# Fluctuations Oil Prices in World and Their Impact on Indonesian Macroeconomics

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**Abstract**. 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. 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. 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.

## 1. Introduction

Changes in international crude oil prices can significantly impact economic outcomes [1], [2]. 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, the coronavirus pandemic's impact on the world economy led to the lowest oil price ever recorded on April 28, 2020, at US$12.34 per barrel. Because of its strong correlation with financial and economic developments around the globe, global oil output and price changes are fraught with unpredictability [3].

Figure 1 illustrates how the price of oil fluctuates globally in response to various events. The Gulf War of 1990 generated a notable 20-dollar surge in oil prices. Sharp swings in oil prices have also been brought on by other notable events, including the Asian financial crisis, the 9/11 attacks, the Iraq War, the 2003 Venezuelan Strike, the global financial crisis of 2008–2009, and the political unrest in Ukraine. Among these, the volatility of oil prices may be greatly impacted by political risk events, particularly those that take place within the Organization of the Petroleum Exporting Countries (OPEC). This is because, according to data from the Global Terrorism Database (GTD), OPEC countries have more superior oil resources and a larger frequency of risk incidents.

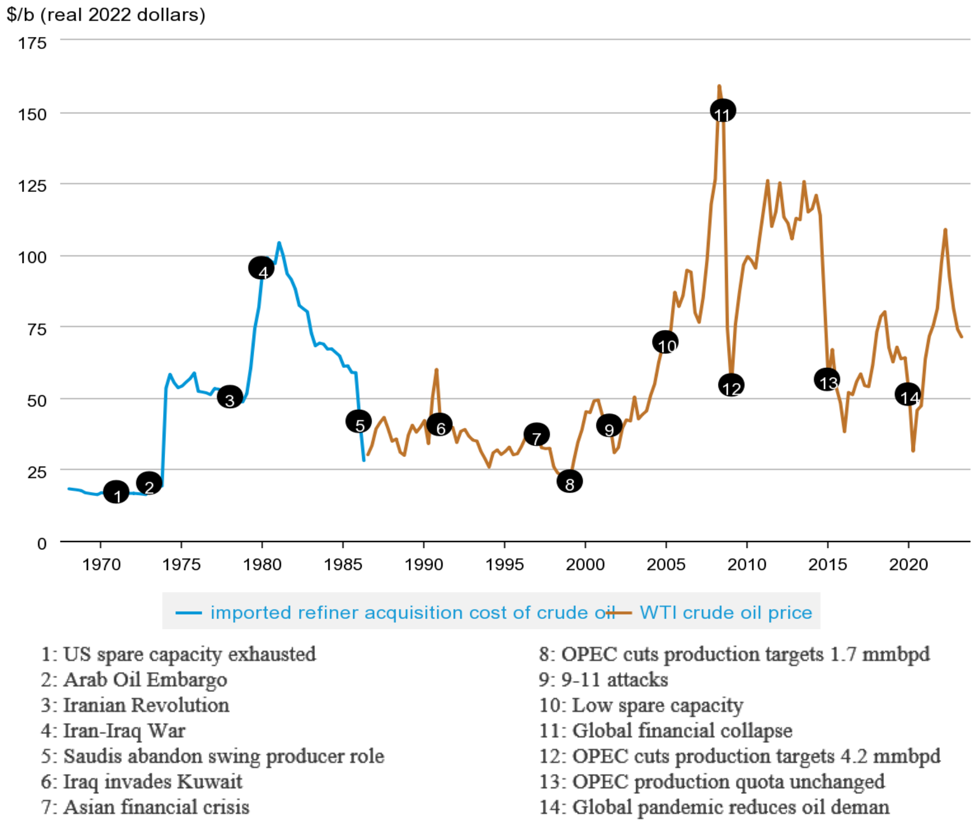


**Figure 1.** Crude oil prices react to a variety of geopolitical and economic events.

Lisnawati [4] stated that the government's revenue from the excluded oil and gas sector, known as Non-Tax State Revenue (PNPB), and from personal income tax (PPh) in the oil and gas industry will be impacted by the drop in oil prices. Even though there are innovations in various parts of the world regarding alternative energy sources, crude oil remains the leading force today [5]. It is impossible to overlook the critical role that energy plays in many facets of the contemporary economy. For instance, the creation of power, the operation of manufacturing machines, and transportation all depend on oil. Petroleum products are utilized as raw materials for consumer items in the home, telecommunications, industry, and construction. This shows that even if some nations lack petroleum reserves, petroleum products are nevertheless heavily used in the global economy. Consequently, the majority of global economies have substantial effects due to fluctuations in oil prices. Business enterprises experience a decline in their level of confidence over their future prospects if there is a substantial disruption in the supply of oil to the worldwide market.

As new patterns about the changing effects of oil price variations on the economy emerge, there is an increasing need to do further research on the effects of oil price shocks on macroeconomic variables in rising nations such as Indonesia. This research aims to investigate, in the Indonesian context, how shocks to oil prices affect a range of macroeconomic variables, such as industrial production, inflation, interest rates, output growth, and currency rates. Indonesia serves as a notable illustration of a developing nation that engages in the importation of refined oil products while simultaneously exporting petroleum.

There is a considerable body of research focused on examining the impact of fluctuations in oil prices on macroeconomic indices. According to one study, changes in oil prices have a favorable impact on economic expansion. Kurihara [6] argues according to his research, sophisticated economies like those in the US, EU, and Japan gain from increased oil prices. In a related study, Baek [7] research, split into two eras, 1998-2003 and 2004-2019, looked at the effects of oil prices on growth, inflation, and exchange rates in Indonesia between 1998 and 2019. He discovered that the rise in oil prices had an impact on the value of the Indonesian currency. In contrast, growing oil prices in the age of net oil importers slow down economic development and depreciate currency rates. Little evidence, meanwhile, suggests that rising oil prices at either time significantly harmed inflation.

In contradistinction to the research undertaken by Tang et al. [8], An investigation conducted in China between 1998 and 2008 found that rising oil prices had a negative effect on investment and output. In their study, Nazir & Hameed [5] investigated the connection between Pakistan's GDP and oil prices. The researchers discovered a significant negative correlation between oil prices and real GDP, as evidenced by their analysis of a comprehensive dataset spanning from 1972 to 2011. Kiliçarslan & Dumrul [9] have the research in Turkey using the SVAR analysis method to look at data from the first quarter of 2005 to the second quarter of 2017. Their study's conclusions showed that rising crude oil prices were linked to lower economic growth as well as higher inflation, real exchange rates, and crude oil prices. In a study conducted by Awad & Khan Niazi [10] the analysis of the relationship between economic growth and oil price shocks revealed no discernible relationship. The research specifically employed Pakistan as the analysis's setting.

This compilation of academic research looks into how changes in oil prices affect inflation or the consumer price index (CPI). Because crude oil products are an essential component of many different consumer items, there is a lot of research done on the relationship between oil prices and consumer pricing [11]. Bhattacharya & Bhattacharyya [12] conducted one of this association's early investigations in India., using monthly data collected between April 1994 and December 2000. Using an impulse response function and a Vector Autoregressive (VAR) model, the researchers determined that an increase in oil prices of 20 percentage points led to an increase in inflation of 1.3 percentage points for other commodities. In a similar vein, Dawson [13] has out research on countries covered by the Organisation for Economic Co-operation and Development (OECD) and found that a just 1% increase in oil prices caused a significant 2.9% decrease in the currency rate. In a study conducted by Bermingham [14] During the period from 1996 to 2008, researchers in Ireland utilized the Engle-Granger and ARDL techniques to investigate the effects of rising oil prices on inflation. The study's results indicated a significant correlation between increasing oil costs and inflation. The study conducted by Ogundipe et al. [15] The research employed annual data spanning from 1970 to 2011 in order to examine the impacts of oil prices, exchange rate volatility, foreign reserves, and interest rates on the Nigerian economy. This study use the Johansen cointegration and Vector Error Correction Model (VECM) approaches to establish a relationship between changes in oil prices and corresponding fluctuations in exchange rate volatility. The study conducted by Jiranyakul [16] The dataset utilized in this study included data collected in Thailand over a period of 23 years, namely from 1993 to 2015. The researcher employed the Johansen cointegration and Granger causality tests in their inquiry. The results of this study suggest that fluctuations in oil prices have a favorable effect on the inflation index. However, it is seen that the uncertainty surrounding oil prices does not exert a substantial influence on the upward movement of inflation. In their study, Bala and Chin [17] This study aims to analyze the disparate effects of oil price shocks on inflation in minor oil-exporting nations, with a particular emphasis on countries such as Nigeria, Libya, Algeria, and Angola. The study utilized the Nardl dynamic panel approach to analyze the effects of oil price variations on the inflation rate. The findings indicated the presence of both positive and negative relationships between these two variables. Mukhtarov et al., [18] A research was undertaken to examine the relationship between inflation, oil prices, and currency rates in Azerbaijan. The researchers utilized the Vector Error Correction Model (VECM) methodology to examine a dataset encompassing the years 1995 to 2017. The researchers have observed that a slight increment of 1% in oil prices and the exchange rate is associated with a subsequent increase in inflation by 0.58% and 1.81%, respectively.

The objective of this study is to analyze the volatility of oil prices in the global market between 1990 and 2021, with the specific purpose of solving the current research deficiency about swings in oil prices. In order to accomplish this purpose, the study adds five macroeconomic variables as explanatory factors. Additionally, the study was conducted in a developing country known for its significant oil production and export activities, as well as its reliance on imported refined petroleum products.

## 2. Method

Oil price dynamics can be explained through a theoretical approach based on postulates [19], [20]. This proposition posits that there exists a stochastic correlation between the prices of oil (Opt) and the levels of aggregate supply (St) and aggregate demand (Dt) in the economy at any given moment. Therefore, the formulation can be presented as follows:

$$Op_t = Op_{t-1} + \varepsilon_t^{op} \tag{1}$$

Meanwhile, aggregate supply can be modeled as follows:

$$S_t = S_{t-1} + \varepsilon_t^{S} \tag{2}$$

In a similar vein, the concept of aggregate demand may be represented in the following manner:

$$D_t = D_{t-1} + \varepsilon_t^{D} \tag{3}$$

Nevertheless, the determination of the aggregate supply of output $Y_t^S$ might be accomplished by making use of the random-walk into equilibrium method. Following this, the determination of the price for crude oil might be articulated in the subsequent manner:

$$Y_t^S = S_t + \beta_1 OP_t = S_{t-1} + \varepsilon_t^S + \beta_2 OP_t \tag{4}$$

The variables $\beta_1\ dan\ \beta_2$ epresent the inverse energy elasticity coefficient of outputs.

In the same way, the determination of aggregate demand of output can be affected by the procedure of random walks and its related rate of exchange (e).

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

The elasticity coefficients of demand for energy output are denoted as $\psi_1\ dan\ \psi_2$.

Equations (4) and (5) demonstrate resemblances to the LM and IS frameworks utilized in macroeconomic models concerning aggregate supply and aggregate demand. These models provide a comprehensive analysis of the correlation between the overall domestic supply and demand prices for oil output, while including macroeconomic factors such as inflation, currency rate, interest rates, and industrial activity.

Huang & Guo [19] provided a comprehensive explanation for the impact of supply production variations and oil price fluctuations on the actual Gross Domestic Product (GDP). Hence, it is plausible that oil price variations possess the capacity to exert an impact on actual oil prices over an extended duration. The structure that needs that will be calculated is depicted as follows:

$$GDPR_t = \alpha_0 + \alpha_1 OILP_{t1} + \alpha_2 INFL_{t3} + \alpha_3 INTR_{t3} + \alpha_4 EXR_{t4} + \alpha_5 IPI_{t6} + \mu_t - 6 \tag{6}$$

### *2.1. Data Source*

This study used the Structural Vector Autoregressive (SVAR) model to analyze data from the period spanning 1990 to 2021, encompassing a total of 32 years of observations. The factors included in this study encompass oil prices, economic growth, consumer price inflation, interest rates, currency rates, and levels of industrial output.

The study employs additional data obtained from the World Bank's database as the major source of data. This data comprises a collection of variable data on consumer prices and industrial production obtained from WDI sources, with the most recent data available for the year 2021. In order to achieve standardization of variables, this study employs the utilization of natural logarithms for all variables. Table 1 provides a comprehensive compilation of full names, detailed descriptions, and reliable sources of data.

**Table 1.** Data and Variable Description

| Variable | Full Name | Description | Source |
|---|---|---|---|
| **OILP** | Brent Crude Oil Price | The price of UK Brent Crude Oil is denominated in US dollars per barrel. | WDI |
| **GDPR** | Economic Growth | The yearly percentage increase in Gross Domestic Product (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 | The lending rate pertains to the interest rate that is used by banks fulfill the quick and medium-term nature financial requirements of both the federal government and the private sector as a whole. | WDI |
| **IPI** | Industrial Production Index | The value introduced refers to the ultimate result of the manufacturing industry, which is obtained by summing up every result and then deducting the intermediary input. | WDI |
| **IPI** | Exchange Rate | The rate of exchange between the Indonesian native currency, the Rupiah, and the United States Dollar (US$). | WDI |

*2.2. Analytical Framework*

In the conventional setup, the vector autoregressive (VAR) framework encompasses all endogenous variables with a collection of K observations, which may be expressed as follows:

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

To identify k = 1…p. Hence, the VAR(p) procedure might be explicitly delineated below:

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

Let $Ai$ represent the coefficient matrix of dimensions K X K for i=1… p. The vector $\mu t$ has k dimensions and is characterized by E ($\mu t$) = 0. Furthermore, $\mu t$ is time-invariant and has a positive definite covariance matrix E ($\mu t \mu t$ $T$) = $\sum u$, where $\sum u$ represents white noise. The VAR(p) process demonstrates stability and produces a stationary time series with reliable mean, variance, and covariance, given adequate initial values. 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:

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

To obtain a solution for the equation involving the variable $yt$, the following steps can be taken:

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

The symbol $Ai$ $*$, where I ranges from 1 to p, represents the structural factor, which is commonly distinct from the equivalent VAR form. The utilization of the structural impulse response function (IRF) makes the Structural Vector Autoregressive (SVAR) model a more suitable tool for analyzing the impacts of different shocks. The Impulse Response Function (IRF) shows the changing response of individual variables for current and potential outcomes of additional variables. The process used for structural decomposition of variance involves the measurement of the extent to which a variable contributes information to other variables within an autoregressive framework. The process of dividing the variability of the endogenous variable is accomplished within a framework known as vector autoregressive (VAR). Moreover, this approach enables the assessment of the error variance linked to a particular variable, as well as other variables within the system. Variable structural vector autoregressive (SVAR) models are characterized by their emphasis on the enforcement of constraints.

The utilization of stationary inversion techniques in the vector autoregressive representation (VAR) facilitates the attainment of this outcome.

$$y_i = A_1^{-1}(L) + \varepsilon_t \tag{11}$$

The vector $yi$ indicates the variables included in the model, whereas $A_1^{-1}$(L) denotes the inverse of the coefficient matrix. The word εt represents the error term. In order to derive a linear combination procedure that captures previous advancements in accordance with the Wald composition, the expression $A_1^{-1}$(L) = $\phi(L)$ was introduced. Thus, the formulation may be stated as follows:

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

In order to extract pertinent unobservable shocks ($\mathscr{E}t$) from the limited observables, a structural vector autoregressive (VAR) model is formulated by imposing a series of restrictions. Consequently, the VAR structural formula is formulated.

$$A_1 y_1 = \sum_{i=1}^{p} A_1^* y_{t-1} + \beta\varepsilon_t \quad \varepsilon_t \sim N(0, 1_m) \tag{13}$$

The endogenous variables $y1$, $gdp$, $infl$, $intr$, $ipi$, and $exr$ are represented as a vector of dimensions 4 x 1. The symbol A1 denotes a square matrix with dimensions m x m, which is used to represent the concurrent effects. Matrix A1* is a square matrix of dimensions m x m that incorporates the lagged effects. Matrix B represents the shock matrix, which is of dimension m x m and is coupled with the matrix representing the "short-run response". The following equation is the structural equation that delineates the connection between $\mu t$ and $\mathscr{E}t$, taking into account the limitations that have been set. The utilization of reduced form residuals is a common practice in the structural vector autoregressive (SVAR) model.

$$\mu_t = A^{-1}\beta\varepsilon_t \tag{14}$$

The estimation of the structural shock vector can be achieved by computing the inverse of matrix A. The variable $A{-}1B\mathscr{E}t$ represents the reaction of $y1$ to a perturbation in the structure. The variance-covariance matrix can be denoted as follows:

$$\mu_t = A^{-1}BB^T A^{-T} \tag{15}$$

The future alterations to the previously indicated equation will depend on the enforced constraints [20], [21]. The restriction structure in the model is formally denoted as ($k$ − 1). Hence, the extent of limitations to be implemented might be stated;

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

The present study employed the structural vector autoregression (SVAR) technique to analyze six variables, with a particular focus on the long-term C (1) matrix. According to Kozluk and Mehrotra [22], 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. According to Chen et al., [23] the non-zero element $ail$ ($i$ = 1,2,3,4,5,6; $j$ = 1,2,3,4,5,6) denotes the reaction coefficient of the ith element to the shock of element j. 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

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

Estimate of Matrix B

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

To begin with, it is important to note that oil prices are mostly driven by external factors and are not significantly impacted by emerging nations and small producers [24] such as Indonesia. Furthermore, it should be noted that economic development does not exhibit an immediate response to alterations in domestic variables within the equation [9]. Furthermore, it should be noted that inflation is mostly driven by fluctuations in GDP and the cost of oil. Furthermore, it should be noted that the relationship between exchange rates and industrial production does not have a simultaneous impact on interest rates. Ultimately, while the impact of the exchange rate on industrial production may not be immediate, it is important to acknowledge that the influence of the exchange rate on all other variables is boundless [25].

## 3. Result and Discussion

### *3.1. Descriptive Statistics*

The results are displayed in Table 2. This research examines many statistical measurements including the mean, median, standard deviation, kurtosis, Jarque-Bera test, and probability. The mean values for the variables under consideration, specifically the average price of oil, economic growth, inflation, industrial production index, and exchange rate, are as follows: 5134.531, 4.680312, 11.00594, 4.161250, 4285.688, and 8624.099, respectively. Furthermore, the variables being examined exhibit 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 production index, and currency rate, correspondingly. In contrast, the variables demonstrate 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, correspondingly. The analysis period spans from 1990 to 2021, during which a total of 32 observations were gathered for each variable. In the present period, the variables that demonstrate the most significant levels of variability, as quantified by their standard deviation, are oil prices and currency exchange rates. The kurtosis measurement indicates that the distribution of GDP, inflation, and interest rates has a leptokurtic shape, with a kurtosis value over 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 utilized to compare the probability values of the distributions in order to determine the asymptotic test. The table provides empirical data suggesting that the probability values linked with all variables exhibit a significant degree of insignificance. Moreover, the mean value roughly approximates the median value. Based on the aforementioned observations, it may be inferred by the researcher that the residual distribution conforms to a normal distribution.

*3.2. 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 utilized a unit root test to analyze many variables, including oil prices, GDP, inflation, interest rates, industrial output index, and currency rate. The results of this investigation are presented in Table 3. The t-statistic for the initial difference I (1) surpasses the critical values for significance levels of 1%, 5%, and 10%. The probability value associated with the first difference suggests that all variables demonstrate stationarity in terms of integration. The combined stationarity test yielded a Fisher Chi-square value of 137.847, which suggests a probability of zero. In a similar vein, the Choi Z-Statistics value is calculated to be -10.2136, yielding a probability of zero. Therefore, the unit root test demonstrates that all variables display 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 | | |

*3.3. Determining the Optimal Lag*

The procedure of selecting the ideal lag is presented in Table 4, where it is observed that the biggest lag is lag one. Consequently, lag one is chosen for the SVAR analysis conducted in this study, as 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

### *3.4. 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. In contrast, the impact of oil price shocks on inflation is predominantly negative.

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.** The outcomes of the Structural Vector Autoregression (VAR) test are shown.

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

Please be advised that in the following text, the symbols ***, **, and * are used to denote statistical significance at the 1%, 5%, and 10% levels, respectively.

### *3.5. SVAR Impulse Response*

The results of this investigation use the concept of impulse response functions to examine and elucidate the dynamics of interactions among research variables within a specific temporal context. The impulsive response function illustrates the reaction of many variables, including economic growth, inflation, interest rates, industrial production, and currency rates, to exogenous shocks of oil prices. The Cholesky decomposition approach is employed in this work to investigate the equation of the structural vector autoregressive (SVAR) model. The objective of this study is to analyze the impact of fluctuations in oil prices on several economic indicators, including economic growth, inflation, interest rates, industrial production, and the official exchange rate. Figure 2 presents the findings of the impulse response function analysis, specifically focusing on the response of important macroeconomic indicators in Indonesia to shocks in oil prices.

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 depiction of the relationship between inflation and short-term oil price shocks may be observed in the third graphic presented in Figure 2. The first response of inflation to fluctuations in oil prices has a positive trajectory, which eventually switches to a negative trajectory in succeeding periods. Following this, there was an observed increase in positive during the third to fifth interval, which was then followed by a period of consistent levels from the fifth to the tenth interval.

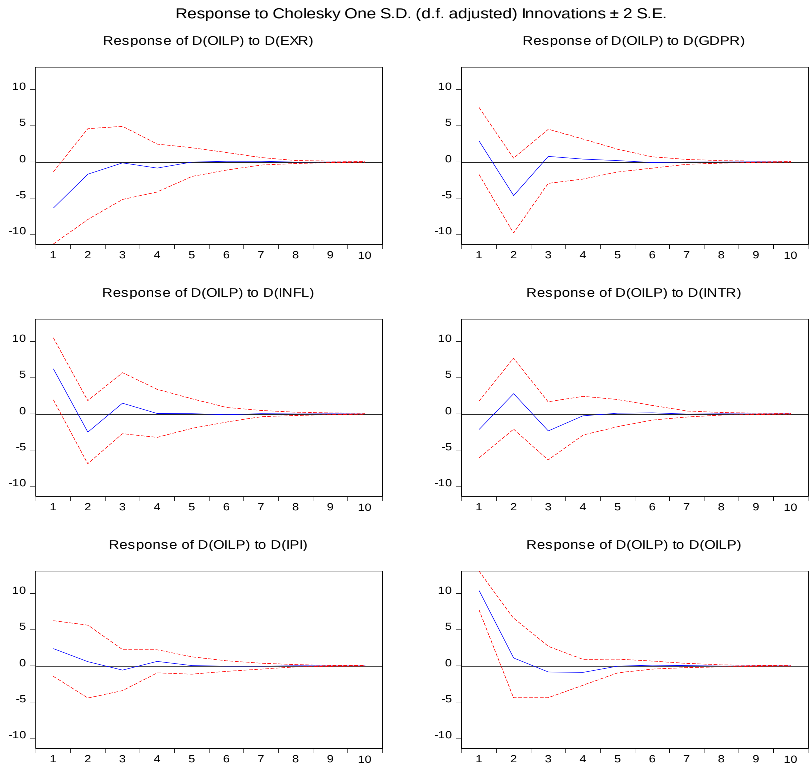


**Figure 2.** Impulse-Response Function

The fourth graphic in Figure 2 illustrates the relationship between short-term oil price shocks and the corresponding changes in interest rates. The early response to fluctuations in interest rates demonstrates a somewhat negative mood, which gradually evolves into a positive sentiment throughout the ensuing period. Afterwards, it returned to a negative condition in the third period, followed by a further recovery of positive from the fourth to the sixth period. Nevertheless, it subsequently reached a state of equilibrium at a neutral level starting with the seventh period and continuing thereafter.

The fifth graphic within the previous section demonstrates the impact of quick oil price shocks on industrial production. The initial response of industrial production to adjustments in oil prices had a declining pattern, shifting from negative to positive before reaching a stable state and maintaining a pretty consistent level starting from the fifth quarter. The influence of fluctuations in oil prices on industrial production is substantial, resulting in both positive and negative outcomes.

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.

## 4. Conclusion

The present study aimed to assess the effects of oil price volatility on macroeconomic indicators within the context of Indonesia. The dataset employed consists of yearly observations spanning the period from 1990 to 2021. The examination focuses on the use of five key macroeconomic indicators, namely growth in the economy, interest rates, inflation, production in industry, and exchange rates. Indonesia, being a nation with a rather modest economy, is of particular interest as a subject of research due to its dependence on the exportation of crude oil and importation of refined oil products. Numerous scholarly investigations have been conducted on the subject of oil price volatility in developing nations. However, it is noteworthy that the majority of these studies have mostly concentrated on a limited number of factors, often not exceeding four. By extending the duration of the investigation to encompass the contemporary time, notable oscillations in global oil prices become apparent. The results of this analysis indicate that there is a positive and substantial relationship between oil price shocks and both GDP and the exchange rate. Additionally, there is a negative and significant relationship between oil price shocks and inflation. In contrast, the impact of oil price shocks on interest rates is found to be positive yet statistically negligible. Similarly, the influence of oil price shocks on the industrial output index is shown to be negative and statistically inconsequential. The research findings further demonstrate that variations in oil prices have a substantial influence on macroeconomic indicators in small and emerging nations that engage in both oil import and export activities, such as Indonesia. Countries have the opportunity to prioritize the development of their mining and mineral sectors due to the presence of ample natural resources. This entails engaging in production and semi-processing activities within their economies. It is imperative for the government to actively promote the use of contemporary technology and offer appropriate incentives to export-oriented operators within the economic sector. In the context of developing nations reliant on oil imports, it is imperative to implement policies aimed at mitigating the adverse effects of oil price volatility on the real sector, while simultaneously diversifying the country's export profits. Consequently, the implementation of these policy measures will serve to facilitate economic diversification by reducing the nation's reliance on oil.

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