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Testing the Volatile Behavior of Oil Prices: New Evidence and Relevant Implications from West Java

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The current research study probes the influence of oil price hike on West Java's economic performance using monthly data from 2019M1-2022M8. This study employs a total of eight proxies for West Java economy, which involve consumer confidence index (IKK), export values (EX), IDR exchange rate (EXC), money in circulation (M), inflation rate (CPI), credit availed by textile and apparel industry (KTPT), cement sales (SEMEN) and car production (MOBIL). Empirical analysis is carried out by employing a Vector Auto-Regression (VAR) model for econometric analysis. The estimated results indicate that the impact of oil prices fluctuations on the economy is unfavorable, and the presence of oil price shocks is more prominent on inflation among other endogenous variables. The discovery provides important implications for relevant policy analysis to ensure a timely solution for the existing issue.

Keywords: Oil price volatility, Inflation, Vector Auto-Regression (VAR) model, Economic performance, West Java

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I. Introduction

The COVID-19 pandemic causes major shocks to the global economy after the global financial crisis in 2008. All of the uncertainty appeared from the pandemic affects various sectors, both economic and non-economic sectors, and influence consumer behavior that consequently leads to extreme and rapid price swings. Empirics have shown that the case of COVID-19 has already made a significant impact on natural resource commodity prices volatility (Guo *et al*., 2022), including crude oil. The price of such natural resources is not stable and tend to fall down in this pandemic period due to the decline in oil demand and consumption. This is suspected by the government's regulation to implement travel bans through strict lockdown measures so that people's mobility is restrained, global supply lines are disrupted and aggregate demand is decreased (Vidya and Prabheesh, 2020). Hence, the lockdowns result in a significant drop in natural resource commodity price (such as crude oil) on the global market, that is from $61 per barrel on January 02, 2020, to $12 per barrel on April 28, 2020, owing to a substantial fall in oil consumption (Prabheesh et al., 2020). For the first time in its history, crude oil prices fell below zero due to a major downturn in economic and production activities during the pandemic (Devour and Narayan, 2020).

Besides the COVID-19 outbreak, several big oil price changes have been discovered in the past decades. The most important oil price change was observed in the 1973 Arab-Israeli War, when OPEC reduced oil exports and oil prices surged from US$4 per barrel in 1973 to US$9 per barrel in 1974. Oil prices changes also occured in 1979 in the months leading up to the outbreak of Iran-Iraq war which hiked oil prices from $13 per barrel in 1979 to $ 36 per barrel in 1981. During the first "Gulf War" in 1990, oil price witnessed an increasing trend to US$32 per barrel in October 1990. Another oil price change was observed in the 2007-2008 financial crises, oil price reached to all time highest level of $131 per barrel in July 2008 and adversely affected the oil importing emerging economies of the world like Asia. Another oil price change took place in 2014 when oil price dropped to $27 per barrel in January 2016. In addition, after peaking at $78 per barrel in October 2018, oil prices plunged to $56 per barrel by December 2018, and it finally came to normal fluctuation before the COVID-19 pandemic crisis.

In 2022, the economic shock induced by this novel pandemic gradually subsided. Following strong economic recovery post-lockdowns, oil prices rise sharply to nearly $100 per barrel and will continue to soar in 2023 (World Economic Forum, 2022). The price increased by around 26% compared to oil prices which slowed at the end of 2021, accounted for $74 per barrel and $71 per barrel for Brent and West Texas Intermediate (WTI), respectively. The price further increased as a consequence of rising geopolitical tensions between Russia and Ukraine which reached its peak in February 2022. Thus, Brent oil prices climbed to $113.34 per barrel in May 2022, increased 65.39% (yoy). Given the significance of Russia's attack on Ukraine, the European Union (EU) has imposed a partial embargo on Russian crude oil imports, especially those carried via seaborne shipments (European Parliament, 2022). The EU also banned insuring and financing seaborne deliveries of Russian goods, which will take full effect by the end of 2022. The International Monetary Fund (IMF) mentions that sanctions will be a source of turmoil in the global economy, since Russia is the world's largest exporter of oil to global markets and among the most important producers and exporters of arable crops in the world.

The geopolitical tension between Russia and Ukraine has affected other countries, including Indonesia. Oil price instability shows that the impacts on oil producers and oil importers are different (Balashova and Serletis, 2020). The study confirmed findings by (Van Eyden et al., 2019; Dilanchiev and Taktakishvili, 2021) that showed

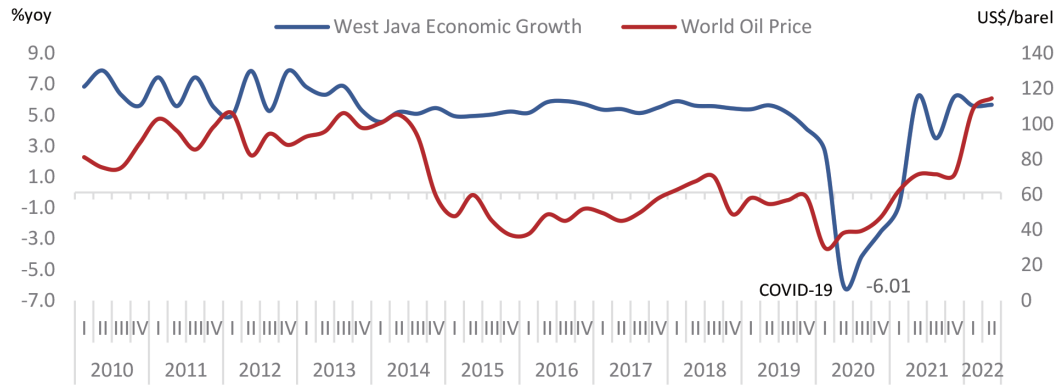

Figure 1. West Java Economic Growth and WTI Oil Price
Source: Statistics Indonesia and Bloomberg

when oil prices went up, the economy of the importing country suffered. In contrast, as the price of natural resources increased, so did their value to countries that exported them. Despite being one of the countries producing crude oil, Indonesia only has a small domestic production and limited reserves, and consequently, has to import large quantities of oil products to meet domestic demands. Therefore, as an oil-dependent country, Indonesia's economy is vulnerable to oil price variations. The price of Indonesian Crude Price (ICP) showed an upward trend starting in August 2021 at $67.8 per barrel and continued to increase every month until March 2022 which reached a price of $113.5 per barrel (Indonesian Ministry of Energy and Mineral Resources, 2022). In September 2022, Indonesian crude price averaged $86.07 per barrel, dropped by $8.10 from the previous $94.17 per barrel in August 2022. Furthermore, the recent surge in oil prices is significant to be aware of since it is the basis for making decisions regarding domestic fuel prices. In turn, the surging fuel prices may raise the inflation rate in Indonesia and affect the ongoing economic recovery.

The paper moves as follows. Section 2 elucidates the problem explored in this paper. Section 3 explains the literature review. Sections 4 and 5 define the methodology and data adopted to conduct the research. Section 6 gives the estimated results. The next section examines the current policy. Finally, the last section provides the conclusion and policy implications.

II. Statement of the Problem

West Java as the third largest contributor to the GDP of Indonesia also faces the risk of volatile behavior of oil prices, which are then transmitted into West Java's economy, with the deepest contraction recorded at -6.10% during the peak of COVID-19 in 2020Q2 (Figure 1). Regarding West Java's level of economic growth, it usually stays around 5-6% (yoy) with household consumption, exports, and investment are contributed the largest. In addition, the top three contributors from the sector are the manufacturing industry, including the textile and apparel and automotive industry, followed by agriculture, forestry and fishing as well as construction sector.

Oil has now become an important input of production, particularly for transportation and manufacturing (Su et al., 2020). Thus, the fluctuations in oil prices affect the performance of the manufacturing sector in West Java, for instance the rise in main raw material prices for the textile industry such as *polyester* and acetic acid, hence force up production input costs. At the same time, the government decision to adjust the prices of

subsidized and non-subsidized fuels as of September 3, 2022, has pushed up production costs and consumer prices which tend to follow the same pattern as fuel prices hiked. In addition, global supply chain disruptions suppress export demand and put a drag on fulfillment of imported raw materials. This will have a negative impact on the performance of the manufacturing sector and may lead to West Java's export competitiveness being impacted as well. Further, domestic prices may increase and later result in lower demand. Since the manufacturing sector has a large contribution to West Java's GRDP, which accounts for 41.80% in 2022Q2 (Statistics Indonesia, 2022), it is imperative to maintain its performance to support the economic growth. Meanwhile, the slowdown in the export component is also causing some concern, as it may be a major driver of West Java's economic growth.

Oil price fluctuations and economic growth are two very important issues in the current global economy, especially during the COVID-19 outbreak and the recent geopolitical conflict. Some studies have been conducted to examine the association between oil prices, economic and financial activity (Xiuzhen, Zheng and Umair, 2022). It was found that the COVID-19 pandemic and global financial problems caused economic activity to decline when oil prices fell. Such study also has been carried out in Indonesia (Baek and Yoon, 2022) who analysed the relationship between supply and demand shocks in the oil market and Indonesia's macroeconomy. Findings revealed that the timing, magnitude, and even direction of the response of Indonesia's macroeconomy were likely to vary depending on the type of shock.

Previously, empirical studies have been conducted to analyse the influence of oil price on economic performance, including for developing countries such as Indonesia. However, to the best of our knowledge, no study has exclusively investigated the impact of oil price fluctuations on West Java's economic performance. Though, West Java is a region that contributes significantly to Indonesia's economic growth and is the second largest oil products consumers in Indonesia, which approached 4,277,570 BB6 until September 2022. For this reason, it highlights the need to examine the impact of oil price on West Java's economy as oil prices volatility is a source of anxiety for economies, particularly for West Java that showed the high dependence on oil consumption. Thus, the objective of the present study to empirically investigate the effect of oil price fluctuations on economic performance of West Java. Empirical analysis is employed econometric procedure named the Vector Auto-Regression (VAR) model. This study is utilized the data set covering the period from January 2019 to August 2022, and macroeconomic variables involved are consumer confidence index (IKK), export values (EX), IDR exchange rate (EXC), money in circulation (M), inflation rate (CPI), credit availed by textile and apparel industry (KTPT), cement sales (SEMEN) and car production (MOBIL). It is expected that examining oil price - economic performance nexus will help policymakers to formulate a suitable policy to keep inflation under control due to changes in oil prices.

Ⅲ. Literature Review

Empirically, many scholars have put efforts to provide an extensive literature regarding the effect of oil prices on economic performance. However, after the emergence of the COVID-19 epidemic, the scholars focus more on looking into the nexus between the oil price and the outbreak of the COVID-19 pandemic. The recent studies showed that the global financial problems and the recent COVID-19 crises have major effects on economic activity when oil prices fall (Xiuzhen, Zheng and Umair, 2022), while revealed that the speed of information propagation between the oil market and financial initiatives was greater during the COVID-19 outbreak than during past global financial crises. These findings are consistent with the study (Sha, 2022) who emphasized that both natural resources and crude oil prices significantly

but asymmetrically affect economic performance. The impact of both variables is positive in the lower quantiles, but negative in the medium and higher quantiles. Gil-Alana and Monge (2020), in their recent study, analysed the influence of COVID-19 on crude oil prices via employing the long memory techniques. The empirical findings indicated that the crude oil price shock becomes inefficient after the COVID-19 pandemic and oil price series exhibits the mean reverting behavior and transitory while having long-lasting effect. In continuation, Sharif et al. (2020) studied the US economic policy uncertainty, oil prices and stock market in the COVID-19 pandemic. Using the wavelet based approach, the study revealed that the COVID-19 significantly affects economic uncertainty, but its effect on geopolitical risk is substantially higher than its effect on the US economic uncertainty. While on the contrary, Albulescu (2020) examined daily data from January 21 to March 13, 2020 and utilized the autoregressive distributed lags (ARDL) model concerning oil prices and economic policy uncertainty in the US. The study reported that an increase in the new cases of COVID-19 does not affect economic policy uncertainty in the long-run US. However, the oil prices negatively affect economic policy uncertainty in the COVID-19 pandemic.

Some studies on the effect of soaring crude oil prices on the economy have been conducted for developing countries. In this regard, the earlier study of (Ocheni, 2015) evaluated the impact of fuel price increase on the Nigerian economy. The study adopted a survey research design approach and used the pearson product moment correlation coefficient. Findings revealed that (i) there is a significant relationship between the recent increases in fuel prices and economic growth in Nigeria; (ii) the Nigeria economy is not developing because of the effect of fuel price hike on purchasing power; (iii) and there is significant relationship between increase in pump price of petroleum and food security. Another study has also been arranged in Vietnam by (Trang, Tho and Hong, 2017) to carry out a numerical analysis on the influences of oil prices on the macroeconomic variables of Vietnam, including inflation, growth rate, budget deficit and unemployment. By using a vector auto regression model, it is realized that a rise in oil prices would lead to higher inflation and budget deficit in Vietnam while its impacts on the gross domestic product growth and unemployment are unclear. The study of Aloui et al. (2018) investigated economic growth, oil price, exchange rate, and inflation nexus for Saudi Arabia by adopting novel Morlet's wavelet methods. Examined results asserted that the variables' association evolves through time and frequency. From the time domain, the results unveil strong but heterogeneous association between the variables; from the frequency domain, it is evident that strong lead and lag, and significant wavelet coherence among these variables. Further, the study reported that the economy is exposed to various global risks including oil market volatility which has a strong negative effect on economic growth.

In addition to the prior, some studies on the impact of natural resource commodity price volatility, specifically oil prices, have been done in the post COVID-19 pandemic era. In this concern, Algamdi et al. (2021) explored the impact of COVID-19's death cases on oil prices in Saudi Arabia using daily data, January 22 –June 14, 2020 and employed an econometric model, the ARDL. The estimates showed that the COVID-19 deaths significantly affect the oil price in the country yet the death ratio indirectly affects the crude oil price volatility. Gupta et al. (2020) illustrated that the spread of the COVID-19 pandemic causes the close down of the production and manufacturing sectors and disturbs the supply chain in China. The authors argued that the postponement of production and industrial activities reduces the demand for natural resources such as oil, which dramatically decreases the prices of raw materials and such resources in other parts of the world. Moreover, (Wang, Cheng and Cao, 2022) explored the effect of global crude oil price on

the economic policy uncertainty (EPU) in BRICS countries via employing the hybrid wavelet artificial neural network model (wavelet-ANN) and the threshold vector auto-regression model (TVAR). The empirical results reported that: (i) oil price has heterogeneous effects on EPU in different BRICS countries, while the EPU of oil importers among BRICS countries (China and India) have a significant negative effect on global oil price in the long run; (ii) in each country, the impact of oil price on EPU illustrates a nonlinear and asymmetric feature; (iii) in the long run, only in India, the fluctuation of global crude oil price significantly positively affects India's EPU.

The recent study of Prabheesh and Laila (2020) empirically examines the impact of the price of crude oil petrol and palm oil on Indonesia's economic growth. Using quarterly data from 2000 to 2019 and adopting linear and non-linear autoregressive distributed lag (ARDL) approach, the study unveils a significant non-linear effect of oil prices on country's output. However, the changes in the palm oil price have a greater effect on the country's output as compared to the changes in petroleum prices. In case of the nexus between oil price fluctuations and macroeconomic activities in particular, (Baek and Yoon, 2022) examined responses of Indonesia's macroeconomy to the supply and demand shocks in the oil market - including growth, inflation, and exchange rate of Indonesia by applying a structural vector autoregressive (SVAR) methodology. The study found that the timing, magnitude, and even direction of the response of Indonesia's macroeconomic activities are likely to vary depending on the type of shock.

Although, extensive literature is available that explores the influence of oil price volatility on economic performance, to the best of our knowledge, no attempts have been made that empirically discussed and probed the impact of oil price fluctuations on West Java's economic performance. Therefore, the present study covers the gap by examining the influence of oil price volatility and economic performance of West Java and employs a total of eight proxies for West Java economic activity including consumer confidence index (IKK), export values (EX), IDR exchange rate (EXC), money in circulation (M), inflation rate (CPI), credit availed by textile and apparel industry (KTPT), cement sales (SEMEN) and car production (MOBIL).

Ⅳ. Methodology

This study adopts a Vector Auto-Regression (VAR) model for econometric analysis. In general, the VAR models are constructed using each endogenous variable to examine the consequences of a shock on a variable on the whole system as well as enable one to explain the values of endogenous variables from the past observed values of both the own and other variables. The VAR estimation technique treats all variables symmetrically. One vector contains more than two variables, and on the right side, there is a lag value (lagged value) of the endogenous variable as representation of the autoregressive property in the model (Asteriou and Hall, 2007).

The VAR model in this study employs several endogenous variables that include the monthly volatility of WTI oil prices (WTI), West Java's Consumer Confidence Index (IKK), West Java's Export Values (EX), Indonesian Rupiah to US Dollar Real Exchange Rate (EXC), Money in Circulation (M), West Java's Inflation Rate (CPI), Total Amount of Credit Availed by Textile and Apparel Industry (KTPT), Cement Sales SEMEN), Car Production (MOBIL). The current study adopts the VAR modeling approach generated from the earlier study of Nizar (2012).

Prior to performing econometric analysis using the VAR model, some mandatory tests need to be done. First, the stationary test is used to check the statistical properties of a process generating a time series do not change over time in the sense that error has a zero mean and constant variance. If one

in which the time-series variables are non stationary and independent, it may result in *Spurious regression* so that the regression results are simply misleading (Enders W., 2015). Next, selection of the lagging order to choose the delay order of the variables. In the analysis of time series approach, it is very important to choose the appropriate lagging order to deliver the estimation results accurately (Zambom and Kim, 2017).

V. Data

Based on the objectives, this study adopted monthly secondary data ranges in time from January 2019 – August 2022. The data applied in this study are as follow:

(1) West Texas Intermediate (WTI) price - As a proxy for the world oil price, we use the monthly data of West Texas Intermediate (WTI) crude oil price denominated in US dollars per barrel collected from *Bloomberg*

(2) Consumer Confidence Index (IKK) describes consumer's perceptions of the country's current and future economic situation and their tendencies to purchase, based on survey by Central Bank of Indonesia measured through a likert type scale. This indicator is often used to represent economic conditions of West Java

(3) Export values (EX) indicates total value of West Java's exports as one of the main components driving the economic growth of West Java in expenditure side. The data was derived from Directorate General of Customs and Excise as monthly units of millions of USD

(4) IDR exchange rate (EX) represents the real exchange rate of IDR against the United States dollar in order to eliminate the price factor of the exchange rate on WTI oil price and reflect the relationship between exchange rate and trade structure, obtained from Central Bank of Indonesia

(5) The amount of money in circulation (M) represents money (paper notes and coins) used in West Java, measured in million Rupiah and collected from Central Bank of Indonesia

(6) Inflation (CPI) describes West Java inflation rate (yoy), derived from Statistics Indonesia

(7) The total amount of credit availed by Textile and Apparel industry (KTPT) represents one of leading sub-sectors of West Java, derived from Central Bank of Indonesia

(8) Cement sales (SEMEN) describe construction activities in West Java, measured in tons and derived from Central Bank of Indonesia

(9) Car production (MOBIL) captures the industry productivity, as one of the supporting sectors of West Java's economy, measured in Rupiah and derived from GAIKINDO

VI. Results and Discussion

1. *Baseline analysis*

Analysis begins by estimating the descriptive statistics of the data. In an empirical investigation, estimating the descriptive statistics is important as it summarizes the entire data. As shown in Table 1, the data consist of 44 observations. Descriptive statistics show that the variables have a variety of different values, with most of them ranging around the middle. The WTI oil price averages out to be around US$4.07 per barrel and can go as high as US$4.74, but it usually stays around $2.80. The mean value for the consumer confidence index is 4.61 and ranging from the minimum value of 4.14 to the maximum value of 4.84. Concerning the export values of West Java, the index shows the mean value of US$9.44 while the minimum and the maximum values are accounted for US$9.29 and US$9.75, respectively. As for inflation rate for West Java, the average value is 2.66% with a maximum value of 4.94% and a minimum value of 1.43%. Mean value of cement sales is 13.6 which fluctuates between 13.19 and 14.04.

Most times series models and techniques, including VAR, require pre-testing the underlying series for unit root to study the stationary of the series of the structural model in a robust manner. Two alternative unit root tests were applied: Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF)

Table 1. Descriptive Statistics

Variable	Observation Number	Mean	Minimum	Maximum
WTI: WTI Crude Oil Price	44	4,07	2,80	4,74
IKK: West Java's Consumer Confidence Index	44	4,61	4,14	4,84
EX: West Java's Export Values	44	9,44	9,29	9,75
EXC: Indonesian Rupiah to US Dollar Real Exchange Rate	44	9,57	9,52	9,67
M: Money in Circulation	44	15,01	12,01	16,78
CPI: West Java's Inflation Rate	44	2,66	1,43	4,94
KTPT: Total Amount of Credit Availed by Textile and Apparel Industry	44	3,85	3,23	3,53
SEMEN: Cement Sales	44	13,6	14,04	13,19
MOBIL: Car Production	44	11,27	7,82	11,84

to test the null hypothesis of non-stationary. First, the test is conducted by plotting the time series to observe any general trends. This can help identify the existence of a unit root and determine whether the data is stationary.

The results in Table 2 show that the series of most of the variables are non-stationary in level with an absolute value of the t-statistics below the critical value. However, it is noted that the ADF value of the first difference reveals a statistically higher t-value in absolute value to the critical values for all series. These results lead to the acceptance of the null hypothesis of non-stationary for all the variables and it concludes that all variables become stationary on first difference. The estimation model used in this analysis has passed the cointegration test, hence the VAR model is still suitable to apply even if all series are stationary on first difference.

Table 2. Unit Root Tests Results

	ADF		PP	
	I(0)	I(1)	I(0)	I(1)
L_WTI	0.3047	0.0003	0.6736	0.0005
L_IKK	0.3412	0.0001	0.3507	0.0000
L_EX	0.0331	0.0000	0.0334	0.0000
L_EXC	0.2497	0.0000	0.2896	0.0000
L_M	0,0000	0.0001	0.0000	0.0000
CPI	0.9998	0.0008	0.9995	0.0004
L_KTPT	0.5289	0.0000	0.4938	0.0000
L_SEMEN	0.0006	0.0001	0.0214	0.0000
L_MOBIL	0.2304	0.0000	0.2304	0.0000

Table 3. VAR Lag Order Selection Criteria

Lag	AIC	SC	HQ
0	-9.517017	-9.137019*	-9.379622
1	-11.28543	-7.485456	-9.911482
2	-10.79947	-3.579512	-8.188962
3	-15.42136*	-4.781421	-11.57430*

*indicates the lag order selected by the criterion

In order to perform the estimation of the VAR model, the appropriate lag length should be selected according to the lag length tests (Enders, 2015). For this purpose, the Akaike information criterion (AIC), Hannah-Quinn Information Criterion (HQIC), and the Schwartz Bayesian criterion (SBC) are applied. The data from 2019 January to 2022 August as reported in Table 3 shows different results with varying levels of significance. The AIC and HQIC result shows that lag 3 is appropriate, whereas SC result suggests that lag 0 is appropriate for the VAR model. However, the Akaike's information criterion (AIC) result is chosen based on the fact that the data used in this study is monthly data, therefore lag 3 is included in the VAR model.

2. *Stability test*

To ensure the validity of the VAR model, it is important to check the results obtained from the VAR estimation meet classical assumptions, including unbiasedness, efficiency and consistency. Moreover, it also requires that the model is stable, and the condition of the model stability is the reciprocal of the modulus of all the roots are in the unit circle. According to Figure 2, the reciprocal of the model captures the stability conditions as the modulus value is in the unit circle, so the model is stable to use for further estimates.

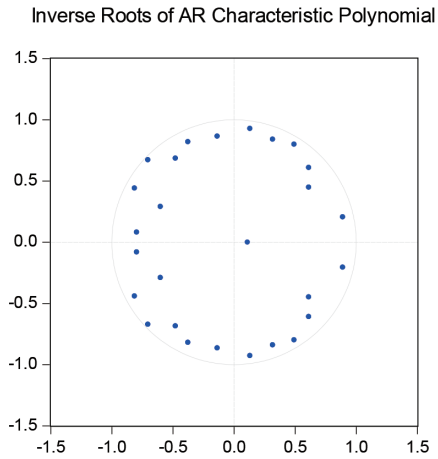

Figure 2. Stability Test

In the analysis of the VAR model, it is usually examined the response of one variable to the shock of one standard deviation of another variable in the system over the specified period, namely the analysis method of Impulse Response Function (IRF) and Orthogonalized Impulse Response (OIRF). Figure 3 depicts the pulse response diagram using one standard deviation shocks and it is shown that oil supply shock would have the following impact:

(1) The shocks of one standard deviation of oil price on the consumer price index turns out to be negative since month 2 which is accounted for -0.004. Then, it increases slightly for the next month and comes to fluctuate between positive and negative until it dies out after month 9.

(2) In response to oil price, West Java's export values is positive at month 1 which allegedly occurred due to spillover demand from countries that benefit from soaring oil prices. However, it shifts negative after month 2 and reaches the low level of -0.019 at month 3 before continuing to fluctuate and slowly reduces thereafter.

(3) With an oil price shock, IDR exchange rate and the amount of money in circulation tend to increase and it reaches maximum at month 2. IDR exchange rate turns to fluctuate whereas the money outflow response becomes permanent and does not die away.

(4) The response of oil price to inflation is shown to be positive and statistically significant when growth peaks at month 2. It then becomes insignificant thereafter and reaches the lowest at month 8, even though the effect remains positive and it dies out for the rest of the period.

(5) The effect of oil price shock on KTPT, cement sales and car production are negative, reaching of level -0.002; -0.001; and -0.005, respectively. In the following period, the KTPT comes to fluctuate and does not die away. Instead, the cement sales and car production die out after month 9. Regarding car production, it climbs the highest level after month 2, which is promoted by increasing export demand for cars.

Findings imply that the presence of oil price pass-

through effect is more prominent on inflation. The magnitude of response of inflation rate to oil price shocks suggests a strong positive influence in the early stages of the shock, and its impact gradually decreases and dies out in the latter part of the period. Since world oil price is one of the basis for making decisions regarding domestic fuel prices, it is crucial to keep tabs on the world oil price. Additionally, oil is considered to be an important source of energy and used as input in production process; therefore, any increase in oil prices results in higher input costs and may be passed on to consumers in the form of higher food and transportation costs, which in turn lead to higher inflation. Further, higher oil prices decrease purchasing power and may have a negative impact on economic productivity.

3. *Variance decomposition*

After performing the IRF analysis to trace out the impact of the shocks on the variables contained in the VAR model over time, then Forecast Error Variance Decomposition (FEVD) is conducted. It determines the contribution of the movements on one variable due to self-incurred shocks or the shocks from other variables. Regarding this study, the results focus on confirming the magnitude of inflation rate due to oil price shock since it shows the greatest impact. Table 4 provides the contribution of the variables to inflation rate of West Java. Initially, inflation is mostly influenced by the inflation itself accounted for 93.2% at month 1 and then the impact decreases to 67.8% in the following period. The world oil price is the second largest source of changes in inflation contributed by 5.1% at the beginning, and causes a 12.5% impact in the 2nd period and 14.5% in the 10th period. It indicates that the oil price shock is considerable source of changes in inflation rates. Meanwhile, the reaction of the rest of variables appears to be entirely statistically insignificant in the first period yet the impact continues to increase in the latter part of the period.

Ⅶ. Policy Response: The Transmission of Oil Price Shocks to Inflation and Economic Growth

Despite the global economic uncertainty, West Java has recorded high economic growth which is above the national average. Still, the global uncertainty which includes the downward revision of global economy growth, the slowdown in global trade, and the disruptions in global distribution channels followed by supply-related shocks to food and energy prices from the Russia-Ukraine war has resulted in global headline inflation hence inflation in West Java remains a concern. Due to this matter, the Indonesian government and related stakeholders have put in strategic efforts to suppress inflation, one of which works through the “Inflation Monitoring and Control Team” (TPI) and

Table 4. Results of Variance Decomposition for Inflation

Period	DL_WTI	DL_IKK	DL_EX	DL_EXC	DL_M	DL_CPI	DL_KTPT	DL_SEMEN	DL_MOB
1	5.101150	1.081225	0.073993	0.580153	0.003411	93.16007	0.000000	0.000000	0.000000
2	12.47085	2.960334	12.73746	2.253310	0.065451	67.80458	0.194945	1.094202	0.418869
3	12.92283	2.101406	23.15602	2.601735	4.739253	49.28289	1.014881	3.412204	0.768790
4	12.03423	3.118558	20.10613	4.650591	4.552716	47.88863	1.064165	4.336536	2.248447
5	14.63622	2.821266	23.84268	4.153988	6.455801	40.37770	2.079264	3.858752	1.774323
6	16.35228	2.806203	22.56919	4.120097	6.681317	37.83808	2.589747	4.705072	2.338011
7	15.51948	2.547532	27.11471	6.219686	7.024549	33.10510	2.239602	4.094214	2.135121
8	15.25150	2.930246	26.17157	6.054089	6.788595	32.73836	3.817277	3.972748	2.275619
9	14.94060	4.181090	25.63599	5.924986	6.958513	32.18992	3.772290	4.151200	2.245418
10	14.49203	4.069668	27.31975	6.117692	6.833855	31.42402	3.639213	3.945431	2.158341

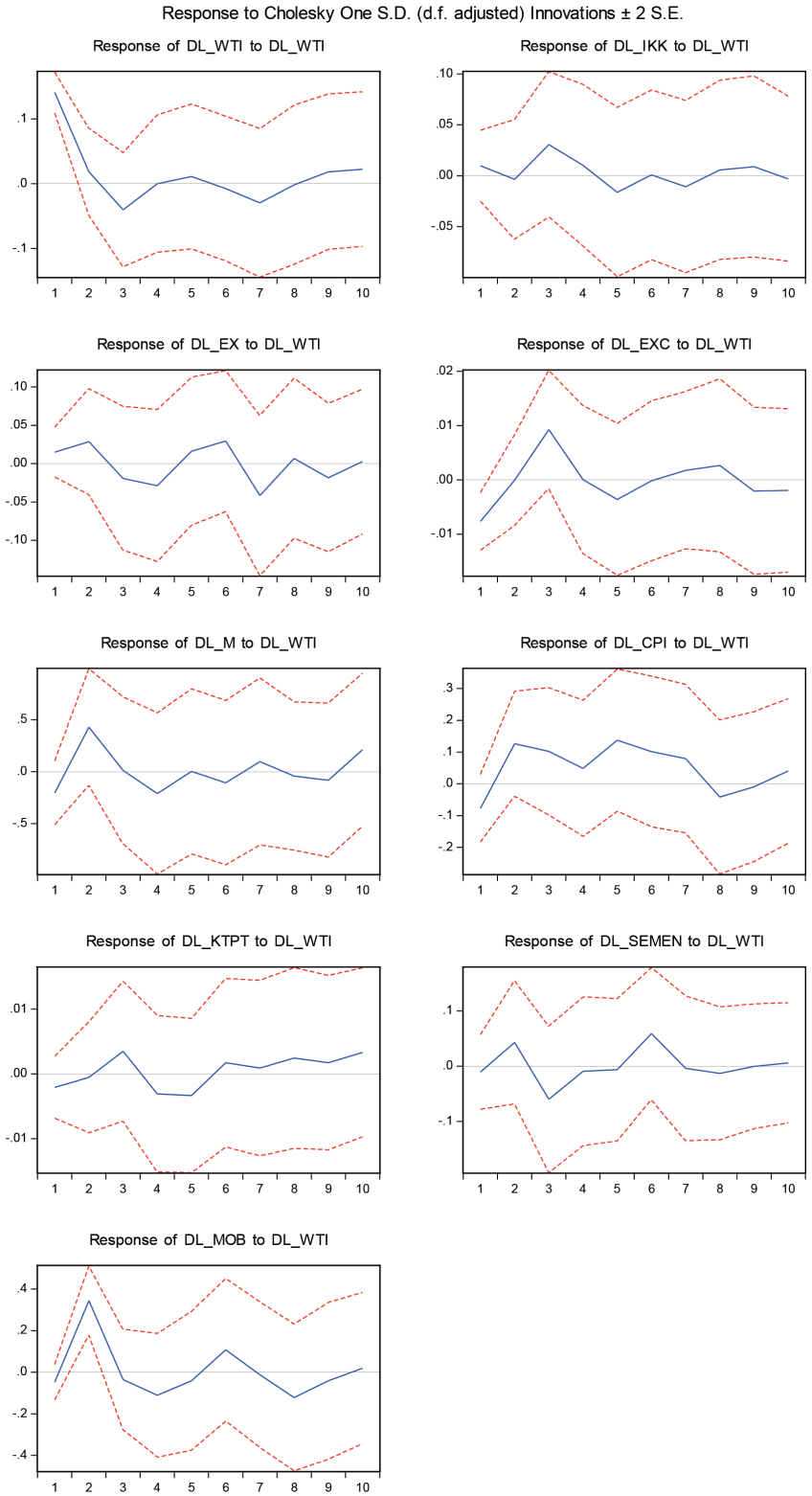

Figure 3. *Impulse Reaction Function*

"Regional Inflation Control Team (TPID)" established by the Government and Central Bank of Indonesia.

TPI has exerted some initiatives to control the inflation rate at the national and regional levels, including the National Movement for Food Inflation Control (GNPIP). GNPIP is expected to optimize efforts and tangible action towards food price stability (from the supply side) and increase production to bolster food security in a more integrated manner for national impact, based on the 4K framework - availability, price, access, and communication, thereby supporting public purchasing power and the national economic recovery. There are also some attempts managed by Central Bank of Indonesia, particularly representative office of West Java that needs to be highlighted. For instance, "Pangsi Ecosystem"or "Ketahanan Pangan-Terintegrasi" in Bahasa means "Integrated Food Security". The Pangsi Ecosystem is a holistic approach to food ecosystem management that covers production, distribution, and marketing to end consumers as well as banking services. The Pangsi Ecosystem is designed to overcome food insecurity related problems and achieve food self-sufficiency through involvement all members of society inclusively.

Moreover, other efforts also have been made to drive West Java economic growth via collaboration between elements of the government and related stakeholders. First, collaborative event initiated by Bank Indonesia West Java Representatives and the West Java Regional National Craft Council, namely the West Java Creative Works (KKJ) and West Java Craft Week (PKJB). The KKJ and PKJB aim to help expand the market for small businesses (MSMEs), encourage MSEs transition into a more sustainable green economy, and promote the implementation of sharia economics. In 2022, the event is featured premium product of 87 creative MSMEs range from crafts, fashion, culinary, and creative industries. In line with this program, "Bangga Buatan Indonesia (BBI)" or "Proud of Indonesian Products" national movement launched by the Indonesian Government has proved to boost economic stimuli by increasing in the number of domestic product purchases. Further, the BBI national movement also sets the main target to add technological utilization and digitalization to help increase MSMEs sales. It is important to note that the achievement of BBI national movement is reached due to joint collaborations of various parties, including ministries/institutions, government regulations, SOEs, marketplace platforms, and top brands. As a result, all of these initiatives have made a great contribution to economic growth.

Ⅷ. Conclusions

The study empirically investigates the impact world oil price shocks have on macroeconomic activities of West Java which include consumer confidence index (IKK), export values (EX), IDR exchange rate (EXC), money in circulation (M), inflation rate (CPI), credit availed by textile and apparel industry (KTPT), cement sales (SEMEN) and car production (MOBIL). Findings indicate that the impact of high crude oil prices on the economy is unfavorable, agreed with the previous study (Nizar, 2012). Results also show one important macroeconomic variable on which oil price effects is inflation rate that creates a new equilibrium in the long run.

It is obvious from the result that the oil price shock can adversely affect the West Java economic performance in the longer period. As net oil importing emerging economies, any change in oil price may lead to an increase in domestic fuel prices which later pass to selling prices and boost inflation in the country. For this reason, monetary authorities as well as the government should not ignore this oil price induced inflation.

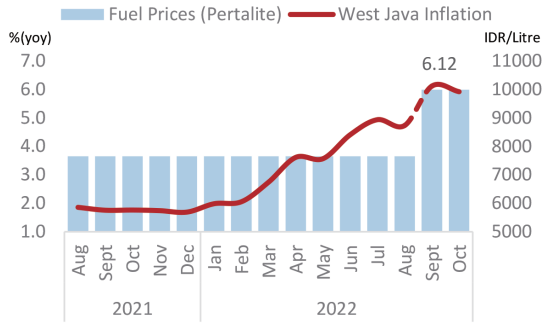

Figure 5. Fuel Prices (Premium) and West Java Inflation 2000-2014

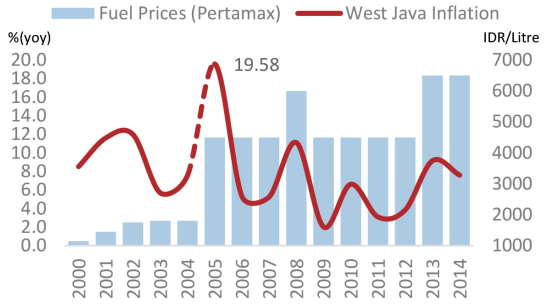

Figure 4. Fuel Prices (Pertalite) and West Java Inflation 2017-2022

Ⅸ. Policy Implications

The findings of this study can lead to important policy recommendations. The Indonesian as well as West Java government should take into account effective steps to decrease the inflationary impact of high oil prices. First, the government should find the right time to increase the price of subsidised fuel. Next, it is also vital to monitor the sectors that are most affected by oil price volatility in order to decrease their dependency on oil products. Such policies can be a solution to reduce the dependency on oil which will help decrease the vulnerability of inflation to oil price changes.

There are also prevailed recommendations of Central Bank of Indonesia, which the government is suggested to embrace, that can be further applied as they prove delivering better inflation control results. It is indicated by West Java's inflation rate caused by adjustment of fuel prices in September 2022 reached 6.12% (yoy) is not as high 2005 level of inflation in Indonesia reached 19.58% (yoy). The recommendations are summarized as follows: i) the National Movement for Food Inflation Control (GNPIP), with short-term focus on open market operations, inter-regional cooperation, and strengthening food security; ii) Integrated Food Ecosystem, as an end-to-end approach from production aspect, distribution and marketing to the end consumer involving various components of society inclusively; iii) The government fiscal stimulus; iv) Integrated logistics.

In the long run, the government and monetary authorities also expect to design policies promoting comprehensive renewable energy sources and utilizing energy-saving and fuel-efficient technologies, though the energy transformation is still in its early stages, and the energy revolution still has a long way to go (Wang, Cheng and Cao, 2022).

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Appendices

Appendix 1. Vector Autoregression Estimates Results

	DL_WTI	DL_IKK	DL_EX	DL_EXC	DL_M	DL_CPI	DL_KTPT	DL_SEMEN	DL_MOB
DL_WTI(-1)	0.140980	-0.019770	0.073091	-0.002297	1.730916	0.598888	-0.024378	0.291275	1.593506
	(0.31385)	(0.24588)	(0.23022)	(0.03915)	(2.18619)	(0.75740)	(0.03373)	(0.47713)	(0.60433)
	[0.44920]	[-0.08040]	[0.31748]	[-0.05867]	[0.79175]	[0.79072]	[-0.72275]	[0.61048]	[2.63680]
DL_WTI(-2)	0.375055	0.191102	0.154529	0.018374	1.079266	-0.013675	0.039797	0.008486	0.048187
	(0.40496)	(0.31726)	(0.29705)	(0.05051)	(2.82084)	(0.97727)	(0.04352)	(0.61564)	(0.77977)
	[0.92616]	[0.60235]	[0.52020]	[0.36377]	[0.38260]	[-0.01399]	[0.91442]	[0.01378]	[0.06180]
DL_WTI(-3)	-0.378703	0.285342	0.154010	-0.008979	-4.400926	0.466644	-0.039775	0.500966	1.727336
	(0.36587)	(0.28664)	(0.26839)	(0.04564)	(2.54859)	(0.88295)	(0.03932)	(0.55622)	(0.70451)
	[-1.03506]	[0.99547]	[0.57384]	[-0.19675]	[-1.72681]	[0.52850]	[-1.01152]	[0.90066]	[2.45181]
DL_IKK(-1)	0.125231	0.139266	-0.008255	0.041398	1.881625	-0.395695	0.066323	0.226198	-0.372427
	(0.37883)	(0.29679)	(0.27789)	(0.04725)	(2.63885)	(0.91422)	(0.04071)	(0.57592)	(0.72947)
	[0.33057]	[0.46923]	[-0.02971]	[0.87613]	[0.71305]	[-0.43282]	[1.62901]	[0.39276]	[-0.51055]
DL_IKK(-2)	-0.165916	-0.191921	0.191833	-0.053655	-1.027203	0.120299	-0.054637	0.036779	0.821107
	(0.32556)	(0.25506)	(0.23881)	(0.04061)	(2.26778)	(0.78567)	(0.03499)	(0.49494)	(0.62689)
	[-0.50963]	[-0.75246]	[0.80327]	[-1.32133]	[-0.45295]	[0.15312]	[-1.56155]	[0.07431]	[1.30981]
DL_IKK(-3)	-0.045444	-0.456793	-0.246944	0.040095	1.769698	-0.363620	0.080320	0.193329	0.268806
	(0.37595)	(0.29453)	(0.27577)	(0.04689)	(2.61875)	(0.90726)	(0.04040)	(0.57153)	(0.72391)
	[-0.12088]	[-1.55091]	[-0.89546]	[0.85506]	[0.67578]	[-0.40079]	[1.98792]	[0.33826]	[0.37133]
DL_EX(-1)	-0.207979	-0.498198	-1.061947	-0.021286	2.374658	2.577113	-0.067557	-1.033804	0.040268
	(0.56755)	(0.44464)	(0.41632)	(0.07079)	(3.95341)	(1.36965)	(0.06100)	(0.86282)	(1.09285)
	[-0.36645]	[-1.12045]	[-2.55077]	[-0.30069]	[0.60066]	[1.88159]	[-1.10756]	[-1.19817]	[0.03685]
DL_EX(-2)	-0.514918	-0.386112	-0.831499	0.103074	6.017335	0.578769	0.016472	-0.481160	0.668871
	(0.60232)	(0.47188)	(0.44183)	(0.07513)	(4.19558)	(1.45355)	(0.06473)	(0.91567)	(1.15980)
	[-0.85490]	[-0.81824]	[-1.88196]	[1.37202]	[1.43421]	[0.39818]	[0.25446]	[-0.52547]	[0.57671]
DL_EX(-3)	-0.459535	-0.162643	0.103322	0.109923	2.030042	-0.892646	-0.006971	-0.222794	0.124821
	(0.47168)	(0.36954)	(0.34600)	(0.05883)	(3.28563)	(1.13830)	(0.05069)	(0.71708)	(0.90825)
	[-0.97425]	[-0.44013]	[0.29862]	[1.86841]	[0.61786]	[-0.78420]	[-0.13752]	[-0.31070]	[0.13743]
DL_EXC(-1)	1.520542	-0.208569	-2.383169	0.006289	-1.603290	-8.348495	-0.449774	3.108372	-8.753838
	(3.37340)	(2.64287)	(2.47454)	(0.42076)	(23.4983)	(8.14092)	(0.36255)	(5.12841)	(6.49569)
	[0.45074]	[-0.07892]	[-0.96307]	[0.01495]	[-0.06823]	[-1.02550]	[-1.24059]	[0.60611]	[-1.34764]
DL_EXC(-2)	7.471276	-0.550058	0.425575	-1.127357	37.75255	10.02691	-1.010043	-3.062094	-5.798606
	(4.26873)	(3.34431)	(3.13131)	(0.53243)	(29.7350)	(10.3016)	(0.45877)	(6.48954)	(8.21971)
	[1.75023]	[-0.16448]	[0.13591]	[-2.11736]	[1.26964]	[0.97334]	[-2.20163]	[-0.47185]	[-0.70545]
DL_EXC(-3)	0.753423	0.817370	1.612042	-0.132347	3.118194	-0.777162	-0.668401	7.364960	15.92359
	(2.95128)	(2.31216)	(2.16490)	(0.36811)	(20.5579)	(7.12223)	(0.31718)	(4.48669)	(5.68287)
	[0.25529]	[0.35351]	[0.74463]	[-0.35953]	[0.15168]	[-0.10912]	[-2.10731]	[1.64151]	[2.80203]

	DL_WTI	DL_IKK	DL_EX	DL_EXC	DL_M	DL_CPI	DL_KTPT	DL_SEMEN	DL_MOB
DL_M(-1)	0.036259	-0.001069	-0.093685	-0.007363	-0.868218	0.063547	-0.001796	-0.161349	-0.196978
	(0.04427)	(0.03468)	(0.03248)	(0.00552)	(0.30839)	(0.10684)	(0.00476)	(0.06730)	(0.08525)
	[0.81901]	[-0.03082]	[-2.88481]	[-1.33333]	[-2.81536]	[0.59479]	[-0.37738]	[-2.39732]	[-2.31065]
DL_M(-2)	0.033183	-0.082913	-0.128819	-0.006876	-0.334457	0.120930	-0.007931	-0.199148	-0.274495
	(0.06207)	(0.04863)	(0.04553)	(0.00774)	(0.43235)	(0.14979)	(0.00667)	(0.09436)	(0.11952)
	[0.53462]	[-1.70507]	[-2.82932]	[-0.88822]	[-0.77357]	[0.80734]	[-1.18888]	[-2.11052]	[-2.29670]
DL_M(-3)	0.016333	-0.088122	-0.064969	6.23E-06	-0.257739	0.050297	-0.007377	-0.093315	-0.182825
	(0.04004)	(0.03137)	(0.02937)	(0.00499)	(0.27892)	(0.09663)	(0.00430)	(0.06087)	(0.07710)
	[0.40790]	[-2.80906]	[-2.21189]	[0.00125]	[-0.92405]	[0.52050]	[-1.71419]	[-1.53291]	[-2.37116]
DL_CPI(-1)	-0.097711	0.032713	0.015683	0.007983	-0.250218	0.326610	0.026918	-0.040179	-0.208547
	(0.09605)	(0.07525)	(0.07046)	(0.01198)	(0.66905)	(0.23179)	(0.01032)	(0.14602)	(0.18495)
	[-1.01730]	[0.43474]	[0.22260]	[0.66635]	[-0.37399]	[1.40907]	[2.60768]	[-0.27516]	[-1.12760]
DL_CPI(-2)	-0.067703	0.069424	-0.009516	-0.003473	-1.009111	0.046923	-0.020686	0.119987	0.116712
	(0.12212)	(0.09567)	(0.08958)	(0.01523)	(0.85065)	(0.29470)	(0.01312)	(0.18565)	(0.23515)
	[-0.55441]	[0.72564]	[-0.10623]	[-0.22798]	[-1.18628]	[0.15922]	[-1.57613]	[0.64631]	[0.49634]
DL_CPI(-3)	0.095607	-0.107229	-0.192624	0.006902	1.391054	0.499774	0.013869	-0.280561	-0.454875
	(0.15348)	(0.12024)	(0.11259)	(0.01914)	(1.06911)	(0.37039)	(0.01649)	(0.23333)	(0.29554)
	[0.62293]	[-0.89177]	[-1.71091]	[0.36056]	[1.30113]	[1.34931]	[0.84079]	[-1.20242]	[-1.53915]
DL_KTPT(-1)	-3.671135	-2.534096	0.131254	0.336717	16.49837	5.845851	0.000416	-0.559734	4.961067
	(2.23731)	(1.75281)	(1.64117)	(0.27906)	(15.5846)	(5.39923)	(0.24045)	(3.40128)	(4.30809)
	[-1.64087]	[-1.44573]	[0.07998]	[1.20662]	[1.05863]	[1.08272]	[0.00173]	[-0.16457]	[1.15157]
DL_KTPT(-2)	-3.580436	0.486662	-0.415164	0.487698	12.91914	0.819314	0.559846	0.162775	2.502913
	(2.70746)	(2.12114)	(1.98604)	(0.33770)	(18.8595)	(6.53381)	(0.29098)	(4.11601)	(5.21337)
	[-1.32243]	[0.22943]	[-0.20904]	[1.44418]	[0.68502]	[0.12540]	[1.92402]	[0.03955]	[0.48009]
DL_KTPT(-3)	-4.616755	1.278092	-0.558457	0.614679	15.56800	2.387239	0.503868	-0.116549	0.475429
	(1.89455)	(1.48427)	(1.38974)	(0.23631)	(13.1970)	(4.57205)	(0.20361)	(2.88019)	(3.64807)
	[-2.43686]	[0.86109]	[-0.40184]	[2.60121]	[1.17966]	[0.52214]	[2.47465]	[-0.04047]	[0.13032]
DL_SEMEN(-1)	-0.119068	-0.279729	-0.064819	0.014446	-0.383965	-0.427915	0.033425	-0.099369	-0.161408
	(0.30019)	(0.23518)	(0.22020)	(0.03744)	(2.09102)	(0.72443)	(0.03226)	(0.45636)	(0.57803)
	[-0.39665]	[-1.18943]	[-0.29436]	[0.38582]	[-0.18363]	[-0.59069]	[1.03604]	[-0.21774]	[-0.27924]
DL_SEMEN(-2)	-0.084354	0.141737	0.242403	-0.036771	-3.998082	-0.591966	-0.055544	0.525993	0.786631
	(0.26083)	(0.20434)	(0.19133)	(0.03253)	(1.81684)	(0.62944)	(0.02803)	(0.39652)	(0.50223)
	[-0.32341]	[0.69363]	[1.26695]	[-1.13028]	[-2.20056]	[-0.94046]	[-1.98149]	[1.32653]	[1.56626]
DL_SEMEN(-3)	0.418236	0.275210	-0.204837	-0.054644	0.716300	-0.559810	0.017885	0.076271	0.116991
	(0.26738)	(0.20948)	(0.19614)	(0.03335)	(1.86252)	(0.64527)	(0.02874)	(0.40649)	(0.51486)
	[1.56418]	[1.31378]	[-1.04436]	[-1.63849]	[0.38459]	[-0.86756]	[0.62240]	[0.18763]	[0.22723]
DL_MOB(-1)	-0.059979	0.045649	0.051178	-0.004777	1.011949	0.218971	-0.038497	-0.016859	-0.183318
	(0.19020)	(0.14901)	(0.13952)	(0.02372)	(1.32491)	(0.45901)	(0.02044)	(0.28916)	(0.36625)
	[-0.31534]	[0.30634]	[0.36681]	[-0.20137]	[0.76379]	[0.47705]	[-1.88324]	[-0.05830]	[-0.50053]

	DL_WTI	DL_IKK	DL_EX	DL_EXC	DL_M	DL_CPI	DL_KTPT	DL_SEMEN	DL_MOB
DL_MOB(-2)	0.184627	-0.090162	0.010366	-0.003440	2.205799	0.282673	0.007732	-0.115022	-0.275442
	(0.16347)	(0.12807)	(0.11991)	(0.02039)	(1.13867)	(0.39449)	(0.01757)	(0.24851)	(0.31476)
	[1.12945]	[-0.70403]	[0.08645]	[-0.16870]	[1.93718]	[0.71656]	[0.44013]	[-0.46285]	[-0.87507]
DL_MOB(-3)	-0.177909	0.021138	0.069118	0.012409	-0.804283	0.256290	0.001916	0.086638	0.249682
	(0.09783)	(0.07664)	(0.07176)	(0.01220)	(0.68144)	(0.23608)	(0.01051)	(0.14872)	(0.18837)
	[-1.81861]	[0.27581]	[0.96317]	[1.01697]	[-1.18028]	[1.08560]	[0.18225]	[0.58256]	[1.32548]
C	-0.046308	-0.015670	0.011666	0.007993	0.158890	0.034904	0.001985	-0.003340	0.001323
	(0.03019)	(0.02365)	(0.02215)	(0.00377)	(0.21031)	(0.07286)	(0.00324)	(0.04590)	(0.05814)
	[-1.53378]	[-0.66248]	[0.52674]	[2.12264]	[0.75550]	[0.47905]	[0.61172]	[-0.07276]	[0.02276]
R-squared	0.810514	0.795055	0.847106	0.837762	0.845297	0.748899	0.847645	0.678131	0.934067
Adj. R-squared	0.384170	0.333930	0.503093	0.472726	0.497216	0.183920	0.504847	-0.046074	0.785718
Sum sq. resids	0.238185	0.146194	0.128165	0.003706	11.55715	1.387153	0.002751	0.550483	0.883139
S.E. equation	0.140886	0.110376	0.103346	0.017572	0.981374	0.339994	0.015141	0.214181	0.271284
F-statistic	1.901080	1.724162	2.462426	2.295012	2.428449	1.325535	2.472721	0.936380	6.296412
Log likelihood	45.71420	55.47648	58.10883	128.9787	-31.92604	10.47497	134.9350	28.95922	19.50550
Akaike AIC	-0.885710	-1.373824	-1.505442	-5.048936	2.996302	0.876251	-5.346752	-0.047961	0.424725
Schwarz SC	0.296506	-0.191608	-0.323226	-3.866721	4.178518	2.058467	-4.164536	1.134255	1.606940
Mean dependent	0.009005	-0.005201	0.009589	0.001361	-0.022665	0.053774	-0.005708	0.008627	0.007120
S.D. dependent	0.179530	0.135243	0.146607	0.024200	1.384025	0.376362	0.021518	0.209411	0.586045

Determinant resid covariance (dof adj.)	2.78E-19
Determinant resid covariance	5.47E-24
Log likelihood	560.4272
Akaike information criterion	-15.42136
Schwarz criterion	-4.781421
Number of coefficients	252