An Empirical Investigation into Casual Relation of Spot and Future Markets and Hedging Effectiveness with reference to NSE Futures

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ABSTRACT-The investigation of the Co-integration and causal relationship between futures and spot prices is very significant especially in an emerging market economy like India. Indian capital market has witnessed significant transformations and structural changes due to implementation of financial sector. This paper examines the relation and impact of Spot prices on Futures prices of NSE Futures contracts and also investigates the optimal hedge ratio and hedging effectiveness of the contracts traded on CNX NIFTY INDEX in India using OLS Model, VAR Model and VECM Model. The Johansen-Juselius Co-integration test used in the study finds two Co-integrating equations indicating long run relationship between Futures and Spot prices of all Future contracts. The Vector Error Correction Model stated that apart from having a long run relationship the prices of Futures are influenced by the prices of Spot in short run in most of the cases whereas in few cases it is vice versa. From Impulse Response graph in case of Spot prices and all the contracts it was found that Spot and Futures markets are highly sensitive to each other's shocks. From the Granger Causality test it was found that there is unidirectional Granger Causality running from Futures prices to the Spot prices for all contracts. This means that Futures plays an important role in explaining the movements in Spot prices. Also Ordinary Least Square Model which was used to study the impact of Spot prices on Futures prices showed a significance which means Futures is impacted by the Spot prices in all the contracts. The indication presented in this study strongly suggests that the Nifty Index Futures contracts are an effective tool for hedging risk.

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

I. Introduction

The investigation of the Co-integration and causal relationship between futures and spot prices is very significant especially in an emerging market economy like India. Indian capital market has witnessed significant transformations and structural changes due to implementation of financial sector. This paper examines the relation and impact of Spot prices on Futures prices of NSE Futures contracts and also investigates the optimal hedge ratio and hedging effectiveness of the contracts traded on CNX NIFTY INDEX in India using OLS Model, VAR Model and VECM Model.

II. Review of Literature

SaritaSatapathy and Dr.Nirmala Chandra Karstudied the causal relationship between Spot and Futures prices of NSE CNX Nifty and some selected stocks of Nifty (TATA Motors, ICICI Bank, INFOSYS, ACC and ONGC) for a period of 5 years i.e. from January 2010 to December 2014 with daily data. They found that there exist a long run relationship between Spot and Futures prices of Nifty and the five stocks considered in the study. **Pati and Padhan (2009)** led a study to find out the price discovery process and lead-lag relationship between NSE CNX Nifty Stock Index Futures and its underlying Spot index with the daily closing prices of Spot and Futures prices. The study suggested that there is long-run relationship between Spot and Futures prices, and the causality test found that there exists a unidirectional causal relationship running from Futures to Spot market. **Kailash Chandra Pradhan and Dr. K. Sham Bhat** investigated the causal relationship between the Spot and Futures on individual securities. The objectives of the study were examined by employing Johansen's co-integration test and vector error correction model (VECM). For the purpose of study the daily closing data was taken from November 9, 2001 to September 29, 2005 for the analysis. The study revealed that Futures leads the Spot in case of 9 individual securities, Spot leads the Futures in case of

7 individual securities and the feedback relation takes place between two markets in case of 9 individual securities. **N.Awang, N.A. Azizan, I. Ibrahim and R.M**. Said investigated the hedging effectiveness of stock index Futures markets in Malaysia and Singapore. The hedge ratio estimation methods applied for the study were conventional OLS model, VECM, EGARCH and bivariate GARCH. The study concluded that the higher hedging effectiveness given by Kuala Lumpur Futures Index (KLFI) was higher than the Straits Times Index (STI) Futures for OLS, VECM and EGARCH, whereas for bivariate GARCH the hedging effectiveness was higher in STI Futures as compare to KLFI. It was also found that the KLFI delivers more effective hedge for all hedge ratio estimation models then STI. Further the study concluded saying that the OLS model performs most effectively in both index Futures markets, followed by EGARCH and thus, the OLS model could function as a better hedging model than other static and time-varying models.

Vasantha G and T. Mallikarjunappa estimated constant and time varying hedging ratios for stock derivatives market taking in to consideration NSE Nifty Spot and its Futures contracts. Intraday data observed at one minute interval of six months was taken for the study from 1 January 2014 to 30 June 2014. The models used for the study were OLS and VECM models for constant hedge ratios and Generalized Autoregressive Conditional Heteroscedasticity model (GARCH) for time varying hedge ratio. Stationarity tests disclosed that the price series are non-stationary and return series are stationary. The study found that the constant hedge ratio models VECM gives highest hedge ratio as compare to OLS and GARCH model but the GARCH model gives highest hedging effectiveness then the other two models. Therefore, the study concluded that time varying hedging models are preferable than the constant hedge ratios. **SaumitraBhaduri and S. RajsSethuDurai** studied the optimal hedge ratio and hedging effectiveness of stock index Futures by analysing four competing models namely simple ordinary least squares (OLS), vector autoregression model (VAR), vector error correction model (VECM) and a class of multivariate generalized autoregressive conditional heteroscedastic model (GARCH).the multivariate GARCH model was used to estimate the time varying hedge ratio whereas the other models give a single point estimate. For the purpose of the study two sets of data were used, the daily data on NSE Stock Index Futures and S&P CNX Nifty Index for the time period of 5 years from 4th September 2000 to 4th August 2005 and for out of sample validation daily data from August 2005 to September 2005 was considered. The study found that the time varying hedge ratio resulting from the multivariate GARCH model generated the higher mean return and higher average variance reduction across hedged and un-hedged position. Further it was also concluded that the OLS model also performs well at shorter time horizon in terms of average variance reduction.

III. Objectives of the Study

1. To examine the causal relationship between Spot and Futures prices of NSE Index.
2. To study the impact of Spot prices on Futures prices of NSE Index.
3. To estimate the hedge ratio and hedging effectiveness of selected contracts traded on NSE Index using appropriate models.

IV. Hypothesis

To study the significant relationship between variables, following null hypothesis are used:

H_1: There is presence of unit root in the series.

H_2: There is no long run relationship between variables.

H_3: Spot prices does not Granger Cause Futures price.

H_4: Futures prices do not Granger Cause Spot prices.

H_5: There is no significant impact of Spot prices on the Futures price of variables.

V. Methodology

In this study we have used the Augmented Dickey–Fuller test (ADF) Test to check the stationary properties of the data / variable. Johansen Cointegration Test is being used to study the long-run relationship between the variables. Evidence of a Short-run relationship is derived by using the VECM model. The impulse response functions and forecast error variance decomposition results are reported further to cross check the dynamic relationship between the variables under consideration. Further, the Granger Causality results are reported to cross check the direction of causality between the variables. The entire variable is converted to logarithmic form to avoid heteroscedasticity and smoothen the series.

VI. 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 Johnson'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.

h) Estimating Hedging Effectiveness

The performance of the hedging strategies can be observed by discovering the hedging effectiveness of each strategy. In order to relate the performances of each category of hedging strategy, un-hedged position is built on the Spot market and the hedged position in particular Index is built with the combination of both the Spot and the Futures contracts. The hedge ratios projected from each strategy defines the number of Futures contracts to be held for reduction of risk. The hedging effectiveness is intended by the variance reduction in the hedged position associated to un-hedged position for each time horizon. According to Baillie and Myers (1991) and Park and Bera (1987) the returns on un-hedged and hedged positions are calculated as follows:

$$R_U = S_{t+1} - S_t$$

$$R_H = (S_{t+1} - S_t) - H(F_{t+1} - F_t)$$

Variances of Un-hedged and Hedged portfolio are:

$$Var(U) = \sigma_s^2$$

$$Var(H) = \sigma_S^2 + H^2\sigma_F^2 - 2H\sigma_{S,F}$$

Where, St and Ft are natural logarithm of Spot and Futures prices, H is the hedge ratio, RH and RU are returns from un-hedged and hedged portfolio, σS and σF are standard deviation of the Spot and Futures returns and σS,F is the covariance.

Hedging effectiveness is said to be the ratio of the variance of the un-hedged position subtracted by the variance of hedged position divided by the variance of un-hedged position.

$$\text{Effectiveness(E)} = \frac{(\text{Var(U)} - \text{Var(H)})}{\text{Var(U)}}$$

i) Variables of the study

To explain the impact of Spot prices on Futures prices, the Spot prices are considered as explanatory variable (independent variable) and the Futures prices are considered as the dependent variable. In the case of Futures the prices are taken contract wise i.e. for one month, near month and Far month. Different variables of the study are defined below in brief.

Spot Price: a Spot price is a present price at which a specific stock can be purchased or sold at a specific time and place.

Futures Price: Futures price is the anticipated value of a specific stock which is associated to the Spot price of that particular stock.

Futures contract: Futures contract is a predetermined arrangement, commonly made on the trading floor of a Futures exchange, to purchase or sell a specific commodity or financial instrument at a decided price in the Futures.

Near Month Contract: a near month contract in Futures is a contract which has the shortest maturity time i.e. 1 month. It is the contract which expires first.

Near to Next Month Contract: it is a Futures contract which expires after the near month contract has expired but before the expiry of far month contract.

Far Month Contract: a far month contract is a Futures contract that has an expiration date that is the farthest beyond the next approaching expiration date.

Empirical Analysis and Results

1. Descriptive Statistics:

Table 1: Descriptive Statistics of Spot and Near Month, Next Month and Far Month Contract

NIFTY INDEX	NEAR MONTH		NEXT MONTH		FAR MONTH	
	Futures	Spot	Futures	Spot	Futures	Spot
Mean	0.010133	0.021725	0.040574	0.040348	0.040318	0.040365
Median	0.060317	0.080849	0.065267	0.080849	0.070034	0.082049
Maximum	16.19468	16.33432	15.90677	16.33432	15.82442	16.33432
Minimum	-13.6774	-13.0142	-13.9914	-13.0142	-13.8955	-13.0142
Std. Dev.	1.67697	1.592154	1.65311	1.56727	1.64942	1.56794

	9		1	5	3	2
Skewness	-0.36563	-0.32062	-0.15554	-0.01994	-0.16342	-0.02006
Kurtosis	12.49242	13.2801	11.204	12.13216	11.1673	12.11663
Jarque-Bera	9313.342	10900.93	6919.979	8562.194	6856.542	8529.639
Observations	2466	2466	2464	2464	2463	2463

Table 1, depicts the summary statistics of contract wise Spot and Futures prices of Nifty Index and Nifty Futures i.e. for near month, next month and far month contracts. The mean value in near month and far month for Spot value is greater than the Futures, whereas for next month the Futures mean is larger than the Spot. The volatility of Spot and Futures prices is given by the standard deviation .The standard deviation of Spot in case of all the contracts is higher than the of Futures. Therefore Spot prices have higher volatility then the Futures prices. The measure of Skewness designates that the data points are symmetric for Spot and Futures prices of near, next and far month as the data point lie within +/- 1 and are moderately skewed. 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. The Jarque - Bera test is used to test the normality of the data series. The null hypothesis for the test is given as H0 = all the data series are normally distributed. As can be observed from the above tables we reject the null hypothesis. Hence, indicating that the data series aren't normally distributed

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2. Unit Root Test

A unit root test assist in determining whether a time series data variable is stationary. The Augmented Dickey Fuller test is a well – known test that is used to check if the data points are stationary and is been used on the closing prices of all the contracts.

From the Table 2, 3 and 4 it is been found that the hypothesis for all three contracts, i.e. Ho: LNSC and LNFC have unit root is rejected, as the P value of all the Spot and Futures prices is less than 0.05. Therefore the alternative hypothesis is accepted i.e. LNSC and LNFC does not have unit root. That means that return series are stationary. The data is stationary at level.

Table 2: Unit Root Test (ADF TEST) for Near Month

CNX NIFTY	LEVEL			
	LNSC		LNFC	
	t-statistics	Prob.*	t-statistics	Prob.*
Augmented Dickey-Fuller test statistic	-46.5844	0.0001	-48.4419	0.0001
Test Critical values:				
1% Level	-3.43281		-3.43281	
5% Level	-2.86251		-2.86251	
10% Level	-2.56733		-2.56733	

Note: Ho: LNSC and LNFC have unit root

Table 3: Unit Root Test (ADF TEST) for Next Month

CNX NIFTY	**LEVEL**			
	LNSC		**LNFC**	
	t-statistics	**Prob.***	**t-statistics**	**Prob.***
Augmented Dickey-Fuller test statistic	-46.8516	0.0001	-48.6144	0.0001
Test Critical values:				
1% Level	-3.43281		-3.43281	
5% Level	-2.86251		-2.86251	
10% Level	-2.56733		-2.56733	
Note: Ho: LNSC and LNFC have unit root				

Table 4: Unit Root Test (ADF TEST) For Far Month

CNX NIFTY	**LEVEL**			
	LNSC		**LNFC**	
	t-statistics	**Prob.***	**t-statistics**	**Prob.***
Augmented Dickey-Fuller test statistic	-46.8546	0.0001	-48.4352	0.0001
Test Critical values:				
1% Level	-3.43281		-3.43281	
5% Level	-2.86251		-2.86251	
10% Level	-2.56733		-2.56733	
Note: Ho: LNSC and LNFC have unit root				

3. Co-integration Test (Johansen Co-integration Test)

The Johansen test for co-integration attempts to discover the existence of co integrating relationship between the contract wise Spot and Futures prices. Table 5, 6 and 7 summarises the results of the test. It attempts to find the number of co integrating equations. With the help of following tables, the researcher has tried to determine the long term association and causal relationship between the Spot and Futures market. From the below tables, the Trace test indicates the existence of two co-integrating equation at 5% level of significance for all the three contracts i.e. one month, two month and three month contract. And, the maximum eigenvalue test rectifies this outcome. Therefore, the two variables of all the contracts exhibit a long run equilibrium relationship between them. The existence of co integrating equations holds the fact that there exists a causal relationship between both the markets throughout different contract durations. A strong association and causal relationship between Spot and Futures market also facilitates better and efficient hedging opportunities.

4. Vector Error Correction Model (VECM)

The Johansen Co-integration test assists in recognising the association and long term trends in the movement of both the markets. The VECM method is used to discover the stability nature of the model and examine the dynamic interaction among the variables. The Vector error correction model helps in studying the short run causality between both the markets. It describes the direction and significance of long run and short run causality that each market can have on one another. The error correction mechanism between both the markets helps in upholding the prices of both the markets at equilibrium.

The Tables 8, 9 and 10 explain the co-efficient of VECM model with the Futures market as dependant variable and the Spot market as independent variable. Hedging at all times takes place in the Futures market with the view point of the Spot market and for this the causality between both the markets is studied.

The Table 8, 9 and 10 shows that the error correction Cointegration equation is negatively significant for all the Futures contracts i.e. for 1 month, 2 month and 3 month contract. This displays that there is long term error correction flowing from the Spot market to the Futures market. This validates the previous finding derived from the Cointegration test that there must be at least one long term causal relationship in one direction.

Here the long term causal relationship is flowing from the Spot markets to the Futures market. The error correction variables are described as:

D(LNF(-1)) : Futures one day lag, **D(LNF(-2)) :** Futures two day lag, **D(LNS(-1)) :** Spot one day lag, **D(LNS(-2)) :** Spot two day lag.

Table 5(a)Unrestricted Cointegration Rank Test (Trace) for Near Month

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.225503	1057.397	15.49471	1
At most 1 *	0.159803	428.508	3.841466	0

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 5(b) Unrestricted Cointegration Rank Test (Maximum Eigenvalue) for Near Month

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.225503	628.8891	14.2646	0.0001
At most 1 *	0.159803	428.508	3.841466	0

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 6 (A) Unrestricted Cointegration Rank Test (Trace) for Next Month

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.264905	1236.498	15.49471	1
At most 1 *	0.17724	479.7275	3.841466	0

Trace test indicates 2 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table 6:(B) Unrestricted Cointegration Rank Test (Maximum Eigenvalue) for Next Month

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.264905	756.7702	14.2646	0.0001
At most 1 *	0.17724	479.7275	3.841466	0

Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table7:(A) Unrestricted Cointegration Rank Test (Trace) for Far Month

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.261589	1228.522	15.49471	1
At most 1 *	0.17844	483.1213	3.841466	0
Trace test indicates 2 cointegratingeqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 7(B) Unrestricted Cointegration Rank Test (Maximum Eigenvalue) for Far Month

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.261589	745.4009	14.2646	0.0001
At most 1 *	0.17844	483.1213	3.841466	0
Max-eigenvalue test indicates 2 cointegratingeqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 8: Vector Error Correction Model for Near Month Contract

NIFTY INDEX	D(LNF)		D(LNS)	
Error Correction	Coefficient	Prob.	Coefficient	Prob.
CointEq1	-1.14052	0.0078	0.359792	0.3753
D(LNF(-1))	0.225003	0.4959	0.072582	0.8167
D(LNF(-2)	0.348701	0.0651	0.284143	0.1126
D(LNS(-1))	-0.87649*	0.0093	-0.68649*	0.0316
D(LNS(-2))	-0.69779*	0.0003	-0.61542*	0.0008
C	-0.0005	0.9899	-0.00038	0.9919
*Note: * indicates rejection of null hypothesis at 5 per cent.*				

Table 9: Vector Error Correction Model for Next Month Contract

NIFTY INDEX	D(LNF)		D(LNS)	
Error Correction	Coefficient	Prob.	Coefficient	Prob.
CointEq1	-1.53318	0.0003	-1.53318	0.6309
D(LNF(-1))	0.505818	0.1205	0.505818	0.5469
D(LNF(-2)	0.466851*	0.0113	0.466851	0.0566
D(LNS(-1))	-1.16635*	0.0004	-1.16635*	0.0101
D(LNS(-2))	-0.80823*	0.0000	-0.80823*	0.0002
C	-0.000418	0.9913	-0.000330	0.9928
*Note: * indicates rejection of null hypothesis at 5 per cent.*				

Table 8 and 9 shows that LNS(-1) and LNS(-2) of the Spot and Futures prices are significant, which means that there exist a short run causal relationship between the Spot and Futures prices. It indicates the in short run the Futures prices of one month contract and two months contract are influenced by the Spot prices. In such cases hedging provides effective or optimal risk coverage, as it is possible to establish short run causality relationship between both the markets. In the case of three months contract as shown in table 9 LNS(-1) is significant only for Futures but insignificant for Spot and LNS(-2) is significant for Spot as well as Futures. This indicates that Spot one lag returns have no influence on current day Spot prices of three months contract but it does influence the Futures prices. It is witnessed that LNF(-1) is not significant for the Spot and Futures prices across all the three contracts, which explains that Futures one lag returns have no effect on the current day Futures prices. Likewise it can also be witnessed that LNF(-2) for Spot prices and Futures prices is significant only in 2 month contract where as it is insignificant for the other two contracts i.e. 1 month contract and 3 month contract. This implies that the Spot prices and the Futures prices in 2 month contract are influenced by Futures two days lag. To Summarize on VECM it can be said that in short run the Spot market and Futures market are affected by the previous movements in Spot prices but are not affected by the Futures price movements. It can is also incidental that Spot markets factor in new information and pass on the same to the Futures market in the long run.

5. Impulse Response

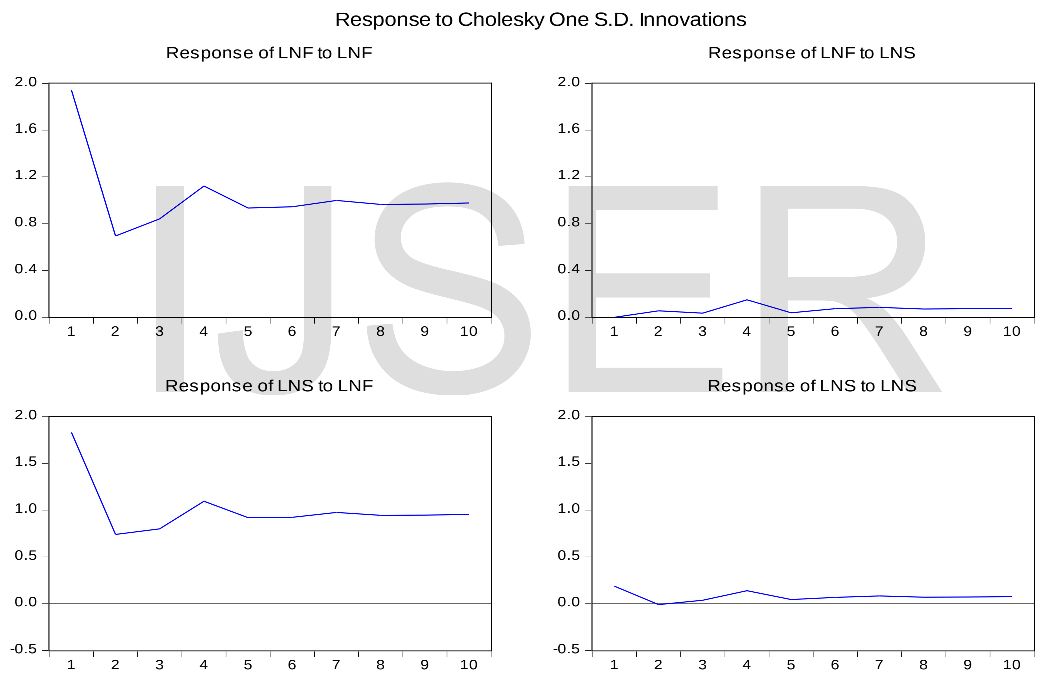

Figure:1 Impulse response chart for Spot and one month contract

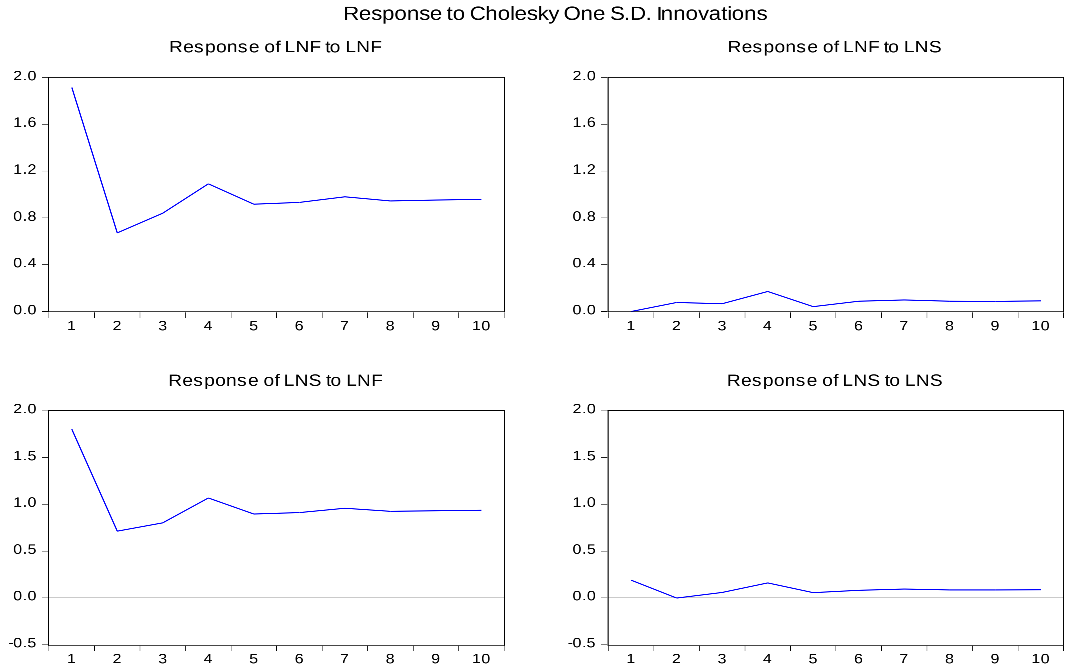

Figure :2 Impulse Response Chart for Spot and 2 month contract

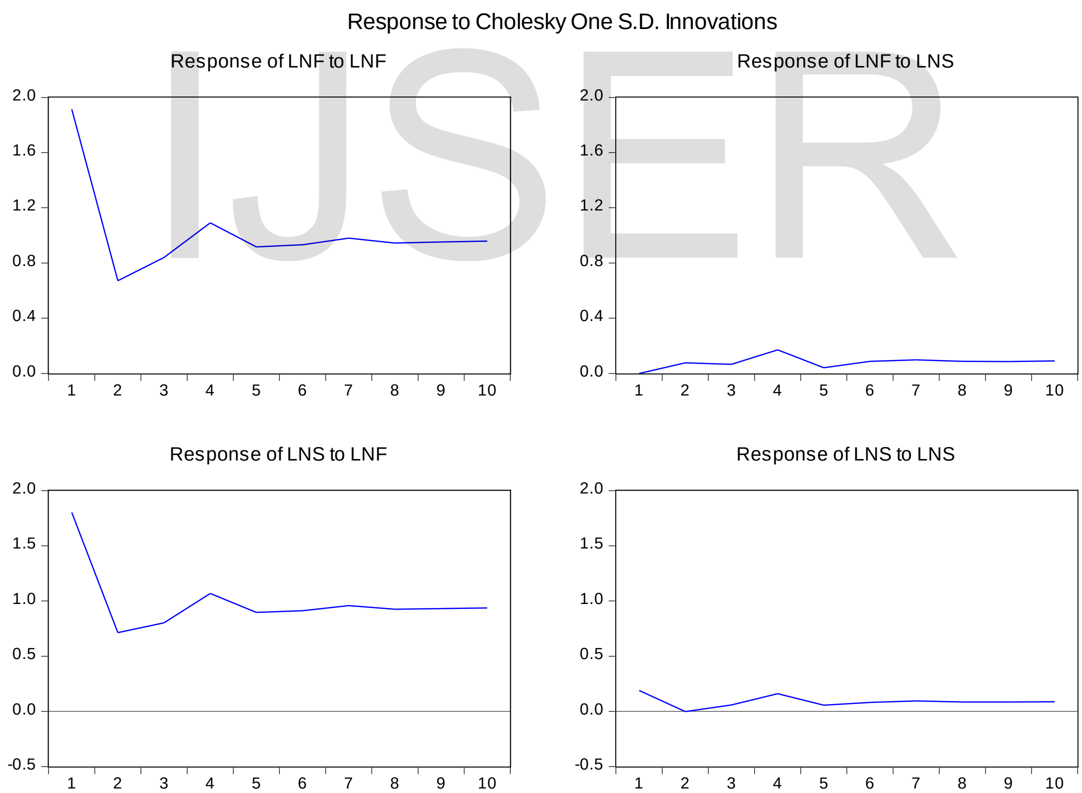

Figure :3 Impulse Response chart for Spot and 3 month contract

To further examine the vigorous interaction between spot and futures prices of the CNX Nifty for 1 Month, 2 Months and 3 Months contract, the impulse response functions is estimated through the VECM mechanism. The response function indicates to what extend there is an increase or decrease in the prices of spot or futures due to one standard

deviation shock in spot prices or future prices. In the figures above the impulse response functions are studied for response of future to future, response of future to spot, response of spot to future and response of spot to spot.
The Figure 1, 2 and 3 shows that one standard deviation shock in Nifty Futures prices leads to slight increase in Nifty Spot prices for 2 periods. Whereas one standard deviation shock in Nifty Spot prices leads to high fall in the Futures prices for one period but then it goes up slowly towards the 4th period. Also one standard deviation shock in Futures decreases the price of Futures to large extend and one standard deviation shock in Spot decreases the price of Spot but to lower extend.

6. Granger Causality Test

In Granger's causality test the null hypothesis is rejected when probability value is significant at 5%. From the Table 11, 12 and 13 it is observed that there is unidirectional causality running from Futures prices to the Spot prices of 1 month contract, 2 month contract and 3 month contracts traded on CNX NIFTY INDEX. This means that the Futures prices have certain information which helps in forecasting the Spot prices.

Table 11 Pair wise Granger Causality Tests (1 month)

Null Hypothesis:	No. of observations	F-Statistic	Prob.
LNS does not Granger Cause LNF	2465	0.00973	0.9214
LNF does not Granger Cause LNS		5.30557	0.0213
Note: * indicates rejection of null hypothesis at 5 per cent.			

Table 12 Pairwise Granger Causality Tests (2 month)

Null Hypothesis:	No. of observations	F-Statistic	Prob.
LNS does not Granger Cause LNF	2463	0.15462	0.6942
LNF does not Granger Cause LNS		4.80044	0.0285
Note: * indicates rejection of null hypothesis at 5 per cent.			

Table 13 Pairwise Granger Causality Tests (3 month)

Null Hypothesis:	No. of observations	F-Statistic	Prob.
LNS does not Granger Cause LNF	2462	0.35022	0.5540
LNF does not Granger Cause LNS		4.58466	0.0324
Note: * indicates rejection of null hypothesis at 5 per cent.			

7. Ordinary Least Square (OLS)

Ordinary least square model is the model use to study whether there is an impact of Spot prices on the Futures prices.

Table 14 Ordinary Least Square for Spot price and 1 month contract

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.01255	0.004457	-2.8154	0.0049
LNS	1.044067	0.0028	372.8947	0
R-Square	0.982588	Durbin-Watson Stat		2.675791
Note: *H_o: There is no impact of Spot prices on the Futures prices* *H_1: There is an impact of Spot prices on the Futures prices*				

ISSN 2229-5518
Table 14 studies the impact of Spot prices on the Futures prices of 1 month contract. The table shows that the probability value is less than 0.05 which means that the null hypothesis is rejected and the alternative hypothesis i.e. H1: There is an impact of Spot prices on the Futures prices, is accepted. This means that Spot prices do have an impact on the Futures prices of 1 month contracts. Also 1% change in the value of Spot leads to 1.044% change in the value of Futures. R-square stated that 98% volatility in Futures prices is explained by the Spot prices and as the value of Durbin-Watson Statistics is near 2 it is said that there is no problem of autocorrelation.

Table 15Ordinary Least Square for Spot Price and 2 Month Contract

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00173	0.004617	-0.37543	0.7074
LNS	1.041779	0.002944	353.8565	0
R-Squared	0.980725	Durbin-Watson Stat		2.730741

Note:
H_0: There is no impact of Spot prices on the Futures prices
H_1: There is an impact of Spot prices on the Futures prices

Table 15 studies the impact of Spot prices on the Futures prices of 2 month contract. The table displays that the probability value is less than 0.05 which means that the null hypothesis is rejected and the alternative hypothesis i.e. H1: There is an impact of Spot prices on the Futures prices, is accepted. This means that Spot prices do have an impact on the Futures prices of 2 month contracts. Also 1% change in the value of Spot leads to 1.041% change in the value of Futures. R-square stated that 98% volatility in Futures prices are explained by the Spot prices and as the value of Durbin-Watson Statistics is 2.730 which is close to 2 it states that the problem of autocorrelation does not exist.

Table 16Ordinary Least Square for Spot Price and 3 Month Contract

Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
C	-0.00158	0.00456	-0.34729	0.7284
LNS	1.044845	0.002909	359.1695	0
R-Squared	0.981273	Durbin-Watson Stat		2.711394

Note:
H_0: There is no impact of Spot prices on the Futures prices
H_1: There is an impact of Spot prices on the Futures prices

Table 16 shows the impact of Spot prices on the Futures prices of 3 month contract. The probability value is less than 0.05 which means that the variables are significant and thus the null hypothesis is rejected and the alternative hypothesis i.e. H1: There is an impact of Spot prices on the Futures prices, is accepted. This means that Spot prices do have an impact on the Futures prices of 3 month contracts. Also 1% change in the value of Spot leads to 1.044% change in the value of Futures. R-square stated that 98% volatility in Futures prices are explained by the Spot prices and as the value of Durbin-Watson Statistics is 2.711 which is close to 2 it states that the problem of autocorrelation does not exist.

Hedging Effectiveness of Index Futures

OLS Regression Model Estimates

Table 17 shows the results of the model estimated for the optimal hedge ratios using the ordinary least squares method of Spot and all three contracts i.e. the near month contract, next month contract and the far month contract. In case of OLS Method, the slope of the regression model is an estimate of the hedge ratio while the R-Square value gives the hedge effectiveness.

Table 17: OLS Regression Model Estimates of 1 Month, 2 Months and 3 Months Contract

Contracts	Constant	Hedge Ratio	Hedging Effectiveness (R-Square)
1 Month Contract	-0.012549	1.044067	0.982588
2 Months Contract	-0.001733	1.041779	0.980725
3 Months Contract	-0.001584	1.044845	0.981273

Table 17 shows that the hedge ratio for 1 month contract is 1.044067, for 2 month contract is 1.041779 and for 3 month contract is 1.044845. Out of all three contracts the hedge ratio of 3 months contract is the highest. The results also show that the hedging effectiveness for one month contract, two month contract and three month contract are 0.982, 0.98 and 0.981 respectively; therefore risk reduction in all three contracts traded on Nifty Index is quite high i.e. it is almost 98% for all the contracts. It indicates that the investors are able to reduce their risks and it is also noticed that even though the contracts consists of different durations, still the hedging effectiveness for all the contracts are almost same for this model.

VAR (Vector Auto Regression) Estimate

The optimal hedge ratio and the hedging effectiveness of all the contracts as per VAR model are presented in the Table 18. The table shows that the hedge ratio for all contracts laid between1.47 to 1.49. The hedging effectiveness of 1 month contract is 0.637, 2 month contract is 0.664 and 3 month contract is 0.663, therefore risk reduction in all the contracts are quite high and the investors can minimise their risk to a good extend. Even though the hedging effectiveness for all the contracts are close to each other but for the 2 month contract it is slightly higher than 1 month contract and 3 month contract. It can also be noticed that even though one month contract had the highest hedge ratio out of all but its hedging effectiveness is lower than the other two contracts.

Table 18: VAR Estimate – One Month Contract, Two Months Contract and Three Months Contract

Contracts	Covariance (Spot, Futures)	Variance (Spot)	Variance (Futures)	Hedge Ratio	Variance (hedged)	Variance (unhegded)	Hedging Effectiveness
1 Month	2.6455	2.5349	2.8122	1.4977	0.9188	2.5349	0.637530
2 Months	2.5656	2.4565	2.7329	1.4714	0.8232	2.4565	0.664879
3 Months	2.5608	2.458	2.7215	1.4754	0.8264	2.4586	0.663848

VECM (Vector Error Correction Model) Estimate

The optimal hedge ratio and the hedging effectiveness of all the contracts as per VECM model are indicated in Table 19. The table pictures that the hedge ratio for all the contracts are ranging from 1.55 to 1.57. The hedging effectiveness for 1 month contract, 2 month contract, and 3 month contract are 0.53, 0.562 and 0.566. Therefore the risk can be reduced by 53%, 56.2% and 56.6% in one month, two month and three month contract respectively. The table also depicts that even though the hedge ratio of one month contract is larger the hedging effectiveness of 3 month contract is higher than then the other two contracts.

Table 19: VECM Estimate – One Month Contract, Two Months Contract and Three Months Contract

Contracts	Covariance (Spot, Futures)	Variance (Spot)	Variance (Futures)	Hedge Ratio	Variance (hedged)	Variance (unhegded)	Hedging Effectiveness
1 Month	2.645589	2.534955	2.812259	1.5775	1.186775	2.534955	0.531835
2 Months	2.565630	2.456562	2.73291	1.5519	1.075498	2.456562	0.562193
3 Months	2.560835	2.458654	2.72157	1.5522	1.066236	2.458654	0.566333

Comparison of Hedge Ratios Estimates for Different Models

The contract wise optimum hedge ratios of different models are presented in table 4.4. It is clear that the hedge ratio of VECM model for all the contracts are higher than the hedge ratio generated from VAR model and OLS model.

Table 20: Hedge Ratio Estimates for Different Models 1 Month, 2 Month and 3 Month Contract

Contract	OLS	VAR	VECM
1 Month	1.044067	1.497794	1.577592
2 Months	1.041779	1.471405	1.551962
3 Months	1.044845	1.475402	1.552286

Table 21: Hedge Ratio Estimates for Different Models 1 Month, 2 Month and 3 Month Contract

Contracts	OLS	VAR	VECM
1 Month	0.982588	0.637530	0.531835
2 Months	0.980725	0.664879	0.562193
3 Months	0.981273	0.663848	0.566333

Table 21 depicts the hedging effectiveness of different models for near month, next month and far month contract. The table shows that the hedging effectiveness concluded from the OLS Model is higher than VAR Model and VECM Model. This means that the risk reduction is higher with OLS Estimate. Though the hedge ratios of VECM Model for all three contracts are higher but the hedging effectiveness is lower than the other two models. Therefore, it is observed that there is a difference in the performance of the hedging effectiveness from OLS, VAR and VECM model. The OLS Model performs extremely well for hedging effectiveness then VAR and VECM model.

Findings and Conclusions

This study tries to examine and gives an understanding of the causal relationship between Stock Index Futures and its underlying Stock Index of Nifty. The paper also studies the impact of Spot prices on the Futures prices. It also estimates the optimal hedge ratios and examines the hedging effectiveness of the NIFTY INDEX using appropriate constant models for a period of 10 years, from January 2006 to December 2015. The time varying model for estimating hedge ratio and hedging effectiveness is not considered for the study.

The Johansen-Juselius co-integration test used in the study finds two co-integrating equations indicating long run relationship between Futures and Spot prices of all three contracts. The Vector Error Correction Model stated that apart from having a long run relationship the prices of Futures are influenced by the prices of Spot in short run in most of the cases whereas in few cases it is vice versa. From impulse response graph in case of Spot prices and all the contracts it was found that Spot and Futures markets are highly sensitive to each other's shocks.

From the Granger Causality test it was found that there is unidirectional Granger Causality running from Futures prices to the Spot prices for all contracts. This means that Futures plays an important role in explaining the movements in Spot prices. Also Ordinary Least Square Model which was used to study the impact of Spot prices on Futures prices showed a significance which means Futures is impacted by the Spot prices in all the contracts.

For the estimation of hedge ratios and hedging effectiveness three models are used i.e. OLS, VAR and VECM. The hedge ratios for all the contracts are higher in the VECM model, but the hedging effectiveness is very high from the OLS Model. Therefore, for risk reduction OLS is an appropriate method for estimating optimal hedge ratios as it provides better results than the VAR and VECM. The indication presented in this study strongly suggests that the Nifty Index Futures contracts are an effective tool for hedging risk.

References

- Aggarwal, N., & Gupta, M. (2013, March). An Empirical Investigation into Hedging performance of Index Ftures: Revisiting Traditional Technique. *Asia-Pacific Finance abd Accounting Review, 1*(2).
- Awang, N., Azizan, N., Ibrahim, I., & Said, R. (n.d.). Hedging Effectiveness Stock Index Futures Market: An Analysis on Malaysia and Singapore Futures Markets. *2014 International Conference on Economics, Management and Development*.
- Bhaduri, S. N., & Sethu Durai, S. R. (2008). Opitimal Hedge Ratio and Hedging Effectiveness of Stock Index Futures: Evidence from India. *Macroeconomics and Finance in Emerging Market Economies, 1*(1), 121-134.
- Bhagwat, D., Omre, R., & Chand, D. (2012, November). An Analysis of Indian Financial Derivatives Market and its Position in Global Financial Derivatives Market. *Journal of Business Management & Social Science Research(JBM&SSR), 1*.
- Bhat, , R. B., & V N, D. (2014, March). Price Volatility and Market Efficiency of Futures Market in India. *IOSR Journal of Business and Management (IOSR-JBM), 16*(3), 11-18.
- Bhatia, s. (2007). Do the S&P CNX Nifty Index And Nifty Futures Really Lead/Lag? Error Correction Model: A Co-integration Approach. *NSE Research paper*(183).
- Dhanya, K., & Janardhanan, V. (2011). Price Discovery in Indian Futures Market- An Empirical Study. *Anvesha, 4*, 57-61.
- Gakhar, D., & Meetu, M. (2013, March). DERIVATIVES MARKET IN INDIA: EVOLUTION, TRADING MECHANISM AND FUTURES PROSPECTS. *International Journal of Marketing, Financial Services & Management Research_, 2*(3).
- Gupta, K., & Singh, D. (n.d.). Price Discovery and Arbitrage Efficiency of Indian Equity Futures and Cash Markets .
- Hull, J. C. (2008). *Options, Futures, and Other Derivatives.* Prentice-Hall of India Private Limitated.
- Kenourgios, D., Samitas, A., & Drosos , P. (2008). Hedge ratio estimation and hedging effectiveness:the case of the S&P 500 stock index Futures contract. *Int. J. Risk Assessment and Management, 9*(1/2).
- Pati, P., & Padhan, P. (2009). Information, Price Discovery ans Causality in the Indian Stock Index Futures Market. *The IUP Journal of Financial Risk Management, IV*, 7-21.
- Prashad, A. (2013). Hedging Performance of Index Futures. *International Journal of Applied Financial Management Perspectives, 2*(2).
- Redhead, k. (2003). *Financial derivatives.* Prentice-Hall India Private Limited.
- S, S. H., & V, D. P. (2014, Mar-Apr). A Study of Derivatives Market in India and its Current Position in Global Financial Derivatives Markets. *IOSR Journal of Economics and Finance (IOSR-JEF), 3*(3), 25-42.
- Satapathy, S., & Kar, D. N. (2015, september). The Causal Relationship between Spot and Futures Prices in India: A Select Case Study of NSE. *INDIAN JOURNAL OF APPLIED RESEARCH, 5*(9).
- Sridhar, A. N. (2005). *Futures & Options.* Shroff Publishers & Distributors Pvt. Ltd.
- Vasantha , G., & Mallikarjunappa , T. (n.d.). Derivatives and Price Risk Management: A Study of Nifty. *Twelfth AIMS International Conference on Management*.

- Vashishtha, A., & Kumar, S. (2010). Development of Financial Derivatives Market in India- A Case Study. *International Research Journal of Finance and Economics*(37).