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The Role of Coal and Palm Oil Prices in Indonesia Stock Performance: An ARDL Approach

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Abstract:

Indonesia is one of the main exporters of coal and palm oil, implying the source of energy in futures. However, these commodities could have a greater impact on national economy, determining stock market performance. The movement of international trade related to these commodities also contributes to pricing creation in global market. This research aims to investigate the effect of coal and palm oil prices on Indonesia stock performance by a stock market index price. The Autoregressive Distributed Lag (ARDL) was employed in this study to gain the long and short-run results. The research observations lasted between September and December 2021. The research novelty lies in exploring the impact of coal and palm oil price movements after the COVID-19 pandemic in 2020 on the Indonesia Stock Market performance. It can be concluded that these effects are short-t and long-term or both. The findings show long- and short-run effects of palm oil prices on the stock market performance. However, Coal has only a long-run effect on the stock performance. The implication of this study is the consideration of these commodities by policymakers and practitioners for policy in developing the stock market performance. The research limitations and recommendations are also discussed.

Keywords: autoregressive distributed lag, Indonesia, coal price, palm oil price, stock price.

煤炭和棕榈油价格在印度尼西亚股票表现中的作用：一种阿德莱方法

摘要：

印度尼西亚是煤炭和棕榈油的主要出口国之一，暗示着期货的能源来源。然而，这些商品可能对国民经济产生更大的影响，决定股市的表现。与这些商品相关的国际贸易活动也有助于全球市场的定价创造。本研究旨在通过股票市场指数价格调查煤炭和棕榈油价格对印度尼西亚股票表现的影响。本研究采用自回归分布滞后(阿德莱)来获得长期和短期结果。研究观察持续时间为 2021 年 9 月至 2021 年 12 月。研究的新颖之

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处在于探索 2020 年新冠肺炎大流行后煤炭和棕榈油价格走势对印度尼西亚股市表现的影响。可以得出结论，这些影响是短期的和长期的，或两者兼而有之。调查结果显示棕榈油价格对股市表现的长期和短期影响。然而，煤炭对股票表现只有长期影响。本研究的意义在于决策者和从业者对这些商品的考虑，以制定发展股票市场表现的政策。还讨论了研究的局限性和建议。

关键词：自回归分布滞后，印度尼西亚，煤炭价格，棕榈油价格，股票价格。

1. Introduction

The global energy crisis that happened in early and mid in 2021 means that the utmost significance of energy source availability. The traditional source of energy production must be converted to renewable energy. Coal is the main source to fulfill the demand of global energy. This commodity is only option due to the low cost for the application and is adequate to meet growing energy demand when the cleaner energy does not comply (Balat, 2007).

Bioenergy is one of the renewable energy sources that have a positive trend in the future. The application of bioenergy is predicted to help in climate change mitigation by displacing fossil fuels while emitting fewer greenhouse gas (GHG) emissions than the replaced fuels (Schlamadinger et al., 1997). Palm oil is one of the of bioenergy feedstock sources because the fresh fruit bunch (FFB) could be processed (Mahlia et al., 2019). Figure 1 shows dynamics of Indonesia Coal and Palm Oil Exports.

This application could implicate the demand for palm oil in the global market, creating the price based on market supply and demand. The function for energy is predicted to create a competition with traditional commodity for energy, meaning the substitutions from traditional to renewable application.

The stock market is essential for the global economy due to the convulsive sector for the financial system and the significant role in creating economic development (Bala, 2013). It is the point of connection between individuals and organizations involved in collecting savings and converting it into investments to participate in the economic development of countries, therefore, this is important for the national economy (Momani & Alsharari, 2012).

The price of a stock depends on various factors, including firm specific factors or external factors in the country or the global world (Poudel, 2016). In a firm's specific factors, there are several mitigations for reducing these, such as increasing the managerial competence, financial management, and firm expansion, concluding this factor can be controlled.

2. Literature Review

Specifically, the stock is also responsible for risk and sustainable criteria, especially in the case of palm oil plantation (Suroso et al., 2021). However, the external factors are interesting to observe, while the movement of economies in global tend to be volatile (Masum, 2014). Additionally, the shock of external factors affects stock markets, such as oil price shocks in

the Japan case (Huang & Guo, 2008). Indonesia is one of the world's largest producers of palm oil and coal, as a main supply for the global world. Figure 1 shows that there is a significant increase in palm oil and coal exports from 1990 to 2020.

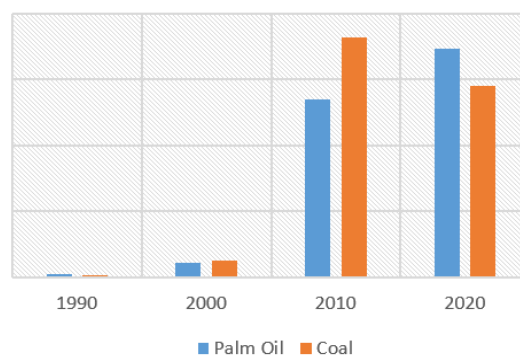


Figure 1. Indonesia coal and palm oil exports (Johnson & Soenen, 2009)

However, Indonesia coal exports relatively decreased from 2010 to 2020. Conversely, the palm oil export was growing every observation year due to the transformation of energy consumption. The movement of exports could be implicated on the price of commodities. Similar to (Huang & Guo, 2008), it is predicted that the shock of commodity prices leads to the movement of stock market, as the economic growth driver.

Currently, there have been several studies on the effect of commodity prices on the stock market. The Argentinian, Brazilian and Peruvian stock markets are significantly influenced by commodity price movements on the same day (Johnson & Soenen, 2009). The palm oil price has a significant impact on the stock market index in the Malaysia case, and both the oil and gold prices are vice versa (Nordin et al., 2014). The increase in commodity prices for gold and platinum prices are related to an increase in the stock market performance, respectively (Mongale, & Eita, 2014). According to Musawa & Mwaanga (2017), copper and oil prices have a short- and short run effect on the Lusaka Stock Market, Zambia. The growing export from Indonesia, especially in palm oil and coal, driven the author to investigate this impact on the stock market based on price scope. Literature observations show scarcity of studies on the impact of commodity prices from long and short-run are on stock market index price. The purpose of this study is to examine the impact of coal and palm oil prices on stock market prices in the long and short-run terms for the Indonesian case.

3. Methodology

This study involved the three variables such as Stock Price, Palm Oil Price and Coal Price with natural logarithm form. Daily secondary data within September 1, 2021 until December 29, 2021 were used for the research. The source of data was Yahoo finance to gain Jakarta Composite Index (JKSE) data, namely: Indonesia stock index price, market insider for palm oil and coal prices. This research employed the ARDL approach in Eviews 10. There are several steps for the fulfillment of the regression as follows: stationary test with Augmented Dickey-Fuller (ADF) test, Philips Perron (PP) test, and Bound test for check the cointegration in the model as a long-run effect or vice versa.

The ARDL method avoids the many specifications required for other standard cointegration tests. These include the decision about the number of endogenous and exogenous variables (if any) to be included in the deterministic element treatment, as well as the determination of the optimal number of lags. Using the ARDL method, it is possible to have different lags for the individual variables, which is impossible with standard cointegration tests. Additionally, the model can be used with a limited sample size such as short periodic. The ARDL model in this study estimates are as follows:

$$\begin{aligned} LnSTOCK_t = & \alpha_0 + \sum_{i=0}^p \beta_{1i} \Delta lnPALM_{t-i} + \\ & \sum_{i=0}^q \beta_{2i} \Delta lnCOAL_{t-i} + \delta_1 LnSTOCK_{t-1} + \\ & \delta_2 LnPALM_{t-1} + \delta_3 LnCOAL_{t-1} + \varepsilon_t \end{aligned} \quad (1)$$

where $LnSTOCK_t$ - Indonesia stock price with proxied by JKSE price, $PALM_{t-1}$ - world palm oil price, $COAL_{t-1}$ - world coal price. α , β and δ - estimation parameters and ε_t - residual, Ln is logarithm natural. After cointegration, the conditional ARDL long-run model is set as the equation:

$$LnSTOCK_t = \alpha_0 + \delta_1 LnPALM_{t-1} + \delta_2 LnCOAL_{t-1} + \varepsilon_t \quad (2)$$

Eventually, we predict the short-term dynamic parameters by observing the error correction model identified from predetermined long-term estimation. The ARDL error correction model (short-run estimation) is

$$\begin{aligned} \Delta LnSTOCK_t = & \alpha_0 + \sum_{i=0}^q \beta_{1i} \Delta LnPALM_{t-i} + \\ & \sum_{i=0}^r \beta_{2i} \Delta LnCOAL_{t-i} + \psi ECM_{t-1} \end{aligned} \quad (3)$$

where 1, 2, 3, and 4 are the short-run dynamic coefficients of the movement of the model toward equilibrium, ψ is the speed at which the dependent variable returns to equilibrium after changes in other variables and ECM is the error correction term obtained from Equation (1). When the coefficient in equation (3) is significantly negative then it indicates the speed of adjustment toward the long-term equilibrium (the opposite) especially when there is a shock in the economy. The value of this coefficient was between 0 and 1. The higher the value, the faster the adjustment toward equilibrium. To ensure that the ARDL model is fit, diagnostic and stability tests are performed include serial correlation, heteroscedasticity and normality tests.

4. Results and Discussion

The descriptive statistics in Table 1 include Mean, Median, Maximum, Minimum, Standard Deviation and Observations. The range and coverage of the data are determined using the mean and standard deviations. According to the calculations, the Indonesia stock price has a maximum value of 8.813%, a minimum value of 8.704%, and a mean value of 8.773%. The maximum value in the palm oil is 8.603%, the minimum value is 8.399, and the mean result is 8.524. The greatest value for the coal price is 10.118, the minimum is 4.844, and the mean value is 7.736 (UN Commodity Trade Statistics Database, 2020). The narrow range and low standard deviation, one on each hand, indicate that the variables are evenly distributed.

Table 1. Descriptive statistics

	Ln(STOCK)	Ln(PALM)	Ln(COAL)
Mean	8.773	8.524	7.736
Median	8.788	8.548	7.435
Maximum	8.813	8.603	10.118
Minimum	8.704	8.399	4.844
Std. Dev.	0.035	0.062	1.877
N	81	81	81

The unit root test results are shown in Table 2. After their first difference adjustment, the Augmented Dickey-Fuller (ADF) unit root test and the Philips-Perron (PP) unit root test indicated that all variables were stationary. If the time-series variables are non-stationary, they should not be used in any regression for preventing misleading regression (Hill et al., 2001).

Table 2. Unit root test

Variables	ADF-Test		PP-Test	
	Level	First-Difference	Level	First-Difference
Stock	-1.652	-11.519***	-1.562	-11.266***
Palm	-2.048	-9.555***	-2.035	-9.558***
Coal	-7.072***	-9.331***	-7.091***	-37.255***

The ARDL bound testing technique was also applied to assess the presence of a long-run link between variables when the model already met all the criteria for the best fit. Because the derived F-statistics in the models are larger than the upper critical limits at 5% and 10% levels of significance, the long-run link

between the variables exists, according to the co-integration findings in Table 3.

Table 3. Co-integration bound test

Test-Statistics	Value	Significance	I(0)	I(1)
F-Statistics	7.576	10%	2.63	3.35
K	2	5%	3.1	3.87

Continuation of Table 3

1%	4.13	5
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The long-run and short-run are estimated in Table 4 and Table 5, reveal that a 1% increasing of palm price leads the increases in long-run for Indonesia stock price by 0.53%. However, the impact from short-run estimation relatively decreased, with a 1% increase in palm price only increase 0.07% for stock prices in Indonesia. In the coal case, there is a long-run positive and significant effect in 5% toward stock price by 0.02%. However, coal has no significant effect in the short-run term on Indonesia stock price. Palm oil has more potential than coal due to a renewable energy campaign from several countries around the world. The benefits of palm oil could be used as a food, cosmetics until bioenergy (Majid et al., 2021). The transformation of energy consumption by using the renewable energy has recently become an important component for global (Omri et al., 2014). The market also responded to this news, meaning the good that it could be implicated in rising in stock prices and vice versa (Galil & Soffer, 2011; Mian & Sankaraguruswamy, 2012). It is also relevant to previous studies that the external factors can be implicated in stock performance from return or price indicators (Soyemi et al., 2019; Salisu et al., 2019; Ildirar & Iscan, 2016).

Table 5.
Short run estimates

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(Ln(STOCK-1))	-0.355	0.096	-3.689	0.000
D(Ln(PALM))	0.073	0.025	2.870	0.005
D(LnCOAL))	0.001	0.000	1.627	0.108
Coint (Eq 1)*	-0.136	0.024	-5.618	0.000
C	0.560	0.221	2.538	0.013
R-squared (R2)	0.327			
Adjusted R-squared (Adj-R2)	0.300			
Durbin-Watson stat (D-W)	2.006			

Indonesia as the producer countries with higher competitiveness in the global palm oil and coal trade (Rifin, 2010; Tandra et al., 2022; Admi et al., 2022). Diagnostic tests are presented in Table 6. The results show that there is no serial correlation in the model confirmed by the Breusch–Godfrey Serial Correlation LM Test. Breusch–Pagan Godfrey, Harvey, and Jarque-Bera tests show that there is no indication about autocorrelation, heteroscedasticity and normality issues. The sensitivity analysis is followed by the corresponding F-statistics and the probability value in Table 6.

Here, the findings show that the model is fit for research conclusion. Additionally, the CUSUM and CUSUMQ tests were also applied to examine the stability of the model in Figure 2 and 3, respectively. The plots of each blue line did uncross the red line means critical value line, which directs the stability of the estimated techniques. This model is well specified to the goodness of fit. Therefore, the model can be

The role of coal must be considered as the one of the primary sources of energy. We also found the negatively significant impact of lagged stock price for stock price, suggesting that the increase of lagged stock price by 1 could implicate a decrease in -0.36% in stock price. The sign of lagged error correction representations (ECMt-1) is correspondingly negative and statistically significant, according to the estimated findings. It terminates the variable relationships. The ECMt-1 coefficient is a speed of adjustment toward the equilibrium coefficient. ECMt-1 is 0.136, meaning that modifications are adjusted by 136 percent from the short-run to the long-run of every year. The R2 score is 0.327, indicating that the independent factors account for 32.7% of the variance in the dependent variable. Additionally, the modified R2 is 67.36%. The Durbin–Watson (D–W) score was 2.006, indicating that the variables are not autocorrelated. All the data (R2, Adj.R2, D–W) indicate that our model is stable and well-fit.

Table 4.
Long-run estimates

Dependent Variable: Stock Prices				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(PALM)	0.534	0.090	5.899	0.000
Ln(COAL)	0.017	0.007	2.260	0.027
C	4.105	0.780	5.261	0.000

used for policy implications and decision making with robust results.

Table 6.
Diagnostic tests

	Obs*R-Square	F-Statistic (Probability)
Breusch-Godfrey Serial Correlation LM Test	0.008	0.004 (0.996)
Heteroscedasticity: Breusch-Pagan-Godfrey	4.083	0.654 (0.687)
Normality Test	Jarque-Bera (Probability)	3.184 (0.204)

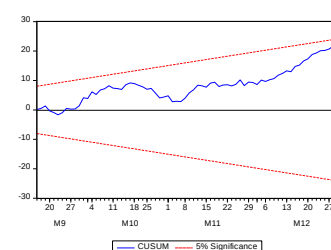


Figure 2. Stability test (CUSUM)

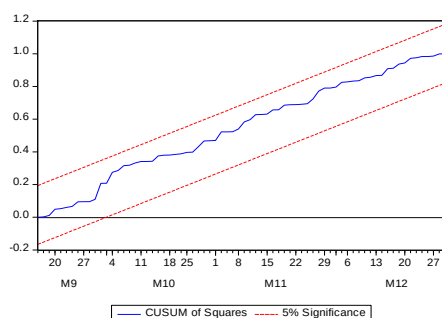


Figure 3. Stability test (CUSUM of squares)

5. Conclusions

This study aims to investigate the effect of coal and palm oil prices on the stock market in Indonesia, especially in market index price. The issues about rising exports every observation year in Indonesia and export leaders for these commodities lead the author interest to examine the relationships. An ARDL approach was applied in this study to determine the long and short-run effects of these commodities on Indonesia stock market performance, proxied by market index price. The results show that the palm oil has a long- and short-run effect on the Indonesia stock price. However, coal price only has a long-run effect. An ARDL model is also robust based on diagnostic and stability tests, which means that the results could be considered.

It is also useful for policymakers and practitioners to create the policy by observing the coal and palm oil prices. Strategy to stabilize the palm oil and coal prices, namely, the diversification in product or market, and the creation of storage for commodity inventory, should be encouraged.

This study provides the insight into the effect of coal and palm oil prices with observations after COVID-19 in 2020 on the Indonesia stock performance. However, we also investigate the effect of these commodities prices in the long and short term. Therefore, the explanations for these effects were clear in the Indonesia stock market case.

Furthermore, the study is also not free from the limitation. First, the scope of study is limited only to a single country. Future studies must consider studying this effect with a comparison of two or three countries. Second, the coal and palm oil prices are more representative of global prices. For the benchmark of the effect of commodity price, future studies could investigate the national price. Third, the other commodity prices need to be considered, adapting the sample conditions, especially in the period of the study.

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