Do macroeconomic variables have any impact on stock market? an Indonesian case study based on ARDL approach

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Do macroeconomic variables have any impact on stock market? an Indonesian case study based on ARDL approach

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Abstract:

- This paper makes an attempt to examine the impact of selected macroeconomic variables on the stock market. Indonesia is taken as a case study. This study is a fresh attempt to investigate the relationship among the variables by applying 'Auto Regressive Distributive Lag' (ARDL) model which has taken care of a major limitation of the conventional cointegrating tests in that they suffer from pre-test biases between the variables. The data used in this study are monthly data of major macroeconomics variables which are inflation rate, interest rate, exchange rate and stock index. This study provides evidence that by applying ARDL technique, there is a significant cointegrating relationship among variables and that macroeconomic variables seem to significantly impact the stock market of Indonesia. Inflation rate was found to have the strongest impact on stock market compared to other macroeconomic variables. The stock index will be most impacted by inflation rate and interest rate, while exchange rate will be most impacted by inflation rate, interest rate and stock index. The findings have important policy implications for the national policy makers, researchers, corporate managers and regulators

Keywords: stock market, macroeconomic variables, ARDL, Indonesia

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1.0 INTRODUCTION (Objectives and issues that motivated the study)

Indonesia is a member of G-20 major economies and is one of the emerging market economies of the world. Indonesia has been classified as a newly industrialized country and also has the largest economy in Southeast Asia. Besides that, Indonesia also gained international recognition regarding Indonesia's economy being recently upgraded in the country's credit ratings by international financial services companies such as Standard & Poor's, Fitch Ratings and Moody's. The reasons for the upgrades that have been mentioned are resilient economic growth, low government debt and prudent fiscal management. In addition to that, those reasons are the key in attracting financial inflows into Indonesia which consists of both portfolio flows and (significant increasing) foreign direct investments (FDI). However, during the global financial crisis in 2008, the economy of Indonesia was impacted and caused a huge drop in Stock Index of Indonesia (IDX). Figure 1 below shows the graph of Stock Index of Indonesia:

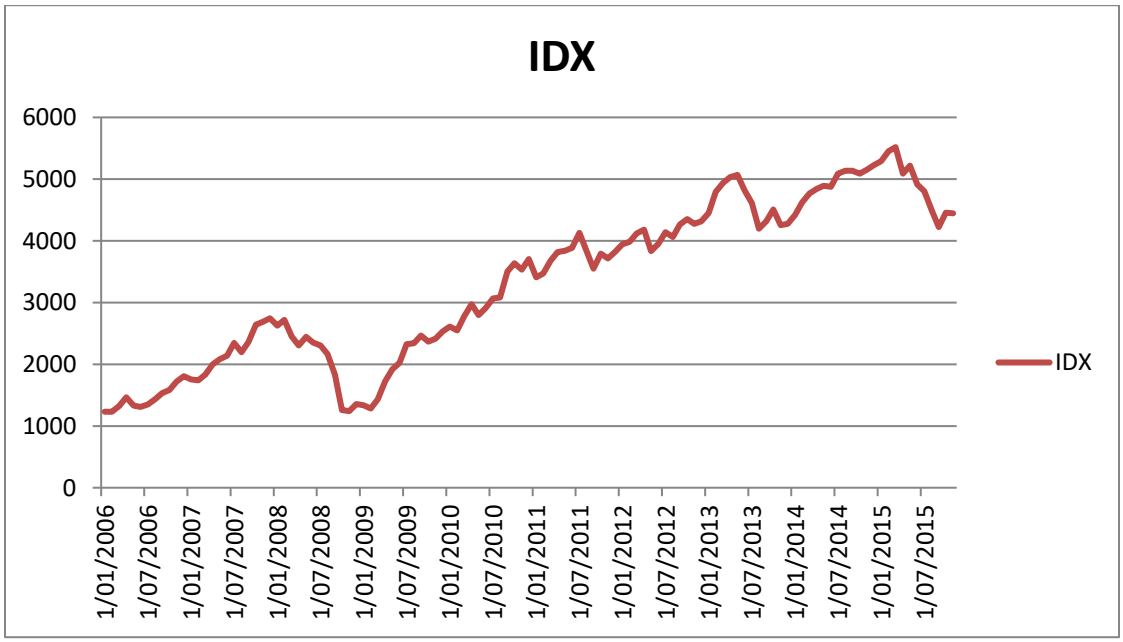


Figure 1 – Stock Index of Indonesia (IDX)

Based on Figure 1, there is a huge drop of stock index in 2008 which is on the year that the global financial crisis happened. Drop in stock index will give a bad impression of the economy of a

particular country. This is because, overall strength and health of a company are usually being indicated by the price of a company's shares. In general, the company and its management are considered to be doing a good job if a company's share price has continued to climb over time. The same goes to the impression of investors towards the economy of a country. When the stock index is doing well then they will assume that the economy of that particular company is good and they will decide to invest in that country. Therefore, it is very important for the policymakers of Indonesia to ensure that their stock index is doing well by examining and controlling variables that will give an impact the stock prices. There are many research that have been done in examining the variables that give an impact on stock prices and the attention of economists, policy makers, investors have been attracted to the interdependence of macroeconomic factors for a long time. It is essential to find out whether there is a relationship between stock index and macroeconomic variables and also to discover and investigate whether the stock price is the leader or stock price is being driven by other macroeconomic variables in order to help the policy makers in making a wise decision for the economy of a country.

Thus, it would be very interesting and useful to investigate the impact of macroeconomic variables on stock index of Indonesia since it will give benefits to policymaker and also help the country to prosper well. Therefore, this study attempts to examine the relationship between stock prices and macroeconomics variable and investigate which variables will impact other variables using Auto – Regressive Distributive Lag (ARDL) approach. The variables that will be used in this study are the stock index of Indonesia and the macroeconomic variables which is inflation rate of Indonesia, interest rate of Indonesia and exchange rate of Indonesia.
Formally, this study has three research questions:

1. Is there is any relationship between stock index of Indonesia and the macroeconomics variables? (inflation rate, interest rate and also exchange rate)

2. If there is a relationship among stock index and macroeconomic variables, which variables will give most impact to stock index and should be controlled first by the policymakers?

3. Is stock index the leader or being led by the macroeconomic variables?

The rest of this paper is organized as follows. The issues that motivating this study and objectives of the study are developed in section 1. Section 2 reviews relationship between stock index and macroeconomics variable in the economics literature. Data sources, methodology and model that applied in this study are documented in section 3. Section 4 presents and interprets the empirical work. This section presents tests for using ARDL approach. Section 5 explains the policy implications based on the empirical results of this study. Last but not least, the concluding remarks are presented in section 6 and limitations of the study in section 7.

2.0 LITERATURE REVIEW

There are many previous studies that provide empirical evidence on the relationship between macroeconomics variables and stock index and this shows that macroeconomic variables has an important role and impact the behavior of stock index.

Based on the study did by Habibullah and Baharumshah (2000), they used quarterly data for the sample period 1981:1 to 1994:4 and Toda and to establish the lead and lag relationship between Malaysian stock market and macroeconomics variable. Five macroeconomic variables are included in their study which is namely money supply, gross national product, price level (Consumer Price Index), interest rate (3-month Treasury bill rate) and exchange rate (real effective exchange rate). The results of their study showed that stock prices lead nominal income, the price level and the exchange rate, but money supply and interest rate lead stock prices. Moreover, there is a study did by Dimitrova (2005) uses monthly data for the United States and the United Kingdom over the period from January 1990 to August 2004 and uses a multivariate, open-economy, short-run model to test the hypothesis that in the short-run, un upward trend in the stock market may cause currency depreciation, whereas weak currency may cause decline in the stock market. Stock prices, exchange rates, domestic output, interest rates, current account balance, oil prices and foreign output are included in the model specification of his study. His study found that by using OLS regression analysis, there is a positive link between stock prices and exchange rates when stock prices are the lead variable and likely negative when exchange rates are the lead variable.

Other than that, there is a research done by Mukherjee and Naka (1995), where they used the Johansen's (1998) VECM and the relationship between the Japanese Stock Market and exchange rate, inflation, money supply, real economic activity, long-term government bond rate, and call money rate are being analyzed by the authors. A cointegrating relation is found in this study and that stock prices contributed to this relation. Furthermore, Bhattacharya and Mukherjee (2002) applying the techniques of unit-root tests, cointegration and long-run Granger non-causality test proposed by Toda and Yamamoto (1995) in order to examine the causal relationships between the BSE Sensex and five macroeconomic variables The findings of the study indicated that there is no causal linkage between the stock prices and money supply, national income and interest rate. On the other hand, the index of industrial production found to leads the stock price and there exists a two-way causation between stock price and rate of inflation.

Besides that, Maysami and Koh (2000) did a research to examine the relationship between stock market and the macroeconomic variables and they concluded that such relationships do exist in Singapore. A cointegrating relation with changes in Singapore's stock market levels is formed by inflation, money supply growth, changes in short- and long-term interest rate and variations in exchange rate. Vuyyuri (2005) uses monthly observations from 1992 through December 2002 to examine the cointegrating relationship and the causality between the financial and the real sectors of the Indian economy. Interest rates, inflation rate, exchange rate, stock return, and real sector was proxied by industrial productivity are the financial variables used in the study. Johansen (1988) multivariate cointegration test supported the long-run equilibrium relationship between the financial sector and the real sector, and the Granger test showed that there is unidirectional Granger causality between the financial sector and real sector of the economy.

There is also a study done by Ibrahim and Aziz (2003) which estimated using vector auto-regression model to explore the relationship or linkages between stock prices and four macroeconomic variables for the case of Malaysia. A long-run relationship between these variables and the stock prices and substantial short-run interactions among them is found in the empirical results of the analysis. They also added that the stock market is playing somewhat predictive role

for the macroeconomic variables. This is similar to the results found by Chong and Goh (2003) which in a further study concluded with the same results. The results showed that stock prices, economic activities, real interest rates and real money balances in Malaysia were linked in the long run both in the pre- and post-capital control sub periods.

Pal and Mittal (2011) examine the long-run relationship between the Indian capital markets and key macroeconomic variables such as interest rates, inflation rate, exchange rates and gross domestic savings (GDS) of Indian economy by using quarterly time series data which is from the period January 1995 to December 2008. The results of the study found out that the macroeconomic variables and Indian stock indices are cointegrated and this indicates a long-run relationship among them. In addition to that, the ECM shows that interest rate has a significant impact on S&P CNX Nifty only while the rate of inflation has a significant impact on both the BSE Sensex and the S&P CNX Nifty. On the other hand, significant impact is seen only on BSE Sensex in case of foreign exchange rate. It is observed that, both the BSE Sensex and the S&P CNX Nifty are insignificantly associated with the changing GDS. They conclude their study by stating that the capital markets indices are dependent on macroeconomic variables even though the same may not be statistically significant in all the cases. There is also a study conducted by Yusoff (2003) on the effects of monetary policy on the Malaysian stock market. His findings showed that there is cointegration between the monetary policy variables and stock prices, with a negative relation between inflation and stock prices and money supply. Additionally, there is also a research done by Ratanapakorn and Sharma (2007) where the data used for this study is from 1975 until 1999 and they adopted Granger causality approach in order to examine the long-term and short-term relationships between the US Stock Price Index (S&P 500) and six macroeconomic variables. They found out that, in the long-run relationship, there is positive relationship between stock prices and the money supply, industrial production, inflation, the exchange rate and the short-term interest rate while the stock prices are negatively related to the long-term interest rate. They stated that in the Granger causality sense, every macroeconomic variable causes the stock prices in the long-run but not in the short-run.

3.0 DATA, MODEL AND METHODOLOGY

3.1 Data

This study uses monthly time series data covering ten years starting from January 2006 and the total number of observations is 119. All data of this study are collected from Datastream for ten-year period. There are four important variables being examined in this study and also widely used as variables in other studies which are consumer price Index of Indonesia, interest rate of Indonesia, exchange rate of Indonesia and also the stock index of Indonesia. The data of these variables have been transformed into log form to make the variance of the variables stationary.

3.2 Methodology

This study uses Autoregressive Distributive Lag (ARDL) approach from Pesaran and Pesaran (1997) and Pesaran et al. (2001) to empirically test the relationship of Indonesia Stock Index with other macroeconomic variables. ARDL approach can be applied to the variables regardless of the order of their integration whereby it manage to take care of the series that are totally I(0), purely I(1) or combination of both. This is in contrast with the cointegration test methods based on Engle-Granger (1987) ,Johansen (1991; 1995) and the Johansen-Juselius (1990) which require all the variables to be of equal degree of integration, I(1). Hence, these methods of cointegration are not appropriate and cannot be applied. Therefore, ARDL approach has been chosen to be applied in this study since this study consists of the combination of I(0) and I(1) which is a combination of both stationary and non-stationary variables. There are some advantages of ARDL over other cointegration approaches.

First of all, the main advantage of ARDL modelling is its flexibility where it can be applied when the variables are in different order of integration (Pesaran and Pesaran 1997). However, there is still perquisite that none of the explanatory variables is of I(2) or higher order, i.e. the ARDL procedure will, however, be inefficient in the existence of I(2) or higher order series. Besides that, another advantage of this approach is that the model takes sufficient number of lags to capture the data generating process in a general-to-specific modelling framework (Laurenceson and Chai 2003). In order to obtain an optimal lag length for each variable, $(p + 1)k$ number of regressions is

estimated where p is the maximum lag to be used, and k is the number of variables in the equation. The model is selected on the basis of different criteria like SBC, AIC, RBC and HQC.

ARDL model is different than multivariate cointegration techniques such as Johansen and Juselius (1988) whereby ARDL model permits the cointegration relationship to be estimated by OLS once the lag order of the model is identified. In addition, this technique is also comparatively more robust in small or finite samples consisting of 30 to 80 observations (Pattichis, 1999; Mah, 2000). Moreover, the problems of endogeneity may also be experienced by the traditional cointegration methods which can be overcome by the ARDL method where it can differentiate between dependent and explanatory variables and eradicate the problems that may rises due to the presence of autocorrelation and endogeneity. Furthermore, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation (Banerjee *et al.* 1993). This ECM allows drawing outcome for LR estimates while other traditional cointegration techniques do not provide such types of inferences. The ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information (Pesaran and Shin, 1999) and also provides unbiased and efficient estimates.

Therefore, the applications of ARDL approach in this study to analyze the relationship among IDX, CPI, INT, and IDR is clearly justified on the above explanations of the advantages of the ARDL technique over other standard cointegration techniques.

After the unit root test which is the stationarity test, the second step in the analysis is to "test the null hypothesis of no cointegration against the alternative hypothesis that there exists cointegration between all variables by using F-statistic. This test is sensitive to the number of lags employed on each first differenced variable (Bahmani-Oskooee, 1999)". The F-test, which has a non-standard distribution, is considered on the lagged levels of the variables in determining whether there is existence of a long-run relationship among the variables. Therefore, two bounds of critical values are obtained and the benchmark for I(0) variables are represented by the lower bounds critical values, while the upper bound critical values serve as benchmark for I(1) variables. According to the bound test, if the computed F-statistics exceeds the upper critical value then there is existence of cointegration. However, if computed F-statistic falls within the two bounds of critical values,

the variables must composed of level and first difference integrated series for possibility of cointegration. Finally, if the F-statistic is below the lower critical value, it shows that there is no cointegration. Next, in the next step, short run and long run linkage is examined by using the error correction model (ECM). The error correction equation is used to find the adjustment speed to the equilibrium in the third stage.

3.3 Model

A simple model is used to examine the variations in stock index of Indonesia. There are many factors that are related and giving impact to stock index but this study will only focus on three main variables in economy and investigate whether they are giving impact to stock index or vice versa.

The functional form of the model is as
IDX=f (CPI, INT, IDR,)

Where,

IDX= Stock Index of Indonesia
CPI= Consumer Price Index of Indonesia (Inflation rate)
INT= BI Rate Indonesia (Interest Rate)
IDR= Exchange Rate of Indonesian Rupiah to US Dollar

The following relationship is examined in order to investigate the impact of those macroeconomic variables on Stock Index of Indonesia:

$$\mathbf{LIDXt = \alpha 0 + \alpha 1 \mathit{LCPIt} + \alpha 2 \mathit{LINTt} + \alpha 3 \mathit{LIDRt} + \mathit{et}\ (1)}$$

Estimating the unrestricted error correction model version of the ARDL model for Stock Index of Indonesia and macroeconomic variables is involved in the ARDL approach to cointegration and below is the error correction version of the model:

LIDX, LCPI, LINT, LIDR

$$dLIDXP_t = a_0 \sum_{i=1}^{8} b_i dLCPI_{t-i} + \sum_{i=1}^{7} c_i dLINT_{t-i} + \sum_{i=1}^{6} d_i dLINT_{t-i} + \mu_t$$

H_0: $\delta_1 = \delta_2 = \delta_3 = 0$ - Long - run relationship exists

$H_{1:}$: $\delta_1 \neq \delta_2 \neq \delta_3 \neq 0$ - Long - run relationship does not exist

4.0 EMPIRICAL RESULTS AND DISCUSSION

4.1 Unit Root Test

As mentioned before, first of all, the data of all variables has been transformed into log form to make the scale of the data become closer and remove the outliers. Then, the empirical testing begins with unit root test which is conducted to examine the stationarity of the variables before proceeding with the ARDL framework. It is necessary to perform unit root test in order to decide whether this study should employ ARDL approach or to use Engle-Granger test and Johansen test. Therefore, unit root test provide important indication to the author on which methodology should be used. There are two types of unit root tests that have been performed in this study which is Augmented Dickey Fuller (ADF) tests (1979) and Philip-Perron (PP) test. The difference between these two tests is that ADF test can overcome the issue of autocorrelation but cannot solve the problem of heteroskedasticity. On the other hand, PP test can tackle both autocorrelation and heteroskedasticity problem using Newey-West adjusted method and therefore, both tests may occasionally produce different results. In this study, firstly the ADF test is performed on each variable in both log and differenced form then followed by PP test. The differenced form for each variable used is created by taking the difference of their log forms. For example, DIDX = LIDX – LIDXt-1.

The results of ADF test are summarized in Table 1 below:

LEVEL FORM OF VARIABLES					
VARIABLE	**ADF**	**VALUE**	**T-STAT.**	**C.V.**	**RESULT**
LCPI	ADF(1)=SBC	58.9427	- 3.547	- 3.445	Stationary
	ADF(5)=AIC	65.8285	- 3.930	- 3.483	Stationary
LINT	ADF(1)=SBC	293.7621	- 2.720	- 3.445	Non-Stationary
	ADF(1)=AIC	299.2169	- 2.720	- 3.445	Non-Stationary
LIDR	ADF(1)=SBC	229.1662	- 1.493	- 3.445	Non-Stationary
	ADF(3)=AIC	236.2993	- 1.325	- 3.527	Non-Stationary
LIDX	ADF(1)=SBC	145.0325	- 2.421	- 3.445	Non-Stationary
	ADF(3)=AIC	152.3818	- 3.038	- 3.527	Non-Stationary
FIRST DIFFERENCE OF VARIABLES					
VARIABLE	**ADF**	**VALUE**	**T-STAT.**	**C.V.**	**RESULT**
DCPI	ADF(1)=SBC	56.0261	- 7.116	- 2.816	Stationary
	ADF(2)=AIC	60.2589	- 5.011	- 2.838	Stationary
DINT	ADF(1)=SBC	288.2841	-4.0265	-2.8157	Stationary
	ADF(1)=AIC	292.3619	-4.0265	-2.8157	Stationary
DIDR	ADF(1)=SBC	229.4890	- 8.251	- 2.816	Stationary
	ADF(2)=AIC	234.0462	- 5.486	- 2.838	Stationary
DIDX	ADF(2)=SBC	143.8207	- 4.417	- 1.913	Stationary
	ADF(2)=AIC	147.8984	- 4.417	- 1.913	Stationary

Table 1- ADF test

The null hypothesis for this test is that the variable is non-stationary. Therefore, when t-statistics is lower than the critical value, we failed to reject the null and hence the variable is non-stationary and vice versa. Based on Table 1 above, there is combination of stationary and non-stationary variables in level form while in first difference form, all variables are stationary. This shows that this study has to employ ARDL approach instead of Engle-Granger test and Johansen test due to the combination of I(0) and I(1) variables. Next, PP test is performed and the results appear as in table 2 below:

LEVEL FORM OF VARIABLES			
VARIABLE	T-STAT.	C.V.	RESULT
LCPI	-2.1952	-3.4502	Non-Stationary
LINT	-1.5012	-3.4502	Non-Stationary
LIDR	-1.3487	-3.4502	Non-Stationary
LIDX	-1.8272	-3.4502	Non-Stationary
FIRST DIFFERENCE OF VARIABLES			
VARIABLE	T-STAT.	C.V.	RESULT
DCPI	-6.8009	-2.9118	Stationary
DNT	-4.3015	-2.9118	Stationary
DIDR	-9.3759	-2.9118	Stationary
DIDX	-7.9405	-2.9118	Stationary

Table 2 – PP test

Based on Table 2 above, we can conclude that all variables are non-stationary in level form and stationary in first difference form. This shows that PP test may sometimes give different results with ADF test. Since ADF test reveals the mixed of I(0) and I(1) while PP test shows all variables are I(1), this study can choose either to employ ARDL approach or to use Engle-Granger test and Johansen test. However, this study found that there is no cointegration of variables at all from the empirical results of Engle-Granger test and Johansen test. Hence, since the results of unit root test are not consistent and there is no cointegration found using Engle-Granger test and Johansen test, the author of this study decided to use ADF test results and proceed to ARDL approach to test the long run relationship among the variables.

4.2 VAR Order Selection

Before proceeding to the test of long-run relationship among variables using ARDL approach, the order of the vector auto regression (VAR) , which is the number of lags to be used is determined and the results reveals in Table 3 below and the details of the results will be in Appendix 9.

Optimal Order	AIC	SBC	Adjusted LR (p-Value)	C.V.
2	777.751			
1		749.581		
1			[.228]	5%

Table 3 – VAR Order Selection

By referring to Table 3 above, the results show that the highest value of AIC gives the optimal order of two, the highest value of SBC recommends the optimal order of one while the Adjusted LR test indicates that the p-value is higher than the critical value at the order of one which is the same results with SBC. Since there is conflict between recommendation of AIC and SBC, it will be more efficient to select the result according to the nature of the data set which we used in this study. The SBC is more concerned on over-parameter. It tends to choose lower order of lags. Therefore, this study decided to use the VAR order of 1.

4.3 Bound Test

Next, bound test will be carried out using ARDL approach to examine the existence of long-run relationship between variables and the null hypothesis for this test is that there is no long-run relationship among the variables. The F-statistics gained from the bound test will be compared to the critical value of upper bound obtained from Pesaran et al. (2001), unrestricted intercept and no trend. Consequently, when the F-statistics of a variable is higher than the upper bound, then the null will be rejected and hence there is a long-run relationship among variables and vice versa. The results of bound test are depicted in Table 4 as follows:

Variable	F-Stat	Upper Bound	Result
DCPI	4.4753[.002]	4.4604	Long-run relationship exists
DINT	2.2539[.069]	4.4604	Long-run relationship does not exists
DIDR	1.1893[.321]	4.4604	Long-run relationship does not exists
DIDX	1.0250[.399]	4.4604	Long-run relationship does not exists

Table 4 – Bounds Test

According to table 4 above, the F-statistics of DCPI shows that the F-statistics exceeds the upper bound where the null hypothesis will be rejected and therefore a long run relationship exists. This result has its economic interpretation where it indicates that in the long-run, the variables in this study which is CPI, INT,IDR and IDX are moving together in a particular direction and this shows that the relationship among the variables is not spurious. In other words, there is a theoretical relationship among the variables and this indicates that the each variable has information for the prediction of other variables and they are in equilibrium in the long-run. Besides that, this result has an important implication for policy makers. Since there is relationship between inflation rate, interest rate, exchange rate and stock index of Indonesia, the policy makers of Indonesia can encourage or discourage investment in stock market by adjusting the inflation rate, the exchange rate, as well as monitoring the interest rate. However, there is a need to know which variables are the leaders and which variables are the followers and this will be determined by the next step which is error correction model.

4.4 Error Correction Model

As mentioned before, cointegration reveals whether there is a long run relationship among the variables or not. Nonetheless, there could be a short-run deviation from the long-run equilibrium and cointegration does not unfold the process of short-run adjustment to bring about the long-run equilibrium. Therefore, there is a need to go for error correction model, ARDL approach in order to understand the adjustment process. This study performed the error correction model (ECM) based on AIC and SBC. The summarization of the results is shown in Table 5 below:

Error Correction Model Based on AIC					
ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLCPI	-.21341	.053131	-4.0166[.000]	5%	Endogenous
dLINT	-0.029198	0.01614	-1.8090[.073]	5%	Exogenous
dLIDR	-0.012265	0.01939	-.63255[.528]	5%	Exogenous
dLIDX	-0.012957	0.018283	-.70871[.480]	5%	Exogenous
Error Correction Model Based on SBC					
ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLCPI	-0.20015	0.048758	-4.1049[.000]	5%	Endogenous
dLINT	-0.030903	0.016346	-1.8906[.061]	5%	Exogenous
dLIDR	-0.021318	0.018706	-1.1396[.257]	5%	Exogenous
dLIDX	-0.01238	0.018517	-.66855[.505]	5%	Exogenous

Table 5 –Error Correction Model Based on AIC and SBC

The deviation from equilibrium (represented by the error-correction term) is examined whether it has a significant feedback effect or not on the dependent variable and this is shown by the „t" ratio or the „p" value of the error-correction coefficient. In simple words, ECM examines which variable is endogenous and which is exogenous. As shown in Table 5, the error correction model based on AIC and SBC reveals which variable is endogenous and which is exogenous by looking at the p-value of ECM. The null hypothesis for this test is that the variable is exogenous and whenever the p-value of the variable is lower than the critical value which is five percent, then the variable is endogenous and vice versa. Based on both ECM test, inflation rate is found to be endogenous while other variables like interest rate, exchange rate and stock index are exogenous. Hence, this shows that the error-correction coefficient being significant and confirms our earlier findings of a significant long-run cointegrating relationship between the variables.

Furthermore, the speed of short-run adjustment of the dependent variable to bring about the long-run equilibrium is indicated by the size of the coefficient of the error-correction term. In addition to that, the intensity of the arbitrage activity to bring about the long-run equilibrium is also shown by the size of the coefficient of the error-correction term. From Table 5 it is reveals that the error correction coefficient of inflation rate is highly significant than other variables which is estimated at -0.21341 (0.000) for AIC and -0.20015 for SBC. This shows that it has the correct sign and implies a moderate speed of adjustment to equilibrium after a shock. Moreover, in short run, the

effects of these variables on the dependent variable are significant or not is indicated by the „t" or „p" value of the coefficients of the □(i.e., differenced) variables.

However, the results of error correction model seems to be different from the previous literature where most of previous studies found out that inflation rate should be exogenous and stock index should be endogenous. In order to reconfirm the results of ECM based on AIC and SBC, Variance Decomposition Method (VDC) will be performed in order to determine which variables the most endogenous and which is the most exogenous.

4.5 Variance Decomposition (VDC)

As mentioned before, the disadvantage of error correction model is that it cannot determine the relative degree of endogeneity or exogeneity among the variables. Therefore, this study applied Variance Decomposition technique in order to examine the relative degree of endogeneity or exogeneity of the variables. The relative exogeneity or endogeneity of a variable can be examined by the proportion of the variance explained by its own past. The most exogenous variables which is the most leader and independent than others is explained mostly by its own shocks (and not by others) while the least endogenous variable is thus the variable whose variation is explained mostly by its own past variations. This study started out by applying orthogonalized VDCs and then followed by generalized VDCs and the details of the results are shown in Appendix 18 until Appendix 25. Table 6 below summarized the results of orthogonalized VDCs :

Forecast at Horizon = 12 months (1 year), 24 months (2 years) and 36 months (3 years)

VARIABLES	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	RANKING
LCPI	12	89.60%	7.28%	0.05%	3.07%	100.0%	1
LINT	12	21.73%	76.41%	0.17%	1.69%	100.0%	3
LIDR	12	1.55%	12.42%	77.93%	8.10%	100.0%	2
LIDX	12	4.61%	13.06%	30.72%	51.62%	100.0%	4
VARIABLES	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	RANKING
LCPI	24	89.60%	7.28%	0.05%	3.07%	100.0%	1
LINT	24	21.73%	76.41%	0.17%	1.69%	100.0%	3
LIDR	24	1.55%	12.42%	77.92%	8.10%	100.0%	2
LIDX	24	4.61%	13.06%	30.72%	51.62%	100.0%	4
VARIABLES	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	RANKING
LCPI	36	89.60%	7.28%	0.05%	3.07%	100.0%	1
LINT	36	21.73%	76.41%	0.17%	1.69%	100.0%	3
LIDR	36	1.55%	12.42%	77.92%	8.10%	100.0%	2
LIDX	36	4.61%	13.06%	30.72%	51.62%	100.0%	4

Table 6 – Orthogonalized VDC

Based on Table 6, forecasted horizon 12 months, 24 months and 36 months showed the same results across the horizon where the most exogenous variable is inflation rate then followed by exchange rate, interest rate and the stock index. This result is contradicts to the results obtained from error correction model. In addition, the contributions of own shocks towards explaining the forecast error variance of each variable for forecast horizon of 12 months, 24 months and 36 months are also the same where the inflation rate is 89.6%, interest rate is 76.41%, exchange rate is 77.92% and stock index is 51.62%. The variable that is explained mostly by its own shocks and depends relatively less on other variables is the leading variable and vice versa. Therefore, stock index is the variable that is the most little explained by its own shocks and it is the most dependent variable. This also shows that stock index is a follower and will be most impacted by inflation rate, interest rate and exchange rate.

However, there are two important limitations of orthogonalized VDCs. Firstly, orthogonalized VDCs assumes that when a particular variable is shocked, all other variables are “switched off”. But more importantly, orthogonalized VDCs do not produce a unique solution, on which the

generated numbers are dependent upon the ordering of the variables in the VAR. Typically, the first variable would report the highest percentage and as such would be specified as the most exogenous variable. Therefore, this study decided to use and applied generalized results which are obtained as follows:

VARIABLE	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	SELF-DEP	RANKING
LCPI	12	81.19%	16.19%	0.11%	2.51%	100.00%	81.19%	1
LINT	12	18.37%	78.83%	0.37%	2.43%	100.00%	78.83%	2
LIDR	12	1.21%	9.95%	61.48%	27.36%	100.00%	61.48%	4
LIDX	12	3.51%	11.24%	23.13%	62.12%	100.00%	62.12%	3
VARIABLE	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	SELF-DEP	RANKING
LCPI	24	81.19%	16.19%	0.11%	2.51%	100.00%	81.19%	1
LINT	24	18.37%	78.83%	0.37%	2.43%	100.00%	78.83%	2
LIDR	24	1.21%	9.95%	61.48%	27.36%	100.00%	61.48%	4
LIDX	24	3.51%	11.24%	23.13%	62.12%	100.00%	62.12%	3
VARIABLE	HORIZON	LCPI	LINT	LIDR	LIDX	TOTAL	SELF-DEP	RANKING
LCPI	36	81.19%	16.19%	0.11%	2.51%	100.00%	81.19%	1
LINT	36	18.37%	78.83%	0.37%	2.43%	100.00%	78.83%	2
LIDR	36	1.21%	9.95%	61.48%	27.36%	100.00%	61.48%	4
LIDX	36	3.51%	11.24%	23.13%	62.12%	100.00%	62.12%	3

Table 7 – Generalized VDC

From the above results, we can make the following observations:

- Exchange Rate is ranked in Generalized VDCs as number four which shows that it is the most endogenous variable while the most exogenous variable is inflation rate then followed by interest rate and stock index.
- There is no change between forecast horizon of 12 months, 24 months and 36 months.
- However, this result contradicts earlier VECM result which indicates that stock price is exogenous and slightly different to the Orthogonalized VDCs, which determine stock index as the most endogenous variable.
- The contributions of own shocks towards explaining the forecast error variance of each variable are the same and no change for forecast horizon of 12 months, 24 months and 36

months where the inflation rate is 81.19%, interest rate is 78.83%, exchange rate is 61.48% and stock index is 62.12%.

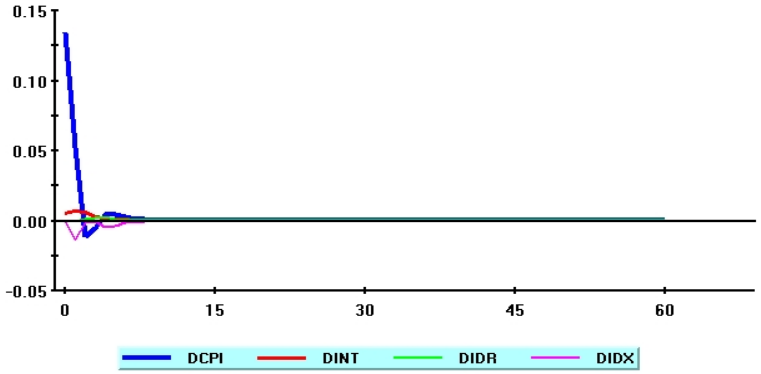
- Therefore, stock index will be most impacted by inflation and interest rate while exchange rate will be most impacted by inflation rate, interest rate and stock index.

In generalized VDCs, the other variables will not be switched off when one variable is shocked. Besides that, the order of the variables does not have an impact on the generated numbers. However, generalized VDC results also contradict with the results from error correction model which found out that inflation rate is endogenous. In this case, this study decided to use the results from generalized VDC since VDC can examine the relative endogeneity and exogeneity while ECM cannot. The above results are very important for the policy makers of Indonesia and investors because it will help them to make the decision. This will be explained further in section 5 which is the section for implications to policy makers.

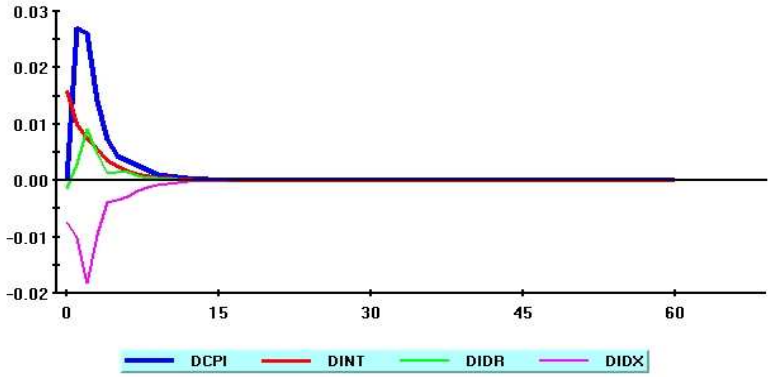
4.6 Impulse response function (IRF)

The same information as the VDCs is presented in the graphical form in this section and this is the section of impulse response functions (IRFs). Therefore, the only difference between impulse response function and VDC is that in impulse response function the information in graphical form. This study started out applying orthogonalized IRF and then followed by generalized IRF. The results of IRF are presented below and the summarization of the orthogonalized results are as follows:

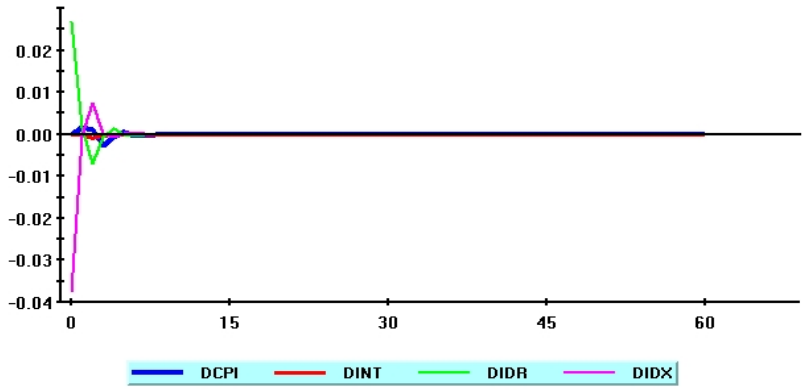
Orthogonalised Impulse Responses
to one SE shock in the equation for DCPI

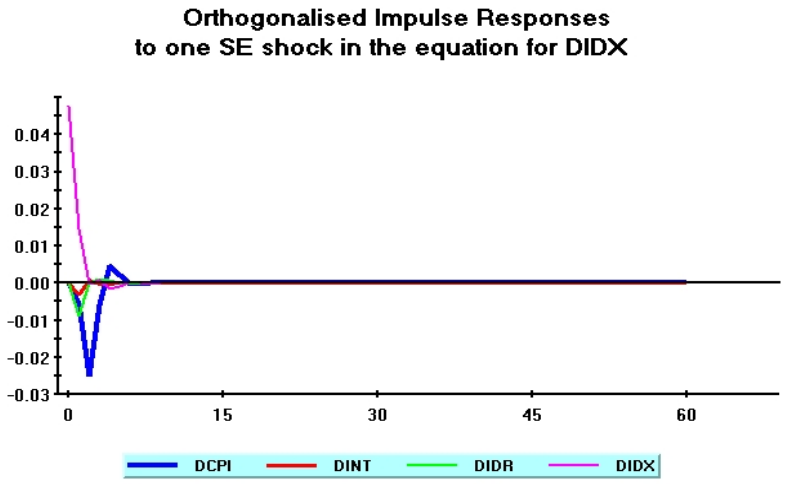


Orthogonalised Impulse Responses
to one SE shock in the equation for DINT

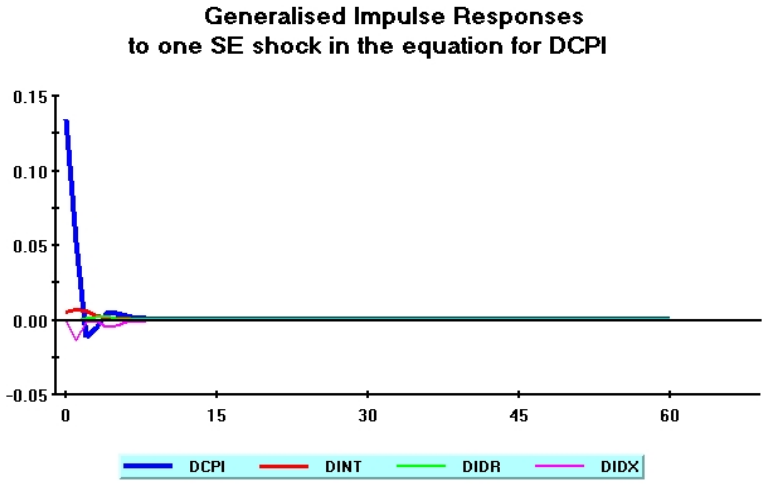


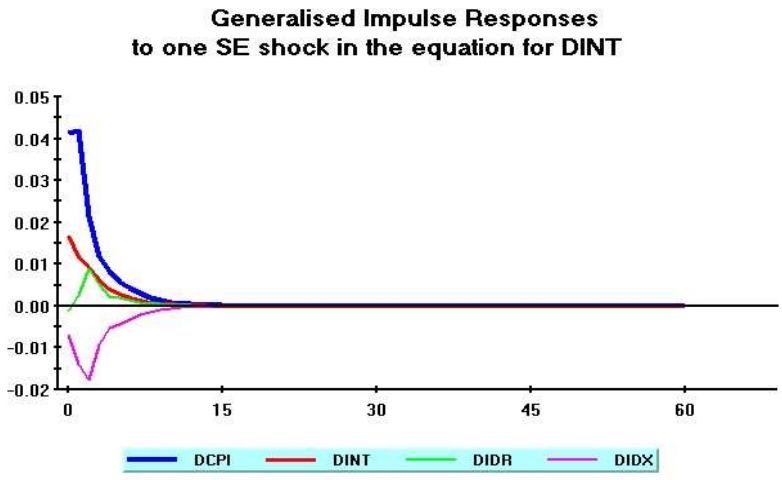
Orthogonalised Impulse Responses
to one SE shock in the equation for DIDR

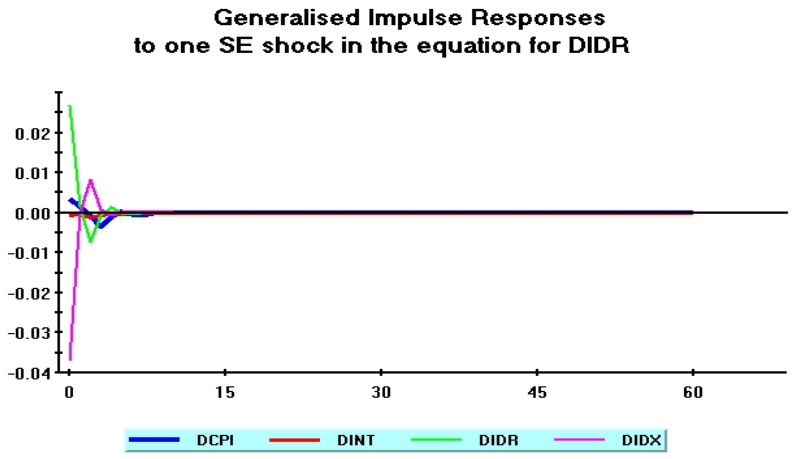


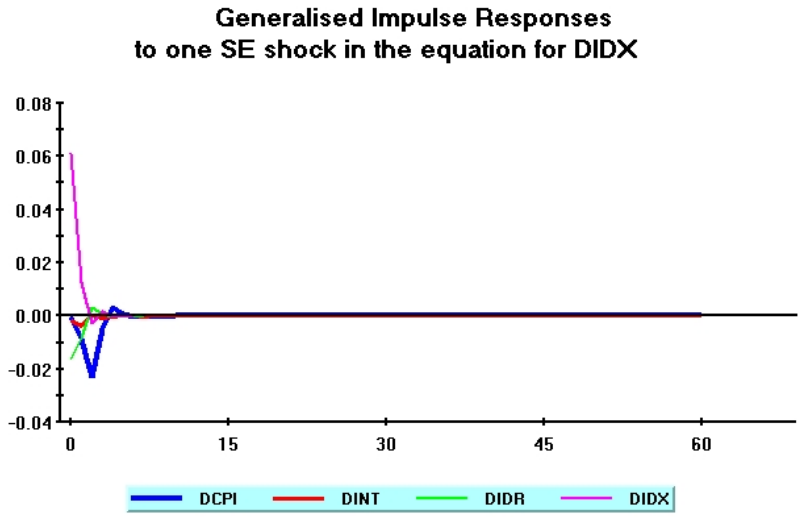


Below is the graphical form of generalized impulse response results:









Based on the graphical results above, it can be concluded that there is not much difference between orthogonalized and generalized and the figures present the orthogonalized and generalized responses of dependent variables to shocks on their independent variables.

5.0 IMPLICATIONS FOR THE POLICYMAKERS AND INVESTORS

Based on generalized VDC, it indicates that the exogeneity of variables started with inflation rate and followed by interest rate, stock index and exchange rate. This result is in line with the result found by Mukherjee and Naka (1995) and also similar to Maysami and Koh (2000) where they found a cointegrating relationship between those variables. This result is very important for the policy makers of Indonesia and also investors because this can help them in making good and wise decisions. The crises in stock markets can be prevented by controlling fluctuations in macroeconomic variables since macroeconomic variables are significantly related and the causation runs from macroeconomic variables to stock prices. Based on results of this study, policy makers should control the inflation rate since it is the most exogenous variables and stock index will be most impacted by inflation. This is because when inflation is lower, it shows that there is not too much many in circulation and when people has less money, this will impact their consumption where they will reduce their spending and cause the profit of companies to goes down which eventually impact the stock price to decline. In addition to that, the policy maker also has to control the interest rate since the results shows that interest rate is the second most exogenous variable. This is because when interest rate is high, the cost of borrowing will be high and this will impact the growth of many companies since most companies borrow to finance their business. Therefore, companies will reduce their borrowing which cause the production of goods to decline and cause a decline in their profits which finally cause a decline in stock price.

According to the generalized VDC results, it shows that stock index is not the most endogenous variable and it is ranked as the second endogenous variable after exchange rate. However, in orthogonalized, it shows that stock index is the most endogenous variable while exchange rate is ranked as second based on exogeneity. Besides that, the contributions of own shocks towards explaining the forecast error variance of stock index and exchange rate are not much difference where stock index is 62.12% and exchange rate is 61.48%. Therefore, since orthogonalized and generalized results are contradicting and there is no much difference of the endogeneity of stock price and exchange rate, this study conclude that both has impact on each other. The result of this study where stock price is found to lead exchange rate is line with the result found by Habibullah

and Baharumshah (2000) and also the same result found by Dimitrova (2005). This is because, when the stock prices fall, this will cause the currency of Indonesia to depreciate as well. Therefore it is very important for the policy maker to ensure increase in stock price in order to make the currency of Indonesia appreciate. On the other hand, when the currency of Indonesia is depreciating, this will cause an increase in cost for the companies since the companies usually got their raw materials from wide variety of sources outside the country and this will eventually cause the profit of the company to decrease and finally the stock price will also decrease. Therefore, policy makers can make a decision on how to control and make economy prosper well by controlling those macroeconomic variables and a wise decision by the policy makers can determine the successful of a country. Besides that, government can also focus on domestic economic policies to stabilize the stock market during any financial crisis. Moreover, this results will also help the investors in making decision whether they should invest in stocks or not and which is the best time to invests in stock and when is the best time to buy and sell the stocks.

6.0 CONCLUDING REMARKS

In conclusion, this study revisit the three researches question posed at the beginning of the study. Based on the above quantitative analysis, we found the answers as follows:

1. There is a significant cointegrating relationship between stock index of Indonesia and the macroeconomics variable. (inflation rate, interest rate and also exchange rate)

2. The variable that will have the most impact on the stock index of Indonesia is inflation rate which is followed by interest rate and exchange rate. Therefore, policymakers should have an eye on inflation rate first then followed by interest rate and exchange rate in order to stabilize the stock market of Indonesia.

3. Stock index is a not the leader and it is being led by other macroeconomic variables which is inflation rate, interest rate and exchange rate. Hence, policymakers can ensure the prosperity and stability of stock market by controlling the aforementioned macroeconomic variables.

7.0 LIMITATION OF THE STUDY

This study has several limitations that should be mentioned to ensure future studies can be built on this. One of the critical limitations of this study is that it has lack of sufficient time period to examine the relationship between different combinations of the variables and this study only uses monthly data for a period of 10- years. It is advisable for other researchers who are interested to continue this study to use a longer period of data since more observations would have yielded a more refined result.

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