Oil Price, GDP, Inflation and Exchange Rate: Evidence from Indonesia as a Net Oil Exporter Country and a Net Oil Importer Country

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List of Acronyms

ADF	Augmented Dickey Fuller
AIC	Akaike's Information Criterion
FPE	Final Prediction Error
GDP	Gross Domestic Product
HQIC	Hannan and Quinn information criterion
IFS	International Financial Statistic
ISS	Institute of Social Studies
IMF	International Monetary Fund
OPEC	Organization of Petroleum Exporting Countries
SBIC	Schwarz's Bayesian Information Criterion
VECM	Vector Error Correction Model
VAR	Vector Autoregressive

Abstract

The aims of this paper is to investigate the effect of oil price to the GDP and other macroeconomics variable such as inflation and exchange rate. Quarterly time series data between 1999 Q1 and 2011 Q4 are employed in this paper. The data used are Indonesia's gross domestic product, world's oil price, Indonesia's inflation, and Indonesia's real exchange rate. In addition, this paper also emphasizes to examine the effect of oil price to GDP and macoreconomic variable when Indonesia experiences as a net oil exporter country and as a net oil importer country. Most of previous studies show the positive relationship between oil price and macroeconomic variables in the oil exporter countries and negative relationship in the oil importer countries.

Using VECM methodology, the findings reveal that higher oil price leads to higher GDP in the short run but insignificant.The result for the influence of oil price in inflation and exchange rate also insignificant in the short run. In the long run, higher oil price will contribute to higher GDP. On the other when indonesia experience as a net oil importer country, the the effect of higher oil price will contribute to lower GDP than that during period net oil exporter. In addition, during period as a net oil importer country, the increase of oil price triggers the increase of inflation and exchange rate but insignificant.

Relevance to Development Studies

Oil has been the major resources to the economic activities as an input of productions. Previously Indonesia as a major oil producer country. Indonesia joined OPEC (Organization of the Petroleum Exporting Countries) in 1962. The declining trend of oil production and the increasing of domestic oil consumption, lead Indonesia became a net oil importer country in 2004 and followed by the resigning from OPEC in 2008. This study investigates the effect of the increase of oil price to GDP, inflation and exchange rate as the indicator of economic activity.

Keywords

Oil price, GDP, inflation, exchange rate, Indonesia, VECM, net oil exporter country, net oil importer country.

Chapter 1
Introduction

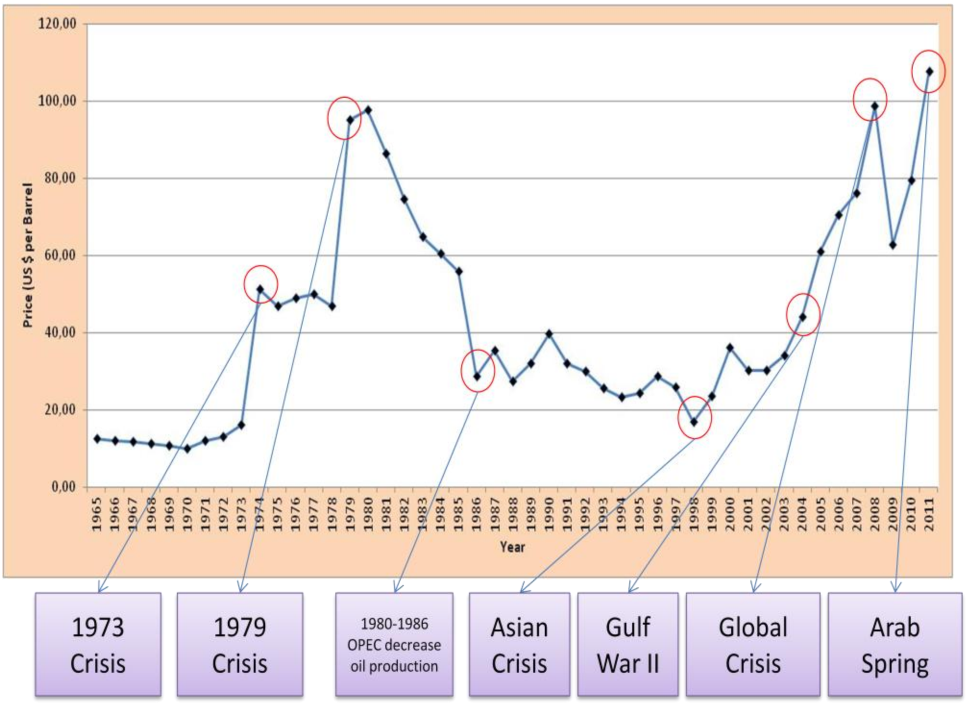
1.1 Background

Today energy source is dominated by oil resources. The problem faced today is the high oil price that is caused by variety of factors. There were crises in the world's oil price since 1970s which were 1970's oil boom, Asian crisis, the second gulf war, global crisis and lately the Arab spring crisis. In 2008, Indonesia suspended its membership from OPEC because Indonesia has started as a net oil-importer. This happens because domestic demand exceeds the production generated in the country. The excess of oil demand is imported from abroad. In addition to the above factors, the energy requirement increases each year while the amount of oil reserves is very limited. Massive explorations in the past has led to scarcity of oil resources.

Economists predict the oil price will incease overtime and permanent. The dramatic increase of oil prices during the past several years and the fear that they will continue to rise are causes for concern. Several studies had been done to show the negative relationship between oil price and economic growth.Hamilton (1983) found that the increase of oil price led to the seven of the eight post World War II recessions in the US. In addition, Dhawan and Jeske (2006) observe that the increase of energy prices has triggerred recessions since 1973. Thus, given the key role that energy plays in modern economies, it is important to understand the channels through which oil price influences economic performance and personal welfare.

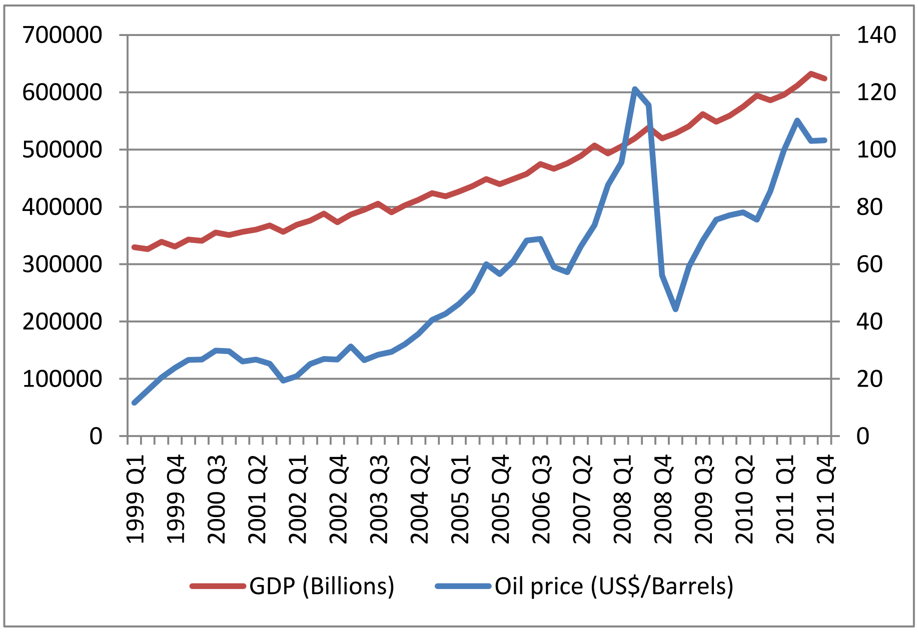
This paper captures the current oil price with quarterly data from 1999 Q1 until 2011 Q4. It is interesting to examine the impact of oil price shock to the GDP of Indonesia during this time period since Indonesia experienced different oil regime in this period. From 1999 Q1 until 2003 Q4, Indonesia experienced as a net oil exporter country whereas from 2004 Q1 until now Indonesia became a net oil importer country. The status of net oil exporter country and net oil importer country can be defined from the value of oil trade (export – import). When the value of oil export exceed the oil import, we can say Indonesia as a net exporter country on the other hand, when the oil import exceed the oil export, Indonesia run a net oil importer. Figure 1-2 shows the relationship between Indonesian GDP and the world's oil price during 1999 Q1 until 2011 Q4.

Figure 1-1
World's oil price shock (1970-2011)



Source: OPEC Database (http://www.opec.org), accessed 05/01/12, figured by the author

Figure 1-2
Indonesia Real GDP and world's oil price (1997 Q1-2011 Q4)



Source : IMF IFS Database (http://elibrary-data.imf.org/), accessed 05/01/12, figured by author

1.2 Problem Statement and Justification.

In the past Indonesia is one of the main oil production countries. Indonesia joined OPEC membership in 1962 and previously contributed a large share in world oil production. The period of 1970s when there was oil boom, Indonesia was benefited from the oil revenue since the revenue contributed the biggest share on Indonesian GDP. Overtime, the massive consumption of oil resources in Indonesia and the declining trend of the oil production since 1998, forced indonesia became a net oil importer country in the 2004. Import of oil has also exceeded export of oil since 2004 indicated Indonesia started its status as as a net oil importer country. Furthermore, in 2008 Indonesia suspended its membership from OPEC because Indonesia could not meet the requirement of 1,3 million barrel/day oil production. Moreover, the oil price affects differently for net oil exporter country and net oil importer country. Oil price also affects the output and other macroeconomic variables such as inflation and exchange rate.

1.3 Research Question

The following main research question will guide the research process:

How does the world's oil price affect the GDP and other macroeconomic variables of Indonesia?

Sub-research question:

- What is the effect of oil price to the GDP when Indonesia experience as a net oil exporter and net oil importer?
- What is the effect of oil price to the other macroeconomic variables such inflation and real exchange rate?

1.4 Research Objectives

The objective of this study is to observe what the impact of the world's oil price to the GDP of Indonesia and other macroeconomic variables in the period between 1999 Q1 and 2011 Q4. The paper investigates the impact of oil price to GDP, inflation and exchange rate since these variables are important as an economic indicators of the country. The paper also emphasizes the effect of oil price shock when Indonesia experiences as a net exporter oil and as a net importer oil. Furthermore, the study use quarterly data to see more accurate result since oil price is very fluctuated.

1.5 Hypothesis

In the period 1999 – 2011 Indonesia experience both as a net oil exporter country and net oil importer country. The hypothesis is based on the theory which is the world's oil price will increase GDP during countries experience as a net oil exporter country since the government get revenue from the surplus of oil trading, and will affect negatively to the GDP when experiences a net-importer oil country. In addition, another hypothesis is an increase in oil price will rise the inflation rate through a cost-push inflation. Moreover, the effect on exchange rate during the net oil exporter will appreciate the exchange rate with the exchange rate pass-through channel. Furthermore, the implementation of fuel subsidy in Indonesia seems to reduce the impact of oil price to the macroeconomic variables.The results of this research which cover the short run and the long run effect of world's oil price is expected to be useful for the government as a policy maker to regulate policy in terms of the movements on oil prices.

1.6 Practical problems in carrying out the research

There is problem when we obtain the GDP data. The data collected from IMF IFS provides GDP data from 1999 Q1 – 2001 Q4 in 1997 constant price and 2000 Q1 – 2011 Q4 in 2000 constant price. It does not provide the 1999 Q1-1999 Q4 data in constant price 2000.To overcome this problem firsly, we get the ratio between 1999 Q1-2001 Q4 (1997 constant price) and 1999 Q1-2001Q4 (2000 constant price) by divided the second data and the first data and calculate the average between the ratio of 1999 Q1-2001Q4 data. Having the average ratio of the data, we multiply it with the 1999 Q1-1999 Q4 (1997 constant price). We only observe the data from 1999 Q1 since the IMF IFS only provide the Indonesia GDP in quarterly data since 1997 Q1. We exclude the observation between 1997 Q1 and 1998 Q4, since between this period there was a structural break which is Asian crisis.

1.7 Organization

This paper is organized as follows: In Chapter 1, I briefly describe the background of the paper which contains the movements of the world oil price and also the various oil shock since 1970. In addition, the paper also depicts the condition of Indonesian GDP and the world oil price from 2000-2011. Furthermore, chapter 1 also discusses the research questions, objective of the paper, hypothesis, problem statement and justification, practical problems in carrying out the research and organization of the paper. Next, chapter 2 is literature review and theoretical framework. The literature review contains the previous literatures that relate directly to the topic of the paper and the research question. The result in the literature review is synthesized into a brief summary. The paper also states the gap in the literature to be a reason to do the further research. The chapter also discusses about the theoretical framework which contains the basic theory that underlies the idea of this paper. Chapter 3 gives an overview of the VAR model. Chapter 4 analyzes the data and shows the result of the regression. Chapter 5 is the conclusion of the paper.

Chapter 2
Overview and Literature Review

2.1 Overview

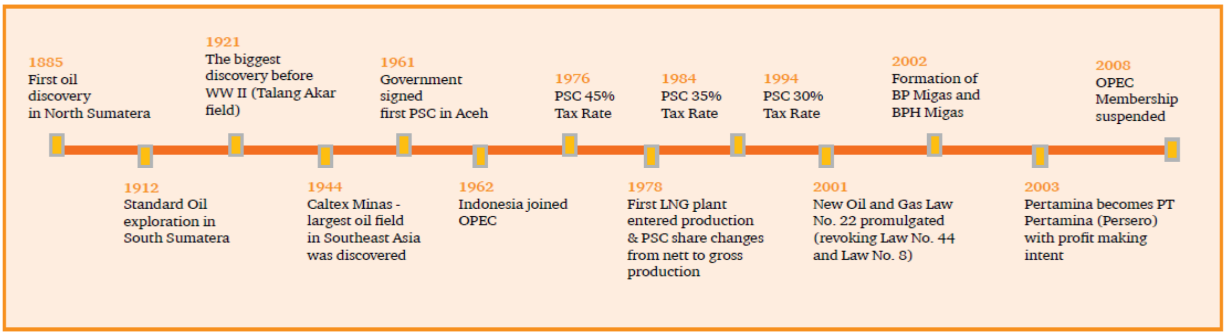
Latest Oil shock in the past decade

In the last decade, world's oil price has been fluctuating. Asian crisis in 1998 decreased the demand of the oil since the company in most of Asian countries lowered their oil consumption.The low consumption of oil in Asian countries during the crisis led to the decline in oil price. Following the Asian crisis, oil price rose gradually. In 2004 there was a shock on oil price triggered by the Gulf War II which was the period when Iraq was attacked by U.S. Since Iraq is one of the biggest oil producing countries, the war caused the rapid decline of world oil supply. Four years following the Gulf War II, the world's oil price continued to soar. The global financial crisis continued to global crisis in 2008 trigger the oil price to hike. The sharp decline in capacity of oil reserve less than one million barrels per day and also the strong speculation of the oil price in the future led to the oil price reach a peak at $145.29 on July 3, 2008. Following the global crisis during 1998, the oil price collapsed significantly until approximate $40 in December 2008. The rapid decline can be explained due to the decrease of the oil demand. During the global crisis, countries lowered their production because of the high oil price. The situation in most of the countries in the world which lowered their production spurred the less demand of oil. The better condition in the world economics led the oil price to increase gradually as the demand of oil rose. The data from OPEC (2012)shows that the price of oil in the end of the 2009 was approximately US$75 per barrel. After that, the oil price increased steadily and ended 2010 with the price approximately US$ 90 per barrel. The latest oil price shock happened during the "Arab spring". The Arab spring is an occasion where protests and demonstrations occurred in the middle east countries. This event started with demonstrations that occurred in Tunisia on 18 December 2010. Demonstrations in tunisia was triggered by the protests against the government. The success of the demonstration in Tunisia were followed by other middle east countries. The protest and riots continued in Algeria, Jordan, Egypt and Yemen. This protest also spread to Libyan and led to the death of Libyan leader Muammar Gaddafi on 20 October 2011.This period of Arab spring, trigger oil price in 2011 to reach a peak above US$ 100 and continued to increase gradually in the next year.

Indonesia Oil condition

The first oil was invented in North Sumatra in 1885. A young Dutch men named A.J. Zilker dicovered oil in Sumatra when he was on moving from East Java to Sumatra during the early 19th century. This discovery of oil (he found paraffin) brought him to his resignation from early job and started to drill with permision from Sultan of Langkat. Five years later since the first discovery of paraffin, he earned some money to start his business in oil. At this early stage, he exploted oil in Pangkalan Brandan. His business was successful (especially in Telaga Tunggal well) when he decided to change his 'infant' business into more subtantial company. After all, the Royal Dutch company for the Working of Petroleum Wells in the Dutch Indies was created in the Hague that formalized Zijlker's business into a strategic ones. This happened in June 16, 1890. In the following years, this oil company had developed and covered other area such as in Eastern Borneo (East Kalimantan). Balikpapan was the first area of exploration in Eastern Borneo that was strted in 1899. The Royal Dutch also supported the oil's exploration through constructing storage and harbour in Pangkalan Susu (Shell. 2012).

Figure 2-1
History of Indonesia Oil (1885-2008)

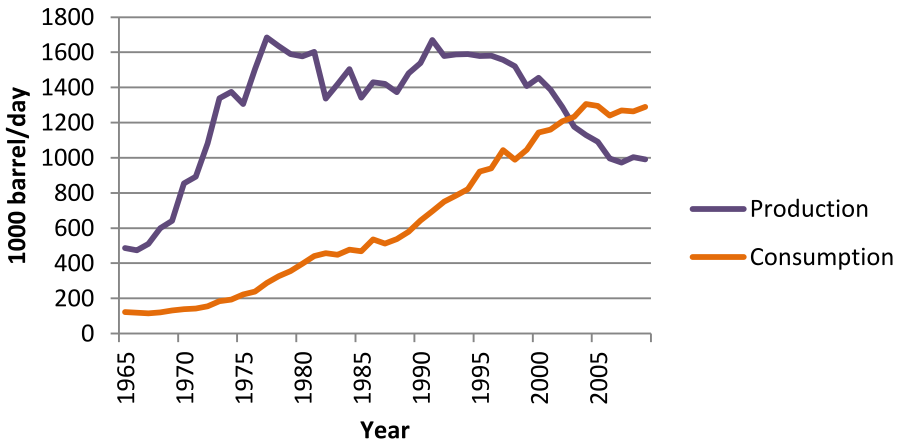


Source : www.shell.com (History of Shell in Indonesia) accessed (05/01/12)

In addition, about 2000's more or less after the invention of oil, Indonesia plays an important actor in global oil and gas market. Because of its supply for 1.2% of world total oil production, Indonesia is listed in the position of twentyfirst in the world oil producer countries. For information, in this period Indonesia has a proven oil reserve approximately 4.2 billion barrels (PwC. 2011).

As seen on the Figure 2.2, consumption of oil is increasing overtime while the production of oil is decreasing especially after 1998. The decreasing of the oil production due to the Asian crisis in 1998. There are many wells that are not productive anymore and also no new investment in oil sector.

Figure 2-2
Indonesia Oil Consumption and Production (1965-2008)

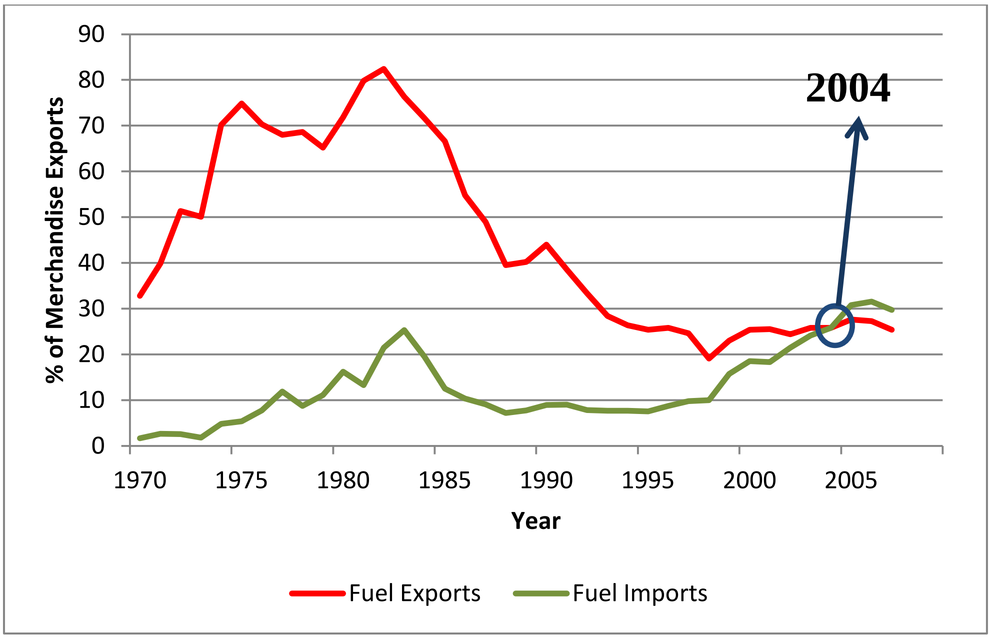


Source: The World Bank Database (http://data.worldbank.org/) accessed 05/01/12, figured by the author.

How Indonesia became a net oil importer country

Pallone (2009) writes in his paper that export of oil is declining overtime whereas import of oil is increasing overtime. As can be seen in figure 2.3, by 2004 import of oil exceeded export of oil and since that time Indonesia became a net oil impoter country. In 2008 indonesia had suspended its membership on OPEC, since Indonesia could not meet the production of 1,3 million barrel/day. He also states that the aging well and postponing the development of new oil well is one of the reasons of the declining production. Another explanation of declining production is there was no new investment in oil sector. Since the collapse of Soeharto, Pertamina (National oil company) did not establish a new partner in Indonesia oil sector. In addition, many people in indonesia is prohibited to allow foreign oil companies to establish their oil company in Indonesia..

Figure 2-3
Fuel import and fuel export 1970-2007



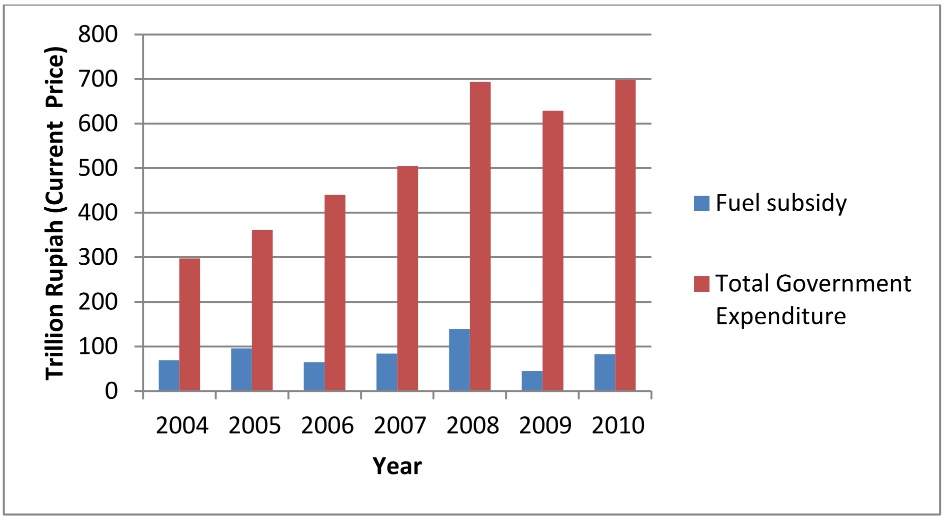
Source: The World Bank Database (http://data.worldbank.org/) accessed 05/01/12. *Figured by the author.*

Figure 2.3 show the declining trend of percentage share of oil export and on the other hand, the percentage share of oil import is increasing. In 2004, the share of oil import is bigger than the share of oil export that led Indonesia started to a net oil importer country.

Indonesia's Fuel Subsidy

Fuel is subsidized by the government of Indonesia. The aim of the fuel subsidy policy in Indonesia is to control the domestic fuel price.the government keep the price of domestic oil to keep the stable price of goods and services. The cheap fuel price is also contribute for the transportation sector and household sector (Rosyadi 2009). On the other hand, the cheap price of oil damages the sustainability of oil resources. Since the oil price is cheap, the demand for oil consumption increases. As Pertamina (National state mining company) suffers from the cheap oil price due to fuel subsidy, the government transfer payment from the central government (de Mello 2008). In addition, fuel subsidy also triggers more problems in government budget. Nowadays, the fuel subsidy in Indonesia almost reachs one hundred trillion Rupiah.

Figure 2-4
Fuel Subsidy and Total Government Revenue (2004-2010)



Source World Bank Database (http://data.worldbank.org/) accessed 05/01/12, figured by the author

Another concern of the fuel subsidy is since the market price is lower than the real price, often oil is smuggled to the other countries to get the profit from the gap between the prices. Furthermore, the fuel subsidy should reach the poor but in reality, mostly the rich benefits from this fuel subsidy especially in transportation sector. For example, the rich which have their own vehicle is benefited from the price of subsidized fuel.

2.2 Theoritical Framework

Transmission mechanism which oil price affects GDP

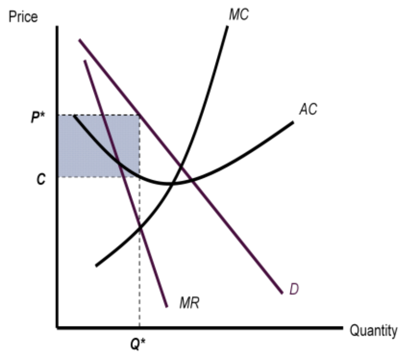
Oil price is one of the important input factors of production. The movements of oil price may lead to the movement of other macroeconomic variables. One factor that influence from the increase of oil price is output of the country (Gross Domestic Product). Based on theory, GDP responses differently from the oil price movement for net oil exporter countries and net oil importer countries. The revenue from the sale of oil in net oil exporter countries may provide a positive impact to economy of that country. For the oil producing country such OPEC countries, oil revenue contributes the biggest share on GPD. When the oil price increases, these countries increase the oil production. The oil price is mostly determined by the OPEC membership countries since group of OPEC countries is one of an example of the multiplan monopoly competition. Oil exporter countries as a group of OPEC coordinate their interest to set the price in order to get the monopoly benefit. This behaviour is also known as cartel which the assumption of OPEC membership countries can collude to get the profit. Nicholson(2001) in his book wrote about the definition of monopoly:

> "A monopoly is a single firm that serves an entire market. This single firm faces the market demand curve for its output. Using its knowledge of this de-

mand curve, the monopoly makes a decision on how much to produce. Unlike the perfectly competitive firm's output decision (which has no effect on market price), the monopoly's output decision will, in fact, determine the good's price." (Nicholson 2002: 495)

The period of "oil boom" in 1973 happened during Yom Kippur war (the period when OAPEC countries declared an oil embargo) reveals that the power of OPEC countries to control the price of oil. During this period, oil price increased significantly and spurred the economic growth of OAPEC membership countries. The explanation of how the OPEC countries benefits from the oil price can be explained by the monopoly theory:

Figure 2-5
Monopoli competition



Source : Nicholson (2002:498) figure 8.1

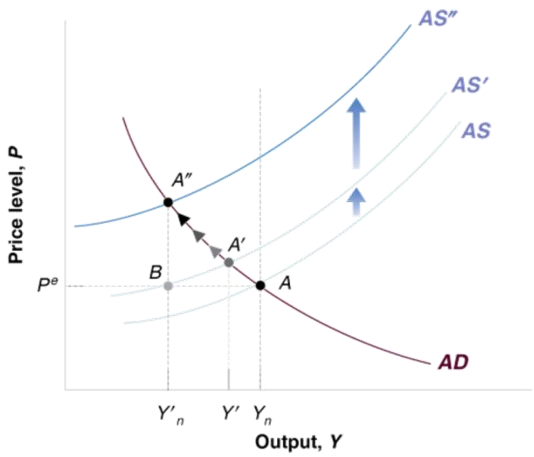
When monopoly exists, then they will produce output at Q* where marginal revenue (MC) is equal to marginal revenue (MR). When they produce at Q*, the market price or the price where demanders willing to pay will be at P*. At this price (P*) monopolist will gain profit as much as shown at the grey area. If monopolist wants to sell extra unit they have to sell at the price below than P* as the result the profit will be lower. However, as long as P*>AC, monopoly will be still profitable.

Above illustration shows that oil exporter countries such OPEC membership countries will be benefited with the increase of oil price. But, as previously mentioned, the behavior of oil price influence the GDP is different for the oil importing countries. These countries may suffer when the oil price increase. The condition when Indonesia experience as net oil importer countries can be explained by the standart aggregate supply-aggragate demand function below. The aggregate supply relation obtained from Blanchard (2000: 131) is as follows:

$$P = P^e(1+\mu)F\left(1-\frac{Y}{L}, z\right) \qquad (2.1)$$

From the equation 2.1 above, in the case of the oil, when the price of oil increases, the markup μ increases. An increase in μ lead to a higher price level (P) and furthermore shift aggregate supply up (Blanchard 2000). Furthermore, an increase in oil price at the end will spur a lower output. The dynamic adjustment of an increase in the oil price is revealed in figure 2.5.

Figure 2-6
Dynamic Adjustment of An Increase of Oil Price



Source : Blanchard (2000:142) figure 7 -11

In the initial level, the aggragate supply curve (AS) intersects the aggregate demand curve (AD) in point A. The initial output is Y_n and the price level is P^e.In the case of oil price increase, the AS curve shift to point B and the intersection between AS and AD moves to point A' along AD curve, the new AS curve is AS' and the new output now is on Y'. The new economy equilibrium in the short run now is on the point A'. Overtime, the increase of oil price shifts the aggregate supply up from AS' to AS''. The price level increases further and also output decreases further from Y' to Y'_n (Blanchard 2000: 142-143).

Transmission mechanism oil effect the Inflation

The main theory which oil price affects the inflation is known as cost-push inflation theory. When the price of input rises, the price in the market also increases. Oil is one of the most important factors in production. An increase of oil price leads to the increase in input factor of production and the company has to sell the goods with a higher price in the market. The higher price level in the market lead sto a higher inflation rate.

Several studies has been done to see the impact of oil price to the inflation such as study by Gisser and Goodwin (1986) examine three popular notion about oil and macroeconomic. They use U.S macroeconomic data which are Real GNP, general price level, rate of unemployment, and real investment. Using a reduced form approach, they found that oil price have both real effect and inflationary effect.

In addition, Al-mulali et al. (2010) examine the impact of oil price to Qatar macroeconomy in the period between 1970 and 2007. Using VECM, the finding shows that the oil price lead to higher inflation.Qatar get the benefit of the financial surplus from the oil revenue. But, since qatar experiences fixed exchange rate regime and tight monetary policy, it leads to higher inflation rate in Qatar.

Transmission mechanism oil effect the exchange rate

Previously, Indonesia is a big oil exporter country, especially in 1970s during the oil boom period. The huge export of oil in the past led to a massive increase in foreign exchange rate.

The nominal currency may appreciate when the country experiences a floating exchange rate regime. The net oil exporter country will suffer a dutch disease since the appreciation of the domestic currency damage the trade of non-oil sector. The dutch disease is the condition when the country get a huge transfer of the foreign exchange due to export of booming commodity that led to appreciation of domestic currency. The result of the appreciation of domestic currency damage the non-booming commodities. In addition, Corden (1984) defines the term Dutch Disease as the negative effects on Dutch industry because of at the nineteen sixties, the Dutch discovered the natural gas, and the export of the natural gas led to the massive increase of the foreign exchange and spur the high appreciation of dutch currency.

Empirical study by Hamilton (1996) analyzes the relationship between real oil price and real exchange rate in member of OPEC country. He used monthly data from 2000:1 to 2007:12. Seven countries of OPEC member are included in his study. Using cointegration test by pooling the series of seven countries, he found that oil price may one of the main reason of the exchange rate movement. The result reveals positive relationship between oil price and real exchange rate as the OPEC membership countries is the net oil exporter country.

2.3 Literature Review

We need to discuss previous studies that have been done by researchers as a comparison to the paper. This chapter briefly discusses the previous study that related to the topic of the paper. The analysis and the results of the previous studies are synthesized into a brief summary. Furthermore, after comparing with previous studies that have been done, the chapter looks for the gap in order to do further research that has not been done yet. There are many studies that had been done that analyze the impact of oil price shock to the macroeconomic variable in some countries.

Empirical evidence on oil price to global economy

Study by Archanskaïa (2011)examines the impact of oil price to global economy. He analyzes the impact of oil price shock between 1970-2006 through supply-driven shock and demand driven shock. They focus on data from countries that are major consumers of oil since those countries are influenced by the oil price shocks.. The data of GDP is obtained from weighting the average of real GDP growth from the countries that consumer of the oil. The findings show that the supply-driven shock is exist in 1970-1992 cause negative impact to the macroeconomic of the countries while in the period of 1992-2006, the oil shock happen because of the demand-driven shock which does not suffer the macroeconomic of the countries. The explanation of these result may because at that time the countries need oil to supply the production in order to perform their economic activities.

Empirical evidence on oil price to U.S. economy

Hamilton (1983) pointed out that seven out of eight of the U.S. recessions since World War II were preceded by a sharp increase in crude oil prices. There is a constant instability in relation beetween oil prices and US microeconomic variables. Example derives from the situation in US in the eighties which showed smaller effect of oil prices to the nattional economy.

Empirical evidence on oil price to OECD countries

Jiménez-Rodríguez (2008) investigates the effect of oil price shocks on output of main industries of six OECD countries which contains four European Monetary Union (EMU) countries (France, Germany, Italy, and Spain), United Kingdom, and the United States of America.He investigates the effect of oil price shock in response to seven main industries named industry 3 (manufacturing), industry 31 (food, beverages and tobacco), (textiles, wearing apparel and leather), industry 33 (wood and wood products), industry 34 (paper and paper products), industry 35 (chemical industry), industry 36 (non-metallic mineral products), industry 37 (basic metals), and Metal products, machinery and equipment (38). The data that are used is industrial level data with sample monthly data from 1975:1 to 1998:12 for Germany, Italy, UK and US, except for France and Spain, they use monthly data from 1980:1 to 1998:12. This study also analyzes the manufacturing structures, oil consumption and other factor as the factor that may lead to differences or similarities output which is affected by the oil price shock. A recursively identified bivariate VAR is applied in the methodology and real oil price as exogenous variable and industrial output as endogenous variable. Several impulse response graphs are included in the research to show the impact of shock in oil price on several industrial outputs of the OECD countries. The result from impulse response functions of the oil price shock to the output of EMU countries (France, Germany, Italy, and Spain) is difference whereas the result for US and UK shows a similar form.

Empirical evidence on oil price to net oil exporter countries

Studies on the impact of oil price movement in net oil importer country has been examined by Al-mulali et al. (2010). They examine the impact of oil shocks on Qatar's GDP using VECM with johansen-juselius and granger causalitity test. The data is obtained from the Qatar macroeconomy data between 1970 and 2007. They found that the oil price spur to positive GDP in Qatar.

Another study by Lorde et. al (2009) analyze the macroeconomic effect of oil price in Trinidad an Tobago. They use annual time series data which are oil price, GDP, government revenue, gross investment, government consumption and the price level between 1996 and 2005. The findings show that oil price has dominant effect to macroeconomic activity of the Trinidad and Tobago. Oil price shock will lead to the negative output in the fist two period and will increase output in the following eight year.

Moreover, Ito (2008) investigates the effect of oil prices of real GDP and inflation for Russia using Vector autoregressive method. Using time series data between 1997:Q1 and 2007:Q4, he found that the increase of oil price led to the increase of real GDP in the following 12 quarter.

Empirical evidence on oil price to net oil importer countries

Studies on the impact of oil price to the macroeconomy in net oil importer countries has been done by Jbir and Zouari-Ghorbel (2009). They study the relationship between oil prices and macroeconomy by the analysis of the subsidy role in Tunisia. Using vector autoregressive (VAR) to analyze the data during period 1993 Q1 until 2007 Q3 they found that there is no direct impact between the oil price and macroeconomy of Tunisia.

Other study from net oil importer has been done by Chang and Wong (2003). They investigate the long run relationship between oil price shock to the macroeconomy of Singapore. Vector Error Correction Model (VECM) is applied. They use quarterly data between 1978 Q1 and 2000 Q3. The result from impulse response and variance decomposition reveal that oil price shock provide a negative effect to the Singapore maroeconomy

Empirical evidence on oil price to Middle East and North African (MENA) countries

Berument et al. (2010), using the VAR (Vector Autoregressive) model with an exogenous variable show that oil prices affect the MENA countries' economic performance variables: real exchange rate, inflation, and output growth. The results of the tests indicate that one standard deviation shock in oil prices has a statistically significant and positive effect on the growth of the mostly net oil-exporting economies: Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria, and the UAE. Oil price shocks do not appear to impose statistically significant effects on the economies of the other countries: Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco and Tunisia. In order to elaborate on the estimates of the latter countries, it identifies the oil shocks as oil demand and oil supply shocks. Overall estimates for the latter countries suggest that output decreases with positive oil supply shocks but output increases with positive oil demand shocks.

Empirical evidence on oil price to Asian countries

Research conducted by Cunado, J. et al. (2005) analyze the oil prices-macroeconomic relationship by means of studying the impact of oil price shocks on both inflation and economic growth rates for some Asian Countries over the period 1975Q1 – 2002Q2. They found six findings; first, because of the role of currency and the variation of domestic price, the effect of oil price is higher when oil prices are calculated in domestic currency. Second, the impact of oil price is only in the short run since the result shows that there is no cointegration vector among variables. Third, the granger causality test shows that oil price cause the economic growth in Japan, South korea and Thailand. Fourth, oil price shocks seems to provide a significant impact on inflation to all countries. Fifth, the impact of oil price to the price consumer is more significant than the impact of oil price to the economic acticity fo the Asian countries. Lastly, the impact of oil price effect is different for Asian countries.

Empirical evidence on oil price to Indonesian economy

Further research by Rosyadi (2009) analyzes the effect of oil price on output in Indonesia. He uses yearly data between 1970 and 2007 covering oil shock in 1970's. Using Vector Auto Regressive Model, he obtains the short-run and long-run relationship between oil price and output in Indonesia. The variables that he includes in his analysis are Real Gross Domestic Product (constant 2000), Real Oil Price, General Government Final Consumption Expenditure (constant 2000), and Trade value (the value of export and import). The empirical result shows there is a cointegration vector which means there is a long run relationship among variables oil price, output government expenditure and trade openness. In addition, the finding in granger causality test reveals that there is one-way relationship of the output and the oil price. The oil price infuences the output in Indonesia. Furthermore, he analyzes the impact of oil price shock when indonesia experienced as net oil exporter country and as a net oil importer country. He uses dummy variable and also the interaction between dummy variable and the oil price variable to analyze the structural break. The result also reveals that higher oil price significantly affects the output, but negatively in the long run.

Based on empirical studies above, most of the findings show that there are a negative effect of oil price and the macroeconomic variables of the net oil importer countries. In contrast, for case in net oil exporter countries, there is a reverse result which is the oil price seems to provide the positive relationship to the macroeconomic variables.

This study focuses on the impact of oil price shock on GDP and macroeconomic variables of Indonesia. The variables that use to be analyzed are GDP, oil price, inflation rate and exchange rates. In this study the writer wants to show whether the oil price shock affects positively or negatively the GDP of Indonesia. The paper applies the VECM method which is also used in the previous studies. We also use this analysis to analyze the relation between oil price, inflation and exchange rate. As mentioned before, the study on the impact of oil price to the macroeconomic variables in Indonesia has been done by Rosyadi (2009).

The gap of this paper from previous study; first, instead of seeing the impact of oil price to output, the paper also examines the effect of oil price to inflation and exchange rate of Indonesia which are not covered in previous studies. Second, the paper uses the time series quarterly data to show better result since the oil price is very fluctuated . Third, the paper uses data until 2011 which captures Global crisis and Arab spring that was not covered in the previous research by Rosyadi (2009).

Chapter 3

Data and Methodology

3.1 Data

Previously in chapter 1, we use four variables in our model to see the impact of oil price to the GDP of Indonesia. The first variables is real Gross Domestic Product as the dependent variable. The second varible is real oil price as the independent variable. These data are the main components to be investigated. Other variables are inflation and exchange rate to capture other macroeconomic variables that are influenced by the oil price. All variables are obtained from the IMF IFS(International Financial Statistic). The time series data that are applied in this paper are quarterly data between 1999 Q1 and 2011 Q4. Dummy variable is also included to separate the period before 2004 when Indonesia experienced as a net oil exporter country and after 2004 until now when Indonesia experiences as a net oil importer country. Moreover, this paper also add interaction variable between dummy variable and oil price to see the impact of oil price to the GDP when Indonesia experienced as a net oil importer country.

3.2. Definition

Gross Domestic Product (GDP)

The term real GDP is applied in this research. The data of real GDP is obtained from the IMF IFS database which is quarterly data between 1999 Q1 and 2011 Q4. The real exchange rate data is in natural logatihm.

Oil Price

Oil price that is included in this paper is world's real oil price taken from IMF IFS database. Real oil price is obtained by multiplying the world's oil price and U.S CPI and divide with Indonesian CPI. Quarterly data between 1999 Q1 and 2011 Q4 is employed. The real exchange rate data is in natural logatihm.

Inflation

The inflation is based on Indonesia CPI .The time series quarterly data between 1999 Q1 and 2011 Q4 data is obtained from IMF IFS which is the percent change consumer price over corresponding period of previous year.

Exchange rate

The term of real exchange rate which is included in this paper is the nominal exchange rate deflated by CPI.The data of nominal exchange rate is quarterly data between 1999 Q1 and 2011 Q4 obtained from IMF IFS database. In order to get the real exchange rate, we multiply the nominal exchange rate with the U.S CPI and divides with the Indonesia CPI. The real exchange rate data is in natural logatihm.

Dummy Variable

The Dummy variable is included in the model to differentiate the structural break between the period of net oil exporter and net oil importer. We set the dummy variables to DUMMY=0 for obeservation 1999 Q1 – 2003 Q4 when Indonesia experienced as a net oil exporter country and set the dummy variables to DUMMY=1 for observation 2004 Q1 – 2011 Q4 when Indonesia experiences as a net oil importer country.

Interaction Variable

To capture the effect of oil price during net oil importer country, we include interaction variable (INTRC) betwen real oil price and dummy variable.

3.3 Methodology

VAR (Vector Autoregressive) Model

In order to investigate the effect of oil price shock to the output and other macroeconomic variables of Indonesia, this paper proposes Vector Autoregressive (VAR) model. The VAR model is useful to be implemented to forecast the time series data set and also to examine the dynamic effect of shock in one variable to the other variables. Widarjono (2007: 371)states that it is common the time series model is a structural model which is based on the economic theory. Sometimes, the appropriate model cannot be determined by the existing economic theory. It is common that the theory is too complex so that we have to build the simplification or the data set is very complex if we only use the existing theory. Sims (1980) built the Vector Autoregressive (VAR) to solve the problems of the traditional structural simultaneous models and single equation models. He built VAR model to minimize the theory approach on the time series model. With this VAR, he wanted to capture the entire economic phenomenon within the model. Furthermore, with VAR that establish by Sims (1980), set of the variables are treated in equality. We do not differentiate between endogenous variables and exogenous variables in VAR. All variables are assumed to have interrelationship in the model.

Based on the VAR proposed by Sims (1980), VAR is useful to investigate this research since the paper examines the interelationship among oil price, GDP, inflation and exchange rate. In order to show the relationship among variables, we need to determine the lags number. This number of lags is used to capture the effect of those variables to the other variables in the system.

Standart n-equation VAR model based on Enders (2004: 312-313):

$$\begin{bmatrix} x_{1t} \\ x_{2t} \\ \cdot \\ x_{nt} \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \\ \cdot \\ A_{n0} \end{bmatrix} + \begin{bmatrix} A_{11}(L) & A_{12}(L) & \cdot & A_{1n}(L) \\ A_{21}(L) & A_{22}(L) & \cdot & A_{2n}(L) \\ \cdot & \cdot & \cdot & \cdot \\ A_{n1}(L) & A_{n2}(L) & \cdot & A_{nn}(L) \end{bmatrix} \begin{bmatrix} x_{1t-1} \\ x_{2t-1} \\ \cdot \\ x_{nt-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ \cdot \\ e_{nt} \end{bmatrix} \quad (3.1)$$

Where: x_{it} are the variables employed in the VAR, i
A_{i0} are the intercept terms
$A_{ij}(L)$ are the polynomials in the lag operator
e_{it} are white-noise disturbances that may be correlated.

The n-equation VAR derived from Enders (2004), can also be written as follows:

$$x_t = A_0 + \sum_{1}^{n} A_i x_{t-i} + e_t \tag{3.2}$$

Where: x_t is an (n x 1) vector containing each of the n variables employed in the VAR,
A_0 is an (n x 1) vector of intercept terms
A_i are (n x n) matrices of coefficients
e_{it} is an (n x 1) vector of error terms
The observation matrices are x_t = [Indonesia's GDP,Inflation, Real exchange rates and Real world's oil price].

Identification and restriction

According to Enders (2004: 302) the identification problem occurs when the total number of parameters in primitive system is different. This lead to under-identified or over-identified the primitive system. In order to get the the exactly-identified system, imposing restriction is needed to overcome the identification problem.

VAR process

Figure 3-1
VAR process

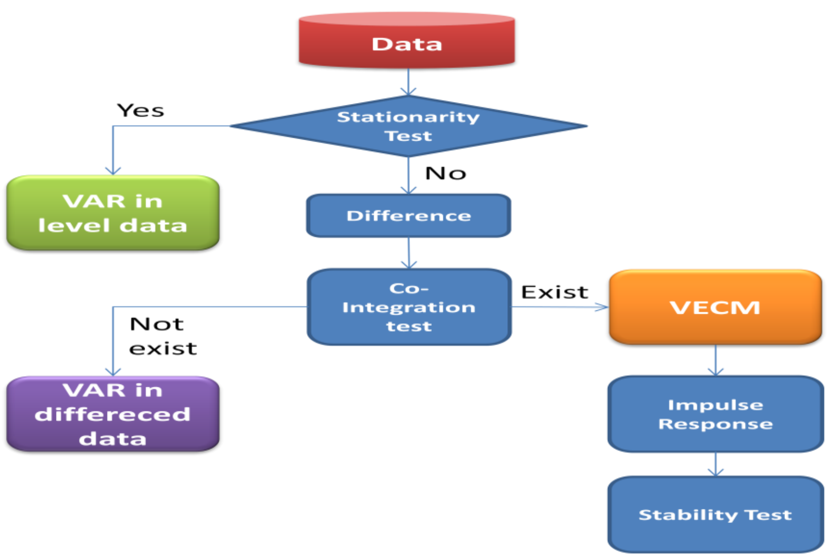


Figure 1 shows the process of VAR system. First of all the set of data should be checked in the stationary test. If the data is stationary in level, then we have VAR in level or usually known as unrestricted VAR. On the other hand, if the data is not stationary in level, then we used the data in difference. The next step when we have stationary data in difference, we should go through to check the cointegration in order to check whether there is cointegration among variables or not. If the result of cointegration test shows that there is cointegration among variables, then we have to use VECM (Vector Error Correction Model). If there is no cointegration exist, then we apply VAR in level.. Furthermore before estimating VAR/VECM model, determine the approriate lag to be included in the model. Having the appropriate lag for the model, then estimate the VAR/VECM model. Furthermore, the Impulse Response Function should be checked before conducting the stability of the model with stability test.

Unit root test

Time series data is often not stationary so cause a spurious regression. Spurious regression happens when the result of regression shows a statistically significant coefficient, but the relationship among variables in the model does not correlated Widarjono (2007: 339). Non stationary data can be said to be stationary when there is a tendency that the mean and variance is not constant. To check the stationary off the variables we need to conduct some test. There are many tests to check the stationary of the variables. There are non-formal test and formal test. Observing the stationary of the variable from the graph is a non formal test on the other hand we can also perform formal test by conducting Augmented Dickey Fuller (ADF) test. In this paper, we will investigate the stationary of the variables by performing ADF test.

Augmented Dickey Fuller test

One of the tests to check the stationary test is Augmented Dickey Fuller proposed by Dickey and Fuller (1981). According to Gujarati (2003), in the condition of u_t are correlated Dickey and fuller have built the Augmented Dickey Fuller test. Standard model specification for ADF (Augmented Dickey Fuller) unit root test is as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (3.3)$$

Where ΔY_t is the difference between variable and its own lag, β1 is a drift or constant trend, the β2 is the parameter of time trend, δ is the unit root, the rests are lag order of the autoregressive process and pure white noise error term.In order to have the correct specification model in ADF test, we have to check whether the variable is a pure random walk, random walk with drift trend or the variable is a random walk with drift trend and time trend. In addition, we also have to check the suitable number of lags to be included in the model. A procedure of unit roots by Enders (2004: 259) is attached on appendices. When we test the joint hypothesis (β1= β2=0) that is model without drift term and time trend, we use the restricted F test. Dickey and Fuller have built critical F values for this condition. Having correct specification for the model and the appropriate number of lags, then we continue to perform the unit root test. There are three equation models in ADF test:

1. Random walk without drift and trend:

$$\Delta Y_t = \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (3.4)$$

2. Random walk with drift:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (3.5)$$

3. Random walk with drift and Trend:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (3.6)$$

Where β1 is a drift trend, β2 is the parameter of of a time trend, ε_t is the white noise error. Three above are derived from equation (3.3). Equation (3.4) is derived when β_1=0 and β_2=0, Equation (3.5) is derived when B_2=0.The null hypothesis and the alternative hypothesis for the model can be written as follows:

Ho : δ = 0 (Y_t is not stationary)

H1 : δ ≠ 0 (Y_t is not stationary)

The τ statistic in Augmented Dickey fuller test is in negative sign (see appendix 2). The greater the negative sign, the more we reject the null hypothesis means that there is no unit root. So, the greater the negative value of the τ statistic, the variable is stationary. In the case we reject the null hypothesis, the variable is integrated of order 0 or I(0) and stationary, where as if we fail to reject the null hypothesis, the variable is not stationary in level. If the variable is not stationary in level, then we have to difference the variable to first difference. If the data is stationary in the first difference, then the variable is integrated in of order 1 or I(1).

This paper investigates four variables which are GDP (LNGDP), inflation (INF), exchange rate (LNRER) anda oil price (LNROIL). Based on standart model specification ADF, the equation can be written as follows:

$$\Delta GDP_t = \beta_1 + \beta_2 t + \delta GDP_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta GDP_{t-1} + \varepsilon_t \quad (3.7)$$

$$\Delta INF_t = \beta_1 + \beta_2 t + \delta INF_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta INF_{t-1} + \varepsilon_t \quad (3.8)$$

$$\Delta LNRER_t = \beta_1 + \beta_2 t + \delta LNRER_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta LNRER_{t-1} + \varepsilon_t \quad (3.9)$$

$$\Delta LNROIL_t = \beta_1 + \beta_2 t + \delta LNROIL_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta LNROIL_{t-1} + \varepsilon_t \quad (3.10)$$

Equation (3.7) , (3.8), (3.9) and (3.10) show the model specification for ADF test for GDP, inflation, exchange rate and oil price respectively.

Cointegration test

If the variable is non stationary in level, first differenced data is used. Since the variable has been differenced, variable may lead to the possibility of the existence of the long run relationship between variable. In order to check whether the variables have a long run relationship with the other variables, we use cointegration test. If there is a cointegration in differenced variable, VECM should be applied. On the other hand, if the result of cointegration test reveals that there is no cointegration in differenced data, the model will be VAR in difference.

Before conducting test for cointegration we have to specify the proper lag to be included in the cointegration test. To determine the lag-order selection, there are several methods such as final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC). We run the test that captures those methods and also captures lag order selection statistics for a series of VAR of order 1 and a sequence of likelihood-ratio test statistics for all the full VARs of order less than or equal to the highest lag order. In order to obtain the suitable lag to be included, from the result the value of the final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's and the Hannan and Quinn information criterion (HQIC) lagorder selection statistics should be checked. The fitted lag is the lag that indicated by the most the criterion.

Furthermore, after we get the fitted lag, then continue to the cointegration test. Johansen (1988) and Johanson-Juselius (1990) have proposed a method to test the cointegration. The trace test is based on Trace statistic and Maximum Eigenvalue statistic. Both of the test compare the Trace statistic or Maximum Eigenvalue statistic with its 5% critical value. The aim of Johansen test is to know how many cointegration vector in the model. If there is no cointegration it imply that there is no long run relationship between variables. In order to check the cointegration, we need to check the result of cointegration test. The table include the rank, eigenvalue,trace statistic and critical value. The null hypothesis is that the number of cointegrating relationships is equal to r, which is given in the "maximum rank" column of the output. The alternative is that there are more than r cointegrating relationships. The null is rejected if the trace statistic is greater than the critical value. Start by testing H0: r = 0. If it rejects, repeat for H0: r = 1. When a test is not rejected, stop testing there, and that value of r is the commonly-used estimate of the number of cointegrating relations. If there is cointegration exist in the Johansen test, it means that there is long run relationship between variable, and we propose the VECM (Vector Error Correction Model), otherwise we use VAR in difference.

Vector Error Correction Model (VECM)

As we discuss above, if there is cointegrated variables in the differenced variables, we built the VECM model. VECM is one of the model from vector aturoreggresive that has cointegration data. The standart model for VECM is as follows:

$$\Delta x_t = \pi x_{t-1} + \sum_{i=1}^{p} \pi_i \Delta x_{t-i} + \varepsilon_t$$

We can call the equation is a traditional VAR in first differences if all elements of π are equal to zero. In the VECM model we obtain three important structures. First, we obtain the short run coefficient matrices which include the parameters of short run adjustment of each variable with itself and to the other variables at its own lag time. Second, we obtain the long run cointegration matrix which present the long-run equilibrium relationship between the variables in x_t. Furthermore, we also obtain the matrix of the speed of adjustment terms which is an error correction if there is deviation to the long run equilibrium will be corrected gradually through short run adjustment. The negative coefficient of the speed adjustment is expected which means any deviation from the long run equilibrium will be corrected.

Impulse Response Function (IRF)

Since the individual coefficients in the VAR models are very difficult to be interpreted, we use the Impulse Response Function analysis. Impulse Response Function analysis is an important one in the VAR model. Analysis of Impulse Response Function traces the response of endogenous variables in the VAR system due to shocks or changes in the error term (Widarjono 2007: 380).

Stability Test

To check whether our model is stable or not, we have to perform stability check. The model can be said as a stable model if the moduli of the remaining r eigevalues are lower than one. The result present the plotted eigenvalue in the circle. Our model is well-specified if the eigenvalue is inside the circle.

Chapter 4

Result and Analysis

This chapter examines the result of the methodology in previous chapter. As stated in previous chapter, VAR model is implemented in the analysis.

4.1 Stationarity test

Before testing the ADF test, first we select the appropriate model for the ADF tests on LNGDP, LNROIL, INF, and LNRER using an F-type test for model specification. The result shows that the variable LNGDP, LNRER and LNOIL are a pure random walk and the variable INF is random walk with constant and trend. Appendix 2 Show the flowchart of a procedure to test for unit roots.

Having selected the correct specification for the ADF test, use the general to specific approach to select the number of lags to include for the ADF test. Based on bayesian information criterion (see appendix. 3), it is found that the variable INF appropriates with number of lag 4, variable LNGDP appropriates with number lag of lag 3, variable LNOIL and LNRER appropriate with number of lag 1.

Furthermore, getting the selected model specification for all the variables, we check for the unit root test. Table 4.2 shows the result of the ADF test in level data. As shown on the table, LNGDP and LNOIL are not significant in in all level critical value which means that we fail to reject the null hypothesis that there is a unit root. Since there is a unit root, LNGDP, LNOIL, LNRER and INF are not stationary in level.

Table 4-1
ADF test in Level data.

Variable		ADF Test	Critical Value			Result
			1%	5%	10%	
LNGDP	C&T	-1.130	-4.139	-3.495	-3.177	Unit Root
LNROIL	Noconst	0.470	-2.620	-1.950	-1.610	Unit Root
INF	C&T	-3.114	-4.139	-3.495	-3.177	Unit Root
LNRER	Noconst	-1.145	-2.620	-1.950	-1.610	Unit Root

Note: 1) Nocons means the variable is pure random walk,
2) C&T means the variable is random walk with drift and trend

Since we have unit root which means not stationary data, we have to perform further test in differenced variables. Table 4.3 shows the result of ADF test in differenced variables. All variables are significant which means that we reject the null hypothesis that there is unit root, so all variables are stationary in first difference.

Table 4-2

ADF test in first differenced data.

Variable		ADF Test	Critical Value 1%	5%	10%	Result
ΔLNGDP	C&T	-23.495***	-4.139	-3.495	-3.177	No Unit Root
ΔLNOIL	Noconst	-5.394***	-2.620	-1.950	-1.610	No Unit Root
ΔINF	C&T	-5.470***	-4.139	-3.495	-3.177	No Unit Root
ΔLNRER	Noconst	-6.791***	-2.620	-1.950	-1.610	No Unit Root

Note: 1) *** denote significance at the 1 % critival value.
2) Nocons means pure random walk, C&T mean random walk with drift and trend.

4.2 Determine lag order selection

As can be seen from the table 4.3, the final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's and the Hannan,Quinn information criterion (HQIC) lag order selection statistics and Bayesian information criterion (SBIC) show that the appropriate number of lag is lag 4. Since there are 4 criteria that propose to use lag 4, we choose lag 4 to be included in Johansen test of cointegration.

Table 4-3
Number of Lag Selection from VAR Estimates

Selection-order Criteria
Endogenous variables: LNGDP LNOIL LNRER INF DUMMY INTRC
Exogenous variables: _cons
Sample: 1998q1 – 2011q4
Number of obs = 56

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	2.23959		4.7e-08	0.156684	0.245075	0.390584
1	233.66	462.84	1.4e-11	-7.98584	-7.3671	-6.34854*
2	271.146	74.972	1.4e-11	-8.04775	-6.89867	-5.00705
3	298.375	54.457	2.4e-11	-7.68228	-6.00285	-3.23818
4	402.629	208.51*	2.1e-12*	-10.5262*	-8.31644*	-4.67872

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SBIC: Schwarz information criterion
HQIC: Hannan-Quinn information criterion

4.3 Cointegration test

From the table 4.4, we can see that there are cointegration vectors. The table includes the ranks, eigenvalues, trace statistics and critical values. The null hypothesis is that the number of cointegrating relationship is equal to r, which is given in the "maximum rank" column of the output. The alternative is that there are more than r cointegrating relationships. The null is rejected if the trace statistic is greater than the critical value. Start by testing H0 : r = 0. If it rejects, repeat for H0 : r = 1. When a test is not rejected, stop testing there, and that value of r is the commonly-used estimate of the number of cointegrating relations. In our case, H0 : r = 0 is rejected at the 5% level (182.5876> 94.15). Then we continue to the r = 1, since the trace statistic is greater than its critical value (123.1194> 68.52), we reject the null hypothesis. Furthermore, we continue to the r = 2, r =3,etc. Finally, when r = 4, the trace statistic is less than its critical value (14.8151< 15.41)and we stop to reject the null hypothesis which means we can conclude that there are four cointegration vectors in the model. The existing of cointegration vectors (four cointegration in our model) explain that the variables have a long run relationship and we should continue to use VECM (Vector Error Correction Model)

VECM restricts the long run relationship among variable so that convergent the cointegration relationship but still let the dynamic changes in short run . The terminology of cointegration is recognized as error correction, since if there is deviation in long run equilibrium will be corrected gradually with the short run adjustment (Widarjono 2007: 375).

Table 4-4 Johansen test for cointegration

Trend : Constant
Sample : 1998q2 – 2011q4
Number of obs = 55
Lags = 5

maximum rank	LL	eigenvalue	trace statistic	5% critical value
0	312.97254	.	179.3134	94.15
1	343.39333	0.71847	118.4718	68.52
2	366.59018	0.61960	72.0781	47.21
3	386.29427	0.56001	32.6700	29.68
4	395.18696	0.30963	14.8846*	15.41
5	401.86065	0.24276	1.5372	3.76
6	402.62925	0.03152		

* indicates there is 4 cointegrated vector

Having cointegration, we continue to build the VEC model. VEC estimates the parameters of cointegrating VECMs. We investigate the main points in the VECM model; the short-run coefficients and the parameters in the cointegrating equations. Since we use lag 4 as the number of lags that we obtain from previous method, we have three matrices of short run coefficient.

4.4 Short run analysis

Table 4.5 shows the matrix of short run coefficients..As can be seen, the oil price has a positive effect to the GDP and the effect is significant in one lag period.

The dummy variable reveals that the GDP during net oil exporter and net oil importer is not significantly different. In addition, the impact of oil price to the GDP does not seem has significant different between period of net oil exporter and net oil importer, though the coefficient of interaction variable in the one period lag and three period lag shows negative sign. The negative sign of these coefficients means the oil price affects GDP become lower than the period of net oil exporter. Furthermore, the effect of oil price to the inflation is also insignificant. In one and three lag period shows a positive sign while in two period lags shows a negative sign which means only in two period lags the increase of oil price decrease inflation. Moreover, we can conclude that the oil price does not seem affect the real exchange rate. All the period lags depict insignificant value. The positive coefficient only exists in one period lag means that the oil price will appreciate the real exchange rate in one lag period, but insignificant.

Table 4-5 Matrix of short run coefficients

	$\Delta LNGDP_t$	ΔINF_t	$\Delta LNRER_t$	$\Delta DUMMY_t$	$\Delta INTRC_t$	$\Delta LNOIL_t$
$\Delta LNGDP_{t-1}$	-0.89	25.98	0.39	-3.85	-13.59	-0.44
	(0.00)	(0.213)	(0.398)	(0.00)***	(0.00)***	(0.74)
$\Delta LNGDP_{t-2}$	-0.99	22.62	0.21	-0.88	-4.69	-1.79
	(0.00)	(0.35)	(0.70)	(0.52)	(0.32)	(0.25)
$\Delta LNGDP_{t-3}$	-0.97	14.88	0.37	1.58	5.547115	-0.46
	(0.00)	(0.48)	(0.43)	(0.18)	(0.17)	(0.73)
ΔINF_{t-1}	0.01	0.25	0.01	-0.01	0.01	0.01
	(0.37)	(0.14)	(0.60)	(0.99)	(0.98)	(0.44)
ΔINF_{t-2}	0.01	0.10	0.01	-0.01	-0.02	0.01
	(0.66)	(0.44)	(0.05)**	(0.43)	(0.39)	(0.75)
ΔINF_{t-3}	0.01	0.21	0.01	-0.02	-0.04	0.01
	(0.05)**	(0.12)	(0.69)	(0.04)**	(0.07)*	(0.26)
$\Delta LNRER_{t-1}$	0.07	-2.28	-0.65	0.40	2.53	1.58
	(0.06)*	(0.84)	(0.01)***	(0.52)	(0.24)	(0.03)**
$\Delta LNRER_{t-2}$	0.02	-7.22	-0.35	-0.67	-1.22	1.20
	(0.53)	(0.51)	(0.15)	(0.28)	(0.56)	(0.09)*
$\Delta LNRER_{t-3}$	0.02	3.47	-0.28	-1.13	-2.83	0.77
	(0.36)	(0.69)	(0.14)	(0.02)**	(0.09)*	(0.16)
$\Delta DUMMY_{t-1}$	0.07	3.21	0.51	-3.16	-12.66	-0.76
	(0.47)	(0.91)	(0.42)	(0.05)**	(0.02)**	(0.68)
$\Delta DUMMY_{t-2}$	-0.03	11.05	0.87	-0.73	-1.55	1.10
	(0.65)	(0.64)	(0.09)	(0.58)	(0.73)	(0.47)
$\Delta DUMMY_{t-3}$	0.03	-9.78	0.72	-4.5	-16.51	0.20
	(0.74)	(0.68)	(0.18)	(0.00)***	(0.00)***	(0.90)
$\Delta INTRC_{t-1}$	-0.03	-0.72	-0.13	0.95	3.71	0.10
	(0.32)	(0.93)	(0.50)	(0.05)**	(0.02)**	(0.86)
$\Delta INTRC_{t-2}$	0.01	-3.41	-0.23	0.24	0.49	-0.40
	(0.87)	(0.62)	(0.13)	(0.06)*	(0.71)	(0.36)
$\Delta INTRC_{t-3}$	-0.01	2.30	-0.20	1.34	4.86	-0.12
	(0.79)	(0.74)	(0.20)	(0.00)***	(0.00)*	(0.78)
$\Delta LNOIL_{t-1}$	0.04	1.46	-0.26	-0.90	-2.72	0.75
	(0.09)*	(0.84)	(0.19)	(0.03)**	(0.06)*	(0.12)
$\Delta LNOIL_{t-2}$	0.01	-1.00	0.13	-0.31	-0.78	0.45
	(0.68)	(0.88)	(0.39)	(0.41)	(0.547)	(0.30)
$\Delta LNOIL_{t-3}$	0.01	0.03	0.04	-1.69	-5.75	0.35
	(0.46)	(0.99)	(0.78)	(0.00)***	(0.00)*	(0.39)

1) ***, **, * indicates the level of significance at 1%,5%, and 10% respectively.
2) P-value is indicated in the bracket

4.5 Long Run Anaysis

The long run relationship can be explained from the table 4.6 below. As discussed in chapter three, imposing the restriction is needed to overcome the identification problem. The order of variables is set based on what we want to analyze and what is suggested by the economic model.

In this paper, we set the order of restriction to see the impact of oil price to the GDP and other economic variables such inflation and real exchange rate. Since there are four cointegration vectors, the Johansen test automatically restricts four restriction in each cointegration equation.

The sequences of the variables is important. The order of variables are; Real GDP, Inflation, Real exchange rate and Real oil price. This means that oil price is affected by its own lags but not affected by the contemporaneous shocks of exchange rate, inflation and growth. Real exchange rate is assumed not to be affected by the inflation and GDP but is assumed to be affected by the oil price contemporaneously. Inflation is considered to be affected by the oil price and exchange rate contemporaneously, but not to be affected by the GDP. In addition, GDP is considered to be affected by the oil price, exchange rate, and inflation contemporaneously, but but not vice versa.

Table 4-6
Johansen normalization restrictions imposed

	$\Delta LNGDP_t$	ΔINF_t	$\Delta LNRER_t$	$\Delta DUMMY_t$
$\Delta LNGDP_t$	1	0	0	0
ΔINF_t	0	1	0	0
$\Delta LNRER_t$	0	0	1	0
$\Delta DUMMY_t$	0	0	0	1
$\Delta INTRC_t$	-0.02	0.64	0.05	0.31
	(0.90)	(0.89)	(0.57)	(0.000)***
$\Delta LNOIL_t$	2.06	-50.55	-1.49	-0.82
	(0.04)**	(0.10)	(0.01)**	(0.000)***
Constant	5.08	202.20	14.84	2.99

1) ***, **, * indicates the level of significance at 1%,5%, and 10% respectively.
2) P-value is indicated in the bracket

Since this paper only focuses the effect of oil price to the GDP,inflation and exchange rate, we derive the cointegration equation from the Johansen normalization restrictions imposed table as follows :

The first cointegration equation:

$$LNGDP = 5.08 - 0.02\ INTRC + 2.06\ LNOIL \qquad (4.1)$$

The second cointegration equation:

$$INF = 202.20 + 0.64\ INTRC - 50.55\ LNOIL \qquad (4.2)$$

The second cointegration equation:

$$LNRER = 14.84 + 0.05\ INTRC - 1.49\ LNOIL \qquad (4.3)$$

As can be seen from the first equation, in the long run, the coefficient of LNOIL is positive and significant, we can conclude that the increase of oil price lead to the increase in GDP. The interaction variable between dummy and oil price shows a negative sign as expected and insignificant indicated that when Indonesia experienced as a net oil importer country, the impact of oil price is not significant.

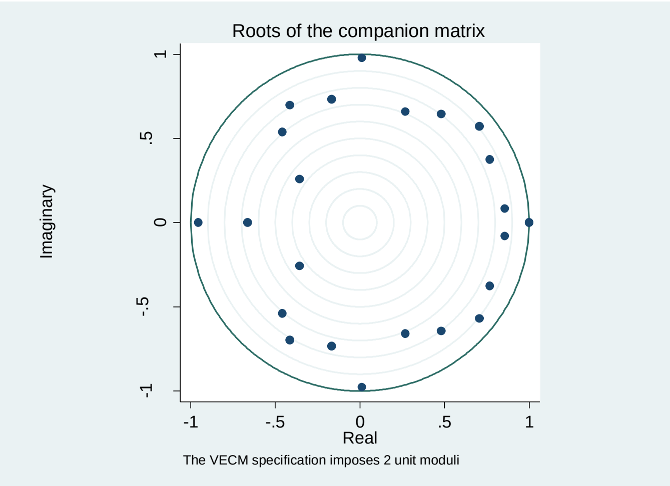
The second cointegration equation shows, in the long run, the coefficient of LNOIL is negative and insignificant to the inflation which means that the increase of oil price lead to the lower inflation. However, the positive sign of the interaction variable shows that the increase of oil price during the net importer period lead to the increase of inflation .

The third cointegration equation shows, in the long run, the increase of oil price causes the appreciate of real exchange rate. On the other hand, during net oil importer period, the oil price affect negatively to the real exchange rate but insignificant. We cannot conclude that oil price affect the real exhange rate during the net oil importer period.

4.6 Post Estimation

After we have VEC Model and estimating the parameters of cointegrating VECMs,we check the stability of the model. We run the stability test to verify whether we have correctly specified the number of cointegrating equations in the system.The result shows a stable process if the moduli of r eigenvalue are lower than one.

Figure 4-1
The Stability Graph



The graph shows that the eigenvalues exist inside the circle. No eigenvalues appear outside the circle. We can conclude from the stability check that our model is stable or well-specified.

Table 4-7
Lagrange multiplier test on lag 4

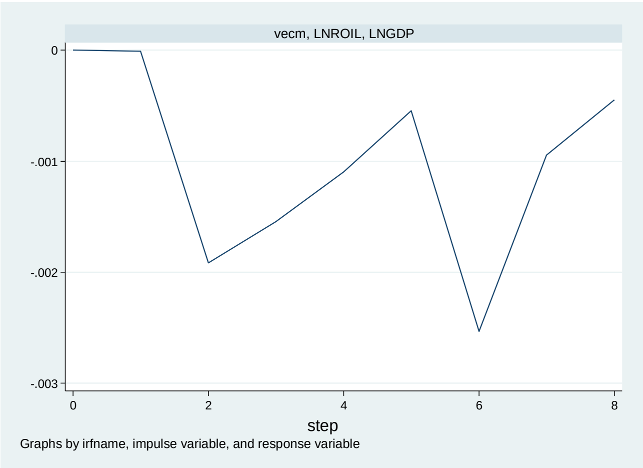
Lag	Chi2	df	Prob > chi2
1	24.5394	36	0.92611
2	42.9759	36	0.19716
3	52.7350	36	0.03549
4	25.6542	36	0.89972

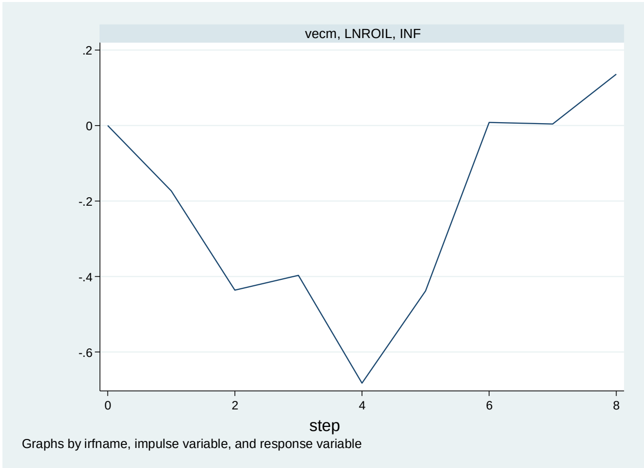
H0: no autocorrelation at lag order

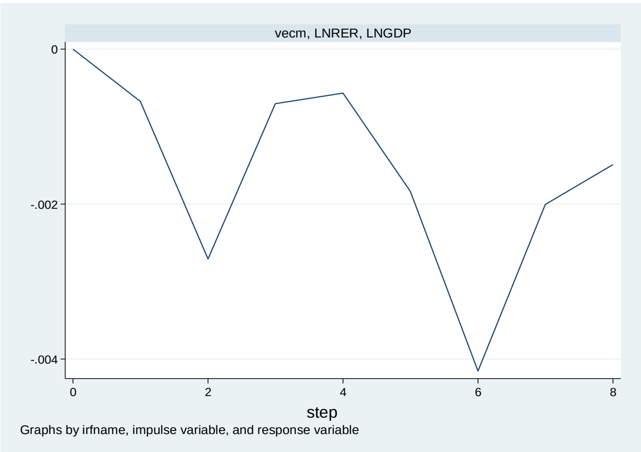
Table 4.10 shows the Lagrange-multiplier test at lag 4. The result shows that at lag 4, we fail to reject that there is no autocorrelation on the system.

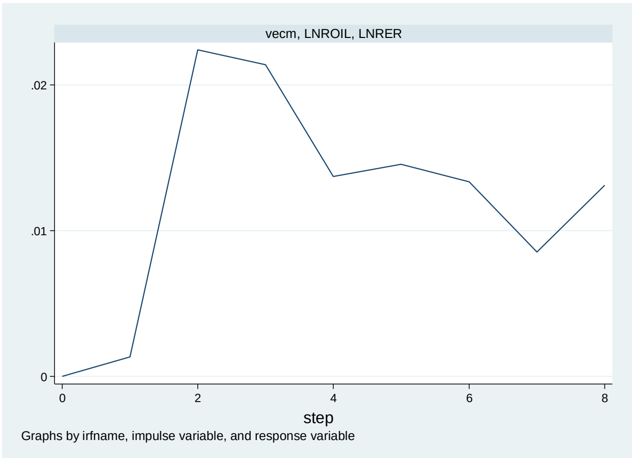
4.7. Impulse Response Function

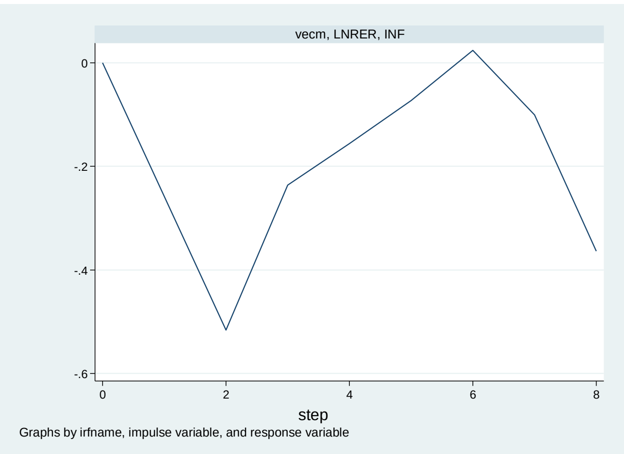
Table 4-8
Impulse Response Function

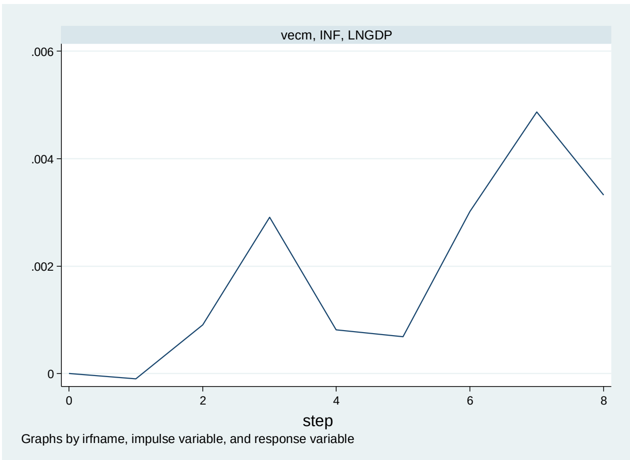












The impulse response function graphs reveal that one positive standart deviation shock on oil price will decline the GDP until periods two. The GDP increase in the following period until period 5. Furhtermore, in the next period the movements of GDP in response to oil price is fluctuated. But the movements is insignificant based on value shown in the graph.

Other picture shows that positive shock in oil price will decline the inflation until period two and continue until period four. The inflation back to the initial condition in period six and start to climb in the following period. The real exchange rate seems to response positively with the oil shock. When there is oil shock, the real exchange rate increases rapidly untl second quarter. In the following periods, the real exchange rate declines but insignificant and still higher than the initial condition. In addition, one positive shock on real exchange rate on GDP has similar pattern to the shock of real exchange rate on inflation. The trend is when there is a shock in real exchange rate, tend to decrease the GDP and inflation until two periods and in the following periods GDP and inflation increase follows by fluctuative movements in the next periods. Lastly, the impulse response functions reveal that one positive shock on inflation will increase the GDP in overall. Though there is also a fluctuative movement, but the movements is insignificant.

Discussion

To recap, this study applied the VECM method to investigate the impact of oil price to macroeconomic variable of indonesia. The short run result shows that the increase of oil price contributes a higher GDP but insignificant. GDP are lower during Indonesia experiences as a net oil importer country. This is relevant to the theory and previous studies that the oil importer country will suffer with the increase of oil price. In addition, the long run result shows that oil price affect GDP positively and significant, this is contradict with the theory and the reason may be because oil price is not the major factor that determine the GDP of Indonesia, there are other factor as Investment. Furthermore, the impulse response functions show that the response of GDP on oil price shock is fluctuative but still below the zero line which means one standart deviation on oil price lead to a decline in GDP. This paper fills the gap of the previous studies in Indonesia since it provides the inflation and exchange rate which is also the indicator of macroeconomic activity.Furthermore, using quarterly data in this paper may capture more detail information that is not provided in anually data in previous studies. The movements of oil price will be observed more detail as we know that oil price is very fluctuative. Moreover, the impulse response function is employed to investigate the response of endogen variable due to the shock of error variables.

Chapter 5

Conclusion

This study aims to examine the impact of the oil shocks on Indonesia's Gross Domestic Product and other macroeconomic variables. This study embarks from other studies that have been done in focusing how oil price affects the economy of the country. The findings from the previous studies, mostly show the impact of oil price shock to the net oil exporter countries are positive since they have been awarded by the revenue from the sale of oil while the effect of oil price shock to the net oil importer countries are negative since the government is burden by the high oil price. Indonesia has experienced as both of a net oil exporter country and net oil importer country. Previously Indonesia is a net oil exporter country which is one of the biggest oil productions in the world. In 1962 Indonesia joined OPEC and has contributed a large share in the OPEC oil production. The declining production of oil at the same time with the increasing demand of oil force Indonesia became a net oil importer in 2004.

The data used in this paper are gross domestic product (LNGDP), inflation (INF), real exchange rate (LNRER) and real world's oil price (LNROIL). Vector Error Correction Model (VECM) is employed in the methodology since there are cointegrations vector in I(1) variables. From VECM we obtain the short run coefficient matrices and the long run cointegration equation.

The results of the paper show that in the short run, the impact of the increase of oil price will spur the decline on Indonesia's gross GDP in one quarter lag and three quarter lag and significant.Only in the two period lag oil prices affect GDP negatifely, but the p-value shows the insignificant effect. The variable interaction between dummy and oil price shows that when Indonesia experiences as a net oil importer country, the effect to the GDP is negative in all quarter lag. The result also reveals that the interaction variable show significant value in one period lags and three periods lag. We can conclude, when Indonesia experience as a net importer of oil, the increase of oil price leads to the decline in the GDP. In addition, the result from the short run coefficient matrices also reveals that oil price effect the GDP positively, and in the one lag period the effect is significant. The sign of intereaction variable is negative as expected but insignificant. This means during the net oil importer period, the effect of oil price on GDP does not have significant difference compare with in net oil exporter period. Moreover, the effect of oil price to the inflation is positive but insignificant. Only in two period lags the shows a negative sign. Furthermore, oil price does not seem has a significant effect to the real exchange rate and positive coefficient only exist in one period lag means that the oil price will depreciate the real exchange rate in one lag period .

From the long run cointegration equations, the oil price is positively affects the GDP and significant while the interaction variable shows a negative sign and insignificant. We can summarize that the condition during the net oil importer, the increase of oil price tends to decrease the GDP but not significant compared with during indonesia experiences as a net oil exporter. Furthermore, we found that the increase of oil price leads to lower inflation. On the other hand, the interaction variable shows that during as a net oil importer Indonesia suffer with a higher inflation. This is what we expect, when Indonesia is a net importer oil, Indonesia will suffer from higher production cost due to the higher input cost leads to the higher inflation.In addition, the increase of oil price appreciates the real exchange rate while during the net oil importer, the increase of oil price depreciates the real exchange rate but insignificant. Furthermore, during net oil importer, the effect of oil price tends to disturb the economic performarnce although the effect is insignificant. But in the long run, Indonesia will suffer more due to the increase of oil price. Some of the results does not seems to accomodate the hypothesis because oil price may not the only factor that affects GDP.

The appropriate policy should be implemented to overcome the problem. The reduction of subsidy might be a good policy to be implemented. Cheap price of subsidized fuel trigger more consumption of the domestic oil. The reduction of the subsidy will keep the sustainability of the domestic oil source. The other concern is Indonesia should create a condusive environment for oil sector investment. If Indonesia can keep the domestic oil consumption and rising the oil production, in the future indonesia might be a net oil exporter country. Furhtermore, the fund obtained from the subsidy reduction can be transferred to fund strategic programs such as health and education programs that can escalate the economic growth.

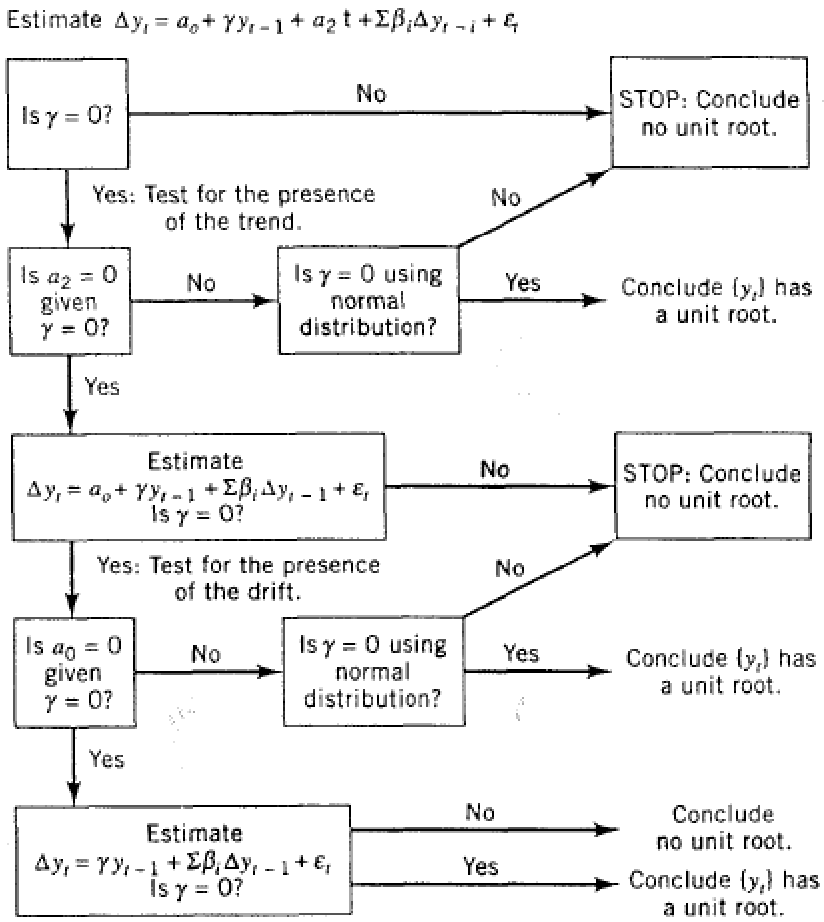
Finally, this paper has some limitation due to lack of the data. Longer period of the data would be better to obtain better result. In addition, some of the results does not seems to accomodate the hypothesis because oil price may not the only factor that affects GDP .Other variables should be included for the further research such as subsidy and investment variable. We need to include subsidy in order to avoid bias, since Indonesia oil price is related to the subsidy. The insignificant effect by the increase of oil price can be explained as oil price is not the only factor that influence GDP. Invesment might be contribute larger effect on GDP. Further study need to be done to to investigate the influence of other factor on output.

Appendices

Appendix 1. Data

Period	GDP	Oil Price	Exchange Rate	Inflation
1999q1	329840	11.6433	8775.7	55.949
1999q2	326404	16.03	7921.2	30.911
1999q3	338819	20.4433	7531.03	6.586
1999q4	330829	23.8067	7192.67	1.654
2000q1	342852	26.6167	7390.93	-0.573
2000q2	340865	26.7667	8286.93	1.101
2000q3	355290	29.8833	8711.87	5.728
2000q4	350763	29.67	9297.37	8.816
2001q1	356115	26.07	9779.7	9.346
2001q2	360533	26.7267	11241.7	11.149
2001q3	367517	25.2133	9614.1	12.762
2001q4	356240	19.3133	10407.9	12.643
2002q1	368650	20.9233	10157.8	14.541
2002q2	375721	25.2033	9076.6	12.557
2002q3	387920	26.9367	8955.7	10.373
2002q4	372926	26.7367	9054.67	10.275
2003q1	386744	31.3367	8905.5	7.745
2003q2	394621	26.4867	8479.3	7.004
2003q3	405608	28.3833	8441.27	6.111
2003q4	390199	29.36	8482.47	5.547
2004q1	402597	32.13	8469.6	4.882
2004q2	411936	35.6267	9001.43	6.734
2004q3	423852	40.5533	9156.17	6.962
2004q4	418132	42.73	9128.2	6.383
2005q1	426612	46.1267	9274.3	7.733
2005q2	436121	50.78	9550.53	7.645
2005q3	448598	59.9633	9994.53	8.413
2005q4	439484	56.5467	9999.6	17.793
2006q1	448485	61	9274.87	16.917
2006q2	457637	68.3	9115	15.51
2006q3	474904	68.7633	9122.53	14.866
2006q4	466101	59.0267	9124.87	6.053
2007q1	475642	57.1933	9107.17	6.583
2007q2	488421	66.13	8968.27	6.286
2007q3	506933	73.57	9242.27	6.44
2007q4	493331	87.6167	9246.3	6.325
2008q1	505219	95.47	9248.2	6.521
2008q2	519205	121.113	9265.27	9.022
2008q3	538641	115.47	9222.45	11.964
2008q4	519392	56.0867	11059.9	11.502
2009q1	528057	44.2067	11630.8	8.563
2009q2	540678	59.17	10509	5.644
2009q3	561637	68.22	9965.7	2.766
2009q4	548479	75.5067	9454.25	2.588
2010q1	559279	77.0467	9270.5	3.651
2010q2	574539	78.1367	9131.93	4.371
2010q3	594069	75.5033	8995.03	6.15
2010q4	585951	85.44	8964.27	6.316
2011q1	595227	99.6567	8897.17	6.837
2011q2	611625	110.137	8584.17	5.892
2011q3	632430	103.04	8599.97	4.668
2011q4	623960	103.19	9000.43	4.118

Appendix 2. Procedure of unit root test



Source: Ender (2004:259), Figure 4.7

Appendix 3. Number of lag in ADF test based on BIC

Lags	LNGDP	INF	LNRER	LNROIL
1	-242.5669	240.2897	-139.5499*	-40.60654*
2	-236.8139	226.4297	-134.6102	-36.05549
3	-303.9547*	222.8817	-133.7979	-32.92859
4	-301.8259	219.2673*	-131.1906	-27.29031

*Indicates the suitable lag in ADF test

Appendix 4. Result of ADF Test

. dfuller LNGDP, trend lags(3)

Augmented Dickey-Fuller test for unit root Number of obs = 48

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.130	-4.168	-3.508	-3.185

MacKinnon approximate p-value for Z(t) = 0.9239

. dfuller d.LNGDP, trend lags(2)

Augmented Dickey-Fuller test for unit root Number of obs = 48

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-23.495	-4.168	-3.508	-3.185

MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller INF,trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 47

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.114	-4.178	-3.512	-3.187

MacKinnon approximate p-value for Z(t) = 0.1029

. dfuller d.INF,trend lags(3)

Augmented Dickey-Fuller test for unit root Number of obs = 47

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-5.470	-4.178	-3.512	-3.187

MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller LNRER, nocons lags(1)

Augmented Dickey-Fuller test for unit root Number of obs = 50

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.145	-2.620	-1.950	-1.610

. dfuller LNRER, nocons lags(1)

Augmented Dickey-Fuller test for unit root Number of obs = 50

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.145	-2.620	-1.950	-1.610

. dfuller d.LNRER, nocons

Dickey-Fuller test for unit root Number of obs = 50

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.791	-2.620	-1.950	-1.610

Appendix 5. Number of Lag Selection from VAR Estimates

. varsoc LNGDP INF LNRER DUMMY INTRC LNROIL

Selection-order criteria
Sample: 2000q1 - 2011q4 Number of obs = 48

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	2.23959				4.7e-08	.156684	.245075	.390584
1	233.66	462.84	36	0.000	1.4e-11	-7.98584	-7.3671	-6.34854*
2	271.146	74.972	36	0.000	1.4e-11	-8.04775	-6.89867	-5.00705
3	298.375	54.457	36	0.025	2.4e-11	-7.68228	-6.00285	-3.23818
4	402.629	208.51*	36	0.000	2.1e-12*	-10.5262*	-8.31644*	-4.67872

Endogenous: LNGDP INF LNRER DUMMY INTRC LNROIL
Exogenous: _cons

Appendix 6. Result of Johansen test

```
. vecrank  LNGDP INF LNRER DUMMY INTRC LNROIL, lags(4)

                       Johansen tests for cointegration
Trend: constant                                        Number of obs =      48
Sample:  2000q1 - 2011q4                                        Lags =       4
-------------------------------------------------------------------------------
                                                         5%
maximum                                      trace    critical
  rank    parms       LL       eigenvalue  statistic    value
    0      114    312.97254         .       179.3134    94.15
    1      125    343.39333     0.71847     118.4718    68.52
    2      134    366.59018     0.61960      72.0781    47.21
    3      141    386.29427     0.56001      32.6700    29.68
    4      146    395.18696     0.30963      14.8846*   15.41
    5      149    401.86065     0.24276       1.5372     3.76
    6      150    402.62925     0.03152
-------------------------------------------------------------------------------
```

Appendix 7. Result of Stability test

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
.01297713 + .9779372*i*	.978023
.01297713 - .9779372*i*	.978023
-.9537705	.95377
.7060899 + .5709747*i*	.908061
.7060899 - .5709747*i*	.908061
.8564367 + .08158786*i*	.860314
.8564367 - .08158786*i*	.860314
.7677125 + .3755649*i*	.854653
.7677125 - .3755649*i*	.854653
-.4145301 + .697153*i*	.811084
-.4145301 - .697153*i*	.811084
.4811808 + .6432334*i*	.803296
.4811808 - .6432334*i*	.803296
-.1681378 + .7323662*i*	.751419
-.1681378 - .7323662*i*	.751419
.2688222 + .6584708*i*	.711231
.2688222 - .6584708*i*	.711231
-.4583146 + .5389135*i*	.707446
-.4583146 - .5389135*i*	.707446
-.6644024	.664402
-.3580014 + .2575463*i*	.441016
-.3580014 - .2575463*i*	.441016

The VECM specification imposes 2 unit moduli.

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