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Walking as an Alternative to Indonesia's Oil Consumption Problem

Heru Wahyudi[1], Winda Rika Lestasi[2], Ratna Septiyanti[1], Widia Anggi Palupi[1]

[1]University of Lampung, Indonesia, [2]Institute of Informatics and Business Darmajaya, Indonesia. *Email: heru.wahyudi@feb.unila.ac.id

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ABSTRACT

Oil is one of the vital energy sources in a country. Indonesia is one of the countries that was once the world's primary leading producer but is currently threatened with an oil deficit. This condition certainly requires the right strategy and policy so that Indonesia can meet its domestic oil needs. This study aims to forecast Indonesia's oil consumption and production for 2022-2026 using past data from 1980-2021. This study used the Auto-Regressive Integrated Moving Average (ARIMA) model, where several alternative models were produced in forecasting oil consumption, namely ARIMA (2, 1, 2), (2, 1, 16), (15, 1, 2), and (15, 1, 16) and also alternative models of oil production, namely ARIMA (3, 1, 9), (3, 1, 11), (13, 1, 9), and (13, 1, 11). Based on several alternative models, the best models for forecasting oil consumption and oil production are (2, 1, 16) and (3, 1, 9), respectively. From the results of this study, it is reduced that Indonesia's oil consumption is far above oil production. This, if left unchecked, can negatively affect the country's economy. Thus, research can be used as a reference for policy-making related to fulfilling oil consumption and increasing oil production in Indonesia.

Keywords: ARIMA, Consumption, Indonesia, Oil, Production
JEL Classifications: E21, E23, Q47

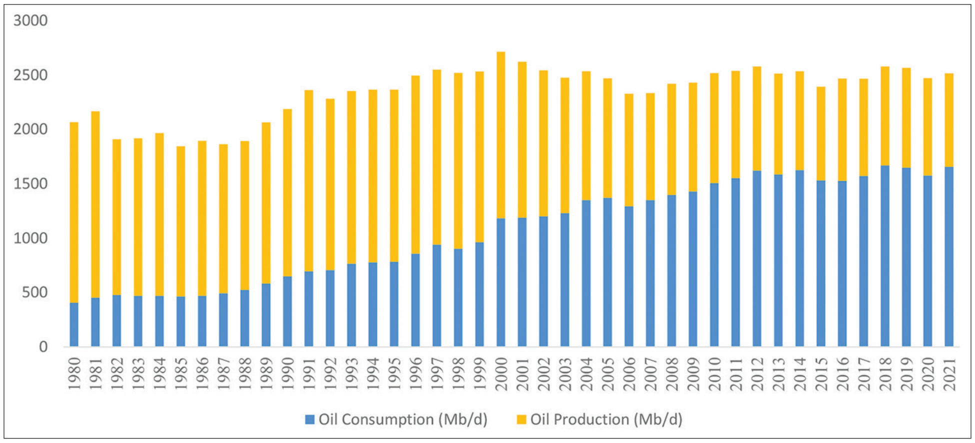
1. INTRODUCTION

Oil holds a very dominant position in meeting energy needs in the country (Kholiq, 2015). Both households and enterprises need oil in their activities. The importance of oil in land productivity is also expressed by Dritsaki et al. (2021) that fat is vital in economic activities both as an import and a good export. The use of oil can be used as industrial raw materials, vehicle fuel, household furniture makers, and ingredients for beauty and health products. Oil has a significant influence on the Indonesian economy; based on research conducted by Setiono (2014), since 1970, Indonesia began to be counted as one of the largest petroleum-producing countries in the world. Since then, the Indonesian economy has relied on oil commodities. From 1980 to early 1990, Indonesia's economic growth was rapid, reaching nine percent per year to be called one of the Asian miracle economies because of such fantastic economic growth.

The dependence of the Indonesian economy on natural resources, especially oil, certainly has an impact on Indonesia's oil reserves which continue to decline every time. Meanwhile, the population and number of industries continue to proliferate in Indonesia. Where it requires high oil consumption as well, this condition raises a new problem; namely, currently, Indonesia is experiencing a gap between oil production and consumption (Setiyowati et al., 2018) and following the presentation of data on the gap between Indonesia's petroleum production and consumption from 1980 to 2021.

Based on Figure 1, it can be seen that the value of oil consumption from 1980 to 1999 was lower than oil production. However, from 2000-2021 oil consumption continued to increase while oil production declined relatively yearly. This indicates an unstable condition in oil consumption and production. On the other hand, oil has a significant role in the State Budget. In terms of oil revenue, it

Figure 1: Indonesia's oil consumption and oil production 1980-2021



Source: Energy Information Administration (EIA), 2023

contributes the most significant revenue for development because oil is the primary commodity of the Indonesian economy. This was developed by Nasution and Wulansari (2019), who, in their research, found that plantation products exported and became Indonesia's leading commodity oil. However, oil expenditure is a commodity that the country substitutes with a reasonably fantastic amount.

Akhmad and Amir (2018) found that the depletion of fossil energy reserves and increasing energy consumption threaten Indonesia's economic development. Oil is one of the wheels of the economy that is important for a country's welfare and economic development, but in Indonesia, faced with a deficit in oil production is undoubtedly a concern for policy-makers, in this case, the government. For policymakers and organizations, oil consumption forecasting is vital in each country's short-term and long-term energy design (Dritsaki et al., 2021). This research differs from other studies because it includes two data on consumption and production in Indonesia. This study aims to estimate how much Indonesia's oil consumption and production needs will be in 2022-2026. The estimated data is based on past data, namely, 1980-2021.

2. LITERATURE REVIEW

Indonesia joined the Organization of the Petroleum Exporting Countries (OPEC) in 1962. OPEC aims to coordinate and unify oil policies in member countries to keep oil income and production efficient, economical, and regular petroleum supply for consuming countries and return adequate capital to investors in the petroleum industry (OPEC, 2013). When joining OPEC, Indonesia had an active role in determining the direction and policy of OPEC, primarily related to the stability of production and oil amounts. However, the title of oil exporter for Indonesia immediately changed to become an oil importer. In 2008 after becoming an oil importer and no longer an oil exporter, Indonesia withdrew from OPEC membership (Faisol et al., 2020). This research will focus on oil consumption and production in Indonesia.

According to Kotler et al. (2007), the production combines various inputs to create outputs. Ideally, outputs will be valuable goods or services contributing to individual utility. Production activities certainly require costs, according to Pashakolaie et al. (2015), oil production costs consist of two main parts: capital and operating costs. Capital costs are incurred during the exploration and development process, while the usual operations include equipment maintenance, product transportation, overhead, and workover costs. One factor that significantly affects a country's oil production is the available oil reserves. According to the Ministry of Energy and Mineral Resources (2021) stated that based on 2020 data, homeland oil reserves will last for the next 9.5 years, while natural gas reserves are 19.9 years.

Consumption activities occur when producers sell their products. People who carry out consumption activities are called consumers. A rational consumer will decide on the combination of goods to be purchased according to their utility. According to Firat et al. (2012), consumption is a complex social phenomenon where people consume goods or services for reasons beyond their primary use value. Someone consumes because of the necessary needs. Various circles need oil, so oil consumption continues to increase, unsurprisingly. Research from Akhmad and Amir (2018) found that energy consumption in Indonesia over the past 10 years has shown an average increase of 7-8%/year, along with an increase in population and better economic growth.

Forecasting is an essential thing that is applied in various scientific fields, such as economics, meteorology, medicine, mechanics, ecology, and various other fields (Dritsaki and Dritsaki, 2020). The gap between oil consumption and production must be considered before a country cannot meet domestic oil needs. The history of Indonesia being able to export oil is much higher than oil consumption is inversely proportional to current conditions, where oil production itself is far from enough to meet domestic consumption. The oil production deficit due to oil reserves owned by Indonesia has been depleted due to population growth and industrial activity that continues to grow. Mardiana et al. (2018) revealed that the impact of high economic dependence on oil encourages many countries to eliminate or sharply reduce dependence on oil consumption. Oil accounts for over one-third of the global primary energy supply and more than 95% of transportation energy use—a vital sector without an easy substitute (Miller and Sorrell, 2014).

3. METHODS

This type of research is quantitative research. The author forecasts Indonesia's oil consumption and production data in this study. Data collection of oil consumption and oil production is taken from https://www.eia.gov website. The data used is annual data in the form of time series data for 1980-2021. The collected data were processed with the Auto-Regressive Integrated Moving Average (ARIMA) model using the help of EViews 10. This study will use the forecasting method.

Forecasting is a statistical model that predicts what happens in the future based on past data, so this model plays a vital role in decision-making. Makridakis et al. (2002) suggest estimating the future is based on past information from a variable or past error called a time series. The forecasting method commonly used is Auto-Regressive Integrated Moving Average (ARIMA) or Box-Jenkins (Hartati, 2017). The ARIMA model uses static data through a differential process (Yakubu and Saputra, 2022). The self-regression (autoregressive) process, abbreviated AR, is a regression of the Y_t series against the past observation of itself (Juanda and Junaidi, 2012). The form of the AR equation is shown in equation (1) as follows.

$$Y_t = b_1 Y_{t-1} + b_2 Y_{t-2} + \ldots + b_p Y_{t-p} + e_t \quad (1)$$

With bp less than one, it is a collection of all variables affecting Y_t apart from the *p*-value of the nearest past observation. Moving Average (MA) is an effort to smooth time series data to eliminate or minimize the impact of cyclical, seasonal, and random factors so that, in the end, a trend direction of data trends for the long term (Santoso, 2019). According to Santoso (2019), the MA concept is to calculate the average data for *n* periods, which are interconnected between time series data. Related to the MA equation can be seen in equation (2).

$$Y_t = e_t + b_1 e_{t-1} + b_2 e_{t-2} + \ldots + a_q e_{t-q} \quad (2)$$

According to Juanda and Junaidi (2012), the behavior of time drag data can often be better explained by combining AR and MA models. In other words, the value of Y_t is influenced not only by the value of that modifier but also by the residual of that modifier in the previous period. The ARIMA model consists of the order p and q, ARIMA (p, d, q) are one of the time series forecasting methods for nonstationary data series. According to Juanda and Junaidi (2012), the general form of the ARIMA model can be seen in equation (3) as follows.

$$Y_t = b_1 Y_{t-1} + b_2 Y_{t-2} + \ldots + b_p Y_{t-p} + e_t + a_1 e_{t-1} + a_2 e_{t-2} + \ldots + a_q e_{t-q} \quad (3)$$

There are several processes for using the ARIMA model in the analysis process, namely:

3.1. Model Identification

The model identification process consists of two processes: static test and correlogram. First is the stationarity of the data. Data that has not been stationer will go through a differencing. After the differential process, the stationary must be rechecked. This study used the Augmented Dickey-Fuller (ADF) and PP Fisher methods. The condition is that when the probability value is greater than the significance level of 0.05, the data is not stationary, even vice versa. When the probability value of ADF is less than level 0.05, the data is declared stationary. The second is the correlogram. A commonly used method for ARIMA model selection through Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) correlogram. For the ARIMA model consists of (p, d q). The p-value is the PACF value, d is the data stationarity level, and q is the ACF value.

3.2. Model Parameter Estimation

After obtaining a tentative model from the identification of the model, the next stage is to estimate the specific model. At this stage, look for the best model. The best model is based on the goodness of fit, which is the level of significance of independent variable coefficient (including constants) through t-tests, F tests, coefficients of determination (R^2), and by using the criteria of the Akaike Information Criterion (AIC) and Schwarz Criterion (SC).

3.3. Model Evaluation

Good models have random residuals (white noise). According to Juanda and Junaidi (2012), if the value of ACF and PACF coefficients is insignificant, then the residue obtained is random. If the residual is not random, then choose another alternative model. ACF and PACF significance testing can be done through Barlett, Box, and Pierce or Ljung Box tests.

3.4. Forecasting

After the data meets the conditions explained in points a, b, and c, the model can be forecasted. To be able to find out forecasting errors, you can use Root Mean Squares Error (RMSE), Mean Absolute Error (MAE), or Mean Absolute Percentage Error (MAPE) (Juanda and Junaidi, 2012). In this study, we will use the MAPE method to determine the accuracy level of the ARIMA model.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistical Analysis

Explaining the results of research on an object can be done using analytical tools, one of which is descriptive statistics. Descriptive statistics consist of the average value (mean), the smallest value (minimum), the highest value (maximum), and the deviation value as indicators that explain the distribution of data in research. Table 1 shows that the average value of Indonesia's oil consumption from 1980 to 2021 is 1070,313 Mb/d. The highest value of Indonesia's oil consumption during 1980-2021 was in 2018, reaching 1670,055 Mb/d, while Indonesia's lowest oil consumption in 1980 was 408 Mb/d. Moreover, the standard deviation from oil consumption is 446.3947. Furthermore, oil production data has an average value of 1278,255 Mb/d. Indonesia, during the 198-2021 period, the highest oil production occurred in 1981 at 1712 Mb/d, while the lowest production value occurred in 2021 at 858.0648 Mb/d. Indonesia's oil production data has a standard deviation value of 292.8622.

4.2. Model Identification

To see a rough estimate of the appropriate model form, namely by looking at the time series data plot of the object of oil consumption and oil production of Indonesia 1980-2021, whether an increase or decrease in time changes marks the data pattern from the graph. Based on Figures 2 and 3, it can be seen that oil consumption data (OC) has a trend, where Figure 2 shows oil consumption which shows an increasing trend. In contrast, Figure 3 is oil production (OP) which shows a downward trend, so it can be concluded that the data is non-stationary on the mean. Then a stationary data test was carried out using the ADF and PP-Fisher tests which stated whether there was a unit root.

Based on Table 2, it is known that Indonesia's oil consumption data for 1980-2021 is at a non-stationary level. This is known from the probability value more significant than the 5% significance level, namely (0.8354, ADF) and (0.8371, PP-Fisher). Because the data is not stationary at the level, a Lagged difference (Lag 1) is performed. After the first difference is made, the probability value of oil consumption of 0.000 is not greater than the significance level, so it can be concluded that the data is stationary on the first difference. Stationary oil consumption data can be continued by forming a model in ARIMA's Least Square Method analysis using EViews 10.

Likewise, with oil production data, it is known that Indonesia's oil production data for 1980-2021 is at a non-stationary level.

Figure 2: Indonesia oil consumption data plot 1980-2021

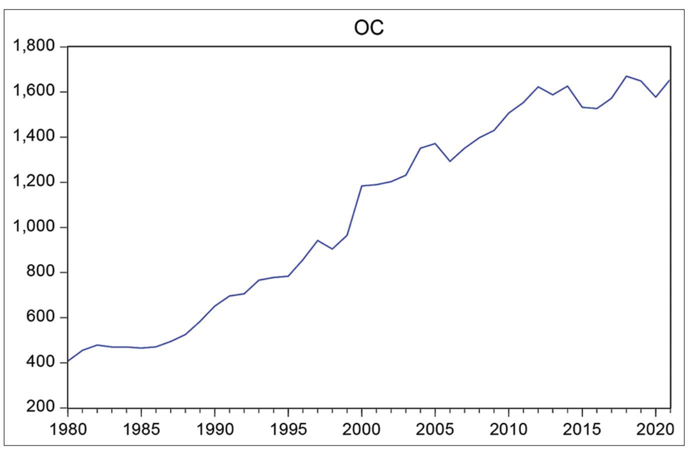
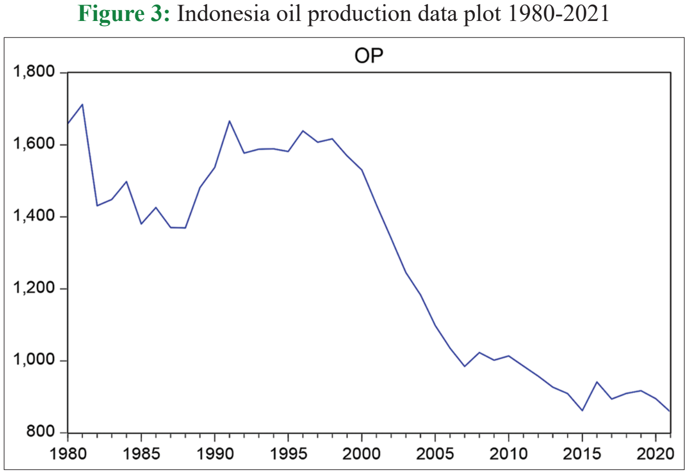


Figure 3: Indonesia oil production data plot 1980-2021



This is known from the probability value more significant than the 5% significance level, namely (0.9389, ADF) and (0.8244, PP-Fisher). Because the data is not stationary at the level, a Lagged difference (Lag 1) is performed. After the first difference in the probability value of oil consumption of (0.0020, ADF) and (0.0000, PP Fisher), the value is not greater than the significance level, so it can be concluded that the data is stationary on the first difference. Stationary oil production data can be continued by forming a model in ARIMA's Least Square Method analysis using EViews 10.

Data on Indonesia's oil consumption and production have been declared stationary at the first difference, which shows that this research model is ARIMA. To be able to find out the ARIMA model, a Correlogram test was carried out. Tables 3 and 4 show that all bars on the autocorrelation graph and partial autocorrelation are already inside the dotted line (Bartlett line). In addition, it is also known that the probability value is almost entirely above 0.05. So it can be concluded that the data is stationary at the level of the first differential. The ARIMA model consists of orders (p, d, q). In Table 2, it can be seen that the value of Partial Correlation (PAC) is used to determine the order AR (p), and the value of Autocorrelation (AC) is used to determine the order MA (q). While order (d) is the level of difference when the data has been declared stationary, in this study, stationary data on first difference, then order (d) is valued at 1. It is known that the PAC value for oil consumption data close to the dotted line is on lags 2 and 15 and for variable oil production on lags 3 and 13. At the same time, the AC value that increases the dotted line is on lags 2 and 16 and for variable oil production on lags nine and 11. So that the ARIMA model that may be used for forecasting oil consumption data there are four models, model 1 is (2, 1, 2), model 2 is (2, 1, 16), model 3 is (15, 1, 2), and model 4 is (15, 1, 16). In comparison, for oil production, there are also four models, model 1 is (3, 1, 9), model 2 is (3,1,11), model 3 is (13, 1, 9), and model 4 is (13, 1, 11).

Table 1: Descriptive statistical analysis

Descriptive statistics	Oil consumption	Oil production
Mean	1070.313	1278.255
Median	1186.587	1369.500
Maximum	1670.055	1712.000
Minimum	408.0000	858.0648
Std. Dev.	446.3947	292.8622
Skewness	−0.118488	−0.122365
Kurtosis	1.455099	1.392875
Jarque-Bera	4.275036	4.624799
Probability	0.117947	0.099023
Sum	44953.15	53686.71
Sum Sq. Dev.	8169996.0	3516499.0
Observations	42	42

Table 2: Stationarity test

Variable	Root unit method	Level	1st different
Oil consumption	ADF-Fisher	0.8354	0.0000*
	PP-Fisher	0.8371	0.0000*
Oil production	ADF-Fisher	0.9389	0.0020*
	PP-Fisher	0.8244	0.0000*

Table 3. Indonesia Oil Consumption Correlogram Test Results

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.021	-0.021	0.0200	0.888
**| . |	**| . |	2	-0.299	-0.300	4.0674	0.131
. | . |	. | . |	3	0.057	0.047	4.2189	0.239
. |** |	. |*. |	4	0.246	0.175	7.1133	0.130
.*| . |	.*| . |	5	-0.102	-0.073	7.6244	0.178
**| . |	.*| . |	6	-0.284	-0.202	11.697	0.069
. |** |	. |*. |	7	0.215	0.171	14.086	0.050
. | . |	.*| . |	8	0.025	-0.139	14.120	0.079
. | . |	. |*. |	9	-0.025	0.136	14.155	0.117
. |*. |	. |*. |	10	0.102	0.177	14.746	0.142
. | . |	. | . |	11	0.047	-0.052	14.877	0.188
.*| . |	. | . |	12	-0.072	-0.033	15.190	0.231
.*| . |	. | . |	13	-0.081	-0.017	15.601	0.271
. |*. |	. | . |	14	0.180	0.062	17.707	0.220
**| . |	**| . |	15	-0.235	-0.256	21.460	0.123
**| . |	.*| . |	16	-0.276	-0.188	26.825	0.043
. | . |	.*| . |	17	0.016	-0.169	26.844	0.060
. |*. |	.*| . |	18	0.103	-0.087	27.651	0.068
.*| . |	. | . |	19	-0.076	-0.033	28.113	0.081
**| . |	.*| . |	20	-0.207	-0.135	31.718	0.046

Table 4. Indonesia Oil Production Correlogram Test Results

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.078	-0.078	0.2708	0.603
. |*. |	. |*. |	2	0.160	0.155	1.4339	0.488
. |*. |	. |** |	3	0.212	0.242	3.5127	0.319
.*| . |	.*| . |	4	-0.155	-0.155	4.6578	0.324
. |*. |	. |*. |	5	0.184	0.093	6.3084	0.277
.*| . |	.*| . |	6	-0.089	-0.073	6.7058	0.349
.*| . |	.*| . |	7	-0.066	-0.066	6.9349	0.436
.*| . |	.*| . |	8	-0.071	-0.150	7.2011	0.515
**| . |	.*| . |	9	-0.244	-0.187	10.470	0.314
. |*. |	. |*. |	10	0.108	0.122	11.134	0.347
**| . |	.*| . |	11	-0.227	-0.123	14.174	0.224
.*| . |	.*| . |	12	-0.087	-0.085	14.631	0.262
.*| . |	**| . |	13	-0.163	-0.240	16.310	0.233
.*| . |	.*| . |	14	-0.188	-0.071	18.617	0.180
.*| . |	.*| . |	15	-0.079	-0.159	19.037	0.212
.*| . |	.*| . |	16	-0.145	-0.105	20.530	0.197
. | . |	. | . |	17	-0.002	-0.043	20.530	0.248
. | . |	. | . |	18	0.007	0.035	20.533	0.304
. |*. |	. |*. |	19	0.100	0.162	21.337	0.318
. |*. |	. | . |	20	0.122	0.004	22.577	0.310

Table 5: ARIMA model estimation summary of oil consumption

Data	Model	AIC	SIC
Oil consumption	Model 1	10.89261	11.05979
	Model 2	10.84867	11.01585
	Model 3	10.85112	11.01830
	Model 4	10.85564	11.02281
Oil production	Model 1	11.37714	11.54431
	Model 2	11.38227	11.54945
	Model 3	11.45836	11.62554
	Model 4	11.38667	11.55385

4.3. Model Parameter Estimation

After alternative models are known, then estimates are carried out. The following summarizes alternative models tested using the EViews 10 program. Some components that are considered related to the regression analysis results in this study are the value of the Akaike Info Criterion (AIC) and Schwarz Criterion (SIC).

Based on Table 5, it can be seen that the best model of oil consumption is Model 2, which is (2, 1, 16) with the smallest AIC value of 10.84867 and the smallest SIC value of 11.01585. While the smallest AIC value for oil production is 11.37714, and the smallest value of SIC is 11.54431 contained in model 1, namely (3, 1, 9).

4.4. Model Evaluation

After the best model is selected, the next stage is model evaluation. Model evaluation is done by analyzing its residuals through ACF and PACF correlogram (Juanda and Junaidi, 2012). The following are the results of evaluating the data model of oil consumption and oil production in Indonesia.

Table 6. Results of Evaluation of Indonesia's Oil Consumption Data Model

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>1</td><td>-0.124</td><td>-0.124</td><td>0.6761</td><td></td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>2</td><td>0.037</td><td>0.022</td><td>0.7375</td><td></td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>3</td><td>-0.038</td><td>-0.032</td><td>0.8057</td><td>0.369</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>4</td><td>0.114</td><td>0.106</td><td>1.4236</td><td>0.491</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>5</td><td>-0.018</td><td>0.010</td><td>1.4397</td><td>0.696</td></tr>
<tr><td>**| . |</td><td>**| . |</td><td>6</td><td>-0.240</td><td>-0.255</td><td>4.3439</td><td>0.361</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>7</td><td>0.160</td><td>0.120</td><td>5.6659</td><td>0.340</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>8</td><td>-0.016</td><td>0.020</td><td>5.6789</td><td>0.460</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>9</td><td>0.056</td><td>0.035</td><td>5.8535</td><td>0.557</td></tr>
<tr><td>. | . |</td><td>. |*. |</td><td>10</td><td>0.054</td><td>0.142</td><td>6.0215</td><td>0.645</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>11</td><td>-0.007</td><td>-0.042</td><td>6.0245</td><td>0.737</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>12</td><td>0.066</td><td>0.004</td><td>6.2886</td><td>0.790</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>13</td><td>-0.135</td><td>-0.071</td><td>7.4440</td><td>0.762</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>14</td><td>0.098</td><td>0.038</td><td>8.0669</td><td>0.780</td></tr>
<tr><td>**| . |</td><td>**| . |</td><td>15</td><td>-0.320</td><td>-0.299</td><td>15.001</td><td>0.307</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>16</td><td>-0.107</td><td>-0.186</td><td>15.808</td><td>0.325</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>17</td><td>-0.076</td><td>-0.110</td><td>16.233</td><td>0.367</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>18</td><td>-0.016</td><td>-0.076</td><td>16.252</td><td>0.435</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>19</td><td>-0.018</td><td>-0.022</td><td>16.280</td><td>0.504</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>20</td><td>-0.153</td><td>-0.126</td><td>18.236</td><td>0.440</td></tr>
</table>

Figure 4: Forecasting results using dynamic forecast oil consumption data

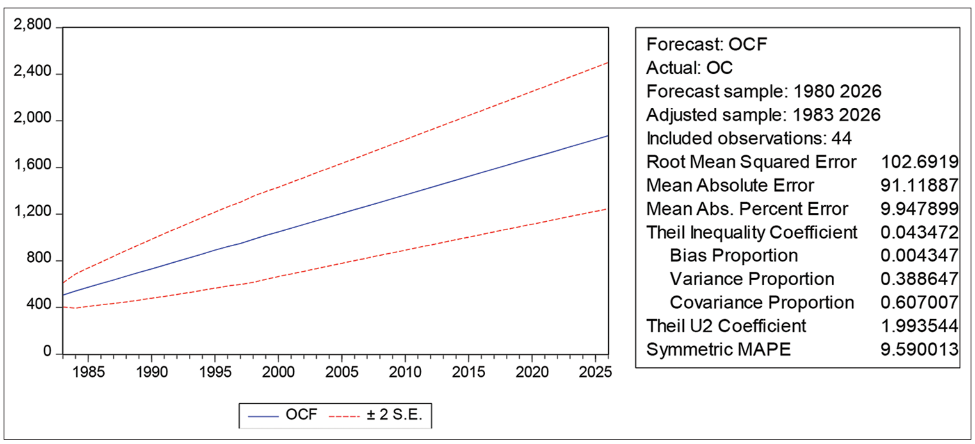
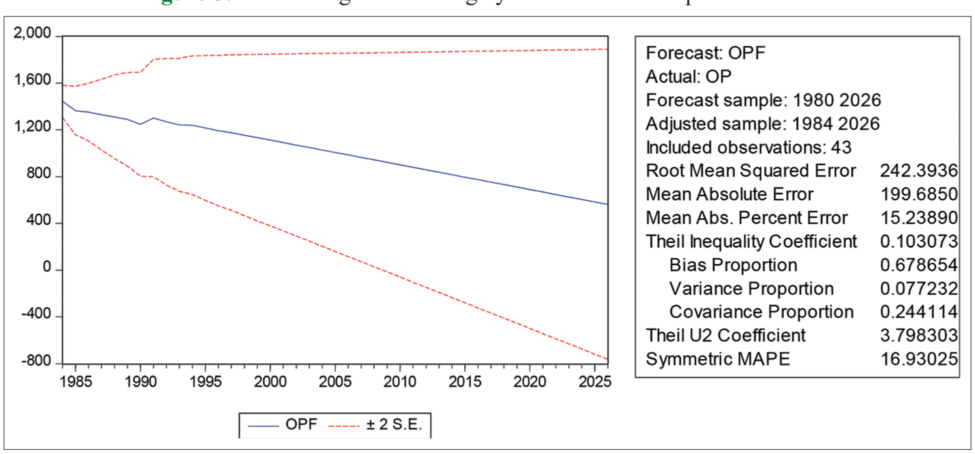


Figure 5: Forecasting results using dynamic forecast oil production data



Based on Tables 6 and 7, the AC and PACF values of the residual values do not have significant results until lag 20. The probability value of oil consumption and oil production is known to be greater than the level of significance, which is 0.05. This shows that the estimated residual value is random, so the ARIMA model for oil consumption and production data is already the best. Furthermore, a heteroscedasticity test was carried out to ascertain whether using the ARIMA or ARCH/GARCH model. The following are the results of the heteroscedasticity test of oil consumption and oil production data.

Table 7. Results of Oil Production Data Model Evaluation in Indonesia

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.043	-0.043	0.0820	
. |*. |	. |*. |	2	0.085	0.083	0.4080	
. | . |	. | . |	3	-0.034	-0.027	0.4604	0.497
.*| . |	.*| . |	4	-0.158	-0.169	1.6458	0.439
. |*. |	. | . |	5	0.076	0.071	1.9271	0.588
.*| . |	. | . |	6	-0.095	-0.064	2.3796	0.666
.*| . |	.*| . |	7	-0.094	-0.130	2.8388	0.725
.*| . |	.*| . |	8	-0.087	-0.107	3.2474	0.777
. | . |	. |*. |	9	0.064	0.100	3.4710	0.838
. |*. |	. |*. |	10	0.212	0.211	6.0171	0.645
.*| . |	.*| . |	11	-0.138	-0.193	7.1368	0.623
. | . |	.*| . |	12	-0.000	-0.083	7.1368	0.712
**| . |	.*| . |	13	-0.230	-0.174	10.470	0.489
.*| . |	.*| . |	14	-0.101	-0.101	11.135	0.517
.*| . |	**| . |	15	-0.115	-0.218	12.033	0.525
.*| . |	.*| . |	16	-0.161	-0.173	13.870	0.459
. | . |	.*| . |	17	-0.056	-0.098	14.100	0.518
. | . |	. | . |	18	0.059	0.052	14.371	0.571
. |*. |	. |*. |	19	0.199	0.089	17.540	0.418
. |*. |	. | . |	20	0.098	-0.028	18.347	0.433

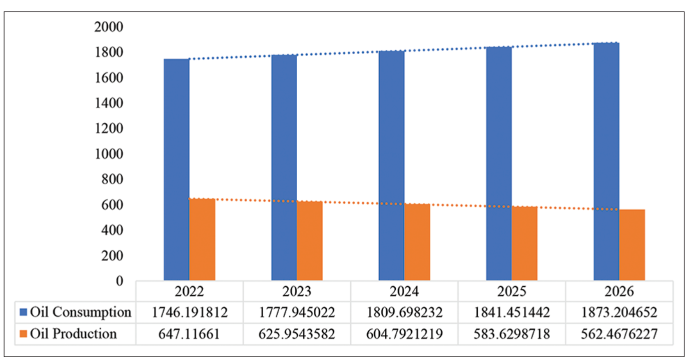
Table 8: Heteroscedasticity test results of oil consumption data

Heteroskedasticity test: ARCH			
F-statistic	0.553414	Prob. F (1,38)	0.4615
Obs*R-squared	0.574179	Prob. Chi-Square (1)	0.4486

Table 9: Heteroscedasticity test results of oil production data

Heteroskedasticity test: ARCH			
F-statistic	0.001633	Prob. F (1,38)	0.9680
Obs*R-squared	0.001719	Prob. Chi-Square (1)	0.9669

Figure 6: Data forecasting oil consumption and production in Indonesia



Based on Tables 8 and 9, it is known that the probability value is greater than the significance level of 0.05. The high probability value compared to the significance level shows that the data is free from heteroscedasticity problems (Winarno, 2017). Thus, the ARIMA model is best for forecasting Indonesia's oil consumption and production data.

4.5. Forecasting

Based on the selection of the best model of ARIMA oil consumption data (2, 1, 16) and ARIMA model oil production (3, 1, 9), the results of forecasting oil consumption (OC) and oil production (OP) for the 5 years are obtained as follows.

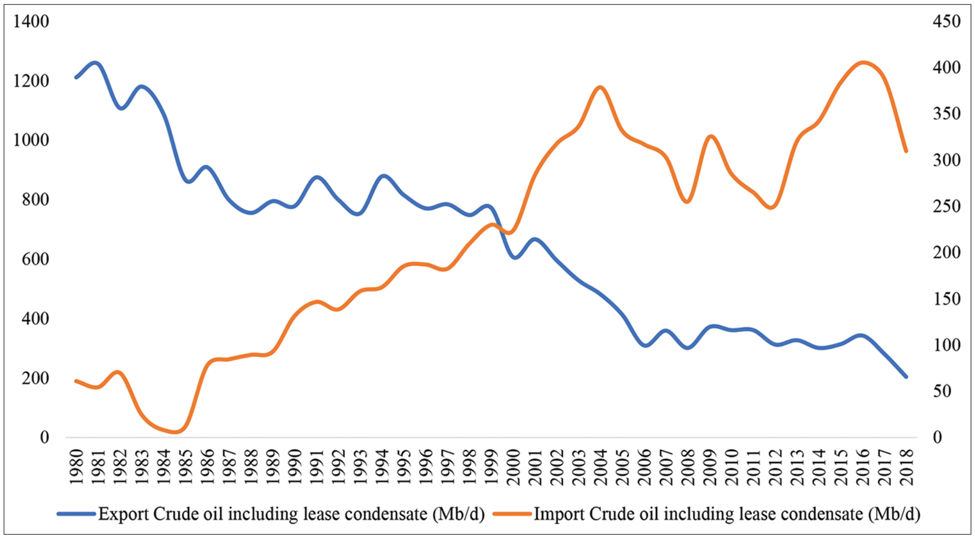
Figure 4 is the result of forecasting the ARIMA model (2, 1, 16) has a Mean Absolute Percentage Error (MAPE) value of 9.947899%. This means that the accuracy rate of the ARIMA model is 90.052101% (100-9.947899). These results show that the ARIMA model is feasible for estimating oil consumption in Indonesia. Moreover, in Figure 5, the forecasting results of the ARIMA model (3, 1, 9) have a MAPE value of 15.23890%. This means that the accuracy rate of the ARIMA model is 84.7611% (100-15.23890), so the ARIMA model is feasible to be used to estimate oil production in Indonesia. Thus, the following is shown in Figure 5, forecasting oil consumption and production data.

5. DISCUSSION

Preparing good and earnest planning through forecasting when setting policies that affect oil consumption and production activities is undoubtedly very beneficial for the community and the government as policy regulators. Moreover, oil is needed in households and companies. Based on the forecasting results in Figure 6, it is estimated that Indonesia's oil consumption always increases yearly while oil production is estimated to decrease yearly. This finding is in line with research conducted by Sasmitasiwi and Cahyadin (2008), which found that the level of oil production in Indonesia continues to decline while the level of oil consumption in Indonesia continues to increase, it can cause a deficit in the Indonesian oil production sector. Another oil problem faced by Indonesia based on Statista Research Department (2023) reveals that the regions of Sulawesi, Kalimantan, and Papua, which are large oil and gas blocks, have not been explored due to a lack of infrastructure, capital, and other barriers to entry.

According to Aprizal et al. (2022), oil reserves and oil production in Indonesia are strongly influenced by investment. Increasing investment in the Indonesian oil sector is necessary to anticipate the oil deficit in Indonesia. Some of Indonesia's efforts are eliminating fuel subsidies, switching to gas, and developing renewable energy (Mardiana et al., 2018). The government can work with the private

Figure 7: Export and import of crude oil, including lease condensate (Mb/d) Indonesia 1980-2018



Source: EIA, Data Processed (2023)

sector to increase Indonesia's oil production while focusing on sustainable development. Investment from within and abroad accompanied by increased technological understanding for the oil sector workforce to increase production efficiency by considering Indonesia's oil reserves. Increased investment and understanding of modern technology are also expected to provide breakthroughs in developing alternative energy sources to produce oil. In addition, to anticipate the deficit in oil production, the government can import to meet domestic oil needs. However, the concern is that imports can reduce foreign exchange reserves. The concern is not to cause new problems but to anticipate other problems. The following is a chart of Indonesia's crude oil exports and imports from 1980-2018.

Based on Figure 7, it can be seen that in 1980-2000, Indonesia could export more oil than the value imports. However, this condition could not last until 2001, when Indonesia's oil exports were much lower than their import value and persisted until 2018. It is sad that the country, once one of the major oil exporters, is facing extreme shortages. Indonesia is an archipelagic country where the islands of Sumatra, Kalimantan, Java, and West Papua Province have resources to support oil needs and the economy. However, unfortunately, domestic consumption continues to increase while production continues to decline. Even in 2019, Indonesia became one of the highest petroleum consumers in the world (Statista Research Department, 2023).

This dependence on oil utilization cannot be tolerated because energy needs continue to increase in line with population growth, increasing industrialization, and the development of sophisticated and cutting-edge technology as it is today (Kholiq, 2015). While oil energy sources that have long been used certainly reduce the number of oil reserves and the process of oil formation takes millions of years, where petroleum is included in the class of non-renewable natural resources. In addition to increasing oil production in terms of oil consumption, the government can cooperate with academics through community service activities to socialize the community to minimize oil consumption through the understanding that petroleum is a non-renewable natural resource. Thus, it is hoped that people will be wiser in consuming oil.

Research conducted by Stanford University revealed that the laziest population to walk in the world is Indonesian; Indonesians only take 3,513 steps/day (Indonesia Expat, 2022). Even though walking can reduce energy consumption, thus a need to increase the awareness of the Indonesian people that not relying too much on transportation can help reduce oil consumption. In addition, based on research conducted by C3 Collaborating for Health (2012) revealed that walking has a positive influence on health and also the environment. In addition, from a psychological perspective, Fatmawati (2016) research found that walking can improve the quality of life by eliminating symptoms of anxiety and depression. Thus, what needs to be done is to increase public knowledge related to this; it can also be done by building a culture of using public rather than private transportation.

6. CONCLUSION

The study results concluded that oil consumption for 2022, 2023, 2024, 2025, and 2026 continues to increase yearly; this condition is inversely proportional to oil production that continues to decline. This forecast can help formulate policies so that Indonesia does not experience an oil energy deficit in the future. Efforts are made to provide convenience for investors related to the oil industry, especially renewable energy development. Convenience is provided through convenience for investors, such as political stability and investor flexibility to choose and calculate future profits. With stable political conditions, investors are expected to feel safe and comfortable investing their funds. This effort certainly requires cooperation from the army of the Republic of Indonesia and the people of Indonesia. The government should also strive to improve regulations that support oil and gas investment. Both in terms of facilities and human resources. So that products owned by Indonesia can be processed into finished goods instead of raw or semi-finished goods so that the community can directly consume them. In addition, regarding consumption, it is necessary to increase public awareness in understanding that oil is an unsellable energy source that every individual and company needs. With the proper regulations set by the government and supported by various parties, it is hoped that it can meet the needs of oil consumption and increase oil production through renewable energy.

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