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Return and Volatility Spillovers of Asian Pacific Stock Markets' Energy Indices

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ABSTRACT

The aim of the study was to investigate the presence of volatility among the Energy Indices of Asia Pacific Stock Markets. To test the volatility among the daily returns of Energy Indices of Asia Pacific Stock Markets, the study selected five sample Asian Pacific stock markets' Energy Indices on the basis of availability of data. The findings of descriptive statistics and the ADF Test revealed, that the daily returns of the sample energy indices of Asian Pacific stock markets were not normally distributed and achieved stationarity at level difference, over the research period. Hence the data may be used for additional analysis. The data were then analysed, by using the GARCH (1,1) model to assess the considerable volatility of daily returns of sample energy indices and the study, which revealed that during the study period, all of the sample energy indices were volatile.

Keywords: Asian Pacific Stock Market, Energy Index, GARCH (1,1), Volatility Spillovers
JEL Classifications: C50;G10;Q40

1. INTRODUCTION

Volatility has evolved as an importance factor in derivative pricing and hedging, risk management, and portfolio management. Studying and predicting volatility is a significant and difficult aspect of finance research (Balaji et al., 2022). Financial market volatility has affected network connections, especially during the COVID-19 outbreak (Wang et al., 2022). Carbon emission futures are the volatility transmitter while green bonds are the volatility beneficiary. International political, economic, and other events have an effect on the overall dynamic connection (Zhang et al., 2022). Oil and gold price variations have an opposite effect on global clean energy stock returns, during bullish market sentiments (Fu et al., 2022). Climate policy has a greater ability to forecast renewable energy volatility, provides a novel perspective for accurate renewable energy volatility prediction, and provides a reliable guarantee for the long-term growth of the energy and financial markets (Liang et al., 2022). The disparity in the estimated effect of positive and negative oil shocks on the volatility of green investments, registered asymmetry effect (OlaOluwa et al., 2022). As investor concerns about environmental sustainability drive them to invest in environmentally sustainable companies, this study may appeal to shareholders, wishing to reduce carbon emissions in their portfolios, by owning renewable energy assets (Dutta et al., 2022). At the same time, investors may continue holding the assets despite their high risk due to the fact that there are risk-return trade-offs (Babu et al, 2022a). Both investors and manufacturers took diverse investment decisions, based on the crude oil market's response to various uncertain measures, and employed diversified investment strategies before and during the COVID-19 pandemic (Niu et al., 2022). It is reasonable to believe that clean energy, oil, and carbon pricing, which are critical areas of discussion, under the world's current efforts at climate change (Mohammed et al., 2022). The extent of shock spillovers from oil price volatility to renewable energy sectors was larger in the medium and long run (Urom et al., 2022). During the years 2018 and 2019, Oil and Natural Gas Corporation Ltd's stock price had only moderate fluctuation (Babu et al., 2022b). Forecasting the total network connectedness requires information on the transmitted returns and volatility spillover from markets (Ghaemi et al., 2022). Energy inflation should be regulated, globalization should be revised and human capital like education and technical skills should be enhanced, in order to optimize natural resource (Liang et al., 2022). Agricultural commodities' prices are positively impacted by fluctuations in energy prices. It is, therefore, imperative that climate change be considered trying to mitigate food insecurity in Iran's provinces (Kargar Dehbidi et al., 2022). Clean energy, realized volatility is successfully predicted by both uncertainty indices and global economic conditions. A shrinkage method consistently outperforms a dimensionality reduction method and a combination forecast method, with respect to clean energy and natural gas (Wang et al., 2022). It has been found that oil volatility causes spillovers to US stock sectors, with the effect being especially pronounced in high volatility regimes. Even though the energy sector accounts for only a small portion of the US stock market, its network connectedness is quite significant (Hernandez et al., 2022).

In the non-price-regulated scenario, energy price fluctuations use a high level of conduction efficiency for influencing the general price index. The effect of fluctuating energy prices shows clear hysteresis, and the lag time of the transmission effect on PPI is larger than that on CPI (Xu et al., 2021). Green returns have been enhanced, especially after the Paris Agreement Concerning the sector's uncertainty and STR model is employed, to assess and quantify the influence of fluctuation on the nonlinear behaviour of clean energy ETFs (Fahmy, 2021). The sharp difference may be due to the fact that increased energy prices might harm the profitability of S&P 500 corporations while not affecting GCE and ECO enterprises (Kanamura, 2019). Prevention of possible risk spillover among carbon and energy markets, might help to construct China's united carbon market and prevent systematic financial problems in the energy market (Qiao et al., 2021). The effectiveness of clean energy asset allocating strategies, as well as the heterogeneous diversification advantages among clean energy stocks sub-sectors, report substantial implications for shareholders, establishing clean energy portfolios to achieve investment objectives (Kuang, 2021). Clean energy shares are more than the oil price when the oil price is low by using VaR model (Tan et al., 2021). There is a negative association between oil volatility spillover shocks and stock returns in specific stock markets, particularly during covid-19 downturns (Boateng et al., 2021).

The fluctuation of the rare earth stock index is highly correlated with the price of crude oil (Song et al., 2021). The volatility spillover interactions in the renewable energy market economy are much more complicated among two markets (Zhou et al., 2021). The energy sector plays a major role in spillover transfer to the other market segments through volatility (Ben Ameur et al., 2021). At various time periods and frequency, commodity price indices considerably influenced the energy price indices (Kirikkaleli and Güngör, 2021). Farmers can protect themselves against unfavorable price changes in the future with the help of commodity futures market (Srinivasan et al., 2022). Only at the lower quantiles, throughout the same timeframes, does the volatility study reveal a strong bidirectional correlation among oil price volatility and renewable energy stock volatility (Hammoudeh et al., 2021). Volatility spillover from the natural gas futures market has significantly decreased, but volatility has not been decoupled from the crude oil, gasoline and heating oil future markets after the U.S. shale gas revolution (Gong et al., 2021).

Ever since COVID-19 pandemic's emergence, the price of oil and other commodities has changed drastically. In order to more effectively reduce moral hazard and preserve financial prosperity, it is essential to investigate the reasons behind price variations and comprehend the origin and route of risk transmission. Szczygielski et al. (2022) devised a new "overall impact of uncertainty" measure and explained by using a natural phenomenon analogy of the overall impact of a rainstorm, to gauge the magnitude and intensity of the impact of uncertainty on energy sector returns and come to the conclusion that COVID-19 linked uncertainty exercised a larger impact on the energy industries of nations. Curto and Serrasqueiro (2022) discovered an increase in unpredictability after February 2020. Energy, grain, and textiles are net beneficiaries of risk spill over among China's commodities, whereas chemical goods and metals are net hazard exporters, according to Shen et al. (2022). Businesses have favourable risk spill over effects on textiles and metals, two worldwide goods. China's commodities were the primary exporters of risk contagion even during early stages of the outbreak. The geopolitical risk index appears to be better in predicting long-term crude oil fluctuation than some other ambiguity indicators, and it also improves performance than other uncertainty indicators in predicting, The U.S. petroleum market equities liquidity tracker has the finest predictive ability, to predict the fluctuation of the price of oil, during non-crisis, and economic growth periods (Li et al., 2022). Wang et al., (2022) discovered that clean energy - realised volatility could be accurately predicted by both uncertainty indicators and global economic situations. For renewable power and natural gas, contraction approaches regularly outperform dimension reduction methods and combination forecast methods. There is a statistically significant non-linear relationship among the markets under study and all energy metals, except Cobalt, have a significant positive linkage with clean energy stock indices and such associations do hold during episodes of high volatility (Gustafsson et al., 2022). In contrast to volatility, which showed up at lesser frequencies, the overall economic instability spill over to the return of the three renewable energy stocks, was concentrated at high frequency (Liu et al., 2021). The markets for clean energy and oil are both subject to spill over instability. It has been discovered that the oil market is a net recipient of volatility, and that volatility overflow is larger in times of extreme positive and negative stress than in periods of moderate shock (Attarzadeh and Balcilar, 2022). In the long run, the impact of crude oil price fluctuation on Turkey's producer and consumer price indices is not equal. Consumer price index and producer price index are more affected over the long term by rising world oil prices rather than by falling prices (Altunöz, 2022).

The aim of the study was to investigate the volatility among the Energy Indices of Asia Pacific Stock Markets. For analysing the aim of the study, following objectives were formulated.

- To test the normality and stationarity of daily returns of sample energy indices of Asia Pacific Stock Markets.
- To analyse the significant volatility of daily returns of sample energy indices of Asia Pacific Stock Markets.
- To explore the causal relationship among daily returns of sample Energy indices of Asia Pacific Stock Markets.

2. METHODOLOGY AND DATA DESCRIPTION

To test the volatility among the daily returns of energy indices of Asia Pacific Stock Markets, the study selected five sample Asian Pacific stock markets' energy indices, on the basis of availability of data. The list of the sample stock markets and energy indices are shown in the Table 1. In view of economic reforms and COVID19, the study selected the sample period from January 2017 to December 2021 and the corresponding data (Daily Prices) of sample energy indices were collected from the Yahoo Finance and Investing.com, for the period of January 2017 to December 2021. At the outset, logarithmic daily returns were calculated, by the following formula:

Table 1: List of sample Asian pacific stock markets' energy indices

Sample country	Sample stock markets	Sample indices
India	National Stock Exchange of India Ltd.	NIFTY ENERGY
New Zealand	NZX, New Zealand's Exchange	S&P NZX ENERGY CAPITAL
Australia	Australian Securities Exchange Ltd.	S&P ASX 200 ENERGY
China	Shanghai Stock Exchange	SSE ENERGY
Japan	Tokyo Stock Exchange	TOKYO SE TOPIX17 ENERGY

$$R_t = \ln \frac{P_t}{P_{t-1}}$$

where R denotes the return during the "t" time period Pt denotes the price of the stock at the end of the time period; Pt-1 denotes the price of the stock at the start of the time period; and ln denotes the natural log.

The study used the following statistical tools to testing the hypotheses of the study

a) Descriptive Statistics – it was used for describe the daily returns of the sample energy indices of Asia Pacific Stock Markets.
b) Augmented Dickey-Fuller (ADF) Test was used to examine the unit root of the daily returns of the sample energy indices of Asia Pacific Stock Markets.
c) GARCH (1, 1) Model was used for testing the volatility of sample energy indices of Asia Pacific Stock Markets.
d) Granger Causality Test was used for testing the causal relationship among the sample Energy indices of Asia Pacific Stock Markets.

3. PRELIMINARY ANALYSIS AND EMPIRICAL RESULTS

The Table 2 give the description information of sample asian pacific nations, energy stock indices. As can be seen from the results, the mean values for all sample countries, energy indices were negative except Nifty Energy Index. The standard deviation implied that the selected variables were unconditionally volatile. Further, the daily returns of the sample indices were negatively skewed, during the study period, it implying that negative values or losses were much more likely (i.e., the left tail particularly extreme). The leptokurtic feature of return distribution was very salient in the sample. Based on the Jarque-Bera Test, the daily returns of the sample energy indices were not normally distributed, during the study period.

To test the unit root of the daily returns of the sample asian pacific countries' energy indices, the Augmented Dickey Fuller Test was used. The corresponding results are shown in Table 3. Each energy index of Asian Pacific Countries' Stock Markets attained stationarity at level difference (i.e. This means that the daily returns of sample Asian Pacific Countries' emerging indices were I(0) process). The Q-Q Plots (Figure 1) also confirmed the

Table 2: Distribution statistics of the daily returns of Asian pacific stock markets' energy indices

	NIFTY ENERGY	S&P NZX ENERGY CAPITAL	S&P ASX 200 ENERGY	SSE ENERGY	TOKYO SE TOPIX17 ENERGY
Mean	0.000636	−0.000628	−0.000114	−0.0000748	−0.0000963
SD	0.013929	0.015229	0.017871	0.014917	0.016905
Skewness	−0.716323	−0.547663	−2.029084	−0.231698	−0.184925
Kurtosis	11.28109	18.47922	28.35884	6.513156	5.385965
Jarque-Bera	3637.389	12702.51	34790.71	636.2213	296.3388
Probability	0.000	0.000	0.000	0.000	0.000

Figure 1: Q-Q Plots for daily returns of Asian pacific stock markets' energy indices

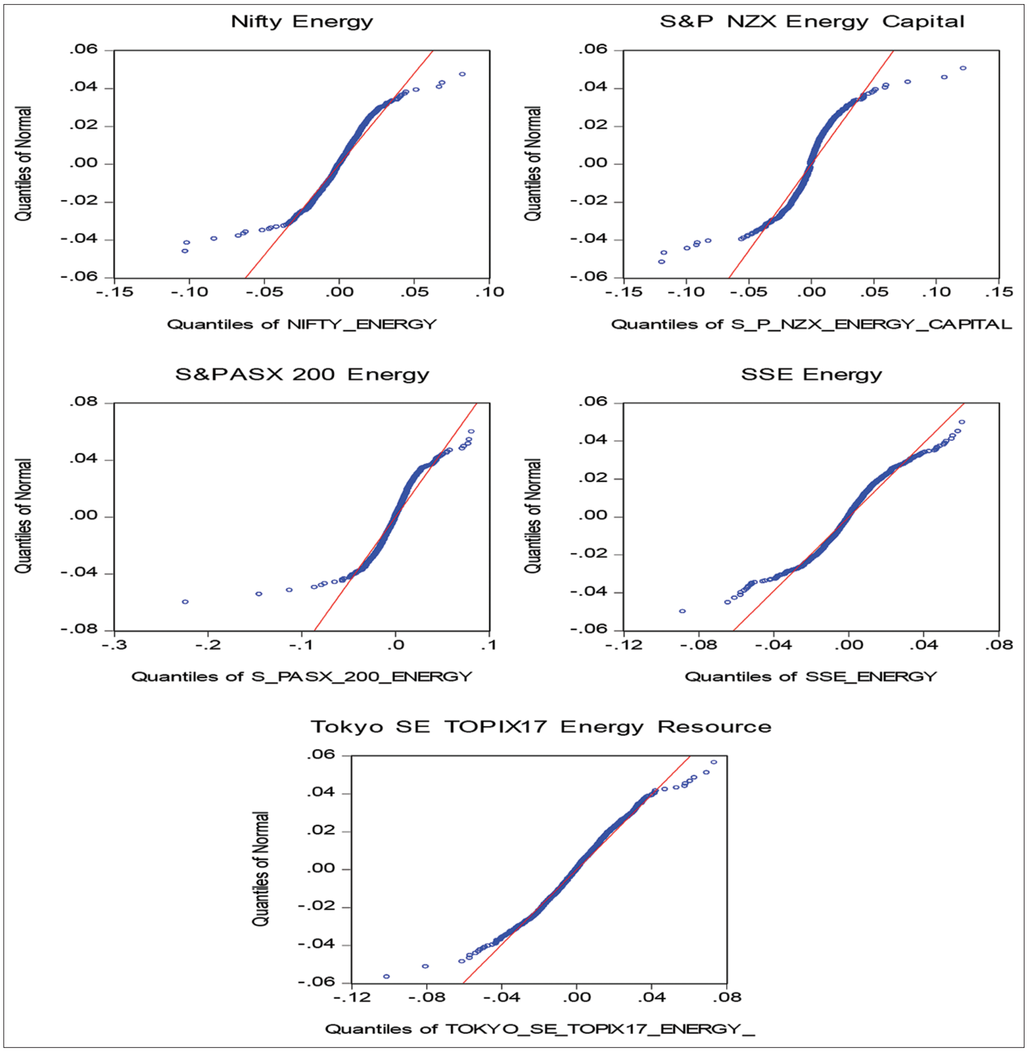


Table 3: Unit root test of the daily returns of Asian pacific stock markets' energy indices

	Augmented Dickey-Fuller test statistic	Test critical values			Prob.
	t-Statistic	1% level	5% level	10% level	
NIFTY ENERGY	−35.63274	−3.43543	−2.86367	−2.56796	0.000
S&P NZX ENERGY CAPITAL	−34.02502	−3.43531	−2.86362	−2.56793	0.000
S&P ASX 200 ENERGY	−36.39551	−3.43531	−2.86362	−2.56793	0.000
SSE ENERGY	−35.92175	−3.43552	−2.86371	−2.56798	0.000
TOKYO SE TOPIX17 ENERGY	−33.47755	−3.4355	−2.8637	−2.56797	0.000

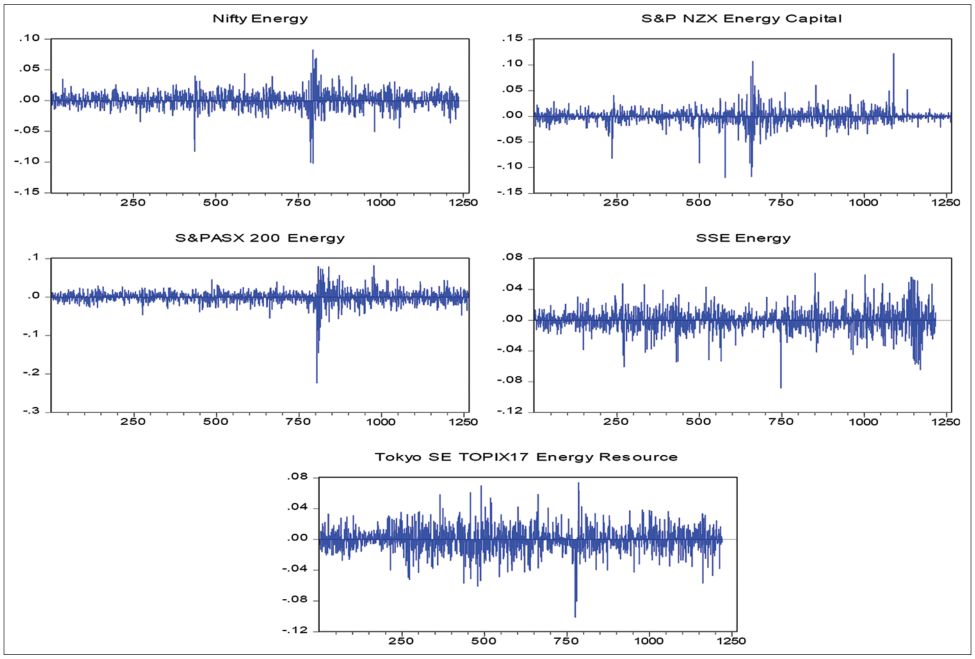
Table 4: GARCH (1,1) model for the daily returns of Asian pacific stock markets' energy indices

	α1	β1	C	Prob.
NIFTY ENERGY	0.107865	0.824431	0.0000114	0.000
S&P NZX ENERGY CAPITAL	0.102048	0.904722	0.00000169	0.000
S&P ASX 200 ENERGY	0.11904	0.878383	0.0000044	0.000
SSE ENERGY	0.13184	0.825451	0.0000105	0.000
TOKYO SE TOPIX17 ENERGY	0.067028	0.916771	0.00000535	0.000

daily returns sample Asian Pacific Countries' emerging indices to be negatively skewed and unit root identified in the sample data, during the study period.

According to the results of GARCH (1,1) Model, as shown in the Table 4, the sample Asian Pacific Countries' Energy Stock Indices were volatile, during the study period. The sum of RESID (-1) and GARCH (-1), for all the sample indices, were closer to one for all the sample indices ($\alpha1+\beta1<1$). The residual Graph (Figures 2) also confirmed the fluctuations of the daily returns of

Figure 2: Residual graph for daily returns of Asian pacific stock markets' energy indices



sample energy indices.

According to results of the Granger Causality Test, as displayed in the Table 5, F value of the sample energy indices indicated that unidirectional relationship between S&PNZXENERGYCAPITAL and S&PASX200ENERGY, SSEENERGY and TOKYOSETOPIX17ENERGY while the rest of the Asian Pacific Energy Stock Indices did not have any bidirectional or unidirectional relationship with other sample indices.

4. CONCLUSION

The aim of the study was to analyse the casual relationship and volatility of Asian Pacific Stock Markets' Energy Indices, for the period of January 2017 to December 2021. Analyse the data Descriptive Statistics, ADF test, GARCH (1,1) Model, and Granger Causality Assess were employed to analyse the data. According to the findings of descriptive statistics and the ADF Test, the daily returns of the sample energy indices of Asian Pacific Stock Markets were not normally distributed and achieved stationarity at level difference, over the research period. As a result the data may be used for additional analysis. The data were then analysed, by using the GARCH (1,1) model to assess the considerable volatility of daily returns of sample energy indices and the study revealed that all the sample energy indices were volatile during the study period. Further, the result of Granger Causality Test found unidirectional relationship between S&PNZXENERGYCAPITAL and S&PASX200ENERGY, SSEENERGY and TOKYOSETOPIX17ENERGY, during the study period. The study also found another interesting result there was no bidirectional relationship among the Asian Pacific Stock Market Energy Indices, during the study period. Therefore, the study concluded that the investors of global stock markets should concentrate and analyse the market movement, during the period of introduction of economic reforms or the incidence of natural disasters like, Cyclone, Earthquake, COVID-19, etc.

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