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OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

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ACKNOWLEDGMENTS

REFERENCES

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PRICE DISCOVERY AND INFORMATION TRANSMISSION IN SPOT AND FUTURE SEGMENTS FOR NSE 50: AN EMPIRICAL STUDY

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ABSTRACT

If markets are informationally efficient then information should be factored in both spot and forward markets simultaneously, but market imperfections results in lead/ lag relationship and one market acts a dominant while other acts a satellite market. In this study, we examine the information transmission process between spot and futures segments for the NIFTY 50 index in India. The daily data files stretch from 1 April 2009 to 31 March 2014. Cointegration and related tools were used to examine the price discovery process and it was empirically results confirm that spot is the dominant trading platform vis-à-vis futures for NIFTY 50 index and price signals emanating from spot are being factored in by the speculators in futures market. The findings are useful for investment professionals, traders, regulators and academia.

JEL CLASSIFICATION
G13, G14, C32

KEYWORDS
price discovery, information transmission, market efficiency, cointegration.

INTRODUCTION

Ever since the introduction of derivatives segment in the Indian equity markets, there has been interactions between the spot and futures markets. The two segments are linked to one another through information transmission and other linkages. The direction and quantum of investment in the two is determined by the price discovery process, which, in turn, determines the extent of arbitrage opportunities available. Price discovery is one of the core functions of any financial market. It is the process of determining the prices of securities through the demand and supply orders of buyers and sellers. Price discovery is the process by which markets attempt to find their fair prices (Schreiber and Schwartz, 1986). If the markets are efficient and frictionless, then price discovery should be instantaneous and contemporaneous. Price discovery function in turn depends on three factors namely: trading costs, trading restrictions and liquidity and leverage benefits. The market having advantage in these will be the dominant market and the other would be satellite market. Risk hedging and price discovery are two important roles of futures market.

CNX Nifty 50 Index of the National Stock Exchange (NSE) which is India's leading stock exchange provides fully automated screen-based trading system with pan India presence. The daily traded volume of equity was INR 26,168 crore as on June 9 2014. Trading in derivatives based on index futures commenced at NSE on June 12, 2000. The daily traded volume of index futures was INR 14,964 crore as on June 9 2014. Both Nifty Index spot and futures are regulated by the Securities and Exchange Board of India (SEBI) under the provisions of the SEBI Act, 1992.

The purpose of this study is to examine the price discovery and information transmission mechanism of the spot and futures market trading platform for NSE 50 stock index. The remainder of the paper is organized as follows: Section two gives a brief review of literature. Section three discusses data sources and description. Section four deals with the methodology while section five discusses the empirical results. Section six provides summary and concluding observations.

REVIEW OF LITERATURE

According to Schwarz and Laatsch (1991), futures markets are an important means of price discovery in spot markets. Powers (1970) argued that futures markets increase the overall market depth and informativeness. Stroll and Whaley (1988) stated that futures markets enhance market efficiency. Fleming, Ostdiek and Whaley (1996) also show that futures lead the spot markets and note that investors prefer low cost markets and futures market will react faster to new information. Chan (1992) and Ghosh (1993) further report the dominant role of S&P 500 futures in the price discovery process. However, using a cointegration approach like that of Ghosh, the study by Wahab and Lashgari (1993) finds that error- correcting price adjustments occur significantly in both the S&P 500 futures and cash markets in price discovery. Ng (1987) finds that futures returns generally lead spot returns for a variety of futures contracts, including the S&P 500 Index. Studies from Non US markets include Iihara, Kato, and Tokunaga (1996) on the Nikkei Stock Average and Abhyankar (1995) on the FTSE 100 and both find that futures lead the spot. As for the Indian context, Thenmozhi (2002), Anandbabu (2003) have found that the futures market in India has more power in disseminating information and therefore has been found to play the leading role in the matter of price discovery. Mukherjee and Mishra (2004) have investigated the possible lead-lag relationship, both in among the Nifty spot index and index futures markets in India and found a strong contemporaneous and bidirectional relationship between the returns in the spot and futures markets.

Although there is no dearth of literature available on the price discovery and information transmission in the mature markets, this paper is an attempt in the direction to ascertain the lead lag relationship between the spot and futures segment of the NSE 50 index spanning a more recent study period.

DATA SOURCES AND ITS DESCRIPTION

The sample used in the study is the NIFTY 50 spot index and NIFTY futures. The data used in the study covers the period from 1st April 2009 to 31 March 2014. The daily prices data for NIFTY 50 spot and futures was extracted from the Bloomberg database. NIFTY futures data obtained was continuous price series of the most liquid near month contracts. Non-trading days were excluded and the remaining data was made date synchronous by eliminating those dates where either the futures or the spot prices were unavailable.

METHODOLOGY

The methodology used includes first converting the daily closing price data to daily returns by taking the log first difference. Return Rt at time t is given by $R_t = \ln P_t - \ln P_{t-1}$, where P_t is the closing price for day t. This was followed by an analysis of the characteristic properties of the return series, by looking at the first four moments (mean, standard deviation, skewness and kurtosis), and substantiating the results of skewness and kurtosis through the Jarque Bera Test for testing normality, and finally, the Ljung Box to check the independence of the series. Thus, the i.i.d. (identically and independently distributed) property of the all the series was tested.

This was followed by testing for stationarity of the data through the Augmented Dickey Fuller (ADF) Test. Then, the appropriate lag length for the autoregressive process, was estimated through the Schwarz Information Criteria (SIC), by selecting the lag length which minimized the SIC. Next, the Johansen's Cointegration

procedure was applied to the data to capture the presence of any long run equilibrium relationships between the spot and futures segments. In the context of the spot and futures segments in a market, the current futures (or spot) price could be represented as being dependent on the spot (or futures) price, as under:

$F_t = \alpha_1 + \beta_1 S_t + \epsilon_{1t}$ ---------- (1)

or

$S_t = \alpha_2 + \beta_2 F_t + \epsilon_{2t}$, ---------- (2)

where F_t and S_t are the futures and the spot prices at time t.

The above can be re-written with residuals, as under:

$F_t - \alpha_1 - \beta_1 S_t = \hat{e}_{1t}$ ..... (3)

or

$S_t - \alpha_2 - \beta_2 F_t = \hat{e}_{2t}$, ... (4)

where êt is the white noise residual term. Equations 3 and 4 are linear combinations of F_t and S_t. If either $\hat{e}_{1t}$ or $\hat{e}_{2t}$ is stationary, then one of them is I(0) and there is at least one long run relationship between F_t and S_t. After confirming the long run relationship, Vector Error Correction Model (VECM) test was undertaken to check their short-run dynamics. Accordingly, the VECM for change in the say futures prices and in the spot prices can be represented as under:

$\Delta F_t = \delta_f + \alpha_f \hat{e}_{t-1} + \beta_f \Delta F_{t-1} + \gamma_f \Delta S_{t-1} + \epsilon_{ft}$ (5)

$\Delta S_t = \delta_s + \alpha_s \hat{e}_{t-1} + \beta_s \Delta S_{t-1} + \gamma_s \Delta F_{t-1} + \epsilon_{st}$, (6)

where $\hat{e}_{t-1}$ measures how the current price of the dependent variable adjusts to the previous period's deviation from the long run, while ΔS_{t-1} and ΔF_{t-1} measure how the current price adjusts to the change in the variables in the previous period. The first part represents the error correction (EC), and its coefficients (α_f and α_s) indicate the speed of adjustment in the futures prices and the spot prices respectively; the smaller the absolute value of the EC term, faster is the adjustment made by the concerned market towards equilibrium and leads the price discovery process. Results of the VECM tests were confirmed through the Granger Causality Test which indicates direction of the causality.

5. EMPIRICAL RESULTS

The descriptive statistics regarding daily returns for the Nifty spot and futures are given below:

TABLE 1: DESCRIPTIVE STATISTICS OF RETURN SERIES

Statistic	Spot	Futures
Mean	0.000609	0.000611
Maximum	0.1633	0.1619
Minimum	-0.0638	-0.0661
Std. Dev.	0.0141	0.0146
Skewness	1.3506	1.2014
Kurtosis	19.1699	17.022
Jarque Bera	13516.60	10178.95
	(0.000)*	(0.000)*
Ljung Box	18.111	15.524
(Q Statistic)	(0.112)	(0.214)
Observations	1207	1207

Note: Fig. in ( ) indicate p-values; * denotes significance at 5% level.

Ljung Box statistics are reported upto 12 lags.

The Nifty Index Spot has daily mean returns of .060%, with standard deviation, as a measure of volatility, being 1.4%. The Nifty Futures has a slightly higher mean return of .061% percent, with standard deviation being slightly higher at 1.46%. Both the Nifty Spot and Futures returns show evidence of fat tails, since the kurtosis exceeds three, which is the normal value, implying leptokurtic distribution; these returns also show evidence of positive skewness, which means that the positive tail is particularly extreme. This result is confirmed by the Jarque Bera test which indicates zero probability for both series, thus the null hypothesis of normal distribution is rejected. Accordingly, both the series are not normal, i.e., not identically distributed. Next, the Ljung Box (LB) test at level indicates a p-value for Q-statistic (for 12^{th} lag) of more than 0.05 for spot series as well as for futures series. Thus, the null hypothesis of no autocorrelation is accepted. Therefore, past values of the innovations do not affect current values in both series, implying that both series are independently distributed.

The results for the stationary tests are as shown below:

TABLE 2: TEST FOR STATIONARITY

Test Statistic	Spot	Futures
At Level	-2.955141	-2.7928
	(-0.1455)	(0.2002)
At First Difference	-36.67748	-33.5827
	(0.0000)*	(0.0000)*

Note: Figures in brackets indicate the p-values;

* denotes significance at 5% level

Results confirm the existence of unit root at level and exhibit stationarity at first difference for all sample series thus conforming that they are integrated to the first order. The Johnson Cointegration results as shown below clearly confirm the strong informational linkages between the two trading platforms having 2 cointegrating vectors.

TABLE 3: RESULTS OF JOHANSEN'S COINTEGRATION TEST

Test Statistic	r=0	r=1
Maximum Eigen value	87.957 (0.0000)*	6.947 (0.0084)*
Trace Statistic	94.905 (0.0000)*	6.947 (0.0084)*
Lag length#	2	2

Note: r – cointegration rank of the model; Figures in brackets indicate the p-values;

* denotes significance at 5% level;

- Based on minimum values of the Schwarz Information Criteria

This also implies that there is informational efficiency across the spot and futures segments in equity market. The VECM has been estimated with the lags as indicated by the Schwarz Information Criteria, and the results are reported below:

TABLE 4: VECM ANALYSIS

Test Statistic	Spot	Futures
Error Correction Coefficient	-0.0159	0.1987
[T-stat]	[-2.431]*	[0.832]

Note: T Statistic or [ ];
* denotes significance at 5% level;
It shows error correction coefficient of the spot is smaller than futures. Hence if the co-integrated series is in disequilibrium in the short-run, it is the spot price that makes less adjustment than the futures price in order to restore the equilibrium. In other words, the spot markets lead the price discovery process. The information provides market traders an incentive to sell/short-sell spot and go long on options and exercise lending opportunities to make arbitrage profits. Such an arbitrage process is probably ensuring a long-run equilibrium relationship between these market pairs as confirmed by cointegration results. Further Granger causality test was performed to ascertain the direction of relationship. The results for the same are shown below in Table 5:

TABLE 5: GRANGER CAUSALITY TEST

Null Hypothesis	F Statistic	P-value
Spot does not Granger Cause Future	2.43228	0.0882**
Future does not Granger Cause Spot	0.3381	0.7132

Note: Lag structure based on minimum values of the Schwarz Information Criteria;
** denotes significance at 10% level
It can be inferred that we have a weak unilateral causality from spot to the futures (interpreted at 10% level of significance). Combining this result with VECM results, shows that spot market relatively leads in price discovery. Thus the information flow is from spot to futures and and investors are basically setting the price in spot markets for the speculators to follow while hedging through the futures market.

6. SUMMARY AND CONCLUSIONS

This paper examines the price discovery process in the spot and futures markets for Nifty 50 in India during the sample period from 1 April 2009 to 31 March 2014. The spot and forward price series were found to be integrated to order 1 and subsequently longrun equilibrium relationship was confirmed. VECM analysis showed that the spot market relatively leads in price discovery process and is the dominant platform to trade the NIFTY 50 index vis-à-vis futures which acts as a satellite platform for the same. Thus although volume wise future trading is lagging behind spot, the market participants in the futures are predominantly speculators who are taking price signals from the investors in spot to take positions in futures. Since inspite of low trading cost and fewer restrictions in futures, price signals seem to be emanating from spot challenges the market efficiency theory and points that other competing markets within India, e.g. the market for BSE as well as markets abroad where Nifty is traded, e.g. Singapore, have been ignored. It is quite possible that signals to the Nifty spot or futures markets are coming from a third market. The study is useful for the investment professionals who can make long/short strategies to make profits. It is also useful for the regulators to see the imperfections prevailing in the market microstructure to better and efficiently manage the smooth functioning of the equity markets.

However, the study has been limited to analysis of information flows between the spot and futures segments of the market. Volatility has been examined only with reference to the standard deviation. In order to broad-base the results of the study, volatility patterns could be studied in greater detail through higher order moments, to arrive at conclusions regarding volatility persistence and clustering, which could increase the usefulness of the study. The relevance of the study could also be enhanced further by extending its scope to cross-markets analysis, to include inter-market linkages, particularly volatility spillovers between markets. Further research could be undertaken along these lines.

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