Macroeconomic Impact on Energy Sector in ASEAN

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Abstract. Global conditions significantly impact the global economy, influencing oil prices, interest rates, and exchange rates, which in turn affect stock prices. Climate change has become a central concern, prompting a shift towards renewable energy production. However, Southeast Asia's energy sector remains the largest regional contributor to greenhouse gas emissions. This study investigates the impact of carbon prices, Brent oil prices, palm oil prices, interest rates, and exchange rates on energy sector stock returns in ASEAN, over the short and long term. The study focuses on six ASEAN stock markets from 2017 to 2022, employing panel data and the Vector Error Correction Model (VECM). The findings reveal that carbon prices, Brent oil prices, palm oil prices, and exchange rates positively affect energy sector stock returns, while interest rates show no effect. Simultaneously, all factors combined influence stock returns. In the short term, carbon prices negatively affect returns, while Brent oil prices, palm oil prices, interest rates, and exchange rates have positive effects. Long-term analysis shows that only carbon prices negatively impact returns. These results highlight the influence of macroeconomic factors on capital markets, emphasizing the need for capital market players to understand these dynamics, particularly in the energy sector, and underscores the importance of transitioning to renewable energy to support sustainable development goals (SDGs).

Keywords: Capital Market, Carbon Emission, Energy Commodity, Green Investment, Stock Returns in Energy Sector.

1 INTRODUCTION

Climate change has become a global focus, as evidenced by the UN including sustainable development as a key goal in the SDGs. Addressing global warming requires transitioning the energy sector towards renewable energy sources (IPCC, 2022). The significance of this issue has led the WTO to establish global carbon prices as a benchmark for carbon emissions. Despite these efforts, ASEAN accounts for 5.84% of global greenhouse gas emissions, with the energy sector contributing 23.5% of this total (Maulana, 2023; Rizaty, 2023). The energy sector in ASEAN countries has an important role in sustainable economic development because most of them depend on coal, oil, or gas to meet their energy needs. For instance, Indonesia is the fourth largest coal producer globally (IEA, 2023).

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The dispute between Saudi Arabia and Russia and the COVID-19 pandemic, which resulted in a lockdown policy, caused oil prices to fall by almost 50% (Rina, 2020; Turak, 2020). This observation aligns with Le et al. (2021), which highlighted a substantial negative effect on oil prices due to these events. Zeinedini et al. (2022) also identified a significant negative correlation between oil prices and the Iran stock exchange index during the COVID-19 pandemic. As global oil prices declined, the Iran stock exchange index, which reflects stock market performance, also decreased. Zeinedini et al. (2022), findings suggest that a decline in global oil prices can contribute to a drop in Iran's stock prices.

The economy has not yet fully recovered due to the dispute between Saudi Arabia and Russia as well as COVID-19, the occurrence of another dispute between Russia, Ukraine, and the European Union until The Fed raises the reference interest rate of 25% to reduce global impact, which is the high commodity prices from the dispute (Koestanto, 2022; Mbah & Wasum, 2022). However, the increase in interest rates causes commodity prices to increase, which impacts the increase of company capital cost and the decrease of company profitability, so the increase in interest rates is a negative signal for investors (Wiratno et al., 2018).

Amid these ongoing conditions, the dispute between Russia, Ukraine, and the European Union can cause global or national risks for commodity-exporting companies due to the fluctuation of exchange rates (Sokhanvar & Bouri, 2023). If exchange rates depreciate against the US dollar, companies may face increased costs for importing raw materials, leading to higher production expenses and reduced profitability. This study focuses on energy commodity companies and aims to assess the impact of exchange rate fluctuations on stock returns in the energy sector.

The securities exchange serves as a marketplace facilitating the aggregation of capital surplus from various parties for the purpose of purchasing and transferring ownership interests in corporations. The primary objective of investment is the accrual of future financial gain. The level of profit obtained by investors based on investment results or the difference from changes in stock price is called stock returns (Haryani & Priantinah, 2018). However, business performance is one of the basic elements influencing stock prices and may also impact stock returns. The industry and macroeconomic conditions can also impact business performance (Halim, 2018). In making decisions to participate in the stock market, the expected return becomes a significant determining factor (Merkoulova & Veld, 2022). Environmental issues have the potential to be considered by investors when assessing the expected return of a stock. For example, a study by Wen et al. (2020) showed that the establishment of a carbon emission trading market in China has a positive impact on the excess stock returns of the companies participating in carbon emission allowance trading (Wen et al., 2020).

This research builds upon the work of Almas et al. (2023) and Moreno et al. (2017) due to their relevance to the study's objectives and variables. Previous studies have

primarily focused on countries like China, the United States, Asia Pacific, Indonesia, and BRICS-T countries. As reported by Kompas, ASEAN contributes 5.84% of global greenhouse gas emissions, surpassing the European region (Maulana, 2023). Within ASEAN, the energy sector is the largest emitter, accounting for 23.5% of total emissions (Rizaty, 2023). Despite the IPCC's assertion that the energy sector is crucial for transitioning to a green economy through renewable energy, research on the impact of carbon prices, oil prices, interest rates, and exchange rates on stock returns in the ASEAN energy sector remains scarce. This study, titled "Macroeconomic Impact on Energy Sector in ASEAN", aims to address this gap and offer new insights.

2 LITERATURE REVIEW

Investment is an action that involves the allocation of funds or other resources into an asset in the hope of obtaining profits in the future to obtaining returns from money that is temporarily stored for consumption in the future (Darmawan, 2023; Tandelilin, 2017).

1. Macroeconomics
   Macroeconomics is the environment in which all companies operate (Ekananda, 2019). He stated that the declarant asserted a correlation between the performance of the capital markets and prevailing economic conditions, positing that fluctuations in macroeconomic factors will induce volatility within the capital markets.
2. Capital Market
   The capital market constitutes a forum for the trading of long-term financial instruments and serves as a critical mechanism for aggregating and allocating capital resources to productive economic sectors. Hence, it could be concluded that a country's capital market promotes economic development (Darmawan, 2023).
3. Green Economy
   The green economy is an economic system that uses resources efficiently, emits less carbon dioxide into the atmosphere, and is inclusive of all social groups (Sutawidjaya et al., 2022).

a. Sustainable Development Goals (SDGs)
   Sustainable economic development or green economy is one of the important aspects adopted by all countries for the peace and prosperity of their people both now and in the future (United Nations, 2014).
b. Green Finance
   Sutawidjaya et al. (2022) state that implementing sustainability requires analyzing the elements that drive these actions, and the financial aspect is one of them because it can drive the overall production process, so green finance can be defined as providing funds for the production process in green fields or projects.
c. Green Investment
   The World Economic Forum stated in its 2013 report that green investment is a socially responsible investment approach. Study Eyraud et al. (2013) state that green investment is the amount of money needed to reduce emissions without drastically reducing non-energy production/consumption.

Research by Wen et al. (2020), supported by Bolton and Kacperczyk (2021), suggests that companies with higher carbon dioxide emissions often experience better stock returns. Conversely, Moreno et al. (2017) found that EUA carbon prices do not influence long-term stock returns in the metallurgical sector. In contrast, Almas et al. (2023) reported that CO^2 returns have a negative impact on stock returns in the energy sector in the short term but a positive effect in the long term. Alamgir and Amin (2021), identified a positive correlation between the stock market index and global oil prices, while Caporale et al. (2022) discovered, except for India, oil prices significantly and positively impact the energy sector in BRICS-T countries. Moreno et al. (2017), demonstrated that Brent crude oil positively affects stock returns in the Spanish metallurgical industry in both the short and long term. Nonetheless, Almas et al. (2023) found that Brent crude oil prices negatively impact stock returns in the energy sector in the Asia Pacific region, both in the short and long term.

Griarti (2022) stated palm oil prices influence the performance of the Indonesian stock market positively in both the long and short term. This aligns with Almas et al. (2023), which also noted a positive impact of palm oil prices on stock prices in both time frames. In contrast, Arintoko (2021) reported that palm oil prices have a positive long-term impact and a negative short-term impact on stock prices. Wong (2022), highlighted a negative impact of interest rates on stock prices, which contrasts with the findings of Suharyanto & Zaki (2021), Moreno et al. (2017), and Almas et al. (2023), who found no significant impact of interest rates on stock returns in the energy or metallurgical sectors. Almas et al. (2022) indicated that exchange rates positively affect stock returns in the energy sector in the short term but have no long-term impact. However, Wong (2022), Suharyanto & Zaki (2021), and Moreno et al. (2017) found that exchange rates negatively impact stock returns in the food and beverage and metallurgical sectors. These inconsistent findings highlight the need for further research. The purpose of this research is to fill the void in empirical evidence correlating the shift towards renewable energy sources with equity market performance within the Association of Southeast Asian Nations (ASEAN), thereby providing novel perspectives on the behavioral patterns of the region's energy sector securities.

Based on the introduction, it is known that the framework of thinking is as in Figure 1 with the following research hypothesis.

H_1: Returns from the Carbon Price Index, Brent Crude Oil Prices, Palm Oil Prices, Interest Rates, and Exchange Rates have partial and simultaneous effects on stock returns in the energy sector.

H_2: Returns from the Carbon Price Index, Brent Crude Oil Prices, Palm Oil Prices, Interest Rates, and Exchange Rates influence stock returns in the energy sector in the long and short term.

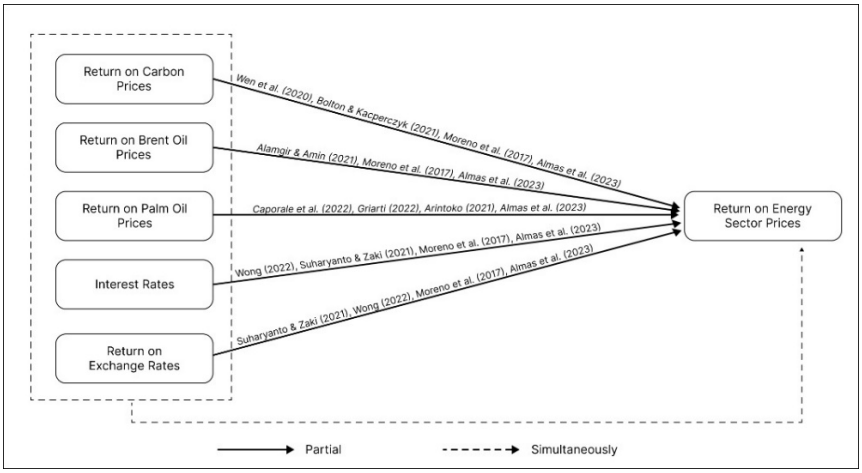

Figure 1. Framework of Research

Figure 1 shows that researchers will test to find the influence of independent variables on dependent variables in ASEAN countries as well as the impact in the short and long term. Therefore, processing this research data will use panel data regression and VECM.

3 RESEARCH METHODOLOGY

This study employed purposive sampling to select its samples. The research population was the ASEAN stock market, which is known to have only 6 countries in ASEAN that have a global stock market, namely Indonesia, Malaysia, Philippines, Thailand, Singapore, and Vietnam. The research samples were energy sectors in 6 countries selected as population. It must be considered that not all stock markets provide monthly prices for each sector, so this study used daily prices, which are averaged into monthly prices for each company in the energy sector in each country. Data for this study were collected from 2017 to 2022.

The research was divided into three stages, starting from calculating returns for all variables, except the interest rate variable, because it has been in percent form with the following equation.

$$R = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

where: R = Return

P_t = Price in time t

P_{t-1} = price in t time minus 1;

Panel data regression testing combines time series and cross-sectional data, helping analyze specific variable relationships within companies (Gujarati, 2003; Moreno

et al., 2017). This study used over 100 data points, which were normally distributed, so classical assumption tests were not required (Gujarati & Porter, 2010). Based on Widarjono (2013), in estimating panel data regression model, there are three approaches: 1) Common Effect Model (CEM), which assumes no differences between time and individuals; 2) Fixed Effect Model (FEM), which allows varying intercepts but constant slopes; 3) Random Effect Model (REM), which accounts for random variations in intercepts and correlations between errors. To select the best model, tests used included: 1) Chow Test (CEM vs. FEM); 2) Hausman Test (FEM vs. REM); 3) Lagrange Multiplier Test (CEM vs. REM) (Ghozali & Ratmono, 2017; Widarjono, 2013). The following equation was used:

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \varepsilon_{it} \quad (2)$$

where: Y_{it} = Stock returns
α = Constant
β = Regression coefficient of independent variables
X_1 = Carbon prices
X_2 = Brent oil prices
X_3 = Palm oil prices
X_4 = Interest rates
X_5 = Exchange rates
ε_{it} = Error coefficient representing overall random disturbances
i = Company
t = Period

After all tests have passed the classical assumption test, it can be continued to the hypothesis test. T-tests and F-tests are used to determine if there are partial or simultaneous correlations between independent and dependent variables (Ghozali & Ratmono, 2017; Sugiyono, 2020). The R-square test is subsequently used to evaluate how effectively the model explains the influence of the influencing factors on the outcome, utilizing the coefficient of determination (Ghozali & Ratmono, 2017).

Following this, Vector Error Correction Model (VECM), which builds upon the Vector Autoregression (VAR) model, is utilized to analyze non-stationary data (Ekananda, 2018). Thus, when non-stationary data occurs at level, differentiation of VAR model level 1 can be used to obtain stationary data. VECM allows for the examination of both short-term and long-term interactions among various factors simultaneously (Moreno et al., 2017).

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \mu_t + \varepsilon_t \quad (3)$$

where: Y = Endogenous variable
Δ = The change
Π = Cointegration matrix that represents the long-term correlation between endogenous variables and can be elaborated into $\Pi = \alpha\beta$
y_{t-1} = An endogenous variable in t-1 period

$\sum_{i=1}^{p-1} \Gamma_i$ = The number of matrices containing short-term correlation between endogenous variables by inputting the number of lags in the model minus 1
μ_t = A vector of deterministic terms
ε_t = The error coefficient

Furthermore, Ekananda (2018) stated that this model is closely related to causal and cointegration tests. This is in line with Rosadi (2012), who stated that the VECM model is related to the causal test commonly called the Granger Causality test and the cointegration test or Johansen test. Based on Moreno et al. (2017), the VECM model can be estimated when all variables are cointegrated in the Johansen test. According to the study by Moreno et al. (2017) and Almas et al. (2023), in the VECM testing stage, precisely after the data stationarity test and after the causal test, selecting optimum lag and stability test of VAR are used, and the impulse response function was used after VECM testing.

4 RESULT / FINDING

The result of the estimation model selection was the CEM model because the Chi-square probability value of the Chow test result was higher than 0.05. Moreover, in Table 1, shows that the probability value of the Hausman test result was higher than 0.05, which means that the REM model was accepted. The difference in results of these two tests caused the Lagrange multiplier test to be used with the results of a probability value higher than 0.05, which means that the CEM model was accepted.

Table 1. The Results of Selecting the Estimation Model

Testing Panel Data Model Selection	Prob.
Chow Test	0.2443
Hausman Test	0.9933
Lagrange Multiplier Test	0.8932

Source: Eviews Output Results

The results of model selection show that the CEM model was selected for this study. The results of the CEM model are in Table 2, and the following equation of panel data regression was obtained.

$$Y = 0.000938 + 0.145304X_1 + 0.267226X_2 + 0.112005X_3 - 0.018997X_4 + 0.525072X_5$$

The equation indicates that the constant value of 0.000938 signifies that, in the absence of independent variables, the stock return (Y) will increase by 0.0938%. Additionally, the beta coefficient for the carbon price variable (X1) is 0.145304. This means that if all other variables remain unchanged and X1 increases by 1%, the stock

return (Y) will rise by 14.53%, and conversely. This interpretation applies similarly to the other variables.

Table 2. The Results of the CEM Model

Variables	Coefficient	T-statistic	Prob.
C	0.000938	0.210605	0.8333
X_1	0.145304	1.980112	0.0483
X_2	0.267226	8.049966	0.0000
X_3	0.112005	2.389037	0.0173
X_4	-0.018997	-0.232754	0.8161
X_5	0.525072	2.415786	0.0161
R-squared			0.247398
Adjusted R-squared			0.238565
F-statistic			28.00725
Prob(F-statistic)			0.000000

Source: Eviews Output Results

Furthermore, the R-Square test was employed to evaluate the extent to which the independent variables can account for changes in the dependent variable. Table 2 reveals an adjusted R-squared value of 0.238565, meaning that the independent variables—such as carbon prices, Brent oil prices, palm oil prices, interest rates, and exchange rates—explain 23.86% of the variability in stock returns within the energy sector. The remaining 76.14% of the variability is due to other factors not covered in this study.

Following this, a t-test was conducted to assess the individual relationships between variables. This involved checking if the significance value (probability) was below 0.05 or comparing the t-statistic to the t-table value. If the t-statistic exceeded the t-table value, it indicates that the independent variables significantly affect the dependent variable; otherwise, they do not. In this study, the t-table value was 1.996. Table 2 shows that variables X1 (carbon prices), X2 (Brent oil prices), X3 (palm oil prices), and X5 (exchange rates) had t-statistic values exceeding the t-table or probability values below 0.05, indicating that these variables significantly affect stock returns in the energy sector. However, variable X4 (interest rates) did not significantly impact stock returns in the energy sector.

Next, an assessment was conducted to analyze the overall relationships among the variables by comparing the f-statistic to the f-table value. If the f-statistic exceeds the f-table value, it indicates that the independent variables collectively have a significant influence on the dependent variable. In this study, the f-table value was 2.235, and as indicated in Table 2, the f-statistic was higher than this value. This implies that the combined effects of carbon prices, Brent oil prices, palm oil prices, interest rates, and exchange rates significantly impact stock returns in the energy sector in ASEAN.

The initial step in the second model involved testing for data stationarity to decide between using the VAR model, the VAR difference model, or the VECM model. The

VAR model is suitable when the data is stationary at its level, whereas the VAR difference or VECM model is necessary if the data is stationary at the 1st difference level. According to Table 3, all variables were stationary at the level except for variable X4, which was stationary only at the 1st difference level. Since the data must be stationary at the same level for consistency, it was concluded that the data are stationary at the 1st difference level, thus making the VECM model the appropriate choice.

Table 3. The Results of the Data Stationarity Test

Variables	Augmented Dickey Fuller (ADF)		Philips Perron (PP)	
	Level	1st difference	Level	1st difference
Y	0.0000	0.0000	0.0000	0.0000
X_1	0.0000	0.0000	0.0000	0.0000
X_2	0.0000	0.0000	0.0000	0.0000
X_3	0.0000	0.0000	0.0000	0.0000
X_4	0.8763	0.0056	0.9582	0.0000
X_5	0.0000	0.0000	0.0000	0.0000

Source: Eviews Output Results

The determination of the most optimal lag can be seen from the smallest of the three statistical criteria values. Table 4 presents the results of the optimal lag test. This can be known from the three information criteria statistics, where there are two smallest values in one lag: SC and HQ in lag 4 of -20.11202 and -21.02266, respectively. Therefore, lag 4 is chosen as the most suitable lag for this study.

Table 4. The Results of Optimum Lag

Lag	Information Criteria Statistics		
	AIC	SIC	HQ
0	-1.956233	-1.950201	-1.953843
1	-2.007393	-1.965165	-1.990663
2	-2.073868	-1.995446	-2.042.800
3	-2.119941	-2.005325	-2.074534
4	-2.162013	-20.11202*	-21.02266*
5	-21.75276*	-1.988271	-2.101190

* indicates lag order selected by the criterion

Source: Eviews Output Results

The VAR stability test is seen from the position of the inverse root value in the circle graph (Ekananda, 2018). In this study, all inverse root values are in the graph, which means that this study is stable enough to make a prediction.

The Granger causality test is utilized to uncover causal relationships among variables within the VAR system (Ekananda, 2018). The results indicated several causal links: carbon prices affect stock returns in the energy sector, palm oil prices impact stock returns in the same sector, and Brent oil prices influence both carbon prices and vice versa. Additionally, palm oil prices are causally connected to stock returns in the

energy sector, carbon prices, Brent oil prices, and interest rates. Other variables did not show causal relationships.

The Johansen cointegration test is employed to examine long-term relationships between variables. A probability value below 0.05 and a critical value lower than the trace statistic value signal the presence of cointegration, allowing for further analysis using the VECM model (Almas et al., 2023). According to Table 5, all probability values are below 0.05, and all critical values are lower than the trace statistic values. This confirms the existence of 6 cointegration relationships in the VECM model at a 5% significance level, indicating 6 pairs of variables with stable long-term correlations. Consequently, the VECM model was used for further estimation due to these long-term correlations.

Table 5. The Results of the Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None	0.451834	961.3604	95.75366	0.0001
At most 1	0.412539	723.2940	69.81889	0.0001
At most 2	0.401822	512.6437	47.85613	0.0001
At most 3	0.338104	309.1523	29.79707	0.0001
At most 4	0.232952	145.7441	15.49471	0.0001
At most 5	0.097724	40.72248	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level

Source: Eviews Output Results

The results from the VECM test are analyzed through t-statistics, with significance being determined when the t-statistic exceeds the corresponding t-table value. At a 5% significance level, this value is 1.996, while at a 1% significance level, it is 2.587. Table 6 reveals that, in the long term, only X1 (carbon prices) has a t-statistic exceeding the t-table value at the 1% level, indicating that carbon prices are the sole variable significantly affecting long-term stock returns. Furthermore, the VECM analysis for carbon prices shows a negative coefficient, which implies that a 1% increase in carbon prices leads to a 1.036591% reduction in long-term stock returns within the ASEAN energy sector.

Table 6. The Results of the Long-Term VECM Test

Variables	Coefficient	t-statistic
X_1	-1.036591	-8.12961*
X_2	0.051060	0.97312
X_3	-0.017535	-0.26112
X_4	0.304911	1.78036
X_5	0.151866	0.48334

* $p < 0.01$, ** $p < 0.05$

Source: Eviews Output Results

According to Table 7, the error correction term results in the Short-Term VECM model show a t-statistic value exceeding the t-table value at a 1% significance level, with a coefficient of -3.10454. This indicates that the model's rate of returning to long-term equilibrium following short-term deviations is very slow.

Table 7. Error Correction Term (ECT)

Error Correction	D(Y)
Equilibrium Correction Term	-3.10454 (-14.3368)*

t statistik (); * p < 0,01, ** p < 0,05

Source: Eviews Output Results

Based on the VECM test results in the short term, as shown in Table 8, all variables impact stock returns in the short term, with t-statistic values exceeding the t-table value at a 1% significance level, though the impact varies by period for each variable. Carbon prices, with negative coefficients from lag 1 to lag 4, can adversely affect stock returns in the energy sector over the next four periods. For instance, a 1% increase in carbon prices in the previous month leads to a 2.629% decrease in stock returns in the energy sector in the following month (lag 1). Similarly, a 1% increase in carbon prices over the previous two months results in a 2.013% decline in stock returns in the next month (lag 2), and this pattern continues for lags 3 and 4.

Table 8. The Results of the Short-Term VECM Test

Variables	Number of lag			
	1	2	3	4
Carbon Prices	-2.629642 (-12.8471)*	-2.013293 (-11.0040)*	-1.387487 (-9.50339)*	-0.593149 (-6.80328)*
Brent Oil Prices	0.145545 (3.69287)*	0.168661 (3.27709)*	0.050511 (1.01015)	0.017922 (0.50447)
Palm Oil Prices	0.109063 (2.15126)*	0.172755 (2.32185)*	0.211512 (2.76358)*	-0.02144 (-0.40545)
Interest Rate	0.956536 (2.51398)*	0.229501 (0.41329)	-0.079202 (-0.14019)	-0.423221 (-1.08793)
Exchange Rate	0.572186 (2.76505)*	0.179953 (0.67243)	-0.147676 (-0.53921)	-0.316498 (-1.44041)

t-statistic (); * p < 0.01, ** p < 0.05

Source: Eviews Output Results

Furthermore, the impulse response function between independent variables and the dependent variable, as Figure 2, shows a graph of response to stock returns in the energy sector or Y to carbon prices or X1 with a dynamic pattern or one that continues to change over time with positive response value. IRF graph to see Y response for short-term is seen from the first 4 periods after the shock in X1. This is based on selecting lag 4 as the optimum lag, so after the 4 period, it is a Y response for the

long term. The occurrence of shock in X1 in period 0 results in a response of Y that increases in the first 2 months and then decreases to a peak in the 4th month, which is then seen from the long-term having a downtrend of Y response to shock little by little.

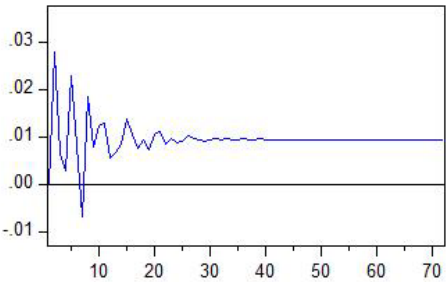

Figure 2. Impulse Response of Stock Returns in the Energy Sector to Carbon Prices.

Figure 3 shows a graph of Y's response to X2 with a dynamic pattern or one that continues to change over time with a positive response value. IRF graph to see the Y response for short-term is seen from the first 4 periods. When the shock of Brent oil prices occurs in period 0, it will result in a Y response that increases in the first 3 months and then decreases to a peak in the 4th month. Moreover, as seen in the long term, a downtrend or Y response to shock is gradually stable.

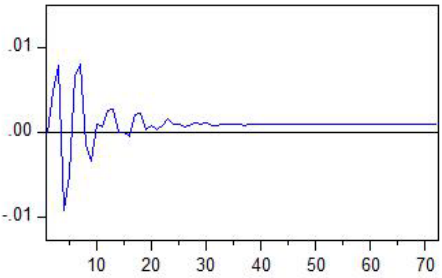

Figure 3. Impulse Response of Stock Returns in the Energy Sector to Brent Oil Prices

Figure 4 shows a graph of Y's response to X3 with a dynamic pattern or one that continues to change over time with a positive response value. IRF graph to see the Y response for short-term is seen from the first 4 periods. When the shock of palm oil prices occurs in period 0, it will result in a Y response that increases in the first 2 months, then decreases in the 3 months, and increases again in the 4th month. Moreover, in the long term, there will be a downtrend.

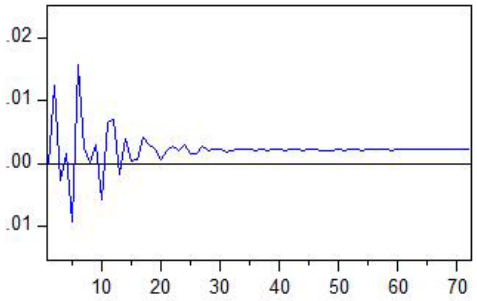

Figure 4. Impulse Response of Stock Returns in the Energy Sector to Palm Oil Prices

Figure 5 shows a graph of Y response to X4 with a dynamic pattern or one that continues to change over time with a positive response value. The IRF graph shows the Y response for the short term from the first 4 periods. When the shock of interest rates occurs in period 0, it will result in a Y response that decreases in the first 3 months and increases in the 4th month. Moreover, for the long term, it will have a downtrend.

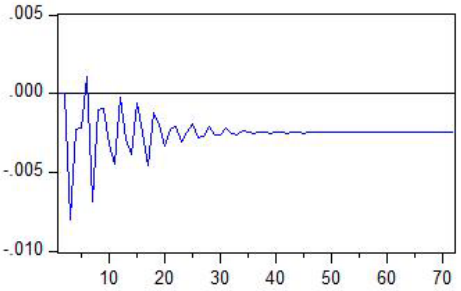

Figure 5. Impulse Response of Stock Returns in the Energy Sector to Interest Rates

Figure 6 shows a graph of Y's response to X5 with a dynamic pattern or one that continues to change over time with a positive response value. IRF graph to see the Y response for short-term is seen from the first 4 periods. When the shock of interest rates occurs in period 0, it will result in a Y response that increases in the first 2 months, then decreases in the 3rd month, and increases again in the 4th month. Moreover, in the long term, there will be a downtrend.

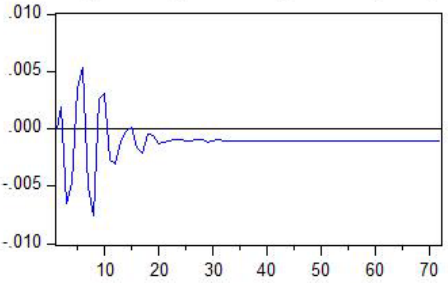

Figure 6. Impulse Response of Stock Returns in the Energy Sector to Exchange Rates

5 DISCUSSION

5.1 The Correlation between Carbon Prices and Stock Returns in Energy Sector

The panel data regression model results indicate that carbon prices positively affect stock returns in the energy sector at a 5% significance level. However, the VECM model shows that while carbon prices influence stock returns in both the short and long terms, the impact is negative at a 1% significance level. This discrepancy arises from the different estimation techniques used: the panel data regression model employs a simpler technique, whereas the VECM model uses a more complex approach. According to the VECM model, a 1% increase in carbon prices results in a decrease in stock returns in the energy sector in ASEAN, affecting Y in the long term. Additionally, carbon prices are predicted to negatively impact stock returns over the next four periods, though the effects will diminish progressively.

The findings of this study align with those of Wen et al. (2020), who reported a significant impact of carbon emissions on stock investment returns. This is further supported by Bolton and Kacperczyk (2021), who found that carbon emission trading markets in China positively influence excess stock returns. Additionally, the results are consistent with Almas et al. (2023), which indicated that carbon prices negatively affect stock returns in the energy sector in both the short and long terms. However, Almas et al. (2023) observed a positive impact in their study, whereas this research found a negative impact. In contrast, Moreno et al. (2017), found no effect of EUA carbon prices on stock returns in the metallurgical sector in the long term. These differing results may be attributed to variations in study periods, subjects, or populations, which can lead to different economic or market conditions and regulations related to carbon emissions.

Furthermore, the results of this study support the green economy theory expressed by Rehman & Holý (2022) because the data of the study are dominated by companies operating in the fossil fuel industry, such as gas, oil, and coal, while there are only a few companies in the renewable energy industry in the entire country. Thus, in order to improve people's welfare, the increase in carbon prices can be a signal to companies operating in the fossil fuel industry to start switching to renewable energy. These results also support the sustainable development goals theory assigned by the UN for the prosperity of society, both today and in the future. Furthermore, the results of this study support green finance and green investment theories, in which the increase in carbon prices affects stock returns in the energy sector, specifically companies operating in the fossil fuel industry, such as gas, oil, and coal. This gives a signal to investors that their funds are better invested in the green sector or green projects so it can minimize the negative impact on the environment and promote economic growth for long-term (Anisah, 2020; Eyraud et al., 2013; Sutawidjaya et al., 2022; WEF, 2013).

5.2 The Correlation between Brent Oil Prices and Stock Returns in the Energy Sector

The panel data regression model results indicate that Brent oil prices positively affect stock returns in the energy sector at a 5% significance level. In contrast, the VECM model shows that Brent oil prices have a positive impact on stock returns in the short term at a 1% significance level but do not influence long-term stock returns. The short-term results from the VECM model suggest that Brent oil prices will positively affect stock returns in the energy sector over the next two periods, with an increasing impact.

These findings are consistent with Alamgir & Amin (2021), who found a positive correlation between the stock market index and oil prices, and Caporale et al. (2022), which reported that oil prices significantly and positively affect the energy sector in BRICS-T countries, excluding India. Moreno et al. (2017) observed that Brent crude oil prices positively impact stock returns in the Spanish metallurgical industry in the short term. However, Moreno et al. (2017) also found a positive long-term effect, which contrasts with this study's finding of no long-term correlation between the variables. Additionally, the results differ from Almas et al. (2023), who reported that both short-term and long-term stock returns in the energy sector and Brent oil prices negatively affect the Asia Pacific region.

5.3 The Correlation between Palm Oil Prices and Stock Returns in the Energy Sector

The panel data regression model results indicate that palm oil prices positively influence stock returns in the energy sector at a 5% significance level. Conversely, the VECM model shows that palm oil prices positively affect stock returns in the short term at a 1% significance level, but do not impact long-term stock returns. For the short term, the VECM model suggests that palm oil prices may negatively affect stock returns in the energy sector over the next three periods, with the impact increasing over time.

This is in line with the study by Griarti (2022), which found that palm oil prices positively affect the performance of the Indonesian stock market in the short term. Almas et al. (2023), also reported a positive impact of palm oil prices on stock prices in the short term. However, while Griarti (2022), Arintoko (2021), and Almas et al. (2023) observed a positive long-term impact between palm oil prices and stock prices, this study found no long-term correlation between the two variables. Additionally, Arintoko (2021) identified a negative impact of palm oil prices on stock prices in the short term.

5.4 The Correlation between Interest Rates and Stock Returns in the Energy Sector

The panel data regression model results indicate that interest rates affect stock returns in the energy sector. Notwithstanding, the VECM model displays that interest rates have a positive impact on stock returns in the short term at a 1% significance level but do not influence long-term stock returns. Specifically, the VECM model suggests that interest rates can positively affect stock returns in the energy sector for the upcoming period, but this impact is not significant in subsequent periods.

The findings of this study align with Wong (2022), which noted that interest rates affect stock value. However, while Wong reported a negative impact, this study finds a positive short-term effect. This differs from Suharyanto & Zaki (2021), Moreno et al. (2017), and Almas et al. (2023), who found that interest rates do not impact stock returns in either the energy or metallurgical industries, whether in the short or long term. This discrepancy may be attributed to the low R-square value in the hypothesis test results, suggesting that the research model is not yet fully developed and could be refined to better explain variations in stock returns in the energy sector.

5.5 The Correlation between Exchange Rates and Stock Returns in Energy Sector

The panel data regression model results indicate that exchange rates positively influence stock returns in the energy sector at a 5% significance level. Similarly, the VECM model shows that exchange rates positively affect stock returns in the short term with a 1% significance level but do not impact long-term returns. Specifically, the VECM model suggests that exchange rate fluctuations are anticipated to exert a positive influence upon the returns generated by equity securities within the energy sector in the forthcoming period. These findings contrast with Wong (2022), Suharyanto & Zaki (2021), Moreno et al. (2017), and Almas et al. (2023), who reported that exchange rates negatively impact stock returns in both the energy and metallurgical sectors. This suggests that exchange rates contribute minimally to explaining the dependent variable, as indicated by the R-squared value of 23.8565%.

6 CONCLUSION AND RECOMMENDATION

6.1 Conclusions

Panel data regression models indicate a positive correlation between carbon prices, Brent oil prices, palm oil prices, and exchange rates with equity returns within the ASEAN energy sector. Conversely, interest rates exhibit no material influence on such returns. Furthermore, these models show that all independent variables collectively impact the dependent variable. According to the VECM model, carbon prices have a negative effect on stock returns in the short term, while Brent crude oil prices,

palm oil prices, interest rates, and exchange rates positively influence returns. In the long term, only carbon prices exert a negative impact on stock returns in the ASEAN energy sector. Consequently, hypotheses H1 and H2 are confirmed. This study underscores the significance of shifting towards renewable energy and advancing sustainable development goals (SDGs). By conducting a conjunctive analysis of economic and environmental sustainability factors, this study introduces a novel framework to the existing body of knowledge. Specifically, it investigates the correlation between carbon and oil price fluctuations and the performance of equity securities within the ASEAN energy sector, a domain heretofore under-explored. The application of China's carbon pricing methodology to the ASEAN context, absent a comparable domestic mechanism, constitutes an innovative approach to this research endeavor.

6.2 Recommendations

Given the absence of carbon pricing mechanisms within ASEAN member states, this study employed carbon price data from the People's Republic of China as a proxy to assess its correlation with equity returns in the ASEAN energy sector. Consequently, the availability of domestic carbon pricing data within ASEAN jurisdictions would facilitate more precise empirical analysis in future research endeavors. Moreover, 76.14% of other variables besides independent variables were found, which can explain the stock returns in the energy sector, showing many opportunities for other variables to influence the dependent variable. Therefore, adding other variables on the micro-scale is suggested to have more data variations on a macro scale. This study can be used as the primary source for companies in the energy sector, mainly the fossil fuel industry, to start planning to transition to producing renewable energy. This is in line with UN and ASEAN SDGs, which establish carbon-neutral future strategies carbon neutral future strategy to substantially reduce the risks to the environment and the lack of ecological resources.

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