

The Impact of Oil Price to Indonesian Macroeconomics Indicators: Pre and Post Asian Crisis

Ahmad LUTHFI

Graduate Student

Graduate School for International Development and Cooperation, Hiroshima University,
1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan

Chathuri SENEVIRATHNE

Graduate Student

Graduate School for International Development and Cooperation, Hiroshima University,
1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan

Shinji KANEKO

Professor

Graduate School for International Development and Cooperation, Hiroshima University,
1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan
e-mail: kshinji@hiroshima-u.ac.jp

Abstract

This study is aimed to investigate the impact of oil price in several measures (Linear, Volatility and Non Linear) to Indonesian macroeconomic variables, pre and post the Asian financial crisis and examine the role of fuel subsidy to cushion the harmful effects. Vector Autoregression (VAR) model was employed to analyzed the impact and it shown that the impact in macroeconomics variables in post crisis was worse than pre crisis. Moreover, the result also revealed that fuel subsidy could be one of factors mitigating the harmful effects in pre-crisis. However, the role seems did not exist in post-crisis even the government provided nine-folds fuel subsidy than pre-crisis. The policy implication of this research is that the government should reform fuel subsidy policy to be a sustainable policy which considering economy, social and also environmental effect.

Keywords: Oil Price; Macroeconomics; Vector Autoregression; Sustainability

1. Introduction

Oil is not only economic commodity but also political commodity; fluctuations of its price could not simply be explained by supply and demand factors. For instance, The Economist put its headline as “Sheikhs vs Shale”, a drastic drop oil price phenomenon in the end of 2014 and early 2015 (“Sheikhs v shale,” 2014). The OPEC (Sheikhs) kept the oil production in regular volume even the world was flooded by oil from shale oil technology. By keeping the volume, they intended to pull down the oil price thus it will halt shale oil production due to its expensive production cost. Regardless of the OPEC aims to keep the price stable, the OPEC acted contrary on increasing oil supply due to the shale oil. This action successfully cancelled at least 150 billion of higher-cost-oil investment in 2015 and more cuts to come next year which could have an effect on oil supply in the future (“Abnormally Normal,” 2015).

From the economic literature, there are several mechanisms explaining how the oil price impedes the economy. In the supply side shock, the role of oil price is as an input factor to the production. The declining in oil supply will hamper the productivity and turns to lessen real wage growth. If wages sticky downward, the economy will decline and lead to rise unemployment and generate further reduction in the economy. In demand side, rising in oil price will shift purchasing power from oil-importing-countries to oil-exporting-countries. This phenomenon will boost the consumer demand in oil exporting countries and vice versa in oil-importing-countries. However, as a net, the effect is declining in consumer demand and it leads to increasing in world saving. More

saving tends to make interest rate lower and push investment higher and lead to unchanged GDP. However, the impact of fall in consumption will lead to declining of GDP (Brown & Yücel, 2002).

Moreover, the oil price effect is not only by increasing and decreasing effect, but also volatility effect, particularly in oil importing country. The uncertainty in oil price as vital production factor makes investors tend to delay their new investment until the price more stable (Bernanke, 1983). In addition, companies tend to hold recruiting new employees until the condition relatively constant (Hamilton, 1988).

From abundant researches, it is widely accepted that the oil price has negative impact to macroeconomic indicators. However, since the governments attempt to mitigate the harmful impacts by its fiscal and monetary policy, forecasting the precise impact become more difficult. In addition, some empirical studies argued that providing fuel subsidy was effective to mitigate the negative impacts. Reference (Jbir & Zouari-Ghorbel, 2009a) found that the harmful impact of oil price in Tunisian economy was transmitted to fuel subsidy (which was proxy by budget deficit). Furthermore, fuel subsidy in Thailand also found lessening the adverse effect of oil price volatility to the economy (Rafiq, Salim, & Bloch, 2009). Nevertheless, different conclusion found by (Plante, 2014) that for both oil-exporting-countries and oil-importing-countries; instead of mitigating the adverse impact, the fuel subsidy could hamper the aggregate welfare in the long run. Thus, the role of fuel subsidy in alleviating the harmful impact of oil price still ambiguous.

Since the conclusion of fuel subsidy role still questionable, this study attempted to address this issue. In order to do so, this research chose Indonesia to be the case study. Indonesia serves as proper case due to some reasons. First, it represents a country which provided with quite huge amount of subsidy (Mourougane, 2010). Second, Indonesia had changed its fuel subsidy policy after Asian crisis, so it is possible to test the different policies in one country. Finally, Indonesia was a unique case which change its status from a net-oil-exporting-country to a net oil-importing-country (BP - British Petroleum, 2013; IEA, 2015).

There are already several researches about the impact of oil price to Indonesia's economy. Reference (Abeyasinghe, 2001) investigated the impact of oil price to several Asian countries including Indonesia. For oil exporting countries such as Malaysia and Indonesia, the first impact was positive to the economy but secondary impact from trading with partner countries was negative and outnumber previous impact. Thus, the net impact was negative. The second literature by (Mehrra & Oskoui, 2007) examined the impact of oil price to four notable oil-exporting-countries; Saudi Arabiya, Iran, Indonesia and Qatar. The impacts were different among the countries; for the countries which have invested their income to oil saving institution (Qatar) and imposed prudent monetary and fiscal policy (Indonesia), the fluctuation in oil price did not have any significant effect on their GDP. The result was contrast to the other two countries.

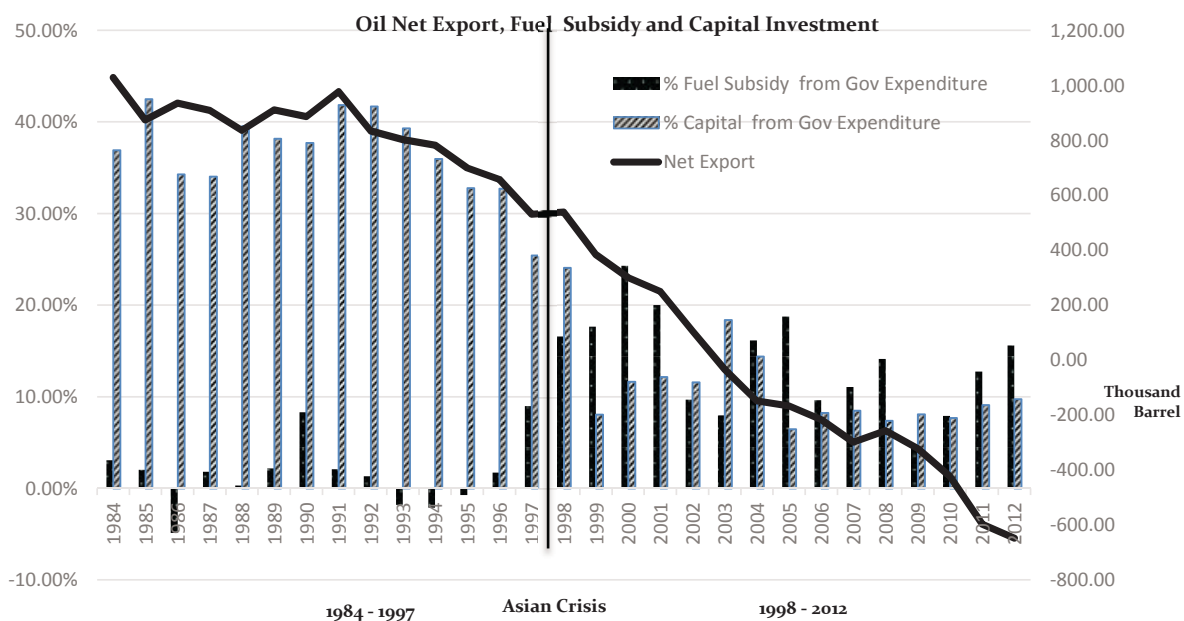


Figure 1. Oil Net Export, Fuel Subsidy and Capital Investment 1984 – 2012

Source: (Bank Indonesia, 2013), (BP British Petroleum, 2013)

However, in addition to that those studies have not considered fuel subsidy policy as tools from government to cushion the harmful effects, their studies also did not take into consideration the structural change from government policy after crisis. In 1984 Q₁ – 2012 Q₄, Indonesia experienced The Asian financial crisis. It began in summer 1997, hit Thailand by devaluating its currency. Furthermore it rapidly spread to other Asian and Latin countries in fall 1997 and arrived in Russia and Brazil around summer 1998. In the beginning of the crisis, Indonesia was predicted as the least affected country due to its quick and concerted action. Unfortunately, because of political problem and weaknesses before the crisis, it became worsen. The economic drastically drop from growing 5 % in 1996, decline to -4% in 1997 and the worst in 1998 by growing – 13.37% (Indonesian Statistical Body, 2013).

2. Indonesia's Fuel Subsidy Policy and Sustainability Development

Since the Asian financial crisis, Indonesia's economy has achieved consistently high growth rate for the last 15 years. As consequences, this economic success along with rising living standard, population growth and rapid urbanization demand more energy(IEA, 2015). Since oil discovery could not satisfy the need of energy, Indonesia became net-oil-importing-country since 2003 and predicted to be a-net-energy-importing-country in 2033 (Sugiono, 2014).

Considering the facts above, Indonesia should have sustainable strategy to cope with the challenges in the future. Sustainable define by the World Commission on Environment and Development as a “development which satisfy the need of the present without compromising the ability of future generation to satisfy their own necessities”(UN, 1987). In sustainable framework, one of the criticisms of Indonesian fuel subsidy policy is that it's inconsistent as sustainable strategy (Mourougane, 2010).

2.1 Indonesia's Fuel Subsidy Policy in Brief

Indonesia is one of “unlucky” countries which turned to be net importing country after more than a hundred years net exporting. The peak of oil production in Indonesia occurred in 1977 producing more than 1.638 million barrel per day which means the net (production – consumption) was around 1.4 million barrel per day. However, since 2003, Indonesia turned to be net-oil-importing and in 2012 41% of its domestic demand and the amount is increasing(BP - British Petroleum, 2013). In responding the facts, Government of Indonesia decided to withdraw from OPEC membership in 2009 after almost half century as one of prominent members (Pallone, 2009).

Before the Asian financial crisis, Indonesia was pointed as a good example on managing energy policy for energy exporting countries. Resource curse, a tendency to develop less in rich-resource-countries; did not happened in Indonesia. Indonesia had political condition that make the policy elite chose a rational economic policy; for instance, more openness on trading. Moreover, rich resource in Indonesia tended to bring more foreign direct investment, more access to technology and also to foreign market (Basri & Hill, 2004; Rosser, 2007). Indonesia's prudent monetary and fiscal policy in that period effectively cushioned the impact of oil price shock to macroeconomic variables. In addition, in monetary policy, the policy makers attempted to keep their currency stable. Furthermore, in the fiscal policy, government tended to avoid budget deficit by limiting energy subsidy and given more fund to infrastructure, education and human capital (Mehrra & Oskoui, 2007).

After the crisis, government changed its fiscal policy. In the figure above, we can see the drastic changing of amount of fuel subsidy and capital investment from period 1984- 1997 and 1998 -2012 and the natural condition of declining of oil production. The figure 1 shown that after crisis, the Government change the fuel subsidy policy by providing more fund to it. On average, the amount of subsidy between 1984–1997 was only 1.59% from national budget. After crisis, the amount rocketed to 13.80%, which almost ninth folds increase. Moreover, the portion of development expenditure shrank form 36.64% from government spending to only 11.03% (one third).Not only the policies, the natural condition also had changed. The average net-oil production drastically dropped from 832 thousand barrel/ day to minus 102 thousand barrel/day.

2.2 Fuel subsidy and Sustainable Development

According to OECD definition, subsidy means “a measure that keeps prices for consumers below market levels, or keeps prices for producers above market levels or that reduces costs for both producers and consumers by giving direct and indirect support”. In the Sustainable Development perspective, subsidy as a general term usually introduce economic, environmental and social with unintended consequences (OECD, 2006). The relation between fuel subsidy and environment and social aspect is not direct relation; it is sequential effects from economy aspect.

For fuel subsidy case, providing more fuel subsidy may lead several impacts in macro level. It could shrink fiscal space in macro level. Government could not afford sufficient fund to other expenditures which more important and have long term effect such as education, health and infrastructure. Another effect is coming from over-consumption of fuel. It could lead to more import

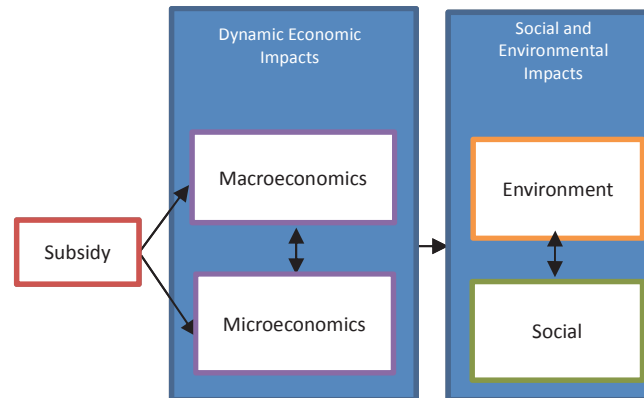


Figure 2. Fuel Subsidy and Sustainable Development
(Adapted from(OECD,2006))

fuel which deteriorate the balance of payment.

In micro level, it also impose some undesirable impacts. It could give false signal; consequently productive resources are not deployed toward their most efficient use. In addition, NOC as fuel subsidy provider cannot compete with other oil companies due to its easy life selling fuel subsidy. Finally, selling lower price of fuel could encourage corruption and smuggling because of price disparity with the neighbouring countries (OECD, 2006) (Mourougane, 2010).

For environment aspect, fuel subsidy can bring about more emission and waste. Since the prices of fuels are below it intended price, consumers tend to consume and emit more pollution. A study predicts that if Indonesia remove all the fuel subsidy in year 1998, it could reduce around 11 % of CO₂ emission or around 28 million kg CO₂ (IEA, 2000). Additionally, resources depletion also one of the environmental effect of fuel subsidy (Mourougane, 2010).

In social aspect, fuel subsidy can lead to an unfair income distribution. If the targeted consumers are not defined well, the richer person tend to obtain more subsidy than the poorer. For instance, study by (Agustina, Granado, Bulman, Fengler, & M. Ikhsan, 2008) found that in year 2007, around 90% of fuel subsidy in Indonesia goes to non-poor family.

As summary, providing fuel subsidy tends to lead to unsustainable development. However, (OECD, 2006) argued that not all subsidy will harm economic, environment and social aspects. The subsidy could be benefitted if it is designed by certain framework which considering the costs and the benefits along with the intended and unintended consequences for economic, social and environment aspects.

3. Data and Methodology

3.1 Data

The explanation of variables are as follow:

Oil Prices are consists of three variants, Linier, Volatility and Non Linier form.

Linear Oil Price (LIN)

We chose Minas as a proxy to crude oil in Indonesia. Minas is the largest oil field in Indonesia, has been producing since 1955 and was used as one of component of OPEC basket price. The data source is OPEC Statistics, a monthly data. To eliminate influence of the exchange rate, we transformed the Dollar price to Rupiah by the average monthly exchange rate published by (International Monetary Fund, 2013; *OPEC and Other regional price*, n.d.).

Realized Oil Volatility (VOL)

For measuring oil price volatility, we employed Realized Volatility following (Merton, 1980), (Andersen et al., 2003; Guo & Kliesen, 2005)) as follow:

Quarterly Realized Oil Volatility is RV, the sum squared monthly price changes in a quarter _q year _t:

$$RV_{qt} = \sum_{m=1}^{m=3} (RET_m)^2 \quad (1)$$

where RET_m is the changing of Minas Oil Price in month _m of quarter _q. This method is unbiased and highly efficient estimator to

measure the volatility rate. (Andersen et al., 2003) (Rafiq et al., 2009)

Net Oil Price Increase (NOPI) and Net Oil Price Decrease (NOPD)

Some scholars argued that measuring oil price using linear oil price is not accurate anymore. Thus, they suggested non linear measurements such as Net Oil Price Increase (NOPI) and Net Oil Price Decrease (NOPD). One of the scholars was Hamilton who argued that current oil prices should be compared with prices over a year and not the previous quarter. Therefore, the net oil price increase is defined as the percentage increase in the current price of oil over the price in the previous 4 quarters if it is positive, and zero otherwise. For measuring NOPI and NOPD we follow (Hamilton, 1996) and formulated as

$$NOPI_t = \text{Max} \left[0, \log(LIN_t) - \log(\text{Max}(LIN_{t-1}, LIN_{t-2}, \dots, LIN_{t-4})) \right] \quad (2)$$

$$NOPD_t = \text{Min} \left[0, \log(LIN_t) - \log(\text{Min}(LIN_{t-1}, LIN_{t-2}, \dots, LIN_{t-4})) \right] \quad (3)$$

Inflation Rate (IF), Real Interest Rate (IR) and GDP Growth

The data were derived from International Financial Statistics IMF, a quarterly data from Q₁ 1984 – Q₄ 2012.

Unemployment (UNP)

The data are derived from Indonesian Statistical Body, a yearly data from 1984 –2012. To make it quarterly basis, we converted by adopting interpolation method from (Lisman, J H C and Sandee, 1964).

Fuel Subsidy (SUB)

In other studies, the authors employed macroeconomic variables to reflect the subsidy policy. Reference (Rafiq et al., 2009) used budget deficit as a proxy of fuel subsidy for Thailand case and (Jbir & Zouari-Ghorbel, 2009a) in Tunisian case used government spending as the proxy. In Indonesian case, because the government paid the fuel subsidy in the end of the year, thus quarterly data did not represent the real situation. For example, the fuel subsidy in government budget for Q₁, Q₂ and Q₃ were usually zero and all subsidy from all quarters put together in Q₄.

One way to estimate subsidy policy is by using PSE method (IEA, 2000). It simply defines subsidy as the gap between the reference energy price and the local energy price. We followed this approach with some adjustments. Basically our approach distributed the yearly fuel subsidy amount to quarterly, based on the gap between reference price and the retail subsidized price in Indonesia. We assumed that the volume of the fuel does not changing in a year, which is still plausible. We can denote the formula as follow:

$$Sub_{qt} = \left(\frac{(FRP_{qt} - FSP_{qt})}{\sum_{q=1}^4 (FRP_{qt} - FSP_{qt})} \right) x Sub_t \quad (4)$$

- SUB_{qt} = Amount of Fuel¹ Subsidy in quarter _q year _t (Local currency)
 FRP_{qt} = Mean of Fuel¹ Reference Price in quarter _q year _t (Local currency)
 FSP_{qt} = Mean of Fuel¹ Subsidy Price in quarter _q year _t (Local currency)
 SUB_t = Total Fuel¹ Subsidy in year _t (Local currency)

3.2 Methodology

To examine the relationship between oil price and macroeconomic variables, we utilized VAR (Vector Autoregression). This method is pioneered by (Sims, 1980) and has become very popular among other methods in analyzing oil and economy relation. In mathematical formula, the equation can be written as:

$$Y_t = \alpha + \sum_{i=1}^n \Phi_i Y_{t-i} + \varepsilon_t \quad (5)$$

Where $Y_t = (Y_{1t}, Y_{2t}, \dots, Y_{nt})'$ is a $n \times 1$ vector of dependent variables, while Y_{t-i} is the corresponding lag terms of order i . Φ_i is the $n \times n$ matrix of autoregressive coefficient of vector Y_{t-i} for $i=1, 2, \dots, p$. $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_n)'$ is the $n \times 1$ intercept vector of the VAR model. $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{nt})'$ is the $n \times 1$ vector of White Noise Process. (Jbir & Zouari-Ghorbel, 2009b).

In matrix form, we can denote our case as:

$$\begin{bmatrix} Oil\ Price_t \\ GGDP_t \\ SUB_t \\ IF_t \\ IR_t \\ UNP_t \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \\ A_{30} \\ A_{40} \\ A_{50} \\ A_{60} \end{bmatrix} + \begin{bmatrix} A_{11} & A_{21} & A_{31} & A_{41} & A_{51} & A_{61} \\ A_{12} & A_{22} & A_{32} & A_{42} & A_{52} & A_{62} \\ A_{13} & A_{23} & A_{33} & A_{43} & A_{53} & A_{63} \\ A_{14} & A_{24} & A_{34} & A_{44} & A_{54} & A_{64} \\ A_{15} & A_{25} & A_{35} & A_{45} & A_{55} & A_{65} \\ A_{16} & A_{26} & A_{36} & A_{46} & A_{56} & A_{66} \end{bmatrix} \begin{bmatrix} Oil\ Price_{t-i} \\ GGDP_{t-i} \\ SUB_{t-i} \\ IF_{t-i} \\ IR_{t-i} \\ UNP_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \\ e_{6t} \end{bmatrix} \quad (6)$$

One problem associated with the use of the basic VAR is the identification of structural shocks. Markov-switching (MS) framework is one of tool for investigating an economic system with possible structural changes and asymmetric effects (Managi & Okimoto, 2013). In our case, we follow Bai & Perron (1998) to identify the structural break. We tested whether the subsidy policy variable (in real term) was changing in those time frames employed method from Bai & Perron (1998).

To investigate the possibility of changes in the variables, the parameters of the model are estimated separately for each subsample. Bai & Perron (1998) indicates that the OLS estimate of the break date is the date that minimizes the residual variance (sum of squared errors divided by sample size) as a function of the break date. Figure 3 plots the residual variance of amount of fuel subsidy.

This evidence suggests that one structural break is present in the full sample we can separate the data from Q₁ 1984 – Q₄ 1997 and Q₁ 1998 – Q₄ 2012.

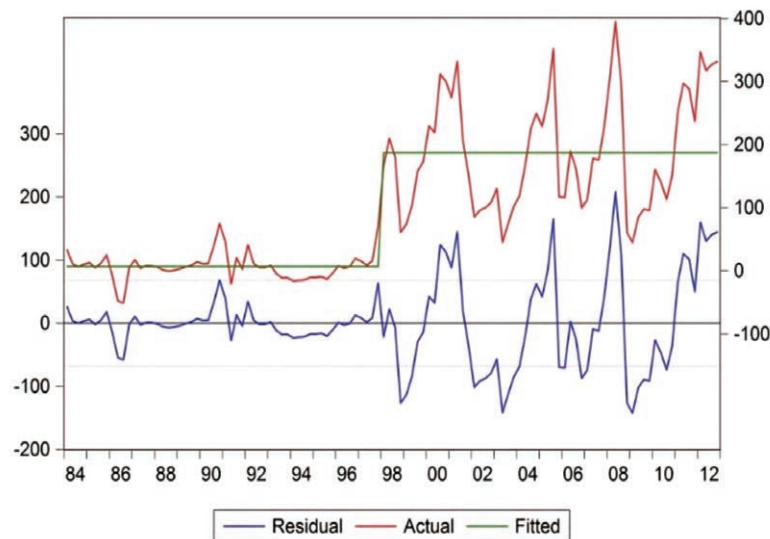


Figure 3. Bai Perron Test Result of Indonesian Fuel Subsidy Q₁ 1984 – Q₄ 2012.

4. Empirical Result

In this section we analysed the empirical result of the VAR model describe in previous section, including Granger causality test, impulse response function and variance decomposition.

4.1 Unit Root Test and Cointegration Test

Since the data are times series data, it is essential to make sure that the data are stationer. The Augmented Dickey Fuller (ADF) and Philips Perron were applied to test the data stationary. Table 1 below resumes the result of both two tests. These tests were based on the three following models: (i) without intercept, (ii) with an intercept and (iii) with an intercept and trend.

From the tests we can conclude that all variables were stationer except for Linear Oil Price, Subsidy and Unemployment. Those variables were integrated in order one (I(1)) and stationer in first difference as shown in Table 2. We differentiated and took natural log for Linear Oil Price and Unemployment. For Fuel Subsidy, we only differentiated due to some negative values.

We further examine whether there is a cointegrating relationship in our three I(1) variables, Linear Oil Price, Subsidy and Unemployment. Here, two conventional cointegration tests are performed: the Johansen's trace test of no cointegration against one

cointegrating vector and the maximum eigenvalue test of no cointegration against three cointegrating vectors. We use the lag length of three, which is selected via the Akaike information criterion (AIC) for both tests. Our results suggest that all three variables are without any cointegrating relationship. Therefore, we will use VAR models in the first differences in the following analysis. (see the result in the appendix A)

4.2 Granger Causality

The result of Granger Causality Tests were presented in the table 2 and 3. It can be seen that in period Q₁ 1984 – Q₄ 1997, Linear Oil Price Shock only Granger-Causes Fuel Subsidy. Moreover, the result shown that there was no significant impact from Oil Volatility, Net Oil Price Increase and Net Oil Price Decrease to Macroeconomic indicators in period 1984 Q₁ – 1997 Q₄. This result confirmed some studies (Basri & Hill, 2004; Mehrara & Oskoui, 2007; Rosser, 2007) that found Indonesian fuel policy in this

Table 1. Unit Root Test

Variables	Level			First Different		
	i	ii	iii	i	ii	iii
ADF						
LIN	-0.94	-3.09	0.21	-9.69***	-9.70***	-9.69***
VOL	-7.78***	-7.77***	-6.14***	-18.02***	-17.95***	-18.10***
GGDP	-3.57***	-3.56**	-2.22**	-24.63***	-24.51***	-24.74***
IR	-2.83*	-2.99	-1.90*	-11.10***	-11.05***	-11.15***
IF	-5.74***	-5.73***	-4.21***	-8.16***	-8.12***	-8.19***
UNP	-1.41	-0.62	0.10	-6.68***	-6.82***	-6.65***
SUB	-2.11	-4.44***	-1.21	-9.11***	-9.10***	-9.11***
NOPI	-8.31***	-8.30***	-7.25***	-11.62***	-11.58***	-11.68***
NODI	-8.11***	-8.15***	-7.47***	-9.38***	-9.34***	-9.42***
PP						
LIN	-0.83	-3.00	0.60	-9.74***	-10.72***	-9.35***
VOL	-7.86***	-7.85***	-6.54***	-44.66***	-45.87***	-44.93***
GGDP	-14.54***	-14.46***	-12.49***	-59.93***	-59.71***	-60.32***
IR	-3.07**	-3.25*	-1.92	-11.11***	-11.06***	-11.15***
IF	-11.15***	-5.45***	-4.21***	-19.51***	-19.44***	-19.64***
UNP	-1.42	-0.78	0.00	-3.06**	-3.07	-3.09***
SUB	-2.26	-3.86**	-1.10	-10.25***	-10.23***	-10.15***
NOPI	-8.05***	-8.04***	-7.23***	-60.00***	-66.15***	-60.41***
NODI	-7.80***	-7.87***	-7.51***	-65.98***	-68.16***	-66.51***

*, ** and *** denote significant at 10%, 5%, and 1 % respectively

Table 2. Granger Causality Test (1984 – 1997)

Null Hypothesis Ho	LINEAR	VOLATILITY	NON LINEAR INCREASE	NON LINEAR DECREASE
	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)
OIL does not Granger Cause				
GGDP	0.28 (0.60)	0.10 (0.75)	1.21 (0.27)	0.79 (0.38)
SUB	9.03*** (0.01)	0.07 (0.79)	0.45 (0.50)	1.14 (0.29)
IF	0.02 (0.88)	0.14 (0.71)	0.07 (0.80)	0.84 (0.36)
IR	0.16 (0.69)	0.03 (0.87)	0.24 (0.63)	1.34 (0.25)
UNP	1.03 (0.31)	0.08 (0.78)	0.75 (0.39)	0.32 (0.57)

*, ** and *** denote significant at 10%, 5%, and 1 % respectively

Table 3. Granger Causality Test (1998 – 2012)

Null Hypothesis Ho	LINEAR	VOLATILITY	NON LINEAR INCREASE	NON LINEAR DECREASE
	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)	χ^2 -Statistic (p-value)
OIL does not Granger Cause				
GGDP	7.38*** (0.01)	10.66*** (0.01)	14.20*** (0.01)	0.91 (0.34)
SUB	1.54 (0.21)	0.48 (0.49)	1.19 (0.28)	0.38 (0.54)
IF	0.52 (0.47)	3.55* (0.06)	13.49*** (0.01)	0.11 (0.74)
IR	1.29 (0.26)	3.90** (0.05)	2.75* (0.10)	0.07 (0.79)
UNP	0.51 (0.48)	0.02 (0.87)	2.38 (0.12)	0.67 (0.41)

*, ** and *** denote significant at 10%, 5%, and 1 % respectively

period was effective in cushioning the harmful effect. As a result, Indonesia was one of exporting countries that did not suffer from resource curse (Rosser, 2007), secure from oil shock and successfully diverted the income source to others than oil (Basri & Hill, 2004), and relatively did not exposed by negative effect of changing in oil price (Mehrara & Oskoui, 2007). Furthermore this test revealed that fuel subsidy policy in this period was efficient, even only 1-2% from national budget, but effective in limiting the negative impact of oil shock.

The result in the second period was different. In the second period, Q_1 1998 – Q_4 2012, all Oil Price Change variables (Linear, Volatility and Non Linear) were Granger- cause Macroeconomic indicators except Net Oil Price Decrease. The Impact of Linear Oil Price Shock was significant for GDP Growth, and for Oil Price Volatility and Net Oil Price Increase, the impact were significant to GDP Growth, Inflation Rate and Real Interest Rate.

4.3 Impulse Response Function

Figures 4 – 8 contained the impulse response functions for the responses of the macroeconomic variables to different oil price change variables. Each figure traced the effect of a one-time shock to the measures of oil shocks on the current and future values of each of the macroeconomic variables. In period 1984 Q_1 – 1997 Q_4 , only Linear Oil Price imposed significant effect, thus we will explain more on that variable. For period 1998 Q_1 – 2012 Q_4 , we described Impulse Response Function of all variables. Figure 4 contained impulse response of macroeconomics variables to Linear Oil Price Shock between 1984 Q_1 -1997 Q_4 , and Figures 5 - 8 depict impulse response to linear, volatility and non linear oil price shocks between 1998 Q_1 – 2012 Q_4 .

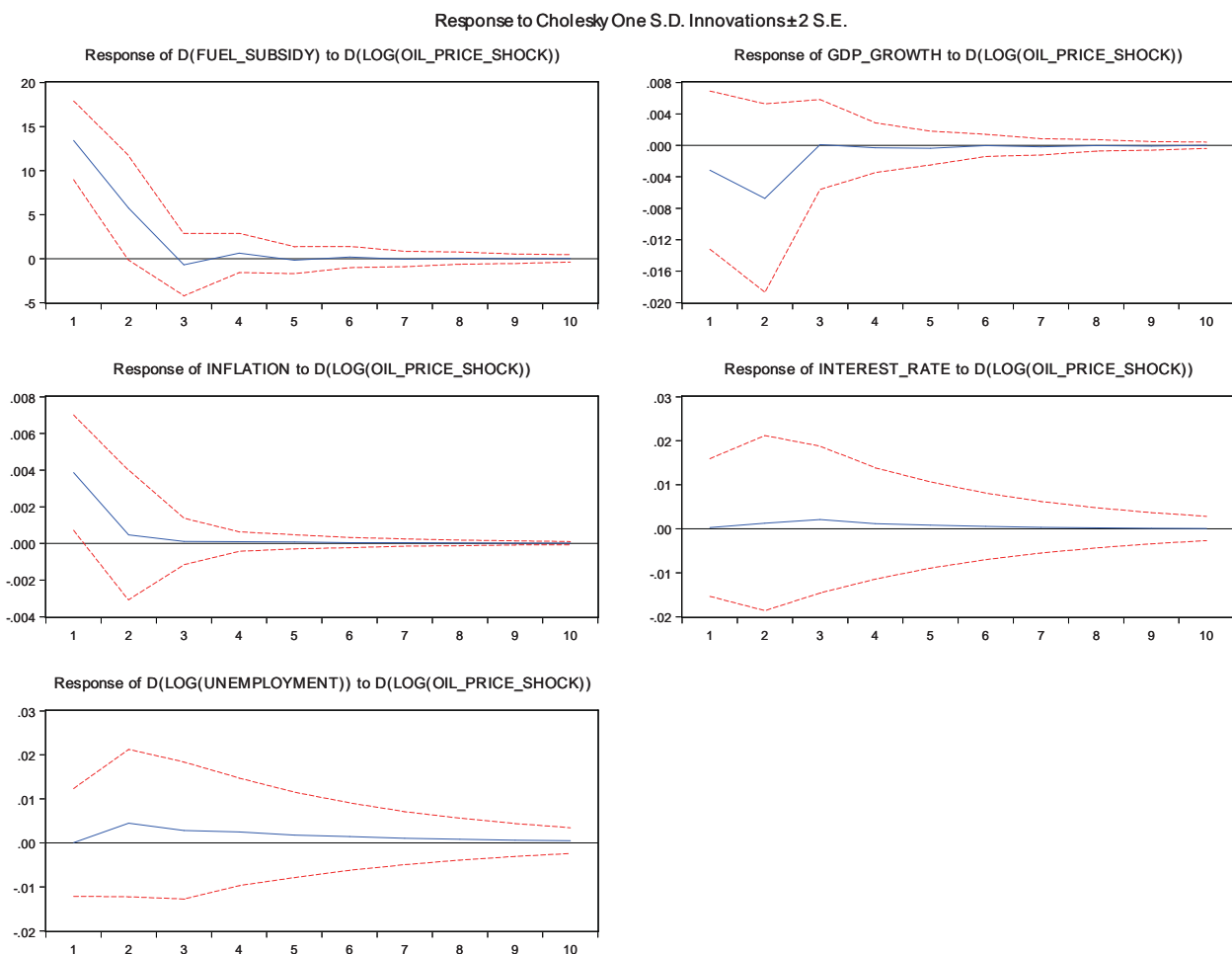


Figure 4. Impulse Response Function of Linear Oil Price 1984 Q_1 – 1997 Q_4

Figure 4 comprised the response of the macroeconomic variables to a shock in the linear oil price between 1984 Q_1 -1997 Q_4 . The respond of fuel subsidy and inflation in the linear oil price shock first were positive response, which lasted for different quarter; the two quarters for inflation and three quarters for fuel subsidy. For GDP Growth, the response was negative until the third quarter, thus indicating that linear oil price shocks had negative effect on output, even though the magnitude was relatively

small. For interest rate and unemployment, the response were almost zero.

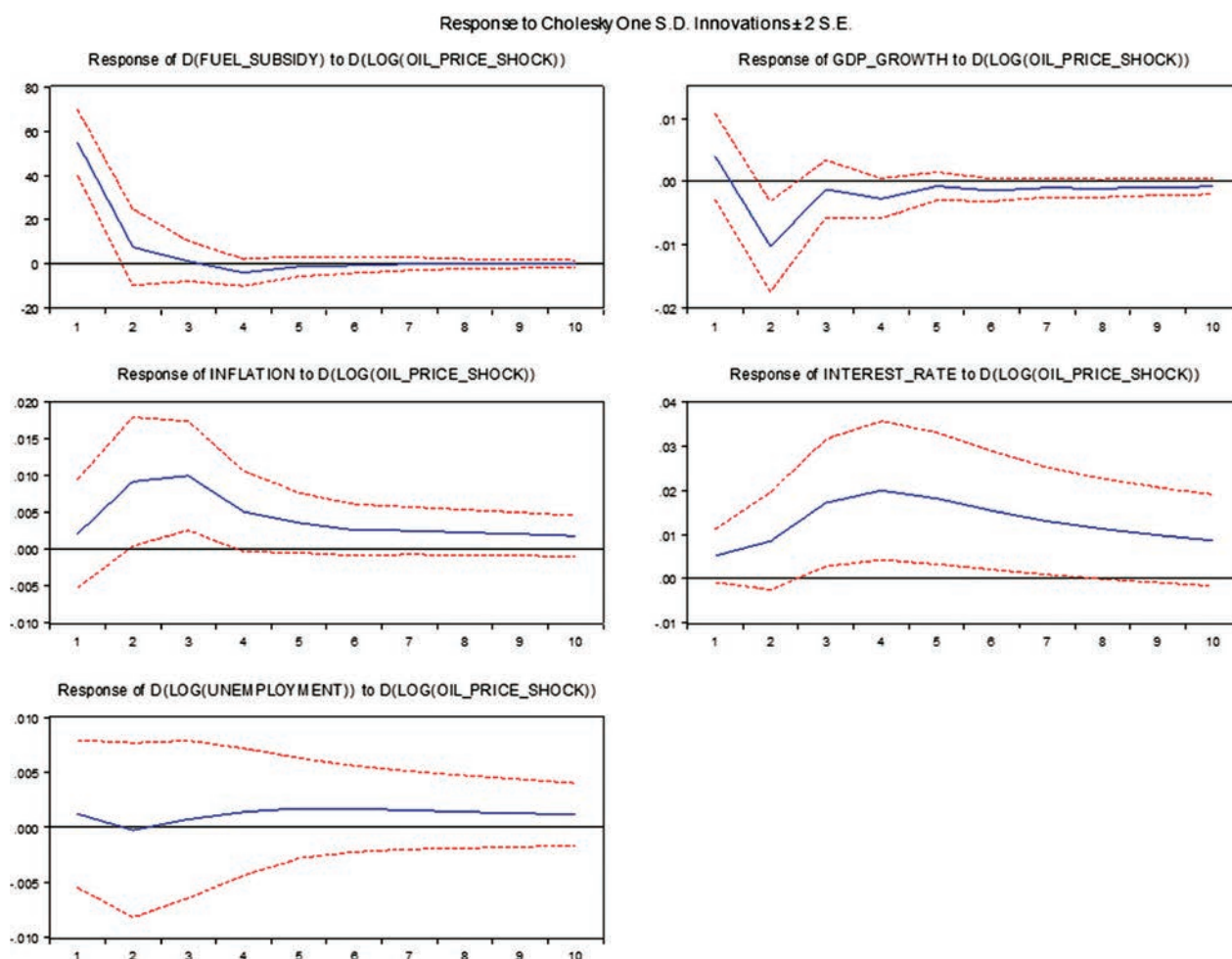


Figure 5. Impulse Response Function of Linear Oil Price 1998 Q_1 –2012 Q_4

Figure 5 contained impulse response of macroeconomics variables to linear oil price shock between 1998 Q_1 – 2012 Q_4 . The Fuel Subsidy response to the linear oil price shock was positive until three quarters. For GDP growth, the response was positive in the first quarter, but turned to be negative in second quarter and diminishing in fifth period. The pattern of fuel subsidy was similar if we compare between period 1984 Q_1 – 1997 Q_4 and 1998 Q_1 –2012 Q_4 ; however the magnitude was higher in the last period (see fig. 4). The interesting is that the response GDP in 1998 Q_1 -2012 Q_4 was different with the previous period. The possible explanation is that the increasing of Linear Oil Price in 1984 Q_1 – 1997 Q_4 will give more revenue for Indonesia and boost the economy because Indonesia in that period was net-oil exporting. In 1998 Q_1 -2012 Q_4 , since 2003, Indonesia became oil-importing country that increasing the Linear Oil Price will deter the economy. For inflation rate and interest rate, the response to the linear oil price shock was positive until 10th quarter. For the unemployment rate, the response was almost zero. This result deduced that the government responds the shock in oil price by giving more fuel subsidy to hinder the negative effects in both periods. The different were, the amount of subsidy is greater in second period (1998 Q_1 – 2012 Q_4) and higher impact hits in second period instead of the first period. One of the possible explanations was that the government in first period was better in managing their oil revenue by investing to the economy. In the second period, Indonesia turned to be net oil exporting country which has less profit from selling the oil and had to finance huge amount of fuel subsidy (BP - British Petroleum, 2013). The amount of fuel subsidy in first period was almost 9 times higher than second period, drastically increase from 1.59% to 13.09%

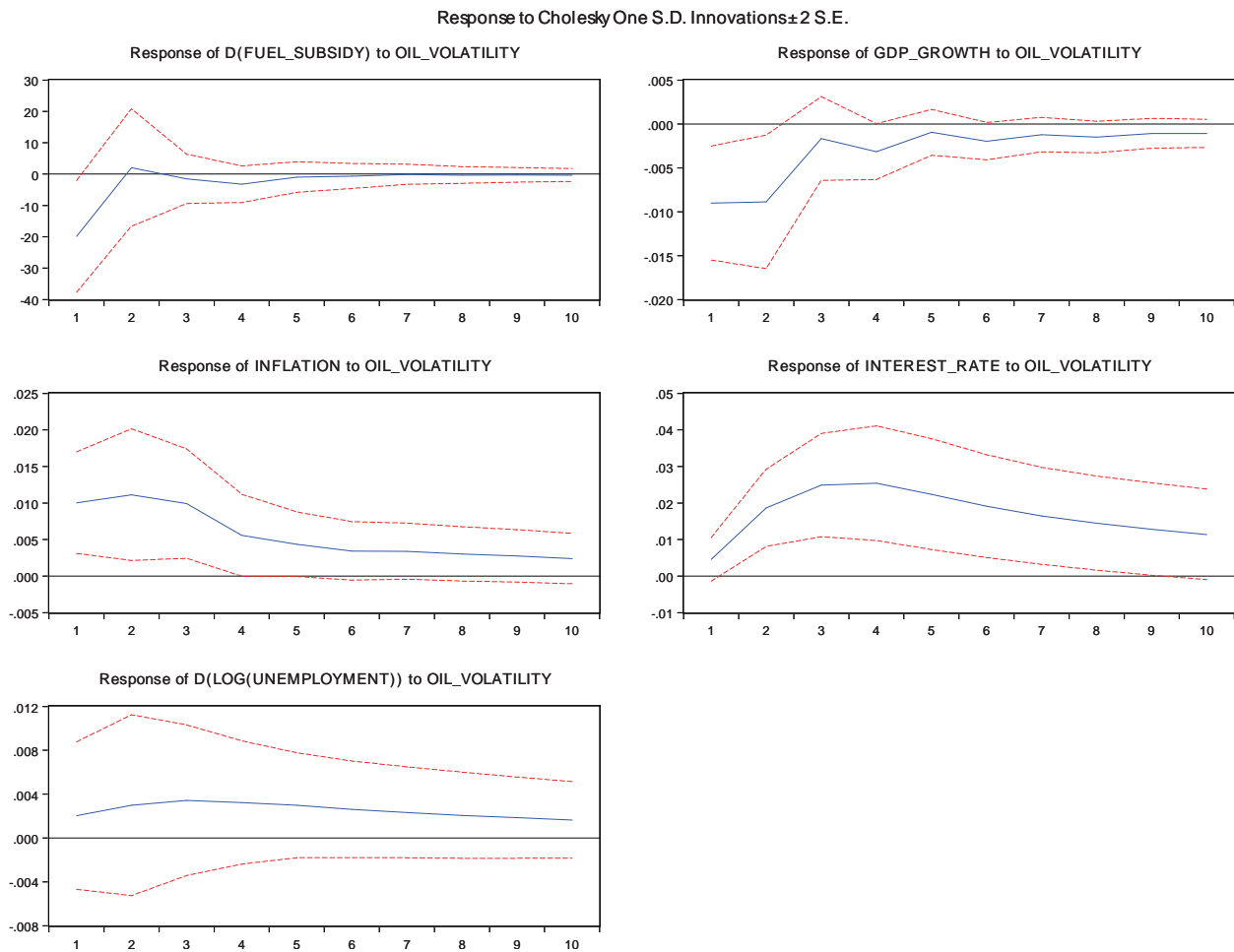


Figure 6. Impulse Response Function of Oil Price Volatility 1998 Q₁ – 2012 Q₄

Figure 6 depicted the response of macroeconomics variables to oil price volatility 1998 Q₁ – 2012 Q₄. The response of fuel subsidy and GDP Growth were negative until second quarter and 10th quarter. The possible explanation for GDP Growth is that the more volatile the Oil Price will be decrease the economy because Indonesia already net-oil-importing in this period, For inflation rate and interest rate, both responses were positive until 10th quarter. Lastly, the unemployment response was positive but very small. This result confirmed the result from Granger Causality test that uncertainty of oil price reduced GDP Growth, rise inflation and interest rate.

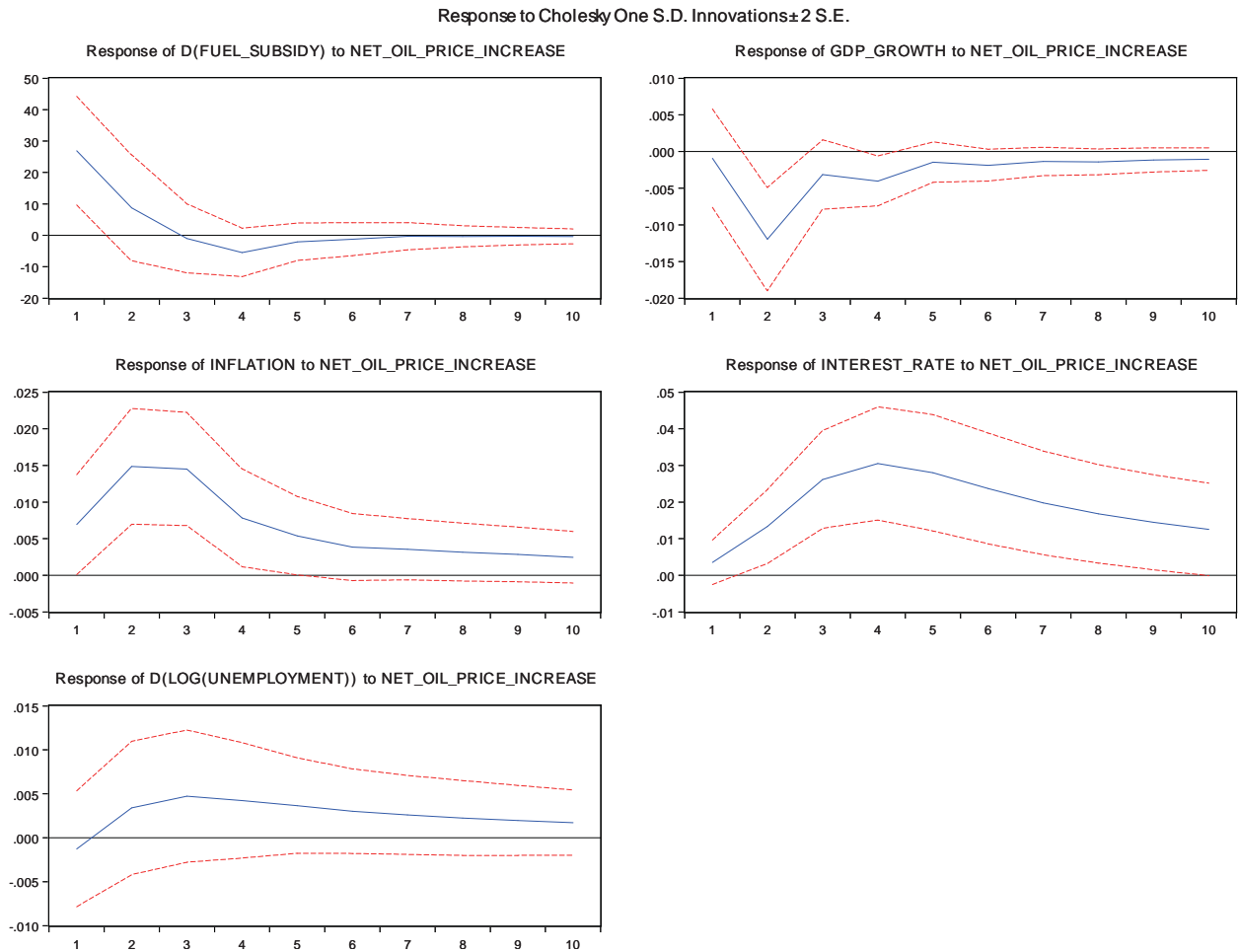


Figure 7. Impulse Response Function of Net Oil Price Increase (NOPI) 1998 Q₁–2012 Q₄

The Figure 7 shown the response of macroeconomic variables to Net Oil Price Increase. The response of Fuel Subsidy was increasing until third quarter, and died out. For GDP growth, the response were negative, peak in the second quarter and still negative until 10th quarter. For inflation, interest rate and unemployment, the responses were positive and still positive after 10th quarter. The peak for inflation, interest rate and unemployment are second, fourth and third quarter, respectively.

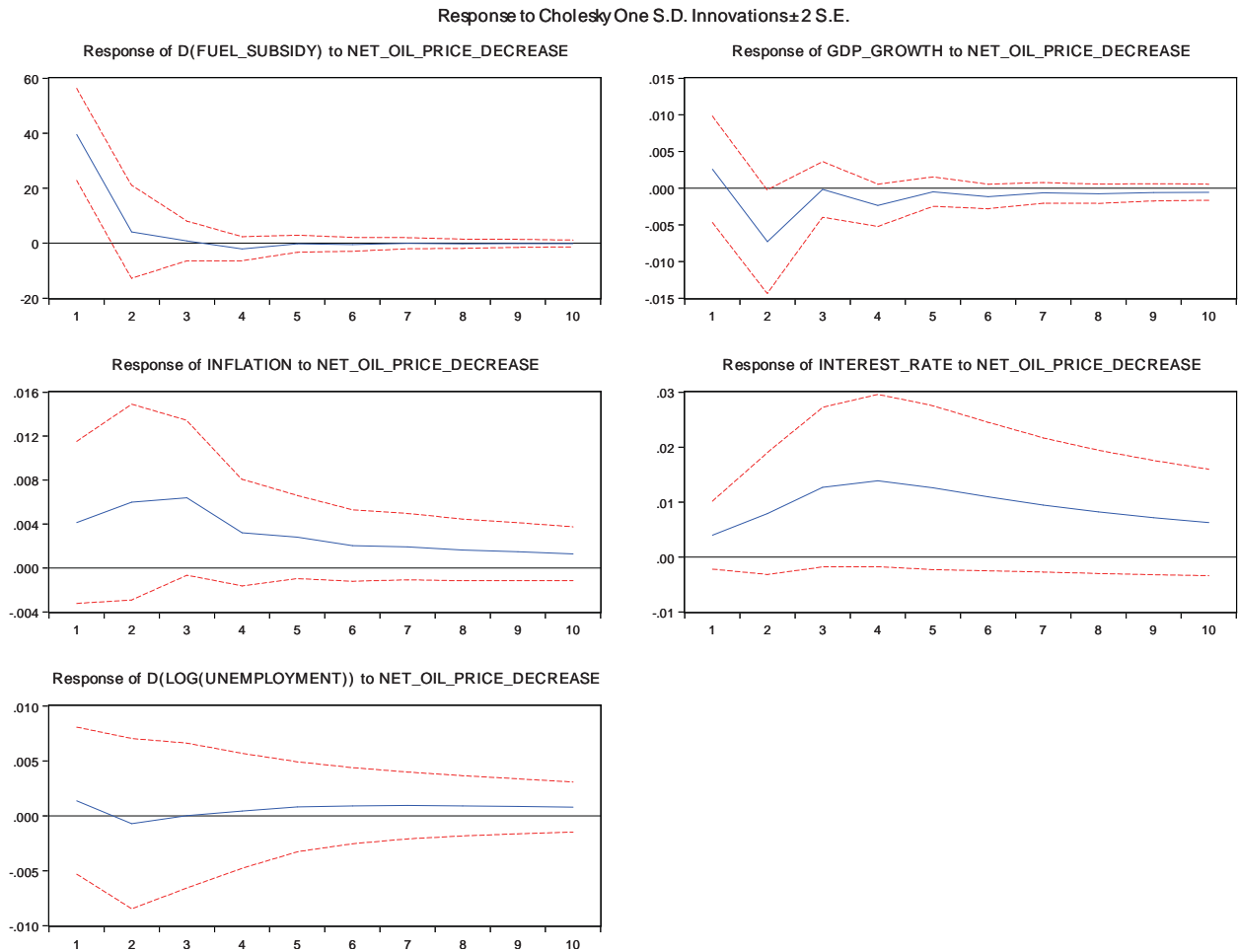


Figure 8. Impulse Response Function of Net Oil Price Decrease (NOPD) 1998 Q₁– 2012 Q₄

The last figure was the response of macroeconomic variables to Net Oil Price Decrease. It was surprise that the responses of macroeconomic variables were similar with the Net Oil Price Increase, except that in the first quarter, GDP growth's response was positive and became negative after that. This capture that as oil-importing country, Indonesia obtain short time positive impact from the decreasing of oil price. However, due to insignificant result in Granger Causality test, this figure only explains that the responses are very small.

4.4 Variance Decomposition

Another instrument to reveal the VAR result was by employing variance decomposition analysis. Variance decomposition gives the proportion of the movement in the dependent variables that are due to their own shocks versus shock to the other variables.

Table 4. Variance Decomposition to Oil Price 1984 Q₁– 1997 Q₄

Dependent Variable	Quarter	LINEAR	VOLATILITY	NONLINEAR INCREASE	NONLINEAR DECREASE
Subsidy	1	50.13	0.02	29.00	9.85
	5	44.01	0.50	26.61	10.46
	10	43.34	0.51	26.36	10.35
GGDP	1	0.72	6.01	1.51	1.24
	5	3.06	7.12	1.28	2.26
	10	3.05	7.11	1.29	2.26
Inflation	1	10.60	2.97	5.07	1.60
	5	10.35	3.60	5.09	2.70
	10	10.33	3.60	5.07	2.70
Interest	1	0.00	0.86	0.40	0.02
	5	0.12	1.56	3.01	1.17
	10	0.13	1.61	3.30	1.28
UNP	1	0.00	2.00	0.14	2.54
	5	0.74	1.23	2.34	1.30
	10	0.77	1.14	2.70	1.21

Table 5. Variance Decomposition to Oil Price 1998 Q₁ – 2012 Q₄

Dependent Variable	Quarter	LINEAR	VOLATILITY	NONLINEAR INCREASE	NONLINEAR DECREASE
Subsidy	1	61.11	7.95	16.53	31.42
	5	58.08	7.81	17.09	29.96
	10	58.03	7.81	17.11	29.94
GGDP	1	2.23	12.07	0.19	0.83
	5	12.95	17.15	19.28	6.33
	10	13.18	17.67	19.76	6.47
Inflation	1	0.56	12.95	3.90	2.07
	5	14.49	23.57	39.33	6.87
	10	15.06	24.70	40.36	7.14
Interest	1	4.74	3.87	3.63	2.71
	5	17.63	33.23	44.54	8.70
	10	20.34	36.00	51.88	9.64
UNP	1	0.22	0.61	1.10	0.28
	5	0.50	3.23	4.21	0.24
	10	1.15	4.57	5.52	0.48

The fourth column of Table 4 contained the variance decompositions for oil price volatility and it can be seen that oil price volatility contributed only 0.02% to variation in output in the first period and slightly increase to 0.50% in the 5th period and end up to 0.51 % in the 10th period. The oil price volatility account only less than 1% for fuel subsidy, about 7 % for GDP growth but account only very small portion for others variables.

Furthermore, in the most cases for the first period (1984 – 1997), only small portion of macroeconomic indicators can be explained by changing in the linear oil price, NOPI and NOPD except for fuel subsidy. Linear oil price shock , NOPI and NOPD account for 40%, 26% and 10% variation in fuel subsidy, respectively.

The situation was totally different for the second period.(see fig.5) In the most cases, almost all variation in the macroeconomic indicators could be explained by changing in the oil price variables. For instance, linear oil price shock and NOPD accounted for about 58% and 30 % variation in the fuel subsidy, respectively. Furthermore, other examples were oil volatility and NOPI account for about 36% and 52% of variation in interest rate respectively. In short, except for unemployment, all the oil price variables could explain variation in the macroeconomic variables. Again, we found evidence that effect of Oil Price in the second period had a more pronounced effect on macroeconomic variables than the first period.

5. Conclusion and Policy Implication

Prior empirical studies have documented the harmful effects from oil price to macroeconomic variables in many countries, from small to big economies, from oil-exporting-countries to net-oil-importing-countries and from developed to developing countries. However, the role of fuel subsidy to cushion the effects still unclear.

This study attempted to reveal the impact of oil price to Indonesian macroeconomic indicators and the role of subsidy to mitigate the impacts employed VAR model. From the VAR model which consist of Granger causality test, impulse response function and variance decomposition, we found several interesting findings.

Based on Ganger causality, we found that for the 1984 - 1997 period, only fuel subsidy is Granger caused by linear oil price shock. However, between 1998 – 2012, we could infer that GDP growth was Granger caused by linear oil price shock, oil price volatility and NOPI. Moreover, interest rate and inflation rate were Granger caused by oil price volatility and NOPI.

Based on the impulse response function, we can inferred that, in the most cases in both periods, impact of oil price variables were positive to fuel subsidy, negative to GDP growth, inflation and interest rate. However, the oil price variables only could explain very small variation of unemployment rate. In addition, the oil price variables in the second period had stronger and longer effect to the macroeconomic variables.

Finally, the result of variance decomposition confirmed Granger causality test and impulse response function that the impact of different type of oil price variables were more powerful in the second period (1998 – 2012).

The policy implication of this result would be that the government should change the fuel subsidy policy to be more sustainable policy. One of the options could be by changing the fuel subsidy type from general subsidy (everyone can access the subsidy) to the targeted subsidy (only for poor people) and establish such kind of petroleum fund to cushion the oil price volatility. This policy can divert the fuel subsidy fund to the development fund and protect the country form the oil price shock (economy aspect) and oil price volatility effects (social) and also reduce the overconsumption due to uncontrolled fuel subsidy (environment).

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Appendix A. Johansenn Test for Cointegration

rank	parm	LL	eigen value	trace statistic	5 % critical value
0	21	-798.294	.	28.1514*	29.68
1	26	-790.65	0.12655	12.8622	15.41
2	29	-786.063	0.07797	3.6895	3.76
3	30	-784.219	0.03212		

rank	parm	LL	eigen value	max statistic	5% critical value
0	21	-798.294	.	15.2891	20.97
1	26	-790.65	0.12655	9.1728	14.07
2	29	-786.063	0.07797	3.6895	3.76
3	30	-784.219	0.03212		

References

- Abeysinghe, T. (2001). Estimation of direct and indirect impact of oil price on growth. *Economics Letters*, 73, 147–153. [http://doi.org/10.1016/S0165-1765\(01\)00476-1](http://doi.org/10.1016/S0165-1765(01)00476-1)
- Abnormally Normal. (2015, November). *The Economist*, 67–68.
- Agustina, C. D. R. D., Granado, J. A., Bulman, T., Fengler, W., & M. Ikhsan. (2008). Black Hole or Black Gold? The Impact of Oil and Gas Prices on Indonesia's Public Finances.
- Andersen, T. G., Bollerslev, T., Diebold, F. X., Labys, P., Econometrica, S., Mar, N., ... Labys, P. (2003). Modeling and Forecasting Realized Volatility. *The Econometric Society*, 71(2), 579–625.
- Bai, J., & Perron, P. (1998). Estimating and Testing Linear Models with Multiple Structural Changes. *Econometrica*, 66 No 1, 47–78.
- Basri, M. C., & Hill, H. (2004). Ideas, Interest and Oil Prices- The Political Economy of Trade Reform During Soeharto's Indonesia. *The World Economy*, Volume 27, Issue 5, pages 633–655.
- Bernanke, B. S. (1983). Irreversibility, Uncertainty, and Cyclical Investment. *Quarterly Journal of Economics*, (February).
- BP - British Petroleum. (2013). *Statistical review of world energy 2013*. London. Retrieved from http://www.bp.com/content/dam/bp/excel/Statistical-Review/statistical_review_of_world_energy_2013_workbook.xlsx
- Brown, S. P. a, & Yücel, M. K. (2002). Energy prices and aggregate economic activity: An interpretative survey. *Quarterly Review of Economics and Finance*, 42, 193–208. [http://doi.org/10.1016/S1062-9769\(02\)00138-2](http://doi.org/10.1016/S1062-9769(02)00138-2)
- Guo, H., & Kliesen, K. L. (2005). Oil price volatility and U.S. macroeconomic activity. *Federal Reserve Bank of St. Louis Review*, 87, 669–683.
- Hamilton, J. D. (1988). A Neoclassical Model of Unemployment and the Business Cycle. *Journal of Political Economy*, 96(3), 593. <http://doi.org/10.1086/261553>
- Hamilton, J. D. (1996). This is what happened to the oil price-macro-economy relationship. *Journal of Monetary Economics*, 38, 221–222. [http://doi.org/10.1016/S0304-3932\(96\)01283-4](http://doi.org/10.1016/S0304-3932(96)01283-4)
- IEA. (2000). *World Energy Outlook 1999: Looking at Energy Subsidies: Getting the Prices Right*. Paris: International Energy Agency. Retrieved from <http://www.worldenergyoutlook.org/media/weowebiste/2008-1994/weo1999.pdf>
- IEA. (2015). *Indonesia 2015 OECD/IEA*. Paris: OECD/IEA.
- Indonesian Statistical Body. (2013). *Indonesian Macroeconomics Indicators*. Jakarta.
- International Monetary Fund. (2013). *International Financial Statistics*.
- Jbir, R., & Zouari-Ghorbel, S. (2009a). Recent oil price shock and Tunisian economy. *Energy Policy*, 37, 1041–1051. <http://doi.org/10.1016/j.enpol.2008.10.044>
- Jbir, R., & Zouari-Ghorbel, S. (2009b). Recent oil price shock and Tunisian economy. *Energy Policy*, 37(3), 1041–1051. <http://doi.org/10.1016/j.enpol.2008.10.044>
- Lisman, J H C and Sandee, J. (1964). Derivation of Quarterly Figures from Annual Data. *Journal of the Royal Statistical Society*, 13(2), 87–90.
- Managi, S., & Okimoto, T. (2013). Does the price of oil interact with clean energy prices in the stock market? *Japan and the World Economy*, 27, 1–9. <http://doi.org/10.1016/j.japwor.2013.03.003>
- Mehra, M., & Oskoui, K. N. (2007). The sources of macroeconomic fluctuations in oil exporting countries: A comparative study. *Economic Modelling*, 24, 365–379. <http://doi.org/10.1016/j.econmod.2006.08.005>
- Merton, R. C. (1980). On estimating the expected return on the market. *Journal of Financial Economics*, 8, 323–361. [http://doi.org/10.1016/0304-405X\(80\)90007-0](http://doi.org/10.1016/0304-405X(80)90007-0)
- Mourougane, A. (2010). Phasing Out Energy Subsidies in Indonesia, (808), 26. <http://doi.org/10.1787/5km5xvc9c46k-en>
- OECD. (2006). *Subsidy Reform and Sustainable Development: Economic, Environmental and Social Aspects*. Paris: OECD Publishing.
- OPEC and Other regional price*. (n.d.).
- Pallone, S. (2009). Indonesia's Oil Crisis : How Indonesia Became a Net Oil Importer. *The Journal of International Policy Solution*, 10.
- Plante, M. (2014). The long-run macroeconomic impacts of fuel subsidies. *Journal of Development Economics*, 107, 129–143. <http://doi.org/10.1016/j.jdeveco.2013.11.008>
- Rafiq, S., Salim, R., & Bloch, H. (2009). Impact of crude oil price volatility on economic activities: An empirical investigation in the Thai economy. *Resources Policy*, 34, 121–132. <http://doi.org/10.1016/j.resourpol.2008.09.001>
- Rosser, A. (2007). Escaping the resource curse: The case of Indonesia. *Journal of Contemporary Asia*, 37(April 2015), 38–58.

<http://doi.org/10.1080/00472330601104557>

Sheikhs v shale. (2014). *The Economist*.

Sims, C. A. (1980). Macroeconomics and Reality. *The Econometric Society*, 48(1), 1–48.

Sugiono, A. et al. (2014). *Outlook Energi Indonesia 2014*. Jakarta. Retrieved from
<http://www.bppt.go.id/index.php/unduh?task=document.download&id=519>

UN. (1987). *Report of the World Commission on Environment and Development: Our Common Future (The Brundtland Report)* (Vol. 4). Oslo.