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DOES FUTURES HELP IN PRICE DISCOVERY OF SPOT: AN EMPIRICAL ANALYSIS OF THE NSE SPOT AND FUTURE INDEX OF INDIA

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ABSTRACT

The present study is an attempt to examine the price discovery mechanism between the stock one month futures and spot(cash) market index for the NSE Nifty Index. It investigate the lead lag relation between these two set of markets by analyzing daily closing prices data for both NSE Nifty stock index & also NSE Nifty one month futures index for a period Jan 1 , 2016 to March 28 2018 (501 observations). The econometric tools applied include Augmented Dickey Fuller (ADF) test & KPSS test of Stationarity of Variables, Johansen Co-integration test , VAR with Error Correction Mechanism test (after determining the optimal no. of lags) & BG Serial Correlation. The results of the study revealed that the spot and futures prices of NSE Nifty were co-integrated and also had significant error corrective mechanism where the speed of correction was very fast at 93 % per period moving from short run disequilibrium to long run equilibrium. The Granger cause-effect relation was however not observed even in the VAR Model as correction towards equilibrium was arrived at a very short period of time thereby contradicting the viewpoints of researchers that futures lead the spot rates in all major stock markets. The diagnostic tests confirmed that time series of spot and futures market was stationary at 1st difference and also free from serial correlation.

Key words: VAR, Price Discovery, ADF, KPSS, Co-Integration

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INTRODUCTION

Let S_t be the spot price on an index for period 't'& F_t be the Future Price of that index & r_f be the risk free rate of return which is assumed to be continuous compounding. Now if markets are perfect then

$$F_t = S_t\,(e)^{rt}; \qquad \text{…(i)}$$

i.e. we can derive the future price by adding risk free rate (which is compounding continuously) to the spot price else there would be arbitrage opportunities . This also shows that the futures market must be contemporaneously correlated with spot market and it follows that any new information should be simultaneously be reflected in both markets. This further means that one market should not lead to the other. The above model eq.(i) may be refined to include dividend i.e.

$$F_t = \{S_t)\}\,(e)^{(r-y)t} \qquad \text{….(ii)}$$

where y is the dividend yield which again is continuous compounding. The above model eq.(ii) has further been refined further by McKinlay & Ramaswamy (1988) and their model may be stated as under :-

$$F_t = \{S_t)\}\,(e)^{(r-y)(T-t)} \qquad \text{….(iii)}$$

where 'T' is the date for expiry for the futures contract. If we take the Log of both sides of equation(iii), the model is expected to take the shape as under :-

$$\text{Ln}\ \frac{F_t}{F_{t-1}} = \text{Ln}\ \frac{S_t}{S_{t-1}} + (r\text{-}y) \qquad \text{….(iv)}$$

A closer look at the models given above (eq. i to eq. iv) reveal that these are pure theoretical models, on the other hand majority of the empirical work in this area has a different story to tell, the research has shown that the assimilation of information in futures market is faster than in the spot market and this has been the case in most of the financial markets.

There are many reasons put forth by proponents as to why futures markets tends to incorporate faster any new information than the spot market. The prominent reason which

most researchers agree is the fact that the futures market *(as seen in most markets)* has lower transaction costs & also enjoys higher levels of liquidity. Some researchers also are of the opinion that there are time delays in making updates in spot markets which favour futures market trading over the spot market (Stool & Whaley 1990)) According to Floros & Voungas (2008) there can be transaction or other capital market effects which makes one market react faster to any new information. Then adding to these are the market restrictions which do result in making the process of lead-lag relation an absolute reality. It has also been noticed in many international markets that both long and short positions are more easy and less expensive to establish in futures market rather than on its counterpart viz. spot market, this also benefits those traders who set up strategies on the basis of revised expectations and do so rather frequently (Wahab, M., & Lashgari, M. (1993)) Here the futures markets react faster and thereby discover the prices and also establish a competitive reference price which helps in deriving the subsequent spot price (Brooks, C. et.al.,(2001))

Thus because of the reasons given above , most of the researchers in this area have concluded that futures lead to spot prices *(or the lead-lag process is from futures to spot prices)* , and give futures the credit of performing this economic function, however again here most researchers are quick to add that the duration of this lead lag relation is extremely small, say a few seconds to few hours ((See Gardabe & Silber, 1983; Kawaller et al. 1987; Stoll & Whaley, 1990 ; Brooks et al., 2001; Kenourgios,2004)).

In view of the above , the present study is an attempt to examine the price discovery mechanism between the futures and spot(cash) market index for the NSE Nifty Index. The study would investigate the lead lag relation (if any) between the two set of indices; futures and spot market indices of the NSE Nifty Index. The data for the study has been taken as daily closing prices of the NSE Nifty stock index & also daily closing prices on the NSE Nifty futures index for the period Jan 1 , 2016 to March 28 2018 (501 observations). The data has been collected from the websites of NSE & Yahoo Finance *(www.,* www.nseindia.com). Data analysis under the study has been carried out using M.S. Excel and EVIEWS.

The rest of the paper is structured as follows: Section II: gives the reviews the existing literature in the area of spot and futures market. Section III: describes the Statistical Description of Data & Diagnostic tests undertaken, Section IV: discusses the statistical and econometric tools used in the study Section V: gives the methodology employed along with

hypothesis to be tested Section VI: provides empirical results of the study & its interpretation & finally Section VII: gives the conclusion, study limitations & scope of future research

REVIEW OF LITERATURE

Under literature review we discuss a mix of papers following different approaches in exploring the relation between futures and spot markets where researchers have employed a number of tools like causality, Co-integration, ECM, flow charts, ARCH & so on. Also the papers have tried to test whether the time interval for collection of data for spot and futures has bearing on the lead lag relation between the spot and futures.

Floros, C. (2009) investigated for cash & futures market of S Africa Exchange (2002-06), price discovery, lead-lag & causality relation. The prices analyzed were daily spot & futures and were obtained from JSE& SAFEX Exchanges. The results obtained showed not only co-integration between the two markets but also bi-directional causality. They concluded that futures play a strong price discovery role. Floros, C., & Vougas, D. (2007) employed a restricted version of BEKK Model called B-GARCH to study the lead-lag relation between spot & futures markets in Greece for the period 99-01.The results showed that futures did indeed play a decisive role in price discovery i.e. futures are more informationally efficient. Nam, S. O., Oh, S., Kim, H. K., & Kim, B. C. (2006) investigated in Korean Market price discovery with respect to KOSPI 200 stock index, stock futures & options. The time interval for data was 1 minute and the sample was March 2001-June 2003. The lead–lag relationship results showed that stock futures lead the stock index. Similar relation was also proved for at the money options which were leading the stock index. Also amongst the futures and options (except OTM options) symmetric lead lag relation was proved to exist. Other results showed in-frequent trading was closely associated with Deep ITM Options, ITM options were not a popular means for arbitrage.

Yang, J., & Bessler, D. A. (2004) explored the linkages by using a technique called directed acrylic graph (DAG) modeling where a flowchart of causality between all the possibilities for each pair of variables is constructed (the sample included nine countries) Other techniques used were co-integration, ECM The results showed that US & UK markets dominated while Japanese market was isolated in the futures market. As far as Europe was concerned the two dominant players were UK & Germany. Brooks, C., Rew, A. G.,

&Ritson, S. (2001) investigated for FTSE 100 spot and index futures market at ten minutes interval the lead-lag relationship between the two for the period 2016-17. The results showed that futures could predict spot market returns Out of the various models fitted, the best model was ECM-Cost of Carry which predicted the spot returns to the extent of 67 %, this model was also used to derive a trading strategy. Alphonse, P. (2000) empirically showed that price discovery between cash and futures market was mainly dominated by the futures by taking intra-day data from CAC 40 futures for the three month period Jan-Mar 1995.Moreover they also showed that mis pricings were mainly due to the arrival of new information in futures market and further lead to stock price adjustment in spot markets. The econometric tools used were Johansen (1988) co-integration, error correction, common trend Stock and Watson (1988) common trend, test for stationarity.

Turkington, J., & Walsh, D. (1999) used a five minute interval for 1995 data between Autralia's stock index prices and the index futures were tested for causality and co-integration after satisfying the level of the integration of two variables. The results showed bi-directional causality amongst the variables thereby rejecting the futures leading the spot theory. Pizzi, M. A., Economopoulos, A. J., & O'Neill, H. M. (1998) examined the relation between S&P 500 stock & futures (3 m & 6m) index & found all indices were I (1) Stationary. Further Engle Granger two step Co-integration procedure was applied and Error Correction reflected smaller than expected speed of correction. Also futures market possessed a stronger lead effect with causality being proved only in one direction. Cheung, Y. W., & Fung, H. G. (1997) researched inter relation between spot and futures interest rates for Euro Dollar Markets for the period 1983-1997.The causality effects showed bi-directional movement between spot &futures markets with futures making a stronger impact on the spot than spot on futures . The two rates (spot and futures) were also co-integrated Causality in Variances of spot and futures showed the direction of information flows from futures to spot. Therefore they concluded that analysis here should not be limited to the returns but also volatility.

Dwyer Jr, G. P., Locke, P., & Yu, W. (1996) found through their study that non-linearity may be the explanation for future-cash relation and this could be viewed as over and above the persistent volatility in their prices. The model tested by them was a cost of carry model for estimating the non-linear relation for their sample of S&P 500 index futures & cash market index (1982-1990) with one minute interval. However they also said that the same model may not work in times of crashes. They also found that Threshold ECM was better than

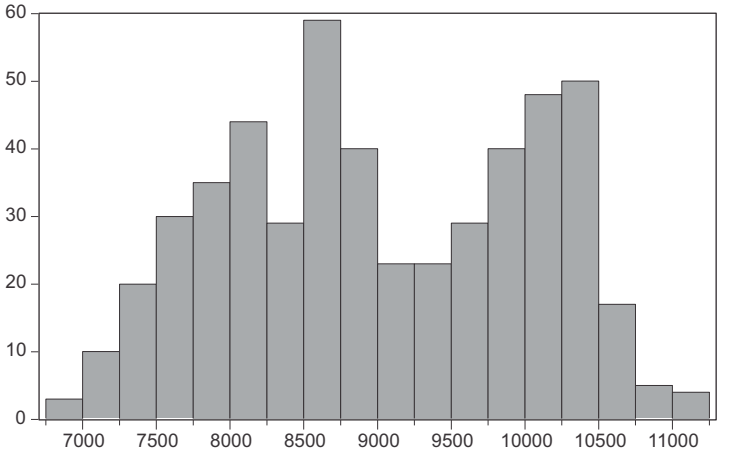
simple ECM, also the convergence between future and spot market was anywhere between 5-7 minutes. Arshanapalli, B., & Doukas, J. (1994) studied the similarity in volatility between S&P 500 index futures & underlying index for cash market for the period October 1, 1987 to October 30, 1987. This was an attempt to test previous studies where it was laid down that there was a strong intra-day relationship between the two markets. The tools used were ARCH common feature as proposed by Engle & Kozicki(1993). The results of the study revealed that cash & futures markets do not have common volatility process. Thus their second moment were independent.

The review of literature has clearly indicated that there is a lead lag relation from futures to spot markets with price being discovered by futures market as seen by majority of these studies. Further most of the researchers are convinced that time interval is important in price discovery and convergence between the two markets is also very quick say within a few minutes. However most of the studies in this area is confined to developed markets & moreover very few studies have looked at the relation post sub-prime crisis.

STATISTICAL DESCRIPTION OF DATA AND DIAGNOSTIC TESTS

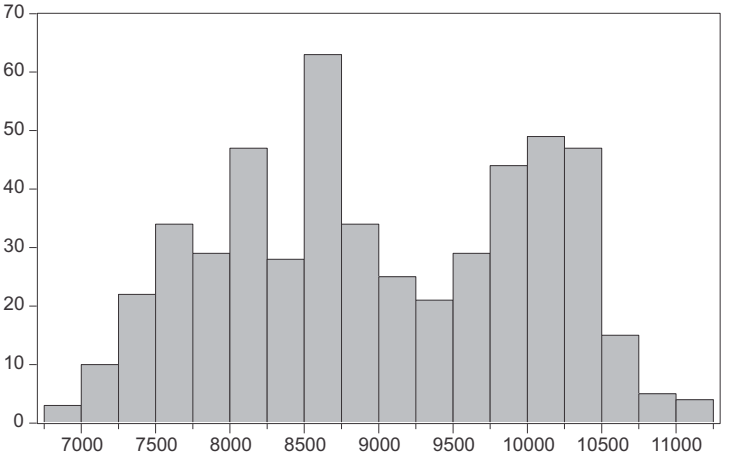
The Statistical Description of our variables *(viz. daily closing prices on one month futures and spot prices on the NSE Nifty Index for the period; Jan 1 ,2016- March 28, 2018 { 501 observations per index})* is given in **Table I (a & b)** below. The Table also shows the Histogram of the two time series & the computations include Mean, Median, Standard Deviation, Skewness & Kurtosis. The table also includes computation of diagnistic test of normalitiy of our indices i.e. JB Statistics. If we look at the table I we find that the average closing prices for NSE Nifty Futures is slightly higher than the average prices of NSE Nifty Spot . Also the Nifty futures shows higher level of risk *(as shown by standard deviation of their closing prices)*. In terms of the distribution of their closing prices, none of the markets was found to be normally distributed *(Normal JB* <5.99 while JB Statistics for our markets are 28.34 & 28.36 for futures & spot respectively)*, on the other hand the skewness (or fat end tail distribution) of NSE Nifty futures was found to be slightly negative at -0.000697 while it was positive at 0.005 for Spot Market*(For a normal distribution, Skewness is '0')* . The Kurtosis (or peakedness of the distribution) for both markets is lower as compared to normal which is around '3' .

Table I (a): Statistical Description of NSE Nifty One Month Futures closing prices for the period Jan 1 ,2016- March 28, 2018



Series: FUTURES_CLOSE	
Sample 1/01/2016 3/28/2018	
Observations 509	
Mean	9028.420
Median	8884.450
Maximum	11085.45
Minimum	6968.500
Std. Dev.	1025.604
Skewness	-0.000697
Kurtosis	1.843925
Jarque-Bera	28.34519
Probability	0.000001

Table I (b) : Statistical Description of NSE Nifty Spot Closing Prices for the Period Jan 1 ,2016- March 28, 2018



Series: SPOT_CLOSE	
Sample 1/01/2016 3/28/2018	
Observations 509	
Mean	9013.799
Median	8867.450
Maximum	11086.00
Minimum	6970.600
Std. Dev.	1024.884
Skewness	0.005300
Kurtosis	1.843628
Jarque-Bera	28.36210
Probability	0.000001

Another diagnostic tool which has been used in the study is BG Serial Correlation test. The Serial Correlation test has been carried out for both the variables. e.g. for variable Nifty futures we run the following equation (v) :-

$$u_t = \psi_1 + \psi_2 \text{ Nifty futures}_{t-1} + \psi_3 \text{ Nifty futures}_{t-2} + \ldots\ldots + \psi_p \text{ Nifty futures}_{t-(p-1)} + \Phi_1 u_{t-1} + \Phi_2 u_{t-2} + \Phi_3 u_{t-3} + \ldots\ldots + \Phi_n u_{t-n} + e_t \quad \ldots. (v)$$

Null Hypothesis (Ho): No Serial Correlation or $\Phi_1 = \Phi_2 = \Phi_3 = \ldots. \Phi_n = 0$

The Computed R^2 (n-p) where 'n' is no. of observations and 'p' are the no. of lags. The Null Hypothesis is No Serial Correlation is compared with χ^2 tables with 'n' df & null is **accepted** if computed value $< \chi^2_n$

METHODOLOGY ADOPTED AND HYPOTHESIS TO BE TESTED

The following statistical & econometric tools have been applied in our study (a) Augmented Dickey Fuller (ADF) test & KPSS test of Stationarity of Variables (b) Johansen Co-integration test (c) VAR with Error Correction Mechanism test (after determining the optimal no. of lags using AIC, FPE & SC Criteria) & (d) BG Serial Correlation

Augmented Dickey Fuller Test

We apply Augmented Dickey Fuller (ADF) test (with intercept) to find out the stationarity of our variables namely; NSE Nifty futures & NSE Nifty Spot. We use the following equations (vi & vii) for this purpose.

$$\Delta \text{ Nifty futures}_t = \beta_1 + (\beta_2 - 1) \text{ Nifty futures}_{t-1} + \sum_{i=1}^{m} b_{3i} \Delta \text{ Nifty futures}_{t-i} + U_{1t} \quad \ldots..(vi)$$

$$\Delta \text{ Nifty spot}_t = \alpha_1 + (\alpha_2 - 1) \text{ Nifty spot}_{t-1} + \sum_{i=1}^{m} \alpha_{3i} \Delta \text{ Nifty futures}_{t-i} + U_{2t} \quad \ldots..(vii)$$

(Note :For equation (vi) ;The variable for which we are testing stationarity is Nifty futures . Δ Nifty futures$_t$ is change in Nifty futures in period t, $(\beta_2 - 1)$ is the coeff. of the Stationarity for variable , $\sum_{i=1}^{m} b_{3i}$ Δ Nifty futures$_{t-i}$ denotes change in Nifty futures in period t-i & is the augmented variable added to take care of autocorrelation and the term adds up 'm' times till the autocorrelation is removed , u_{1t} is random error term. Similarly we carry out stationarity test for our eq.(vi) namely the Nifty spot using explanation as given for equation (vi))

The testable hypothesis for our Stationarity test of our Variable *Nifty futures* (eq. (vi)) would be

Null Hypothesis (H_0) : $\beta_2 - 1 = 0$ 0r $\beta_2 = 1$ (Nifty futures has a unit root i.e. is not stationary)

Alt Hypothesis (H_a) : $\beta_2 - 1 < 0$, (Nifty futures is stationary)

We test the Null Hypothesis of variable Nifty Spot in a similar manner (see eq. (vii))

Note: We would be testing our Hypothesis at one tail only as we want to avoid the explosive process

KPSS Kwiatkowski–Phillips–Schmidt–Shin (KPSS)

The second test we use for testing of stationarity is KPSS which is a non-parametric test & follows a different set of hypothesis i.e. Null Hypothesis is presence of a trend while the Alternative Hypothesis is absence of trend but with a possibility of existence of stochastic root. Since for any financial time series, stochastic root must be removed, however existence of a trend is not much of a problem as it is a mean reverting process. Under KPSS, the procedure followed is to regress the variable against the constant and trend using OLS & the residuals obtained are added to get partial sum of residuals (S_t) or sum at each stage e.g. S_3 would mean sum of first three residuals, S_4 as sum of first four residuals and so on; thus we finally arrive at the following formula :

$$S_{it} = \sum_{j=1}^{n} \sum_{i=1}^{j} u_j \qquad \text{……..….(viii)}$$

(i=1,2,3,...t, j=1,2,3,..n, n is the no. of observations in the sample). To arrive at KPSS Formula we also compute an estimate of the variance of the residuals (σ^2 {u}),

$$\mathbf{KPSS(u) = n^2 \sum S_{ij}^2 / s^2_u} \qquad \text{……(ix)}$$

KPSS(u)follows a non-standard distribution, if KPSS (u) is larger than critical then the Null is rejected. Thus after carrying out the two stationarity tests (ADF & KPSS) on our variable, the variable under consideration shall be stationary only when we reject the null hypothesis under ADF test and accept the null for KPSS. If these criteria are satisfied we can safely

assume that our variable is stationary and we can proceed with subsequent analysis.

Johansen Co-integration test

To check for the possible co-integration between the variables Nifty Futures & Nifty Spot we apply Johansen (1988) and Johansen & Juselius (1990) Co-integration Procedure The equation for Johansen Test is given as :-

$$\Delta Y_{qt} = \theta_q + \pi_q Y_{q(t-k)} + u_{tq} \quad \text{....(x)}$$

where Y_{qt} is a column vector of 'q' variables, 't' is the time period which is same across all 'q' variables. The regression in eq.(x) solves for rank of matrix π_q & also gives only some of the vectors as co-integrated. If the result is no co-integration, Matrix π_q has a rank '0' & if co-integration is detected, we proceed towards computation of characteristic roots and eigen values. The test statistics given are "trace" & "Max Eigen Value" whose values are compared with 5% critical values to know whether co-integration exists or not. The results of the Johansen Co-integration test between the variables Nifty Futures & Nifty Spot are given in Appendix (IV)

Vector Error Correction Model

Once it is proved that the variables are co-integrated (which is known from the co-integration results given in Appendix (IV) ideal recourse would be to develop a VAR equation with the lagged residuals as the error corrective mechanism. The VAR would also assist in developing equilibrium relation between the two variables and thereby ascertain the speed of this equilibrium/convergence for this lead-lag relation. We develop our VAR model as Vector Error Correction Model which for our two variables is given below (eq. xi & xii). The lagged residuals u_{t-1} reflecting the convergence between the two time series in these models are obtained by running an OLS between the two variables. The no. of lags in our independent variables have been ascertained from Optimal Lag Identification tools like AIC, SC & HQ (See Appendix VI)

$$\Delta \text{Nifty futures}_t = \beta_1 + \beta_2 u_{t-1} + \sum_{i=1}^{m} b_{3i} \Delta \text{Nifty spot}_{t-I} + \sum_{i=1}^{m} b_{4i} \Delta \text{Nifty future}_{t-i} + e_{1t} \quad \text{... (xi)}$$

$$\Delta \text{Nifty spot}_t = \lambda_1 + \lambda_2 u_{t-1} + \sum_{i=1}^{m} \lambda_{3i} \Delta \text{Nifty future}_{t-I} + \sum_{i=1}^{m} \lambda_{4i} \Delta \text{Nifty spot}_{t-i} + e_{2t} \quad \text{... (xii)}$$

RESULTS OF THE STUDY

The results of our study are given in tabular format in Appendices. Appendix I & II shows the testing of the stationarity of our variables using Unit root ADF & KPSS tests respectively. Appendix I which gives the results of our Unit root test using ADF, reveals that the computed 't' value of Nifty Spot and Nifty Futures Closing prices are -0.74434 & -0.75463 respectively which are higher than the 5% critical 't' tau statistics of Dickey Fuller at -2.883753, thereby accepting the Null Hypothesis of Unit root at closing prices. On the other hand the computed 't' value of Nifty Spot and Nifty Futures first difference prices are -20.68709 & -21.26337 which are much lower than 5 % critical values leading to the rejection of the Null of Presence of Unit Root (Non Stationary time series). Thus we conclude that for both of our variables NSE Nifty Spot and Futures, the data is stationary only at 1st difference.

Appendix II gives the results of our second test; KPSS which we have carried out as an additional test for testing the stationarity of our variables. This test has been included in the study as our first test i.e. ADF unit root test is known to suffer from low power. Under the KPSS test, the acceptance of Null Hypothesis shows that a variable is stationary but with a trend or in other words acceptance of Null rejects the alternative hypothesis that the time series has a unit root. The results of the KPSS test given in Appendix II show that Null of both Nifty Spot and Futures is accepted only at 1st difference. The computed critical values at first difference for Nifty Spot and Futures are 0.088300 & 0.088334 respectively which are much lower than the KPSS critical value at 5 % which is 0.463000. Thus the combined results of both the tests, ADF and KPSS show that it is only at first difference that the two variables are stochastic stationary.

Appendix III (a & b) gives the results of the BG LM Serial Correlation Test. The results reveal that for Nifty Spot, the computed Observed R-squared value of 12.62608 has a Probability ('p' value) of Chi Square at 8 lags as 0.1254 which would accept the Null Hypothesis of No Serial Correlation The same result is also shown if we consider 'F' Statistics for this test. Similarly for Nifty Futures, the computed Observed R-squared value of 11.78370 has a Probability ('p' value) of Chi Square at 8 lags as 0.1611 which would again accept the Null Hypothesis of No Serial Correlation. This brings us to the conclusion that the two time series are free from serial correlation.

Appendix IV gives the Regression results for Co integration using Johansen Method. It has two tables: Appendix IV (a) which gives the results of Unrestricted Co-integration Rank Test (Trace) & Appendix IV (b) which gives the results of Unrestricted Co-integration Rank Test (Max Eigen value). Upon examining the results given in Appendix IV(a) we find that the first row gives the value of "trace statistics" (48.55872) which exceeds the critical value (15.49471) thereby rejecting the Null Hypothesis of No Co-integration. The second row of Appendix IV (a) has a different null hypothesis and is only considered if Null of previous row is rejected. Since in our case we have rejected the Null in previous row, we move to the second row where the Null Hypothesis is defined as *At Most one Co-integration*. Again observing the value of trace statistics (0.935301) which now is lower than the critical value (3.841466) thereby we accept the Null Hypothesis of *At Most one Co-integration*. The same results can be known by directly observing the 'p' statistics given in the last column of the Appendix IV (a). Moving to the results of Appendix IV (b) which gives the results of Unrestricted Co-integration Rank Test (Max Eigen value), here again we observe the relevant statistics value of "Max Eigen Value" has a value of 47.62342 which exceeds the critical value :14.26460 at 5 % level thereby here too we reject the Null Hypothesis of No Co-integration. Moving to next row in a similar manner we arrive at the same result i.e. we accept the Null of *At most 1 Co-integration*. Thus our final result shows that there exists co-integration between the two variables and only one pair of co-integration is detected.

After the co-integration is established we develop a VAR Model with error correction term and the results of the same are given in Appendix VI. However before we run a VAR, we need to determine the optimal lag for VAR for which we compare different criteria (AIC, FPE & SC) (see Appendix V). The Appendix V shows that the optimal lag for our model is six as given by AIC & FPE while it is at 1 lag if we go by SC Criteria. In such a case we decide by the majority and therefore we prepare our VAR Model at six lags. The VAR-VECM results given in Appendix VI shows that the error corrective term was negative and significant with a high speed of correction at 93 % per period *(in our case one period is one day)*. Thus the movement from short run disequilibrium to long run equilibrium was achieved in just more than one day's time. Also as far as the Granger Causality through VAR, the results however could not prove any cause-effect relation, this was mainly because the correction towards equilibrium was arrived at an extremely short period of time.

CONCLUSION & SCOPE FOR FURTHER RESEARCH

The present study made an attempt to examine the price discovery mechanism between the one month futures and spot(cash) market index for the NSE Nifty Index by analyzing daily closing prices for the period Jan1, 2016 to March 28 2018 (501 observations). It investigated the lead lag relation between these two set of markets using econometric tools like Johansen Co-integration test , VAR with Error Correction Mechanism test (with optimal no. of lags) & BG Serial Correlation. The results showed that the spot and futures prices of NSE Nifty were co-integrated and also had significant error corrective mechanism with a high speed of correction at 93 % per period(per day) from short run disequilibrium to long run equilibrium. The Granger cause-effect relation was however not observed from the results mainly because the correction towards equilibrium in the VAR-VECM Model was arrived at a very short period of time.

It is interesting to compare these results where we could not find any cause effect relation amongst the spot and futures process with similar studies done on other markets especially the developed markets where futures lead the spot rates; these results are clearly contradictory. We have tried to identify the likely reasons for such a difference which are first the development of futures market on NSE is of recent origin while the spot or the cash market has thrived in our country for decades and therefore the interest and knowledge of investors in the future market is considerably less as compared to investors in developed markets. Second most of the researchers which have shown that futures actually discover the price have used data which has an extremely short time interval e.g. Stoll & Whaley (1990) have used a time interval of five minutes . Thirdly studies have identified different types of effects which exist in the markets and have tried to use different tools to eliminate these effects before arriving at the final decision as to which market actually discovers the price; these effects include effects of in-frequent trading, stale stock prices effects & bid price effects. The NSE Market of India too is not immune to such types of effects and it would not be wrong to say that such effects do play an important role in price discovery in India Markets which can become another interesting area of research for researchers in this field.

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Appendices

Appendix I : Testing of the Stationary of Variables : Unit root ADF

Null Hypothesis	*ADF test 't' critical 5 % level*	*Level Computed 't' value*	*Level 'p' value*	*1st Diff Computed 't' value*	*1st Diff 'p' value*
Nifty Spot has a unit root	-2.883753	-0.74434	0.8330	-20.68709	0.0000
Nifty Futures has a unit root	-2.883753	-0.75463	0.8302	-21.26337	0.0000

Appendix II : Testing of the Stationary of Variables : KPSS

Null Hypothesis	**KPSS computed LM values (Level)**	**KPSS computed LM values (1st Diff)**	***Null : Accept / Reject***
Futures Price is trend non-random	2.708162	0.088334	**Reject at Level, Accept at 1st diff**
Spot is trend non-random	2.710546	0.088300	**Reject at Level, Accept at 1st diff**

Critical Values for KPSS test: 5 % : 0.463000 & 1 % 0.739000

Appendix III: Serial Correlation test results

Appendix III (a) Serial Correlation for Closing NSE Nifty Futures

Breusch - Godfrey Serial Correlation LM Test:

F-statistic	1.485285	Prob. F(8,215)	0.1639
Obs*R-squared	11.78370	Prob. Chi-Square(8)	0.1611

Appendix III (b) Serial Correlation for Closing NSE Nifty Spot

Breusch -Godfrey Serial Correlation LM Test:

F-statistic	1.597776	Prob. F(8,215)	0.1268
Obs*R -squared	12.62608	Prob. Chi -Square(8)	0.1254

Appendix IV : Regression results for Co integration using Johansen Method

Appendix IV (a) Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None *	0.090506	48.55872	15.49471	0.0000
At most 1**	0.001861	0.935301	3.841466	0.3335

Appendix IV (b) Unrestricted Co-integration Rank Test (Max Eigen value)

Hypothesized No. of CE(s)	Eigenvalue	Max -Eigen Statistic	0.05 Critical Value	Prob.
None *	0.090506	47.62342	14.26460	0.0000
At most 1**	0.001861	0.935301	3.841466	0.3335

* Null Hypothesis : No Co-integration is rejected

** Null Hypothesis is accepted that there is only one co-integration.

Appendix V : VAR Lag Order Selection Criteria

Lag	FPE	AIC	SC
0	1.67e+08	24.60875	24.62559
1	511590.1	18.82103	**18.87153***
2	501689.7	18.80149	18.88565
3	497016.6	18.79213	18.90996
4	499977.3	18.79806	18.94956
5	494704.7	18.78746	18.97262
6	**493351.1***	**18.78471***	19.00353
7	498690.1	18.79546	19.04795
8	503500.2	18.80504	19.09120

**** Null Hypothesis : No Co-integration is rejected***

***** Null Hypothesis is accepted that there is only one co-integration***

Appendix VI : VAR-VECM Regression Results

't' statistics in [ ]

	D(FUTURES CLOSE)	D(SPOT CLOSE)
ECM(-1)	***-0.930145***	**-0.570335**
	[-2.46150]	**[-1.51180]**
D(FUTURES CLOSE(-1))	**-0.182836**	**-0.061240**
	[-0.44740]	**[-0.15010]**
D(FUTURES CLOSE(-2))	**-0.057245**	**-0.017299**
	[-0.14235]	**[-0.04309]**
D(FUTURES CLOSE(-3))	**0.581934**	**0.528351**
	[1.50260]	**[1.36650]**
D(FUTURES CLOSE(-4))	**0.039411**	**-0.009882**
	[0.10582]	**[-0.02658]**

D(FUTURES CLOSE(-5))	**0.031688**	**-0.070909**
	[0.09186]	**[-0.20588]**
D(FUTURES CLOSE(-6))	**0.081427**	**0.107495**
	[0.26060]	**[0.34460]**
D(SPOT CL(-1))	**0.235478**	**0.134770**
	[0.57087]	**[0.32726]**
D(SPOT CL(-2))	**0.077888**	**0.019501**
	[0.19198]	**[0.04815]**
D(SPOT CL(-3))	**-0.560215**	**-0.517047**
	[-1.43599]	**[-1.32753]**
D(SPOT CL(-4))	**-0.155366**	**-0.121164**
	[-0.41467]	**[-0.32392]**
D(SPOT CL(-5))	**-0.071715**	**0.039241**
	[-0.20579]	**[0.11279]**
D(SPOT CL(-6))	**-0.106726**	**-0.140770**
	[-0.33579]	**[-0.44363]**
C	**5.415145**	**5.542772**
	[1.72122]	**[1.76469]**
