIMA-ARCH Models)

Heteroskedasticity ARCH test on Oil-Price Equation

F-statistic	0.035242	Prob. F(1,139)	0.8514
Obs*R-squared	0.035740	Prob. Chi-Square(1)	0.8501

	Period	1	2	3	4	5	6	7	8	9	10
Oil-Price Equation	AC	-0.016	0.045	0.022	-0.046	0.089	-0.067	-0.024	0.042	-0.039	0.02
	PAC	-0.016	0.045	0.024	-0.047	0.086	-0.061	-0.032	0.042	-0.026	0.004
	Q-statistic	0.0367	0.3346	0.409	0.72	1.9008	2.5682	2.6591	2.9295	3.1676	3.2313
	Prob	0.3721	0.4284	0.523	0.698	0.593	0.632	0.752	0.818	0.869	0.919

Heteroskedasticity ARCH test on Gold-Price Equation

F-statistic	0.203068	Prob. F(1,138)	0.6530
Obs*R-squared	0.205708	Prob. Chi-Square(1)	0.6502

	Period	1	2	3	4	5	6	7	8	9	10
Gold-Price Equation	AC	-0.038	0.062	-0.032	-0.037	-0.066	-0.075	-0.063	-0.021	0.031	-0.088
	PAC	-0.038	0.061	-0.028	-0.043	-0.066	-0.077	-0.065	-0.024	0.026	-0.099
	Q-statistic	0.211	0.7704	0.9212	1.1201	1.7717	2.6208	3.2275	3.2955	3.4386	4.624
	Prob	0.2179	0.2847	0.337	0.571	0.621	0.623	0.665	0.771	0.842	0.797