

GLOBAL COMMODITY PRICE DYNAMICS ON IHSG RETURN VOLATILITY

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Abstract:

The Composite Stock Price Index (IHSG), as the main indicator of the Indonesian stock market, exhibits time-varying volatility that is highly sensitive to external shocks, particularly fluctuations in global commodity prices. This study aims to examine the impact of global gold prices, crude oil prices, and coal prices on the volatility of IHSG returns using the Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models. The study employs daily data from January 2015 to December 2024, comprising 2,609 observations. Estimation is conducted using the Maximum Likelihood method under the assumption of normal distribution. The results indicate that, in the mean equation of the GARCH model, global oil prices have a positive and statistically significant effect on IHSG returns, while gold and coal prices do not exhibit significant effects. In the variance equation, both ARCH and GARCH parameters are statistically significant, confirming the presence of volatility clustering and high volatility persistence in the Indonesian stock market. Diagnostic tests based on the ARCH LM procedure reveal no remaining conditional heteroskedasticity in the residuals, indicating that the model is well specified and stable. These findings highlight the dominant role of global oil prices in shaping stock market risk in Indonesia, whereas gold primarily serves as a safe-haven asset and coal exerts a sector-specific influence. This study provides empirical evidence on volatility transmission from global commodity markets to the Indonesian stock market and offers important implications for investors and policymakers in managing market risk.

Keyword: IHSG; Global Oil Prices; Global Gold Prices; Coal Prices; GARCH

1. Introduction

Global financial market developments over the past decade have been characterized by increasing economic uncertainty, geopolitical volatility, and sharp fluctuations in global strategic commodity prices. The 2015–2024 period in particular reflects complex global dynamics, ranging from the global economic slowdown and trade wars to geopolitical conflicts and the energy transition. In the context of a developing country like Indonesia, the dynamics of global commodity prices, particularly gold, oil, and coal, play a significant role in shaping capital market behavior, particularly the return volatility of the Jakarta Composite Index (JCI). Stock return volatility is a key indicator of market risk, reflecting investor sensitivity to changes in information and external shocks (Bekaert & Hoerova, 2016). This study, using a volatility model capable of capturing persistence and time-varying volatility, is still not optimal in the context of the Indonesian stock market. Therefore, this study fills this gap by applying the ARCH/GARCH model to daily data for the 2015–2024 period to empirically analyze how the dynamics of global gold, oil, and coal prices affect the JCI's return volatility.

2. Research Methods

2.1. Object, time and place

The object of this research is the return volatility of the Jakarta Composite Index (JCI), as an indicator of Indonesian stock market risk. The JCI was chosen because it represents the aggregate performance of the national stock market and reflects investor responses to domestic and global economic dynamics. The independent variables in this study include world gold prices, world oil prices, and world coal prices, which are considered sources of external shocks to the Indonesian stock market. This study uses secondary data with an observation period from January 1, 2015, to December 31, 2024, thus encompassing various phases of the global economic cycle, including periods of high uncertainty and post-crisis commodity price fluctuations. Spatially, this study focuses on the Indonesian stock market, with world commodity prices reflecting global market conditions.

2.2. Data Collection Techniques

The data used in this study is quantitative time series data with a daily frequency, which is commonly used in financial market volatility analysis because it is able to capture short-term risk dynamics more accurately (Tsay, 2010). Data on the Jakarta Composite Index (JCI) were obtained from official sources on the Indonesian capital market, while data on world gold prices, world oil prices, and world coal prices were obtained from credible international databases widely used in financial and energy economics research (Mensi et al., 2020). All data were collected through documentation and literature studies, without involving surveys or field experiments, as is common in empirical research based on financial markets.

Variables were analyzed in logarithmic return form to eliminate trends and ensure data stationarity, as well as to represent relative price changes more stably and symmetrically, in accordance with the assumptions of the conditional volatility model (Tsay, 2010). The use of logarithmic returns also allows for a more consistent application of the ARCH–GARCH model in estimating conditional variance. The collected data were then tested for feasibility through descriptive statistical tests and stationarity tests before model estimation was carried out, to ensure the validity of the inferences and the stability of the resulting parameters

2.3. Data Analysis Techniques

This study uses a volatility econometric approach, namely the ARCH and GARCH models, to analyze the effect of global commodity prices on the return volatility of the Jakarta Composite Index (JCI). The ARCH model is used to capture the influence of past return shocks on conditional variance, while the GARCH model is developed to capture the persistence of short-term and long-term volatility. The analysis begins with calculating the JCI return and commodity price returns, followed by a stationarity test using the Augmented Dickey-Fuller (ADF) method. Model estimation is performed using the Maximum Likelihood (ML) method and the assumption of a normal distribution. Model feasibility is evaluated through parameter significance, information criteria values, and the ARCH LM diagnostic test to ensure there is no remaining conditional heteroscedasticity in the residuals. The entire estimation process is performed using EViews software.

3. Results and Discussion

The results of the ARCH(1) and GARCH(1,1) model estimations are: the volatility of the JCI return is time-varying and shows volatility clustering characteristics, where periods of high volatility tend to be followed by subsequent periods of high volatility. In the mean equation, the GARCH estimation results show that world oil prices have a positive and significant influence on the JCI return, while world gold prices and world coal prices do not show a significant influence.

3.1. Research Results

Statistically significant ARCH and GARCH values indicate that the JCI return volatility is influenced by past shocks and has a high degree of persistence, as explained in the conditional volatility model framework developed by (Engle, 2018). A large GARCH coefficient value indicates that the impact of market shocks does not immediately subside, but persists for several periods, reflecting the phenomenon of volatility clustering in the stock market (Engle, 2018). Furthermore, the ARCH LM test results showing a probability value above the 5 percent significance level indicate that there is no remaining conditional heteroscedasticity in the residuals, so the GARCH model can be considered feasible and able to adequately capture the dynamics of Indonesian stock market volatility.

Dependent Variable: IHSG
 Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
 Date: 02/07/26 Time: 13:45
 Sample: 1/01/2015 12/31/2024
 Included observations: 2609
 Convergence achieved after 25 iterations
 Coefficient covariance computed using outer product of gradients
 Presample variance: backcast (parameter = 0.7)
 GARCH = C(5) + C(6)*RESID(-1)^2 + C(7)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000220	0.000154	1.423204	0.1547
BATUBARA	0.008927	0.006238	1.431072	0.1524
EMAS	0.010969	0.014999	0.731308	0.4646

OIL	0.027538	0.005347	5.150339	0.0000
Variance Equation				
C	5.05E-06	6.89E-07	7.328858	0.0000
RESID(-1)^2	0.106615	0.010187	10.46533	0.0000
GARCH(-1)	0.825566	0.017989	45.89166	0.0000
R-squared	0.010421	Mean dependent var		0.000116
Adjusted R-squared	0.009281	S.D. dependent var		0.009204
S.E. of regression	0.009161	Akaike info criterion		-6.776843
Sum squared resid	0.218642	Schwarz criterion		-6.761102
Log likelihood	8847.391	Hannan-Quinn criter.		-6.771141
Durbin-Watson stat	1.972078			

Sumber: Olah Data Eviews GARCH

$$IHSG = 0.000219807293747 + 0.00892737469678 * BATUBARA + 0.0109690143094 * EMAS + 0.0275383432862 * OIL$$

$$GARCH = 5.05270744506e-06 + 0.106614901464 * RESID(-1)^2 + 0.825566035349 * GARCH(-1)$$

The interpretation of the data processing image above shows that world oil prices are the strongest and most significant global commodity factor in influencing the JCI return during the 2015–2024 period. This is reflected in the coefficient of 0.027538 with a z-statistic value of 5.150339 and a probability of 0.0000. World gold prices do not show a significant influence on the JCI return, as indicated by a coefficient of 0.010969, a z-statistic of 0.731308, and a probability value of 0.4646. World coal prices have a positive coefficient of 0.008927, but it is not statistically significant, with a z-statistic of 1.431072 and a probability value of 0.1524.

Heteroskedasticity Test: ARCH

F-statistic	1.265005	Prob. F(1,2606)	0.2608
Obs*R-squared	1.265362	Prob. Chi-Square(1)	0.2606

Test Equation:

Dependent Variable: WGT_RESID^2

Method: Least Squares

Date: 02/07/26 Time: 14:33

Sample (adjusted): 1/02/2015 12/31/2024

Included observations: 2608 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.978046	0.048136	20.31826	0.0000
WGT_RESID^2(-1)	0.022027	0.019585	1.124725	0.2608
R-squared	0.000485	Mean dependent var		1.000079
Adjusted R-squared	0.000102	S.D. dependent var		2.245606
S.E. of regression	2.245492	Akaike info criterion		4.456493
Sum squared resid	13140.06	Schwarz criterion		4.460991
Log likelihood	-5809.267	Hannan-Quinn criter.		4.458122
F-statistic	1.265005	Durbin-Watson stat		1.999475
Prob(F-statistic)	0.260809			

Sumber: Olah Data Uji Diagnostik ARCH LM

The results of the interpretation of Figure 1.2 supporting test results through the F-statistic of 1.265005 with Prob. F (1.2606) of 0.2608 provide a conclusion that is consistent with the Chi-Square

test. In addition, the WGT_RESID^2 (-1) coefficient which is not statistically significant (p -value = 0.2608) indicates that the previous period's squared residuals have no effect on the current period's squared residuals. The conclusion is that there is no problem of continued heteroscedasticity (remaining ARCH effect), and the residual model can be considered to have met the assumption of variance stationarity or homoscedasticity.

3.2. Discussion

The ARCH and GARCH model estimation results show that the JCI return volatility during the 2015–2024 period is influenced differently by each global commodity, both in terms of statistical significance and transmission mechanisms, reflecting the heterogeneity of risk transmission channels from commodity markets to stock markets (Mensi et al., 2020). The most consistent and robust finding is the influence of world oil prices, which are empirically proven to have a positive and significant effect on JCI returns in both model specifications. This result is in line with the Global Financial Cycle theory, which states that oil prices function as an indicator of the global economic cycle and international risk sentiment, thus influencing cross-border capital flows to risky assets in developing countries (Miranda-Agrippino et al., 2022). Rising oil prices often reflect global economic expansion and increased energy demand, which then drives positive spillovers to emerging market stock markets, including Indonesia.

Global gold prices show inconsistent results across model specifications. In the ARCH model, gold prices have a positive and significant effect on the JCI return, while in the GARCH model, this effect is insignificant. This difference indicates that gold's role in the Indonesian stock market is contextual and dependent on the long-term volatility structure. Global coal prices show a positive but statistically insignificant coefficient in the GARCH model, although weakly significant in the ARCH model. These results indicate that the impact of coal prices on the Indonesian stock market tends to be sector-specific, primarily limited to mining and energy issuers, and therefore not fully transmitted to the JCI as an aggregate index. This finding supports the argument in the literature that certain export commodities can improve the performance of their related sectors without necessarily affecting overall stock market volatility.

The variance equation estimation results show that the ARCH and GARCH parameters are significant and positive, confirming the presence of volatility clustering and high volatility persistence in the JCI. This finding aligns with modern financial volatility theory, which states that market shocks are continuous and do not subside within a single period (Conrad & Kleen, 2020). Furthermore, the ARCH LM test results, which show no remaining conditional heteroscedasticity in the residuals, indicate that the GARCH model adequately captures volatility dynamics. Therefore, this study's results are consistent with modern financial market literature and reinforce previous empirical findings regarding the time-varying nature of volatility in emerging market stock markets (Antonakakis et al., 2018).

3.3. Relation to Research Objectives

This study directly addresses the research objectives formulated in the introduction. The first objective, which is to model the JCI return volatility using the ARCH–GARCH approach, is achieved by identifying time-varying volatility, volatility clustering, and high volatility persistence. These results confirm that the GARCH approach is an appropriate method for describing the risk dynamics of the Indonesian stock market.

Analyzing the influence of global gold prices, global oil prices, and global coal prices on the return volatility of the Jakarta Composite Index (JCI) also yields clear results. This research demonstrates that global oil prices are the most dominant and consistent global commodity factor influencing the dynamics of JCI returns and risks, thus filling a research gap regarding the role of global energy in Indonesian stock market volatility. Meanwhile, the findings regarding gold as a safe haven, which is insignificant in the long term, and coal's sectoral impact, provide a more nuanced understanding of the heterogeneity of the role of global commodities in the domestic stock market.

The results of this study not only empirically answer the research questions but also address a previously identified research gap, namely the limited number of studies that simultaneously examine gold, oil, and coal in relation to JCI return volatility using daily data and dynamic volatility models. These findings strengthen the research's contribution to the financial literature and provide a relevant empirical basis for investors and policymakers in understanding and managing Indonesian stock market risk amidst global commodity price dynamics.

4. Conclusion

Global oil prices have proven to be the most dominant and significant global commodity factor influencing JCI returns during the 2015–2024 period. The positive coefficient and very strong significance level indicate that global oil price movements are perceived as an indicator of global

economic conditions and energy demand, thus playing a significant role in shaping investor sentiment and the movement of Indonesian stock market returns. Global gold prices did not significantly influence JCI returns. This finding confirms gold's more dominant role as a safe haven asset rather than a direct driver of stock returns. Thus, gold price fluctuations more closely reflect changes in global risk appetite and the level of market uncertainty than fundamental factors directly influencing JCI performance. Global coal prices show a positive but statistically insignificant coefficient on the JCI return. This indicates that although Indonesia is one of the world's major coal exporters, the impact of rising coal prices tends to be sector-specific and has not been widely transmitted to all JCI components. The influence of coal on the aggregate stock market is relatively weaker compared to global oil, which has more comprehensive macroeconomic implications. The GARCH model estimation results indicate that JCI return volatility is persistent and time-varying, indicated by the significance of the ARCH and GARCH parameters and the presence of volatility clustering. Furthermore, the ARCH LM diagnostic test results indicate no remaining conditional heteroscedasticity in the residuals, thus the GARCH model used is considered appropriate and reliable in capturing the dynamics of Indonesian stock market risk during the study period.

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