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The Impact of Macroeconomic Volatility on the Indonesian Stock Market Volatility

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ABSTRACT

This study examines the relationship between macroeconomic variables volatility (industrial production, exchange rate, inflation rate and money supply) and stock market volatility in Indonesia. Monthly data from January 1986 to December 2013 are employed in this study. Using GARCH (1, 1) and Granger Causality test, the results show that the macroeconomic variables volatility has no impact toward the Indonesian stock market volatility. However, there is only an unidirectional causal relationship running from stock market volatility to exchange rate volatility. Therefore, policy makers should take into account stock market volatility in making any policy related to exchange rate.

JEL: G14, E20, C58

Keywords: Macroeconomic; stock market; volatility; GARCH; Granger Causality.

1. INTRODUCTION

The impacts of macroeconomic volatility on stock market volatility received a considerable attention among academicians, economists and financial analysts. Understanding the significant information of volatility in macroeconomic variables would generally help to forecast the stock market volatility (Liljeblom & Stenius, 1997; Oseni & Nwosa 2011; Zakaria & Shamsuddin, 2012). Volatility can determine the degree of uncertainty surrounding the stock future's returns (Madura, 2012) and very important is risk management, portfolio optimization and asset pricing (Abdalla and Winker, 2012). In addition, stock market volatility reached high levels during financial crisis and significantly led stocks prices plummeting especially in emerging markets.

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Arnold and Vrugt (2006) noted that the relation among the stock market and real macroeconomic variables is intuitively appealing as macroeconomic fundamentals may affect company cash flows and overall market risk.

In addition, Madura (2012) argued that the economic conditions, market conditions and firm-specific conditions may cause impact toward future cash flows could also influence the stock price. Consequently, the value of corporate equity in future relies on the condition of the macroeconomic activities, thus it is not surprising the stock market volatility acts as a function of the macroeconomic variables volatility (Liljeblom & Stenius, 1997; Morelli, 2002; Oseni & Nwosa, 2011).

There have been abundant of the empirical studies examining the relationship between macroeconomic variables and stock markets using different countries, samples and methodologies (see Liljeblom & Stenuis, 1997; Ibrahim & Yusoff, 2001; Morelli, 2002; Ibrahim & Aziz, 2003; Lin, Li & Liu, 2007; Choo et al, 2011; Oseni & Nwosa, 2011; Zakaria & Shamsuddin, 2012; Gul & Khan, 2013). In terms of volatility, the results reported are mixed thus this issue is still open for further empirical examination. For example, Liljeblom and Stenuis (1997) and Morelli (2002) found evidence significant relationship between stock market volatility and real macroeconomic volatility in a developed country. The results are consistent with Oseni and Nwosa (2011) and Zakaria and Shamsuddin (2012) in the case of emerging markets. However, Schwert (1989) and Choo et al., (2011) found that stock market volatility cannot be explained by macroeconomic volatility.

Although there have been numerous studies investigating the relationship between macroeconomics variables volatility and stock market volatility, however studies particularly in an emerging market of Indonesia is very limited. Index of Economic Freedom (2013) reported that Indonesia is the biggest economy in the Southeast East Asian region as Indonesia exports large amounts of manufactured goods, coal and tins. Permani (2011) mentioned that tins and coal exports are the largest amount in the world which contributing 30% and 37% respectively. In terms of market capitalization, stock market of Indonesia recorded USD 397 billion in 2012 and USD 92 billion value of share traded in the same year. Therefore, this study intends to provide new empirical evidence in the relationship between macroeconomics volatility and stock market volatility in this Southeast Asia's largest economy. We hope to further shed some light on the issue and contribute to the existing literature on the subject matter.

The rest of the paper is organized as follows. Section 2 describes the methodology and provides the description of the data. Section 3 offers empirical findings. Finally, Section 4 presents concluding remarks.

2. METHODOLOGY AND DATA

2.1 Data Description

Monthly data of Jakarta Composite Index (JCI), Industrial production Index (a proxy for Gross Domestic Product), exchange rate, inflation rate and money supply from 1st January 1986 to 31st December 2013 are used in this study. All the data are collected from Data Stream Thomson Reuters and transformed into natural logarithm.

2.2 Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model

GARCH has become popular to measure volatility in recent financial time series as new information that is captured by the most recent squared residuals (Gujarati & Porter, 2009). Autoregressive Conditional Heteroskedasticity (ARCH) model which allows conditional variance change over time depends upon the past information is the first model introduced by Engle (1982). The model later extended to Generalized ARCH (GARCH) model originally proposed by Bollerslev (1986) which allows the conditional mean and variance to be dependent upon previous own lags.

In general, the GARCH (p, q) equation is estimated as follows:

$$y_t = \lambda_0 + \sum_{i=1}^{k} \lambda_i y_{t-i} + \varepsilon_t ; \qquad \varepsilon_t = N(0, \sigma_t^2) \tag{1}$$

$$\sigma_t^2 = \varphi + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \tag{2}$$

Equation (1) is a conditional mean equation, is an autoregressive process of order k (AR (k)) where y_t and y_{t-i} indicate the current and lagged returns. Parameter λ_0 is the constant while k is the lag length and the heteroskedastic error term is ε_t with its conditional variance (σ_t^2). Equation (2) is the conditional variance equation where σ_t^2 is conditional variance. Parameter φ is constant, α_i is the coefficient of the lagged squared residuals based on conditional mean and β_j is the coefficient for the lagged conditional variance. Following Liljeblom and Stenius (1997); Zakaria and Shamsuddin (2012), in this study GARCH (1, 1) is used.

2.3 Granger Causality Test

Granger causality test is developed by Granger (1969) for testing the statistical causal relations between dependent variables and independent variables. Following Yusuf and Rahman (2012), we employ VAR model as follows:

$$VJCI_t = \alpha + \sum_{i=1}^{k1} \delta_i VIP_{t-i} + \sum_{i=1}^{k2} \phi_i VEXC_{t-i} + \sum_{i=1}^{k3} \theta_i VIR_{t-i} + \sum_{i=1}^{k4} \gamma_i VMS_{t-i} + \varepsilon_t \quad (3)$$

Where

VJCI	= stock price index volatility
VIP	= industrial production volatility
VEXC	= the exchange rate volatility
VIR	= inflation rate volatility
VMS	= money supply volatility

The appropriate lag length of VAR models is based on Akaike Information Criterion (AIC) in all estimation process due to the model is very sensitive to the lag length used

3. EMPIRICAL FINDINGS

3.1 Descriptive Statistics and Correlation

Table 1: Descriptive Statistics

	Δ JCI	**Δ IPI**	**Δ EXR**	**Δ CPI**	**Δ MS**
Mean	0.0168	0.0063	0.0095	0.0021	0.0155
Std. Dev.	0.0985	0.0667	0.0781	0.0708	0.0240
Skewness	3.0227	-0.0412	6.1750	-4.9642	4.0596
Kurtosis	33.623	10.067	64.787	55.332	40.994
Jarque-Bera	13600.40	697.2764	55416.56	39602.96	21069.55
Probability	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*

Notes: Δ *presents 1st-order differences;* * *denotes significant at 5% levels*

Table 1 shows the descriptive results of stock market return and macroeconomic variables involving mean, median, standard deviation, skewness, kurtosis and Jacque-bera in the first order differences. From the table above, the mean of the variables ranging from a high of 0.0168 for the stock market return to a low of 0.0021 for the average of inflation rate. The standard deviation of stock market return (0.0985) shows a great variation whereas the variation of money supply (0.0240) is the lowest. With the exception of CPI and IPI, all variables are positively skewed whereas IPI and is negatively skewed. Based on Jacque-bera statistic, all variables are not normally distributed.

Table 2: Correlation Coefficients

	JCI	**IPI**	**EXR**	**CPI**	**MS**
JCI	1.0000				
IPI	-0.0370	1.0000			
EXR	-0.0683	-0.1098	1.0000		
CPI	-0.0664	0.0204	-0.1514	1.0000	
MS	0.0613	-0.0884	0.7272	-0.1505	1.0000

Table 2 above shows the correlation amongst the variables utilized in this study. Stock market return only has a positive correlation of 0.0613 with money supply. However, industrial production, exchange rate, inflation rate are negatively correlated with stock market return which is -0.0370, -0.0683 and -0.0664 respectively. The highest correlation is between exchange rate and money supply at 0.73 while the lowest is between industrial production and inflation at 0.02.

3.2 GARCH (1, 1) Model

Table 3: Estimation Results of GARCH (1, 1) Model and Diagnostics

	JCI	**IPI**	**EXR**	**CPI**	**MS**
Mean Equation					
C	695.43 (0.9979)	4.5023 (0.0000)*	8.3358 (0.0000)*	4.9848 (0.0000)*	13.237 (0.0000)*
AR(1)	0.9999 (0.0000)*	0.9809 (0.0000)*	0.9910 (0.0000)*	0.9824 (0.0000)*	0.9627 (0.0000)*
Variance Equation					
C	0.00063 (0.0002)*	0.0020 (0.0000)*	-3.43E-06 (0.4319)	1.60E-06 (0.4613)	0.0144 (0.0092)*
RESID(-1)^2	0.1857 (0.0000)*	0.6798 (0.0000)*	5.0545 (0.0000)*	16.998 (0.0000)*	0.7516 (0.3924)
GARCH(-1)	0.7791 (0.0000)*	0.1008 (0.1365)	0.1708 (0.0000)*	0.0237 (0.0000)*	-0.3571 (0.3273)
Diagnostic					
Q(20)	878.45 (0.000)*	324.81 (0.000)*	160.15 (0.000)*	2.7307 (1.000)	235.33 (0.000)*
$Q^2(20)$	280.03 (0.000)*	166.59 (0.000)*	14.727 (0.792)	0.2560 (1.000)	35.860 (0.016)*
LM	0.0016 (0.9680)	0.0597 (0.8070)	0.0421 (0.0421)*	0.1004 (0.7514)	0.0007 (0.9787)

*Notes: * denotes significant at 5% levels*

Table 3 shows the parameter estimates and their corresponding p-value involving mean equation, variance equation and diagnostic checks in the GARCH (1, 1) model for the stock market and four macroeconomic variables. From the table above, the parameter of mean equation developed by AR (1) show that JCI and all macroeconomic variables are significant at 5% level which indicates that the mean of the variables depends on the past conditional variances. Besides, from the estimated variance equation of GARCH model, it can be seen that JCI, EXR and CPI follows a GARCH (1,1) model because it is significant at 5% level while IPI follows ARCH (1) model because it is not significant at 5% level.

Subsequently the Box-Ljung (Q) statistic of the residuals used 20 lags which suggested from Morelli (2002) and Zakaria and Shamsuddin (2012) to examine the serial correlation statistic of the residuals. The results show that JCI, IPI, EXR and MS shows evidence of autocorrelation at 5% level of significance except CPI. Finally, the Lagrange multipliers (LM) shows that JCI, IPI, CPI and MS have no ARCH errors as it is not significance at 5% level of significance. On the other hand, exchange rate has ARCH errors affect.

3.3 VAR Granger causality test

Since the GARCH (1, 1) model has derived the volatility of stock market and volatility of macroeconomic variables for Indonesia, this paper may proceed to vector autoregressive model (VAR) Granger causality test to examine the causal relationship between the variables. The lag length of the respective VAR model is determined according to the Akaike information criterion (AIC). Table 5 presents the Granger causality test result for Indonesia.

The results show that all macroeconomics volatility has no significant impact on stock market volatility. Consistent with Agrawal et al (2010), Zhao (2010) and Yusuf and Rahman (2013), we also found that stock market volatility has significant influence on exchange rate volatility. There exists a bi-directional causality running between money supply volatility and exchange rate volatility. Industrial production volatility seems to be influenced by both exchange rate and money supply volatility. As a conclusion, to some extent, consistent with Schwert (1989), Morelli (2002) and Zakaria and Shamsuddin (2012) we also found that there is a weak relationship between macroeconomic volatility and stock market volatility for the case of Indonesia.

Table 4: Granger Causality of Variables Volatility

Hypothesis	Chi-Sq	p-value	Concluding remarks
VIPI =/=>VJCI	0.3027	0.8595	VIPI =/=>VJCI
VEXR =/=> VJCI	0.8354	0.6586	VEXR =/=> VJCI
VCPI =/=> VJCI	0.2871	0.8663	VCPI =/=> VJCI
VMS =/=> VJCI	0.7635	0.6827	VMS =/=> VJCI
VJCI =/=> VIPI	0.9244	0.6299	VJCI =/=> VIPI
VJCI =/=> VEXR	6.5254	0.0383	VJCI ==> VEXR
VJCI =/=> VCPI	1.4906	0.4746	VJCI =/=> VCPI
VJCI =/=> VMS	0.6978	0.7055	VJCI =/=> VMS
VEXR =/=> VIPI	11.383	0.0034	VEXR ==> VIPI
VCPI =/=> VIPI	0.0589	0.9710	VCPI =/=> VIPI
VMS =/=> VIPI	10.992	0.0041	VMS ==> VIPI

VCPI =/=> VMS	0.8723	0.6465	VCPI =/=> VMS
VIPI =/=> VEXR	2.0413	0.3604	VIPI =/=> VEXR
VIPI =/=> VCPI	0.5503	0.7594	VIPI =/=> VCPI
VIPI =/=> VMS	4.3853	0.1116	VIPI =/=> VMS
VCPI =/=> VEXR	1.2017	0.5483	VCPI =/=> VEXR
VMS =/=> VEXR	19.164	0.0001	VMS ==> VEXR
VEXR =/=> VCPI	2.4448	0.2945	VEXR =/=> VCPI
VEXR =/=> VMS	35.374	0.0000	VEXR ==> VMS
VMS =/=> VCPI	1.5790	0.4541	VMS =/=> VCPI

Notes: =/=> Not Granger-caused; ==>Granger-caused

4. CONCLUSION

This study provides new empirical evidence regarding the impact of macroeconomic variables volatility on stock market volatility in Indonesia. Using GARCH (1, 1) model and Granger causality test, we found evidence that macroeconomics volatility has no significant impact on stock market volatility. However, the results show an unidirectional causality running from stock market volatility to exchange rate volatility. In addition, there exists a dynamic interaction between money supply volatility and exchange rate volatility. Our results are not consistent with Liljeblom and Stenuis (1997) and Morelli (2002) who found evidence of significant relationship between stock market volatility and real macroeconomic volatility but consistent with Schwert (1989) and Choo et al (2011) who found that stock market volatility cannot be explained by macroeconomic volatility. Zakaria and Shamsuddin (2012) argued that the finding is justifiable in the case of emerging market mainly due to the dominance of non-institutional investors and the existence of information asymmetry problem among investors. These factors could contribute to the weak relationship between stock market volatility and macroeconomic volatilities in the emerging market of Indonesia. For the purpose of policy making, any shocks in stock market should be taken into consideration by the Indonesian authorities to design policies pertaining to its foreign exchange markets.

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