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OIL PRICE SHOCK: ITS TRANSMISSION AND EFFECT TO THE INDONESIA'S ECONOMY

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ABSTRACT

The research reviewed the impacts of the price changes against the economic variables especially the price of producers, the price of consumers (inflation), and the industrial production in Indonesia. The research employed ARDL and VAR methods for calculating the effect accumulation of the price changes and other associated variable. The result of the research shown that the variation of the effects accumulation apparently was more caused by the changes of the variable of producers price, the price of consumers (inflation),and the industrial production itself. The effect of the price changes of the petroleum was relatively low which was possibly caused by the subsidy policy combined by the company expense structure, the amount of food portion in inflation calculation and the changes of currency exchange rate.

Penelitian ini mengkaji dampak perubahan harga minyak terhadap variable ekonomi khususnya harga produsen, harga konsumen (inflasi), dan produksi industri di Indonesia. Penelitian ini menggunakan metode ARDL dan VAR untuk menghitung akumulasi efek dari perubahan harga minyak dan variabel yang terkait dengan efek tersebut. Hasil penelitian ini menunjukkan bahwa variasi dari akumulasi efek tersebut ternyata lebih disebabkan oleh perubahan dari variable harga produsen, harga konsumen (inflasi), dan produksi industry itu sendiri. Efek dari perubahan harga minyak cukup rendah yang kemungkinan besar disebabkan karena kebijakan subsidi yang dikombinasikan dengan struktur biaya perusahaan, besarnya porsi makanan dalam perhitungan inflasi, dan perubahan nilai tukar.

1. INTRODUCTION

1.1. Background of Study

As a main resource, oil has penetrated every sector of the economy, in particular the industrial sector that uses it as its main input. Oil has an important role in sustaining the world economy. For Indonesia specifically, oil has the largest portion of final energy consumption, which is more than 57% on average for the last eleven years. In addition, oil still dominates coal and gas as an energy source, with the industrial sector as the largest oil consumer. As a commodity, world oil prices are constantly changing according to market mechanisms (supply and demand). Historically, oil has experienced dramatic ups and downs in prices. Oil price volatility can affect the consumption levels of both industry and households and, to some extent, affect the economy as a whole.

Since Indonesia is no longer a net oil exporter, the effect of oil price volatility to the economy might be significant. By 2004, Indonesia had become a net oil importer, though it still exports some oil (Bradsher, 2008). This was caused by the downward trend in oil production for the past decade paired with the increasing consumption of oil products. Indonesia's reserves continue to diminish since most of its oil production is from mature fields. In addition, the declining investment in oil infrastructure has resulted in a drop in output below one million barrels per day. In the mid-1990s, Indonesia's average oil production was about 1.5 million barrels per day, but now it is only about 950 thousand barrels per day. These factors led the government to withdraw its membership from OPEC. A study from Cunadoand Gracia (2004) finds that there have been four main negative oil shock periods: 1978-1979, 1989-1990, 1999-2000, and 2007-2008. The effect of oil price volatility to the Indonesian economy in these periods is not very clear.

When the oil shock occurred in 1989-1990, Indonesia's economic growth only decreased 0.1%, from 9.1% to 9%, while the inflation rate rose by 3.56%. At that time, the average price of West Texas Intermediate (WTI) crude oil increased significantly, by around 25% from $19.6/barrel to $24.5/barrel. In 1999-2000, oil prices, inflation and economic growth all moved in the same direction. Oil prices increased by 58.8%, inflation rose 7.3%, and economic growth went up 4.1%. In the most recent oil shock in 2007-2008, an increase in oil prices had a different result on the Indonesian economy. When oil price increased 38.6%, the inflation rate went up by more than 4%;

however, economic growth declined by 0.3%. One year later, when oil prices decreased 38%, economic growth also decreased 1.5%. Finding out how exactly oil shocks affect Indonesia's economy makes this topic interesting to be explored. The existence of a price control policy through subsidies inIndonesia may lessen the effects of oil price increases to the economy. In developed countries, the effects of oil price increases are quite clear. Because developed countries do not implement oil subsidies, the effects of oil price increases will be fully transferred to the market, generally called supply-side effects. The increase in oil prices will add the scarcity of energy as basic input to production. It will then reduce the growth of output and production, give pressure to wages and increase unemployment. However, these effects are not likely in Indonesia. The implementation of subsidies can distort prices by setting them at lower levels, so the increase in oil prices will not fully affect the economy (incomplete transfer). The implementation of subsidies is intended to help the poor meet their basic needs; subsidies are focused on consumers in the form of under-priced products, though producer subsidies also exist (Morgan, 2007). The government subsidizes a number of products such as fertilizer and seeds, food, electricity, and fuel. Knowing how far subsidies distort the effects of changes in oil prices to the economy is one question that needs to be answered.

For the next few years, Indonesia's dependence on oil is predicted to be even greater. Volume of oil consumption continues to show an upward trend and the deficit is predicted to reach 400,000 barrels per day by 2020. Indonesia's dependence on imported oil to meet domestic consumption needs is not a good condition; it makes the domestic economy more volatile in accordance with the changes of oil prices. In addition, when oil price increases, the state budget's allocation for subsidies must also increase. It will reduce the productivity of the state budget in shaping the economy and creating jobs, considering that subsidies are not categorized as productive spending. Some argue that it would be better if the budget for subsidies were allocated for building infrastructure that supports economic growth such as roads, railways, airports, schools etc. Knowing the effect of changes in oil prices to the economy will be very helpful to policy makers to deal with this issue and prepare appropriate actions. Based on the reasons as explained above, this paper will focus on studying how oil price shocks affect the Indonesian economy and studying the transmission channels of oil price shocks.

This paper is organized as follows. Section II reviews the literature and explains fuel subsidies in Indonesia. Section III describes the data and the methodology. Section IV presents the estimation results and output analysis and section V provides theconclusion.

2. LITERATURE REVIEW AND HYPOTHESIS

2.1. Previous Study

Past research on this question has shown differing results. Researchers who used developed countries as their samples gave results which went beyond what was expected. Generally, they concluded that the effect of oil price shock to the economy was not from the change in oil price itself but from the resulting monetary policy implemented. For instance, Bohi (1989) investigated the importance of energy shocks to the economy using the United States, the United Kingdom, Germany, and Japan as his samples. He found that tight monetary and fiscal policies during the periods of price shock were responsible for the general weakening of those countries' economies. This result was reinforced by Bernanke, Getler, and Watson (1997) and was in line with Hamilton (1983). There are several weaknesses in these examples. By using developed countries as their sample, it is clearly understandable that those results were obtained. Developed countries do not subsidize their domestic oil prices; the effect of an oil price increase will be completely transferred to the economy. As stated above, the increase in oil price will add the scarcity of energy as basic input to production and will then reduce the growth of output and production. On the other side, as stated by Taylor (2000), the increase in oil price will raise the level of inflation and inflation expectation. The central bank will increase the level of interest rates in anticipation of this expectation. Pressures on production output and increases in inflation will weaken the economy. However, there still remains the question of how increases in oil prices will affect developing countries which have different government policies and industrial structures. We assume it will lead us to a different coefficient of the effect of oil price changes.

Not many researchers use developing countries as their sample. Kumar (2005) tried to figure out the effect of oil shocks to macroeconomic variables in India. He found that oil prices Granger cause macroeconomic activities and gave an asymmetric impact on industrial growth. Cunado and Gracia (2004) used six countries in Asia as their sample and found that the relationship between oil price and economic activity was significant. The oil price effect was higher on inflation when it wasexpressed in local currencies. However, its effect was limited only to the short-run. They failed to reveal the long-run relationship between those two variables. Another study gave conflicting results. Tang, Wu, and Zhang (2009) used China as their sample. They found that there was a long-run relationship between oil price shocks and growth. However, they found no evidence for a direct relationship between oil prices and the CPI in short run. Oil price only affected PPI whose impact also in CPI. As a result, there was a channel for oil price to influence the level of inflation through the PPI. A small amount of research that uses developing countries as sample and the uncertainty of oil price effects to the economy in either the short-run or the

long-run shows that this topic is interesting to explore and gives an ample opportunity for more research.

2.2. Domestic Oil Price in Indonesia

The government of Indonesia introduced subsidies for social considerations. Their purpose is to make basic needs available at prices which are affordable for the poor. Subsidies cover several oil products: gasoline, kerosene and diesel. The price of these products is set by the stated-owned energy company (Pertamina). However, Pertamina needs the government's approval when it plans to increase the prices of these products. As shown in Figure 1, international oil prices followed the upward trend until July 2008, when it went down, but returned to its increasing trend in January 2009. To some extent, the prices of gasoline, kerosene and diesel in Indonesia responded to the fluctuation of international oil prices. The first increase in the prices of gasoline, kerosene and diesel was in February 2005. At that time, the international oil price had increased around 48% compared to January 2003. Even at a glance, we can see that while international oil prices were trending upward from January 2003 to January 2005, the prices of gasoline, kerosene and diesel did not respond at all in Indonesia. This was because of the existence of subsidies that absorbed the effects of the increases in international oil prices. Once the government thought that the budget for subsidies could no longer bear the effects of the increases in international oil prices, it decided to increase the prices of gasoline, kerosene and diesel to keep government expenditure at a safe level. This occurred again in October 2005, when international oil prices increased by 30% compared to February 2005. The government responded by allowing the price of gasoline to increase by 87.5% and it doubled the price of diesel. However, the government slightly decreased the price of kerosene by around 9%, considering that most consumers of kerosene were from low income households. In May 2008, the government again increased the prices of gasoline, kerosene, and diesel by around 33%, 28%, and 25%, respectively, in anticipation that the trend of international oil prices would continue to increase. International oil prices reached a peak in July 2008 and declined to their lowest level in December 2008. The government responded to the decrease in international oil prices by letting the prices of gasoline and diesel go down three times: December 1, 2008, December 15, 2008, and January 15, 2009 by total 25% and 18%, respectively. Since then, the prices of gasoline, kerosene, and diesel have been stable up to now, even while international oil prices have been constantly changing. This recent history illustrates that domestic oil prices do not directly respond to the fluctuations of international oil prices. While international oil prices fluctuate, Indonesian oil prices tend to be stable as long as they remain in the price range that the budget for subsidies can cover.

Another important point that should be noted is that sometimes politics are involved in the decision to increase or decrease domestic oil prices. For instance, there was speculation that the motivation behind the government's decision to decrease the domestic oil prices in 2008 was not purely economic, or solely as a response to the decrease in international oil prices. It could have been political, because the incumbent president was running again in an election in 2009. This speculation is reasonable because at that time the domestic oil prices in Indonesia were still below the international prices. If the government really wanted to set its domestic oil prices close to international prices to reduce the amount of subsidies in the next few years, it was unnecessary to decrease its domestic oil prices.

2.3. Fuel Subsidy

Morgan (2007) shows that the energy subsidy in Indonesia has focused on consumer subsidies in the form of under-pricing of energy, though producer subsidies in the form of tax expenditure also exist. In a previous publication (Morgan, 2004), he elaborates on the way subsidies work, which depend on the form of subsidies. In OECD countries, subsidies are commonly given to the producers in the form of direct payment as a grant paid for each unit of production or support for research and development. In developing countries, most subsidies go to consumers, and often take the form of price controls. In this case, the government sets a certain price ceiling for domestic oil which is commonly below full cost. If the price of domestic oil rises above the price ceiling, the government must increase the subsidy allocation to cover this price difference. In Indonesia's case, the state-owned energy company (Pertamina) sets the domestic prices of oil products each month based changes in international oil prices (Hoetomo, 2004). If international oil prices rise, Pertamina can increase the domestic price of oil products as long as they still remain below the ceiling prices set by the government. If there are conditions that push the domestic oil prices above the ceiling prices (such as an increase in international oil prices that is higher than predicted or actual oil consumption that is higher than budgeted for), the government has two choices: either increase the budget allocated for subsidies or allow Pertamina to increase its prices to avoid financial losses. In these cases, the fluctuation of international oil prices could determine the total amount of subsidies. As shown in Figure 2, the amount of fuel subsidies rises when international oil prices increase and falls when international oil prices decline.

Two major hikes in the amount of subsidies occurred in 2005 and 2008. In 2005, the average price of oil was US$56.60/barrel, an increase of more than 36% compared to the price in 2004. This forced the central government to raise the size of fuel subsidies to Indonesian Rupiah (IDR) 95.5 trillion. Anticipating that the subsidy spending was getting larger and would increase the state budget deficit, the central

government made the decision to raise domestic oil prices. Increases occurred twice, in March and October 2005. In 2005, the price of kerosene almost doubled, the price of gasoline rose 150%, and the price of diesel fuel increased 160%. In addition, the government also reduced the number of fuel products which were eligible for subsidies. Since October 2005, diesel oil and fuel oil for industries have not received subsidies; while gasoline, diesel, and kerosene still get subsidy.

In 2008, the amount of subsidies allocated for fuel significantly increased with the increasing prices of oil, which reached more than US$100/barrel on average. In that year, the subsidy amount rose more than 65% compared 2007. To reduce the pressure on the state budget, the government increased domesticoil prices in May 2008. The price of kerosene increased 25%, the price of gasoline rose 33%, and the price of diesel fuel increased 28%. In the same year, the government also announced a policy to reduce Indonesia's dependence on oil. The government planned to phase out the sale of subsidized fuel for private cars and restrict it to public-transport providers and motorcycles. This program is expected to be fully implemented by 2014. The government also designed another program to reduce the burden to low income households due to the increase in fuel prices; it designed a compensation program in the form of cash transfers given to 19 million families, at a total amount of IDR 14 billion. In addition, the government has planned to implement programs to reduce the amount of its fuel subsidy including reducing the volume of subsidized fuel by implementing energy diversification, closed distribution systems, fiscal incentives and disincentives; designing compensation variance programs such as transforming the price subsidy to a direct subsidy, a social safety net to shield the vulnerable; and focusing on fuel price reference: by minimizing fuel distribution cost, full cost absorption of fuel provision, effective targeting and costing of fuel subsidy.

2.4. Research Hypotheses

This paper proposes hypotheses that oil price will significantly affect macroeconomic variables in the sense that oil price increase (decrease) will raise (lower) wholesale price, raise (lower) consumer price, and lower (raise) industrial production. It is expected also that oil price fluctuation will mostly explain the variance in those macroeconomic variables.

3. RESEARCH METHODOLOGY

3.1. Variables and Data Description

This research is based on time series data taken from the Ministry of Finance of Indonesia and the Statistical Agency of Indonesia. Variables developed in this paper are measured based on Indonesia's monthly data with the sample from January 2000 to September 2011 (140 observations). To test the validity of the transmission mechanism, this paper develops variables as follows:

1. Oil price inflation. This is the growth in oil price measured in domestic currency by the formula:

$$\pi_t^{oil} = \frac{(WTI_t) - (WTI_{t-1})}{WTI_{t-1}}$$

In this sample period, the average oil price inflation is 0.0132 with a standard deviation of 0.0847. It has been very volatile compared to the other three variables. In 2008, oil prices experienced an increasing trend as financial crises occurred and then continued to drop after reaching their peak on July 11. Taking correlation among those variables, it shows seen that oil prices have a positive correlation with wholesale price inflation and the growth of the industrial production index. However, it has an unexpected negative correlation with consumer price inflation, though the coefficient is small.

2. Wholesale price inflation. This is the growth in the wholesale price index, which is measured with the base year 2000=100. Wholesale price inflation is measured by this formula:

$$\pi_t^{WPI} = \frac{(WPI_t) - (WPI_{t-1})}{WPI_{t-1}}$$

Over sample period, the average value of wholesale price inflation is 0.0078 with a standard deviation of 0.015. Wholesale price inflation is relatively stable over time. It has positive correlation with oil price inflation and consumer price inflation, suggesting that these variables will move together in the same direction.

3. Consumer price inflation. This is the growth in the consumer price index, which is also measured with the base year 2000=100. Consumer Price Index (CPI) itself is an indicator of price movements of goods and services consumed by households from retail transactions. Consumer price inflation is measured by this formula:

$$\pi_t^{CPI} = \frac{(CPI_t) - (CPI_{t-1})}{CPI_{t-1}}$$

The average value of consumer price inflation is 0.0065 with a standard deviation of 0.0087 over the sample period. Consumer price inflation was stable over time with the exception of October 2005, when the government increased the price of premium/gasoline (87.5%), diesel fuel (104.8%), and kerosene (185.7%). Inflation in 2005 was 17.11%, much higher than the targeted inflation which was 6% ± 1%. Consumer price inflation has a positive correlation with wholesale price inflation and, surprisingly, it has a negative correlation with oil price inflation.

4. The growth in the Industrial Production Index. This variable is developed as the proxy of economic activity which is measured with the base year 2000=100. This variable measures the changes in real production of large and medium non-oil manufacturing establishments. The industrial production index experiences seasonal patterns and has been adjusted by using the Census X-12 approach which was developed by the U.S. Census Bureau for decomposition of seasonal time series. Over the sample period, the average value of growth in industrial production is lower compared to the other three variables at 0.0055 with a standard deviation of 0.0508. It has positive correlation with oil price inflation, suggesting that these two variables will move together in the same direction. The growth in industrial production itself is computed by this formula:

$$\pi_t^{IPI} = \frac{(IPI_t) - (IPI_{t-1})}{IPI_{t-1}}$$

3.2. Methodology

This research will achieve its purpose by developing the following procedures. It will test the transmission channels of oil shocks to the economy.

1. The Stationarity Test.

As a first step to processing the data, the unit root test is employed to test the stationarity. It is important to know whether the data is stationary or not. If the variables in the regression model are not stationary, we cannot assume that the standard t-test is valid since the t usual ratio does not follow the normal t distribution. Another reason is that it would produce a spurious coefficient. The regression test will yield a high R-squared even though the variables are not related, since these variables experience trending over time (Wooldridge, 2009). The Dickey-Fuller test with Akaike's Info Criterion (AIC) for lag length is carried out for all variables.

2. Auto-Regressive Distributed Lag Model (ARDL)

To examine the degree of pass-through from oil price, the IMF's model (WEO, 2011) is employed by regressing wholesale price inflation, consumer price inflation, and the growth of industrial production on current and 12 lags of monthly oil price, controlling for 12 lags of each dependent variable. The reason for using a lag in this model is that the effect of oil price changes will not occur instantaneously, but rather last over finite periods. When there is shock on oil price at t, the effect is predicted to last to some extent in the future (t+1, t+2,...,t+n). In other words, the changes in the economic variables now could be caused by the shock of oil price in a previous period. In particular, the estimated equation is as follows:

$$\pi_t^{WPI} = \sum_{j=1}^{12} \beta_j \pi_{t-j}^{WPI} + \sum_{k=0}^{12} \gamma_k \pi_{t-k}^{oil} + \varepsilon_{i,t} (1)$$

$$\pi_t^{CPI} = \sum_{j=1}^{12} \beta_j \pi_{t-j}^{CPI} + \sum_{k=0}^{12} \gamma_k \pi_{t-k}^{oil} + \varepsilon_{i,t} (2)$$

$$\pi_t^{IPI} = \sum_{j=1}^{12} \beta_j \pi_{t-j}^{IPI} + \sum_{k=0}^{12} \gamma_k \pi_{t-k}^{oil} + \varepsilon_{i,t} (3)$$

The first equation estimates the effect of oil price to wholesale price inflation. In this equation, oil price independently and directly affects wholesale prices under the basic assumption that oil is used as a main input in the production process. The second equation shows the consumer price inflation as a function of oil price. This equation investigates whether the oil price effect will be transmitted to consumer price with the existence of a subsidy policy. The last equation shows the effect of oil price on the growth of industrial production. This equation tries to find the effect of oil prices on broad economic activities. To know the degree of the long-term pass- through coefficient, we take a sum of the coefficients on oil price inflation (γk) divided by 1 minus the sum of the coefficients on lagged of each dependent variable (βj).

3. Vector Auto-Regressive (VAR)

Following Hooker (2002), Kilian (2006), and Davis and Diaz (2008), the vector autoregressive (VAR) model is employed to quantify the effect of changing oil prices on the Indonesian economy. VAR is used in this research because of its capability as a tool to accommodate shock into the model. In this case, the shock is oilprice. Ptaff (2008) expressed VAR in the following form:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t$$

where:
y_t: a vector of endogenous variables at time t,
A: coefficient vectors (i = 1,...,p),
p : number of lags in the system
ε_t:a vector of residuals

In this paper, recursive VAR is employed instead of reduced form VAR. A recursive VAR not only estimates the current level of a variable based on the past movement of that variable and the other variables in system, but also includes some contemporaneous values as regressors. This is done to construct the error terms in the each regression equation to be uncorrelated with the error in the preceding equations (Stock and Watson, 2001). This paper employs three recursive VAR equations to examine the effect of oil price changes on wholesale price inflation, consumer price inflation, and growth of industrial production. The contemporaneous regressor in each equation is oil price inflation. In addition, impulse response function is also used in this model, because it gives information about when the economic variables will respond once the shock hits the system. Finally, Cholesky variance decomposition is used to determine the proportion of

the forecast-error variance of each endogenous variable attributable to each shock at different forecast horizons.

4. RESULTS AND FINDINGS

4.1. The Stationarity Test

The Dickey-Fuller test gives the result that all variables are stationary at the 1% significance level. In other words, all data have the t usual ratio that follows the normal t distribution and do not produce spurious regression. In this case, all variables are ready to enter the Auto-regressive Distributed Lag Model and Vector Auto-Regressive Model.

4.2. Auto-regressive Distributed Lag Output

This empirical study shows that there is strong evidence that oil price affects wholesale price inflation. According to the Auto-regressive distributed lag model, wholesale price inflation is positively related to oil price inflation. Column 2 of Table 1 shows that the highest coefficient of oil price is 0.092 at the current time, which is significant at the 1% level according to the t-statistic test. This positive relationship remains until lag 3 and then fades away. The effect of oil price appears again at lag 5 with a small coefficient and is only significant at the 10% level. The evidence that oil price changes affect wholesale prices is accordance with the conditions in Indonesia. Since October 2005, the government has no longer provided subsidies for diesel oil for industrial purposes; the government continues to implement subsidies for gasoline, diesel, and kerosene for retail consumers, but not for industry. When there is no longer a subsidy, the price of domestic fuel for industry will fluctuate according to the international price of oil. In this case, the increase in oil price will raise the input cost for industry and finally increase the prices of goods at the producer level. However, the degree of long term pass-through is quite small (0.0758 or 7.5%). The cost structure of the companies could be one of the reasons why this effect is so small. Data from the Ministry of Energy shows that for the last eleven years (2000-2010), the industrial sector has consumed, on average, 42% of total energy. From this, the greatest portion of energy used in industry is coal (25%). Oil which is used as fuel comes in at second place (23%). From this percentage, we can calculate that in total, the portion of oil used as fuel is only 9.66% of the total consumption of energy. This number will slightly increase if we include other petroleum products. The percentage becomes 13.9%.

While it has been demonstrated that the impact of oil price changes on wholesale price inflation is significant, there is no evidence that oil price affects consumer price inflation. As we can see in Column 3 of Table 1, the coefficients for oil price are very small and no one of them is significant even at the 10% significance level. This case also occurs in China. Tang, Wu, and Zhang (2009) using China as their sample, found that oil price changes do not significantly affect CPI. Theoretically, if there is an increase in oil prices as a main input cost, its impact will be transmitted to the price at both producer and consumer levels. However, the output shows a different result. In the case of Indonesia, it could be explained by the combination of the following reasons:

The appreciation of the exchange rate could be the first reason why oil price changes do not affect consumer price inflation. Because oil is imported, it largely depends on the exchange rate. If the appreciation of exchange rate (rupiah) is higher than the increase in oil price, the effect of oil prices on the domestic economy can be offset. However, data for the last eleven years showed that, for the most part, the increase in oil price was higher than the appreciation of the exchange rate (Figure 3). This could be understood because oil is a commodity that is more volatile than currencies. Even though the value of currencies is also determined by the market, it will not fluctuate as high as oil prices. The government will stabilize the exchange rate movement to some extent by buying or selling dollars. It is important to keep the exchange rate stable for the sake of imports and exports. As a consequence, there is only a small part of the effect of the oil price increase that can be absorbed by the exchange rate.

The second reason is the weight of fuel in the calculation of the CPI. The Consumer Price Index in Indonesia is measured based on the weight of the price from a basket of seven categories of goods and services: foods; processed foods, beverages, and tobacco; housing, electricity, gas, and fuel; clothing; health; education, recreation and sports; and transportation, communication, and finance. The weight of fuel in the CPI's calculation is not high enough. The total weight of the basket of housing, electricity, gas, and fuel is 25.41%. It should be noted that this weight is not only for fuel, but also includes housing, electricity, and gas. The basket which has the highest weight in the CPI's calculation is foods. Its weight is around 19.57%, followed by processed foods, beverage, and tobacco, at 16.55%. Based on this, we can infer at least two things. First, if the government can keep the domestic price of foods stable, the change in oil price does not have much effect because it only has small fraction in the CPI's calculation. Duma (2008) also points this out, stating that the presence of government (through administered price) in Srilanka helps to partly explain the low impact of oil prices to inflation. Second, if the movement of the prices of the first two baskets (food and processed food, beverages, and tobacco) is more than the housing, electricity, gas, and fuel basket, the increase in oil price does not have much effecton the CPI. In this case, the CPI is more likely determined by the movements of the first two baskets. It seems that this second reason is more likely in the case of Indonesia. Figure 4 shows that the movement of the first two baskets is more volatile than the third basket. On average, the effect of the first two baskets to CPI is higher, except in October 2005 when government increased the price of premium/gasoline (87.5%), diesel fuel (104.8%), and kerosene (185.7%).

However, that was the second time the government increased the domestic oil price. The first increase was in March 2005 when the government increased the price of premium/gasoline (32.5%) and diesel fuel (27%). The government's decision to increase domestic oil prices was triggered by the increase in world oil prices and the limitations of the state budget's financial capacity to provide more subsidies. Overall, inflation in 2005 was 17.11%, much higher than the targeted inflation which was 6% ± 1%.

The third reason, which could be the most appropriate reason, is the subsidies provided by the government. On average in ten years, the government provided subsidies for oil products using around 14%-15% of the total state budget. This amount of the subsidies will increase (decrease) in line with the increase (decrease) in world oil prices. In the case of an oil price increase, the amount of the subsidy will increase to some level which the state budget can still accommodate. If the burden of subsidy cannot be borne anymore, the government will decide to increase the domestic oil price. The existence of this subsidy will distort the domestic oil price by keeping it at a lower level compared to the world oil price. As consequence, oil's consumption pattern does not change even when oil price increases. The consumption of gasoline continues to grow over time even during periods when the oil price also increases. The increased price of oil does not have much effect because it is absorbed by subsidy.

The relationship between oil price and industrial production is shown in Column 4 of Table 1. The coefficient of the oil price is very small and there is no evidence that oil price affects the growth in industrial production except at lag 3 where it is significant at the 10% level. This could be explained by the following reason. As we discussed above, because of the subsidy policy, oil price changes do not have much effect on consumption patterns. In other words, consumption patterns are independent from changing oil prices. It does not really matter whether the price of oil increases or decreases, the consumption of oil just keeps increasing. As we could see in Figure 5, consumption of gasoline had an increasing trend from 2000 to 2008 whileoil prices also rose. In 2009, even though on average the oil price decreased, consumption of oil was still increasing. The increasing trend of oil consumption raises the demand of industries which are intensive in the use of energy by consumers such as motor vehicles, or in production, such as chemicals. Data from Statistical Agency of Indonesia supports this idea as shown in Figure 6. The stock of vehicles shows an increasing trend with the highest growth in the stock of motorcycles. Moreover, Herrea, Lagalo, and Wada (2010) noted that the increase in demand for motor vehicles could represent an important demand for downstream industries such as rubber and plastic. The increase in demand of these industries can support the increase in the growth of industrial production. In this case, we can conclude that industrial production could still grow because of the increase in the demand driven by the increasing trend of oil consumption (which is independent from the effect of oil price). This is why there is no evidence that oil prices affect the growth of industrial production.

4.3. Vector Auto Regressive Output

Ozcicek and Millin (1999) indicate that an important element in the specification of VAR models is the determination of the lag length, so that using a proper lag in VAR model is a critical issue. Even the accuracy of forecast from VAR model depends on the selection of the lag length (Hafer and Sheehan, 1989). Lutkepohl (1993) indicates that selecting a higher order lag length than it should be will increase the forecast error of VAR. Inversely; the lower order lag will generate autocorrelated errors. This paper uses standard lag length selection criteria such as the sequential modified likelihood ratio (LR) test, the Final Prediction Error (FPE), the Akaike Information Criterion (AIC), the Hannan-Quinn Information Criterion (HQ), and the Schwarz Bayes Information Criterion (SBIC).

As shown in Table 2, model 1 and model 2 select one lag, while model 3 selects three lags. Table 2 also shows that SBIC's selection of lag length criteria in all three models give other results which are zero lags for model 1 and 2 and two lags for model 3. HQIC selects zero lags for model 2. In this case, this paper follows the selection order lag length which is shown by AIC. As suggested by Ivanov and Kilian (2001), in the context of VAR models, AIC tends to be more accurate with monthly data. HQIC will fit for quarterly data on samples over 120 and SBIC will work better with any sample size for quarterly data especially on VEC models. This paper also performs a residual test of the VAR to determine if the residuals are stationary. Table 3 shows that at one lag for model 1 and model 2 and at three lags for model 3, the probability is more than 5%.This means that the null hypothesis of no serial correlation at these lags could not be rejected.

As shown in Figure 7, an oil price shock has an immediate and positive effect to wholesale prices, consumer prices, and industrial production. The effect reaches its maximum within the first month. The impact of oil prices on wholesale prices falls significantly by the second month and dies out after five months. The impact of oil prices on consumer prices is relatively small. It seems to fall and fade away more quickly than the other two, with zero effect after four months. This result supports the research done in Srilanka by Lueth et.al (2006), finding that inflation remains manageable though oil price increases. Subsidy helps contain the impact of oil shock on inflation. The impact of an oil price shock on industrial production is less clear. Its impact turns negative after two months, partly reflecting the adjustment process by companies in the domestic economy to the shock.

This paper also provides estimation of pass-through from oil price to wholesale price, consumer price, and industrial production which is derived from impulse response functions. Following Duma (2008),

pass-through coefficients are predicted after accounting for disturbances of the other endogenous variables in the model. For instance, for oil price, pass-through coefficients are calculated by dividing the cumulative impulse response dependent variable after j months by the cumulative response of the oil price to the oil price shock after j months. These pass-through coefficients are shown in Figure 8.

Generally pass-through from oil prices to wholesale prices, consumer prices, and the producer price index is positive. Pass-through to wholesale prices rises from 3% in the first month following the shock to about 4% in the third month and then becomes relatively stable for the rest of the 12 months. This result supports Cunado and Garcia (2004), finding that the relationship between oil prices and economic growth occurs only in short run. Pass-through to consumer prices is small and limited. It is only 0.2% in the first month after the shock and then experiences a small increase to 0.3% in the twelfth month. This limited impact from oil price to inflation could be partly reasoned by the existence of the oil subsidy policy. Pass-through to industrial production is less clear. It starts at 5.3% in the first month of the shock and then reaches a maximum point of 7.6% before turning negative, to -1.3% in the third month. This pattern is similar with the impulse response of industrial production to the oil price shock as discussed above.

Forecast error variance decomposition tries to estimate how much of a change in avariable is due to its own shock and how much is due to shocks to other variables. This study shows that most of the variation is due to its own shock. In the first month, oil prices have no effect in explaining the variation of the shock in wholesale prices, consumer prices, and industrial production. Oil price starts to contribute to variation in the second month. For wholesale prices, oil price shock explains about 2.8% of the variation in the second month and then increases to 3.2% for the rest of the months. With consumer price, the contribution of oil price towards explaining the variation is very small. In the second month, oil price shock only explains about 0.05% of the variation. In the rest of the months, it only explains about 0.06%. In this case, oil price shock to consumer price is minimal. For industrial production, oil price shock explains more of the variation than in wholesale prices and consumer prices. In the first month, oil price shock explains 1.3% of the variation. This contribution jumps up to 6.1% in the fourth month and increases again to 7% in the fifth month and remains stable for the rest of the following months. This effect is more on short term, which is similar with the research of Tang, Wu, and Zhang (2009) in China.

Generally, using VAR to explain the oil price shock gives a similar result to what the Auto-regressive Distributed Lag Model (ARDL) does. VAR reveals that the pass-through coefficient of oil price and its contribution towards explaining the variation in wholesale price is quite small, around 3%-4%. This finding is even smaller than what ARDL finds, which is 7.5%. The reason for this small effect could be the cost structure in industry as explained above. The portion of oil as fuel is only 9.66% of the total consumption of energy. The pass-through of oil price to consumer price is limited, at below 1%. The ability of oil shock to explain the variation is also small. Subsidies given to consumers could be the main reason. Subsidies will absorb the effect of oil price changes by keeping the domestic oil price at a lower level. The cumulative pass-through coefficient of oil price to industrial production is greater than the pass-through to price index although it is still relatively small. Pass-through to industrial production reaches its maximum (7.6%) in the second month of the shock before it becomes negative (-1.3%) in the third month and then returns to positive values again (2%-3%). The small portion of oil as fuel from total consumption of energy makes the effect of oil on real production relatively insignificant. In addition, the subsidies that keep the domestic oil price at a lower level still push the demand of vehicles and downstream industries (rubber and plastic) and allow the real production to keep growing.

5. CONCLUSION

Employing two different tools of analysis which are Auto- regressive Distributed Lag (ARDL) and Vector Auto-regressive (VAR) relatively give similar results. This paper finds that the effect of oil price changes to wholesale prices is significant although the pass-through coefficient is relatively small due to the cost structure of industrial sector. The existence of a subsidy policy plays a great role in absorbing the effect of oil prices on inflation because there is no direct connection between domestic oil prices and international oil prices. The ARDL model finds that the effect of oil price changes to consumer prices is not significant. The VAR model reveals that the ability of oil price shock to explain the variation is even smaller. Subsidies also have another effect. Keeping the domestic oil price at low levels makes the demand for vehicles keep growing even when the oil price is relatively high. This is the main reason why this paper finds no evidence of oil price's effect to industrial production.

6. IMPLICATIONS AND LIMITATIONS

6.1. Implications

This research shows the importance of a stable exchange rate policy, a stable food prices and subsidy policies in the Indonesian economy. As it has been done so far, central bank keeps maintaining the exchange rate of rupiah on its fundamental value for the sake of export import. However, it is important to note that capital mobility both in stock and bond market has profound effect to the volatility of rupiah. Data shown that rupiah has reached over Rp10.000/USD due to capital outflow triggered by the Fed's announcement to discontinue its quantitative easing program, which has spurred dollar to the emerging market. To reduce the volatility of rupiah

from external shock, it is important to consider implementing capital control as Brazil and South Korea have done so far.

This study also confirms the importance of food prices to determine inflation. In this case, government needs to maintain stable food prices by ensuring supplies, which is supported by good infrastructure. It implies that the needs for government to increase budget allocation for infrastructure become urgent. This study also shows that effect of oil prices on inflation is not significant, which is likely caused by the subsidy policy. This confirms that the subsidy policy is like a "buffer" in the economy to reduce external pressure on inflation. However, to what extent this "buffer" will last depends on the financial capacity of the government. With continuing decline in oil lifting and rising trend in oil prices, in long termthe subsidy policy should continue to be reduced, adjusting to the international oil price. Moreover, subsidy's allocation fund could be shifted into more productive spending such as increasing budget for capital expenditure.

This study is useful for private sector as a consideration in terms of investment and risk management decisions. This study shows that by keeping the domestic oil price remain below international price, it is seen that the demand for automotive products continues to increase, which also indirectly encourages the demand for plastic and rubber. By understanding these relationships, at least investors could decide in what sector they will take decision to invest when oil prices increase.

6.2. Limitations

This study assumes that there is a linear relationship in oil price effect, which means that either oil prices rise or fall will have the same effect. However, there is a possibility that rise in oil prices has a greater effect on macroeconomic variables than when oil prices decline. Therefore, a considerable research remains to be done to explain the nonlinear effect of oil price changes. Another ample room for next research is to see how the influence of oil price fluctuation on investment decisions specifically on companies' capital expenditure (real sector) and stock market (financial sector).

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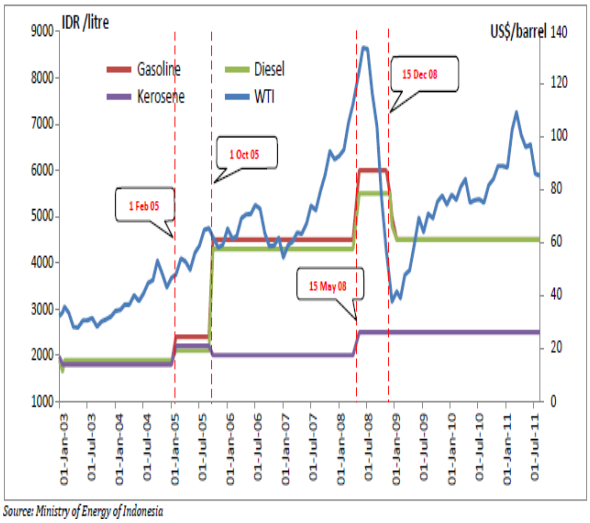
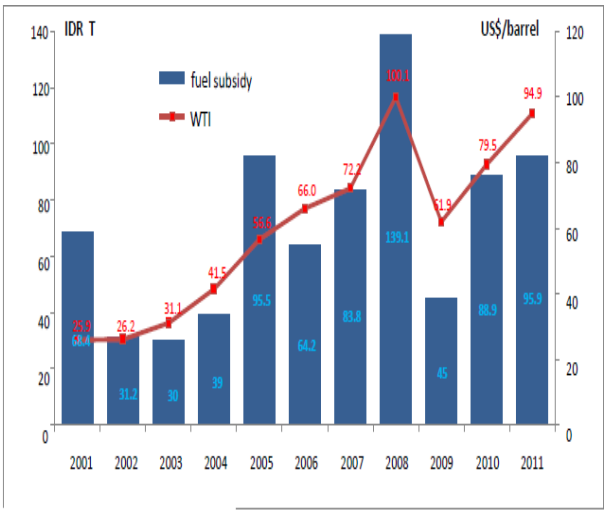
APPENDIX



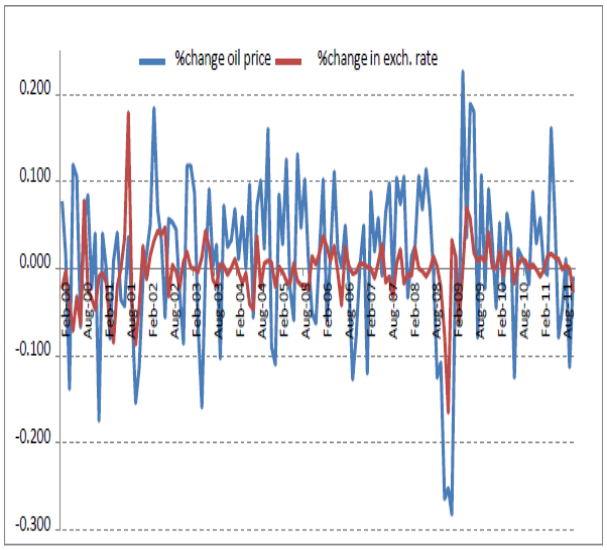
Source: Ministry of Energy of Indonesia

Figure 1. Domestic and International Oil Prices



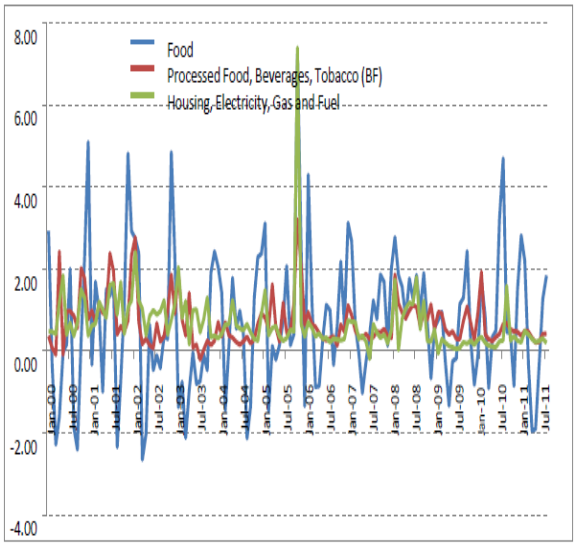
Source: Ministry of Finance of Indonesia

Figure 2. Fuel Subsidy and Oil Prices



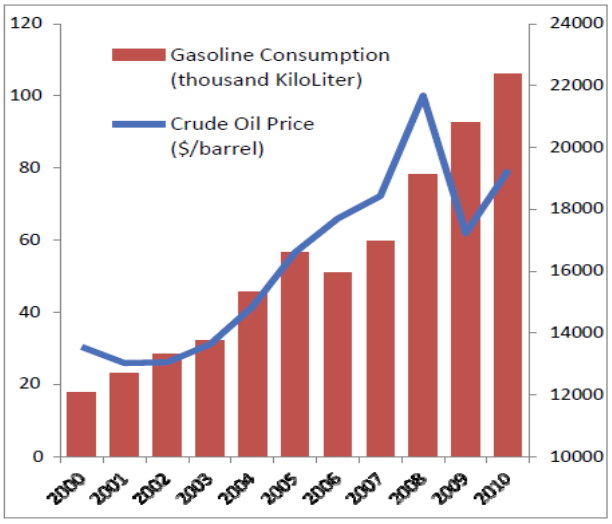
Source: Ministry of Finance of Indonesia

Figure 3. The Exchange Rate Movement



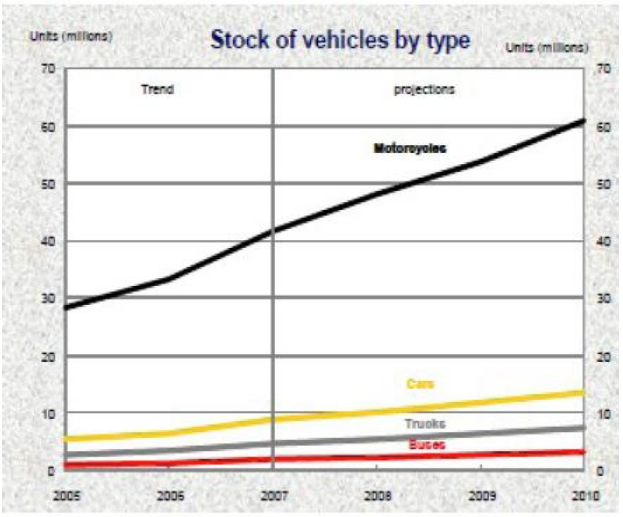
Source: Ministry of Finance of Indonesia

Figure 4. The Movement of CPI's Components



Source: Ministry of Energy of Indonesia

Figure 5. Gasoline Consumption and Oil Price



Source: Statistical Agency of Indonesia, taken from hMinistry of Finance of Indonesia

Figure 6. Stock of Vehicle by Type

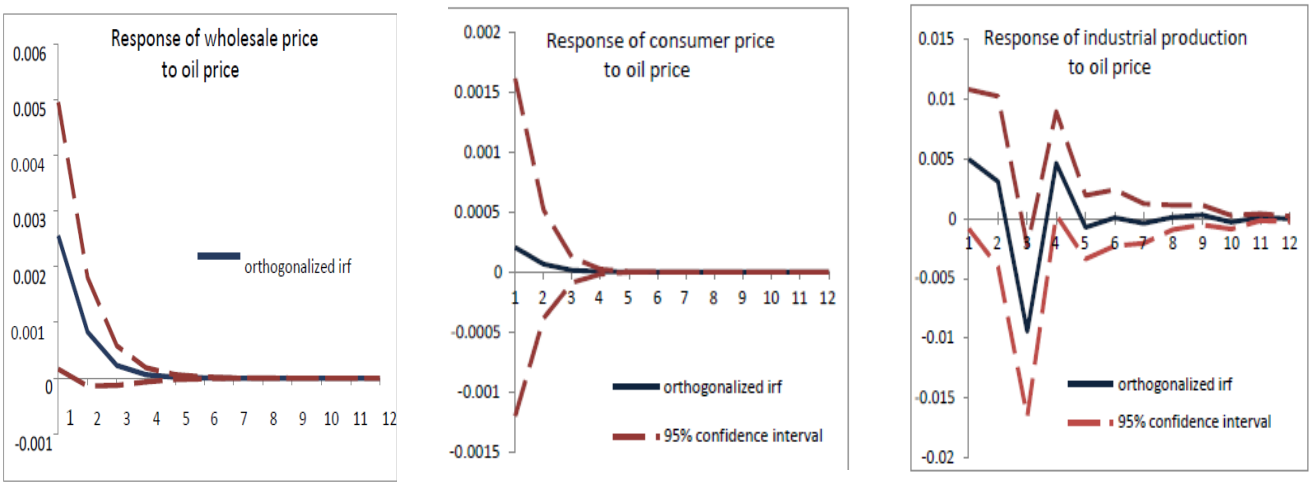


Figure 7.Impulse Response Function

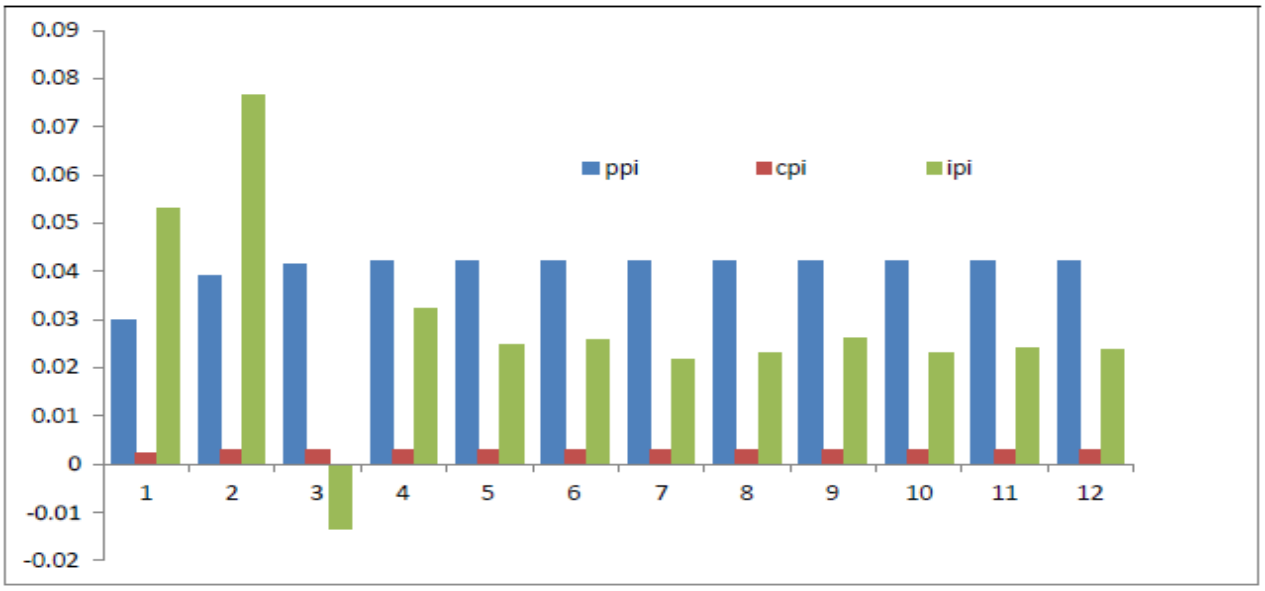


Figure 8.Estimated Cumulative Pass-Through Coefficients of Oil Price

Table 1. Summary of Output Auto Regressive Distributed Lag

Variables	Wholesale Price Inflation	Consumer Price Inflation	Growth of Industrial Production
Oil price	0.092***	0.003	0.039
Oil price (lag 1)	0.042**	0.003	0.059
Oil price (lag 2)	0.039**	0.013	0.05
Oil price (lag 3)	0.02	0.007	-0.081*
Oil price (lag 4)	0.025	0.013	-0.011
Oil price (lag 5)	0.032*	-0.009	0.005
Oil price (lag 12)	-0.003	0.016	0.066
Observations	128	128	128
R-Squared	0.446	0.202	0.528
Long-term pass through coefficient	0.0758	0.0783	0.1023

****p<0.01, **p<0.05, *p<0.1*

Table 2. Lag Selection Order

No	Model	Lag	LL	LR	FP	AIC	HQIC	SBIC
1	Oil Price to Wholesale Price	0	533.877	N/A	1.40E-06	-7.82172	-7.80431	-7.77888
		1	542.613	17.472*	1.3e-06*	-7.89137*	-7.83915	-7.76287
		2	545.011	4.796	1.30E-06	-7.86781	-7.78077	-7.65364
		3	548.504	6.9858	1.30E-06	-7.86035	-7.7385	-7.56052
		4	549.718	2.4276	1.40E-06	-7.81938	-7.66272	-7.43388
2	Oil Price to Consumer Price	0	595.988	N/A	5.50E-07	-8.73511	-8.71771	-8.69228
		1	601.037	10.099*	5.40E-07	-8.75054*	-8.69832	-8.62204
		2	603.433	4.7921	5.60E-07	-8.72695	-8.63992	-8.51279
		3	604.103	1.3397	5.80E-07	-8.67798	-8.55614	-8.37815
		4	607.425	6.6452	5.90E-07	-8.66802	-8.51136	-8,28252
3	Oil Price to Industrial Production	0	372.61	N/A	0.000015	-5.45015	-5.43274	-5.40731
		1	395.91	46.599	0.000011	-5.73396	-5.68174	-5.60546
		2	409.194	26.569	9.70E-06	-5.8705	-5.78347	-5.65633
		3	415.626	12.864*	9.3e-06*	-5.90626*	-5.78442*	-5.60643
		4	417.23	3.2083	9.70E-06	-5.87103	-5.71437	-5.48553

Note: * indicates lag order selected by criterion each test at 5% level

Table 3. VAR Residual Serial Correlation LM Test

No	Model	Lag	Chi2	Prob
1	Oil Price to Wholesale Price	1	2.2528	0.68938
		2	7.0935	0.13103
		3	2.6136	0.62442
		4	2.5311	0.63908
2	Oil Price to Consumer Price	1	2.3175	0.67758
		2	4.7408	0.31494
		3	1.1955	0.87884
		4	4.8662	0.3031
3	Oil Price to Industrial Production	1	5.1448	0.27276
		2	8.7372	0.06802
		3	4.8936	0.29839
		4	5.6601	0.22601

H0: no autocorrelation at lag order