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The Impact of Carbon And Energy Prices on The Return of Energy Sector Stock in Selected Asia-Pacific Countires

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ABSTRACT

The stock market is very important in the country's economy, namely as a source of corporate funding and especially in investments that have the aim of increasing the welfare of investors and companies. The purpose of this study is to analyze the effect of the rate of return on carbon costs, Brent crude oil, palm oil, interest rates, and exchange rates on the rate of return on energy stock prices in Asia-Pacific countries from 1st January 2016 to end of December 2021. In this study, the phenomena were explored utilizing quantitative approaches to collect data and test previously determined hypotheses. The panel data model is used, as well as the VECM (Vector Error Correlation Model) test. The results show that the influence of CO2 return on energy sector returns is negative in the short term but positive in the long term. Return on energy industry and return on Brent oil have both short-term and long-term unfavorable effects. The return of the use of palm oil has an advantageous long-term and short-term impact on the energy industry's return. The exchange rate has only a short-term negative relationship with the return of energy. Lastly, there is no long-term or short-term correlation between interest rates and the return on energy. The implication of this result is that industries must switch to using environmentally friendly devices and governments must declare regulations to emitters producers.

Keywords: Energy, Carbon Price, Oil Price, Interest Rate, Exchange Rate

INTRODUCTION

Stock markets are at the heart of financial systems. The primary function of stock markets is to serve as a mechanism for converting savings into real-world financing. Stock markets, in theory, can accelerate economic growth by mobilizing and increasing domestic savings and improving the quantity and quality of investment. Better savings mobilization may increase the rate of saving, and if stock markets allocate savings to higher-yielding investment projects, the increasing rate of return to savers will make savings more desirable. As a result, more savings will be directed toward the corporate sector. Efficient stock markets make corporations compete on an equal basis for funds and help make investment more efficient. Stock markets may also improve accounting and tax standards as investors seek more and better information to compare the performance of different corporations. As a result, it would be in the corporation's best interests to provide that information to facilitate thorough comparisons between competing corporations. One outstanding benefit of the existence of stock markets is the potential imposition of greater discipline in the area of economic management which are being sensitive to policy changes, particularly monetary policy, and help enhance policy creditability. The stock exchange provides a safe and regulated environment in which market participants can buy or sell stocks and other appropriate instruments.

In the modern era of digital technological technology such as internet trading, communication

with overseas brokers, and the speed of news on a country's stock exchange make it easier for investors to get information and trade in the capital market. Globalization also provides possibilities for state officials to welcome foreign investors. This incident also resulted in greater integration of the world's stock exchanges. Because of limits for international investors such as political stability, consistency of law enforcement, economic system & prospects, and social fairness, stock exchanges around the world are not always fully interconnected or segregated (El-Wassal, 2013). Research focus on stock market in several countries in Asia Pacific which are as follows:

Table 1. Stock Market List

No	Country	Ticker	Founded	Company listed
1	Australia	ASX	1987	2144
2	Canada	TSX	1861	1649
3	China	SSE	1990	1644
4	Japan	JPX	1949	3852
5	South Korea	KRX	1956	2356
6	New Zealand	NZX	2002	184

Source: Stock Market of each above countries

Each countries have their own stock market, and it will show the stock of changes price per sector every day. One of the sectors that is available in each country is the energy sector. Energy price movements are often considered to be a key factor affecting the economic output. The energy sector is a stock market category that includes companies that produce or supply energy. Companies involved in the exploration & development of oil & gas reserves, oil & gas drilling, coal combustion and refining are all part of the energy sector or industry. Renewable energy is an example of integrated power utility companies in the energy industry. Fuel combustion activities in the energy sector are grouped into three subcategories, namely power generation, oil refineries, solid fuel production and other energy industries. This category is consuming the most fuel to produce energy.

According to Credit & Kashi (2022), the energy sector contributes about 40 percent of global emissions of $\mathbf{CO_2}$. Energy-related $\mathbf{CO_2}$ emissions at the point of combustion make up the bulk of such emissions and are generated by the burning of fossil fuels. Fossil fuels consist mainly of carbon and hydrogen. When fossil fuels are combusted (burned), oxygen combines with carbon to form $\mathbf{CO_2}$ and with hydrogen to form water (H2O). These reactions release heat and one of the causes of global warming.

Innovative efforts to achieve carbon neutrality are gathering pace among companies in Asia Pacific countries. Such as, 2021 saw Nippon Life Insurance (NLI), one of Japan's largest private institutional investors, announce a goal to achieve net-zero emissions for companies in its stock and bond portfolios by 2050. China in particular is also at the forefront of many sustainable energy developments. After a decade of building solar and wind power plants, China now has some 570 GW of installed renewable energy capacity and it is the world's largest producer of wind turbines and solar panels. Australian blockchain firm power ledger

has been working with Thai Digital Energy Development (TDED) to foster the country's energy trading infrastructure, enabling the trading of renewable energy certificates and carbon credits. The more businesses that commit to being science-based technology, the closer they will be to achieving their net-zero carbon emission targets. This business community may easily face an urgent challenge to slow or stop the harmful effects of climate change. A perception survey from the world economic forum global risk report by (Mundial. & Marsh & McLennan., 2022), states that climate change in the next 10 years is considered the riskiest long-run threat, factors cause is by $\mathbf{CO_2}$ (carbon dioxide). For decades, carbon markets have been seen as part of the solution to climate change. Carbon market refers to a market where each unit of carbon credits that represent emission reductions are exchanged within a defined framework.

However, research really suits with Moreno (2017) because the relate variable and the purpose that the research used and implemented. Using data panel and Vector Error Correction Model (VECM) will be estimated through reach the results. The purpose of this title is to investigate and analyze the relationship between carbon prices, oil prices, palm oil prices, exchange rates, and interest rates with return of energy sector in long and short run. Furthermore, the study concentrated on Asia Pacific.

Stock prices can be influenced by several internal and external factors. Several experts have examined various variables that affect price changes in the stock market. In the background, the price of stock market determined by interest rate shows in Moreno (2017), has been stated that there is no significant effect on stock market. The price of stock market settled on exchange rate conducted by Suharyanto & Zaki (2021), which said there is a significant negative effect on stock market and exchange rate. Different result comes from Wong (2022), said that exchange rate found to have a significant impact on the real stock price. The price of stock market determined by carbon prices shown on Tian (2011), stated that in the short run, stock market is significantly affected by carbon prices, but this effect diminishes over the long run. Different result with Wen (2020), explained that stock market prices are significantly has negative effect on the long-run and short-run period on carbon prices. The price of stock market determined with oil prices demonstrated on Salisu (2019), said that stock prices respond positive effect on oil price. Moreover, price of stock market with palm oil prices stated by Arintoko (2021), said that in the long run, stock prices have a significant positive relationship with palm oil price. This finding also indicated by figure 1.2 until figure 1.6 that supported there is relationship between carbon price, Brent oil price, palm oil price, exchange price, and interest price with stock market prices, even though this finding has not instable or inconclusive because the results put forward by researchers above are still different, making the results even more ambiguous therefore it must be retested.

In addition, research about carbon price and palm oil price on market price still limited. According to Moreno (2017), many investigations were carried out in European countries and used Europe emission trading prices. Because Asian countries are new to carbon trading, research is still limited. Therefore, this research focuses on examining Asian countries that already own and determine carbon prices. The identification results above can be formulated in the form of a research question as follows:

1. How do the carbon price, crude Brent oil price, palm oil price, interest rate, and exchange rate affect the energy stock returns in Asia Pacific countries in short run and long run?
2. How do the carbon price, crude Brent oil price, palm oil price, interest rate, and exchange rate affect the energy stock returns in Asia Pacific countries?

RESEARCH METHODS

The research approach used by the researcher is a quantitative approach that is measured accurately and thoroughly, as well as an objective hypothesis test. Based on the methodology, this research is quantitative. According to (Arikunto, 2019) quantitative research is a research method that matches its name, many are required to use numbers, starting from data collection, interpretation of the data, and the appearance of the results. According to Sekaran & Bougie (2016), the term population refers to the entire group of people, things, or events of interest which the researcher attempts to reach conclusions. The population in this study were stock market in energy sector prices, carbon price index, crude Brent oil price, palm oil price, exchange rate and interest rate.

Based on what has been describes in chapter 1, this study uses a research period from January 2016 to December 2021. The criteria determined for taking samples in this study are as follows:

1. Energy sector prices are listed on ASX, TSX, SSE, JPX, KRX, and NZX stock market and also listed on YahooFinance (finance.yahoo.com) from 1 January, 2016, to December 31, 2021.
2. Carbon index prices are listed on S&P global (spglobal.com) from 1 January, 2016, to December 31, 2021.
3. Crude Brent oil prices and palm oil prices are obtained from World Bank Data (data.worldbank.org) from 1 January, 2016, to December 31, 2021.
4. Exchange rate and interest rate are obtained from Fred (fred.stlouisfed.org) from 1 January, 2016, to December 31, 2021. All of the currency for exchange rate is convert to dollar USD.

This study uses secondary data. Secondary data may include previously gathered data that is being considered for reuse for new questions for which the data was not originally intended (Martins, 2018). This analysis uses the Eviews 12 program for statistical analysis and to obtain a regression model. This regression analysis is to see the causal relationship that occurs between one variable and another. The data processing procedure in this study is divided into several stages, including: calculate the return price, VECM test, panel data test, and robustness test.

Theoretical Framework

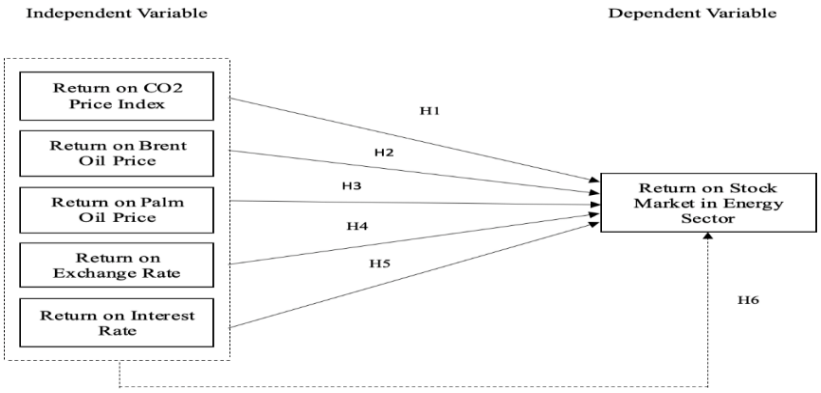


Figure 1. Theoretical Framework
Source: Modified from Anggraeni & Lutfillah (2019)

→ : The partial effects of independent variable on the dependent variable.

⇢ : The simultaneous effects of independent variable on the dependent variable.

Research Hypothesis

Based on the theoretical framework, the hypothesis obtained are in the form of:

1. H1: There is a significantly partial effect of carbon return on the changes of return on energy sector of stock market.
2. H2: There is a significantly partial effect of Brent oil return on the changes of return on energy sector of stock market.
3. H3: There is a significantly partial effect of palm oil return on the changes of return on energy sector of stock market.
4. H4: There is a significantly partial effect of exchange rate on the changes of return on energy sector of stock market.
5. H5: There is a significantly partial effect of interest rate on the changes of return on energy energy sector of stock market.
6. H6: There is a significant simultaneous effect of carbon return, Brent oil return, palm oil return, exchange rate and interest rate on the changes return on energy sector of stock market.

RESULT AND DICUSSION

This chapter will discuss the results of study starting from first descriptive statistics related to research data to understand the pattern of empirical data. Second, VECM pre-estimation test results (including stationary tests, VAR optimal lag test, stability test, granger causality, johansen cointegration test), VECM test result, and panel data regression result.

Descriptive statistics

Table 2. Descriptive Statistics Table

Index	Mean	Maximum	Minimum	Std. Dev
Energy Sector Price	-0.00056	0.185	-0.314	0.035
$\mathbf{CO_2}$ Price	0.00265	0.062	-0.212	0.018
Brent Oil Price	0.01955	0.329	-0.400	0.105
Palm Oil Price	0.01367	0.159	-0.127	0.062
Exchange Rate	-1.57E-0	0.107	-0.101	0.013
Interest Rate	0.00522	3.00	-2.00	0.284
Observation	432			

Based on Table 2. total of observations is 432, it acquired from 6 variables multiplied by a 72-month research period of six years. Given that:

1. The energy sector's average return is -.0005, with a maximum of.185 and a minimum of -.314 as well as a standard deviation of.035.
2. The average return of $\mathbf{CO_2}$ is .003, with a maximum of .062 and a minimum of -.212, it has a standard deviation of .018.
3. The average return of Brent oil is .019, with a high of .329 and a lowest price of -.4. The standard deviation is .011.
4. The mean return of palm oil is .014, with a maximum of.159 and a minimum of -.13. The value has a standard deviation of.062.
5. Exchange rate has a value of mean at -.000 with maximum at .12 and minimum at -.101, also for the standard deviation, it is stated at .013.
6. The average of interest rate is at .005. Maximum value is 3 and minimum value is -2. It is confirmed that standard deviation of interest rate is .284.

A data set's standard deviation reflects its level of variability. It is deemed to be good if the standard deviation value is less than mean.

The results show that, expect for energy sector, all variables have a value greater than its mean, indicating fewer variations in data. It can also be interpreted that the data is heterogeneous, there are fluctuations in stock trading with a large enough difference. Meanwhile, the data for energy sector return shows quite variety.

Even though the energy sector has variety, it has negative value on average along with exchange rate. The negative mean can be interpreted that the market is giving a negative signal which indicates the energy sector return and the exchange rate in most companies has decreased or loss in 72-months (January 2016 – December 2021).

Result

Pre-Estimation Test Results

Stationarity Test

Before estimating and using the Vector Error Correction Model (VECM) method needs to perform a stationarity test since the VECM analysis makes the assumption that all variables must be stationary at the same order/degree. The test method used to test the stationarity of the data in this study is the ADF (Augmented Dickey Fuller). The ADF test is used to determine the presence of a unit root in a series, thereby helping in determining whether or not the series is stationary. The results of the data stationarity test can be seen in Table 2.

Table 3. Stationary Test Result

Variable	Level	1st Difference
	ADF t-statistic	ADF t-statistic
Energy Sector Price	-2,14***	-8,55***
CO_2 Price	-2,98	-9,92***
Brent Oil Price	-1,54***	-3,88***
Palm Oil Price	-2,14	-7,43***
Exchange Rate	-3,04***	-15,17***
Interest Rate	-0,68***	-5,13***

Notes: ***) significant at the 5 percent significance level

The return of energy sector and palm oil return are not stationary at the level stage, according to the stationary test results, therefore all variables are not stationary at the level stage. Then stationary test is performed at the first difference level, with the result that all variables are stationary at the first difference level with all probability value <0,05. Non-stationary data frequently exhibit an imbalance relationship in the short run, but an equilibrium relationship is more likely in the long run. A cointegration test is required to determine whether there is a long-run relationship in a variable. Therefore, to analyze long-run information, the VAR model will be used combined with the error correction model to become VECM.

VAR Optimal Lag Test

This test is carried out to determine at what lag position the model can be optimal. Determining the optimal lag in this study using Akaike's Final Prediction Error Criterion (FPE), Akaike Information Criterion (AIC), Schward-Bayes Criterion (SC), and Hannan-Quinn (HQ). The test results for determining the optimum lag length can be seen in Table 4.

Table 4. VAR Optimal Lag Test

Lag	Logl	AIC	SC	HQ
0	3735.068	-19.42223	-19.36050*	-19.39774
1	3805.071	-19.59933	-19.16723	-19.42794*

2	3862.296	-19.70988	-18.90740	-19.39158
3	3924.563	-19.84668	-18.67383	-19.38148
4	3959.148	-19.83931	-18.29609	-19.22720
5	3998.882	-19.85876	-17.94517	-19.09975
6	4041.629	-19.89390	-17.60993	-18.98798
7	4109.511	-20.05995	-17.40561	-19.00712
8	4165.261	-20.16282*	-17.13811	-18.96308

* Indicates lag order selected by the criterion
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Akaike Information Criterion (AIC), can be applied as a model selector that is able to assess the relative quality of each model by using the maximum likelihood estimate as the appropriate calculation. The AIC value is the corrected score information for each model. The model that has the smallest AIC value is the best model (Marine Fisheries, 2020). Based on the test results, lag 8 is obtained as the optimal lag because the value of lag 8 in AIC columns have the smallest value which is -20,16282.

Stability Test Result

Based on Stability Test Result data analysis, shows the results of the VAR model stability and it is known that the VAR model made is stable, this is because the modulus value obtained is less than 1. This result also supported by figure 1 in the appendix that shows all dots are contained within the large circle.

Granger Causality

Causality test was conducted to determine whether an endogenous variable can be treated as an exogenous variable. This stems from ignorance of the influence between variables. If the prob value <0.05, then there is a causality relationship which is significant. Based on the Granger Causality data analysis, variable that have the significant causality relationship refers to $\mathbf{CO_2}$ return to energy sector return and vice versa, Brent oil return to energy sector return, palm oil return to energy sector return, interest rate to energy sector return, Brent oil return to $\mathbf{CO_2}$ return and vice versa, palm oil return to $\mathbf{CO_2}$ return, palm oil return to Brent oil return and vice versa, and Brent oil return to interest rate. The rest of it do not have causality relationship to each variable.

Johansen Cointegration Test

The cointegration test determines the possibility that there will be a long-run balance, namely whether or not there is a similarity in movement and stability of the relationship between the variables in the study. The Johansen cointegration test method was used to conduct the cointegration test. If the probability value is 0.05, it indicates the presence of a cointegration equation, indicating that it has a long-run balance and can proceed to the vector error correction model estimation stage.

Table 5. Cointegration Test Result

Hypothesize No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None*	0.404987	784.6444	95.75366
At most 1 *	0.339813	591.5125	69.81889
At most 2 *	0.277176	437.0463	47.85613
At most 3 *	0.261700	316.2988	29.79707
At most 4 *	0.252648	203.4322	15.49471

At most 5 *	0.225581	95.09884	3.841465

Notes: *) significant at the 5 percent significance level

Based on Table 5. all of the probabilities have a value of 0 (less than 0.05) and the value of critical value < trace statistic value, these results indicate that the variable has a long-run reciprocal relationship or cointegration and can be used with VECM.

Vector Error Correction Model Estimation Results

After conducting a series of tests on the variables starting with the data stationarity test, the optimal lag determination test, and the Johansen co-integration test, the next step is to look at the results of the estimation of the Vector Error Correction model on the model considering that the results of the Johansen cointegration test state that there is a similarity of cointegration which indicates a long-run balance. This method aims to see the long-run and short-run effects of the independent variables on the dependent variable. It has an effect if the value of t count is greater than the value of t table, but it has no effect if the value of t count is less than the value of t table. The VECM result can be seen in Table 6.

Table 6. VECM Result for long-run

Variable	Price Volatility
CO_2 Price	1.932614
	(2.73110) ***
Brent Oil Price	-1.049005
	(-7.29498) ***
Palm Oil Price	2.638425
	(13.0307) ***
Exchange Rate	0.671329
	(0.72169)
Interest Rate	0.007115
	(0.12703)

Notes: () t statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

According to the results of the VECM test indicate a positive stable long-run relation between energy sector return with the return of CO_2 and palm oil. Moreover, Brent oil return show negative long-run relation with energy sector return. Those variables have a long-run effect because the value is significant at level 1%, whereas the exchange rate and interest rate have no long-run effect on the return of the energy sector.

Table 7. VECM Result for short-run

Variable	Number of lags							
	-1	-2	-3	-4	-5	-6	-7	-8
Energy sector price	-0.5080 (-3.98) *	-0.5935 (3.72) *	-0.3603 (-1.83)	-0.0702 (-0.32)	0.0628 (0.28)	0.1109 (0.58)	0.1075 (0.79)	0.0556 (0.74)
CO_2Price	0.3776 (1.58)	-0.0361 (-0.13)	-0.5643 (-1.56)	-1.0894 (-2.75) *	-1.1762 (-3.03) *	-0.8545 (-2.59) *	-0.2636 (-1.12)	-0.2470 (-1.91)

Brent Oil Price	-0.6052 (5.43) *	-0.5680 (-5.49) *	-0.4914 (-5.25) *	-0.4046 (-4.84) *	-0.2909 (-4.19) *	-0.1999 (-3.74) *	-0.1112 (-3.0) *	-0.0622 (-3.0) *
Palm Oil Price	1.5449 (5.63) *	1.4228 (5.78) *	1.2062 (5.55) *	0.9584 (5.13) *	0.7256 (4.78) *	0.4891 (4.27) *	0.2809 (3.60) *	0.1345 (3.23) *
Exchange Rate	0.5955 (3.88) *	0.8711 (3.20) *	0.7683 (2.15) *	1.1383 (2.81) *	0.7919 (2.00) *	1.0067 (2.79) *	0.4360 (1.525)	0.4958 (2.57) *
Interest Rate	0.0025 (0.401)	0.0025 (0.231)	0.0032 (0.216)	0.0060 (0.365)	0.0068 (0.402)	0.0045 (0.283)	0.0003 (0.031)	0.0009 (0.129)

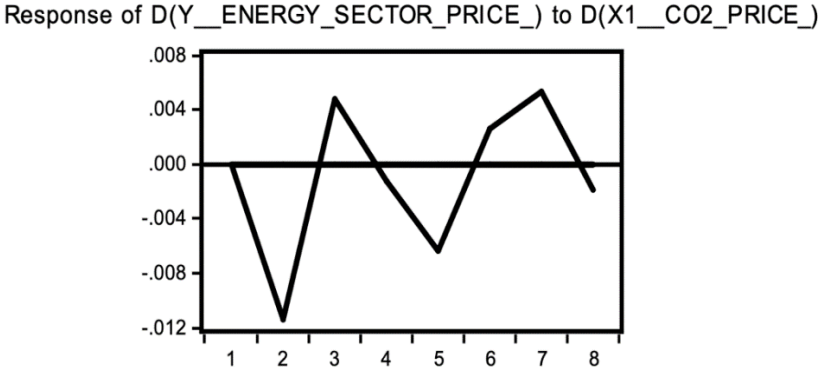
Notes: () t statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

It can be explained that in the short-run (according to the type of data used, monthly edition data from January 2016 to December 2021) the price of:

1. $\mathbf{CO_2}$ return in the fourth, fifth and sixth lags have a negative short-run effect on energy sector return and the rest have no effect. Take an example from lag 4, which is significant at a real level of 1%, namely the $\mathbf{CO_2}$ return variable at lag 4 of 1.0894. This means that if there is an increase in the return of $\mathbf{CO_2}$ by one percent in the previous period, it will cause an increase in the return of $\mathbf{CO_2}$ by 1.1 percent. This shows that $\mathbf{CO_2}$ return movements are strongly influenced by $\mathbf{CO_2}$ return movements in the previous period.
2. Brent oil return have a negative short-run effect, palm oil return and exchange rates that exclude lag 7 have a positive short-run effect on price of energy sector.
3. The interest rate and exchange rate at lag 7 have no short-run association with energy return.

Based on the data shown above, it is possible to conclude that Brent crude oil return, palm oil return, and the exchange rate have a monthly connection, although the energy sector pricing only has a monthly connection in the first and second months. Furthermore, the $\mathbf{CO_2}$ return is only connected in the fourth, fifth, and sixth months, with the rest having no relationship. Furthermore, the interest rate is unrelated to the month. This can be explained by the fact that the interest rate is set by the government as the regulator, not the market, therefore the rate in one month has no effect on the rate in following month.

Impulse Response Function



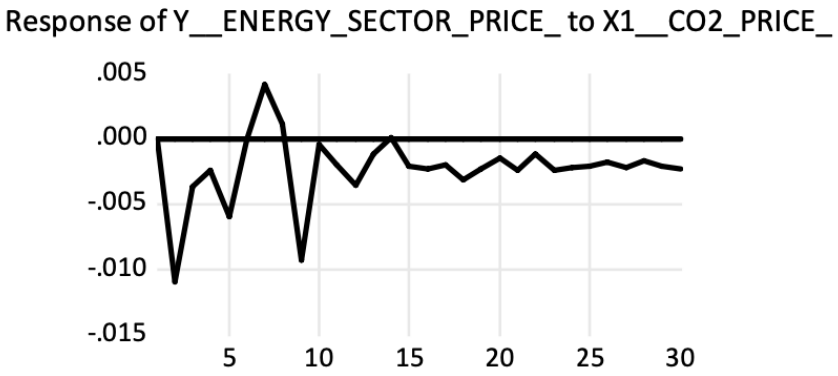


Figure 2. Impulse Response Energy Sector to CO_2 Price

If the price of CO_2 rises, the price of energy sector will rise in the third and seventh months, and the price outside of those months are not optimal. It is not advised to purchase stocks during the first month because the price has sharply decreased.

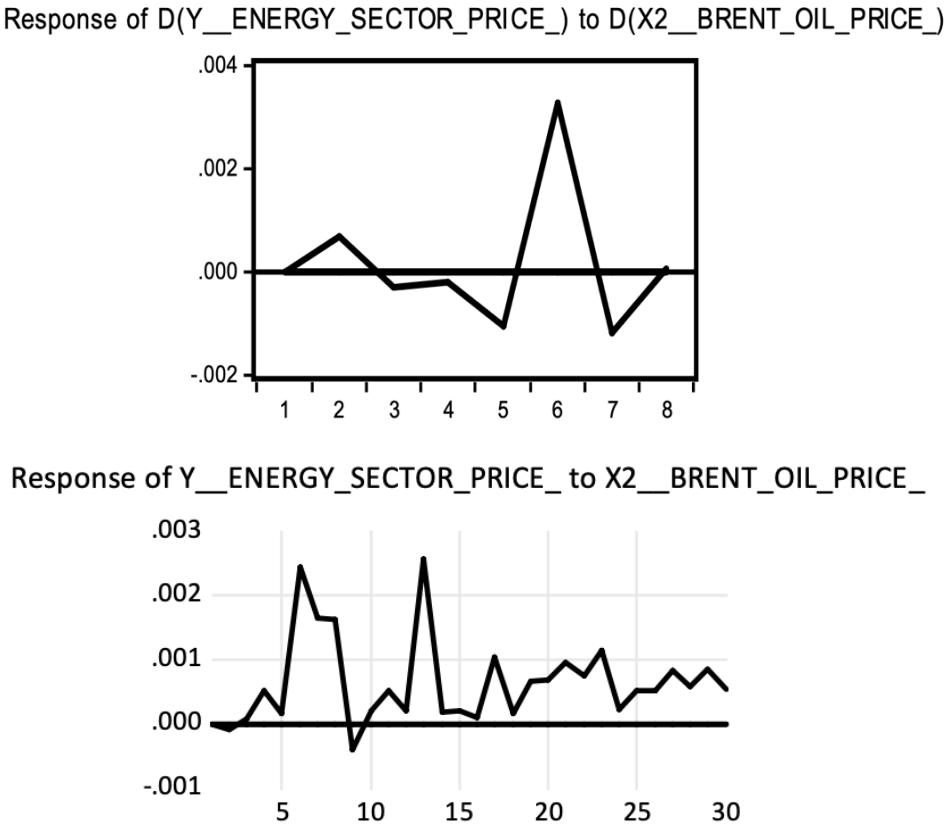


Figure 3. Impulse Response Energy Price to Brent Oil Price

Brent oil prices climbed in the second month and hit a highest in the sixth month. Except for that month, the response has decreased.

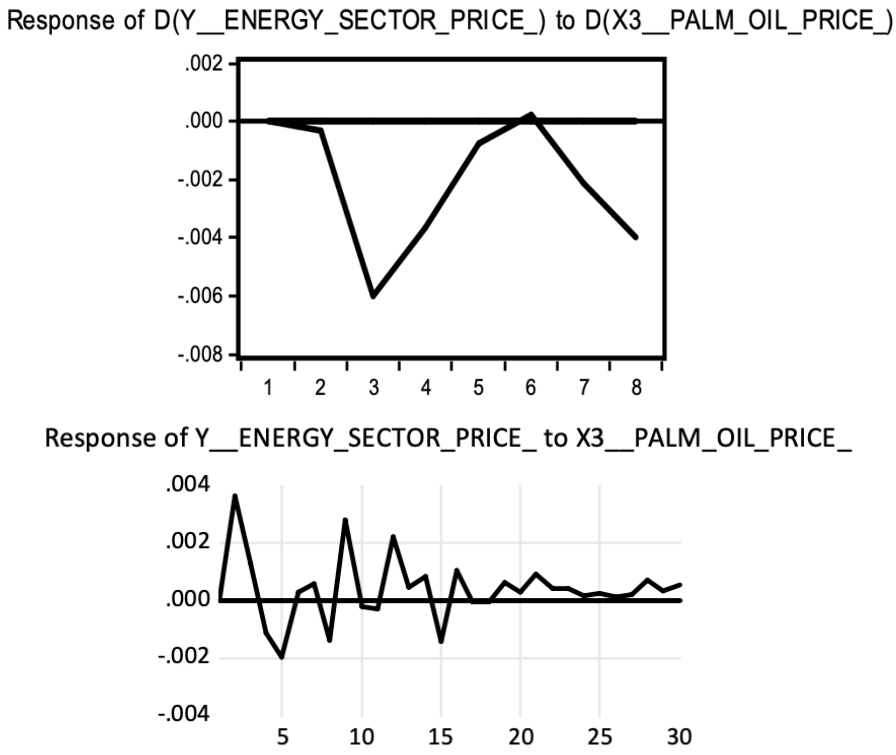


Figure 4. Impulse Response Energy Price to Palm Oil Price

The response of palm oil prices is all negative in the eighth month, it will drop drastically in the third month and then increase again but the price is still negative or equal to zero. then back down in the eighth month.

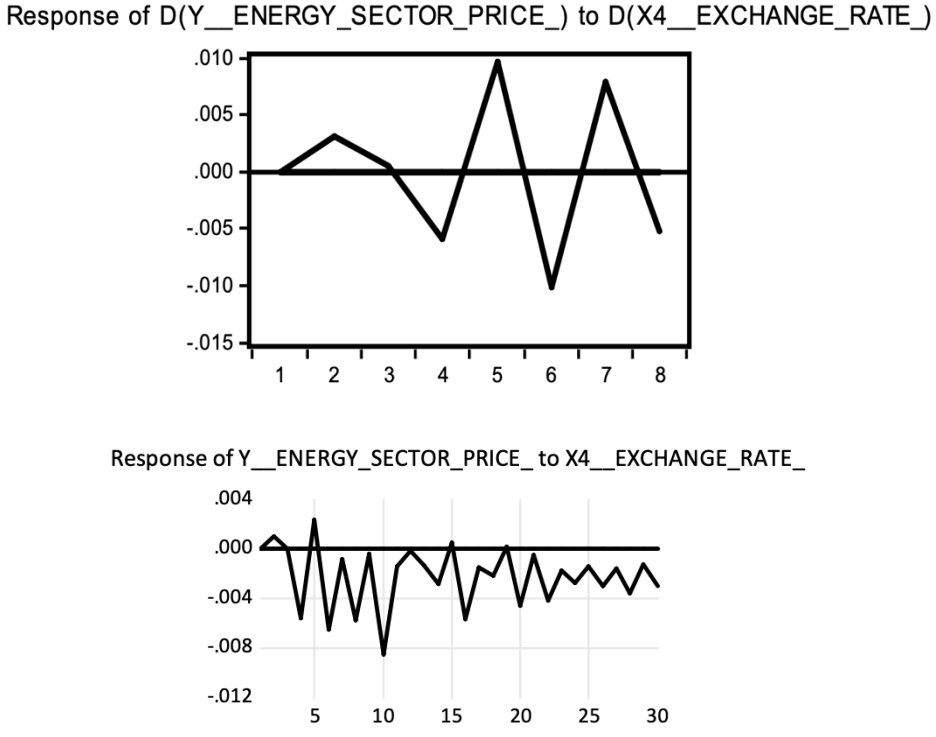


Figure 5. Impulse Response Energy Sector Price to Exchange Rate

In the last eight months, the exchange rate's reaction to the price of energy has fluctuated significantly. Prices will reach to the highest point in the fifth month before plummeting dramatically in the sixth month. Then, in the seventh month, it quickly recovers.

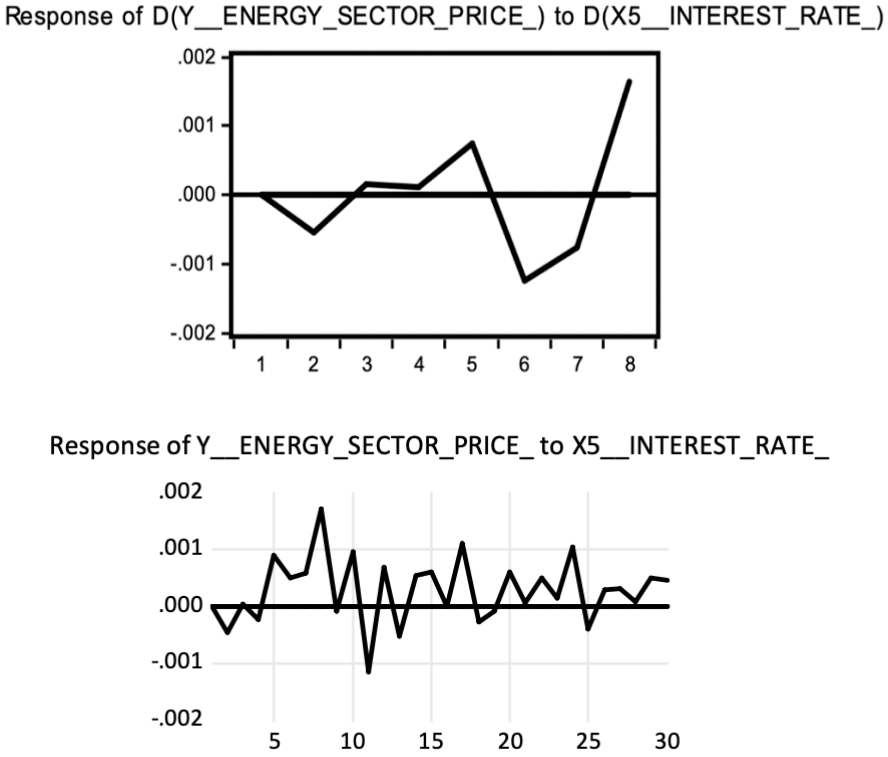


Figure 6. Impulse Response Energy Sector Price to Interest Rate

The interest rate response experienced a very significant decrease in the sixth month and experienced an optimal price in the eighth month

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Panel Data Analysis

Table 8. Result of Panel Data Analysis

Independent Variable	Price volatility of energy sector		
	OLS Model	F.E. Model	RE Model
$\mathbf{CO_2}$ Price	1.00	0.85	1.00
	(12.38)	(11.93)	(12.52) ***
Brent oil price	0.022	0.001	0.022
	(1.458)	(0.23)	(1.475)
Palm oil price	0.035	0.004	0.035
	(1.451)	(1.09)	(1.467)
Exchange rate	-0.198	-0.15	-0.198
	(-1.847)	(-1.22)	(-1.867) *
Interest rate	0.0038	-0.001	0.0038
	(0.783)	(-0.56)	(0.792)
Adj-$\boldsymbol{R^2}$	0.3199	0.287	0.328
SE	0.029	0.023	0.029
F Test	41.56	18.41	41.56

Durbin W	1.6	1.8	1.6
Prob(F-stat)	0.0000	0.0000	0.000
Chow Test	0.0151		
Hausman Test		1.00	

Notes: () t statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Results in Table 8. it can be seen that:

1. In the Chow test, the cross-section F is worth 0.0151, which means the value is less than 0.05 so that H0 is rejected and H1 is accepted. Thus, the appropriate regression model to use is the fixed effect model (FEM). In the Hausman test, the p-value is 1.00 which means more than 0.05 so the results show that H0 is accepted and H1 is rejected. The random effect model (REM) regression model is more fits the data well at the .05 significance level (F=41.56). The regression equation is,

   Y = -.004 + 1.002$\mathbf{CO_2}$P + .022BOP + .0355POP +(-.198ER) + .0038IR
2. If $\mathbf{CO_2}$ price increases by one percent, the price of energy price sector is expected to increase by 1%, holding all the variables constant (t table equal 12.52). The price increase in $\mathbf{CO_2}$ could be caused by machines that are not go-green and sustainable, causing the industry to generate more $\mathbf{CO_2}$ pollution, forcing them to pay greater for capacity that exceeds the limit. As a result, the price of the energy industry and $\mathbf{CO_2}$ increased. When the price of $\mathbf{CO_2}$ rises, we expect an increase in manufacturing output and mobility of accommodation, along with an increase in energy demand. Because the demand for energy increases, the price of the energy sector will increase. We may conclude that the link between $\mathbf{CO_2}$ price and $\mathbf{CO_2}$ price is positively significant.
3. For one percent increase in Brent oil price, the price of energy sector is expected to increase by .022%, holding all the variables constant (t table equal 1.475). The rise in demand for food industry sector, households, and all production that uses oil has led the price of Brent oil and energy sector price as well.
4. Whenever palm oil price increases by 1%, the price of energy sector will increase by .035 percent, holding all the variables constant (t table equal 1.467). Palm oil demand has risen in recent years as many developed nations transition away from trans fats and toward healthier alternatives. However, due to crop failures and the Ukrainian-Russian conflict, supply has been limited that caused energy sector price and palm oil increase.
5. The link between the exchange rate and sector energy prices is negative, which indicates that when the exchange rate depreciates 1 percent, the energy sector prices increase by .198 percent. The increase in energy sector price put pressure on high inflation and the ability to stimulate domestic economic growth in various countries. The increase in the Fed's exchange rate was in response to high inflation in the United States, and the very strong US dollar also caused pressure to weaken various world currencies. in conclusion, if the price of energy sector increase, the exchange rate will decrease.
6. The price of energy is predicted to rise by .004% for every one percent increase in interest rates. This means that it has little impact, and changes in energy sector pricing are irrelevant when the government boosts or decreases interest rates.
7. The adj-R square value of 0.328 explains that the $\mathbf{CO_2}$P, BOP, ER & IR variables can predict the energy sector price by 32.8%.
8. $\mathbf{CO_2}$ price effect the price volatility at a significant level of 1% and exchange rate is significant at level of 10%, with a positive effect which means $\mathbf{CO_2}$ price and exchange **rate** have partial effect on the ESP. Moreover, the increases of Brent oil price, palm oil price and interest rate do not

significant or do not affect the price of the energy sector. Then simultaneously obtained from prob F statistic of 0.000 < 0.05 which can be concluded that the $\mathbf{CO_2}$P, BOP, POP, ER & IR variables simultaneously influence ESP.

Discussion

Based on the result from the previous it can be described that energy sector price has a positive and significant effect on $\mathbf{CO_2}$ price. $\mathbf{CO_2}$ price increases could be caused by machines that are not environmentally friendly and sustainable, causing the industry to emit more $\mathbf{CO_2}$, requiring them to pay more for capacity that exceeds the limit. As a result, the price of the energy industry and $\mathbf{CO_2}$ increased, this result is supported by Tian (2011) which state that $\mathbf{CO_2}$ price significantly affected by stock market in electricity companies.

Energy sector return has negative effect on Brent crude oil. The increase in demand for oil in the food industry, households, and all other sectors has driven up the return of Brent oil and the energy sector. This result is inversely proportional to the findings from Salisu (2019), which says that stock returns respond more to the positive changes in oil prices than the negative changes.

Energy sector return has a positive effect on palm oil return. Demand for palm oil has increased in recent years as many industrialized countries shift away from trans fats and toward healthier alternatives. However, due to crop failures and the Ukrainian-Russian conflict, supply has been limited, causing energy and palm oil return to rise. This finding is supported by Arintoko (2021), that clearly stated that stock price has a significant positive relationship with crude palm oil.

Energy sector return has no significant effect on the exchange rate in the long-term investment and has a positive effect in short-term investment. Investors will benefit if they analyze the exchange rate of short-term investment earnings to buy shares in the energy sector, this could ne cause by the increase in energy sector return put pressure on high inflation and the ability to stimulate domestic economic growth in various countries. The increase in the Fed's exchange rate was in response to high inflation in the United States, and the very strong US dollar also caused pressure to weaken various world currencies. In conclusion, if the return of energy sector increases, the exchange rate will decrease, this result is backed up by Wong (2022), that declare the exchange rate is mostly found to have a significant impact on the stock market price. The reason there is no significant relationship in the long-term between exchange rate and energy sector prices can be stated that either the appreciation or depreciation of domestic money against the USD does not affect fluctuations in the stock prices of companies in the energy sector. From these results it can be illustrated that it is easy for energy sector companies to export and import raw materials and finished products to countries that use USD as their transaction currency because issuers do not need to think about fluctuations in exchange rates. For investors, these results can also be taken into consideration for their investment activities.

The interest rate has not associated with price variations for energy sector firms; this may be explained by the fact that the interest rate is determined by the government as the regulator that stated differently in months, not by the market. As a result, the rate in one month has no effect on the rate in the following month.

CONCLUSION

The purpose of this research was to econometrically analyze and examined the causal relationship among independent variable to dependent variables using VECM model and panel data regression. Panel data regression was used to ascertain carbon price, exchange rate, interest rate of 6 countries in Asia Pacific (Australia, Canada, China, Japan, South Korea, and New Zealand), crude Brent oil return and palm oil return changes affect the Asia Pacific countries energy stock market returns. VECM was used to test for the presence of short-run

and long-run relationship between variables. The possible conclusions are:

1. The effect of $\mathbf{CO_2}$ return on energy sector is negative in the short term but favorable in the long term. Both the short-term and long-term effects of energy sector return on the return of Brent oil are negative. The return of palm oil has a positive long-term and short-term impact on the pricing of the energy industry. The value of the exchange rate has only a negative short-term link with the return of energy. Lastly, there is no long-term or short-term relationship between interest rates and energy return.
2. Energy sector return has a positive and significant effect on $\mathbf{CO_2}$ return and has a significantly negative effect on exchange rate. Return changes in the energy sector stock index are unaffected by Brent oil return, palm oil return, or interest rates.

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