Asian Academy of Management Journal, Vol. 21, No. 1, 161–180, 2016

MACROECONOMIC DETERMINANTS OF STOCK MARKET VOLATILITY: AN EMPIRICAL STUDY OF MALAYSIA AND INDONESIA

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ABSTRACT

The present study examines the relationship between stock market volatility and the volatility of macroeconomic variables in Malaysia and Indonesia. The relationship is examined through the analysis of the monthly data concerning stock indices and macroeconomic variables in Malaysia and Indonesia for the period of 1998 until 2013. Firstly, in order to estimate the conditional volatility of each series, GARCH family models are employed. Secondly, a Seemingly Unrelated Regression (SUR) is utilized to determine whether any significant relationship exists between stock volatility and macroeconomic volatility. The results of the present study provide evidence of a significant relationship between the volatility of stock markets and macroeconomic variables in both countries. In particular, the results indicate that macroeconomic volatility and trade openness explain 81% of stock market volatility in Malaysia; and 75% of stock market volatility in Indonesia. The results of the present study provide more precise information for investors making decisions relating to asset allocation. Additionally, the findings are beneficial for managers and policy makers seeking to reduce the negative effects of stock market volatility on economic performance.

Keywords: stock market, macroeconomic variables, volatility, GARCH, Seemingly Unrelated Regression (SUR)

INTRODUCTION

One can safely state that the stock market volatility is a major factor that influences economic growth in both developed and developing economies (Oseni & Nwosa, 2011). Volatility, which is measured by the standard deviation or variance of stock returns, is regularly used as a basic measure of the total risk of financial assets (Tsay, 2010; Brooks, 2008). It has been widely argued that financial markets play a significant role in the economic growth and development by encouraging the accumulation of capital and acting as a channel for efficient capital allocation. Therefore, stock market volatility may harm the smooth functioning of the financial system and affect negatively the economic

performance and growth (Merton & Bodie, 1995; Mala & Reddy, 2007). However, a question remains regarding the determinant factors of stock market volatility. Several theoretical and empirical discussions exist in financial literatures that support claims concerning the relationship between stock market and macroeconomic variables. The Arbitrage Pricing Theory is the principal theory used to support the existence of such relationship.

Malaysia and Indonesia have provided significant opportunities for foreign investors in recent years since these countries are characterised by both the risks and benefits related to the emerging markets; and the willingness to facilitate foreign investment. Furthermore, Malaysia and Indonesia have experienced the financial reforms in recent decades which encourage their economic efficiency, and supports cross-country investing. The analysis of stock market volatility in Indonesia and Malaysia provide valuable information for investment diversification; and for policy makers monitoring the stability of Indonesian and Malaysian stock markets.

Figure 1 provides visual representation of cyclical properties of stock market volatility in Malaysia and Indonesia. It provides the stock market volatility in relation to GDP growth from 1990 Q4 to 2013 Q1. A strict affiliation is recognised to exist between the two series. The volatility of stock markets is clearly higher during recessions. The close relationship between GDP growth and stock market volatility emphasises the significant effect of the macroeconomic activity on the stock market volatility in Malaysia and Indonesia.

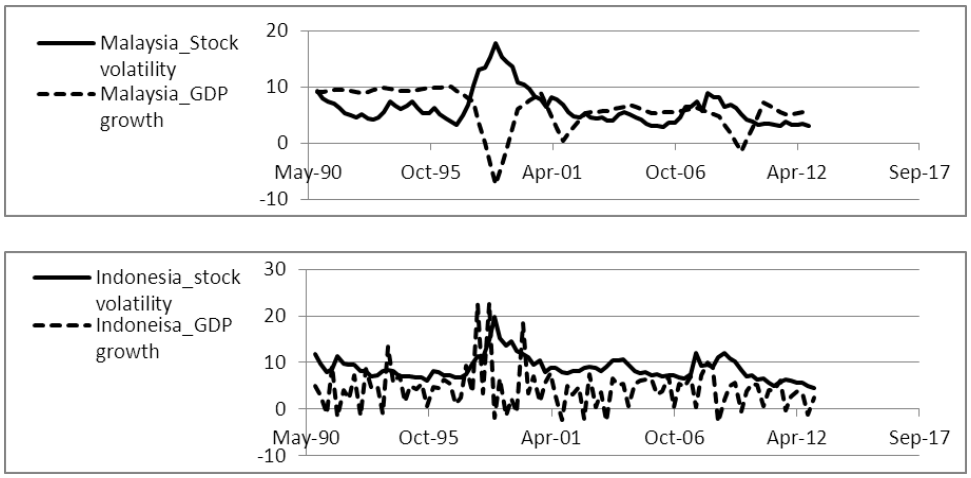


Figure 1. Stock market volatility and economic condition

Source: Author's calculation using stock indices and GDP data obtained from DataStream

The general attempt to link stock market and macroeconomic variables has only been performed in relation to stock return (first moment). The studies that examine the relationship between stock market volatility (second moment) and macroeconomic variables in Asian countries do not pay attention to the correlation among international stock markets. For example, the Malaysian and Indonesian stock markets are expected to interact with each other because Malaysia and Indonesia are located in the same region and characterised with similar cultural and policies implementations as well as close relationship in trade policies (Gee & Karim, 2010). Therefore, a method that efficiently handles autocorrelation between the error terms is required to investigate the determinant factors of stock market volatility in Malaysia and Indonesia. The Seemingly Unrelated Regression (SUR) method introduced by Zellner (1962) imposes no assumptions on the correlation of the errors and easily incorporates restrictions on the coefficients. Therefore, SUR method is efficient in the case of presence autocorrelations across disturbance (Engle & Rangel, 2008).

In order to achieve the objective of the present study, a two-step methodology proposed by Morelli (2002) and Engle and Rangel (2008) is employed. Firstly, the generalised autoregressive conditional heteroskedasticity (GARCH) method is employed to estimate the volatility of stock market and macroeconomic variables. Secondly, a SUR method is employed to determine whether any significant relationships exist between stock market volatility and macroeconomic variables. The present study contributes to the literature by utilising SUR method to investigate the macroeconomic determinants of stock market volatility in Malaysia and Indonesia. Using SUR method, it is possible to incorporate the correlation between Malaysian and Indonesian stock markets. Furthermore, it is possible to determine the degree of importance of each factor in the stock market volatility; and to determine the predicting power of SUR model for Malaysia and Indonesia.

As a further contribution, the models developed in the present study include trade openness to investigate the causal relationship between trade openness and stock market volatility. It is accepted that an open economy will encounter a greater number of adverse shocks because of more international risk sharing between markets (Haddad, Lim, Pancaro, & Saborowski, 2013). Thus, trade openness is an important factor to transmit volatility between countries and is significant for predicting volatility. Unfortunately, few attempts have been made in extant literature to investigate the effect of trade openness on stock market volatility.

LITERATURE REVIEW

During the recent years, a lot of studies have been performed to determine the relationship stock market and macroeconomic variables; however, the relationship between stock market volatility (second moment) and macroeconomic variables is still limited. Some extant studies delve into macroeconomic determinant of stock market volatilities. We can point to the studies by Morelli (2002); Engle, Ghysels and Sohn (2006); Beltratti and Morana (2006); Engle and Rangel (2008); Diebold and Yilmaz (2008); Batten, Ciner and Lucey (2010); Wang (2010); Oseni and Nwosa (2011); Walid, Chaker, Masood and Fry (2011); Beetsma and Giuliodori (2012). The study by Morelli (2002) utilises a two-step procedure including (1) Generalised Autoregressive Conditional Heteroskedasticity (GARCH) models and (2) an Ordinary Least Square (OLS) method to determine the predictive power of macroeconomic volatility in relation to stock market volatility in the UK. Morelli (2002) finds that the volatility of macroeconomic variables can explain only 4.4% of variation in stock market volatility. Engle and Rangel (2008) introduce the spline-GARCH model to estimate the volatility of low-frequency data for macroeconomic variables in a sample including 50 countries. Then Panel approach and SUR method are utilised to find the relationship between stock market volatility and macroeconomic volatility. Engle and Rangel (2008) find that stock market volatility is influenced by the volatility of three macroeconomic variables: inflation, interest rate and real GDP.

The number of studies that investigate about macroeconomic sources of stock market volatility (second moment) in Asian countries is still limited (e.g., Habibullah, Baharom, & Kin Hing, 2009; Walid et al., 2011). Habibullah et al. (2009) investigate the effect of inflation and output growth on stock volatility in some Asian countries (i.e., Malaysia, India, Japan, Korea and the Philippines). Using GARCH model they find that the effect of inflation on stock volatility is insignificant in all countries except Korea. Moreover, the impact of output growth on stock volatility is found to be significant in India and the Philippines. Furthermore, Walid et al. (2011) uses a Markov switching-EGARCH model and shows that exchange rate changes affects stock market volatility significantly in four emerging countries, namely Singapore, Hong Kong, Mexico and Malaysia.

The gap attributed to the studies in Asian countries is that no attention has been paid to the correlation between international stock markets in Asian countries when estimating the sources of stock market volatility. However, significant correlation between international stock markets locating in the same region is expected. Existence of correlation between international stock markets may affect the results of estimations; therefore, it is necessary to use a method which can efficiently handle the correlation among stock markets.

Another *lacunae* in extant studies is that trade openness is ignored in the numerous studies that examine the sources of stock market volatility. However, an open economy is extremely susceptible to external shocks. Furthermore, Basu and Morey (2005) explain that an open economy utilises imported intermediate inputs. However, private sectors face a restricted amount of intermediate factors in a closed economy. In an open economy, productive efficiency occurs because of utilising all of its resources efficiently. Consequently, growth process will be self-sustained which results in technological efficiency and random walk behavior in the stock prices. Therefore, a significant relationship between trade openness and stock prices is probable.

DATA AND METHODOLOGY

The present study investigates the relationship between stock market volatility and volatility of macroeconomic variables in Malaysia and Indonesia. As a result, the dataset utilised in the present study consists of monthly observations for stock indices, namely the Kuala Lumpur Composite Index (KLCI) and the IDX composite price index (Indonesia); and a set of macroeconomic variables, including consumer price index (CPI), exchange rate (EX), interest rate (INT), industrial production index (IPI), money supply (M) and trade openness (OPEN) in both countries. The present study uses data concerning the Indonesian Interbank Call Rate for INT; Indonesian Rupiahs to US Dollar for EX; Malaysia Klibor One Month – Offered Rate for INT; and Malaysian Real Effective Exchange rate for EX. The data are collected from Thomson Reuters Data stream and cover the period from April 1998 until January 2013. The period between April 1998 and January 2013 is selected which is suitable for investigating the volatility of stock markets since it includes two main crises: the Asian financial crisis of 1997 and the global financial crisis of 2008.

The Census X12 method is utilised to adjust the seasonal fluctuation in macroeconomic variables[1]. Trade openness (OPEN) is measured as follows:

$$\text{OPEN} - (\text{Export} + \text{Import})/\ \text{GDP}$$

This measurement is in the line with practice in the literature (e.g., Giovanni & Levchenko, 2008; Kim, Lin, & Suen, 2010; Haddad et al., 2013). Furthermore, the frequency conversion method is utilised to intrapolate the quarterly data of trade openness. Prior to modeling, the first difference of stock indices and macroeconomic variables in both countries are calculated as follows:

$$R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

Where P_t is the current monthly data and P_{t-1} is previous month's data for stock indices and macroeconomic variables.

Following Morelli (2002) and Engle and Rangel (2008), a two-step approach is employed. Engle and Rangel (2008) use the Spline GARCH method in the first step. The Spline GARCH method is a version of GARCH model, introduced by Engle (1982) and Bollerslev (1986), which allows high-frequency financial data to be linked with the low-frequency macro data like GDP. However, all the series employed in this study have the same frequency (monthly); thus, employing the Spline-GARCH is not required in the present study. Using monthly data to find the relationship between stock market volatility and macroeconomic volatility is consistent with the studies such as Morelli (2002).

The GARCH (*p,q*) model, introduced by Engle (1982) and Bollerslev (1986), can be expressed as follows:

$$R_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i R_{t-1} + \varepsilon_t \tag{2}$$

$$\varepsilon_t \mid I_{t-1} : N(0, h_t)$$

$$h_t = \gamma_0 + \sum_{i=1}^{q} \gamma_t \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \delta_t h_{t-i} \tag{3}$$

where R_t represents the first difference of stock indices and macroeconomic variables at time *t*. $\varepsilon_t \mid I_{t-1}$ denotes the error term with respect to the information at time *t*–1 and is assumed to be normally distributed. Equation (3) represents the variance equation, while h_t is the conditional variance of stock indices and macroeconomic variables at time *t*. *P* is the order of GARCH terms and *q* is the order of ARCH term.

The second step involves regressing stock market volatility as a dependent variable against the volatility of macroeconomic variables to determine whether any significant relationship exists between stock market volatility and macroeconomic volatility. The equation for each country takes the following form:

$$h_{SMt} = \beta_0 + \sum_{j=1}^{5} \beta_j h_{MVjt} + \beta_6 OPEN + e_t \tag{4}$$

where h_{SMt} is the stock market volatility at time *t*; and h_{MVjt} represents the volatility of macroeconomic variables at time *t*. All other variables are as previously defined.

Equation (4) can be estimated by OLS method separately for each country if we assume that the error terms are uncorrelated across the equations. However, the Malaysian and Indonesian stock markets are located in the same region and thereby are assumed to be highly interacted with each other because of similar cultural and policies implementations as well as closely relationship in trade policies (Gee & Karim, 2010). Therefore, it is so plausible that the error terms may be correlated across the two equations.

In order to improve the regression model so that the error terms become uncorrelated across the equations, the Seemingly Unrelated Regression (SUR) model developed by Zellner (1962) is employed. The SUR method imposes no assumptions on the correlation of the errors (Engle & Rangel, 2008). The equation (4) is estimated jointly as a system with two equations including the regression equations for Malaysia and Indonesia. Following the study by Engle and Rangel (2008), the SUR model is estimated using yearly data because a high correlation exists between residuals when the SUR model is estimated using monthly data. The average conversion method is utilised to convert monthly data to yearly data which are used in model (4) when estimating the two-equations system.

RESULTS

The present section reports the empirical findings produced by the estimated GARCH models for stock indices and macroeconomic variables; the stationary test on the estimated volatility; and the results of the SUR model which are estimated for Malaysia and Indonesia.

Tables 1 and 2 present the descriptive statistics for first difference of stock indices and macroeconomic variables in Malaysia and Indonesia. The mean series varies between –0.2686 and 1.0482 in Malaysia. Meanwhile, the mean series in Indonesia ranges between –0.5141 and 1.4229. INT is found to have the lowest mean with a negative value, while M is found to have the highest mean in both countries. Although the first difference of the KLCI show the highest standard deviation in Malaysia, INT shows the highest value of standard deviation in Indonesia. In both countries, all series show evidence of excess kurtosis, which indicates that the series are leptokurtic. The skewness is negative for KLCI; EX; INT in Malaysia; and IPI in Indonesia, which indicates a fatter left side of their distribution than the right side. The Jarque-Bera normality test indicates that all series depart from normal distribution. The Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests are

performed to examine the existence of unit roots and the results indicate that all the series are stationary.

Table 1
Descriptive statistics and stationary test (Malaysia)

	First difference						OPEN
	KLCI	EX	INT	CPI	IPI	M	
Mean	0.4093	0.0408	–0.2686	0.2292	0.4363	1.0482	1.8615
Maximum	26.654	15.561	16.454	3.8899	14.640	5.7852	2.3048
Minimum	–34.410	–21.247	–2.636	–1.2036	–13.540	–2.5147	1.4914
Std. dev.	6.8251	2.5212	5.0060	0.3866	4.9474	1.3416	0.2092
Skewness	–0.2426	–0.4406	–3.2295	3.2318	0.1541	0.5527	–0.0280
Kurtosis	7.0821	28.337	27.226	32.310	3.6666	3.7609	1.8853
Jarque-Bera	193.64	7338.3	7203.2	10247.3	6.1144	20.485	13.7523
Probability	0.0000	0.0000	0.0000	0.0000	0.0470	0.0000	0.00103
ADF	–14.05***	–15.15***	–8.23***	–12.61***	–17.146***	–14.24***	–1.81
PP	–14.03***	–15.25***	–12.55***	–12.61***	–27.121***	–14.27***	–1.57
KPSS	0.056	0.229	0.055	0.072	0.026	0.355	0.453

Note: ADF indicates the Augmented Dickey-Fuller test under the null hypothesis of the existence of a unit root. PP indicates the Phillips-Perron unit root test under the null hypothesis of the existence of a unit root. KPSS indicates the Kwiatkowski-Phillips-Schmidt-Shin unit root test under the null hypothesis of being stationary. In Table 1, *** denote statistically significant at the 1% level, respectively.

Additionally, the descriptive statistics for OPEN are provided in Tables 1 and 2 for comparing trade openness in both countries. As observed in Table 1, the mean of OPEN in Malaysia is approximately 1.86, which is much higher than the value reported for Indonesia (0.58). Additionally, the maximum value of OPEN in Malaysia is 2.3, which is approximately twice the value of the variable in the case of Indonesia (1.11). The conclusion can be drawn that the Malaysian economy is more open than the Indonesian economy. Table 1 indicates that OPEN in Malaysia is found to be stationary by KPSS unit root test while, as demonstrated in Table 2, the OPEN in Indonesia is found to be stationary by using ADF, PP and KPSS unit root tests.

Table 2
Descriptive statistics and stationary test (Indonesia)

	First difference						OPEN
	IDX	EX	INT	CPI	IPI	M	
Mean	1.0564	0.6118	–0.5141	0.8301	0.3937	1.4229	0.5888
Maximum	95.995	64.753	195.442	11.934	25.539	23.686	1.1135
Minimum	–39.646	–34.209	–204.90	–1.0608	–31.862	–4.6449	0.4375
Std. dev.	9.5254	6.9728	34.6642	1.5108	7.8498	2.3257	0.1143
Skewness	2.3528	3.4646	0.42926	4.0245	–0.9638	3.6582	2.3995
Kurtosis	30.894	36.807	16.5566	23.5296	8.2025	35.4593	10.322
Jarque-Bera	11903.2	13497.1	2075.84	4133.16	230.86	12547.6	855.93
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ADF	–17.29***	–11.93***	–20.05***	–6.68***	–0.84***	–16.25***	–4.69***
PP	–17.30***	–12.92***	–28.35***	–6.68***	–4942***	–16.25***	–3.15**
KPSS	0.079	0.065	0.028	0.302	0.155	0.123	0.382

Note: ADF indicates the Augmented Dickey-Fuller test under the null hypothesis of the existence of a unit root. PP indicates the Phillips-Perron unit root test under the null hypothesis of the existence of a unit root. KPSS indicates the Kwiatkowski-Phillips-Schmidt-Shin unit root test under the null hypothesis of being stationary. In Table 2, *** and ** denote statistically significant at the 1% and 5% levels, respectively.

Tables 3 and 4 present the results from the GARCH family models, which are fitted to the stock markets and macroeconomic variables in Malaysia and Indonesia. Furthermore, Tables 3 and 4 show the results of the Ljung-Box diagnostic tests utilised to select the adequate models. As shown in Table 3, the Ljung-Box (Q and Q^2) statistics indicate no serial correlation up to lag 12, at the 5% and 10% levels in all series for Malaysia. Similarly, the results of the Ljung-Box statistics in Table 4 indicate no evidence of serial correlation in the residuals up to lag 8 at the 5% and 10% levels in all series for Indonesia. The results indicate that the fitted models are well specified in mean and variance equations for both countries.

Table 3
GARCH model and diagnostic tests (Malaysia)

		Log-likelihood	Box-Ljung	
			Q (12)	Q^2 (12)
Stock market	GARCH(1,1)	–860.6384	16.499	20.522
Exchange rate	AR(1)-EGARCH(1,1)	–494.1449	13.278	3.9545
Interest rate	AR(1)-GARCH(1,1)	–407.2552	7.7987	1.4633
Consumer price index	AR(2)-GARCH(1,1)	–51.93638	13.231	3.1091
Industrial production index	AR(2)-ARCH(1)	–644.1135	15.139	5.482
Money supply	AR(3)-EGARCH(1,1)	–373.0256	9.5386	7.2669

Under the null hypothesis of no autocorrelation, Q (12) and Q^2 (12) are distributed as $\chi^2(12)$ with the critical value of 26.217, 21.0261 and 18.5494 at 1%, 5% and 10% respectively.

Table 4
GARCH model and diagnostic tests (Indonesia)

		Log-likelihood	Box-Ljung	
			Q(8)	Q^2 (8)
Stock market	AR(1)-EGARCH(1,1)	–1260.651	9.632	1.515
Exchange rate	AR(1)-GARCH(1,1)	–541.8226	16.896	9.907
Interest rate	ARMA(1,1)-GARCH(1,1)	–1084.720	10.450	8.108
Consumer price index	AR(1)-GARCH(1,1)	–207.4222	5.654	0.149
Industrial production index	AR(2)-ARCH(1)	–451.8579	9.983	7.014
Money supply	ARMA(1,1)-GARCH(1,1)	–526.5174	7.828	3.490

Under the null hypothesis of no autocorrelation, Q (8) and Q^2 (8) are distributed as $\chi^2(8)$ with the critical value of 20.0902, 15.5073 and 13.3616 at the 1%, 5% and 10% level respectively.

The volatility profiles for all variables in both countries are provided in Appendix A and Appendix B. Generally, it is observed in Appendix A that the volatility of the KLCI declines during the period under investigation. Two peaks exist in the volatility trend in 1998 and 2008, which can be attributable to the Asian financial crisis and the global financial crisis, respectively. The volatility of EX, IPI, M, INT and CPI demonstrate constant trends. Although the Asian financial crisis and global financial crisis affect the volatility of EX and INT significantly, it is observed that the volatility of IPI and M is not affected by financial crises.

Furthermore, CPI volatility shows a steep rise during the global financial crisis. OPEN exhibits a decreasing trend with a peak during Asian financial crisis.

Appendix B demonstrates that the volatility of the IDX experienced two significant rises during the Asian and global financial crises. Although the volatility of EX, INT, IPI, M and CPI are influenced by both Asian and global financial crises, the effect of the Asian financial crisis of 1998 is considerably greater than the effect of the Asian financial crisis of 2008. OPEN also shows a steep rise during the Asian financial crisis.

To find a method that is efficiently appropriate for the structures of our data, we look at the correlations between residuals coming from individual regressions for each country. Table 5 presents such correlations between residuals of Malaysia; and the residuals of Indonesia from 1998 to 2012. Table 5 shows a significant correlation is existed between the residuals, implying the important gain in using SUR method that imposes no assumption on the correlation structure of the errors.

Table 5
Correlation of residuals

Year	Correlation	Year	Correlation	Year	Correlation
1998	0.527369	2003	–0.481340	2008	0.267977
1999	–0.109282	2004	–0.729834	2009	0.874996
2000	0.167049	2005	0.415927	2010	0.295567
2001	–0.254799	2006	–0.085753	2011	–0.005236
2002	0.096905	2007	0.437616	2012	–0.252438

Table 6 present the results of SUR model performed using equation (3) for Malaysia and Indonesia. Table 6 shows that OPEN and the volatility of EX, INT and CPI show positive and significant effects on stock market volatility in Malaysia. OPEN is the most important variable to determine the stock market volatility in Malaysia, which is highly significant and has the highest value of coefficient among macroeconomic variables. In terms of explanatory power, OPEN and volatility of macroeconomic variables explain 81% of the variation in stock market volatility in Malaysia. In the case of Indonesia, the volatility of EX, INT, CPI and M exert a statistically significant effect on stock market volatility. While the volatility of EX, INT and M affect stock market volatility positively, the volatility of CPI affects stock market volatility negatively in Indonesia. In addition, OPEN is not an important determinant in stock market volatility fluctuation in Indonesia. Among the variables which affect stock market volatility in Indonesia, CPI volatility is the most important factor to determine the

stock market volatility which has the highest value of coefficient among macroeconomic variables. Generally, the volatility of macroeconomic variables is able to explain 75% of the variation in stock market volatility in Indonesia. Although the negative relationship between CPI volatility and IDX volatility is not consistent with extant literature, the reason may be attributed to the administered price adjustments in Indonesia. The energy prices (e.g., fuel and electricity) are set by the government in Indonesia and puts serious pressure on the government's annual budget deficit. Furthermore, the government budget deficit may surge inflation due to the borrowing or issuing money with the intention of balancing the budget. On the other hand, the subsidised energy that keeps energy prices at low levels may decrease the fluctuations in stock market. As a result, energy subsidies affect CPI volatility and stock market volatility in opposite directions; and a negative relationship between inflation uncertainty and stock market volatility is halted.

As demonstrated in Table 6, the Ljung-Box [Q (12)] statistics indicate no serial correlation up to lag 8 and 12, at the 1% level between error terms across two equations. The Jarque-Bera normality test indicates that error terms are normally distributed.

The difference between the results concerning the two countries may stem from two reasons. First, the Malaysian economy is more open than the Indonesian economy. As stated in the descriptive statistics presented in Tables 1 and 2, the mean of trade openness is approximately 1.8 for Malaysia, but only approximately 0.58 for Indonesia. Second, the higher efficiency of the KLCI, compared with that of the IDX, is confirmed by the empirical results obtained in the present study. As presented in Table 4, the Indonesian stock market follows an autoregressive of order one (AR (1)), which indicates that returns in the Indonesian market depend upon their own previous values. However, the Malaysian stock market follows an AR(0) process, indicating the existence of an efficient (informational) stock market in Malaysia.

Table 6
The SUR model

	Malaysia	Indonesia
Trade openness	10.193 (0.000)	–7.146 (0.185)
Conditional volatility of:		
• Exchange rate	1.724 (0.017)	0.454 (0.001)
• Interest rate	0.150 (0.030)	0.082 (0.000)
• Consumer price index	6.737 (0.093)	–10.923 (0.000)
• Money supply	–4.840 (0.118)	3.974 (0.015)
• Industrial production index	1.748 (0.371)	0.343 (0.248)
Adjusted R-squared	0.8120	0.7558
	Joint	
Jarque-Bera Probability	5.977 (0.201)	
Q (12)	29.882 (0.981)	

The values reported in the parentheses indicate *P* values. Under the null hypothesis of no autocorrelation. Q (12) is distributed as $\chi^2(12)$ distribution with the critical value of 26.217 at 1% level.

Appendix C and Appendix D show the scatter plots of stock volatility versus openness; and stock market volatility versus the volatility of macroeconomic variables in Malaysia and Indonesia, respectively. Figure 3 demonstrates that a significant relationship exists between stock market volatility; and OPEN and the volatility of EX, INT and CPI in Malaysia, which is consistent with the results generated by the SUR model. In the case of Indonesia, the scatter plots represented in Appendix D confirm the existence of a significant relationship between stock volatility; and the volatility of EX, INT, CPI and M.

CONCLUSION

The present study investigates the relationship between stock market volatility and the volatility of macroeconomic variables in Malaysia and Indonesia. A two-step procedure is employed that first utilises the well-known GARCH models to examine the volatility of the desired series, followed by an examination of the relationship between stock volatility and the volatility of macroeconomic variables by SUR method.

The results of SUR method provide evidence of the existence of a significant relationship between stock market volatility and the volatility of macroeconomic variables in both countries. According to the results, 81% of the variation in stock

market volatility in Malaysia can be explained by trade openness and the volatility of macroeconomic variables. This value reduces to 75% in Indonesia. EX volatility and INT volatility have significant and positive effects on stock market volatility in Malaysia and Indonesia. However, the effects of CPI, M and OPEN on stock market volatility are country specific. Although CPI volatility affects the stock market volatility significantly in both countries, the relation is positive in Malaysia and negative in Indonesia. Besides, M volatility affects the Indonesian stock market volatility significantly; however, stock market volatility in Malaysia is not affected by M volatility. Although trade openness has a significant impact on stock market volatility in Malaysia, no evidence is found concerning the existence of such a relationship in the case of Indonesia. Trade openness is the most influential macroeconomic factor to determine the stock market volatility in Malaysia; and CPI volatility exerts the highest effect on stock market volatility in Indonesia. The difference between the results concerning the two countries may stem from energy subsidies in Indonesia; and the differing degree of trade openness and stock market efficiency in the two countries.

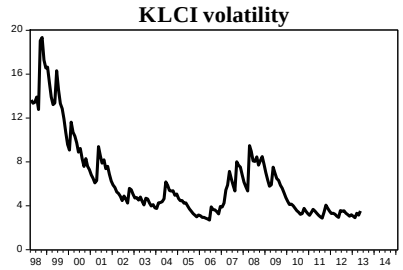
In summary, based on the selected macroeconomic variables in the present study, one can conclude that the volatility of macroeconomic variables strongly explains the stock market volatility in Malaysia and Indonesia. The results of the present study provide precise information concerning the determinant factors of stock market volatility in Malaysia and Indonesia which are useful for investors when making asset allocation decisions. Additionally, the findings are useful for managers and policy makers to seeking to reduce the negative effect of stock market volatility on economic growth and performance. In particular, they should be aware of the changes in trade openness and the volatility of EX, INT and CPI in Malaysia; and the volatility of EX, INT, CPI and M in Indonesia.

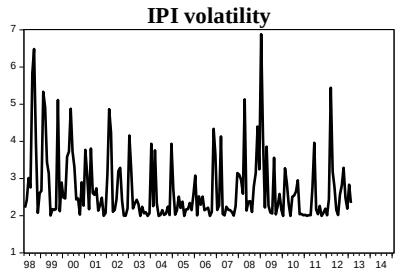
NOTE

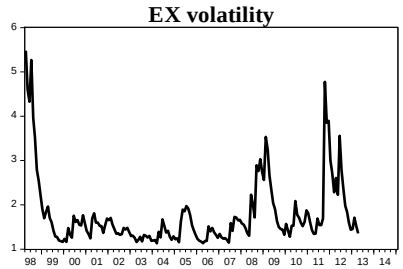
1. The frequency conversion is applied by Eviews software and using linear-Mach last method. In this method, each value in the low frequency series is assigned to the last high frequency observation related to the low frequency period, then all intermediate points on straight lines are placed connecting these points.

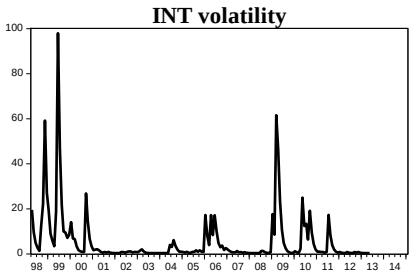
APPENDICES

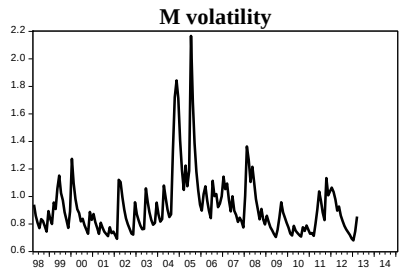
Appendix A
Volatility profile (Malaysia)

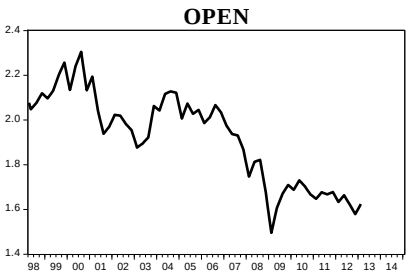


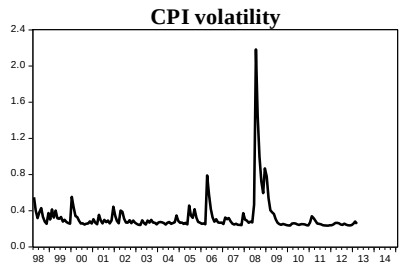




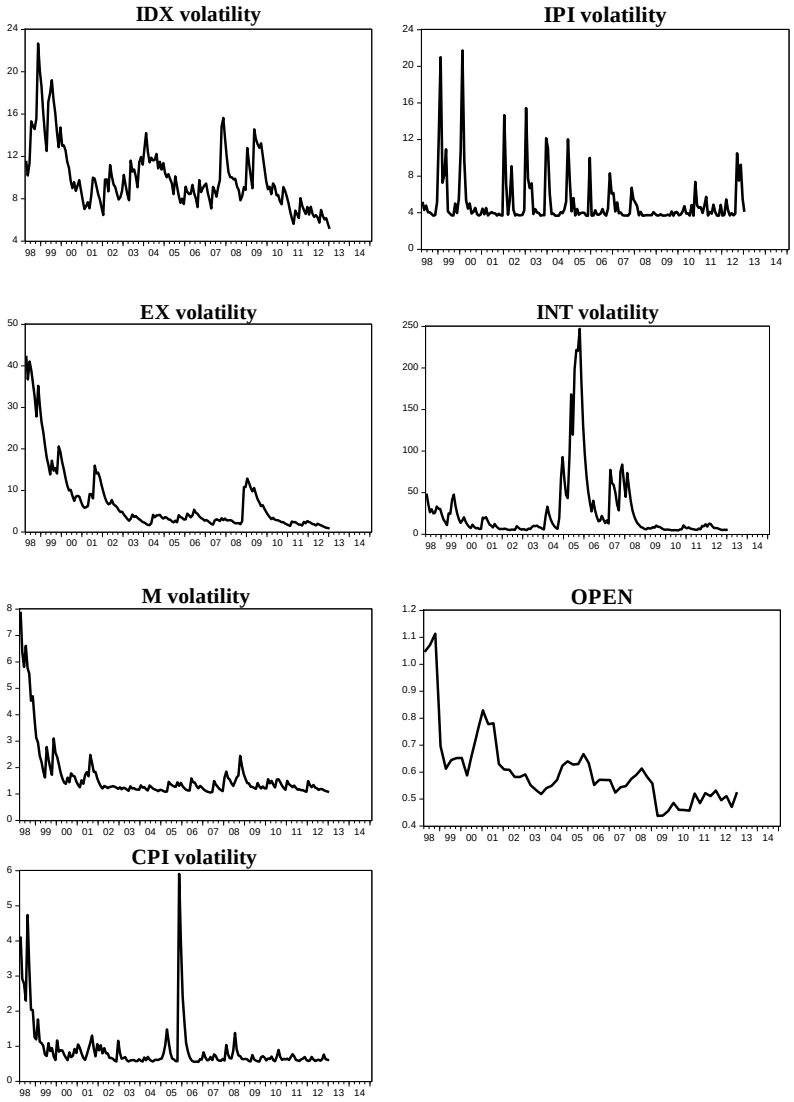




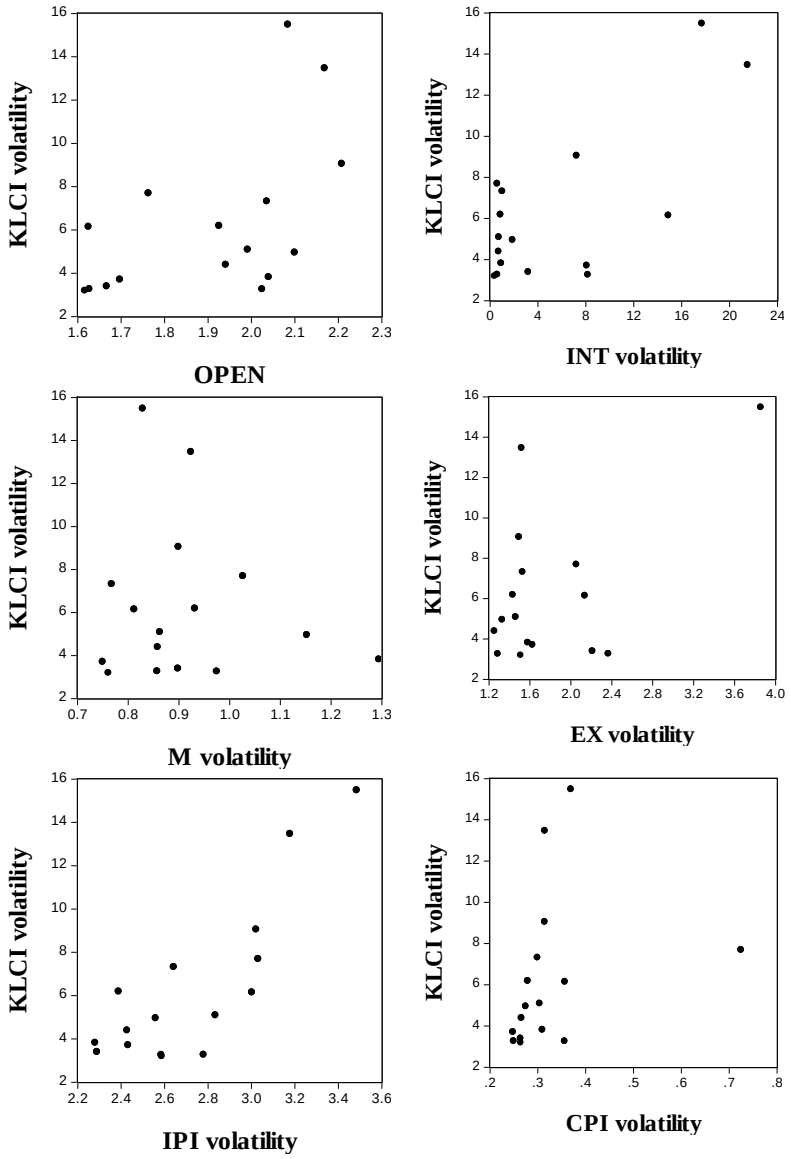




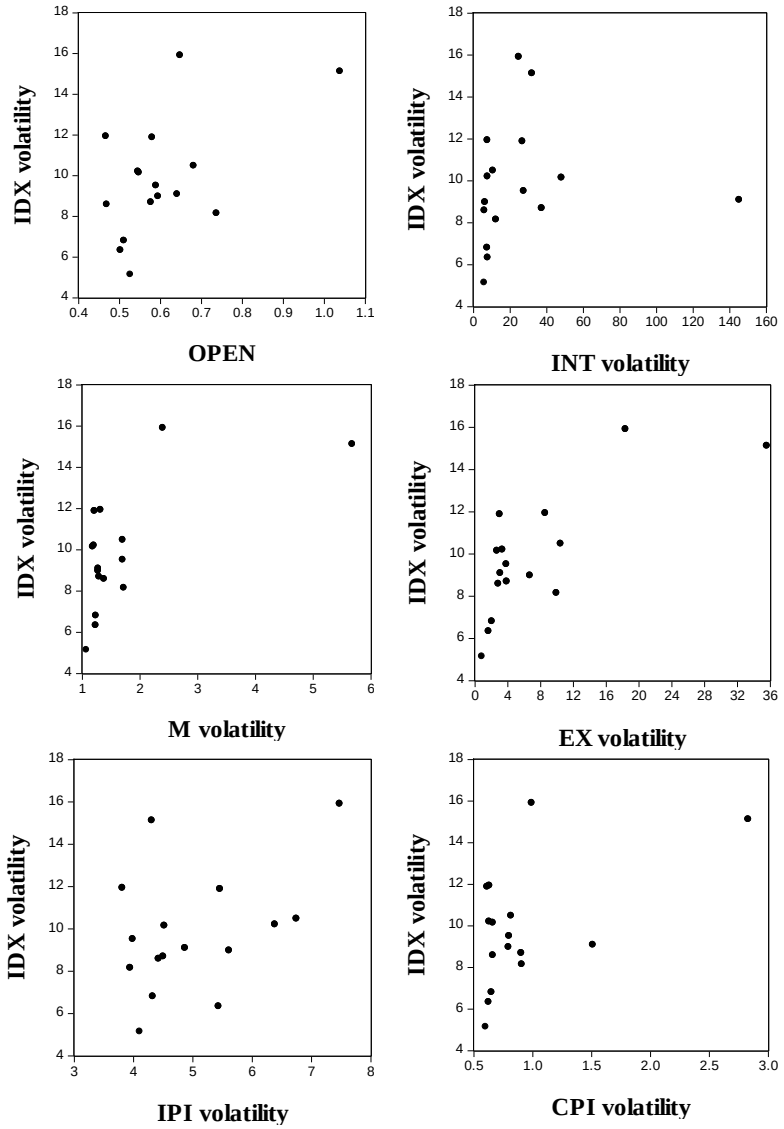
Appendix B
Volatility profile (Indonesia)



Appendix C
Scatter plots (Malaysia)



Appendix D
Scatter plot (Indonesia)



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