

Geopolitical Risk and Global Oil Price Volatility Effects on Energy Sector Returns: Evidence from Asia–Pacific Markets

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Abstract

Introduction: The present study takes into account the geopolitical risk index, OVX, and monthly closing returns of energy stock indices from important countries located in the Asia Pacific region: Australia, China, Hong Kong, India, Japan, the Philippines, South Korea, Thailand, the United States, and Vietnam. **Method:** The MS-GARCH estimation results reveal that, with the exception of countries like Australia, Japan, and Hong Kong, all other countries demonstrate significant volatility and volatility clustering in their energy stock returns against OVX across the different regimes during the study period. **Results:** The MS-GARCH estimation results between energy stock returns and geopolitical risks of the select countries show that, except Australia, Hong Kong, and Vietnam, all other countries are affected significantly due to the presence of volatility and volatility clustering arising from geopolitical risks. **Originality:** The study takes an integrated, region-specific approach to comprehending how global oil price volatility and geopolitical risk interact to affect energy sector returns in the Asia-Pacific area. It simultaneously evaluates both geopolitical risk and oil market uncertainty using sophisticated econometric techniques that capture regime shifts, non-linear dynamics, and cross-market heterogeneity. Also, it offers new insights into how external shocks spread differentially across net-oil-importing and exporting economies by concentrating on Asia-Pacific markets. The study also presents comparative evidence from several Asia-Pacific markets, revealing structural variations influenced by market maturity, policy frameworks, and energy reliance. **Conclusion:** This study has successfully captured volatility clustering through various econometric mechanisms.

Keywords: CBOE Crude Oil Volatility; Energy Sector Returns; FIGARCH; Geopolitical Risks (GPR); MS-GARCH; Time-varying Co-movements

JEL Codes: C32; C53; G15; Q43; Q47

Introduction

With the technological advancements of the twentieth century, crude oil has prevailed as the widely adopted energy source. Crude oil is vital for the expansion of the global economy since it enables almost every type of productivity, from worker commutes to the operation of several industries. Since crude oil is an essential element of most of the world's production, alterations in the price of the commodity can have an enormous effect on matters related to economic policy, including inflation, consumer and manufacturer costs, business earnings projections, and even patterns in the personal savings of individuals. These variations in the crude oil price are observed mainly due to mismatches in the supply and demand of crude oil. Several factors, such as the overall economic outlook,

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changes in interest rates, real exchange rates, etc., are responsible for this imbalance of crude oil supply and demand. Geopolitical risk (Austin *et al.*, 2025) is another major factor that could trigger this imbalance in the crude oil price and ultimately affect the energy sector. Various past geopolitical events have shown how geopolitical events influence the crude oil price. For example, after the attacks on September 11, the price of Brent oil went up by five per cent. Likewise, during the initial two weeks following the Russia-Ukraine war in the month of February 2022, Brent oil prices shot up by about thirty per cent (Ferrari Minesso *et al.*, 2024). Mainly, these geopolitical events influence crude oil prices through two important transmission paths. Firstly, any kind of geopolitical event presents greater uncertainty about the economic outlook among investors and consumers. These results are composed of consumption, investment, and economic activities, which ultimately drive demand shocks and hence affect crude oil prices (Cunado *et al.*, 2020). On the other hand, geopolitical events drive supply shocks via crude oil supply disruptions. Several recent studies, like Mignon and Saadaoui (2024), Chen *et al.* (2024), Shahbaz *et al.* (2024), Ngo *et al.* (2024) and others, have argued that any kind of risk arising due to geopolitical events occurring in the crude oil-producing region not only puts a stain on the trade of that particular region but also disrupts the crude oil supply and affects the global crude oil market. Hence, it is clear from the above discussion that geopolitical events can affect the energy market greatly through different transmission paths.

During the last couple of years, different studies have been made to analyse the impact of geopolitical risks on stock returns. The studies of Monge *et al.* (2023), Jiao *et al.* (2023), Li *et al.* (2023), Pan *et al.* (2023), Zhang *et al.* (2022), Alqahtani *et al.* (2022), Agoraki *et al.* (2022), Jung *et al.* (2021), Smales (2021), and others reported that geopolitical events affect stock returns greatly. Despite all of this, several questions are still unanswered, in the Asia-Pacific region, how is the volatility of the global oil price affected by geopolitical risks? Do geopolitical risks affect the returns of the energy sector?

Keeping in mind these critical questions, the present study aims to conduct a comprehensive study that examines the effects of geopolitical risks and global oil price volatility on energy sector returns, focusing on important countries in the Asia Pacific region, such as Australia, China, Hong Kong, India, Japan, the Philippines, South Korea, Thailand, the United States, and Vietnam.

Review of Literature

According to the study by Cunado *et al.* (2020), geopolitical risk is like a double-edged sword. Results of time-varying parameter structural vector autoregressive estimation techniques reported that, on one hand, geopolitical risks imposed adverse demand shocks by contracting economic activity, which ultimately reduced returns from oil. Conversely, this study revealed that geopolitical events can create supply shocks that disrupt oil supply and result in increased oil prices.

The study by Lee *et al.* (2021) considered monthly data on the geopolitical risk index and global crude oil prices to examine whether or not inconsistency in global crude oil prices is explained with the help of geopolitical risks. The results of this study reported that geopolitical risks have a powerful ability to estimate global crude oil prices. The outcomes of all the causality tests found that one-way causality was moving from the geopolitical risk index to global crude oil price volatility.

Alqahtani and Klein (2021) used the ARDL technique to explore the effect of oil price changes and geopolitical risk on different stock markets belonging to the Gulf Cooperation Council (GCC) member states. The results of this study found that, except for Qatar, all the stock markets of GCC member countries exhibited a strong response to changes in energy prices and instability. This study also found that uncertainty arises due to geopolitical events exhibiting heterogeneous impacts on the stock markets of GCC member countries.

Using the Markov-switching model, Qian *et al.* (2022) also documented that geopolitical risks contain information that enables them to be a powerful predictor of oil market volatility. In addition to these findings, this study reported that oil market volatility is negatively impacted by geopolitical risk.

Li *et al.* (2022) ascertained the spillover effects among risks arising from geopolitical risks, the crude oil market, and sectoral stock markets of China by employing the nonlinear Granger causality test and

connectedness network approach. The results of this study reported that one-way causality was transmitted from Brent oil volatility and the Chinese stock markets to geopolitical risk.

The empirical investigation of Wu *et al.* (2023) using the GARCH-MIDAS model found the heterogeneous influence of geopolitical risk on the oil market. This study found that geopolitical risk drives oil price imbalance and demand for oil, but in contrast, it negatively influences oil supply.

Khan *et al.* (2023) examined the combined impact of geopolitical risk and oil price fluctuation on stock returns and volatility in Pakistan using data from the Geopolitical Oil Price Risk (GPOPR) index developed by Bonaparte (2019). The findings demonstrated that GPOPR only exerts a causal influence on stock returns in normal market circumstances. Whereas GPOPR has a causal effect on stock volatility under all market conditions.

After thoroughly analysing several previous studies, it is identified that no such comprehensive studies have been done yet that exhibited the effects of geopolitical risks on global oil price volatility and energy sector returns, focusing on the Asia Pacific region.

Based on the above research gap, the following objectives have been finalised:

- To study the volatility clustering within the selected stock indices arising from geopolitical risk and the crude oil volatility index.
- To study the regime shifts in the selected stock indices in the Asia-Pacific region.
- To study the long-memory effects within the selected stock indices in the Asia-Pacific region.

Methodology

The geopolitical risk (GPR) index developed by Caldara and Iacoviello (2022) is used in this study to represent geopolitical risk. The current study considers the crude oil volatility index (OVX) and monthly closing returns of energy stock indices of ten countries: Australia, China, Hong Kong, India, Japan, the Philippines, South Korea, Thailand, the United States, and Vietnam. The corresponding energy stock indices are S&P ASX 200, SSE Energy, Hang Seng Composite Industry, CNX Energy, Nikkei 500 Electric Power, ACEN, KOSPI 200 Energy & Chemicals, EGCO, S&P 500 Energy, and VNE. Country-specific GPR data are also collected to measure geopolitical risk. The period of the study extends from January 2011 to December 2023. It is important to note that the GPR indices for most of the selected countries do not extend beyond January 2011, except for a few countries. Therefore, the authors decided to select January 2011 as the common beginning point for our study period. All the raw data are converted into corresponding natural logarithmic returns to remove the innate disadvantages associated with time series data. The data on the GPR indices are collected from the newly constructed database by Caldara and Iacoviello (2022), and the data on energy stock returns and crude oil volatility are collected from the databases of [investing.com](https://www.investing.com) and [cboe.com](https://www.cboe.com), respectively. The main analysis of the study is done with the application of the Markov Switching GARCH (MS-GARCH) model and the Fractionally Integrated GARCH (FIGARCH) model, which is supported by unit root tests and descriptive statistics for preliminary scrutiny of the dataset.

Results

Descriptive Statistics

Table 1: Descriptive Statistics of Geopolitical Risks of Select Asia-Pacific Countries

Parameter/ Countries	Australia	China	Hong Kong	India	Japan	Philippines	South Korea	Thailand	Vietnam	United States
Mean	0.1019	0.6484	0.0621	0.2014	0.2316	0.0540	0.3660	0.0329	0.0779	2.30
Median	0.0800	0.5685	0.0430	0.1880	0.188	0.0454	0.2940	0.0291	0.0602	2.15
Maximum	0.4400	1.8261	0.4193	0.5222	0.7815	0.3741	1.6190	0.2490	0.3764	6.90
Minimum	0.0000	0.2385	0.0000	0.0309	0.0463	0.0000	0.0598	0.0000	0.0000	1.25
Std. Dev.	0.0806	0.3023	0.0710	0.0992	0.1518	0.0489	0.2653	0.0327	0.0613	0.75
Skewness	1.4654	1.1486	2.6671	0.9638	1.4335	2.7135	2.0193	2.5940	2.0001	2.05
Kurtosis	5.5184	4.2349	12.2373	3.9106	4.9942	15.1928	8.5952	15.5486	8.5312	11
Jarque-Bera	97.0665	44.215	739.5844	29.544	79.2796	1157.78	309.5193	1198.5100	302.8753	548
Probability	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*

(* indicates significance at 1% level)

Table 1 demonstrates the results of the descriptive statistics of geopolitical risks for select countries in the Asia-Pacific region from January 2011 to December 2023. For all the countries, the p-values of the Jarque-Bera test are significant, indicating the non-normality of the dataset.

Table 2a: Descriptive Statistics of Energy Stock Returns

Parameter/ Variables	S&P ASX 200 (Australia)	SSE Energy (China)	Hang Seng Composite Industry (Hong Kong)	CNX Energy (India)	Nikkei 500 Electric Power (Japan)
Mean	10898.0900	1723.0100	9391.7040	13986.0400	205.7956
Median	10924.7000	1625.5000	8741.4100	12518.1000	209.9350
Maximum	16973.9000	3256.6200	16105.1100	36748	332.6200
Minimum	5879.5000	969.6700	4861.0200	6968.1000	127.4200
Std. Dev.	2386.0590	500.5848	2696.7480	6732.9440	44.2487
Skewness	0.2447	1.1804	0.6225	1.0421	0.2729
Kurtosis	2.4467	4.0768	2.5498	3.2028	2.7733
Jarque-Bera	3.5472	43.7671	11.3925	28.5050	2.2709
Probability	0.1697	0.0000*	0.0033*	0.0001*	0.3212
Observations	156	156	156	156	156

(* indicates significance at 1% level)

Table 2b: Descriptive Statistics of OVX and Energy Stock Returns

Parameter/ Variables	ACEN (Philippines)	Kospi 200 Energy & Chemicals (South Korea)	EGCO (Thailand)	VNE (Vietnam)	S&P 500 Energy (United States)	OVX
Mean	3.0681	1348.94	179.4519	6632.9030	526.8066	37.5597
Median	1.978	1289.6150	170.5000	6070.7500	533.5400	34.8800
Maximum	12.2600	2210.1000	359	16800	727.6300	170.5500
Minimum	0.8060	797.2700	84	2042.2000	216.8200	15.6100
Std. Dev.	2.6438	315.6060	59.8789	3023.8300	111.1738	16.6400
Skewness	1.5662	0.7816	0.8533	1.0224	-0.5859	3.8456
Kurtosis	4.4552	3.1266	3.5801	3.8126	3.2506	28.9670
Jarque-Bera	77.5480	15.9897	21.1213	31.4708	9.7532	4767.391
Probability	0.0000*	0.0003*	0.0002*	0.0000*	0.0100*	0.0000*

(* indicates significance at 1% level)

Table 2a and Table 2b portray the results of the descriptive statistics of the OVX and energy stock indices. In table 2a, the Jarque-Bera test confirms that all stock return indices, except for the S&P ASX 200 and Nikkei 500 Electric Power, are non-normal in nature.

Again, in table 2b, the data is noted to be non-normal.

Dickey-Fuller – Generalised Least Squares (DF-GLS) Unit Root Test**Table 3: Dickey-Fuller – Generalised Least Squares (DF-GLS) Unit Root Test Results of OVX, Geopolitical Tensions and Energy Stock Returns**

DF-GLS (ERS)					
Trend and Intercept					
Variables/Parameters	At Level		At First Difference		Stationarity Order
	t-Statistic	Critical Value	t-Statistic	Critical Value	
Hang Seng Composite Industry (Hong Kong)	-1.7585	-3.5140	-10.9876	-3.5152	I(I)
S&P ASX 200 (Australia)	-1.9228	-3.5140	-10.7011	-3.5152	I(I)
SSE Energy (China)	-1.0189	-3.5140	-10.5597	-3.5152	I(I)
CNX Energy (India)	-0.3937	-3.5140	-10.0113	-3.5152	I(I)
Nikkei 500 Electric Power (Japan)	-1.9469	-3.5140	-10.7643	-3.5152	I(I)
ACEN (Philippines)	-1.9620	-3.5140	-10.3756	-3.5152	I(I)
Kospi 200 Energy & Chemicals (South Korea)	-2.1765	-3.5140	-12.0990	-3.5152	I(I)
EGCO (Thailand)	-0.9524	-3.5140	-12.2025	-3.5152	I(I)
VNE (Vietnam)	-2.1032	-3.5140	-10.2882	-3.5152	I(I)
S&P 500 Energy (United States)	-1.7971	-3.5140	-12.1470	-3.5152	I(I)
OVX	-5.8656	-3.5140	-14.2530	-3.5152	I(0)
GPR (China)	-7.3415	-3.5140	-15.1269	-3.5152	I(0)
GPR (Hong Kong)	-3.5447	-3.5140	-12.2675	-3.5152	I(0)
GPR (India)	-7.2323	-3.5140	-12.7800	-3.5152	I(0)
GPR (Japan)	-3.5236	-3.5140	-11.8100	-3.5152	I(0)
GPR (South Korea)	-4.4782	-3.5140	-13.9429	-3.5152	I(0)
GPR (Philippines)	-10.2289	-3.5140	-14.5545	-3.5152	I(0)
GPR (Thailand)	-11.313	-3.5140	-17.3659	-3.5152	I(0)
GPR (Vietnam)	-5.0831	-3.5140	-16.9394	-3.5152	I(0)
GPR (Australia)	-2.9012	-3.5140	-3.5570	-3.5152	I(I)
GPR (United States)	-6.4609	-3.5140	-15.5449	-3.5152	I(0)

Table 3 represents the results of the unit root test proposed by Elliot, Rothenberg, and Stock, where it is observed that all the select energy stock returns are non-stationary at the level and stationary at first difference, indicating the non-existence of a unit root at first difference. However, the crude oil volatility index (OVX) is free from the unit root at the level. All the geopolitical risk indices are free from the unit root at the level, except for Australia, which had stationarity at the first difference.

Markov Switching GARCH (MS GARCH) Model**Table 4: MS GARCH Estimation Results between Energy Stock Returns and OVX**

Independent Variable: OVX					
Indices	Fitted Parameters	Estimate	Standard Error	t value	Pr(> t)
S&P ASX 200 (Australia)	α_{01}	0.1500	0.0600	2.0200	0.1100
	α_{11}	0.2100	0.0000	2.2300	0.1500
	β_1	0.5400	0.0000	5.8500	0.1600
	α_{02}	0.6200	0.0400	2.6000	0.2400
	α_{12}	0.9900	0.0000	2.7900	0.3000
	β_2	0.0000	0.0000	5.8500	0.5400
SSE Energy (China)	α_{01}	0.5400	0.0000	6.1400	0.0000*
	α_{11}	0.7200	0.1500	2.1500	0.0000*
	β_1	0.9100	0.0000	2.0100	0.0000*
	α_{02}	0.1500	0.0000	2.6000	0.0000*
	α_{12}	0.1400	0.1500	3.1400	0.0000*
	β_2	0.6400	0.1400	3.1500	0.0510**
Hang Seng Composite Industry (Hong Kong)	α_{01}	0.3200	0.0100	3.1600	0.6200
	α_{11}	0.5100	0.1700	5.8500	0.1200
	β_1	0.9800	0.2800	2.6000	0.1500
	α_{02}	0.5440	0.3400	5.1400	0.5100
	α_{12}	0.5400	0.5600	6.1400	0.3200
	β_2	0.8200	0.1500	9.1800	0.6200

CNX Energy (India)	α_{01}	0.1200	0.0120	5.1400	0.0000*
	α_{11}	0.1300	0.1250	4.2300	0.0000*
	β_1	0.1600	0.6540	2.3400	0.0000*
	α_{02}	0.1500	0.1540	5.8500	0.0000*
	α_{12}	0.1200	0.9600	2.6000	0.0310**
	β_2	0.3200	0.1500	8.5400	0.1000***
Nikkei 500 Electric Power (Japan)	α_{01}	0.3200	0.1400	6.1400	0.4100
	α_{11}	0.6100	0.2000	5.1400	0.5200
	β_1	0.8200	0.0300	2.1400	0.6300
	α_{02}	0.8700	0.0300	5.1200	0.1500
	α_{12}	2.1300	0.0100	4.1200	0.7100
	β_2	2.1400	0.0400	6.1200	0.5800
ACEN (Philippines)	α_{01}	1.2000	0.1200	3.1200	0.0000*
	α_{11}	0.6500	0.1100	5.1400	0.0000*
	β_1	0.8200	0.1200	2.1400	0.051**
	α_{02}	0.9100	0.1400	5.4100	0.0000*
	α_{12}	0.5400	0.0000	6.1200	0.0000*
	β_2	0.6100	0.0000	5.1200	0.0000*
Kospi 200 Energy & Chemicals (South Korea)	α_{01}	0.7500	0.1000	4.1200	0.0000*
	α_{11}	0.8200	0.0000	6.1200	0.0000*
	β_1	0.9100	0.1000	3.1200	0.0320**
	α_{02}	0.7400	0.5000	5.1400	0.0000*
	α_{12}	0.6100	0.4000	5.1400	0.0000*
	β_2	0.5500	0.6000	2.1400	0.0000*
EGCO (Thailand)	α_{01}	0.6300	0.0900	5.1200	0.0000*
	α_{11}	0.3600	0.0800	4.1200	0.0000*
	β_1	0.6300	0.0700	2.4200	0.0000*
	α_{02}	0.6500	0.0600	1.2300	0.0000*
	α_{12}	0.4800	0.0500	5.1200	0.0000*
	β_2	0.1700	0.1500	2.3600	0.1040***
VNE (Vietnam)	α_{01}	0.1900	0.5000	1.2300	0.0000*
	α_{11}	0.5400	0.4000	3.2100	0.0000*
	β_1	0.6100	0.3000	5.1200	0.0000*
	α_{02}	0.4700	0.4000	4.1200	0.0000*
	α_{12}	0.4800	0.4200	6.1200	0.0000*
	β_2	0.6300	0.5000	3.1200	0.0500**
S&P 500 Energy (United States)	α_{01}	0.5200	0.000	5.1400	0.0000*
	α_{11}	0.2400	0.0400	4.1200	0.0000*
	β_1	0.2900	0.000	1.6300	0.0000*
	α_{02}	0.6400	0.321	5.1400	0.0000*
	α_{12}	0.1500	0.0600	6.1300	0.0400**
	β_2	0.7400	0.0400	4.1500	0.0000*

(* indicates significance at 1% level, ** indicates significance at 5% level, *** indicates significance at 10% level)

Table 5: MS GARCH Estimation Results between Energy Stock Returns and Geopolitical Tensions

Independent Variable: GPR					
Indices	Fitted Parameters	Estimate	Standard Error	t value	Pr(> t)
S&P ASX 200 (Australia)	α_{01}	0.1700	0.000	3.1000	0.1100
	α_{11}	0.1200	0.0200	4.1200	0.1500
	β_1	0.1500	0.0000	5.1200	0.1600
	α_{02}	0.4500	0.1400	1.2300	0.8400
	α_{12}	0.2100	0.0000	2.3200	0.1100
	β_2	0.3600	0.0000	2.5100	0.2300
SSE Energy (China)	α_{01}	0.2100	0.0200	2.6100	0.0000*
	α_{11}	0.5400	0.0200	2.5400	0.0000*
	β_1	0.8900	0.0500	2.1500	0.0000*
	α_{02}	0.1000	0.1200	9.1200	0.0000*
	α_{12}	0.1300	0.1890	1.1400	0.0000*
	β_2	0.0100	0.0200	1.4100	0.0000*
Hang Seng Composite Industry (Hong Kong)	α_{01}	0.1500	0.0600	4.1200	0.1400
	α_{11}	0.1600	0.1200	4.1300	0.2500

	β_1	0.8500	0.3500	2.1500	0.3200
	α_{02}	0.9400	0.0100	5.1200	0.1200
	α_{12}	0.4700	0.0800	2.3600	0.5200
	β_2	0.2300	0.1000	2.1400	0.1300
CNX Energy (India)	α_{01}	0.2400	0.1200	2.4500	0.0500**
	α_{11}	0.5100	0.1500	2.7800	0.0740***
	β_1	0.2600	0.0600	7.1200	0.0000*
	α_{02}	0.9400	0.0700	5.1600	0.0000*
	α_{12}	0.5600	0.6100	2.3000	0.0000*
	β_2	0.3400	0.5100	3.1600	0.0000*
Nikkei 500 Electric Power (Japan)	α_{01}	0.2100	0.1500	2.0300	0.0000*
	α_{11}	0.3600	0.0120	3.1200	0.0000*
	β_1	0.3600	0.1400	3.5600	0.0000*
	α_{02}	0.6500	0.0150	3.8900	0.0000*
	α_{12}	0.7800	0.0800	3.6500	0.0000*
	β_2	0.8500	0.0900	3.6500	0.0000*
ACEN (Philippines)	α_{01}	0.7400	0.0800	3.4500	0.1000***
	α_{11}	0.1200	0.0800	1.1200	0.0750***
	β_1	0.5400	0.0400	1.1600	0.0000*
	α_{02}	0.2100	0.0150	4.1200	0.0000*
	α_{12}	0.3100	0.0600	4.1500	0.0000*
	β_2	0.6200	0.0210	5.6200	0.0000*
Kospi 200 Energy & Chemicals (South Korea)	α_{01}	0.5100	0.0350	2.3600	0.0000*
	α_{11}	0.4500	0.0150	2.5900	0.0000*
	β_1	0.2100	0.0170	3.1400	0.0000*
	α_{02}	0.3100	0.0820	2.5600	0.0000*
	α_{12}	0.5100	0.0500	1.1200	0.0090*
	β_2	0.2100	0.0600	1.5400	0.0000*
EGCO (Thailand)	α_{01}	0.6200	0.0400	1.6500	0.0000*
	α_{11}	0.5100	0.1200	1.9600	0.0000*
	β_1	0.6300	0.0210	1.6200	0.0000*
	α_{02}	0.3200	0.2100	1.4500	0.0000*
	α_{12}	0.4500	0.3600	1.7800	0.0000*
	β_2	0.6100	0.1520	1.6200	0.0000*
VNE (Vietnam)	α_{01}	0.5200	0.0100	1.5600	0.1250
	α_{11}	0.3100	0.0100	6.3200	0.1010
	β_1	0.2500	0.0500	2.3200	0.4200
	α_{02}	0.6200	0.0650	3.2600	0.1500
	α_{12}	0.5100	0.0450	3.5600	0.1260
	β_2	0.6400	0.4500	4.1200	0.2400
S&P 500 Energy (United States)	α_{01}	0.5200	0.2300	4.1600	0.0000*
	α_{11}	0.3100	0.1500	1.8900	0.0000*
	β_1	0.6200	0.0800	1.7400	0.0000*
	α_{02}	0.5600	0.8000	1.5600	0.0000*
	α_{12}	0.3200	0.1700	1.4500	0.0000*
	β_2	0.3200	0.1500	1.1200	0.0000*

(* indicates significance at 1% level, ** indicates significance at 5% level, *** indicates significance at 10% level)

Table 4 showcases MS GARCH estimation results between the energy stock returns and the OVX during the study period. It is observed that, except for Australia, Japan, and Hong Kong, all other countries demonstrate significant volatility and volatility clustering in their energy stock returns across the different regimes during the study period. Again, table 5 depicts the MS-GARCH estimation results between energy stock returns and geopolitical risks of the select countries. It is observed that, except in Australia, Hong Kong, and Vietnam, all other countries are noted to be affected significantly due to the presence of volatility and volatility clustering from geopolitical risks.

Since it is observed that countries like Australia, Japan, Vietnam, and Hong Kong demonstrated no effect of volatility or volatility clustering, it is further decided to apply the FIGARCH model to study the presence of volatility along with the long-memory effect.

Fractionally Integrated GARCH (FIGARCH) (1,1,1) Model**Table 6: FIGARCH Estimation Results between Energy Stock Returns and OVX**

FIGARCH (1,1,1)								
Independent Variable: OVX								
Dependent Variables	Constant (ω)	p-value	ARCH (α)	p-value	GARCH (β)	p-value	FIGARCH (δ)	p-value
S&P ASX 200 (Australia)	1986431	0.0374**	-0.2936	0.0872***	0.6833	0.0164*	1.2508	0.0040*
SSE Energy (China)	5391.137	0.8045	0.4631	0.8313	0.4812	0.8206	1.0318	0.000*
Hang Seng Composite Industry (Hong Kong)	2138465	0.0259**	0.5161	0.0701***	0.2701	0.0601***	0.8321	0.0274**
CNX Energy (India)	101108.3	0.5574	0.1901	0.7380	0.9446	0.0000*	1.1800	0.1145
Nikkei 500 Electric Power (Japan)	1594.604	0.0026*	0.4236	0.2599	0.1427	0.4497	0.8134	0.0414**
ACEN (Philippines)	0.0010	0.9694	0.5539	0.2822	0.2261	0.3232	0.6231	0.4048
KOSPI 200 Energy & Chemicals (South Korea)	875.6915	0.0979***	0.5188	0.0003*	0.6845	0.0000*	1.0831	0.0000*
EGCO (Thailand)	166.16930	0.3738	0.1947	0.7340	0.5240	0.3043	1.0542	0.0000*
VNE (Vietnam)	129652.3	0.1021***	0.7647	0.0024*	0.3034	0.5501	0.4989	0.5467
S&P 500 Energy (United States)	0.0002	0.5988	0.3416	0.4978	0.8124	0.0256**	0.9278	0.2795

(* indicates significance at 1% level, ** indicates significance at 5% level, *** indicates significance at 10% level)

Here, table 6 represents the FIGARCH model between the energy stock returns and the crude oil volatility index (OVX) during the study period from January 2011 to December 2023. The ARCH term denotes the existence of volatility within the select energy stock returns, denoted by α , whereas the GARCH term represents the variance in volatility among the select energy stock returns, denoted by β . The FIGARCH is represented using δ , which highlights the presence of long-memory effects. The results for Australia, Hong Kong, and South Korea show the presence of volatility, volatility clustering, and long-memory effects within their energy stock returns. Whereas, for China, Japan, and Thailand, only long-memory effects are present in their energy stock returns as compared to India and the United States, where only volatility clustering can be found. Vietnam suffers only from volatility. However, the Philippines is not affected by either of the volatilities from the crude oil volatility index.

The conditional variance of the FIGARCH (1,1,1) estimation between energy stock returns and the crude oil volatility index is graphically represented below:

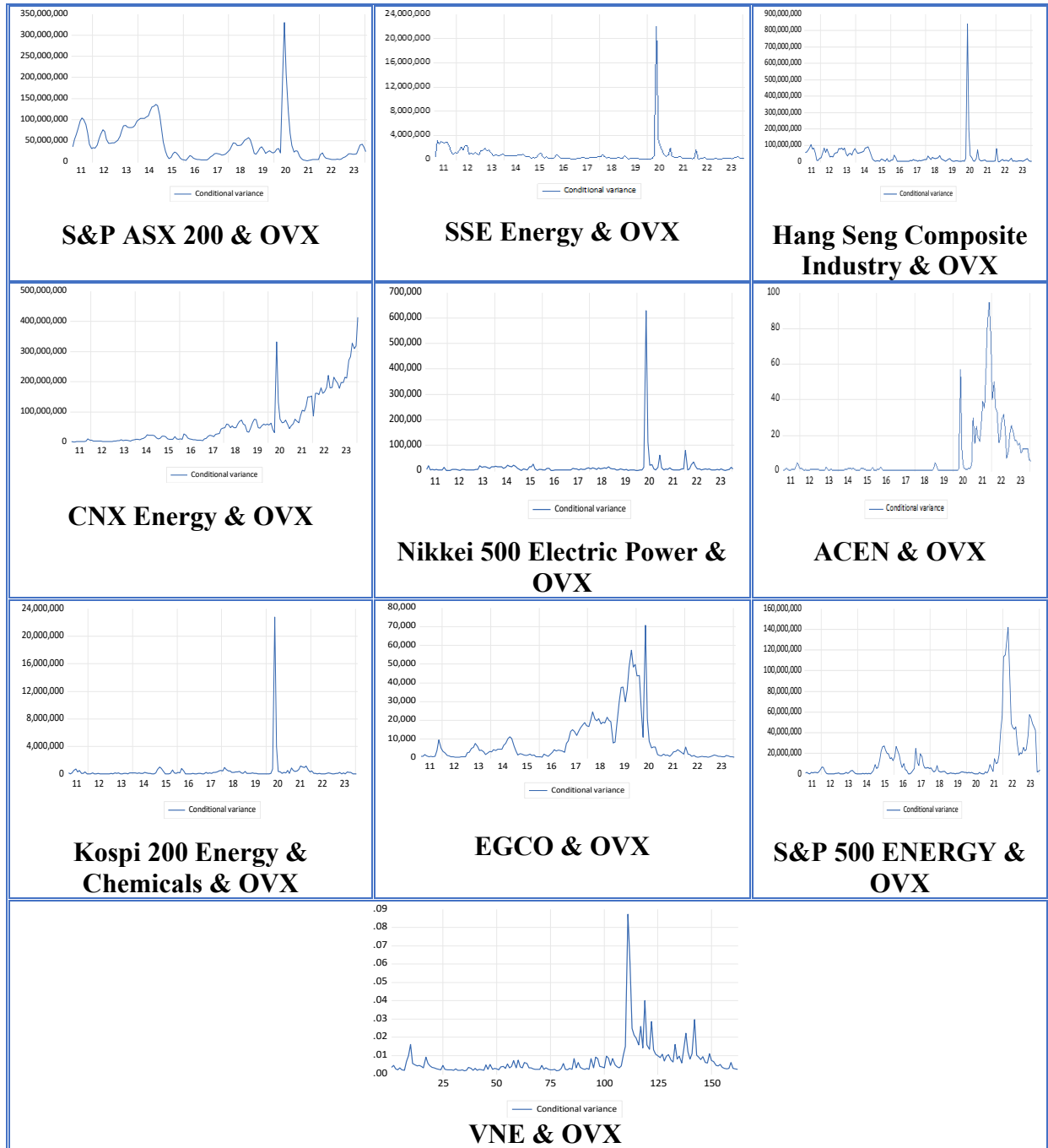


Figure 1: Graphical Representation of FIGARCH Estimation Results between Energy Stock Returns and OVX

Table 7: FIGARCH Estimation Results between Energy Stock Returns and Geo-Political Risks

FIGARCH (1,1,1)								
Independent Variable: GPR								
Dependent Variables	Constant (ω)	p-value	ARCH (α)	p-value	GARCH (β)	p-value	FIGARCH (δ)	p-value
S&P ASX 200 (Australia)	0.0015	0.1096***	0.4191	0.3896	0.2036	0.6549	0.1096	0.1212
SSE Energy (China)	0.0004	0.4219	0.03	0.8802	0.6198	0.0776***	0.6292	0.0818***
Hang Seng Composite Industry (Hong Kong)	0.0109	0.6971	0.8402	0.0001*	0.4194	0.2817	-0.3806	0.4817
CNX Energy (India)	0.0080	0.0368**	-0.3188	0.324	-0.4986	0.0703***	-0.0770	0.1887

Nikkei 500 Electric Power (Japan)	-0.0004	0.8772	0.6463	0.2214	0.6054	0.2617	0.1027	0.069***
ACEN (Philippines)	0.0010	0.3309	-0.0688	0.7919	0.8154	0.0000*	1.5987	0.0004*
Kospi 200 Energy & Chemicals (South Korea)	0.0021	0.2753	0.9247	0.0000*	0.6631	0.0000*	-0.1516	0.3315
EGCO (Thailand)	0.0006	0.4511	0.8690	0.000*	0.6519	0.0013*	-0.0447	0.8614
VNE (Vietnam)	0.0263	0.2175	0.8111	0.000*	0.5196	0.0032*	-0.2648	0.1362
S&P 500 Energy (USA)	0.0008	0.2554	0.3583	0.5735	0.2368	0.7009	0.3225	0.1282

(* indicates significance at 1% level, ** indicates significance at 5% level, *** indicates significance at 10% level)

Table 7 provides the results of the FIGARCH (1,1,1) estimation between energy stock returns and the geopolitical risks of the select Asia-Pacific countries. It is observed that Australia and the United States do not suffer from either volatility. China, India, and the Philippines suffer from volatility clustering and long-memory effects. Hong Kong suffers only from volatility. Japan suffers only from long-memory effects. South Korea, Thailand, and Vietnam suffer from both volatility and volatility clustering during the study period. The conditional volatility between energy stock returns and geopolitical risks for the selected countries is graphically demonstrated in Figure 2 below:

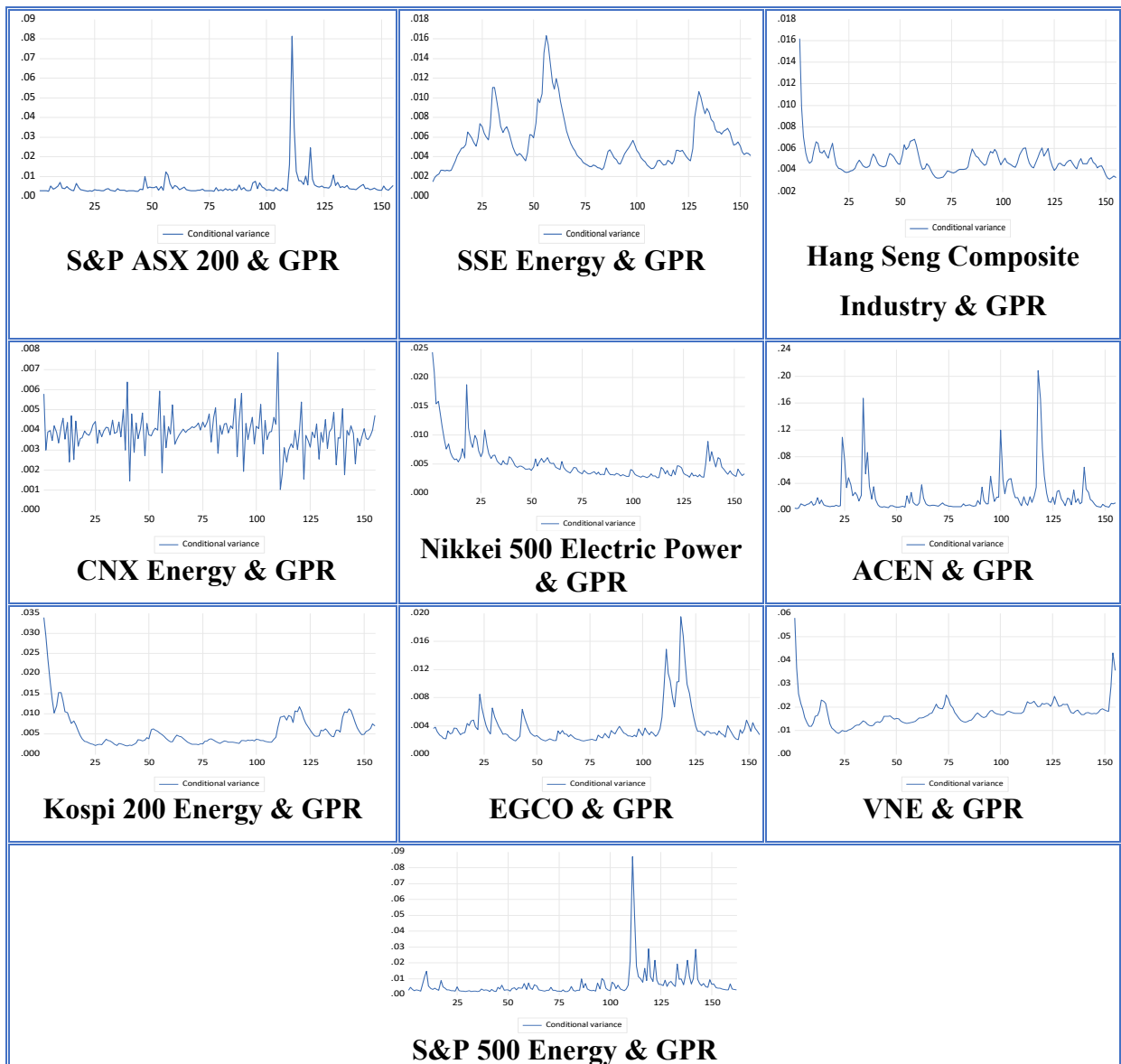


Figure 2: Graphical Representation of FIGARCH Estimation Results between Energy Stock Returns and GPR

Novelty of the Study

This study is unique in that it takes an integrated, region-specific approach to comprehending how global oil price volatility and geopolitical risk interact to affect energy sector returns in the Asia-Pacific area. This study stands out from previous research because it simultaneously evaluates both geopolitical risk and oil market uncertainty using sophisticated econometric techniques that capture regime shifts, non-linear dynamics, and cross-market heterogeneity. The study offers new insights into how external shocks spread differentially across net-oil-importing and net-oil-exporting economies by concentrating on Asia-Pacific markets, one of the world's fastest-growing energy-consuming areas but underrepresented in empirical literature. The identification of separate high- and low-volatility regimes and their asymmetric effects on returns is made possible by the use of time-varying and regime-dependent models, namely, Markov Switching GARCH-type volatility models and connectedness frameworks. This method assists in identifying behavioral variations in investor reactions during times of elevated geopolitical tensions compared to stable periods. The study also presents comparative evidence from several Asia-Pacific markets, revealing structural variations influenced by market maturity, policy frameworks, and energy reliance. There is a lack of geographically specific results because most research focuses on the US, Europe, or the global oil industry as a whole in the preceding studies. The present study adds fresh empirical data that advances our understanding of energy finance worldwide by emphasising cross-national differences and particular vulnerabilities.

Discussion

The findings for Australia reveal no significant evidence of volatility effects, volatility clustering, or long-memory effects. In comparison to many other regions, Australia enjoys a reasonably stable geopolitical environment. Coal, natural gas, oil, and renewable energy sources are all part of Australia's extremely diversified energy portfolio. The energy sector of Australia A strong and well-established regulatory framework governs Australia's energy sector. by a strong and well-established regulatory framework. Energy firms benefit from predictable operating environments and reduced uncertainty brought about by clear and stable rules, which also lessen the influence of external geopolitical shocks on volatility. Australia is geographically shielded from the direct effects of regional wars because of its distance from important geopolitical hotspots like the Middle East, the Indo-Pacific region, and the South China Sea. Moreover, Australia possesses a robust economy and a stable political system, which lowers the probability of volatility and increases the persistence in stock returns by creating a stable environment for commercial activities, particularly for the energy industries. Again, strong economic alliances and trade ties are maintained by Australia with major world powers such as the US, China, and Japan, which act as a protective shield for Australia's energy industries against unfavourable geopolitical developments, resulting in lower volatility and steadier stock returns. It is also found that to protect themselves from possible geopolitical threats, Australian energy industries frequently use advanced risk management techniques. A more consistent volatility pattern and the lack of notable ARCH, GARCH, and FIGARCH effects are the results of effective risk management, which lessens the effect of geopolitical shocks on stock returns. Additionally, Australia produces a lot of natural gas, coal, and increasingly renewable energy, making it a net exporter of energy. Energy independence results in steadier returns on energy stocks by lowering exposure to geopolitical risks' effects on the world energy market (Brik & Ouakdi, 2024).

Australia's combined role as a significant energy exporter and a price-taker in international oil markets shapes its energy sector returns in a unique way. Export demand: Geopolitical uncertainties, particularly tensions with key Asian trading partners like China, heavily impact export demand. Geopolitical uncertainties, particularly tensions with important Asian trading partners like China, significantly impact export demand. Trade tensions or political conflicts with China may result in lower exports of coal, which might cause negative shocks to energy stock returns. On the other hand, rises in global oil prices brought on by Middle Eastern wars typically result in higher profits for Australian energy companies, which improves stock performance. But asymmetry is brought about by volatility. Price increases boost profitability, but severe drops in oil prices lower investor confidence and reduce export earnings. Additionally, by making exports more competitive and stabilising profits, exchange

rate fluctuations, particularly the depreciation of the Australian dollar during times of global uncertainty, can somewhat protect exporters. Political risk in the home country is also important. Fossil fuel companies face uncertainty as a result of climate policies and the shift to renewable energy, which increases the impact of global oil shocks on market volatility. Australia's energy sector is therefore more susceptible to geopolitical upheavals that impact trade flows, particularly in the Asia-Pacific area, but it also shows positive sensitivity to increases in oil prices (Zadmehr *et al.*, 2026).

Being the top oil importer in the world has a significant impact on China's energy sector. Conflicts in oil-producing regions and other rising geopolitical tensions usually result in higher oil prices, which raise input costs for Chinese companies and reduce profit margins. The energy sector's returns suffer as a result, particularly for downstream sectors like petrochemicals and refining. Furthermore, access to energy resources, technology, and international financing markets is impacted by geopolitical threats like trade conflicts between the United States and China. Sanctions or limitations on the transfer of energy-related technologies might reduce operational effectiveness and raise stock performance uncertainty (Huang *et al.*, 2025).

Due to its open financial system and reliance on imported energy, Hong Kong's energy sector is comparatively tiny but extremely vulnerable. Rather than directly affecting energy output, geopolitical threats mostly impact Hong Kong through financial market channels. Utility companies and transportation-related energy industries are impacted by the volatility of global oil prices, as higher oil prices raise operating expenses. However, investor sentiment has a greater influence. Due to its status as a major global financial centre, Hong Kong is subject to capital flow volatility amid geopolitical unrest, which exacerbates stock market swings, particularly those of energy-related stocks (Wong, 2026).

Conflicts in the Middle East and other geopolitical issues frequently result in higher oil prices, which can strengthen U.S. energy equities. Additionally, policy choices that impact global supply dynamics, such as sanctions and the release of strategic reserves, have an impact on the U.S. energy sector. Energy stock volatility is greatly impacted by global risk perception due to financial market integration. Technological advances like shale extraction have made us less dependent on imports, which has made us more resilient (Jasiūnas *et al.*, 2021). Rapid expansion and rising energy demand, along with a partial reliance on imported oil, define Vietnam's energy sector. Increased expenses for domestic businesses due to rising oil prices have a detrimental impact on stock returns and profitability. Investor confidence and oil exploration activities are greatly impacted by geopolitical uncertainties in the South China Sea (Koirala *et al.*, 2025). Conflicts over maritime borders can raise operational risks and cause project delays.

Limitations and Further Scope

The conclusions may not be as applicable to other locations with various institutional frameworks, energy policies, and market structures because the analysis is limited to certain economies in the Asia-Pacific energy sector. While other significant macroeconomic and financial factors such as exchange rate fluctuations, interest rates, inflation, renewable energy transition policies, carbon pricing, and economic policy uncertainty are not specifically included in the empirical framework, the study mainly concentrates on the effects of geopolitical risk and global oil price volatility. Different enterprises and subsectors, such as oil and gas producers, renewable energy companies, and electrical utilities, may respond differently when using aggregate energy sector indexes. Furthermore, the research is based on historical data, which suggests that these correlations may change over time due to structural fractures brought about by exceptional occurrences like the COVID-19 pandemic, the conflict between Russia and Ukraine, or significant policy interventions. The chosen econometric approach may not adequately account for non-linear behavioural reactions or the causal mechanisms underpinning geopolitical shocks and swings in the oil market, but it does capture statistical reliance and dynamic interactions.

The scope of this study can be expanded in a number of significant ways by future research. To enable a thorough cross-regional evaluation of the transmission effects of geopolitical risk and oil

price volatility on energy sector returns, researchers may expand the analysis by adding more established and emerging regions. To create a more comprehensive picture of the dynamics of the energy market, future research may also take into account other sources of uncertainty, such as supply chain interruptions, financial stress indices, economic policy uncertainty, and climate risk. Disaggregated analysis at the firm level may show whether a company's size, ownership structure, or business style affects how sensitive it is to geopolitical events.

Conclusion

Over the last few decades, the Asia-Pacific region has emerged as a central hub for the global economy. This area is home to some of the world's fastest-growing economies, such as India, China, Indonesia, the Philippines, and Vietnam, among others. Additionally, it encompasses several highly populated nations, notably India and China, which together account for nearly sixty per cent of the global population. This demographic factor underscores the region's importance as a potential consumer market. Furthermore, from a strategic perspective, the Asia-Pacific region is crucial to the world economy, as it encompasses key trade routes, including the Malacca Strait, the South China Sea, and initiatives like the Belt and Road Initiative (BRI).

Against this backdrop, the study aims to investigate the impact of geopolitical risks and fluctuations in global oil price volatility (OVX) on the energy sector returns of countries within the strategically important Asia-Pacific region, which holds considerable significance in both geopolitical and geo-economic contexts. The fundamental analysis of the research is conducted utilising the MS-GARCH model alongside the FIGARCH model, which showcases some interesting findings.

The results of the MS-GARCH estimation indicate that, with the exception of Australia, Hong Kong, and Vietnam, all other nations experience significant impacts stemming from the volatility and volatility clustering associated with geopolitical risks. Again, in terms of the OVX and energy stock returns, the MS-GARCH results indicate that, with the exception of Australia, Japan, and Hong Kong, all other countries exhibit notable volatility and volatility clustering in their energy stock returns in relation to OVX throughout the various regimes analysed during the study period. The estimation results from the FIGARCH model indicate a notable relationship between energy stock returns and geopolitical risks, revealing that China, India, and the Philippines experience both volatility clustering and long-memory effects. In contrast, the volatility observed in Hong Kong is unique to that region, while Japan exhibits only long-memory effects without significant volatility. Additionally, the study reveals that both volatility and volatility clustering affect South Korea, Thailand, and Vietnam. The study indicates that both volatility and volatility clustering significantly impact South Korea, Thailand, and Vietnam throughout its duration.

Given the region's heavy reliance on imported fossil fuels and growing integration with global commodity dynamics, geopolitical shocks and the ensuing vulnerability of the Asia-Pacific energy markets have far-reaching practical implications for investors, regulators, and energy-market participants. Increased geopolitical tensions, such as conflicts in the Middle East, the strategic competition between the US and China, disruptions to maritime trade routes, and instability in important oil-producing nations, immediately translate into more volatility in returns for investors in the energy industry. More sophisticated risk management techniques are therefore required, such as cross-asset diversification, hedging with derivative instruments, and incorporating oil volatility and geopolitical risk indicators into investment models. Investors cannot rely on short-term corrections due to the persistent character of such shocks, which is represented in long-memory volatility patterns displayed by FIGARCH-type models. Instead, they must proactively anticipate prolonged uncertainty. Investors are rapidly directing capital toward renewable and low-carbon energy companies throughout the Asia-Pacific region as volatility spreads to the equities, currency, and commodity markets.

Conflict of Interest

The authors declare no conflict of interest

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AI Assistance Declaration

No assistance was taken from AI in the completion of the study

Author Credit Statement

B.B.: Conceptualisation, Formal Analysis, Resources, Reviewing, Editing, and Visualisation, Supervision and Project Administration; R.G.: Methodology, Software, Investigation, Original Draft Preparation; D.D.: Validation, Data Curation.

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