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An Empirical Investigation on Spot and Futures Market With Reference to Energy Sector on NSE

Dr. P. Sri Ram

ABSTRACT- The importance of volatility is widespread in the area of financial economics. Equilibrium prices, obtained from asset pricing models, are affected by changes in volatility, investment management lies upon the mean-variance theory, while derivatives valuation hinges upon reliable volatility forecasts. Portfolio managers, risk arbitrageurs, and corporate treasurers closely watch volatility trends, as changes in prices could have a major impact on their investment and risk management decisions. Volatility may be defined as the degree to which asset prices tend to fluctuate. Volatility is the variability or randomness of asset prices. Volatility is often described as the rate and magnitude of changes in prices and in finance often referred to as risk. This study has been carried out on Spot and Futures market with reference to energy sector stocks on NSE. It also analysed the co-integration and Causal relationship between Spot and Futures prices of stocks and index. The study also estimated the impact of Spot market on Futures market. The study has been carried out on volatility of Indian Stock Market represented by S&P CNX Nifty Index along with influence by energy sector stocks.

Index Terms- Spot Market, Future Market, Johansen-Juselius Co-integration,OLS Model, VAR Model and VECM Model

Introduction

The issue of changes in volatility of stock returns in emerging markets has received considerable attention in recent years. The reason for this enormous interest is that volatility is used as a measure of risk. The market participants also need this measure for several reasons. It is needed as an input in portfolio management. It is indispensable in the pricing of options.

This study has been carried out on Spot and Futures market with reference to energy sector stocks on NSE. It also analysed the co-integration and Causal relationship between Spot and Futures prices of stocks and index. The study also estimated the impact of Spot market on Futures market. The study has been carried out on volatility of Indian Stock Market represented by S&P CNX Nifty Index along with influence by energy sector stocks. This study analyzes the co-integration and casual relationship between the Spot prices and Futures prices in stock market. It also studies the impact of Spot prices on Futures prices of selected stocks from energy sector and index (S&P CNX Nifty Index). It also studies the volatility of stock market represented S&P CNX Nifty Index along with influence by energy sector stocks under study. NSE accounts more percent of the total trading volume in the derivatives segment; therefore, we use the S&P CNX Nifty Index to study the volatility behaviour of the market

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Literature Review

Roy (2013) studied Economic Recession and Volatility in Indian Stock Market by using Parkinson Model, Garman & Klass Model and found that returns were mostly negative in both the market indexes during the recession period with the higher volatility when the market was falling and vice. Mallikarjunappa & Afsal (2008) used GARCH model to studies the volatility implications of the introduction of derivatives on stock market volatility in India using the S&P CNX Nifty Index as a benchmark. They concluded that price sensitivity to old news is higher during pre Futures period than post Futures period and with introduction of Futures, market volatility is determined by recent innovation. Mall, Pradhan, & Mishra (2011) investigate the dynamics of the time varying volatility of India's index Futures market over the sample period spanning from June 2000 to May 2011 using GARCH, EGARCH and TGARCH models. The study shows clustering, high persistence and predictability and responds symmetrically for positive and negative shocks. he reported that the trading volume growth of nearby-month index Futures is the most influential factor for volatility in the Futures market in India. Gahlot, Datta, & Kapil (2010) examined the impact of derivative trading on stock market volatility. They considered closing prices of S&P CNX Nifty as well as closing prices of five derivative stocks and five non derivative stocks from April 1, 2002 to March 31, 2005 and used GARCH model for the study. They found that there is no significant change in the volatility of S &P CNX Nifty, but the structure of volatility has changed to some extent. They also found mixed effect in case of 10 individual stocks. Purohit, Chhatwal, & Puri (2014) focused towards empirically testing the volatility of the Indian stock Market owing to the selected variables like Nifty index, Nifty junior, one month Futures on Nifty index and Nifty turnover. They also analysed the impact of derivative trading on volatility of Spot market and investigate the dynamic relationship between all the series returns. The objectives of the study were explained by employing Johansen's co-integration test and GARCH model. They found that there is long run relationship between the series and it is the Nifty index that brings the volatility in the VIX not the one month Futures.

Objectives of Study

1. To analyze the co-integration and causal relationship between the Spot prices and Futures prices of energy sector stocks represented in S&P CNX Nifty.
2. To estimate the impact of Stock prices on Stock Futures prices on NSE.
3. To estimate the impact of Stock Index prices on Index Futures prices on NSE.
4. To study the volatility of stock market represented by S&P CNX Nifty Index-with reference to energy sector stocks.

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Hypothesis

To study the significant relationship between variables, following hypotheses are used

H01: There is presence of unit root in the series.

H02: There is no long run relationship between variables.

H03: Spot price does not granger cause Futures price.

H04: Futures price does not granger cause Spot price.

H05: There is no significant impact of Spot prices on Futures prices of variables.

Methodology of Study

a) Collection of Data

The study is based on secondary data i.e. Spot and Futures prices of Bharat Petroleum Corporation Ltd., Cairn India Ltd., GAIL (India) Ltd., NTPC Ltd., Oil & Natural Gas Corporation Ltd., Power Grid Corporation of India Ltd., Reliance Industries Ltd., Tata Power Co. Ltd. and indices such as S&P CNX Nifty and Nifty index Futures. All data has been collected from website of NSE (www.nse.com). The stocks are selected based on energy sector.

b) Period of the Study

The study is undertaken for the period of 5 years from January 2011 to December 2015.

c) Research Design

The stocks considered for research are from energy sector. Daily returns of all the variables for both Spot and Futures prices are calculated as log returns using the following equations:

$$R_{S_1 t} = \ln[\frac{S_t}{S_{t-1}}] \qquad R_{F_1 t} = \ln[\frac{F_t}{F_{t-1}}]$$

R_s – Daily Spot returns

R_f – Daily Futures returns

S_t – Closing price of stock for Spot

F_t – Closing price of stock for Futures

t – Corresponding day

In this study Stationarity of the prices are tested using ADF test. Johansan's co-integration test is used to test the presence of long term equilibrium relationship between the Spot

and Futures prices of stocks and index. The Vector Error correction model is used to analyse the error correction mechanism which occur disequilibrium between them. Granger Causality test is used to determine causal relationship between Spot and Futures prices of variables. OLS model is used to check if there is significant impact of Spot prices on Futures prices. The GARCH model is used to analyse the volatility of stock market represented by S&P CNX Nifty Index along with influence by energy sector stocks under study.

The analysis has been done with the help of software's like MS Excel and Eviews.

Statistical Techniques

a) Augmented Dickey- fuller test (ADF)

Augmented Dickey- fuller test is used for testing unit root. In autoregressive time series models the presence of unit root causes a violation of the assumptions of classical linear regressions. A unit root means that the observed time series is not stationary. When non stationary time series are used in regression model one may obtain apparently significant relationships from unrelated variables. This phenomenon is called spurious regression. Therefore ADF test is used to check if time series data is stationary or not as non stationary data may give use inappropriate results.

b) Johanson's Co-integration Test

The co-integration test is useful in analysing the presence of stationary linear combination among the non stationary variables of the same order. If such combination is found, an equilibrium relationship is said to exist between the variables. The Johanson's co-integration test is applied in research to study relation between Spot and Futures prices of variables under study.

c) Vector Error Correction Model

When Futures and Spot prices are co-integrated, return dynamics of the both prices can be modelled through vector error correction model. Vector error correction model specifications allow a long-run equilibrium error correction in prices in the conditional mean equations (Engle and Granger, 1987). Similar approach has been used to model short run relationship of co-integrated variables (Harris et al. 1995; Cheung and Fung, 1997; Ghosh, Saidi and Johnson, 1999).

d) Granger Causality

Granger causality test has been performed to understand lead and lag relationship between the Spot and Futures prices of variables under study. The Granger causality test is a statistical test to find out whether one time series is useful in forecasting another. To measure the bivariate causality between

the variables of interest, particularly with the Spot and Futures prices, simple pair-wise granger causality tests are conducted.

e) Impulse Response

The impulse response explains the responsiveness of shock of variable effects the other variable. So for each variable in the system, a unit shock is applied to the error and the effect over time is analyzed. An impulse response refers to the reaction of any dynamic system I response to some external changes. In both the cases, the impulse response describes the reaction of the system as a function of time.

f) Ordinary Least Square (OLS) Model

Ordinary least-squares (OLS) regression is a generalized linear modelling technique that may be used to model a single response variable which has been recorded on at least an interval scale. The technique may be applied to single or multiple explanatory variables and also categorical explanatory variables that have been appropriately coded. In this paper OLS is applied to single explanatory variable to estimate the impact of Spot prices on Futures prices of variables under study where Spot prices is independent variable and Futures price is dependent variable.

g) GARCH Model

The volatility of stock price is estimated through Generalized Auto Regressive Conditional Hetroscedasticity (GARCH) model. The model is applied mainly to analyze the financial data. Statistically, volatility denotes strong autocorrelation in squared returns, which can be detected through Hetroscedasticity tests. GARCH is a generalized form of ARCH, which helps in judging the volatility (Bollerslev, 1986). GARCH captures the tendency for estimating time series data for volatility clustering. The model helps to know the behaviour of returns, where the behaviour of the dependent variables is postulated to be function of the past values of the dependent and independent variables (Engle, 2002). It enables the understanding of the relationship between information and volatility. In this paper GARCH Model is used to study the volatility of stock market represented by S&P CNX Nifty Index along with influence by energy sector stocks under study.

Variables

To explain the impact between Spot and Futures, Spot prices is considered as explanatory variable i.e. independent variable where as Future prices is considered as dependent variable. An independent variable is a variable that is being manipulated in an experiment in order to observe the effect on a dependent variable. The dependent variable is simply that, a variable that is dependent on an independent variable.

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Data Analysis and Findings

1. Descriptive Statistics

Table 1: Descriptive statistics of Spot and Futures prices of variables

		Mean	Std. dev.	Skewness	Kurtosis
BPCL	Spot	0.021909	2.89753	-11.7874	290.8568
	Futures	0.020991	2.85979	-11.4476	279.8675
CAIRN	Spot	-0.07135	1.93581	-0.35108	6.088012
	Futures	-0.07184	1.88635	-0.37085	6.267079
GAIL	Spot	-0.02487	1.80524	-0.15019	6.29801
	Futures	-0.02534	1.77836	-0.19612	6.86430
NTPC	Spot	-0.02612	1.71134	-0.39306	8.43982
	Futures	-0.02675	1.66860	-0.40553	8.29301
ONGC	Spot	-0.13522	4.53460	-25.9197	825.7292
	Futures	-0.13584	4.50828	-25.99207	828.6662
POWERGRID	Spot	0.03056	1.417906	-0.29784	7.634953
	Futures	0.029794	1.421691	-0.268102	8.099396
RELIANCE	Spot	-0.00285	1.704935	-0.060258	4.133421
	Futures	-0.00344	1.681668	-0.092112	4.252941
TATAPOWER	Spot	-0.24182	6.917722	-30.52596	1025.139
	Futures	-0.24202	6.924849	-30.4429	1021.4
NIFTY	Spot	0.021219	1.099668	-0.152303	4.637069
	Futures	0.021203	1.062623	-0.181167	4.584373
Source: Compilation by Author					

Table 1 shows the descriptive statistics of Spot and Futures data of Bharat Petroleum Corporation Ltd. (BPCL), Cairn India Ltd., GAIL (India) Ltd., NTPC Ltd., Oil & Natural Gas Corporation Ltd. (ONGC), and Power Grid Corporation of India Ltd., Reliance Industries Ltd., Tata Power Co. Ltd. and S&P CNX Nifty.

The mean indicates the average value for the last five years for Spot and Futures prices. It can be seen that the rate of return as given by the mean is greater for the Spot markets than compared with Futures market.

The volatility as given by the standard deviation is higher for TATAPOWER and ONGC. Both have a highly volatile Futures and Spot market as compared to other variables.

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The measure of skewness indicates that the data points of all variables both Spot and Futures prices are symmetric i.e. the data points lie within +/- 1 and are negatively skewed with the exception of BPCL, ONGC and TATAPOWER where in the data points do not lie within +/-1.

The kurtosis data points for all data series lies above three which indicates leptokurtic behaviour of the data series featuring sharper peaks longer and fatter tails on both the ends.

2 **Unit root test**

A unit root test helps to find out whether a time series data variable is stationary. Stationarity of Series is tested using Augmented Dickey–Fuller test. The hypothesis for testing stationarity of series using ADF test is:

H0- There is presence of unit root in the series.
H1- There is no unit root in the series.

Table 2.: Critical Values

Significance level	1% level	5% level	10% level
Critical Values	-3.43541	-2.86366	-2.56795

Table 3: Result of Stationarity at level

Variables	t- Statistics	Prob.*
BPCL	-35.20072	0.00
CAIRN	-27.4306	0.00
GAIL	-34.3808	0.00
NTPC	-36.1476	0.00
ONGC	-34.7259	0.00
POWERGRID	-37.6021	0.00
RELIANCE	-34.0482	0.00
TATAPOWER	-36.1294	0.00
BPCL FUT1	-35.0834	0.00
CAIRN FUT1	-36.5089	0.00
GAIL FUT1	-34.5057	0.00
NTPC FUT1	-35.5999	0.00
ONGC FUT1	-34.8064	0.00
POWERGRID FUT1	-37.3266	0.00

RELIANCE FUT1	-34.2924	0.00
TATAPOWER FUT1	-36.1383	0.00
NIFTY	-33.6015	0.00
NIFTY FUT1	-32.2558	0.00

Source: Compilation by Author

Table 2 shows the critical values of ADF test at level. All the series are tested at level for stationarity. The results of stationarity of all the series at level is given in table 3. Comparing Table 2 and Table 3 shows that t-statistics of ADF test is less than the critical value in all the series, so the null hypothesis is rejected i.e. There is unit root in series and accept the alternate hypothesis. This shows that all the series are stationary at level. Now since data is stationary it can be used to perform further analysis.

3. Johansen test for Co-integration

The Johansen test for co-integration helps to find out whether there is presence of co integrating relationship between Spot and Futures prices. The main aim of this test is to find out whether there is long-term relationship between variables or not. The results of the test are given in table 4.3. This test tries to find the number of co integrating equations using maximisation of Eigen values and trace test. Here this test tries to determine the long term relationship or association between the Spot prices and Futures prices.

Table 4: Johansen test for co integration (Spot and Futures)

Variables	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Critical Value	Probability*
BPCL	None *	0.26265	599.8115	15.4947	0.0001
	At most 1 *	0.16522	223.2065	3.8414	0.0000
CAIRN	None *	0.231815	589.0812	15.49471	0.0001
	At most 1 *	0.191746	263.118	3.8414	0.0000
GAIL	None *	0.272641	636.2998	15.4947	0.0001
	At most 1 *	0.178375	242.8377	3.8414	0.0000
NTPC	None *	0.210619	506.9616	15.4947	0.0001
	At most 1 *	0.159415	214.6401	3.8414	0.0000
ONGC	None *	0.242717	577.1212	15.4947	0.0001

	At most 1 *	0.172138	233.4914	3.8414	0.0000
POWERGRID	None *	0.237961	574.7401	15.4947	0.0001
	At most 1 *	0.175718	238.8481	3.8414	0.0000
RELIANCE	None *	0.267723	614.2327	15.4947	0.0001
	At most 1 *	0.169191	229.0988	3.8414	0.0000
TATAPOWER	None *	0.24844	574.107	15.49471	0.0001
	At most 1 *	0.163796	221.0995	3.841466	0.0000
NIFTY	None *	0.264348	606.2514	15.49471	0.0001
	At most 1 *	0.167645	226.801	3.841466	0.0000
Note: * denotes rejection of null hypothesis at 5 percent significance					

Source: Compilation by Author

Thehypothesis to test the long-term relationship between variables using Johansen integration test is

H0: There is no long run relationship between variables.

H1: There is long run relationship between variables.

Reject H0 if $p < 0.05$

From the above table 4, the p-values of trace statistics in all cases is less than 0.05. So at 5% significance level, the null hypothesis that there is no long run relationship between variables is rejected and alternate hypothesis that there is long run relation between variables is accepted. This shows that Spot prices and Futures prices of respective variables are co-integrated i.e. there exists long run relationship between the data series.

4. Vector Error Correction Model

The Johansen test helps us in understanding the association and long term trends in movement among both the markets. The Vector error correction model helps in analysing the short run co-integration between both the markets. It explains the direction and significance of long run and short run co-integration that each market can have on one another.

Table 5 : Estimates of vector correction model

Variables	Cs	s,t-1	S,t-2	f,t-1	f,t-2	constant
BPCL	-2.5127*	1.8119*	0.6233*	-2.4245*	-0.9080*	0.0002
CAIRN	-1.7206*	1.2497*	0.3179*	-1.8811*	-0.6508*	-0.0013
GAIL	-1.7529*	1.2622*	0.6472*	-1.8811*	-0.9745*	0.0006
NTPC	-0.5846*	0.1246	-0.047	-0.8079*	-0.3040*	0.0015
ONGC	-4.1916*	3.2434*	1.7493*	-3.8723*	-2.0573*	0.0021
POWERGRID	-0.9936*	0.5706*	0.2452*	-1.2407*	-0.5375*	-0.0004
RELIANCE	-3.8770*	3.0033*	1.3455*	-3.5054*	-1.5860*	-0.0003
TATAPOWER	-1.4178*	1.4127	0.1828	-2.0957	-0.5124	-0.0001
NIFTY	-1.5222*	-0.9817*	-0.2715*	0.4150	-0.0190	0.00021
Note: * indicates rejection of null hypothesis at 5 percent.						

Source: Compilation by Author

The above table shows the co-efficient of VECM model with the Futures prices (Futures market) as dependant variable and the Spot prices (Spot market) as explanatory variable. It can be seen from the above table that the error co-efficient Cs which is the long term co-integration coefficient, is negatively significant for all the variables. This shows that is long term error correction flowing from the Spot market to the Futures market.

The following error correction variables are explained as:

S,t-1 : Spot one day lag

$S_{,t-2}$: Spot two day lag

$f_{,t-1}$: Futures one day lag

$f_{,t-2}$: Futures two day lag

The table shows that St-1 and St-2 is significant for all the variables, which signifies that there exist short run co-integration between the Spot and Futures prices except for NTPC and TATAPOWER for which St-1 and St-2 is not significant, which signifies that there exist no short run co-integration between the Spot and Futures prices. It implies that Futures prices in the short run move independently of Spot prices for NTPC and TATAPOWER whereas for other variables, it implies that Futures prices in the short run are dependent of Spot prices.

It can be observed that Ft-1 and ft-2 is significant across all the variables except for TATAPOWER and NIFTY which explains that Futures one lag and Futures two day lag returns influence the present day Futures prices except for TATAPOWER and NIFTY.

5**. Granger Causality**

The Granger causality test is a statistical test to find out whether one time series is useful in forecasting another. The null hypotheses to test the granger causality are as follows.

H1: Spot price does not granger cause Futures price.

H2: Futures price does not granger cause Spot price.

Reject H0 if $p < 0.05$

To measure the bivariate causality between the variables, particularly with the Spot and Futures prices, simple pair-wise granger causality tests are conducted and the results are shown in table

Table 6: Granger Causality for variables

Null Hypothesis	F-statistic	Prob.	Remark
BPCL_SPOT does not Granger Cause BPCL_FUTURES	2.01698	0.133	Unidirectional
BPCL_FUTURES does not Granger Cause BPCL_SPOT	6.29584	0.001*	
CAIRN_SPOT does not Granger Cause CAIRN_FUTURES	0.54885	0.577	Unidirectional
CAIRN_FUTURES does not Granger Cause CAIRN_SPOT	5.38294	0.004*	

GAIL_SPOT does not Granger Cause GAIL_FUTURES	0.32473	0.722	No
GAIL_FUTURES does not Granger Cause GAIL_SPOT	2.87701	0.056	
NTPC_SPOT does not Granger Cause NTPC_FUTURES	2.73706	0.065	Unidirectional
NTPC_FUTURES does not Granger Cause NTPC_SPOT	9.31344	0.000*	
ONGC_SPOT does not Granger Cause ONGC_FUTURES	37.3117	0.000*	Bidirectional
ONGC_FUTURES does not Granger Cause ONGC_SPOT	39.2531	0.000*	
POWERGRID_SPOT does not Granger Cause POWERGRID_FUTURES	1.46014	0.232	Unidirectional
POWERGRID_FUTURES does not Granger Cause POWERGRID_SPOT	6.00484	0.002*	
RELIANCE_SPOT does not Granger Cause RELIANCE_FUTURES	0.50805	0.601	No
RELIANCE_FUTURES does not Granger Cause RELIANCE_SPOT	0.84962	0.427	
TATAPOWER_SPOT does not Granger Cause TATAPOWER_FUTURES	2.48347	0.083	Unidirectional
TATAPOWER_FUTURES does not Granger Cause TATAPOWER_SPOT	4.38972	0.012*	
NIFTY_SPOT does not Granger Cause NIFTY_FUTURES	1.08003	0.339	Unidirectional
NIFTY_FUTURES does not Granger Cause NIFTY_SPOT	3.9599	0.019*	
Note: * denotes rejection of null hypothesis at 5 percent significance			

Source: Compilation by Author

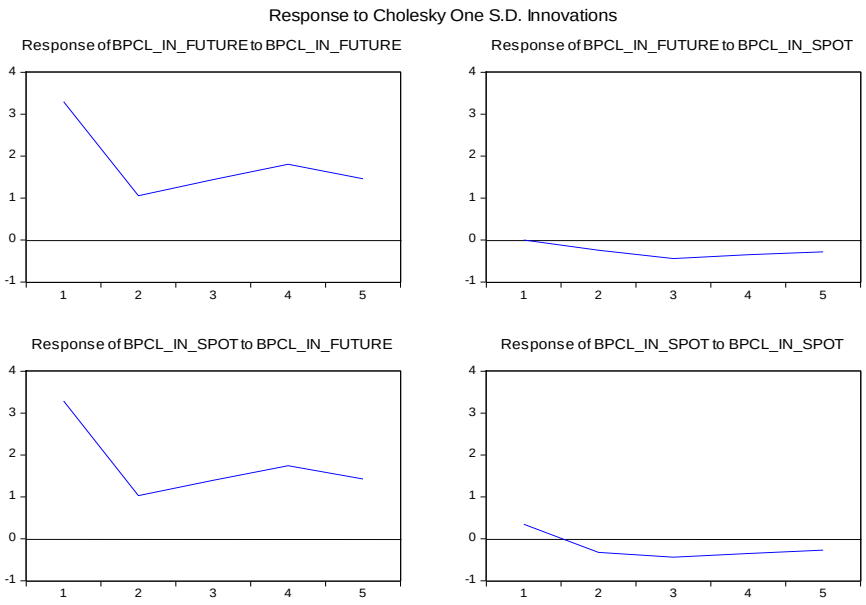
Table 6 shows the result of Granger causality test for BPCL, CAIRN, GAIL, NTPC, ONGC, POWERGRID, RELIANCE, TATA POWER and NIFTY. The null hypothesis is rejected if p-value is less than 0.05 and the alternate hypothesis is accepted.

The result shows that BPCL has unidirectional Granger causality i.e. Futures prices of BPCL has effect on Spot prices of BPCL as null hypothesis is rejected at 5 percent significance whereas Spot prices has very less effect on Futures prices as null hypothesis is accepted at 5 percent significance during price discovery process. In case of CAIRN, there is also unidirectional causality with respect to Spot and Futures prices of CAIRN. The Spot prices of CAIRN do not have effect on Futures prices but Futures prices play a crucial role in price discovery process. The result of GAIL shows that there is no granger causality with respect to Spot and Futures prices i.e. Futures prices and Spot prices has no effect on each other during price discovery process. In case of ONGC there is bidirectional Granger causality i.e. Futures prices and Spot prices has the effect on each other during price discovery process. The result of POWER GRID, TATA POWER and NIFTY shows unidirectional Granger causality i.e. their Futures prices has effect on Spot prices during price discovery process whereas their Spot prices has very less effect on Futures prices during price discovery process. Lastly the result of RELIANCE shows that there is no granger causality with respect to Spot and Futures prices.

6. **Impulse Response**

The impulse response explains the responsiveness of shock of variable effects the other variable. So for each variable in the system, a unit shock is applied to the error and the effect over time is analyzed. An impulse response refers to the reaction of any dynamic system response to some external changes. In both the cases, the impulse response describes the reaction of the system as a function of time.

Graph 1: Impulse Response of BPCL



Graph 2: Impulse Response of CAIRN

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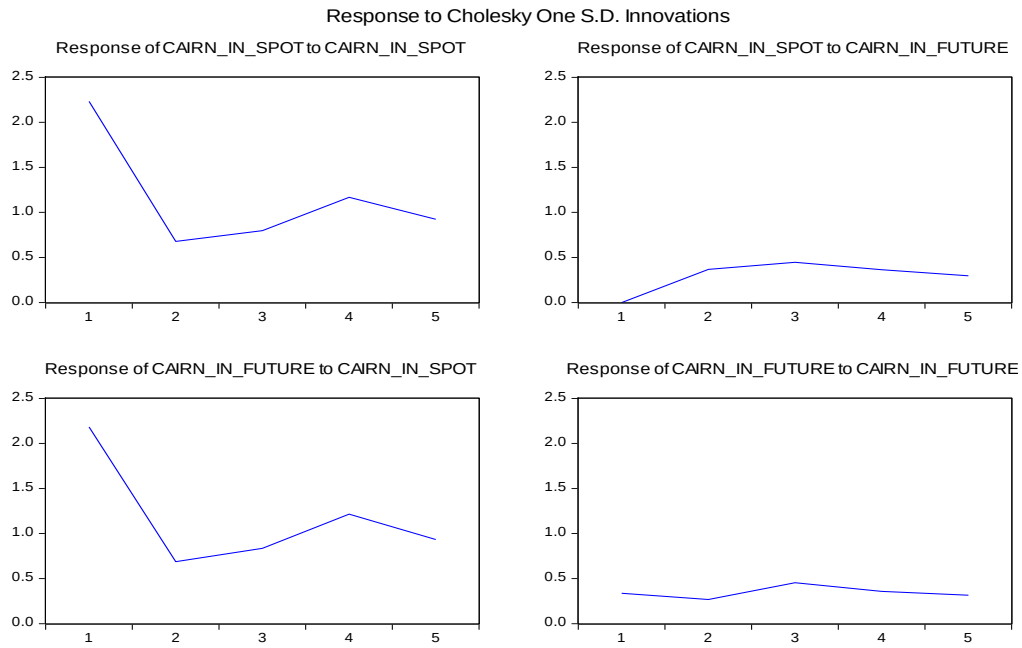
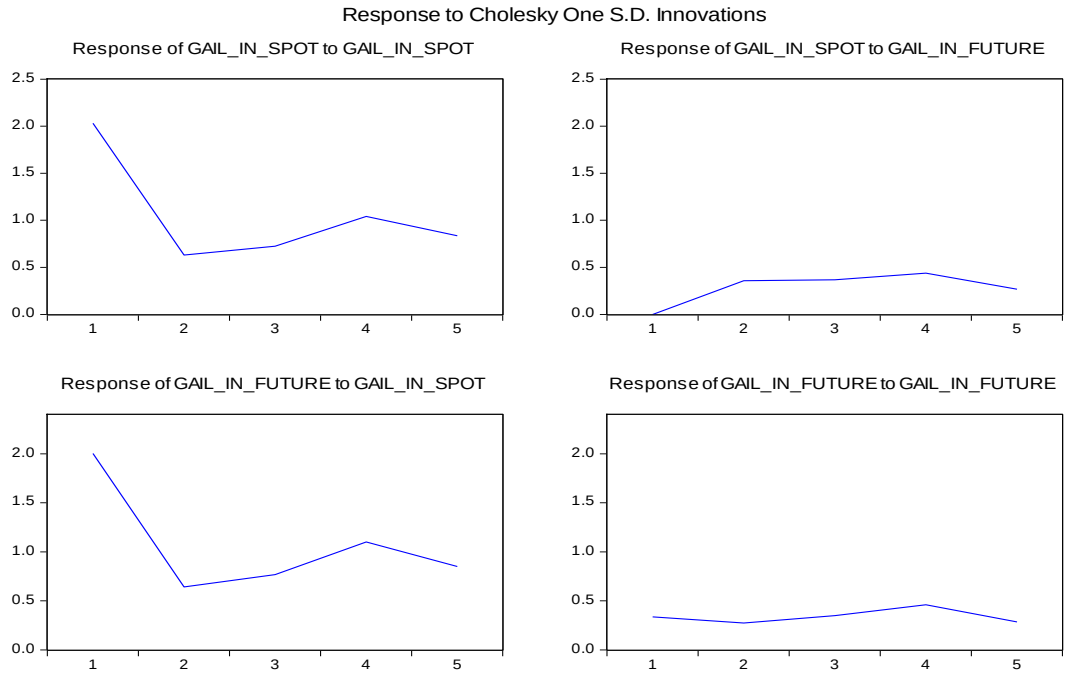


Graph 3: Impulse Response of GAIL



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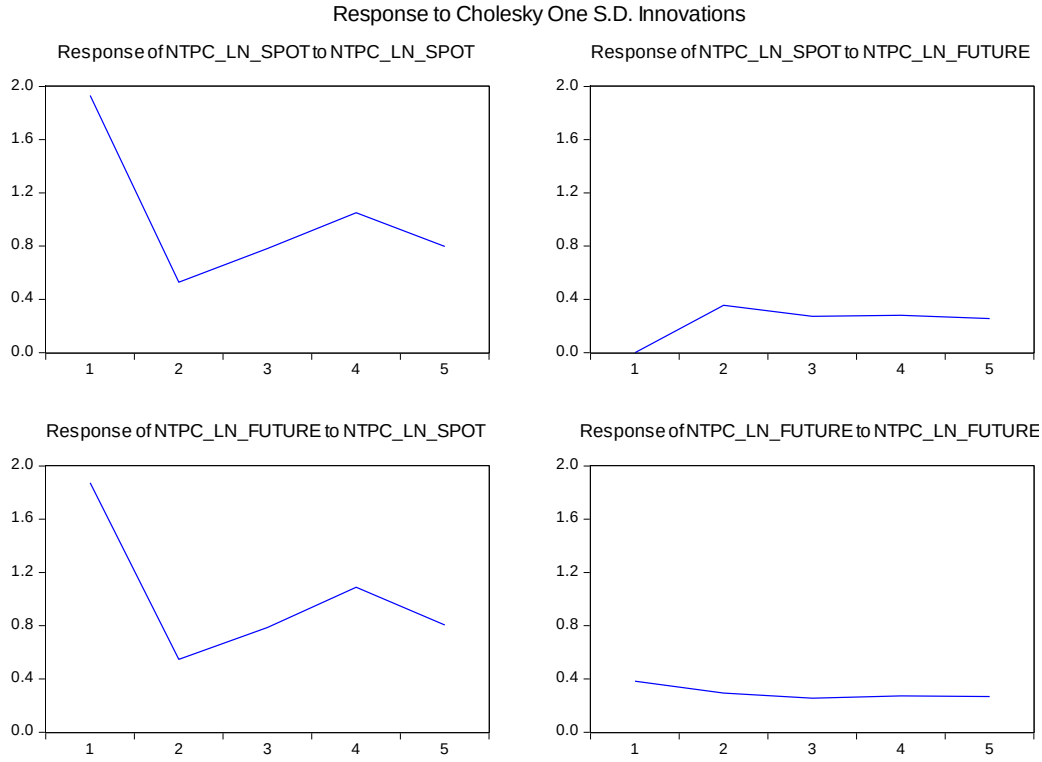
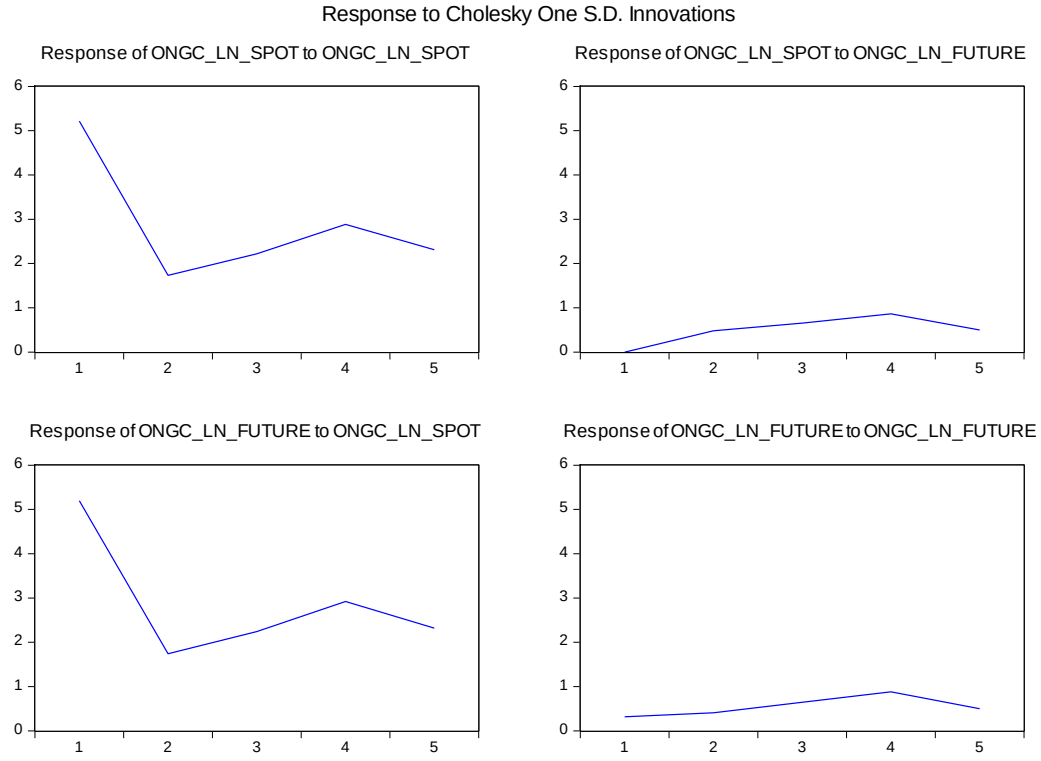
Graph 4: Impulse Response of NTPC



Graph 5: Impulse Response of ONGC



Graph 6: Impulse Response of POWERGRID

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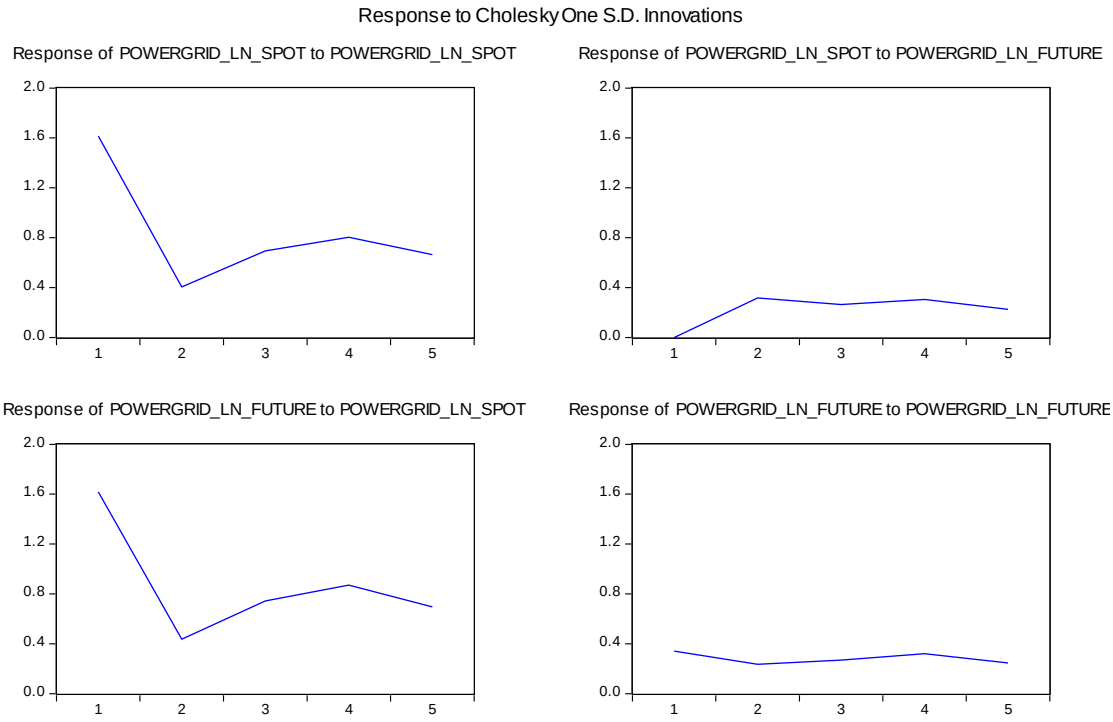
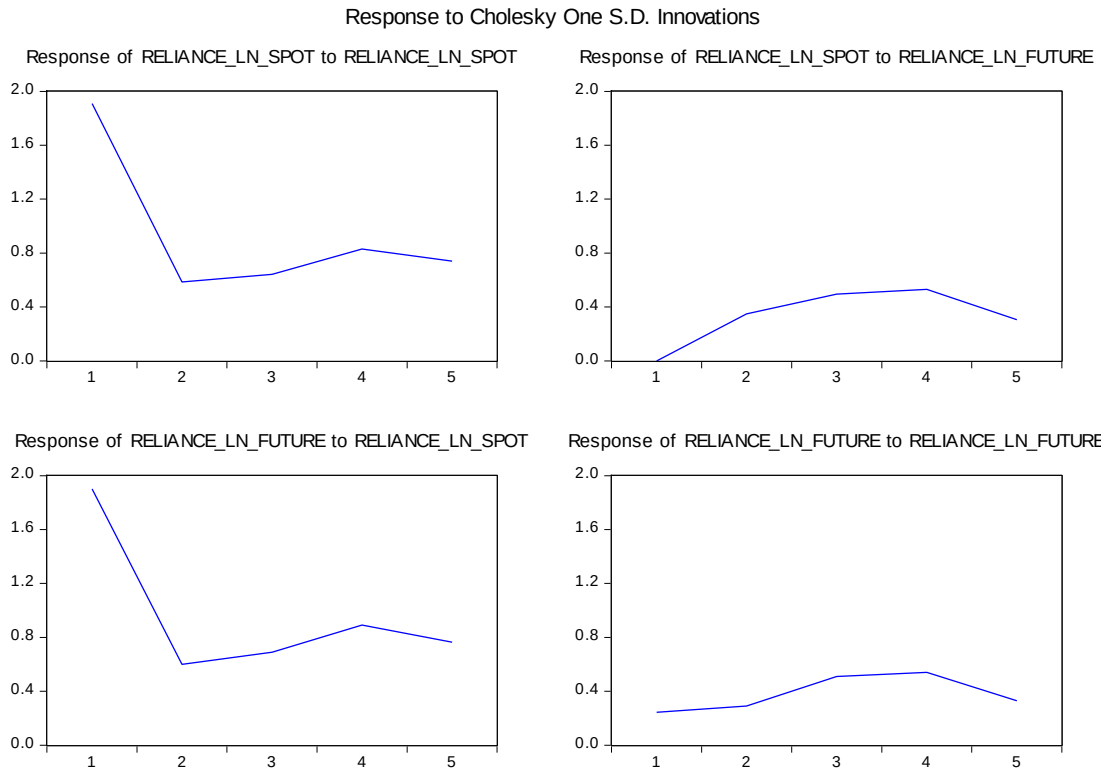


Graph 7: Impulse Response of RELIANCE



Graph 8: Impulse Response of TATAPOWER

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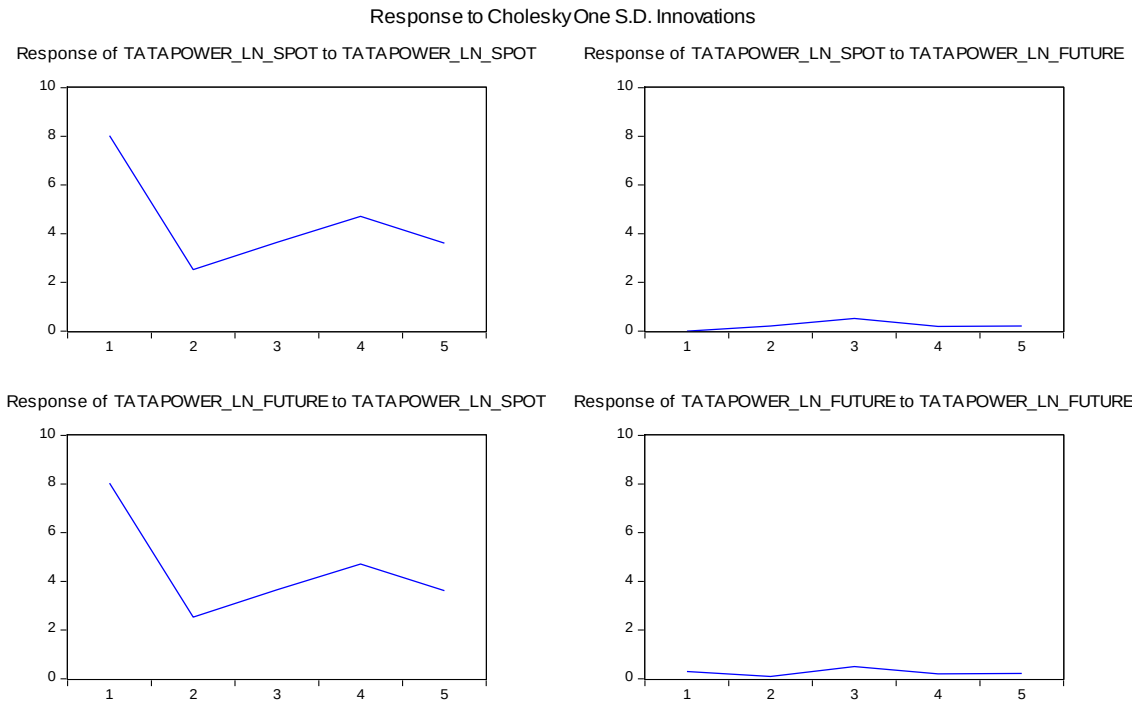
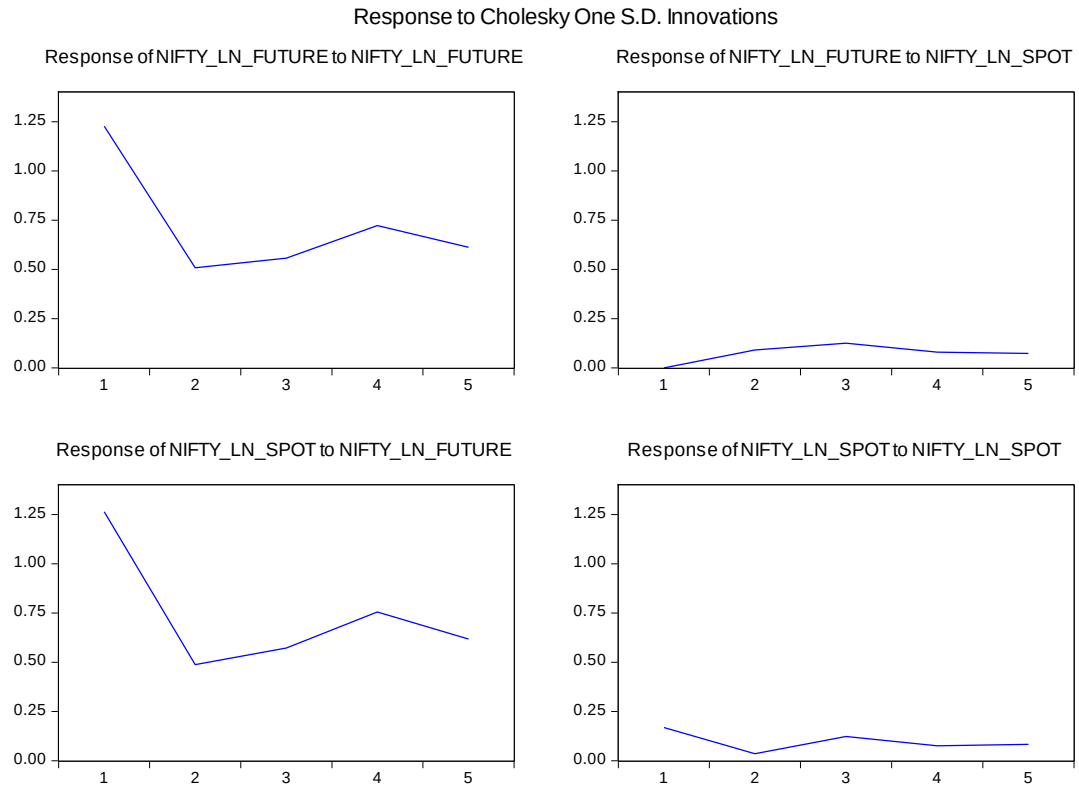


Graph 9: Impulse Response of NIFTY



Above figures shows response in Spot prices because of one standard deviation shock given by Futures prices, response in Spot prices because of one standard deviation shock given by Spot prices itself, response in Futures prices because of one standard deviation shock given by Spot prices and response in Futures prices because of one standard deviation shock given by Futures prices itself over the time period.

It can be seen that there is positive impact in Spot prices of all variables because of one standard deviation shock given by their Futures prices over period of time. There is also positive impact in Spot prices of all variables because of one standard deviation shock given by Spot prices itself over period of time except for BPCL where there is negative impact in Spot prices.

It can be also seen that there is positive impact in Futures prices of all variables because of one standard deviation shock given by their Spot prices over period of time except for BPCL where there is negative impact in Futures prices. Lastly there is positive impact in Futures prices of all variables because of one standard deviation shock given by their Futures prices itself over period of time.

7 **OLS Model**

Ordinary least square (OLS) model is used to check if there is impact of Spot prices on Futures prices where Futures prices is dependent variable and Spot prices is independent variable. It is used to determine the significance of coefficient of independent variables. The hypothesis for testing impact of Spot on Futures prices using OLS model is

H0: There is no significant impact of Spot prices on Futures prices of variables.

H1: There is significant impact of Spot prices on Futures prices of variables.

Reject H0 if $p < 0.05$

If the coefficient of independent variable i.e. Spot prices is significant then it can be said that there is impact of Spot prices on Futures prices. The result of OLS test is summarized in table 7.

Table 7: Result of OLS test for variables

Variables	Coefficient	t-Statistic	Prob.	Adjusted R-squared	D-W stat.
BPCL SPOT	0.9794	283.3579	0.00*	0.9847	2.43
CAIRN SPOT	0.9578	188.4559	0.00*	0.9662	2.58
GAIL SPOT	0.9665	178.8725	0.00*	0.9626	2.47
NTPC SPOT	0.9490	149.2902	0.00*	0.9472	2.28
ONGC SPOT	0.9916	489.4295	0.00*	0.9948	2.45
POWERGRID SPOT	0.9726	140.4742	0.00*	0.9408	2.49
RELIANCE SPOT	0.9756	237.4929	0.00*	0.9784	2.55
TATAPOWER SPOT	0.9999	766.9454	0.00*	0.9978	2.63
NIFTY SPOT	0.9529	209.6807	0.00*	0.9725	2.51
Note: * denotes rejection of null hypothesis at 5 percent significance					

Source: Compilation by Author

The table 7 explain the result of OLS model with the Futures prices as dependant variable and the Spot prices as explanatory variable. It can be seen that coefficient of independent variable (Spot prices) of all variables are significant i.e. the null hypothesis is rejected at 5 percent significance which shows that there is significant impact of Spot prices on Futures prices of respective variables. The result of BPCL shows that if there is 1% change in Spot price then Futures prices will change by 0.9794%. The Adjusted R-squared is 0.98 which tells that 98% variations in Futures prices are explained by Spot prices. CAIRN result shows that there is 0.9578% change in Futures prices because of 1% change in Spot prices of CAIRN. It can be also seen about 96% variations in Futures prices are explained by its Spot price as per Adjusted R-squared. The result of GAIL shows that 1% change in its Spot prices changes Futures prices by 0.9665%. The Adjusted R-squared is 0.96 which tells that 96% variations in Futures prices are explained by Spot prices. NTPC result shows that there is 0.9490% change in Futures prices because of 1% change in its Spot prices. It can be also seen about 94% variations in Futures prices are explained by its Spot price as per Adjusted R-squared. The result of ONGC shows that if there is 1% change in Spot price then Futures prices will change by 0.9916%. The Adjusted R-squared is 0.99 which tells that 99% variations in Futures prices are explained by its Spot prices.

POWERGRID result shows that there is 0.9726% change in Futures prices because of 1% change in its Spot prices. It can be also seen about 94% variations in Futures prices are explained by its Spot price as per Adjusted R-squared. The result of RELIANCE shows that there is 0.9756% change in Futures prices because of 1% change in Spot prices of RELIANCE. About 97% variations in Futures prices are explained by its Spot price as per Adjusted R-squared.TATAPOWER result shows that if there is 1% change in Spot price then Futures prices will change by 0.9999%. The Adjusted R-squared is 0.99 which tells that 99% variations in Futures prices are explained by its Spot prices.S&P CNX Nifty result shows that about 97% variations in Futures prices are explained by its Spot prices as per Adjusted R-square. The coefficient of nifty Spot is 0.9529 shows that 1% changes in nifty's Spot prices changes its Futures price by 0.9529%. Overall it can be seen that there is significant impact of Spot prices on Futures prices of respective variables under study. Variations in Futures prices are caused by its Spot prices by more than 90% in all the variables. Durbin-Watson statistics of the all variable is close to 2 which show that there is no autocorrelation problem in the model. This show that model is good.

8 GARCH Model

The volatility of Nifty 50 is estimated using Generalized Auto Regressive Conditional Hetroscedasticity (GARCH) model. Here GARCH Model is used to study the volatility of stock market represented by S&P

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CNX Nifty Index along with influence by energy sector stocks under study. The result of GARCH model is summarized in the table 8

Table 8: Estimate of GARCH (1, 1) for S&P CNX Nifty

Variable	Coefficient	Std. Error	Z-Statistic	Prob.
C	0.024147	0.008539	2.827929	0.0047*
RESID(-1)^2	0.029198	0.007695	3.794276	0.0001*
GARCH(-1)	0.945432	0.012678	74.57096	0.0000*
BPCL SPOT	-0.00597	0.005342	-1.11702	0.2640
CAIRN SPOT	-0.00786	0.007376	-1.06616	0.2864
GAIL SPOT	-0.01885	0.007001	-2.69195	0.0071*
NTPC SPOT	-0.00212	0.008841	-0.23958	0.8107
ONGC SPOT	-0.00047	0.004427	-0.10563	0.9159
POWERGRID SPOT	0.023198	0.014936	1.55314	0.1204
RELIANCE SPOT	-0.02113	0.009852	-2.14446	0.0320*
TATAPOWER SPOT	-0.01224	0.007295	-1.67778	0.0934
Note: * indicates rejection of null hypothesis at 5 percent.				

Source: Compilation by Author

In table 8, C is coefficient of Nifty 50 index returns. The coefficient of S&P CNX Nifty is 0.024147. RESID(-1)^2 is previous period's squared residual i.e. previous day's S&P CNX Nifty information about volatility that is ARCH term(α). GARCH(-1) is conditional variance (β). The coefficient of ARCH and GARCH are significant, which shows the persistence of information effect on the S&P CNX Nifty returns volatility. In simple terms the volatility in NIFTY 50 is due to internal shocks i.e. both the last period's squared residual and conditional variance. The ARCH coefficient (α) is low (0.029198) indicates less impact of previous events or news in India. The GARCH coefficient (β) is very high i.e. (0.945432) which shows that the volatility of nifty 50 is very high due to its own previous returns. The sum of coefficient of ARCH and GARCH (α + β) is close to one during the analysis period i.e. 0.97463, indicating high persistence of volatility. The information effect on the conditional variance is lasting and will take a long time to die away. It can be also observed that from all stocks of energy sector, only GAIL and RELIANCE has significant impact over S&P CNX Nifty volatility i.e. volatility in S&P CNX Nifty is due to GAIL and RELIACE from energy sector stocks.

Findings

The descriptive statistics of the study has shows that the rate of return as given by the mean is greater for the Spot markets than compared with Futures market. Standard deviation is higher for TATAPOWER and ONGC in both Futures and Spot market which shows that they are highly volatile as compared to other variables. The measure of skewness indicates that the data points of all variables both Spot and Futures prices are symmetric except for BPCL, ONGC and TATAPOWER where data points do not lie within +/-1. The kurtosis data points for all data series lies above three which indicates leptokurtic behaviour of the data series.

ADF test was performed to analyse the stationary of data and it is found that all the data was stationary at level. Further Johanson's Co-integration test was carried out to see long term relationship between Spot and Futures market and test revealed that both Futures and Spot prices are correlated to each other. Return dynamics of the both Spot and Futures prices is modelled through vector error correction model. It revealed the error co-efficient Cs which is the long term co-integration coefficient, is negatively significant for all the variables. This shows that is long term error correction flowing from the Spot market to the Futures market. VECM also revealed that there exists short run co-integration between the Spot and Futures prices except for NTPC and TATAPOWER which implies that Futures prices in the short run are dependent of Spot prices except for NTPC and TATAPOWER. To analyse the causal relationship between Spot and Futures returns Granger causality test was used and the result showed that there is bidirectional relationship between Spot and Futures for ONGC. In case of BPCL, CAIRN, NTPC, POWERGRID, TATAPOWER and NIFTY, there is unidirectional relationship i.e. Futures market has effect the Spot market. Impulse Responses test revealed that there is positive impact in Spot prices of all variables because of one standard deviation shock given by their Futures prices over period of time. It can be also seen that there is positive impact in Futures prices of all variables because of one standard deviation shock given by their Spot prices over period of time except for BPCL where there is negative impact in Futures prices.

OLS Model was used to estimate the impact of Spot market on Futures market and test revealed that Spot prices of all variables have significant impact on their respective Futures prices i.e. Spot market has significant impact on Futures market. GARCH Model was used to study the volatility of stock market represented by S&P CNX Nifty Index along with influence by energy sector stocks under study. The test revealed that value of beta is greater than the alpha suggesting past conditional variance has greater impact on volatility of S&P CNX Nifty returns then recent news announcement. High beta shows presence of volatility because of old news. It was be also observed that from all stocks of energy sector, only GAIL and RELIANCE has significant impact over S&P CNX Nifty volatility i.e. volatility in S&P CNX Nifty is due to GAIL and RELIACE from energy sector stocks.

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