ABSTRACT

Purpose: This study aims to determine the effect and correlation of daily and weekly returns on commodity prices on the IDX Energi index on the Indonesia Stock Exchange.

Theoretical Framework: Commodities are goods in the form of raw materials or raw materials that have a selling value. Energy commodities are mining products in the form of extracted fossils which can be used as energy sources. Stock price indices can be divided into several categories, namely stock market indices, sectoral stock price indices and individual stock prices. The stock market index is a representation of the total listed stock prices based on certain criteria and methods and is evaluated periodically.

Method: The research period used was January 25 2021 to July 30 2023. The analysis technique used was multiple regression and Dynamic Conditional Correlation Generalized AutoRegressive Conditional Heteroskedasticity.

Results: The results showed that the daily and weekly returns from energy commodities had a significant positive effect on the return on the IDX Energy index. Weekly returns on commodity prices can predict returns on the IDX Energi index better than daily returns. Energy commodities are also correlated with the IDX Energi index, but the dynamic correlation pattern of natural gas price returns to the IDX Energi index is different from the dynamic correlation pattern between world oil and coal prices. In general, returns on oil, natural gas and coal prices have an effect and are correlated with returns on the IDX Energi index.

Conclusions: The research results can be used as a decision making in investing, especially investing in companies that are included in the IDX Energi sector. The weekly return of the IDX Energi index can be predicted through returns on energy commodity prices, but the contribution is still small. Subsequent research can add new variables that can affect the movement or return of the IDX Energi index, besides that it can examine with a longer sample period.

Keyword: energy commodity, sectoral index, IDX Energy, DCC GARCH.
THE ENERGY COMMODITIES PRICE AND THE ENERGY SECTOR INDEX: EVIDENCE FROM INDONESIA STOCK EXCHANGE

RESUMO

Purpose: This study aims to determine the effect and correlation of daily and weekly returns on commodity prices on the IDX Energi index on the Indonesia Stock Exchange.

Theoretical Framework: Commodities are goods in the form of raw materials or raw materials that have a selling value. Energy commodities are mining products in the form of extracted fossils which can be used as energy sources. Stock price indices can be divided into several categories, namely stock market indices, sectoral stock price indices and individual stock prices. The stock market index is a representation of the total listed stock prices based on certain criteria and methods and is evaluated periodically.

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Palavras-chave: energy commodity, sectoral index, IDX Energy, DCC GARCH.

1 INTRODUCTION

Commodity price movements are of concern to stock investors because commodity price movements can be used as a prediction of stock price index movements, particularly in the commodity-producing stock sector. Investors need to find out the effect of commodity prices on the stock price index, or the correlation between the two. Investors do this to support their investment decision making in the stock market. Analyzing the relationship between commodity price movements and the stock price index is worth studying.

The stock price index for the energy sector, namely IDX Energi, on the Indonesia Stock Exchange has increased since it was first launched. The increase in the index coincided with rising energy commodity prices such as oil, natural gas and coal prices (Abdelhady et al., 2023). The surprising thing was that when the upward trend in
commodity prices ended, the IDX Energi index also ended its upward trend and turned into a downward trend (Salem et al., 2023). Energy commodity prices, such as oil prices, have started to experience a downward trend since mid-2022, while oil and coal prices have decreased starting in the 3rd quarter of 2022. The downward trend in commodity prices has resulted in the IDX Energi index starting to experience a downward trend at the end of 2022 (Kirikkaleli & Güngör, 2021; Ordu & Soytas, 2016; Dutta et al., 2020; Rahmat & Apriliani, 2023).

Previous studies have conducted several studies on the influence and correlation of energy commodity prices on the stock price index. Johnson & Soenen (2009) examined the correlation of commodity price movements with the stock market index movements of Argentina, Brazil and Peru. Oberndorfer (2009) examines the effect of oil, natural gas and coal prices on the stock prices of companies that produce energy commodities. Heaton et al. (2011) examined the effect of energy commodity prices on the energy sector index of the Australian stock market. Chebbi & Derbali (2015) examined the correlation of oil and natural gas prices with the QE Al Rayan Islamic index. Reboredo (2015) examines the effect of oil prices on the share price of the renewable energy sector. Tiwari et al. (2018) examined the effect of world oil prices on stock market indices and sectoral stock price indices, but the magnitude of the effect varied in each sector. Riga et al. (2016) examined the effect of world oil prices on the stock price index of all sectors on the Indonesia Stock Exchange. Aumeboonsuke (2021) examines the effect of energy commodity prices, metal commodities and raw material commodities on the Thai stock market index.

This study focuses on analyzing the influence and dynamic correlation of commodity prices in the energy sector, namely world oil prices, world natural gas prices and world coal prices on the energy sector stock price index on the Indonesia Stock Exchange. The benefits of this research are to help investors, especially investors in the Indonesian stock market, in making decisions before investing or buying shares in the energy sector on the Indonesia Stock Exchange. Investors need to know the effect of energy commodity prices on the energy sector stock price index, and need to assess the potential for energy commodity price movements to predict company stock price movements (Arezki et al., 2014; Hasan et al., 2021; Hanif et al., 2021; Sharma & Escobari, 2018). Research that reveals external factors that influence the stock price index is still limited, especially in the energy sector on the Indonesia Stock Exchange.
2 THEORETICAL FRAMEWORK

2.1 ENERGY COMMODITY

Commodities are goods in the form of raw materials or raw materials that have a selling value. Energy commodities are mining products in the form of extracted fossils which can be used as energy sources (Hammoudeh, 2015; Emara et al., 2015; Dmytrów et al., 2021). Energy commodities that are often traded are oil, natural gas and coal (Ahmed & Sarkodie, 2021). According to Salisu et al. (2019) commodity price movements are a good indicator for predicting stock price movements. Iyke & Ho (2021) said the same thing that returns from commodities affect stock price returns.

2.2 ENERGY SECTOR STOCK INDEX

Stock price indices can be divided into several categories, namely stock market indices, sectoral stock price indices and individual stock prices (Sharma & Banerjee, 2015). The stock market index is a representation of the total listed stock prices based on certain criteria and methods and is evaluated periodically. The sectoral stock price index is a measure of the performance of a company in a particular business group or industry, while the individual stock price is the cost required to buy a company's shares (Alkathery et al., 2022; Oviedo et al., 2020; Vacha & Barunik, 2012; Shaikh, 2022; Andriosopoulos & Nomikos, 2014; Wicaksana & Ramadhan, 2022).

The IDX Energi Index is a sectoral stock price index on the Indonesia Stock Exchange. The sector index represents the performance of listed companies. The sector index is a grouping of companies that produce energy commodities. Companies that are included in the energy sector are companies that produce energy commodities such as oil, natural gas and coal (Robiyanto et al., 2019; Sharma & Banerjee, 2015).

2.3 RELATIONSHIP BETWEEN ENERGY COMMODITY PRICE AND ENERGY SECTOR STOCK INDEX

The relationship between energy commodities and the energy sector stock price index needs further investigation. Commodity price movements can affect stock price index movements (Benkraiem et al., 2018; Iscan, 2015; Oberndorfer, 2009). Not all commodities can affect, only certain commodities that have a relationship with the stock market index that can affect the movement of the stock price index (Nordin et al., 2020; Ordu & Soytaş, 2016). According to Ahmed & Sarkodie (2021) said the same thing that
external factors such as changes in commodity prices can affect the movement of the stock price index. Based on this, there are indications that the energy sector stock price index is vulnerable to changes in energy commodity prices. This is because energy commodity prices affect the financial performance of companies in the energy sector. High commodity prices make companies that produce energy commodities get greater income, so that the company's financial performance will increase. The company will later represent its performance through a sectoral stock price index (Robiyanto et al., 2019; Valadkhani et al., 2014).

Research by Johnson & Soenen (2009) shows that commodity prices have a high correlation of daily movements with the stock market indices of Argentina, Brazil and Peru. Oberndorfer's research (2009) proves that the prices of oil, natural gas and coal affect the stock prices of companies that produce energy commodities. Research by Heaton et al. (2011) research results show that energy commodity prices affect the Australian stock market energy sector index. Research by Chebbi & Derbali (2015) shows that oil and natural gas prices correlate with the QE Al Rayan Islamic index. Reboredo's research (2015) proves that oil prices affect the movement of stock prices in the renewable energy sector. Research Tiwari et al. (2018) proved that world oil prices affect stock market indices and sectoral stock price indices, but the magnitude of the effect varies in each sector. Research Riga et al. (2016) also proves that world oil prices have a positive effect on the stock price index of all sectors on the Indonesia Stock Exchange. Aumeboonsuke's research (2021) proves that the prices of energy commodities, metal commodities and raw material commodities affect the movement of the Thai stock market index.

3 METHODOLOGY

The research data used are daily and weekly returns from oil prices (Oil) measured using Crude Oil WTI prices USD / Barrel, natural gas (Gas) are measured using Natural Gas prices USD / MMBtu and coal (Coal) are measured using Coal prices USD / Tons, as well as the energy sector stock price index (IDX Energi) on the Indonesia Stock Exchange. The research time period used was January 26 2021 to July 28 2023. The analytical method used was multiple linear regression and Dynamic Conditional Correlation Generalized AutoRegressive Conditional Heteroskedasticity (DCC GARCH). This study will reveal the effect of oil, natural gas and coal prices on the energy
sector stock price index using daily and weekly return data. The equation of multiple linear regression is written as follows:

\[ ENRG_d = \alpha + \beta_1 OIL_d + \beta_2 GAS_d + \beta_3 COAL_d \]
\[ ENRG_w = \alpha + \beta_1 OIL_w + \beta_2 GAS_w + \beta_3 COAL_w \]  

In addition to analyzing the effect, this study will reveal the dynamic correlation of oil, natural gas and coal prices on the energy sector stock price index using daily and weekly return data. The analysis technique used is DCC GARCH based on R. Engle (2002) which is written as follows:

\[ H_t = D_t \cdot R_t \cdot D_t \]  

\( H_t \) = Conditional covariance matrix at time t  
\( D_t \) = Diagonal matrix of standard deviation over time  
\( R_t \) = Symmetrical correlation matrix of varying time

Statistical calculations of DCC GARCH are formulated as follows:

\[ r_t \mid =_{t-1} \sim N(0, D_t \cdot R_t \cdot D_t) \]
\[ D_t^2 = \text{diag} \{\omega_i\} + \text{diag} \{\kappa_i\}^\circ r_{t-1}' r_{t-1} + \text{diag} \{\lambda_i\}^\circ D_{t-1}^2 \]
\[ \varepsilon_t = D_t^{-1} r_t \]
\[ Q_t = S^\circ (\mu' - \alpha - \beta) + \alpha^\circ \varepsilon_{t-1}' \varepsilon_{t-1} + \beta^\circ Q_{t-1} \]
\[ R_t = \text{diag} \{Q_t\}^{-1} Q_t \text{diag} \{Q_{t-1}\}^{-1} \]  

The log calculation is formulated as follows:

\[ r_t \mid =_{t-1} \sim N(0, H_t) \]
\[ L = -\frac{1}{2} \sum_{t=1}^{T} (n + \log(2\pi) + \log|H_t| + r_t' H_t^{-1} r_t) \]
\[ L = -\frac{1}{2} \sum_{t=1}^{T} (n + \log(2\pi) + \log|D_t \cdot R_t \cdot D_t| + r_t' D_t^{-1} R_t^{-1} D_t^{-1} r_t) \]
\[ L = -\frac{1}{2} \sum_{t=1}^{T} (n + \log(2\pi) + 2 \log|D_t| + \log |R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t) \]
\[
L = -\frac{1}{2} \sum_{t=1}^{T} (n + \log(2\pi) + 2 \log|D_t| + r_t' D_t^{-1} D_t^{-1} r_t - \varepsilon_t' \varepsilon_t + \log|R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t)
\]

The approximate model of the sum of the volatility and correlation is as follows:

\[
L(\theta, \phi) = L_v(\theta) + L_c(\theta, \phi)
\]

The formula for volatility is as follows:

\[
L_v(\theta) = -\frac{1}{2} \sum_t (n \log(2\pi) + \log|D_t|^2 + r_t D_t^{-2} r_t)
\]

The formula of the correlation is as follows:

\[
L_c(\theta, \phi) = -\frac{1}{2} \sum_t (\log|R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t - \varepsilon_t' \varepsilon_t)
\]

4 RESULTS AND DISCUSSION

4.1 DESCRIPTIVE STATISTICS

The results of the descriptive statistical analysis of the prices of oil (Oil), natural gas (Gas) and coal (Coal), as well as the IDX Energy index (IDX) are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Obs.</th>
<th>Mean</th>
<th>Max</th>
<th>Min</th>
<th>Std. Dev.</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>654</td>
<td>0.000971</td>
<td>0.083544</td>
<td>-0.12126</td>
<td>0.025389</td>
<td>-19.5429***</td>
</tr>
<tr>
<td>Gas</td>
<td>654</td>
<td>0.001155</td>
<td>0.157862</td>
<td>-0.16528</td>
<td>0.045483</td>
<td>-27.9140***</td>
</tr>
<tr>
<td>Coal</td>
<td>654</td>
<td>0.001541</td>
<td>0.405751</td>
<td>-0.35109</td>
<td>0.036819</td>
<td>-24.6443***</td>
</tr>
<tr>
<td>IDX</td>
<td>654</td>
<td>0.001689</td>
<td>0.073274</td>
<td>-0.06494</td>
<td>0.015486</td>
<td>-23.3374***</td>
</tr>
<tr>
<td>Weekly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>130</td>
<td>0.004246</td>
<td>0.26302</td>
<td>-0.12963</td>
<td>0.056254</td>
<td>-12.6562***</td>
</tr>
<tr>
<td>Gas</td>
<td>130</td>
<td>0.004453</td>
<td>0.227662</td>
<td>-0.24142</td>
<td>0.091517</td>
<td>-11.2524***</td>
</tr>
<tr>
<td>Coal</td>
<td>130</td>
<td>0.007672</td>
<td>0.755029</td>
<td>-0.34097</td>
<td>0.097816</td>
<td>-11.3974***</td>
</tr>
<tr>
<td>IDX</td>
<td>130</td>
<td>0.008587</td>
<td>0.177553</td>
<td>-0.07005</td>
<td>0.035565</td>
<td>-9.8357***</td>
</tr>
</tbody>
</table>

Note: ***, **, * significant level at 1%, 5% and 10%.

Source: Data processed, 2023
Table 1. shows the descriptive statistics of the data used in this study. The number of observed daily price return data is 654 data, while the weekly price return data is 130 data. The data used has an average close to zero with varying maximum and minimum values. The stationarity test uses the Augmented Dickey–Fuller test at the Level level. Based on the results of the stationarity test, it shows that the data used meets the stationary test.

4.2 COMMODITY ENERGY ON IDX ENERGY

The results of multiple linear regression analysis of oil, natural gas and coal prices on the IDX Energi index are as follows:

<table>
<thead>
<tr>
<th>IDX Energy (Daily)</th>
<th>IDX Energy (Weekly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>Prob.</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td><strong>0.001450</strong></td>
</tr>
<tr>
<td><strong>Oil</strong></td>
<td><strong>0.089597</strong></td>
</tr>
<tr>
<td><strong>Gas</strong></td>
<td><strong>0.025724</strong></td>
</tr>
<tr>
<td><strong>Coal</strong></td>
<td><strong>0.079654</strong></td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.079363</td>
</tr>
<tr>
<td><strong>Adjusted R^2</strong></td>
<td>0.075114</td>
</tr>
<tr>
<td><strong>F-Statistic</strong></td>
<td>18.67765</td>
</tr>
<tr>
<td><strong>Prob (F-Statistic)</strong></td>
<td>0.00000***</td>
</tr>
</tbody>
</table>

Note: ***, **, * significant level at 1%, 5% and 10%.
Source: Data processed, 2023

Table 2. shows the results of the multiple linear regression analysis of daily and weekly returns on oil, natural gas and coal prices on the IDX Energi index. The results of multiple linear regression analysis on daily returns show that the daily return on oil prices has an effect value of 0.089597 with a significance value of 0.0002. The daily return on natural gas prices has an influence value of 0.025724 with a significance value of 0.0473 and the daily return on coal prices has an influence value of 0.079654 with a significance value of 0.0000. Based on the results of the analysis, it shows that the daily return on oil, natural gas and coal prices has a significant positive effect on the daily return on the IDX Energi index.

The results of multiple linear regression analysis on weekly returns show that weekly returns on oil prices have an effect value of 0.154003 with a significance value of 0.0047. The weekly return on natural gas prices has an influence value of 0.061949 with
a significance value of 0.0406 and the weekly return on coal prices has an influence value of 0.117769 with a significance value of 0.0002. The results of the analysis show that the weekly return on oil, natural gas and coal prices has a significant positive effect on the weekly return on the IDGX Energy index.

Analysis of the coefficient of determination using the R² value aims to find out how much the return on energy commodity prices can predict the return on the IDGX Energy index. The results of the analysis show that daily returns have an R² value of 0.079363, while weekly returns have an R² value of 0.298637. This means that the daily return of energy commodities can only predict the return of the IDGX Energi index of 7.93%, while the weekly return of energy commodities has a greater ability to predict the return of the IDGX Energi index, which is equal to 29.86%. Based on these results, it shows that the ability of commodity price returns to predict returns on the IDGX Energi index is still limited.

4.3 DCC GARCH COMMODITY ENERGY ON IDGX ENERGY

The results of the DCC GARCH analysis of the prices of oil, natural gas and coal against the IDGX Energi index are as follows:

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>0₁</th>
<th>0₂</th>
<th>(0₁ + 0₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>0.175839</td>
<td>0.011870</td>
<td>0.814655</td>
<td>0.826525</td>
</tr>
<tr>
<td></td>
<td>(0.0001)***</td>
<td>(0.5126)</td>
<td>(0.0000)***</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>0.107120</td>
<td>-0.114607</td>
<td>1.003898</td>
<td>0.889291</td>
</tr>
<tr>
<td></td>
<td>(0.0043)***</td>
<td>(0.0000)***</td>
<td>(0.0000)***</td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>0.149843</td>
<td>0.026353</td>
<td>0.669042</td>
<td>0.695395</td>
</tr>
<tr>
<td></td>
<td>(0.0002)***</td>
<td>(0.2782)</td>
<td>(0.0223)**</td>
<td></td>
</tr>
<tr>
<td>Weekly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>0.425138</td>
<td>-0.060918</td>
<td>0.754495</td>
<td>0.693577</td>
</tr>
<tr>
<td></td>
<td>(0.0008)***</td>
<td>(0.2613)</td>
<td>(0.0075)***</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>0.278480</td>
<td>0.006751</td>
<td>0.814795</td>
<td>0.821546</td>
</tr>
<tr>
<td></td>
<td>(0.0009)***</td>
<td>(0.9092)</td>
<td>(0.0911)</td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>0.465203</td>
<td>-0.033502</td>
<td>0.833905</td>
<td>0.800403</td>
</tr>
<tr>
<td></td>
<td>(0.0016)***</td>
<td>(0.3475)</td>
<td>(0.0000)***</td>
<td></td>
</tr>
</tbody>
</table>

Note: ***, **, *, significant level at 1%, 5% and 10%.
Source: data processed, 2023

Table 3 shows the results of calculations from the dynamic correlation of daily and weekly returns on oil, natural gas and coal prices on the IDGX Energi index. The results show that at daily and weekly intervals, the return on oil, natural gas and coal prices has a significant correlation with the return on the IDGX Energi index. The correlation of daily
returns on oil, natural gas and coal prices with the daily returns on the IDX Energi index has a lower correlation than weekly returns, although the correlation between the two is still relatively low.

Figure 1. Garch's DCC results

![Garch's DCC results](image)

Source: Data processed, 2023

Figure 1. shows that the dynamic correlation of daily and weekly returns. The dynamic correlation between the daily return on oil prices and the daily return on the IDX Energi index ranges from the lowest correlation of 0.03688 to the highest of 0.265134 and the average dynamic correlation is 0.172344. The dynamic correlation between the daily return on natural gas prices and the daily return on the IDX Energi index ranges from -0.899135 to a maximum of -0.244530 and an average dynamic correlation of 0.113993. The dynamic correlation between the daily return on oil prices and the daily return on the IDX Energi index ranges from the lowest correlation of -0.048648 to the highest of 0.452148 and the average dynamic correlation is 0.148368.
Figure 1 also shows that the dynamic correlation between weekly returns on oil prices and weekly returns on the IDX Energi index moves from the lowest correlation of -0.070785 to the highest correlation of 1, and the average correlation is 0.329567. The dynamic correlation between weekly returns on natural gas prices and weekly returns on the IDX Energi index tends to be stable with the lowest correlation of 0.225419 and the highest of 0.288572, and an average correlation of 0.259322. The dynamic correlation between the weekly return on coal prices and the weekly return on the IDX Energi index moves with the lowest value of 0.086579498 and the highest of 0.471986334, and the average correlation is 0.378095.

The results of the analysis show that the dynamic correlation of energy commodity price returns to the IDX Energi index shows different patterns. The dynamic correlation of daily returns is more volatile than weekly returns. When compared to the dynamic correlation between energy commodities, the dynamic correlation of returns on world oil and coal prices on the IDX Energi index has a different pattern of movement than the dynamic correlation of returns on natural gas prices. There are several different patterns of movement where the correlation of return on oil and coal prices has increased, but the correlation of returns on natural gas prices has actually decreased and vice versa. In the daily sample, the dynamic correlation of coal returns is more stable than the others, while in the weekly sample the dynamic correlation of oil price returns is more stable.

5 CONCLUSION

This study aims to determine the magnitude of the effect of energy commodity price returns (oil, natural gas and coal) on the IDX Energi index. In addition, this research is also to determine the correlation of energy commodities to the IDX Energi index. The results showed that oil, natural gas and coal price returns had a significant positive effect on the IDX Energi index on daily and weekly samples, but weekly returns could predict returns on the IDX Energi index better than daily returns. Other results show that oil, natural gas and coal price returns are correlated with the IDX Energi index. The dynamic correlation pattern of natural gas price returns is different from the dynamic correlation of oil and coal price returns. The effect and correlation of natural gas on the IDX Energi index is the smallest when compared to the effect of oil and coal price returns.

The research results can be used as a decision making in investing, especially investing in companies that are included in the IDX Energi sector. The weekly return of
the IDX Energi index can be predicted through returns on energy commodity prices, but the contribution is still small. Subsequent research can add new variables that can affect the movement or return of the IDX Energi index, besides that it can examine with a longer sample period.
REFERENCES


