Risk–Return and Portfolio Optimization of Selected Energy Sectors in India

[1]Dr. R. Vijayapriya, [2]Mr. G. Balasubramaniyan

[1]Associate Professor, Department of Management Science (PG),
Kongu Arts and Science College (Autonomous), Erode – 638107, Tamil Nadu
[2]Ph.D. Research Scholar, Department of Management Science (PG),
Kongu Arts and Science College (Autonomous), Erode – 638107, Tamil Nadu

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ABSTRACT:

This study empirically examines the risk–return characteristics and portfolio optimization of selected energy sector stocks in India with reference to the Nifty 50 index, using secondary data for the period 2015–16 to 2024–25. A purposive sample of two leading energy companies associated with the Nifty 50 is analysed through descriptive statistics, beta estimation, Jarque–Bera normality tests and Augmented Dickey–Fuller unit root tests to assess volatility, distributional properties and stationarity of daily log returns. The results show low average returns but high volatility, pronounced negative skewness and extreme kurtosis for the Nifty 50, ADANI and NTPC, indicating substantial downside risk and strong deviations from normality, while beta values reveal heterogeneous market risk profiles, with ADANI behaving as an aggressive stock and NTPC as a defensive stock. ADF test outcomes at level and first difference confirm that the energy sector return series are strongly stationary with mean-reverting behaviour, providing a robust econometric foundation for applying time-series and volatility models in portfolio construction. The findings highlight that Indian energy sector stocks offer both significant risk and diversification potential, and that careful evaluation of their risk–return and stationarity properties is essential for designing optimal portfolios aligned with investor risk preferences in the Indian equity market.

Keywords: Risk–return, Portfolio optimization, Energy sector stocks, Nifty 50 index, Beta and volatility analysis, Augmented Dickey–Fuller test

INTRODUCTION

The Nifty 50 is one of the important benchmark indices of the Indian equity market, representing the performance of 50 large-cap companies listed on the National Stock Exchange of India. Launched in 1996 and managed by NSE Indices Limited, the index serves as a key indicator of overall market trends and investor sentiment in India. It covers companies across diverse sectors such as banking, information technology, energy, pharmaceuticals, automobiles and consumer goods, thereby providing a broad representation of the Indian economy (Rao et al., 2024). The Nifty 50 is calculated using the free-float market capitalization weighted method, which ensures that only the actively traded shares available in the market are considered. This methodology makes the index more reflective of real market movements and liquidity conditions. Due to its diversified composition, it is widely used by investors, fund managers, and analysts as a benchmark for evaluating portfolio performance

and making investment decisions (Muchandikar & Mailcontractor, 2023). In addition, the Nifty 50 plays a significant role in the development of financial products such as index funds, exchange-traded funds (ETFs), and derivatives like futures and options. It also acts as a barometer for economic health, as fluctuations in the index often mirror changes in macroeconomic conditions, corporate earnings, and global market trends (Hegde & Charithra, 2025).

Energy Sector Stocks in the Nifty 50

Energy sector stocks in the Nifty 50 represent companies involved in the production, distribution, and management of energy resources such as oil, gas, electricity, and renewable power. These stocks play a vital role in reflecting the economic and industrial growth of India, as energy is a fundamental input for all sectors (Sahoo & Mahadik, 2025). Major energy companies in the index include firms engaged in petroleum refining, power generation, and infrastructure development, making them key contributors to market performance. Energy stocks are often influenced by global crude oil prices, government policies, and geopolitical events, which can lead to fluctuations in their returns. However, they are generally considered stable and dividend-paying investments, attracting long-term investors. With India's increasing focus on renewable energy and sustainability, the sector is undergoing significant transformation. Thus, energy sector stocks in the Nifty 50 provide both growth opportunities and portfolio diversification benefits for investors. (Tarczynska-Luniewska et al., 2022)

Risk–Return and Portfolio Optimization

Risk–return analysis and portfolio optimization among companies of the Nifty 50 play a crucial role in guiding investment decisions. The fundamental principle is that higher returns are generally associated with higher risk, requiring investors to balance both factors effectively. By analyzing the measures such as expected return, standard deviation, beta, and Sharpe ratio, investors can evaluate the performance and risk profile of individual stocks within the index (Joshi, 2015). Portfolio optimization techniques, based on Modern Portfolio Theory, help in selecting a combination of stocks that maximizes returns for a given level of risk or minimizes risk for a desired return. Diversification across sectors like banking, IT, energy, and FMCG reduces unsystematic risk and improves stability. In the Nifty 50 context, optimal portfolios often include a mix of high-growth and stable stocks, enabling investors to achieve better risk-adjusted returns while maintaining long-term investment sustainability. (Markowitz, 1952)

RESEARCH REVIEWS

According to Kumar and Bagrecha (2026) attempted a study to construct an optimal investment portfolio from Nifty 50 constituent stocks. The analysis confirmed a strong positive risk-return relationship ($r = 0.8144$) and validate all hypotheses at the 5% significance level. Additionally, sector analysis reveals that automobile and basic materials stocks deliver superior risk-adjusted performance, while IT and FMCG sectors underperform, emphasizing the importance of sector-aware portfolio construction. Thus, the study demonstrates that Sharpe Ratio-based optimization provides a robust, practical, and replicable framework for achieving superior portfolio performance in the Indian equity market. The author Bhattacharyya (2025) aimed to conduct an exploratory statistical analysis of stock prices of major Indian energy firms and apply simulation-based techniques. The study mentioned that the cost of equity for large Indian energy firms ranges between 7.55% and 19.02% per annum, with no consistent sectoral pattern observed. Also, the stock prices of these firms exhibit weak to moderate positive correlation, limiting diversification benefits. The study further identifies that optimal portfolios typically consist of 3 to 4 dominant stocks, yielding returns between 24% and 38% per annum with associated risks ranging from 14% to 31%. Additionally, portfolio performance is found to be more sensitive to the choice of optimization objective functions than to the benchmark indices used.

In view of Mallika and Ojha (2024) analyzed that the risk–return trade-off in portfolio construction

by applying key financial metrics and models, particularly the Sharpe Single Index Model. It is noticed that stock behavior varies significantly in terms of volatility and market sensitivity, highlighting the importance of understanding both systematic and unsystematic risks. The study emphasizes that effective portfolio management requires diversification across sectors, active risk management, and strategic allocation of assets to balance stability and growth. It also concludes that integrating modern approaches such as behavioral finance, AI-driven models, and macroeconomic analysis can enhance investment decisions. The study of Lasya et al. (2023) examined that the importance of constructing an optimal portfolio for investors by applying the Sharpe Single Index Model to select suitable stocks from the Nifty 50 and to minimize risk while maximizing returns, particularly for risk-averse investors. The analysis confirmed that portfolio construction plays a crucial role in reducing risk compared to investing in individual securities, and that most investors prefer long-term investments in equity shares due to their higher return potential. The study also indicated that investors tend to favor fundamentally strong companies such as Infosys, Sun Pharmaceutical Industries, and Tata Power based on their performance and yields. The research depcited that effective portfolio construction requires careful analysis of excess returns, market returns, cutoff rates, and allocation of funds, emphasizing diversification as a key strategy for achieving optimal investment outcomes.

The researchers Tarczynska-Luniewska et al. (2022) assessed that the impact of major economic crises on the performance and risk exposure of energy sector companies listed on the S&P BSE Energy Index. The authors revealed that the COVID-19 pandemic had only a short-term psychological impact on stock prices, after which the index and companies recovered quickly and continued to grow, whereas the Russia–Ukraine conflict caused greater volatility and deviation in stock performance, limiting growth. Moreover, the study concludes that the Indian energy sector remains fundamentally strong, with relatively low risk exposure and high growth potential, offering attractive investment opportunities due to lower stock prices, consistent production, and the potential for both capital appreciation and dividend returns, despite challenges related to price sustainability and external market influences. In case of Rabha and Singh (2021) intended to apply the Sharpe Single Index Model to construct an optimal portfolio using blue-chip stocks listed on the National Stock Exchange of India. By analyzing 27 blue-chip securities using both weekly and monthly data, the study evaluates return performance, beta, and risk components to identify eligible securities for portfolio inclusion. The findings reveal a significant contrast between data frequencies, where only one stock qualifies for the optimal portfolio using weekly data, while 18 stocks qualify using monthly data, indicating that high-frequency data is too volatile for reliable portfolio construction under this model. The study proves that monthly data is more appropriate, especially for long-term investment decisions involving blue-chip stocks, which are generally stable, financially sound, and provide consistent dividends.

RESEARCH METHODS

The study adopts a quantitative, empirical research design based on secondary data to examine the risk–return relationship and portfolio optimization of selected energy sector stocks with reference to the Nifty 50 index. The research is analytical in nature and relies on established financial models and statistical tests to evaluate the performance and risk profile of the sampled securities. The sample consists of two leading energy sector companies that are part of, or closely associated with, the Nifty 50 index. Firms are selected using purposive sampling based on criteria such as market capitalization, liquidity and consistent trading activity over the study period, ensuring that the sample represents actively traded, financially significant energy stocks in the Indian market. The analysis is based entirely on secondary data drawn from reliable sources including the official NSE website, company annual reports and recognised financial databases. The study period spans 2015–16 to

2024–25, providing a long horizon that captures multiple market cycles, regulatory changes and macroeconomic shocks affecting the Indian energy sector and the broader Nifty 50 constituents. To address the research objectives, the study employs a set of financial and statistical tools, including mean return and standard deviation to summarise return and total risk, beta analysis to measure systematic risk relative to the Nifty 50 benchmark, the Jarque–Bera test to assess normality of return distributions, and the Augmented Dickey–Fuller (ADF) test to examine the stationarity and time-series properties of daily log returns. These tools together provide a comprehensive framework for characterising risk–return behaviour and for evaluating the suitability of energy sector stocks for inclusion in optimized portfolios.

RESULTS AND DISCUSSION

Descriptive Statistics of Daily Log Returns of Stock Indices

Table 1 presents the descriptive statistics of daily log returns for the Nifty 50 index (NSE50) and the selected energy sector stocks, ADANI and NTPC, over the study period. It provides an initial empirical overview of their return behaviour by summarizing measures of central tendency, dispersion, and distributional shape. The mean and median values indicate the typical daily performance of each series and help to identify whether returns are systematically positive or exhibit frequent small corrections. The maximum and minimum figures capture extreme price movements, revealing the magnitude of shocks that have affected the benchmark index and the energy stocks. Standard deviation quantifies the volatility of returns and thus the overall risk faced by investors holding these assets. Skewness highlights the direction of asymmetry in the distribution, signalling whether large negative or positive returns are more prevalent. Kurtosis reports the degree of peakedness and tail thickness, indicating the presence of fat tails and the likelihood of extreme events relative to a normal distribution. The Jarque–Bera statistic and its probability value formally test the normality assumption for each return series. The sum and sum of squared deviations provide additional information on the cumulative behaviour and total variation in the data.

Table 1

Descriptive Statistics of Daily Log Returns of Stock Indices

	NSE50	ADANI	NTPC
Mean	0.046	0.066	0.033
Median	0.063	-0.076	0.000
Maximum	47.795	22.523	8.743
Minimum	-47.280	-142.715	-16.788
Std. Dev.	1.995	4.427	1.678
Skewness	-0.419	-13.604	-0.666
Kurtosis	369.817	446.917	12.253
Jarque-Bera	14374963	20134624	9018.952
Probability	0.000	0.000	0.000
Sum	118.824	161.287	82.445
Sum Sq. Dev.	10201.23	47859.55	6975.594
Observations	2564	2443	2477

Table 1 shows that the daily log returns of NSE50, ADANI and NTPC are characterized by low average returns, high volatility, pronounced asymmetry and extreme fat-tailed behaviour, indicating substantial risk and clear deviation from normality. The mean values indicate that the average daily log returns for all three series are positive but numerically very small, suggesting modest day-to-day appreciation over the sample period rather than large systematic gains. The maximum and minimum values reveal very large positive and negative jumps, especially for ADANI, which experiences the most extreme downside movement among the three, pointing to substantial exposure to idiosyncratic and event-driven shocks in this stock. Standard deviation is highest for ADANI, followed by NSE50 and NTPC, implying that ADANI exhibits the greatest return variability and therefore the highest total risk, while NTPC is relatively less volatile. The higher dispersion of ADANI's returns suggests that investors in this stock face greater uncertainty and potential for large gains or losses compared to the benchmark index and NTPC, which is crucial for portfolio risk management and asset allocation decisions.

The skewness coefficients are negative for all three series, indicating that large negative returns occur more frequently than large positive returns, and that the distribution of returns is tilted towards the left tail. This left-skewness points to asymmetric downside risk, which is particularly important for risk-averse investors and for stress-testing portfolios that include these energy sector stocks. The kurtosis values, especially for NSE50 and ADANI, are extremely high relative to the normal benchmark of 3, confirming very fat-tailed distributions with a high probability of extreme outcomes. The Jarque–Bera statistics for all three series are very large, with associated probabilities equal to 0.000, clearly rejecting the null hypothesis of normality for daily log returns.

Table 2 reports the beta values of the selected energy sector stocks, ADANI and NTPC, with reference to the Nifty 50 benchmark index. Beta measures the systematic risk of each stock, indicating the sensitivity of its returns to movements in the overall market. A beta greater than one implies that the stock is more volatile than the market, while a beta less than one suggests relatively lower market-related risk. By presenting the beta coefficients side by side, the table enables a direct comparison of the market risk profiles of ADANI and NTPC within the context of portfolio construction. Hence, Table 2 provides a concise yet essential input for risk–return assessment and for identifying suitable energy sector stocks for inclusion in an optimal portfolio.

Table 2

Beta Value of the Stocks

	ADANI	**NTPC**
Beta Value	1.421	0.776

Table 2 indicates that ADANI carries substantially higher systematic risk than NTPC when measured against the Nifty 50 benchmark. The beta value of 1.421 for ADANI implies that, on average, ADANI's returns are 42.1% more volatile than the market; the stock tends to amplify market movements, rising more in bullish phases and falling more in bearish phases. In contrast, NTPC's beta of 0.776 suggests that its returns are less sensitive to market fluctuations and that it behaves as a relatively defensive stock, exhibiting lower market-related risk than the benchmark index. For portfolio construction, this implies that ADANI is suitable for investors seeking higher risk–return potential and willing to accept greater exposure to market swings, whereas NTPC is more appropriate for risk-averse investors aiming to stabilize portfolio volatility while maintaining exposure to the energy sector.

Augmented Dickey-Fuller Test of the Stocks

Table 3 presents the Augmented Dickey–Fuller (ADF) test results for the daily log returns of ADANI and NTPC at level, under the null hypothesis that each series contains a unit root. The table reports the ADF test statistics and associated p-values alongside the critical values at the 1%, 5% and 10% significance levels for both stocks. It also includes the estimated regression coefficients, standard errors, goodness-of-fit measures and diagnostic statistics corresponding to the ADF regression equations. By summarizing these outputs, Table 3 provides a formal assessment of the stationarity properties of the energy sector return series used in the study.

Null Hypothesis: ADANI and NTPC has a unit root

Table 3

Augmented Dickey-Fuller Test of the Stocks (At Level)

	ADANI		NTPC	
	t-Statistic	**P Value**	**t-Statistic**	**P Value**
ADF Test	-47.235	0.000	-51.0262	0.0001
1% level	-3.433		-3.4328	
5% level	-2.863		-2.86251	
10% level	-2.567		-2.56733	

Table 3 reports the Augmented Dickey–Fuller (ADF) test results for the daily log returns of ADANI and NTPC at level and shows that both series are strongly stationary. For ADANI, the ADF test statistic of −47.235 is far more negative than the critical values at the 1%, 5% and 10% levels (−3.433, −2.863 and −2.567), and the p-value of 0.000 indicates that the null hypothesis of a unit root is decisively rejected. Similarly, for NTPC, the ADF statistic of −51.0262 is well below all three critical values (−3.4328, −2.86251 and −2.56733), with an associated p-value of 0.0001, again rejecting the unit root hypothesis and confirming stationarity. These results imply that the log return series of both energy sector stocks do not follow a random walk, exhibit mean-reverting behaviour, and are suitable for further time-series modeling, such as GARCH and regression-based risk–return analysis, without additional differencing. In summary, Table 3 establishes a sound econometric basis for the subsequent volatility and portfolio optimization exercises by verifying that the underlying return data are stationary processes.

Table 4

Regression Output of Adani Stock (At Level)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ADANI (-1)	-0.947	0.020	-47.235	0.000
C	0.056	0.089	0.636	0.525
R-squared	0.473	Mean dependent var		0.001
Adjusted R-squared	0.473	S.D. dependent var		6.077
S.E. of regression	4.410	Akaike info criterion		5.807
Sum squared resid	48255.970	Schwarz criterion		5.811
Log likelihood	-7206.820	Hannan-Quinn criterion		5.808
F-statistic	2231.118	Durbin-Watson stat		2.004
Prob(F-statistic)	0.000			

The regression output for the ADF test on ADANI shows a highly significant negative coefficient on the lagged return (−0.947, p = 0.000), confirming stationarity and strong mean reversion in the series. The R-squared of 0.473 indicates that nearly half of the variation in the dependent variable is explained by the model, while the F-statistic (2231.118, p = 0.000) confirms overall model significance. The Durbin–Watson statistic of 2.004 suggests no serious autocorrelation problem, and the information criteria values support the adequacy of the ADF specification used.

Table 5

Regression Output of NTPC Stock (At Level)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NTPC (-1)	-1.026	0.020	-51.026	0.000
C	0.034	0.034	1.022	0.307
R-squared	0.513	Mean dependent var		0.001
Adjusted R-squared	0.513	S.D. dependent var		2.404
S.E. of regression	1.679	Akaike info criterion		3.875
Sum squared resid	6970.263	Schwarz criterion		3.879
Log likelihood	-4794.632	Hannan-Quinn criterion		3.876
F-statistic	2603.671	Durbin-Watson stat		2.001
Prob(F-statistic)	0.000			

This table reports the regression output of the ADF test for NTPC and shows that the series is strongly stationary with pronounced mean reversion. The coefficient on the lagged NTPC return (−1.026) is highly significant (t = −51.026, p = 0.000), indicating that shocks to returns die out quickly over time. The R-squared and adjusted R-squared of 0.513 suggest that around half of the variation in the dependent variable is explained by the model, and the large F-statistic (2603.671, p = 0.000) confirms overall model significance. The Durbin–Watson statistic of 2.001 points to the absence of serious autocorrelation, while the information criteria values (Akaike, Schwarz and Hannan–Quinn) support the adequacy of the ADF specification for NTPC's return series.

Augmented Dickey-Fuller Test of the Stocks (1st Difference)

Table 6 presents the Augmented Dickey–Fuller (ADF) test results for the first differences of the daily log returns of ADANI and NTPC, under the null hypothesis that the differenced series still contain a unit root. The table reports the ADF test statistics and corresponding p-values for D(ADANI) and D(NTPC), along with the 1%, 5% and 10% critical values, thereby allowing formal inference on the stationarity of the first-differenced series. By summarizing these outputs, Table 6 complements the level-based tests in Table 3 and verifies whether differencing further strengthens the evidence of stationarity in the energy sector return series. This information is important for confirming the robustness of the time-series properties of the data before applying volatility models and portfolio optimization techniques.

Null Hypothesis: D(ADANI) and D(NTPC) has a unit root

Table 6

Augmented Dickey-Fuller Test of the Stocks (1st Difference)

	ADANI		NTPC	
	t-Statistic	**P Value**	**t-Statistic**	**P Value**
ADF Test	-22.553	0.000	-22.189	0.000
1% level	-3.433		-3.433	
5% level	-2.863		-2.863	
10% level	-2.567		-2.567	

Table 6 shows that the first-differenced daily log returns of both ADANI and NTPC are clearly stationary. The ADF test statistics for D(ADANI) (−22.553) and D(NTPC) (−22.189) are much more negative than the corresponding critical values at the 1%, 5% and 10% significance levels (−3.433, −2.863 and −2.567), indicating strong rejection of the null hypothesis of a unit root in the differenced series. The p-values for both stocks are 0.000, further confirming that the first differences do not exhibit non-stationary behaviour and that shocks to the differenced returns dissipate over time. These results reinforce the evidence from the level tests, demonstrating that the return series are robustly stationary and suitable for further time-series modeling and volatility analysis within the risk–return and portfolio optimization framework.

Table 7

Regression Output of Adani Stock (1st Difference)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(ADANI(-1))	-7.370	0.327	-22.553	0.000
C	0.004	0.091	0.042	0.966
R-squared	0.814	Mean dependent var		-0.003
Adjusted R-squared	0.813	S.D. dependent var		10.520
S.E. of regression	4.544	Akaike info criterion		5.872
Sum squared resid	50674.520	Schwarz criterion		5.907
Log likelihood	-7233.537	Hannan-Quinn criterion		5.884
F-statistic	769.561	Durbin-Watson stat		2.005
Prob(F-statistic)	0.000			

This regression output corresponds to the ADF test for the first-differenced ADANI series and confirms strong stationarity with pronounced mean reversion. The coefficient on D(ADANI(−1)) is −7.370 with a very small standard error (0.327) and a highly significant t-statistic of −22.553 (p = 0.000), indicating that changes in returns adjust sharply towards equilibrium. The R-squared and adjusted R-squared values of 0.814 and 0.813 show that more than 81% of the variation in the dependent variable is explained by the model, while the large F-statistic (769.561, p = 0.000) confirms overall model significance. The Durbin–Watson statistic

of 2.005 suggests the absence of serious autocorrelation, and the information criteria (Akaike, Schwarz and Hannan–Quinn) indicate that the chosen ADF specification provides a reasonably good fit to the differenced ADANI return data.

Table 8

Regression Output of NTPC Stock (1st Difference)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NTPC(-1))	-8.747	0.394	-22.189	0.000
C	0.001	0.035	0.040	0.968
R-squared	0.829	Mean dependent var		0.002
Adjusted R-squared	0.828	S.D. dependent var		4.170
S.E. of regression	1.729	Akaike info criterion		3.940
Sum squared resid	7310.246	Schwarz criterion		3.977
Log likelihood	-4831.664	Hannan-Quinn criterion		3.953
F-statistic	790.755	Durbin-Watson stat		2.003
Prob(F-statistic)	0.000			

This regression output corresponds to the ADF test for the first-differenced NTPC series and confirms strong stationarity with rapid mean reversion. The coefficient on D(NTPC(−1)) is −8.747 with a small standard error (0.394) and a very large negative t-statistic (−22.189, p = 0.000), indicating that changes in NTPC returns adjust sharply back towards equilibrium after shocks. The R-squared and adjusted R-squared values of 0.829 and 0.828 show that roughly 83% of the variation in the dependent variable is explained by the model, while the high F-statistic (790.755, p = 0.000) confirms overall model significance. The Durbin–Watson statistic of 2.003 suggests no serious autocorrelation, and the information criteria (Akaike, Schwarz and Hannan–Quinn) indicate that the chosen ADF specification provides a good fit to the differenced NTPC return data.

FINDINGS AND DISCUSSION

The findings show that the selected energy sector stocks in India exhibit high volatility, fat-tailed return distributions and clear mean-reverting, stationary behaviour, with marked differences in their market risk profiles relative to the Nifty 50 index. Descriptive statistics indicate that NSE50, ADANI and NTPC all have low but positive average daily log returns, combined with substantial dispersion, especially for ADANI. The presence of large positive and negative extremes, pronounced negative skewness and very high kurtosis confirms that these series are exposed to significant downside risk and extreme events, and deviate sharply from normality as supported by the Jarque–Bera test.

Beta estimates show that ADANI is an aggressive stock with a beta of 1.421, implying that it amplifies market movements, whereas NTPC, with a beta of 0.776, behaves as a relatively defensive stock. This heterogeneity in systematic risk suggests that combining high-beta and low-beta energy stocks with the Nifty 50 benchmark can be used to tailor portfolio risk exposure to different investor preferences, with ADANI suitable for high-risk, return-seeking strategies and NTPC for stabilising portfolios. The Augmented Dickey–Fuller tests at level yield highly negative test statistics for both ADANI and NTPC, far below the 1%, 5% and 10% critical values, with p-values close to zero, indicating strong rejection of the unit root hypothesis. Regression outputs associated with

the ADF tests show significant negative coefficients on lagged returns and Durbin–Watson statistics close to two, confirming stationary, mean-reverting dynamics without serious autocorrelation problems, thereby validating the use of these series in time-series and volatility modeling.

ADF tests on first-differenced returns for ADANI and NTPC again produce very negative test statistics and zero p-values, reinforcing the robustness of stationarity in the transformed series. The high R-squared values and significant F-statistics in the differenced regression models indicate that lagged differenced returns explain a large share of variation in changes in returns, and that shocks to returns adjust sharply back towards equilibrium for both stocks. Taken together, the results suggest that Indian energy sector stocks associated with the Nifty 50 offer both diversification benefits and substantial risk, characterised by high volatility, asymmetric downside risk and non-normal return distributions. The confirmed stationarity and mean-reversion of returns provide a sound econometric basis for applying advanced risk–return and portfolio optimization techniques, and the distinct beta profiles of ADANI and NTPC highlight the importance of stock selection within the energy sector when designing optimal portfolios for different risk tolerances.

CONCLUSION

The study concludes that selected energy sector stocks associated with the Nifty 50 index exhibit distinctive risk–return characteristics that are highly relevant for portfolio design in the Indian equity market. Descriptive evidence shows that these stocks, particularly ADANI, are characterised by high volatility, pronounced negative skewness and extreme kurtosis, implying substantial downside risk and frequent extreme price movements relative to the benchmark index. Beta estimates confirm that ADANI behaves as an aggressive, high-beta stock while NTPC functions as a defensive, low-beta stock, highlighting the importance of stock-level heterogeneity in constructing portfolios that match different investor risk preferences. Augmented Dickey–Fuller tests at level and first difference demonstrate that the daily log returns and their changes for both ADANI and NTPC are strongly stationary and mean-reverting, providing a robust econometric basis for applying time-series and volatility models without further differencing. The findings reinforce modern portfolio theory insights that careful selection and combination of energy sector stocks with varying risk profiles can enhance diversification and risk-adjusted performance, and they underscore the need for investors and fund managers to explicitly account for non-normal return distributions and sector-specific dynamics when optimizing portfolios in the Indian energy segment.

POLICY AND FUTURE RESEARCH IMPLICATIONS

From a policy perspective, the evidence of high volatility, fat-tailed returns and heterogeneous beta values in Indian energy sector stocks underscores the need for regulators and market participants to strengthen risk disclosure, stress testing and investor education, particularly for retail investors allocating to high-beta names such as ADANI. Policymakers may also encourage the development of diversified energy-focused index funds and ETFs that combine aggressive and defensive stocks to provide more balanced exposure to the sector, while promoting transparency around sector-specific risks linked to global commodity prices and geopolitical events. For future research, the study suggests extending the analysis to a broader set of energy and renewable energy firms, incorporating additional risk measures such as value-at-risk, expected shortfall and GARCH-based volatility forecasts, and comparing optimization outcomes under alternative objective functions and behavioural finance-informed models. Researchers could also explore dynamic portfolio strategies that adjust weights in response to changing macroeconomic conditions and policy interventions, thereby deepening understanding of how the Indian energy sector can contribute to sustainable, risk-adjusted returns over different market cycles.

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