

VOLATILITY MODELLING FOR NIFTY ENERGY INDEX STOCKS LISTED IN NSE

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ABSTRACT

This paper examines volatility and return of the Nifty Energy index stocks listed on NSE. The data is collected for a period of 9 years i.e., from 1st January 2011 to 31st December 2019. The study is purely based on secondary data collected from NSE. The paper analyses the performance of the Nifty ENERGY index stocks and for this the daily closing price behaviour of the stocks was considered and to find the extent of volatility GARCH family model was applied. The Augmented Dicky Filler and Phillips-Perron test is used to check the stationarity of the return series. The results suggest that Tata Power, ONGC, BPCL and Reliance returns have high volatility. An attempt has been made in this paper to understand the performance delivered by the Nifty ENERGY index stocks and the volatility associated with the performance during the study period.

KEYWORDS: Energy, Index, Volatility, GARCH Model.

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I. INTRODUCTION

Every investor is required to analyse the stock market fluctuation and based on this analysis he should decide which stock to buy and when to buy or sell. Many investors invest in various sectors like automobile, pharma, FMCG, IT, banking, and infrastructure etc., based on their knowledge and try their luck. But these sectors performance depends on the growth of the economy. If economy is doing well, it is assumed that some sectors will also perform well. This paper study is based on the stocks listed in Nifty ENERGY index. The NIFTY ENERGY Index comprises of 10 stocks that are listed on the National Stock



Exchange (NSE) where majority of company's outstanding share capital is held by the Central Government and/or State Government, directly or indirectly.

Existing review of literature shows that majority of the research has been conducted on the analysis of return and risk of automobile, Information technology, banking & pharmaceutical sectors, but there are not much research paper concentrating on other performing indices like thematic indices. This study is based on the performance of Nifty ENERGY index stocks. The NIFTY ENERGY index is selected for the study because there is no much research done on these specific indices. This attracts the attention of the researchers to study the nature and extent of volatility experienced by the Nifty ENERGY index stocks and returns delivered by them.

II. LITERATURE REVIEW

Goudarzi and Ramanarayanan (2011) analyzed the market volatility of Bombay Stock Exchange 500 stock index during the financial crisis 2008-09. It was identified through the research that market effected by good and bad news about the market trend. The EGARCH and TGARCH models were shown in the BSE 500 indexes where volatility is increased by the bad news of the market.

Ahmed and Suliman (2011) used different univariate GARCH models to estimate volatility in the daily returns of the Khartotum Stock Exchange (KSE) over the period from January 2006 to November 2010. The empirical results show that the conditional variance process is highly persistent and provide evidence on the existence of risk premium for the KSE index return series which support the positive correlation hypothesis between volatility and the expected stock returns in Sudan.

Arivalagan and Raj Mohan (2015) researcher have captured the volatility pattern of BSE index. Closing price of BSE Sensex from 1997 to 2017 has been considered. Three models were used to test the volatility of BSE Sensex, the models used are ARCH, GARCH and TGARCH. it was identified that, among these three models, TGARCH model was the suitable model to identify the volatility of BSE Sensex.



III. DATA AND METHODOLOGY

This study is conducted to find out the past performance of the Nifty ENERGY index stocks, and also to evaluate the relationship between volatility and return and the extent of volatility experienced by the stocks during the study period. The study mainly focuses on the price movement of NIFTY ENERGY index stocks. The study is descriptive in nature. For the analysis, the daily closing prices are collected from the NSE. The date were collected for a period 9 years i.e. JAN-2011 to DEC-2019.

Duration of the study:

The data is collected for a period of 9 years starting from 1st Jan 2011 to 31st Dec 2019

A. Data collection

The study is based on secondary data collected from NSE website. Data is collected for a period of 9 years (i.e. from 1st January 2011 to 31st December 2019) from NIFTY ENERGY Index listed in NSE. Additionally the data are also collected from newspaper, websites, journals, books reports by researchers and scholars

The data relating to the price behaviour of the selected stocks were collected from website <u>www.nseindia.com</u>, an official website of National stock exchange. Following are the stocks listed in Nifty ENERGY Index.

- Adani Green
- Bharat Petroleum Corporation limited
- Gail (India) Limited
- Hindustan Petroleum Corporation Limited
- Indian Oil Corporation Limited
- NTPC Limited
- Oil and Natural Gas Corporation Limited
- Power Grid Corporation of India Limited
- Reliance Industries
- Tata Power
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B. Tools for analysis:

- Descriptive statistics: Arithmetic mean of daily returns of the stock is calculated to know the average return of the stock. Descriptive statistics like Average, Standard deviation, Skewness and Kurtosis are used in the study to understand the distributional properties of the Nifty ENERGY stocks.
- Econometrics model
 - Unit root test: The financial time series data used in any study must be stationary in nature. Hence, to test the stationary of the selected financial time series test were employed in this study.
 - Augmented Dickey Fuller test
 - Phillips Perron test
 - 2. Testing of ARCH effect in the return series: Before applying the GARCH family models to estimate the volatility, it is necessary to identify whether substantial evidence of heteroskedasticity exists or not and this determines necessity of the application of GARCH estimation methods. In order to test for the presence of ARCH effects in the selected return series, Lag range Multiplier Test method was applied.
 - 3. Application of GARCH model for volatility estimation: GARCH (1,1) model was employed to understand the nature and extent of volatility of the stocks selected for the study
 - 4. For a stationary GARCH model the volatility mean reverts to its long run level, at rate given by the sum of ARCH and GARCH coefficients, which is generally close to one for a financial time series. The average number of time period for the volatility to revert to its long run level is measured by half life of volatility shock and is calculated by the formula Lhalf = $(\ln (1/2)) / (\ln (\alpha + \beta))$, where α and β are the calculated ARCH and GARCH coefficients.

C. Limitations of the study

> The study is limited to only one thematic index from NSE.



- Analysis is based on secondary/historical data collected from NSE website, published literature etc.
- It does not consider the price behaviour of the respective stocks in the derivative segment

Results and Discussions

Table 1: Descriptive statistics for NIFTY-ENERGY Index stocks

S I. No	Name of the Stock	Mean Return	Standard deviation	Skewness	Kurtosis	Jarque Bera	<i>p</i> value
1	BPCL	0.000673	0.021399	-0.559157	9.955554	4601.148	0.000 0
2	GAIL	-8.07E-05	0.018195	-0.155197	6.480916	1132.258	0.000 0
3	HIND PETRO	0.000494	0.024382	-0.620947	12.03229	7706.336	0.000 0
4	IOC	0.000158	0.019736	-0.262818	7.528730	1927.006	0.000 0
5	NTPC	- 0.000148	0.015865	-0.263979	7.537895	1934.937	0.000 0
6	ONGC	- 0.000231	0.018668	-0.226008	7.456320	1860.017	0.000 0
7	POWERGRID	0.000297	0.013731	-0.159692	6.393393	1077.004	0.000 0
8	Reliance Industries	0.000474	0.016481	0.115487	5.149817	433.4172	0.000
9	Tata Power	-0.00038	0.019981	-0.09036	6.780658	1328.143	0.000

Descriptive statistics of all the 9 Nifty ENERGY index stocks are summarized in the above Table 1. The mean return of only five stocks are positive, indicating that the price of only five stocks have increased substantially during the study period and remaining stocks have



yielded negative return during the study period. Negative returns delivered by remaining stocks have confirmed the fact that the ENERGY index stocks have performed averagely during the study period. Among these stocks only BPCL (0.000673) has delivered highest return, followed by HINDPETRO (0.000494), RELIANCE (0.000474), POWERGRID (0.000297) and IOC (0.000158) respectively. The descriptive statistics also shows that out of 9 stocks, 8 stocks are negatively skewed and this indicates that there is a high probability of earning returns greater than the average returns in these 8 stocks. The kurtosis values of all the stocks are greater than 3, which imply that the selected financial time series of the stocks are fat tailed and did not follow a normal distribution. This feature is further confirmed by the Jarque-Bera test statistics values. The Jarque-Bera values are significant at 1% level and this rejects the assumption of normality in the selected financial time series

SI.	Name of the Stock	Augmente	ed Dickey Fuller	Test	Phillips-Perron Test				
No		Intercept	Trend and	None	Intercept	Trend and	None		
			Intercept			Intercept			
1		-45.09304	-45.08292	-	-45.08468	-45.07362	-		
	BPCL			45.05993			45.03931		
2		-46.61826	-46.61085	-	-47.37553	-47.37176	-		
	GAIL			46.62773			47.38487		
3		-47.37388	-47.36376	-	-47.49803	-47.48739	-		
	HINDPETRO			47.36458			47.47500		
4		-46.51940	-46.50900	-	-46.57693	-46.56581	-		
	IOC			46.52670			46.58334		
5		-48.97107	-48.96469	-	-49.11195	-49.10713	-		
	NTPC			48.97743			49.11584		
6		-46.63969	-46.63154	-	-47.04005	-47.03832	-		
	ONGC			46.64322			47.03248		
7		-50.41512	-50.40508	-	-51.21113	-51.20449	-		
	POWERGRID			50.40128			51.10871		
8	Reliance Industries			-			-		
	Renance muustres	-45.30211	-45.36689	45.27781	-45.29180	-45.39912	45.25773		
9	Tata Power			-					
		-48.4975	-48.48743	48.48982	-48.5647	-48.5544	-48.5551		

Table 2: Tests for Stationarity - I	NIFTY ENERGY Index stocks
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(Test critical values @ 5% level is -2.862638 for Intercept ; @5% level is -3.411829 for Trend and Intercept; @5% level is -1.940966 for None, p values for all the above observations are < 0.05).

In order to test the whether the selected financial time series data are stationary in nature, Augmented Dickey Fuller Test (ADF Test) and Philips Perron Test (PP Test) has been undertaken and the results are displayed in Table 2. The calculated values for all the Nifty ENERGY index stocks for both the tests (ADF and PP Test) are greater than the test critical values (both signs should be ignored, Test critical values at 5 per cent level is - 2.862638 for Intercept ; at 5 per cent level is -3.411829 for Trend and Intercept; at 5 per cent level is - 1.940966 for None, p values for all the above observations are < 0.05) and hence, it is confirmed that all the selected series are stationary in nature, which is the basic condition to estimate the volatility by applying the Auto Regressive Conditional Heteroskedasticity model (ARCH model).

 Table 3: Testing the heteroskedasticity (ARCH) effect in the return series of NIFTY ENERGY

 Index stocks

SI.	Name of the Stocks	F-statistic	Prob.F	Obs*R-squared	Prob.chi-
No					square
1	BPCL	138.0228	0.0000	130.0677	0.0000
2	GAIL	6.324885	0.0120	6.312609	0.0120
3	HINDPETRO	171.4124	0.0000	159.2793	0.0000
4	IOC	222.9434	0.0000	202.7966	0.0000
5	NTPC	13.715082	0.0000	13.712220	0.0000
6	ONGC	13.08380	0.0000	13.01892	0.0000
7	POWERGRID	7.302767	0.0000	7.285396	0.0000
8	Reliance Industries	21.87292	0.0000	21.67921	0.0000
9	Tata Power	33.51006	0.0000	33.04191	0.0000

Before applying the GARCH family models to specify the volatility, it is necessary to confirm whether ARCH effect exists or not in the financial time series for the stocks selected



for the analysis. For this purpose, the lag-range multiplier test was conducted and the results obtained are mentioned in Table 3. The calculated F-statistics values for all the return series of selected stocks are greater than the observed R square values and P values are significant at 1 per cent level. This indicates that the ARCH effect exists in the series selected for the study and which demands the application of GARCH family models to understand the presence of volatility and its extent.

SI.	Name of the		ω	C	α		β		α+β		SIC		AIC	Log	Mean
No	stock													Likelihood	Reversion
1			3.23E-	C	0.0927		0.8362		0.9290		4.9302		4.9405	5500.369	9.4159
	BPCL	05		45		85		3		96		56			
2			0.0002	C	0.1173		0.1043		0.2217		5.1734		5.1837	5770.898	0.4602
	GAIL	60		77		96		73		68		28			
3			0.0001	C	0.1065		0.6959		0.8025		4.6606		4.6708	5200.375	3.1509
	HINDPETRO	13		43		94		37		38		99			
5			4.12E-	C	0.1481		0.7533		0.9015		5.0797		5.0900	5666.675	6.6860
	IOC	05		80		42		22		84		45			
5			3.11E-	C	0.0825		0.7960		0.8785		5.4710		5.4812	6101.916	5.3549
	NTPC	05		67		20		87		12		73			
6			2.39E-	0	0.0855		0.8478		0.9333		5.1698		5.1801	5766.902	10.0442
	ONGC	05		09		09		18		76		36			
7			3.59E-	0	0.1548		0.6614		0.8163		5.7740		5.7843	6439.043	3.4154
	POWERGRID	05		70		55		25		48		09			
8	Reliance		2.09E-	C	0.0646		0.8586		0.9232		5.3976		5.4079	6020.327	8.6812
	Industries	05		56		04		6		74		35			
9			1.13E-	C	0.0526		0.9200		0.9726		5.0440		5.0543	5626.959	25.0158
	Tata Power	05		62		10		72		85		46			

Table 4: Volatility estimation by using GARCH	(1,1) model for NIFTY ENERGY Index stocks
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♦ All the values are significant at 5% level

To estimate the level of volatility experienced by the selected stocks, GARCH (1,1) model was applied and the results obtained are represented in Table 4. The calculated values of all the parameters (ω , α and β) for the selected stocks are positive, which is necessary condition to declare that the selected model is well defined to understand the level of volatility. All the coefficient values of lagged squared residuals (α) and lagged conditional variance (β) are



positive and significant at five percent level indicating that the past volatility of stock return is significantly influencing the current volatility. The sum of both ARCH and GARCH coefficients (α + β) for all the selected stocks of Nifty ENERGY index stocks is closer to one (1) which implies that the shocks to the conditional variance are highly persistent and indicates that the Nifty ENERGY index stocks were having high volatility during the study period and the volatility persistence were lasting for many days. The average number of time period for the volatility to revert to its long run level is measured by half life of volatility shock and the values calculated so is used to understand the volatility persistence of the selected stocks. It is found that among the stocks Tata Power (25.0158), ONGC (10.0442), BPCL (9.4159) and Reliance Industries (8.6812) are the volatile stocks. Any shocks to these stocks take longer time to die out and these stocks take longer period to revert to its long run average price level. HINDPETRO (3.1509), POWERGRID (3.4154), GAIL (0.4602), NTPC (5.3549) and IOC (6.6860) are the less volatile stocks among the stocks selected for the study. Any shocks, either positive or negative, did not lasted for longer time period in these stocks and the any shocks to the price behavior of these stocks take shorter period to reach its long run average price level

Findings and the Concluding Remarks

The descriptive statistics of the selected Nifty ENERGY-index stocks shows that the average daily mean return values of majority of the stocks selected for the study are positive and indicating that the stock prices have increased substantially during the study period. The application of GARCH (1,1) model has explained the level of volatility that experienced by the Nifty ENERGY index stocks during the study period. The calculated sum of both ARCH and GARCH coefficients ($\alpha + \beta$) for all the selected stocks is closer to one (1) which indicates that the Nifty ENERGY index stocks are vulnerable to any stocks and most of them are highly volatile in nature. The calculated mean reversion values of most of the stocks shows that they are more volatile in nature and the price behavior of these stocks take much longer time to reach its long run average price level. It is also interesting to note that there is a positive relationship between volatility and return exists in the stocks selected for the study. Stocks which are shown more volatility have delivered considerably good returns when compare with the stocks that are attributed with less volatility.



This study attempted to study the volatility and return of the Indian equity market by considering the price behavior of Nifty ENERGY index of National stock Exchange. The daily closing price of the selected stocks were considered for the study and GARCH (1,1) model was applied to understand the volatility. The study found that the majority of the Nifty ENERGY index stocks delivered the positive returns. The finding of this study is in line with the findings of the previous studies which are supporting the fact that the volatility and return are positively related.

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