

FLUCTUATIONS OIL PRICES IN WORLD AND THEIR IMPACT ON INDONESIAN MACROECONOMICS

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ABSTRACT

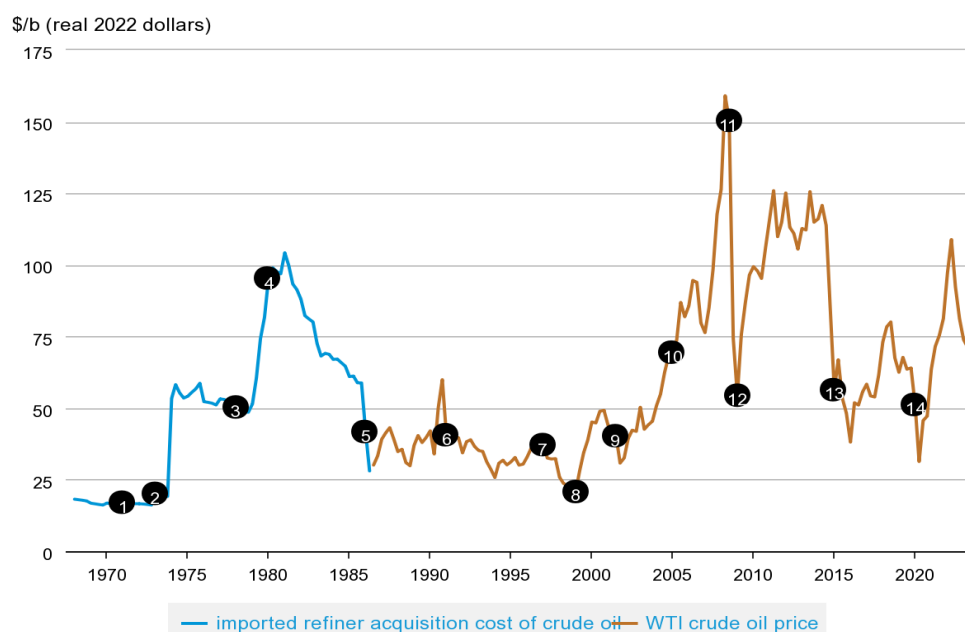
The impact of oil price fluctuations on GDP, inflation, exchange rates, interest rates, and industrial production indices in Indonesia is examined within a structural vector autoregressive (SVAR) framework. To accurately identify the relationship between oil prices and macroeconomic activity, the entire sample period is 1990-2021. Research shows that oil price shocks significantly impact three variables: GDP, inflation, and exchange rate. The results also show that oil price shocks hurt two other variables, namely the interest rate variable and the industrial production index. The findings derived from the analysis of the impulse response function indicate a detrimental effect on the growth of production, while exerting a favorable influence on inflation. However, the impact on industrial production, interest rates, and exchange rates is very modest and characterized by a degree of uncertainty.

Key words: Oil Prices; Macroeconomics; Indonesia

INTRODUCTION

Changes in international crude oil prices can significantly impact economic outcomes. (Wang & Zhang, 2014; Wei et al., 2008). Since the 1950s, oil has become the most efficient energy source in developed countries in various parts of the world. On July 3, 2008, world oil prices reached their highest point of US\$145 per barrel during the global financial crisis. However, on April 28, 2020, the lowest oil price was recorded at US\$12.34 per barrel due to the decline in global economic activity caused by the coronavirus pandemic. There is a lot of uncertainty associated with global oil production and its price fluctuations due to its close connection with economic and financial events in various parts of the world (Iwayemi & Fowowe, 2011).

As seen in Figure 1, international oil prices experience ups and downs according to events that occur, a sharp increase of around 20 dollars caused by the Gulf War that occurred in 1990. Other significant events, such as the Asian economic crisis, the 9-11 attacks, The Iraq War, the Venezuelan Strike in 2003, the global financial crisis of 2008-2009, and the political crisis in Ukraine, have also triggered sharp fluctuations in oil prices. Among them, political risk events, especially those occurring in the Organization of the Petroleum Exporting Countries (OPEC), may significantly impact oil price volatility. This is because OPEC countries have more excellent oil resources and a higher frequency of risk events, according to Global Terrorism Database (GTD) statistics.



- | | |
|---------------------------------------|--|
| 1: US spare capacity exhausted | 8: OPEC cuts production targets 1.7 mmbpd |
| 2: Arab Oil Embargo | 9: 9-11 attacks |
| 3: Iranian Revolution | 10: Low spare capacity |
| 4: Iran-Iraq War | 11: Global financial collapse |
| 5: Saudis abandon swing producer role | 12: OPEC cuts production targets 4.2 mmbpd |
| 6: Iraq invades Kuwait | 13: OPEC production quota unchanged |
| 7: Asian financial crisis | 14: Global pandemic reduces oil demand |

Figure. 1 Crude oil prices react to a variety of geopolitical and economic events

Lisnawati, (2016) stated that the decline in oil prices will affect government revenue from personal income tax (PPH) in the oil and gas sector and government revenue from the excluded oil and gas sector, Non-Tax State Revenue (PNPB). Even though there are innovations in various parts of the world regarding alternative energy sources, crude oil remains the leading force today (Nazir & Hameed, 2015). The role of energy in various sectors of the modern economy is crucial and cannot be ignored. For example, oil has essential requirements in producing electricity, use of production machinery, and transportation. Petroleum products are used as raw materials in industry, telecommunications, construction, and consumer goods in the home. This indicates that petroleum products are used widely throughout the world economy, even though these countries do not have petroleum reserves. Thus, global oil price fluctuations have a significant impact on most economies around the world. Economic entities become uncertain about prospects whenever there is a severe disruption in the supply of oil to the worldwide market.

There is a growing necessity to undertake additional study on the effects of oil price shocks on macroeconomic variables in emerging nations like Indonesia, as new trends emerge about the evolving impact of oil price fluctuations on the economy. The objective of this study is to examine the effects of oil price shocks on various macroeconomic indicators, including output growth, inflation, interest rates, exchange rates, and industrial production, within the context of Indonesia. Indonesia serves as a paradigmatic illustration of a developing nation characterized by the exportation of petroleum and the importation of processed oil products.

Many studies examine the impact of changes in oil prices on macroeconomic indicators. One of the studies is that oil price fluctuations positively affect economic growth. Kurihara, (2015) argues in his study of more developed countries such as the US, EU, and Japan that rising oil prices benefit more advanced economies. In a related study, Baek, (2021) research examined oil prices on growth, inflation, and exchange rates in Indonesia in 1998-2019, divided into two periods, between 1998-2003 and 2004-2019. He found that the spike in oil prices affected the appreciation of the Indonesian currency. On the other hand, in the era of net oil importers, rising oil prices reduce growth and cause exchange rate depreciation. However, there is little evidence that increasing oil prices in either period had a significant adverse impact on inflation.

In contradistinction to the research undertaken by Tang et al., (2010), a study carried out in China during the period from 1998 to 2008 revealed that the escalation of oil prices had a detrimental impact on both investment and production. In their study, Nazir & Hameed, (2015) examined the relationship between oil prices and GDP in Pakistan. They utilized a dataset spanning from 1972 to 2011 and arrived at the finding that oil prices have a detrimental impact on real GDP over an extended period of time. Kiliçarslan & Dumrul, (2017) conducted a study in Turkey that employed the SVAR analysis technique to examine data from the period spanning from the first quarter of 2005 to the second quarter of 2017. The findings of their study indicated that a rise in crude oil prices was associated with a decline in economic growth, as well as an increase in crude oil prices, inflation, and the real exchange rate. In a study conducted by Jawad & Khan Niazi, (2017) on the correlation between oil price shocks and economic growth, it was concluded that there is no significant impact between these variables. Specifically, the research focused on Pakistan as the context for analysis.

This collection of scholarly studies investigates the effects of oil price changes on the consumer price index (CPI) or inflation. The correlation between oil prices and consumer pricing is frequently examined as a result of the significant role that crude oil products play as a fundamental input for a wide range of consumer goods. (Sek et al., 2015). One of the initial investigations of this association was carried out in India by Bhattacharya & Bhattacharyya, (2001), utilizing monthly data spanning from April 1994 to December 2000. The

researchers employed a Vector Autoregressive (VAR) model and an impulse response function to ascertain that a 20 percentage point rise in oil prices resulted in a subsequent 1.3 percentage point increase in inflation pertaining to other commodities. In a similar vein, Dawson (2006) conducted a study on nations belonging to the Organisation for Economic Co-operation and Development (OECD) and discovered that a just 1% escalation in oil prices resulted in a substantial 2.9% decline in the real exchange rate. In a study conducted by Colin Bermingham, (2008) in Ireland spanning the period from 1996 to 2008, the Engle-Granger and ARDL methodologies were employed to examine the impact of increasing oil prices on inflation. The findings of the study revealed a substantial relationship between rising oil prices and inflation. The study conducted by Ogunipe et al. (2014) employed annual data spanning from 1970 to 2011 to examine the impact of oil prices, exchange rate volatility, external reserves, and interest rates on the Nigerian economy. The study use Johansen cointegration and VECM methodologies to ascertain that alterations in oil prices result in a commensurate increase in exchange rate volatility. The study conducted by Jiranyakul (2016) examined data from Thailand spanning the years 1993 to 2015. The researcher employed the Johansen cointegration and Granger causality tests in their analysis. The findings of this study indicate that oil price shocks have a positive impact on the inflation index, however oil price uncertainty does not exhibit a significant influence on the upward trajectory of inflation. In their study, Bala and Chin (2018) examine the asymmetrical impacts of oil price shocks on inflation within the context of small oil-exporting nations, specifically focusing on countries such as Nigeria, Libya, Algeria, and Angola. The Nardl dynamic panel methodology was employed to examine the impact of oil price fluctuations on the inflation rate, revealing both positive and negative associations between the two variables. Mukhtarov et al. (2019) conducted a study on the correlation between inflation, oil prices, and exchange rates in Azerbaijan. The authors employed the Vector Error Correction Model (VECM) technique to analyze data spanning from 1995 to 2017. The researchers discovered that a marginal increase of 1% in oil prices and the exchange rate corresponded to a subsequent rise in inflation by 0.58% and 1.81%, respectively.

This study aims to examine the volatility of oil prices in the worldwide market from 1990 to 2021, with a focus on addressing the existing research gap on oil price fluctuations. To achieve this objective, the study incorporates five macroeconomic variables as explanatory factors. Furthermore, the research was carried out in a developing nation characterized by its oil production and exportation, as well as its importation of refined petroleum products.

METHOD

Oil price dynamics can be explained through a theoretical approach based on postulates (Ali Ahmed & Wadud, 2011; Huang & Guo, 2007). This postulation will state that there is a stochastic relationship between oil prices (Op_t) and aggregate supply (S_t) and aggregate demand (D_t) activity in the economy at each point in time. Therefore, the formulation can be presented as follows:

$$Op_t = Op_{t-1} + \varepsilon_t^{op} \quad (1)$$

Meanwhile, aggregate supply can be modeled as follows:

$$S_t = S_{t-1} + \varepsilon_t^s \quad (2)$$

Similarly, aggregate demand can also be modeled as follows:

$$D_t = D_{t-1} + \varepsilon_t^d \quad (3)$$

However, the aggregate supply of output Y_t^s can be determined by the process of random walk to equilibrium and the price of oil can then be formulated as follows:

$$Y_t^s = S_t + \beta_1 Op_t = S_{t-1} + \varepsilon_t^s + \beta_2 Op_t \quad (4)$$

Where, β_1 dan β_2 is the inverse energy elasticity coefficient of output.

Likewise, the process of aggregate demand for output can also be determined by the random walk process and its own exchange rate (e),

$$Y_t^D = D_t + \psi_1 e_t = D_{t-1} + \varepsilon_t^D + \psi_2 e_t \quad (5)$$

Where, ψ_1 dan ψ_2 is the elasticity coefficient of demand for energy output.

Equations (4) and (5) exhibit similarities to the LM and IS representations of aggregate supply and aggregate demand models in the field of macroeconomics. These models elucidate the relationship between aggregate domestic supply and demand prices for oil output, taking into account macroeconomic variables such as inflation, exchange rate, interest rates, and industrial output.

Huang & Guo (Huang & Guo, 2007) succeeded in explaining why changes in supply output and fluctuations in oil prices can affect real Gross Domestic Product (GDP). Therefore, oil price fluctuations have the potential to influence real oil prices in the long term. So, the model to be estimated is represented as follows:

$$GDPR_t = \alpha_0 + \alpha_1 OILP_{t1} + \alpha_2 INFL_{t2} + \alpha_3 INTR_{t3} + \alpha_4 EXR_{t4} + \alpha_5 IPI_{t5} + \mu_t - \theta \quad (6)$$

Data Source

This research uses the SVAR model for the 1990-2021 period which includes 32 years of observations. The variables used include: oil prices, economic growth, inflation (consumer prices), interest rates, exchange rates, and industrial production levels.

The data source for this research is secondary data from the World Bank—a collection of variable data on consumer prices and industrial production from WDI sources with the latest year 2021. To standardize variables, this research uses natural logarithms for all variables. Full names, descriptions, and data sources are listed in Table 1.

Table 1. Data and Variable Description

Variable	Full Name	Description	Source
OILP	Brent Crude Oil Price	UK Brent Crude Oil in US\$ per barrel	WDI
GDPR	Economic Growth	The annual growth rate (percentage) of GDP at market prices: Estimated as $\left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right) \%$ for each year	WDI
INFL	Inflation	Consumer Prices at annual % change	WDI
INTR	Interest Rate	Lending rate at which Banks meet the short and medium-term financing needs of government and the private sector.	WDI
IPI	Industrial Production Index	Value added is the net output of Industrial sectors after adding up all outputs and subtracting intermediate inputs.	WDI
IPI	Exchange Rate	Price at which Indonesia local currency (Rupiah) exchange for one unit of US\$	WDI

Analytical Framework

In the classical configuration, the VAR framework includes all endogenous variables and a set of K observations as follows:

$$Y_t = (Y_{1t}, Y_{2t}, Y_{3t}, \dots, Y_{kt}) \quad (7)$$

For $k = 1 \dots p$. Therefore, the VAR(p) process can be formally defined as follows:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} \dots + A_p y_{t-p} + \mu_t \quad (8)$$

Let A_i represent the coefficient matrix of dimensions $K \times K$ for $i=1 \dots p$. The vector μ_t has k dimensions and is characterized by $E(\mu_t) = 0$. Furthermore, μ_t is time-invariant and has a positive definite covariance matrix $E(\mu_t \mu_t^T) = \Sigma$, where Σ represents white noise. The VAR(p) process exhibits stability and generates a stationary time series with dependable mean, variance, and covariance when appropriate beginning

values are provided. The VAR(p) model represents a set of reduced form equations. The mechanics employed to analyze the VAR indicator are devoid of any direct association with economic theory. The VAR construction methodology was devised as a means to address the limitations inherent in the VAR approach. Enhancing the applicability of this strategy within the framework of established economic theory. The standard structural vector autoregressive (SVAR) model can be formally characterized as:

$$Ay_t = A_1^*y_{t-1} + A_2^*y_{t-2} + \dots + A_p^*y_{t-p} + \beta\varepsilon_t \quad (9)$$

Then to solve the equation for y_t as follows:

$$Ay_t = A^{-1}A_1^*y_{t-1} + A^{-1}A_2^*y_{t-2} + \dots + A^{-1}A_p^*y_{t-p} + A^{-1}\beta\varepsilon_t \quad (10)$$

The notation A_i^* for $i = 1 \dots p$ denotes the structure factor, which typically differs from the corresponding VAR form. The Structural Vector Autoregressive (SVAR) model is considered to be a more appropriate approach for discerning the effects of various shocks by utilizing the structural impulse response function (IRF). The Impulse Response Function (IRF) illustrates the dynamic reaction of individual variables to the present and future values of other variables. The process of structural variance decomposition involves quantifying the extent to which each variable contributes information to other variables in autoregression. This is achieved by partitioning the variability of the endogenous variable into several components within a vector autoregressive (VAR) framework. Additionally, this method allows for the estimation of the error variance associated with a specific variable as well as other variables in the system. Variable structural vector autoregressive (SVAR) models place significant emphasis on the enforcement of constraints through the utilization of stationary inversion techniques in the vector autoregressive representation (VAR).

Where y_t represents the vector of variables included in the model $A_1^{-1}(L)$ refers to the inverse of the coefficient matrix, whereas ε_t is an error term. To obtain a linear combination process that reflects past innovations in line with the Wald composition, it was created $A_1^{-1}(L) = \phi(L)$ therefore the formulation is as follows:

$$y_t = \phi(L)\mu_t = \sum_{h=0}^{\infty} \phi_h \mu_{t-h} \quad (12)$$

To recover relevant unobservable shocks (ε_t) from the reduced observables, a structural VAR representation is constructed by applying a set of constraints. Therefore, the VAR structural formula is created:

$$A_1 y_t = \sum_{i=1}^p A_i^* y_{t-i} + \beta \varepsilon_t \quad \varepsilon_t \sim N(0, I_m) \quad (13)$$

The variables y_t , gdp , $infl$, $intr$, ipi , and exr are denoted as a 4 x 1 vector of endogenous variables. A_1 represents a square matrix of size $m \times m$, which captures the contemporaneous effects. A_1^* is another square matrix of size $m \times m$, which includes the lagged effects. The matrix B represents the shock matrix, also of size $m \times m$, and is associated with the "short-run response" matrix. The subsequent equation is the structural equation that establishes the relationship between μ_t and ε_t , while considering the imposed constraints. The reduced form residuals employed in the structural vector autoregressive (SVAR) model can be utilized;

$$\mu_t = A^{-1}\beta\varepsilon_t \quad (14)$$

A^{-1} can be estimated to obtain the structural shock vector. $A^{-1}B\varepsilon_t$ is the response of y_t to a structural shock. And, the variance-covariance matrix can be represented by;

$$\mu_t = A^{-1}BB^T A^{-T} \quad (15)$$

The subsequent modifications to the aforementioned equation will be contingent upon the imposed limitations. (Lutkepohl, 2006; Lutkepohl & Kratzig, 2004). The restriction structure in the model is defined as $(k - 1)$. Therefore the amount of restrictions to be imposed can be indicated;

$$\frac{k(k-1)}{2} \quad (16)$$

This study involved an examination of six variables using the structural vector autoregression (SVAR) method, specifically utilizing the long-term C (1) matrix. According to Kozluk and Mehrotra (2009), the SVAR modeling technique for six variables is outlined. They state that when an element in the matrix is equal to zero, it indicates the absence of an anticipated simultaneous reaction resulting from a particular shock in that variable. The non-zero element a_{ij} ($i = 1,2,3,4,5,6; j = 1,2,3,4,5,6$) represents the response coefficient of the i th element to the shock of element j , as stated by Chen et al., (2016). The narrative structure within the A matrix equation encompasses a sequence of connections that originate from exogenous variables and extend towards endogenous variables. The structural vector autoregression (SVAR) limitations of the matrix adhere to the limits that are obtained from economic theory. In addition to the realm of economic theory, there exist six limits that are applicable.

Estimate of Matrix A

$$\begin{matrix} \text{Variabel} \\ \begin{matrix} OILP_t \\ GDP R_t \\ INFL_t \\ INTR_t \\ EXR_t \\ IPI_t \end{matrix} \end{matrix} \begin{bmatrix} GDP R_t & OILP_t & INFL_t & INTR_t & EXR_t & IPI_t \\ \begin{matrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{matrix} \end{bmatrix} \quad (17)$$

Estimate of Matrix B

$$\begin{matrix} \text{Variabel} \\ \begin{matrix} OILP_t \\ GDP R_t \\ INFL_t \\ INTR_t \\ EXR_t \\ IPI_t \end{matrix} \end{matrix} \begin{bmatrix} GDP R_t & OILP_t & INFL_t & INTR_t & EXR_t & IPI_t \\ \begin{matrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & a_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & a_{66} \end{matrix} \end{bmatrix} \quad (18)$$

First, oil prices are determined externally and are not influenced by developing countries and minimal producers (Amaiquema & Amaiquema, 2017) such as Indonesia. Second, economic growth does not respond simultaneously to changes in domestic variables in the equation (Kiliçarslan & Dumrul, 2017). Third, inflation is mainly influenced by changes in GDP and oil prices. Fourth, exchange rates and industrial production do not simultaneously influence interest rates. Finally, although the exchange rate may not directly affect industrial production, there is no limit to the influence of the exchange rate on all other variables (Basnet & Upadhyaya, 2015).

RESULTS AND DISCUSSION

Descriptive Statistics

The elements that are discussed in this study encompass many statistical measures such as the mean, median, standard deviation, kurtosis, Jarque-Bera test, and probability. The findings are presented in Table 2. The mean values for the variables of interest, namely the average oil price, economic growth, inflation, industrial output index, and exchange rate, are 5134.531, 4.680312, 11.00594, 4.161250, 4285.688, and 8624.099, respectively. In addition, the variables under consideration possess maximum values of 10163.00, 8.220000, 75.27000, 7.680000, 4806.000, and 14582.20 for oil prices, economic growth, inflation interest rates, industrial output index, and currency rate, respectively. In contrast, the variables exhibit minimal values of 1548.000, -13.13000, -0.440000, -6.910000, 3825.000, and 1842.810 for oil prices, economic growth, inflation, interest rates, industrial production index, and currency rate, respectively. The analysis period encompasses the years 1990 to 2021, during which a total of 32 observations were collected for each variable. During this era, the variables that exhibit the highest degree of fluctuation, as measured by their standard deviation, are oil prices and currency rates. The kurtosis measurement suggests that the GDP, inflation, and interest rates have a distribution with a peak above 3.0.

Table 2. Descriptive Statistics

	LOIL	LDGDP	LINFL	LINT	LIPI	LEXR
Mean	5134.531	4.680312	11.00594	4.161250	4285.688	8624.099
Median	4594.500	5.120000	8.410000	4.560000	4271.000	9235.255
Maximum	10163.00	8.220000	75.27000	7.680000	4806.000	14582.20
Minimum	1548.000	-13.13000	-0.440000	-6.910000	3825.000	1842.810
Std. Dev.	2783.327	3.777920	12.83100	2.504195	304.7157	4230.800
Skewness	0.410543	-3.563468	4.064748	-2.733651	0.301229	-0.443016
Kurtosis	1.874639	16.89521	21.02865	13.03359	1.855848	2.049369
Jarque-Bera	2.587492	325.1600	521.4944	174.0858	2.229384	2.251670
Probability	0.274242	0.000000	0.000000	0.000000	0.328016	0.324381
Observations	32	32	32	32	32	32

Given that the remaining variables in the distribution exhibit kurtosis values that deviate from 3, it is appropriate to categorize the distribution as exhibiting flat kurtosis, characterized by both short tails and a higher concentration of data in the center. The Jarque-Bera normality test was employed to compare the probability values of the distributions in order to ascertain the asymptotic test. The table presents evidence indicating that the probability values associated with all variables are quite small. Additionally, the average value closely approximates the median value. Based on these findings, the researcher deduces that the residual distribution adheres to a normal distribution.

Time Series Properties: Unit Root Test

The Augmented Dickey-Fuller (ADF) technique was employed to conduct the Unit Root Test in this study. The study conducted a unit root test for all variables, including oil prices, GDP, inflation, interest rates, industrial output index, and currency rate. The findings of this analysis are displayed in Table 3. The calculated t-statistic for the first difference I (1) exceeds the threshold values for significance levels of 1%, 5%, and 10%. The probability value associated with the first difference indicates that all variables exhibit stationarity at the level of integration. At the level of the combined stationarity test, the Fisher Chi-square value is 137.847, indicating a probability of zero. Similarly, the Choi Z-Statistics value is -10.2136, also with a probability of zero. Hence, the unit root test indicates that all variables exhibit integration at the first difference order.

Table 3. Unit Root Test with ADF

Method	Statistic		Prob.*		
ADF - Fisher Chi-square	137.847		0.0000		
ADF - Choi Z-stat	-10.2136		0.0000		
Series	t-stat	Prob.	Order of Integrtn	Max Lag	Obs
L(OILP)	-5.153010	0.0000	I(1)	2	30
L(DGDP)	-3.893620	0.0000	I(1)	2	30
L(INFL)	-2.653751	0.0000	I(1)	2	30
L(INTR)	-6.525979	0.0000	I(1)	2	30
L(IPI)	-6.073577	0.0000	I(1)	2	30
L(EXR)	-6.593246	0.0002	I(1)	2	30
Test critical values:	1% level		-3.689.451		
	5% level		-2.971.937		
	10% level		-2.625.159		

Optimal Lag Determination

The optimal lag selection process is shown in Table 4 with the largest lag being lag one, therefore the lag used in the SVAR analysis in this study is lag one which is indicated by LR, FPE, SC and HQ.

Table 4. Optimal Lag Selection

VAR Lag Order Selection Criteria						
Endogenous variables: LOIL LDGDP LINFL LINTR LIPI LEXR						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1004.326	NA	7.20e+21	67.35509	67.63533	67.44474

1	-876.5822	195.8745*	1.67e+19*	61.23881	63.20049*	61.86637*
2	-840.3671	41.04375	2.26e+19	61.22447*	64.86758	62.38993

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Structural VAR Estimates

The findings of the VAR Structural analysis are presented in Table 5 within the context of this research. The table in column one demonstrates the impact of oil prices on macroeconomic variables, revealing the presence of three statistically significant factors. Specifically, there is a notable and substantial beneficial impact of oil price shocks on both GDP and exchange rates. Conversely, there is a strong negative effect of oil price shocks on inflation.

In the context of macroeconomic variables, the impact of oil prices appears to be negligible. Specifically, when examining the variables of interest rates and industrial production index, it is observed that oil price shocks have a positive but statistically insignificant effect on interest rates, while they have a negative but statistically insignificant effect on the industrial production index.

To clarify, the escalation of crude oil prices in Indonesia leads to a decline in the country's Gross Domestic Product (GDP), inflation levels, and the exchange rate. Conversely, the decrease in crude oil prices did not exert any influence on interest rates and industrial production indexes.

Tabel 5 Results of Structural VAR Test

	OILP	GDP	INFL	INTR	IPI	EXR
OILP	1577.635*** (0.0000)					
GDP	0.002554** (0.0000)	2.037332*** (0.0000)				
INFL	-0.004511*** (0.0024)	1.343321*** (0.0096)	5.788491*** (0.0000)			
INTR	0.000681 (0.0977)	0.054332 (0.6957)	0.105280** (0.0172)	1.401158*** (0.0000)		
IPI	-0.000385 (0.3664)	-0.204742 (0.1384)	0.041130 (0.3898)	0.500109*** (0.0058)	1.390432*** (0.0000)	
EXR	0.007003** (0.0299)	-2.419892** (0.0236)	-0.986101*** (0.0064)	0.670454 (0.6582)	-1.720712 (0.2070)	10.38518*** (0.0000)

Note: ***, ** and * indicate significant at 1%, 5% and 10% levels respectively.

SVAR Impulse Response

The present study utilizes the framework of impulse response functions to examine and elucidate the dynamics of interactions among research variables within a limited time horizon. The impulse response function illustrates the reaction of many variables, including economic growth, inflation, interest rates, industrial production, and currency rates, in response to exogenous oil price shocks. This study conducts the Cholesky decomposition of the structural vector autoregressive (SVAR) equation and investigates the impact of oil price shocks on various economic indicators, including economic growth, inflation, interest rates, industrial production, and the official exchange rate. The results of the impulse response function for the reaction of the primary macroeconomic variables to oil price shocks in Indonesia are depicted in Figure 2.

The initial illustration presented in Figure 2 illustrates the immediate reaction of the exchange rate in Nigeria to fluctuations in oil prices. The response of the exchange rate exhibited an initial surge followed by a period of stabilization during the second interval, ultimately reaching a state of stability in the third interval.

Subsequently, the trend reverts to a negative trajectory during the fourth period, followed by a shift towards positivity during the fifth, sixth, and seventh periods. Subsequently, the pattern stabilizes during the eighth, ninth, and tenth periods, exhibiting a flat trend.

The subsequent illustration depicted in Figure 2 presents the reaction of Gross Domestic Product (GDP), which is a measure of economic growth, in response to transient fluctuations in oil prices. The initial reaction of gross domestic product (GDP) to fluctuations in oil prices has a positive trend, which subsequently transitions into a negative trajectory over the second period. Subsequently, during the third session, it exhibited a favorable trend once again. The ascending trajectory was sustained until the sixth interval. Subsequently, there is a discernible shift in the pattern throughout the 8th to the 10th period.

The response of inflation to short-term oil price shocks is depicted in the third diagram in Figure 2. The early reaction of inflation to oil price shocks has a positive trend, which subsequently transitions to a negative trend in the subsequent time. Subsequently, a resurgence in positivity was observed during the third to fifth period, followed by a period of stability from the fifth to the tenth period.

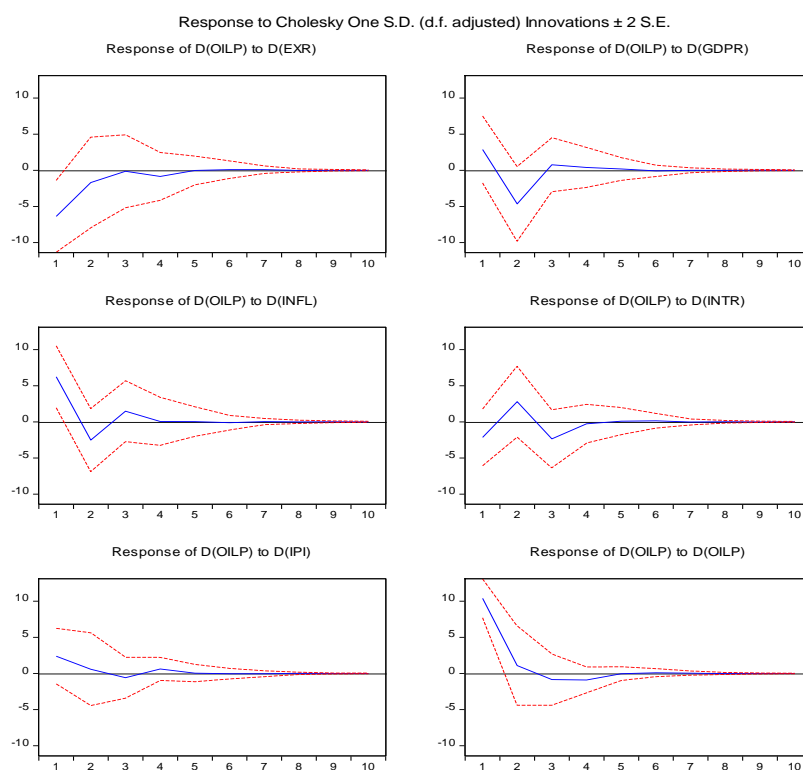


Figure 2. Impulse-Response Function

The response of interest rates to short-term oil price shocks is depicted in the fourth diagram of Figure 2. The initial reaction to changes in interest rates exhibits a slightly unfavorable sentiment, which subsequently transitions into a positive sentiment over the second period. Subsequently, it reverted to a negative state during the third period, followed by a subsequent resurgence of positivity from the fourth through the sixth period. However, it then stabilized at a neutral level during the seventh period and beyond.

The response of industrial production to short-term oil price shocks is seen in the fifth diagram of Figure 2. The first reaction of industrial production to fluctuations in oil prices exhibited a downward trend, transitioning from negative to positive before stabilizing and remaining relatively constant from the fifth quarter onwards. The impact of oil price shocks on industrial output is significant, eliciting both favorable and unfavorable consequences.

The ultimate illustration depicted in Figure 2 exhibits the reaction of oil prices to self-induced disturbances. The observed phenomenon initially elicited a favorable reaction, but then exhibited a significant decline leading to an unfavorable response by the fourth interval. The sixth period marks the transition to a

favorable influence. The positive trend persists until the eighth period, after which it stabilizes in the subsequent period.

CONCLUSION

This study tested the impact of oil price fluctuations on macroeconomic variables in Indonesia. The data used is annual data from 1990 to 2021. They use five macroeconomic variables: economic growth, inflation, interest rates, industrial production, and exchange rates. As a country with a relatively small economy, which relies on exporting crude oil and importing finished oil products, this makes Indonesia an exciting case study. There are many studies on oil price fluctuations in developing countries, but rarely research focuses on more than four variables. By expanding the research period to cover the recent period, it can be observed that there are significant fluctuations in world oil prices. The findings in this study show that the effect of oil price shocks on GDP and the exchange rate is positive and significant, and the effect of oil price shocks on inflation is negative and significant. In contrast, the effect of oil price shocks on interest rates is positive and insignificant, and the effect of oil price shocks on the index industrial production is negative and insignificant. The findings of this research also show that oil price fluctuations significantly impact macroeconomic variables in small and developing countries that import and export oil, such as Indonesia. With abundant natural resources, countries can focus on developing the mining and mineral sectors, which involve production and semi-processing activities in their economies. The government must encourage export-focused operators to use modern technology and provide the right incentives in this economic sector. For developing countries that import oil, the policy is to reduce the impact of oil price fluctuations on the real sector and diversify the country's export earnings. Therefore, implementing these policy recommendations will ensure that the government diversifies the economy to reduce the country's dependence on oil.

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