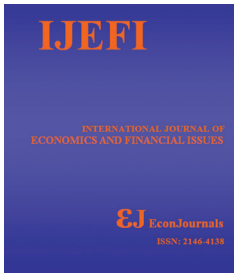

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Effect of Exchange Rate, Foreign Direct Investment and Portfolio Investment on the Indonesian Economy: A Structural Cointegrating Vector Autoregression Approach

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ABSTRACT

This study develops macroeconomic models that involves the output gap, the level of prices, interest rates, exchange rates, current account, foreign direct investment and portfolio investment. The modeling adapts to the characteristics of the data, the perspective of a new macroeconomic theories that are relevant to the conditions in Indonesia, and the appropriate methodology used structural cointegrating vector autoregression. The test results indicate the presence of four significant cointegrations and affect change in macroeconomic variables that are endogenous. The four cointegrations are output gap, price, interest rates and exchange rates cointegration. The long-term relationships indicate that exchange rates cointegrated against the output gap, price, interest rate on the one hand and cointegrated by the interest rate, current account and foreign direct investment on the other. The exchange rate has a relationship with key macroeconomic variables in Indonesia. Taking into account the increasing globalization of economic and financial, policy of inflation targeting in Indonesia should be consistent in giving more attention to exchange rates and financial markets.

Keywords: Long-term Relationships, Structural Cointegrating Vector Autoregression, Inflation Targeting
JEL Classifications: C51, E10, E58, E66

1. INTRODUCTION

In globalization, the issue of the exchange rate becomes the attention of researchers and policy makers. Interconnection via the exchange rate channel is becoming more important in addition to the current account channel in an open economy. Openness of economy is marked by increasing dynamic mobility of foreign capital will further increase the interconnection between the exchange rate and foreign investment with macroeconomic variables such as the level of the output, interest rates, inflation, and current account. In the context of inflation targeting policy, the role of the exchange rate is the key in the design of monetary policy to the open economy. Recently, exchange rate is still being debated in the monetary policy, for example, in Taylor (2001). Studies through the development of macroeconomic models in the context of an open economy based on the new macroeconomic perspective become an alternative to the researchers debates. Macroeconomic models are more likely describe the interconnections and interdependencies between variables as the impact of risk and uncertainty of globalization. Consequently economic policy, especially monetary policy will emphasize forward looking and looking important role in macro-economic shock.

In studies using time series, there are still a lot of researches in Indonesia that do not investigate the cointegration based on economic theory in the model, except models with the approach of error correction model (ECM) and vector ECM (VECM). Theoretical approach used mostly pays less attention to micro-economic aspects. Cointegration needs to be investigated when most of the macroeconomic variables have a stochastic trend in time series analysis. Cointegration becomes an important trait in contemporary time series analysis. Cointegration approach is also associated with the need to analyze the short-term and long-term impact to the economy. Short-term economic fluctuations deeply considering the role of shock and its association with long-term relationships of macroeconomic variables, associated with this study need to be carried out. In the context of an open economy,

the role of shock is more important along with the increasing relations between macroeconomic variables. The relationships between macroeconomic variables in the economy increasingly becomes a concern, especially in connection with monetary policy focused on inflation targeting as the perspective of a New Consensus Macroeconomics (NCM).

In the context of the current economic and financial globalization, it requires empirical study basing on the principles of the New Neoclassical Synthesis (NNS) and NCM in the development of macroeconomics models in Indonesia. It requires the adjustment of existing predecessor studies based on the same scope of topic or study, in terms of the theoretical approach, the methodology and the selection and measurement of variables. This is carried out and adjusted to focus the necessary research. The study with the model describing multi long-term relationship based on the theory needs to involve it in the effect on endogenous variables individually. The model is a model that describes the interdependence and interconnection of macroeconomic variables in Indonesia in the economic and financial globalization as a consequence of the current open economy.

The key variables in this problem is the exchange rate, foreign direct investment and portfolio investment because all three have a significant relationship with the main variables of macroeconomic; they are output gap, prices and interest rates, as well as the crucial variable of the current account.

The use of time series model is not appropriate before testing the cointegration. If the data have a stochastic trend, it will have implications for the inaccurate estimated short-term change. Therefore, the test on the effect of short-term change of predetermined variables, in this case is lag variables (as in the estimation of time series models, such as vector autoregression [VAR] and VECM), to the changes in variables concerned is invalid and insignificant economically without linking to the long-term relationship.

Estimated time series models carried out without taking into account long-term relationship provide insignificant result of shock impact analysis economically. It requires model approach that establishes a restriction based on the theory to determine the long-term relationship as anchor. In understanding the interdependence between macroeconomic variables, the shocks of macroeconomic variables need to be identified by the structural cointegrating VAR (SCVAR) model to study the effect of a shock on changes in the macroeconomic variables.

2. METHODOLOGY

2.1. Data

The data required in accordance with the kinds of variables studied are secondary data, obtained from data published by Bank Indonesia, the Central Bureau of Statistics, International Monetary Fund, the OECD, the Central Bank of Indonesia's trading partners and other credible sources both in publications as well as through on-line website. In accordance with the problems and objectives, the time period of data used starts from 2001Q1 to 2013Q4. Description of the variables are presented in Table 1.

2.2. Model

Engle and Granger (1987), Johansen (1991) and Phillips (1991) suggest that cointegration is a possible way to solve the problem of spurious regression with the existence of unit root variables. Engle and Granger (1987) state that the existence of cointegration between integrated variables (nonstationary) is prevalent to be investigated prior to parameter estimation or hypothesis testing. Long-term relationship that does not contain unit root, I(0), indicates that the basic theory supports it as suggested in Garratt et al. (2003).

The presence of cointegration or long-term relationship based on a theory will make analysis of short-term fluctuations and the shock impact to be more significant. This is because changes of short-term behavior can be compared with equilibrium (the long-term) as anchor. However, cointegration between variables is a very special phenomenon.

Garratt et al. (2003) suggests that the intertemporal optimization problem faced by households and firms (as in real business cycle or RBC models) allows a steady-state or long term relationship. Intertemporal optimization is an element in the NNS elements according to Goodfriend and King (1997), in addition to rational expectation, imperfect competition, and expensive price adjustment. In the principles of the new synthesis as the reference

Table 1: Variables in the model

Name of variable	Notation	Variable measurement
Output gap between domestic and world	$y-y^w$	Gap between real output of Indonesia and rest of the world
Relative price of domestic and world	$p-p^w$	Gap between price index of Indonesia and the world, proxied by consumer price index with base year 2002
Relative interest rate of domestic and world	$r-r^w$	(0.25 ln (1+r/100) for SBI/BI rate and 0.25ln (1+r^w/100) for 3-month LIBOR)
Real effective exchange rate	*reer*	Real index measured by weighted basket of currencies of the Indonesia partner countries
Current account	*ca*	Percentage of GDP of indonesia
Foreign direct investment	*fdi*	Percentage of GDP of indonesia
Portfolio investment	*pi*	Percentage of GDP of indonesia

GDP: Gross domestic product

of NNS and NCM, Woodford (2009) suggests the importance of using observed data, model establishment emphasizes on a model established on a theory rather than based solely on more general relationships. Woodford also emphasizes the unity between the inseparable micro and macro-economic aspects as a basis for testing the short-term and long-term effect by the change in the economy.

The idea of Arestis (2009) and Angeriz and Arestis (2007) representing NCM, develops macro-economic models for open economy. The relationship of variables in the model allows the relationship of output, price, interest rate, exchange rate, and current account cointegration. However, because cointegration is a very special symptom, all cointegrations assumed in Arestis's model do not necessarily occur.

The debate on the empirical result of the curve J effect (Chee-Wooi and Tze-Haw, 2008; Insukindro and Rahutami, 2007; Aziz, 2008; Ahmad and Yang, 2004; Baek et al., 2006; Ardalani and Bahmani-Oskooee, 2007 and Halicioglu, 2007) encourage the assumption that current account cointegration does not occur (not supported by theory).

Economic theory in the model is the basis of long-term relationship or cointegration. Basic micro theories allow the long-term relationship. Theory or basic micro about the consumption of time series selection and intratemporal between domestic goods and imported goods in Gali and Monachelli (2005) and Beidas-Strom and Poghosyan (2011) is the basis of long-term relationship in the output cointegration to the interest rate and exchange rate, as well as foreign direct investment (Moosa, 2002), through the transfer of technology to support production activities.

In Arestis et al. (2010), the maximization problem faced by suppliers who have the opportunity to change the price will generate the relationship between inflation with the output gap and inflation expectation. This relationship can be associated with long-term relationship between prices and the output gap. Meanwhile, household consumption on goods composite in which there are imported goods allows the exchange rate pass-through into domestic prices. This transmission underlies long-term relationship between the output gap and the exchange rate.

The rules of monetary policy modeling the nominal interest rate determined by inflation, output gap and real exchange rate (Taylor, 2001) on the study evaluation of Ball (1999), Svensson (2000) and Taylor (1999) and discussed by Obstfeld and Rogoff (1995). These are as the basis of the nominal interest rate cointegration to the output gap, inflation and exchange rates. Taylor's rule model of monetary policy is also followed by Gali and Monacelli (2005), Lubik and Schorfheide (2007), Arestis (2009a), and Beidas-Storm and Poghosyan (2011).

Cointegration of exchange rate based on the model of Arestis (2007) and Angeriz and Arestis (2007) as well as the mechanism of foreign exchange market in response to demand for foreign exchange is not only at the time of the entry of foreign direct investment, but also at the time of the reversal of risk to the stability of the exchange rate (Agarwal, 1997). The significance of cointegrations is negative with error correction coefficient between −1 and 0, indicating a correction toward equilibrium (long-term) by endogenous variables when there is exogenous shock effect each time period.

The research model is designed for the Indonesian economy characterized by a small open economy with free floating exchange rate and adopting inflation targeting, as well as emerging markets countries with dynamic economic growth and high investment. The model representing the characteristics consists of four main equations representing the four blocks, namely, (1) The equation output (representing IS curve), (2) the price equation (representing Phillips curve, (3) the policy interest rate equation (representing the rule of monetary policy), and (4) the exchange rate equation.

The four models are treated as cointegration equation in the structural model. In the short term, the model expansion is designed as a forward looking model. A forward looking model is a display of the New Keynesian framework and in the perspective of NCM based on dynamic optimization model with nominal rigidity and imperfect competition as central elements in the new synthesis of conveyed by Goodfriend and King (1997). As in NCM model in the version of Arestis (2007; 2009) models, in a long-term relationship, money is not included in the model and the money is neutral in the long term. In the short-term dynamics, money is treated as a residual in the model and does not have feedback in affecting other variables.

In the macroeconomic literature, the IS curve describing the relationship between the interest rate and output is required to understand how monetary policy and financial market affect the output. The changes in interest rate (r) affect the three components of aggregate expenditure; they are consumption (C), investment (I), and net exports (NX) (Hubbard et al., 2012. p. 309). In the development, the output does not only have the relationship with the interest rate (r) as in the IS curve, but other variable, namely the exchange rate (e) also affects net exports (NX). Output in the long term is a reflection of the strength of aggregate demand and supply. The changing technology is the decisive factor in the long-term output growth through the increase in productivity as in the neoclassical growth theory. Neoclassical model argues that economic development requires high capital investment. Long-term growth can only be achieved through the development of technology, capital accumulation and population growth. Foreign direct investment can encourage economic growth when the technology development has a consistent and permanent positive effect. According to Neoclassical theory, foreign investment is like domestic investment, it will increase domestic production through the development of technology and the spillover effect as well as capital accumulation. Investment factor supply and the development of technology will increase the potential output that determines the output gap occurred. As in Garratt et al. (1998), that technological development in a small open economy is determined by the level of world technological development.

In relation to the interest of the central bank in conducting monetary policy, the concept of output gap is more important than the output level because the output gap reflects economic fluctuation more

which becomes the focus of the central bank (Hubbard et al., 2012). The concept of output gap used in this model refers to Garratt et al. (1998) that is the output gap between domestic and world. The natural rate of output depends on the productivity and world output as in the model of Gali and Monacelli (2005). The output gap between domestic and world in this case is determined by the flow of foreign direct investment that has an impact on technology spillover and knowledge on domestic. The effect of foreign direct investment to output growth is widely studied, for example in the study of Borensztein et al. (1995; 1998), Balasubramanyam et al. (1996), Alfaro et al. (2003) and Ray (2012).

The key relationship between inflation and monetary policy models is represented by the inflation equation (Wickens, 2008). According to Keynesian model, inflation is determined from the Phillips curve. At first, Phillips curve expresses the relationship between inflation and unemployment. Phillips curve evolves to become the New Keynesian Phillips Curve (NKPC) where inflation is not dependent on unemployment. The modification of NKPC appeared is called as hybrid NKPC.

The equation system in the model built consists of the following equations:

$$y_t - y_t^w = \alpha_0 + \alpha_1(r_t - r_t^w) + \alpha_2 reer_t + \alpha_3 fdi_t r_t - r_t^w = {}_0 + {}_1(y_t - y_t^w) + {}_2(p_t - p_t^w) + {}_3\, reer_t + {}_4\, pi_t$$

$$\alpha_1 > 0;\ \alpha_2 > 0;\ \alpha_3 > 0 \quad (1)$$

$$p_t - p_t^w = \beta_0 + \beta_1(y_t - y_t^w) + \beta_2 reer_t$$

$$\beta_1 > 0;\ \beta_2 > 0 \quad (2)$$

$$r_t - r_t^w = {}_0 + {}_1(y_t - y_t^w) + {}_2(p_t - p_t^w) + {}_3\, reer_t + {}_4\, pi_t$$

$$\gamma_1 < 0;\ \gamma_2 < 0;\ \gamma_3 < 0;\ \gamma_4 < 0 \quad (3)$$

$$reer_t = {}_0 + {}_1(r_t - r_t^w) + {}_2\, ca_t + {}_3\, fdi_t \begin{pmatrix} (y - y^w)_t \\ (p - p^w)_t \\ (r - r^w)_t \\ reer_t \\ ca_t \\ fdi_t \\ pi_t \end{pmatrix}$$

$$\lambda_1 > 0;\ \lambda_2 > 0;\ \lambda_3 > 0 \quad (4)$$

$$ca_t = {}_0 + {}_1(y_t - y_t^w) + {}_2\, reer_t + {}_3\, fdi_t$$

$$\chi_1 > 0;\ \chi_2 > 0;\ \chi_3 > 0 \quad (5)$$

$$fdi_t = {}_0 + {}_1(y_t - y_t^w) + {}_2(p_t - p_t^w) + {}_3(r_t - r_t^w) + {}_4\, reer_t$$

$$\delta_1 < 0;\ \delta_2 < 0;\ \delta_3 < 0;\ \delta_4 < 0 \quad (6)$$

$$pi_t = {}_0 + {}_1(y_t - y_t^w) + {}_2(p_t - p_t^w) + {}_3(r_t - r_t^w) + {}_4\, reer_t$$

$$\varphi_1 < 0;\ \varphi_2 < 0;\ \varphi_3 < 0;\ \varphi_4 < 0 \quad (7)$$

$y_t - y_t^w$ is the output gap between domestic and world, $r_t - r_t^w$ is the relative interest rate of domestic and world, $reer_t$ is real effective exchange rate, fdi_t is foreign direct investment, $p_t - p_t^w$ is relative price of domestic and world, ca_t is the current account, and pi_t is portfolio investment.

In addition to the four main equations in a model system, there are three other endogenous variables; they are the current account, foreign direct investment and portfolio investment. The three variables represent a long term relationship of external variables reflecting domestic and global economic linkages.

Garratt et al. (2003) suggests the need for an econometric approach in analyzing the macroeconomic model in which the variables are interacting each other with a variety of possibilities through the possible logic theory. SCVAR model is able to explain the short term dynamics as in the VAR, in addition to the establishment of long term relationship based on economic theory. The relationship between variables is possible in the short-term as in the relationship between variables in the long term according to the theory. Logic theory explaining the relationship between long term variables based on micro model and macroeconomic theories as in theory or literature can be used to describe the relationship between variables in the short term.

Analysis of the short-term dynamic response to the economic shock can be carried out when there is a relationship between variables in the long-term based on the theory through the restriction imposed (Garratt et al., 2003). The importance of shock as discussed in Bernanke et al. (1997) is for a better understanding of the role of the US monetary policy after the post-war business cycles. The understanding of the role of monetary policy leads to an understanding of the implications of monetary policy on the economy stabilization effect in the short term. In the perspective of macroeconomic NNS and NCM based on the new synthesis, it states that a shock can affect demand and supply, as well as the importance of the role of monetary policy on the short term economic stabilization. Garratt et al. (2003) also suggests that the strength of intertemporal optimization approach lies in the identification of macroeconomic disruption as a shock in the process of emergence of tastes and technology. RBC theory states real shock as the measurement of most fluctuations in the business cycle. RBC theory sees fluctuations in the business cycle as an efficient response to exogenous changes in the situation of the real economy.

3. RESULTS AND DISCUSSION

3.1. Unit Root and Cointegration Test

Unit root test indicates that all variables have the same degree of integration on I (1). The test is carried out by augmented Dickey-Fuller statistical test following Garratt et al. (2003) and Jacobs et al. (2003). The unit root test results are presented in Table 2.

From the cointegration test using the result of trace statistic test[1] in Table 3, it can be concluded that there are four cointegrations. There are four cointegrations representing the output equation, the price equation, the interest rate equation and the exchange rate equation.

$$\beta = \begin{pmatrix} 1 & 0 & 14.889 & -0.145 & 0 & 0.094 & 0 \\ 0.0194 & 1 & 0 & -1.805 & 0 & 0 & 0 \\ 0.029 & 0.043 & 1 & -0.014 & 0 & 0 & 0.009 \\ 0 & 0 & 11.794 & 1 & -0.029 & -0.111 & 0 \end{pmatrix}$$

$$\begin{pmatrix} (y - y^w)_t \\ (p - p^w)_t \\ (r - r^w)_t \\ reer_t \\ ca_t \\ fdi_t \\ pi_t \end{pmatrix}$$

The four cointegrations do not contain unit root, I(0), indicating that the basic theory supports it as suggested in Garratt et al. (2003). The presence of cointegration or long-term relationship based on a theory will make the analysis of short-term fluctuations and the impact of a shock to be more significant. This is because changes of short-term behavior can be compared with equilibrium (the long-term) as anchor. The four cointegrations that do not contain unit root is the precondition of the implementation of the model containing cointegration in SCVAR model.

Cointegration of output gap indicates the presence of a long-term relationship between the output gap and the interest rate, exchange rate, and foreign direct investment. Cointegration of price indicates the presence of a long-term relationship between price and the output gap and the exchange rate. Among the variables developed in Phillips Curve for the open economy allow the occurrence of cointegration in this research. Cointegration of interest rate indicates the presence of a long-term relationship between the interest rate and the output gap, the price level, exchange rate and portfolio investment. According to Taylor rules, the variables in the development of monetary policy rules, except for portfolio investment, are cointegrated or establish a long-term relationship. Meanwhile, the cointegration of portfolio investment in this research indicates the relationship between the financial market and domestic and world relative interest rate.

Cointegration of exchange rate indicates the presence of a long-term relationship between the real effective exchange rate and interest rate, the current account and foreign direct investment. The long-term relationships indicate that the exchange rate is connected to the output gap, the price, the interest rate on the one hand and cointegrated with the interest rate, the current account and foreign direct investment on the other. The exchange rate has a key relationship with macroeconomic variables in Indonesia.

Cointegrations of output, price, interest rate and exchange rate are significant in the model with a coefficient between −1 and 0 in each equation. Cointegration of output has significant effect on the output gap equation with a coefficient of −0.676. Cointegration of price has a significant effect on the output gap with a coefficient of −0.813. Cointegration of interest rate has a significant effect on the output gap with a coefficient of −0.995. Cointegration of exchange rate has a significant effect on the output gap and the exchange rate with a coefficient of −0.306 and −0.596, respectively. The output gap adjusts back to its equilibrium, or the equilibrium of interest rate and the equilibrium of exchange rate. Exchange rate variable adjusts back to the equilibrium of price and its equilibrium. Meanwhile, behavioral variables, such as the current account, foreign direct investment and portfolio investment will likely not reach the equilibrium and the implications will be difficult to predict when there is an external shock compared to the relatively manageable variables that are the level of output, price, interest rate and exchange rate.

Table 2: Unit root test

Variable	ADF test			
	With intercept		With intercept and trend	
	t-statistics	P	t-statistics	P
$y-y^w$	−0.603	0.861	−1.613	0.773
$\Delta(y-y^w)$	−2.907	0.052		
$p-p^w$	−2.049	0.266	−1.736	0.721
$\Delta(p-p^w)$	−7.005	0.000		
$r-r^w$	−2.558	0.109	−2.625	0.271
$\Delta(r-r^w)$	−4.254	0.002		
reer	−2.578	0.104	−2.264	0.445
Δ*reer*	−7.637	0.000		
ca	−2.231	0.198	−2.611	0.278
Δ*ca*	−9.547	0.000		
fdi	−2.096	0.247	−2.546	0.306
Δ*fdi*	−9.892	0.000		
pi	−2.600	0.101	−2.682	0.248
Δ*pi*	−8.415	0.000		

Testing with maximum 10 lags. Probability based on one-tail P value of MacKinnon (1996), All variables are stationary at first differences, I(1) with α=5% except $\Delta(y-y^w)$ with α=10%. ADF: Augmented Dickey-Fuller

Table 3: The result of cointegration test

H_0	H_1	Trace statistic	Critical value 0.05	P
$r=0$	$r=1$	182.326*	125.615	0.000
$r<1$	$r=2$	128.866*	95.754	0.000
$r<2$	$r=3$	84.968*	69.819	0.002
$r<3$	$r=4$	54.438*	47.856	0.011
$r<4$	$r=5$	29.537	29.797	0.054
$r<5$	$r=6$	13.178	15.495	0.108
$r<6$	$r=7$	0.901	3.841	0.343

*Significant at the critical value of 0.05, indicating 4 cointegration equations, Source: Bank Indonesia, Central Statistic Agency, International Monetary Fund, and Bank for international Settlements, processed

3.2. Result of SCVAR Model Estimation

The result indicates that the macroeconomic variables individually can be affected by the equilibrium (long-term) of the other variables in addition to the variable itself. The results of SCVAR model estimation are presented in Table 4. This result differs from Rahutami (2007), Sugeng (2012) and Suhartoko (2013) who found the effect of equilibrium (long term) on the variables themselves.

In the short-term, inflation (relative to the domestic and world) and the current account changes have significant effect on the growth of

1 Using JohansenCointegration test

Table 4: Summary of result of SCVAR model

Variable	Sign of the significant estimated parameters of endogenous variables in the model
$\hat{\varepsilon}_{1t-1}$	$\Delta(y-y^w)$ (−)
$\hat{\varepsilon}_{2t-1}$	$\Delta reer$ (−)
$\hat{\varepsilon}_{3t-1}$	$\Delta(y-y^w)$ (−)
$\hat{\varepsilon}_{4t-1}$	$\Delta(y-y^w)$ (−) $\Delta reer$ (−)
$\Delta(y-y^w)_{t-1}$	$\Delta(y-y^w)$ (−) Δca (−) Δpi (+)
$\Delta(p-p^w)_{t-1}$	$\Delta(y-y^w)$ (+) Δfdi (+)
$\Delta(r-r^w)_{t-1}$	$\Delta(r-r^w)$ (+) $\Delta reer$ (−) Δfdi (−)
$\Delta reer_{t-1}$	$\Delta(p-p^w)$ (+) Δfdi (+)
Δca_{t-1}	$\Delta(y-y^w)$ (−) $\Delta(p-p^w)$ (−)
Δfdi_{t-1}	$\Delta(p-p^w)$ (−) $\Delta reer$ (−) Δpi (−)
Δpi_{t-1}	Δfdi (−)
Average R^2	0.546
Average $\bar{R}^2$	0.394

SCVAR: Structural cointegrating vector autoregression

the domestic and world output gap. Inflation has a positive effect, while the current account has a negative effect on the growth of the output gap. If domestic inflation is higher than the world inflation, it will increase the output gap, while the improvement of current account will reduce the output gap. Relatively high inflation will reduce the growth of domestic output due to weak demand caused by high inflation.

The characteristics of economic growth in Indonesia indicate that demand factor plays a major role in the short-term output fluctuations. The magnitude and trend of the current account deficit in Indonesia also contributes significantly to slow down the growth of output. This means that the current account contributes significantly to the growth of the domestic economy. Openness and globalization will provide unfavorable effect for Indonesia when there is an imbalance in the current account.

In the short term, the exchange rate, current account and foreign direct investment have significant and positive on the relative inflation. The exchange rate has a positive effect, while the current account and foreign direct investment have negative effect on inflation. The increase in the real exchange rate means that the price of domestic goods and services are relatively expensive against the price of foreign goods and services. If the exchange rate increases, this condition is associated with the high domestic prices in the short term. This condition causes the current account to go down or increasing the deficit. At the level of equilibrium of real exchange rate, the occurred current account deficit is associated with the entry of net capital. Such a situation is consistent with the economic theory of open economy and the fact occurred in Indonesia. There is no other variable, except the interest rate which affects positively the relative domestic and world interest rate changes in the short term. In the short term, the changes in interest rate and foreign direct investment have negative effect on the exchange rate changes.

The effect of endogenous variables in the short term takes place with a lag of one period. Lag variables have an effect in the possible model due to psychological, technological, and institutional factors as suggested in Gujarati and Porter (2009). Given that the macroeconomic model is based on the microeconomic aspects, then these factors possibly affect on the behavior of individual agents as a representation of economic behavior. The involvement of the lag time is also in accordance with the inflation targeting framework in Indonesia which is looking forward in accordance with the policy impact on inflation that requires time lag.

3.3. Impact of Shocks

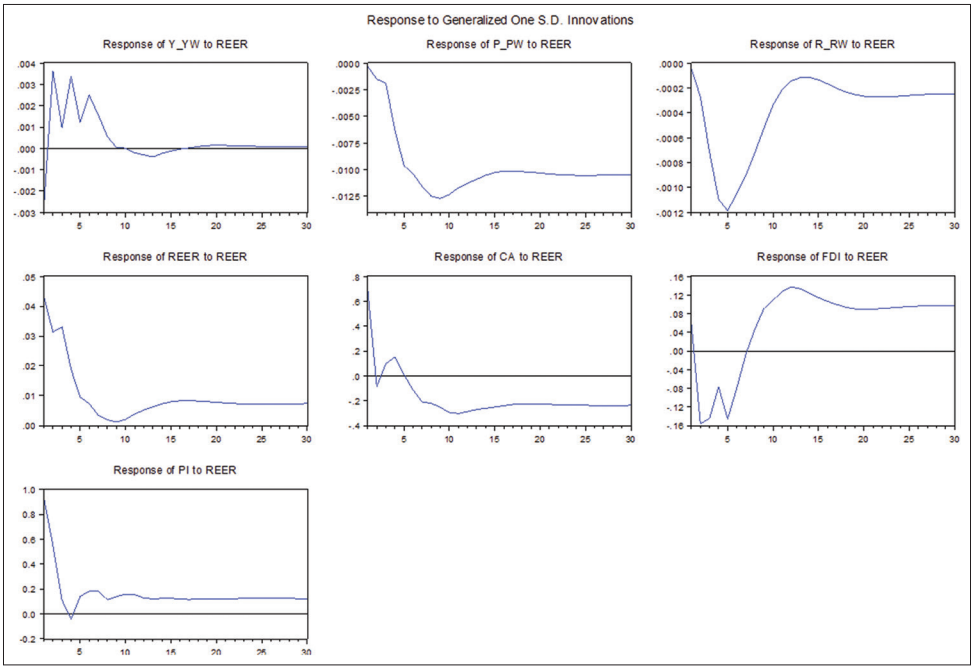
The impact of the shock to the output gap is the rising prices (inflation), rising interest rate, but provides a positive impact on the current account. The positive impact on the current account is derived from the increasing demand on domestic by world as a representation of the relative improvement in the world economy toward domestic. The positive impact of the exchange rate may occur along with a positive impact on the current account. In contrast, the output gap shock has a negative and steady impact on foreign direct investment and portfolio investment. The output gap shock will reduce foreign direct investment and portfolio investment.

Price shock has a positive and steady impact on the output gap, price itself, interest rate, exchange rate and the current account balance, while it has a negative and steady impact on foreign direct investment and portfolio investment. Interest rate shock has a negative and steady impact on the output gap. Interest rate shock has a negative impact on foreign direct investment and portfolio investment.

Exchange rate shock has an impact on the increase of output gap as shown in Figure 1. When there is an impact, then the increase in the domestic currency causes a decline in exports so that domestic output is down and the output gap increases. The exchange rate shock has a negative impact (decrease) from the beginning and steady on the price and interest rate. The increase in unexpected exchange rate encourages the price level and the interest rate falls. The exchange rate shock increases the value of the exchange rate itself. The increase in unexpected exchange rate encourages the rise in the further exchange rate.

Current account shock has an impact to an increase of the output gap and interest rate steadily. The current account shock has an impact to increase the price, but it is not steady. The exchange rate responds positively on the current account shock. Meanwhile, foreign direct investment responds negatively on the current account shock steadily.

Figure 1: Response of the variables in the model to exchange rate shocks



Foreign direct investment shock has an impact on an increase in the output gap steadily as shown in Figure 2. Foreign direct investment shock will lead to the transfer and abundance of technology from developed countries to developing countries to be disrupted so that it will reduce domestic output steadily and the output gap increases.

Portfolio investment shock has an impact to the decrease in the output gap, prices, interest rates, and the current account as shown in Figure 3. Conversely, portfolio investment shock has an impact to the increase in the exchange rate and foreign direct investment steadily.

In general, the contribution of shock itself on endogenous variable variation individually is the greatest. The dominance of the interest rate shock occurs in affecting the interest rate variation in a time horizon of 30 quarters. Meanwhile, the variations of foreign direct investment and portfolio investment variable are not overly dominated by the shock itself. The average interest rate shock dominates the effect on changes in foreign direct investment and portfolio investment.

The steady final impact as in Table 5 is the permanent or constant impact on individual variables. The majority of macroeconomic variables shocks have a negative impact on individual variables. The output gap has a negative impact (rise) by its own shock, price shock, exchange rate shock, current account shock, foreign direct investment shock, if there is unanticipated increase of the shock variables. Exchange rate variable has a positive response to all the unanticipated increase in the variables, except the interest rate shock. Foreign direct investment rises to respond on the unanticipated decline in the output gap, the price, and the interest rate. Conversely, foreign direct investment rises by responding to unanticipated rise in the exchange rate, current account, foreign direct investment and portfolio investment. Foreign direct investment negatively responds to the unanticipated rise in the output gap, the price and the interest rate. Portfolio investment negatively responds to the unanticipated rise in the output gap, the price, the interest rate and the current account. The results of the shock impact indicate that the variables of exchange rate, foreign direct investment and portfolio investment are responsive to the unanticipated changes. This means that these three variables are relatively unstable when there is an unexpected change. Conversely, the shock of these three variables will decrease the interest rate. The price gap and price expectation variable in the model have an effect on the magnitude and pattern of response without changing the direction of the response from positive to negative or vice versa.

The study of Aizenman et al. (2008) indicates that the central banks in 16 inflation emerging targeting countries do not follow the pure inflation targeting strategy, but respond systematically to the real exchange rate shock. The degree of dependence on export goods will reinforce this finding. In accordance with the study result of Aizenman et al., the study confirms that the exchange rate shock is the key in affecting the domestic economy. Exchange rate shock can cause high effect on domestic inflation in the case of depreciation, the problem on the export competitiveness in the case of appreciation, and the trade flow in the case of excessive exchange rate volatility (Jefferis, 2012).

4. CONCLUSION AND IMPLICATIONS

In the economic and financial globalization, the exchange rate plays a key role in Indonesia which embraces open economy. Multi long-term relationship through the exchange rate is proven in Indonesia's macroeconomic model. The more dynamic mobility of foreign capital proves the significance of foreign direct investment and portfolio investment in the long-term relationship on other main macroeconomic variables, such as output level, interest

Figure 2: Response of the variables in the model to foreign direct investment shocks

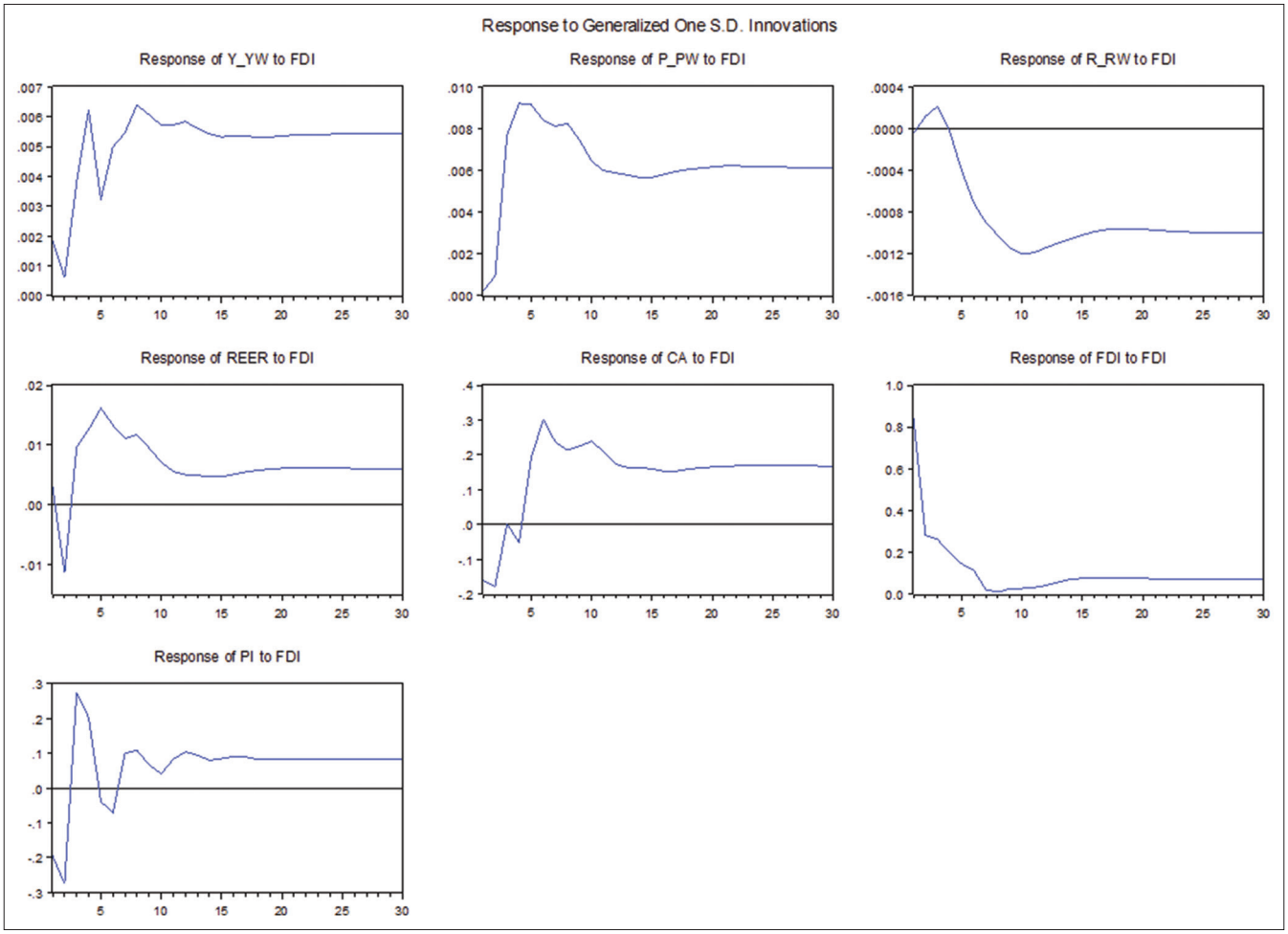


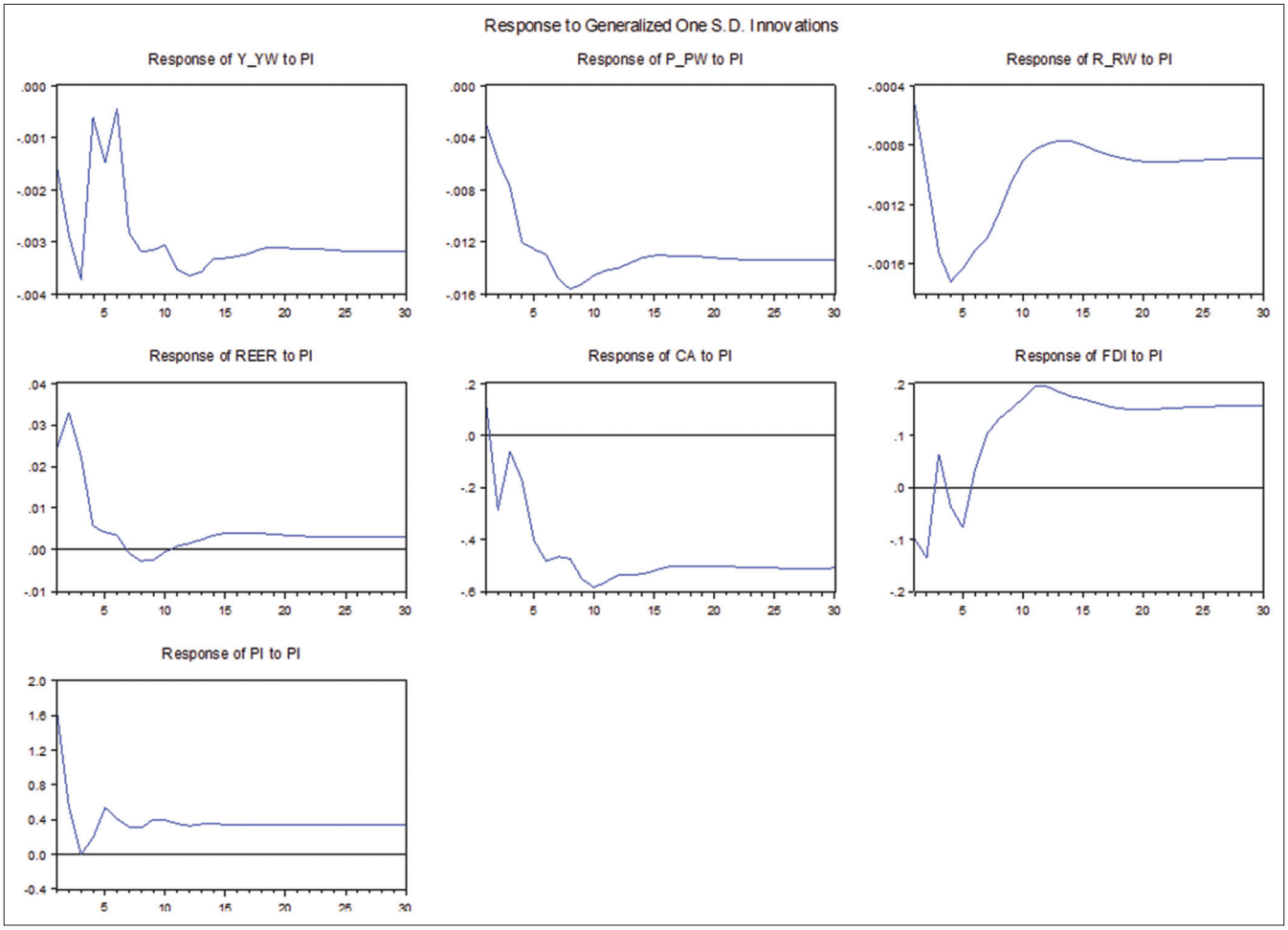
Table 5: Summary of analysis of shock impact through impulse response function

Shock	Final impact as the steady impact						
	Output gap	Price	Interest rate	Exchange rate	Current account	Foreign direct investment	Portfolio investment
Output gap	+	+	+	+	+	–	–
Price	+	+	+	+	+	–	–
Interest rate	–	+	+	–	+	–	–
Exchange rate	+	–	–	+	–	+	+
Current account	+	–	+	+	+	+	–
Foreign direct investment	+	+	–	+	+	+	+
Portfolio investment	–	–	–	+	–	+	+

rate, inflation and the current account. In the context of inflation targeting policy, the role of the exchange rate is the key in the design of monetary policy for an open economy, such as Indonesia that is more appropriate to apply the rules of the policy rather than by discretion. The shocks of exchange rate, foreign direct investment and portfolio investment play a major role in affecting the interest rate changes. Unanticipated rises in the exchange rate, foreign direct investment and portfolio investment are responded by the decline in domestic and foreign relative interest rates.

Because there is the linkage implication between financial market and domestic and world relative interest rate, then the policy of interest rate determination needs to be directed not only on price stability, but also on the stability of financial market by taking into account the global financial conditions. Monetary policy in the determination of the interest rate is not only based on macroeconomic factors, such as inflation, exchange rate and economic growth, but also takes into consideration to the condition of the financial market as part of the macroprudential policy. Short-term capital inflows need to be part considered in performing the policy of interest rate determination. The response of interest rate policy will be different between when high capital inflows and low capital inflows or even negative. The consistency of attention to the stabilization of the exchange rate will support the efforts to stabilize the financial systems, including financial market, in addition to supporting the price stabilization.

Figure 3: Response of the variables in the model to portfolio investment shocks



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