

Lead Lag Relationship between Futures and Spot Prices in Select Nifty Companies

Rajani Balakrishna Bhat*, Suresh V. N.**

Abstract:

The equity derivatives market in India has undergone remarkable changes in terms of instruments introduced. Introduction of single stock futures, amidst great misgivings, was solely responsible for placing Indian exchanges in the topmost position in the global scenario. Till 2006-07, single stock futures were the most traded instruments in the Indian equity derivative segment. But, post-Global Financial Crisis, there has been a continuous drift in favour of index options from single stock futures. There has been a continuous decline in the share of single stock futures, the gain being that of index options. This is considered as a clear indication towards mature stock market. Even though the inception of derivative trading has significantly influenced the trading volatility in the capital market segment, it is yet to be seen whether the introduction of derivatives has achieved its purpose or not. The present study is an attempt to study the impact of volatility on the stock market after the introduction of derivatives in Indian segment. The study takes into account a period of thirteen years, from 9th November 2001 to 31st March 2014. A bunch of Nifty companies which satisfy the set criteria are selected for the study. The study reveals that there exists causality between the futures and spot prices of these companies. These companies are found to be co-integrated in the long run as well as in the short run.

Keywords: Derivatives Market, Futures Prices, Index Futures, Indian Stock Market, Informational Efficiency, Market Efficiency, Price Discovery, Single Stock Futures, Spot Prices

Introduction

A financial system sans derivatives is considered to be incomplete since most of the financial pursuits are risky in varying degrees because these activities deal with future cash flows that are by nature uncertain. In order to attain an unconstrained pare to efficient allocation of resources and diversification of risks, the financial system should have ample opportunities to trade and price various kinds of risks. Since derivatives are nothing but securitisation of risks, the existence of derivative markets is essential for achieving economic optimality.

The past decade has witnessed an explosive growth in the use of financial derivative products by a wide range of corporate and financial institutions. The major driving force behind the volatile growth of derivative products are the increased volatility in asset prices in the financial markets, increased integration of national financial markets with the international markets, noticeable improvements in communication facilities and sharp decline in their costs, development of more sophisticated risk management strategies and the innovations in the derivative markets (Bhalla, 2012).

The Indian derivatives market is said to have emerged as the leading market in the world within about three years of its existence. This increase has been caused, among other things, primarily by the increase in trading in stock futures. The turnover in index futures and index options, although introduced the earliest, has remained low. The option trading in India was still very small during the initial years, but that scenario has changed after 2007-08 (ISMR issues, 2003-2014). The concentration of trading activity in stock futures and stock options indicate that the market is overly speculative in nature.

* Assistant Professor, Post Graduate & Research Department of Commerce, The Cochin College, Kochi, Ernakulam, Kerala, India. Email: rajanispai@gmail.com

** Associate Professor & Head of Department, Post Graduate Department of Commerce, Maharaja's College, Ernakulam, Kerala, India. Email: snvichattu@gmail.com

Although derivatives were introduced simultaneously on the BSE and NSE, in 2001, there was hardly any derivatives market as a part of BSE; more than 99 percent of the volume of turnover was currently accounted for by NSE. This was the situation till 2011-12. But in 2013-14, there took place a 'volume explosion' in BSE in the number of contracts, where since the equity derivative turnover, once again surged (FIA Annual Survey, 2012). Currently, NSE has a turnover share of 78% of equity derivative turnover in the total turnover scenario. Index futures and index options are gaining more importance in the Indian derivative segment at present. The volume of turnover in derivatives market has increased from a paltry sum of Rs 2365 crore in 2000-01 to Rs 382 trillion in 2013-14. The total exchange traded derivatives volume shows a figure of 57.76 percent as compounded growth rate during 2013-14. NSE retains its position as a market leader in the Indian derivatives market by accounting for about 78 % of total turnover. During 2013-14, the F&O segment of NSE reported a total turnover for Rs 382 trillion as against Rs 315 trillion during the preceding year. It is found that the futures are more popular than options, and futures contracts on securities being the most popular till 2007-08, thereafter index futures have gained more popularity (National Stock Exchange Fact Books).

Statement of the Problem

Theoretically speaking, the introduction of futures trading is said to bring more volatility into the market. The rationale behind this statement is that futures trading increases volatility by roping in more uninformed traders who then trade in both spot and futures market. These speculators drive the prices to fluctuate by their activity to earn profits. This irrational speculation has been analysed and the analysts have come to the conclusion that these speculators in fact destabilise the market.

The perception still remains intact that the futures prices are more volatile than spot prices and that this higher volatility is then transmitted to the spot market through arbitrage. A large number of studies examine the relationship between futures trading volume and the price volatility in the underlying asset. Schwert (1990), in his study on the futures market volume and spot market price volatility, has found that when there is high volatility of S&P 500 index, there is found to be high activity in stock market and futures volume are also found to be high. Studies by Smith (1989), Darrat & Rahman (1995) but come up with a different point of view that there is no effect observed by

S&P 500 futures volume on the changes in the volatility. The study by Khan & Huazi (2009) provides evidence to contrary opinion to the hypotheses that future trading volume destabilises the cash market or that an increase in trading volume in one market relative to the other market occurs in destabilising the cash market.

Again, the study by Jian, Bessler, & Dand (2001) provides the evidence that unexpected surge in the futures trading volume is proportional to price volatility in the underlying market for the commodity futures market selected. Illueca and Lafente (2003) study the simultaneous relations between the trading volume and return in the Spanish stock index futures market. This study provides a positive proof of relationship between price volatility and unexpected component of trading volume.

Amidst the two main schools of thought that prevail in the existing literature about the association between futures and spot market volatility, contradictory results are to be found. The objective set forth in this study is to analyse the relationship between single stock futures trading and its cash market counter deals. The effect of inception of stock index futures on the underlying stock markets is an area of major concern for policy makers, exchanges, and also investors. The regulatory agencies have from first raised their objections against the inception of single stock futures at the Indian Exchanges on behalf of public interest. They anticipate the possibility of manipulation of index futures due to the presence of stock futures. In fact, the existences of stock futures were cited as architectural weakness in the market.

Objectives of the Study

The study aims to fulfil the following objectives:

- (1) To examine the lead-lag relationship between the futures and spot prices in Indian Stock market.

Hypotheses of the Study

The hypotheses formulated for the above stated objectives are:

1. H01: There exists a lead-lag relationship between futures and spot prices in the Indian derivatives market.
2. H02: Futures prices have a significant role in price discovery mechanism, thereby making the markets efficient.

Contribution of the Present Study

Understanding the influence of futures (spot) market over spot (futures) market is a crucial question with regard to market's micro-structure design. This area has become of great interest to policy makers, academicians, and market regulators since it provides an idea about the market efficiency, volatility, hedging, and arbitrage opportunities. Hence, there is a need to pursue this topic. Review relating to the previous studies depicts a picture with mixed results. Certain results show a positive relation between futures and spot prices, others a negative relation and also there are certain studies which have come up with no significant relations between futures market and spot market of Indian segment. Also the earlier studies concentrate only on establishing a relation between spot and futures market. The present study therefore, is an attempt to identify an existence of lead-lag relationship between spot and futures market.

Research Design

The study is predominantly empirical in the nature. The study takes the form of empirical when examining the lead-lag relationship between futures and spot prices. The data for examining the lead-lag relationship between futures and spot prices has been collected from the secondary sources. The data is in the form of closing prices of the companies selected – both from the futures segment and spot market. The near month closing prices have been accounted in the study, eliminating next month

and far month closing prices. This has been collected from the official website of NSE for the period of the study. BSE data has not been accounted for in the study as NSE is being considered as the benchmark for measuring the extent of derivative trades in India since the majority of derivative trading is taking place in NSE.

The period of the study for examining the lead-lag relationship between futures and spot prices is from 2001-02 to 2013-14, comprising 13 years. This period called as post-derivative period, ranges from 9-11-2001 to 31-3-2014 for 20 companies, from 31-1-2003 to 31-3-2014 for two companies - ICICI Bank and WIPRO, and from 29-8-2003 to 31-3-2014 for one company – HDFC Bank.

The companies selected for the purpose of the study are 23 companies which satisfy the required conditions stipulated for the study. The conditions framed for selection of the companies for the study are:

1. The companies selected are those on which single stock futures are permitted for trading in the F&O segment of NSE since 9th November 2001.
2. The companies selected are those which are included in Nifty and permitted for trading in F&O segment since January 2003.
3. The companies selected are those which are included in the Nifty for a minimum period of eleven years for the period of the study.

Table 1 gives the names of 23 companies which are found to comply with the above stated conditions.

Table 1: List of the Companies Selected for the Study

S. No.	Name of the Company	Notation
1	ACC Ltd	ACC
2	Ambuja Cements Ltd	AMBUJA
3	Bharat Heavy Electricals Ltd	BHEL
4	Bharat Petroleum Corporation Ltd	BPCL
5	Cipla Ltd	CIPLA
6	Dr.Reddy's Laboratories Ltd	DRREDDYS
7	Grasim Industries Ltd	GRASIM
8	Housing Development Finance Corp Ltd	HDFC
9	HDFC Bank Ltd	HDFCBANKLTD
10	Hindalco Industries Ltd	HINDALCO
11	Hindusthan Unilever Ltd	HINDUNLVR
12	ICICI Bank Ltd	ICICIBANK
13	Infosys Ltd	INFOSYSTCH

14	ITC LTD	ITC
15	Mahindra & Mahindra Ltd	M&M
16	Ranbaxy Laboratories	RANBAXY*
17	Reliance Industries Ltd	RELAINCE
18	Reliance Infrastructure Ltd	RELINFRA
19	State Bank of India	SBIN
20	Tata Motors Ltd	TATAMOTORS
21	Tata Power Co. Ltd	TATAPOWER
22	Tata Steel Ltd	TATASTEEL
23	Wipro Ltd	WIPRO

• Ranbaxy Laboratories was acquired by Sun Pharmaceuticals on April 7, 2014.

Tools Used for Analysis

The data collected were analysed using the statistical tools. For analysing the secondary data collected from the website of NSE, the software of E Views 5.0 version was used. Simple statistical tools like descriptive statistics, line

graphs are used to study the data collected. Econometric tools of unit root tests - Augmented Dickey Fuller Test, Phillips - Perron Test, Johansen's co-integration test, Granger causality, vector error correction method model are used to analyse the secondary data.

Table 2 shows the descriptive statistics for the whole study period for the stocks selected, for futures prices and spot prices.

Data Analysis and Interpretation

Descriptive Statistics

Table 2: Descriptive Statistics for Raw Data

Company	No. of Obs	Mean	Median	SD	Variance	Skewness	Kurtosis	JB
ACC FUT	3093	723	799	395	155960	-0.091	-1.306	224.0
SPOT	3093	723	799	394	155600	-0.099	-1.310	226.0
AMBUJA FUT	3093	168	149	85	7261	1.492	2.142	1735.0
SPOT	3093	167	149	85	7236	1.495	2.148	1742.8
BHEL FUT	3093	1163	873	903	815153	0.233	-1.592	354.1
SPOT	3093	1163	882	901	812670	0.229	-1.595	354.6
BPCL FUT	3093	415	375	137	18660	0.796	-0.030	326.2
SPOT	3093	414	374	136	18529	0.788	-0.030	319.7
CIPLA FUT	3093	443	324	300	89850	1.521	1.004	1320.3
SPOT	3093	442	323	299	89124	1.523	1.011	1325.2
GRASIM FUT	3093	1889	2176	933	871366	-0.282	-1.010	172.6
SPOT	3093	1886	2176	930	865776	-0.291	-1.014	176.0
HDFC FUT	3093	1193	800	763	582119	1.055	-0.280	583.9
SPOT	3093	1192	798	762	581006	1.055	-0.281	583.8
HINDALCO FUT	3093	394	170	413	170464	1.294	0.187	867.1
SPOT	3093	394	170	413	170198	1.294	0.185	867.0
HINDUNILVR FUT	3093	273	234	131	17217	1.337	0.827	1007.5
SPOT	3093	273	234	131	17053	1.335	0.828	1005.0
INFOSYS FUT	3093	2740	2630	974	948214	0.880	0.523	433.9

SPOT	3093	2737	2629	972	945377	0.883	0.526	436.4
ITC FUT	3093	449	253	389	151150	1.538	1.559	1529.8
SPOT	3093	448	253	389	151549	1.544	1.581	1548.2
M&M FUT	3093	587	642	267	71055	-0.406	-0.662	141.4
SPOT	3093	586	641	266	70693	-0.411	-0.651	141.7
RANBAXY FUT	3093	564	480	249	61815	0.928	-0.193	448.8
SPOT	3093	563	480	248	61649	0.929	-0.193	449.6
RELIANCE FUT	3093	998	850	626	392236	1.233	0.966	902.5
SPOT	3093	995	846	624	389748	1.229	0.941	891.2
RELIANCEINFRA FUT	3093	635	537	369	136480	1.720	3.932	3506.9
SPOT	3093	633	537	368	135121	1.708	3.865	3419.8
SBIN FUT	3093	1367	1333	806	649869	0.177	-1.116	176.5
SPOT	3093	1365	1332	806	648875	0.176	-1.117	176.8
TATAMOTORS FUT	3093	498	422	299	89601	0.713	-0.310	274.2
SPOT	3093	498	424	300	89810	0.713	-0.306	274.0
TATAPOWER FUT	3093	559	407	471	222165	0.635	-1.125	371.0
SPOT	3093	560	405	471	222246	0.632	-1.129	370.0
TATASTEEL FUT	3093	416	407	186	34456	0.286	-0.160	45.6
SPOT	3093	415	406	185	34392	0.285	-0.172	45.7
DRREDDY FUT	3093	1165	989	531	281976	0.904	0.232	427.8
SPOT	3093	1163	988	529	279338	0.901	0.222	424.1
ICICBANK FUT	2786	727	822	320	102339	-0.302	-1.139	192.7
SPOT	3093	667	748	352	123803	-0.189	-1.320	243.0
HDFCBANK FUT	2642	1003	744	589	347251	0.959	-0.175	408.1
SPOT	3093	890	676	608	370196	0.998	0.013	513.1
WIPRO FUT	2786	585	484	313	98281	2.076	3.800	3666.9
SPOT	3093	677	507	410	167882	1.415	0.639	885.0

Source: Computed by Researcher

The statistics reveal that mean of all the companies selected, both in case of futures and spot prices are with a positive sign. The standard deviation of INFY, in case of both futures and spot prices are the highest among the companies selected, followed by GRASIM. The standard deviation is lowest for AMBUJA. The price series are negatively skewed for ACC, GRASIM, M&M, and ICICIBK. The negative skewness implies the distribution with a long left tail. This implies that the investors have a greater chance of extremely negative outcomes. All other companies depict a positively skewed distribution, which implies that the investors have a chance of frequent small negative outcomes and a few extreme gains.

The kurtosis value is more than 3 only for RELINFRA, futures and spot and for WIPRO futures prices. This shows that the mean distribution is leptokurtic, which in turn means that the investors face lesser risk of extreme outcomes.

In order to check whether the data collected has the skewness and kurtosis matching a normal distribution, the Jarque-Berra test is adopted as the goodness of fit test. The results of Jarque-Bera (JB) test rejects the null hypotheses of the test of being normal as the calculated values exceed the critical value of 5.99 at 5% level of significance from the chi-square distribution.

Results of ADF Test

Using graphs, non-stationarity of the data is confirmed. This is further confirmed using the unit root test of Augmented Dickey Fuller test. The test is done on the assumption that the data series show a trend and an intercept, which is evident in the graphs plotted. The lag length criterion is fixed using Schwarz Info Criteria (SIC). The maximum lag of 28 is selected for doing the test.

The null hypothesis proposed in the unit root test is there is unit root in the given data. i.e., the time series data is Stationary. As the p-value is higher than 5%, at level, the null hypotheses cannot be accepted. Hence, the test is run

at first difference and at this juncture, the null hypothesis is accepted as p-value is less than 5%. That indicates that the time series is Stationary after differencing at first level. These results are consistent when an intercept and a linear trend are included as deterministic components in the test equation. The lag length is fixed using automatic selection which applies the Schwarz criterion. The lag selected is 28, the lag point where SIC is minimum as reported in Table 3. The P values cited are based on one-sided Mackinnon values (1996).

Table 3 gives the results of ADF test for both – futures and spot prices for the companies selected for the study.

Table 3: Results of ADF Test

S. No.	Company	Values	ADF Statistic for Futures	ADF Statistic for Spot
			At 1st differencing	At 1st differencing
1	ACC	Calculated	-53.76467	-53.35081
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
2	AMBUJA	Calculated	-56.93341	-56.85331
		Probability	0.0001	0.0000
		Decision	Stationary	Stationary
3	BHEL	Calculated	-53.65677	-53.59310
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
4	BPCL	Calculated	-54.21489	-54.69008
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
5	CIPLA	Calculated	-54.32216	-54.36126
		Probability	0.0001	0.0000
		Decision	Stationary	Stationary
6	DRREDDYS	Calculated	-55.96582	-55.66757
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
7	GRASIM	Calculated	-53.98837	-53.39317
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
8	HDFC	Calculated	-56.34947	-56.46570
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
9	HDFC BANK	Calculated	-51.53206	-51.54307
		Probability	0.0000	0.0000

		Decision	Stationary	Stationary
10	HINDALCO	Calculated	-54.92176	-54.7877
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
11	HINDUNILEVER	Calculated	-55.23502	-55.11840
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
12	ICICI BANK	Calculated	-48.57931	-47.91090
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
13	INFY	Calculated	-55.39433	-55.51488
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
14	ITC	Calculated	-55.48838	-55.33223
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
15	M&M	Calculated	-52.33738	-52.20075
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
16	RANBAXY	Calculated	-54.69372	-54.32491
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
17	RELIANCE	Calculated	-54.79005	-54.32232
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
18	RELINFRA	Calculated	-54.93616	-40.80783
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
19	SBIN	Calculated	-52.40306	-51.11604
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
20	TATAMOTORS	Calculated	-52.36149	-52.06030
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
21	TATAPOWER	Calculated	-56.00968	-55.93095
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
22	TATASTEEL	Calculated	-53.41053	-52.11456
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
23	WIPRO	Calculated	--55.29588	-55.00311
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary

Source: Computed by Researcher

- Further information on computation of data may be made available on demand

From Table 3, it is evident that in case of all the companies selected, the data is found to be non-stationary at level. It becomes stationary only at first differencing, in case of both futures and spot prices.

unit root test of Phillips - Perron. This test selects the lag reported as bandwidth using Newey - West which applies the automatic selection criterion using the Barley - Kernel method. The bandwidth selected by this method is 11. The method also treats intercept and linear trend as exogenous variables, same as that of ADF test. The results of the PP test are given in Table 4.

Results of PP Test

The stationarity at first level differencing results obtained from the ADF test, is further confirmed using another

Table 4: Results of PP Test

S. No.,	Company	Values	PP statistic for Futures	PP statistic for Spot
			At 1st differencing	At 1st differencing
1	ACC	Calculated	-53.75175	-53.33080
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
2	AMBUJA	Calculated	-56.92594	-56.85321
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
3	BHEL	Calculated	-53.62788	-53.56002
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
4	BPCL	Calculated	-54.21179	-54.69159
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
5	CIPLA	Calculated	-54.33687	-54.36720
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
6	DRREDDYS	Calculated	-55.9872	-55.69747
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
7	GRASIM	Calculated	-54.44340	-53.96060
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
8	HDFC	Calculated	-56.48052	-56.62100
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
9	HDFC BANK	Calculated	-51.54989	-51.56767
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
10	HINDALCO	Calculated	-54.91917	-54.78324

		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
11	HINDUNILEVER	Calculated	-55.30965	-55.31357
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
12	ICICI BANK	Calculated	-48.42113	-47.69963
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
13	INFY	Calculated	-55.41416	-55.55162
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
14	ITC	Calculated	-55.49839	-55.33845
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
15	M&M	Calculated	-52.24779	-52.09988
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
16	RANBAXY	Calculated	-54.71402	-54.40149
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
17	RELIANCE	Calculated	-54.78601	-54.32269
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
18	RELINFRA	Calculated	-54.93388	-54.04489
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
19	SBIN	Calculated	-52.31141	-50.94705
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
20	TATAMOTORS	Calculated	-52.26822	-51.94825
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
21	TATAPOWER	Calculated	-56.01892	-55.93740
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
22	TATASTEEL	Calculated	-53.65707	-52.33567
		Probability	0.0000	0.0000
		Decision	Stationary	Stationary
23	WIPRO	Calculated	-55.33897	-55.05233
		Probability	0.00000	0.0000
		Decision	Stationary	Stationary

Source: Computed by Researcher

- Further information on computation of data may be made available on demand

Table 4 shows the test results statistics for PP tests. The raw data is converted into natural log form to test the stationarity. This conversion is primarily done to avoid the heteroscedasticity problem which might exist in the data. In this test also, the data series are found to be non-Stationary at level, but becomes Stationary at first level differencing. The results confirm the results obtained from the earlier ADF test.

A non-Stationary stochastic process that can be made Stationary by considering the first differences is said to be integrated of order one, I (1). More generally, a data generating process (DGP) is said to be integrated of order d, (I (d)), if first differences have to be applied d times to make the process stationery or asymptotically Stationary. Hence, it can be said that the data relating to futures and spot prices of the companies concerned are found to be non-Stationary at level, i.e., having a unit root at level but becomes Stationary after first differencing i.e., does not show the unit root after differencing at first level. The tests run for checking stationarity are Augmented Dickey Fuller and Phillips-Perron. The results of both tests are very much in harmony indicating the validity of the test results.

Therefore, after checking the stationarity of the data

converted into natural log form is found to be Stationary at first difference, i.e., the data series are found to be integrated at first order I(1).

Results of Johansen's Co-integration test

The test checks the existence of co-integration between the two variables - future prices and spot prices of the concerned companies. The null hypotheses proposed for the test is:

H0: There is no long run association between the two variables selected.

In order to check the existence of co-integration, the trace statistic and max-eigen statistic are verified. The trace statistic verifies the existence of co integration equation between the two variables whereas max-eigen value determines the number of co integrating equation which are existing between the variables. The lag length is selected as 1 and the system assumes a linear deterministic trend in the equation. If the P value is less than 5%, the null hypotheses cannot be accepted. Hence, the null hypotheses of there is no co integration between two variables cannot be accepted and alternate hypotheses of there exists at most one co integration equation is accepted.

Table 5 reveals the results statistics.

Table 5: Results of Johansens's Co-Integration Test

S. No.	Company	Hypothesised No. of CE(s)	Trace Statistic	P Value	Max-Eigen Statistic	P Value
1	ACC	None	226.3617	0.0001	224.2727	0.0001
		At most 1	2.088938	0.1484	2.088938	0.1484*
2	AMBUJA	None	433.8411	0.0001	427.6074	0.0001
		At most 1	1.738882	0.1873	1.738882	0.1873*
3	BHEL	None	284.4525	0.0001	282.8760	0.0001
		At most 1	1.576492	0.2093	1.576492	0.2093*
4	BPCL	None	312.2394	0.0001	302.3768	0.0001
		At most 1	1.76337	0.0778	1.76337	0.0778*
5	CIPLA	None	344.9111	0.0001	338.9584	0.0001
		At most 1	0.116060	0.7334	0.116060	0.7334*
6	DRREDDYS	None	407.2312	0.0001	407.2312	0.0001
		At most 1	0.619105	0.4314	0.619105	0.4314*
7	GRASIM	None	251.8441	0.0001	246.9736	0.0001
		At most 1	0.109846	0.7404	0.109846	0.7404*
8	HDFC	None	366.8337	0.0001	363.3608	0.0001

		At most 1	3.472891	0.0624	3.472891	0.0624*
9	HDFC BANK	None	252.4796	0.0001	247.3183	0.0001
		At most 1	0.7215795	0.3957	0.7215795	0.3957*
10	HINDALCO	None	400.8147	0.0001	398.2688	0.0001
		At most 1	2.545923	0.1106	2.545923	0.1106*
11	HINDUNILEVER	None	243.1052	0.0001	242.9642	0.0001
		At most 1	0.140954	0.7073	0.140954	0.7073*
12	ICICI BANK	None	237.0789	0.0001	232.0034	0.0001
		At most 1	2.173882	0.1405	2.173882	0.1405*
13	INFY	None	256.5097	0.0001	248.6728	0.0001
		At most 1	1.881069	0.1702	1.881069	0.1702*
14	ITC	None	231.6191	0.0001	231.6191	0.0001
		At most 1	0.721579	0.3957	0.721579	0.3957*
15	M&M	None	210.4708	0.0001	205.0834	0.0001
		At most 1	4.847938	0.1203	4.847938	0.1203*
16	RANBAXY	None	274.4531	0.0001	270.4543	0.0001
		At most 1	2.413182	0.1205	2.413182	0.1205*
17	RELIANCE	None	238.6805	0.0001	235.1390	0.0001
		At most 1	3.541519	0.0598	3.541519	0.0598*
18	RELINFRA	None	234.7815	0.0001	232.8865	0.0001
		At most 1	3.031992	0.0816	3.031992	0.0816*
19	SBIN	None	224.7670	0.0001	220.6065	0.0001
		At most 1	1.136184	0.2865	1.136184	0.2865*
20	TATA MOTORS	None	223.2865	0.0001	216.7095	0.0001
		At most 1	6.27470	0.5412	6.27470	0.5412*
21	TATA POWER	None	248.7401	0.0001	248.7401	0.0001
		At most 1	1.312073	0.2520	1.312073	0.2520*
22	TATA STEEL	None	223.4918	0.0001	215.9885	0.0001
		At most 1	1.136184	0.2864	1.136184	0.2864*
23	WIPRO	None	244.33175	0.0001	236.3988	0.0001
		At most 1	0.796897	0.3721	0.796897	0.3721*

Source: Computed by Researcher

* signifies accepting the alternate hypotheses at 5% level of significance.

From Table 5, it is evident that in all the cases, the null hypotheses of having no co integration between the variables cannot be accepted. Thereby the alternate hypothesis that there exists the co integration between the two variables is accepted. The trace statistic and max-eigen statistic gives the same type of results. Therefore, after this test, it can be concluded that there exists a long run association between futures and spot prices in case of the companies selected for the study. That is, the futures prices and spot prices are found to be co-integrated after Johansen's co-integration test states that they share a common stochastic trend and will grow proportionally,

i.e., they move together in long run or they have a long run association.

Results of Granger Causality Test

Engle & Granger (1987) identifies that if co-integration exists between two variables in the long run, then there must be unidirectional or bidirectional Granger causality between these two variables. Engel and Granger also identify that the co-integrated variables must have an error correction model mechanism.

Once the presence of co-integrating vectors is determined, the study adopts Granger causality test. Table 6 gives the the direction of causality must be known. For this purpose test results of Granger causality.

Table 6: Results of Granger Causality

S. No.	Company	Particulars	F Statistic	P value	Direction of Causality
1	ACC	SACC does not Granger Cause DFACC	1.25476	0.2228	Bidirectional
		FACC does not Granger Cause DSACC	1.51254	0.0918	
2	AMBUJA	SAMBJ does not Granger Cause DFAMB	0.31389	0.9943	Bidirectional
		FAMB does not Granger Cause DSAMBJ	1.10764	0.3430	
3	BHEL	SBHEL does not Granger Cause DFBHEL	0.94574	0.5117	Unidirectional Spot causes Futures
		FBHEL does not Granger Cause DSBHEL	2.00197	0.0121	
4	BPCL	SBPCL does not Granger Cause DFBPCL	1.55015	0.0797	Unidirectional Spot causes Futures
		FBPCL does not Granger Cause DSBPCL	3.16595	3.E-05	
5	CIPLA	SCIPLA does not Granger Cause DFCIPLA	0.84710	0.6249	Bidirectional
		FCIPLA does not Granger Cause DSCIPLA	1.01741	0.4332	
6	DRREDDYS	SDRREDDYS does not Granger Cause FDRREDDYS	0.76888	0.7138	Bidirectional
		FDRREDDYS does not Granger Cause SDRREDDYS	1.17805	0.2811	
7	GRASIM	SGRASIM does not Granger Cause FGRASIM	1.07699	0.3724	Bidirectional
		FGRASIM does not Granger Cause SGRASIM	0.95546	0.5008	
8	HDFC	SHDFC does not Granger Cause FHDFC	0.80580	0.6723	Bidirectional
		FHDFC does not Granger Cause SHDFC	0.53708	0.9212	
9	HDFC BANK	SHDFCBK does not Granger Cause FHDFCBK	0.78756	0.6929	Bidirectional
		FHDFCBK does not Granger Cause SHDFCBK	0.60405	0.8740	
10	HINDALCO	SHINDALCO does not Granger Cause FHINDALCO	1.02920	0.4208	Bidirectional
		FHINDALCO does not Granger Cause SHINDALCO	0.67776	0.8088	
11	HINDUNILEVER	SHINDUNLVR does not Granger Cause FHINDUNLVR	1.42488	0.1262	Bidirectional
		FHINDUNLVR does not Granger Cause SHINDUNLVR	1.19847	0.2646	
12	ICICI BANK	SICICIBK does not Granger Cause FICICIBK	1.28893	0.2000	Bidirectional
		FICICIBK does not Granger Cause SICICIBK	1.18248	0.2776	
13	INFY	SINFY does not Granger Cause FINFY	0.85216	0.6191	Bidirectional
		FINFY does not Granger Cause SINFY	0.63626	0.8471	
14	ITC	SITC does not Granger Cause FITC	0.77962	0.7018	Bidirectional
		FITC does not Granger Cause SITC	0.63244	0.8504	

15	M&M	SMM does not Granger Cause FMM	1.29221	0.1978	Unidirectional Spot causes Futures
		FMM does not Granger Cause SMM	2.05903	0.0094	
16	RANBAXY	SRANBAXY does not Granger Cause FRANBAXY	1.32668	0.1767	Bidirectional
		FRANBAXY does not Granger Cause SRANBAXY	1.51892	0.0897	
17	RELIANCE	SRELAINCE does not Granger Cause FRELAINCE	0.66385	0.8221	Bidirectional
		FRELAINCE does not Granger Cause SRELAINCE	0.72470	0.7614	
18	RELINFRA	SRELINFRA does not Granger Cause FRELINFRA	1.28770	0.2006	Bidirectional
		FRELINFRA does not Granger Cause SRELINFRA	1.17556	0.2832	
19	SBIN	SSBIN does not Granger Cause FSBIN	2.08417	0.0083	Unidirectional Futures causes spot
		FSBIN does not Granger Cause SSBIN	1.47113	0.1069	
20	TATA MOTORS	FTMOTORS does not Granger Cause STMOTORS	1.10503	0.3455	Bidirectional
		STMOTORS does not Granger Cause FTMOTORS	0.67254	0.8139	
21	TATA POWER	STPOWER does not Granger Cause FTPOWER	0.54775	0.9145	Bidirectional
		FTPOWER does not Granger Cause STPOWER	0.83184	0.6425	
22	TATA STEEL	STSTEEL does not Granger Cause FTSTEEL	1.35870	0.1587	Bidirectional
		FTSTEEL does not Granger Cause STSTEEL	1.35352	0.1615	
23	WIPRO	SWIPRO does not Granger Cause FWIPRO	0.73627	0.7492	Bidirectional
		FWIPRO does not Granger Cause SWIPRO	0.36937	0.9864	

Source: Computed by Researcher

The results reported in Table 5 furnish information about Granger causality tests, i.e., the cause and effect relationship between the futures and spot price series. The results reveal that there exists a casual relationship either unidirectional or bidirectional between the selected companies. Out of 23 companies selected for the study, there exists bidirectional causality in case of 19 companies. In case of the other four companies, there is found to have a unidirectional casualty. Further, out of these four companies, unidirectional causality from spot to futures is found in case of three companies and in case of last company, unidirectional causality from futures to spot is found.

The existence of unidirectional causality, from spot market to futures market implies any changes in futures market

is caused by the corresponding changes in spot market. i.e., changes in futures market can be explained by prices of spot market. Correspondingly, unidirectional causality from futures to spot market implies that any subsequent changes in spot market are caused by changes in futures market.

Bidirectional causality indicates a feedback relationship between futures and spot market. From the presence of such a relationship, it can be inferred that the futures (spot) prices may contain additional information for the prediction of process in the spot (futures) market. There exists a bidirectional relationship in case of all the selected companies, except in case of companies –BHEL, BPCL, M&M and SBIN where in the first three companies – BHEL, BPCL and M&M there exists unidirectional

causality from spot to futures and in case of SBIN, the causal relationship is unidirectional where it is futures affecting the spot, as it is exhibited by the F-statistic and corresponding p values.

Results of VECM

It is pertinent to note that the results revealed by Granger causality tests are highly dependent on the number of

lagged terms introduced in the model (Gujarati, 2012). Because of this, results arrived at may not be conclusive. The lag selected in this case is 15 using AIC and SIC using optimal lag length criteria. Hence, these results are further put to test using VECM. The results of VECM are given in Table 7 and 8.

Table 7: Results of VECM depicting the Error Correction Term

S. No. (1)	Company (2)	Regression Equation (3)	Results	
			ECT (4)	Inference (5)
1	ACC (2)	Spot on Futures	-0.158665** (0.0123)	F S ↔
		Futures on Spot	-0.007368* (0.9056)	
2	AMBUJA(2)	Spot on Futures	-0.220269* (0.0853)	F S ↔
		Futures on Spot	-0.080602* (0.5257)	
3	BHEL(2)	Spot on Futures	-0.0003 (0.0024)	S F →
		Futures on Spot	-0.080377* (0.5431)	
4	BPCL(2)	Spot on Futures	-0.0003 (0.0001)	S F →
		Futures on Spot	-0.122107* (0.0794)	
5	CIPLA(4)	Spot on Futures	-0.127014* (0.4788)	F S ↔
		Futures on Spot	-0.0987* (0.5828)	
6	DRREDDYS(2)	Spot on Futures	-0.166482* (0.1023)	F S ↔
		Futures on Spot	-0.150673* (0.1386)	
7	GRASIM(2)	Spot on Futures	-0.221965** (0.031)	F S ↔
		Futures on Spot	0.038838* (0.5960)	
8	HDFC(2)	Spot on Futures	-0.266208** (0.0391)	F S ↔
		Futures on Spot	-0.018605* (0.8859)	
9	HDFC BANK(3)	Spot on Futures	-0.203048* (0.1880)	F S ↔
		Futures on Spot	-0.000914* (0.9953)	

10	HINDALCO(2)	Spot on Futures	-0.153122* (0.3645)	F S $\longleftrightarrow$
		Futures on Spot	-0.124510* (0.4617)	
11	HINDUNILEVER(2)	Spot on Futures	-0.052558* (0.3281)	F S $\longleftrightarrow$
		Futures on Spot	-0.127231** (0.0157)	
12	ICICI BANK(8)	Spot on Futures	-0.070544* (0.4246)	F S $\longleftrightarrow$
		Futures on Spot	-0.069116* (0.4341)	
13	INFY(4)	Spot on Futures	-0.180784* (0.2591)	F S $\longleftrightarrow$
		Futures on Spot	0.016476* (0.9173)	
14	ITC(2)	Spot on Futures	0.108939* (0.5278)	F S $\longleftrightarrow$
		Futures on Spot	-0.290455* (0.0941)	
15	M&M(3)	Spot on Futures	0.000121 (0.0001)	S F $\longrightarrow$
		Futures on Spot	-0.19235* (0.0557)	
16	RANBAXY(2)	Spot on Futures	-0.18439* (0.065)	F S $\longleftrightarrow$
		Futures on Spot	0.005025* (0.9288)	
17	RELIANCE(5)	Spot on Futures	0.023214* (0.8629)	F S $\longleftrightarrow$
		Futures on Spot	-0.186040* (0.1675)	
18	RELINFRA(3)	Spot on Futures	-0.082502* (0.4082)	F S $\longleftrightarrow$
		Futures on Spot	-0.152333* (0.1354)	
19	SBIN(2)	Spot on Futures	-0.084399* (0.3484)	F S $\longleftrightarrow$
		Futures on Spot	0.773093 (0.000)	
20	TATAMOTORS(2)	Spot on Futures	-0.1201588* (0.2305)	F S $\longleftrightarrow$
		Futures on Spot	-0.043354* (0.6657)	
21	TATAPOWER(2)	Spot on Futures	-0.133157* (0.2937)	F S $\longleftrightarrow$
		Futures on Spot	-0.060672* (0.6349)	

22	TATASTEEL(2)	Spot on Futures	-0.114503* (0.1650)	F S ↔
		Futures on Spot	-0.051288* (0.5396)	
23	WIPRO(2)	Spot on Futures	-0.23218* (0.8259)	F S ↔
		Futures on Spot	-0.166061* (0.1133)	

Source: Computed by Researcher

- Refers significance at 5% level of significance and ** refers to significance at 1% level of significance.
- Numbers given in the brackets in Column 2 represents the lags used.
- Figures in the parenthesis in Column 4 report t-statistics

After establishing a single co-integrating vector between futures and spot markets in case of selected companies, the Vector Error Correction Model is adopted to establish any causal nexus between futures and spot markets in case of selected companies. The selection of optimal lag length criteria in case of these companies is determined through AIC and SIC. The lags determined in case of these companies are 2 for ACC, AMBUJA, BHEL, BPCL, DRREDDYS, GRASIM, HDFC, HINDALCO, HINDUNLVR, ITC, RANBAXY, SBIN, TATAMOTORS, TATAPOWER, TATASTEEL and WIPRO; 3 for HDFCBK, M&M and RELINFRA; 4 for CIPLA and INFY; 5 for RELIANCE and 8 for ICICIBK.

The error correction term provides the information about the long run association between the vectors and also the causality nexus between them. As regards the former part of the information provided, the null hypothesis is this test is there is no long run association between the co-integrated vectors.

As evident in the results, the null hypothesis cannot be accepted. It can thus be understood from the results, there exists a long run association between the vectors of all the selected companies.

It is evident from the table that the error correction term happens to be negative and significant in case of nineteen companies. This proves that there exists a bidirectional causality or feedback relationship between futures and spot market in these cases. This means that the both futures and spot markets prices of these companies play a leading role through price discovery process and is said to be

informationally efficient and reacts more quickly to each other. Hence, in this case, it is found a contemporaneous and bidirectional lead lag relationship between the futures and spot markets and price discovery happens in both the markets simultaneously.

The speed of convergence or error correction term provides information about not only the causality but also the direction of causality. The magnitude of error correction term provides the information as to which market leads the other. If the EC Term, in the case of spot on futures is greater in absolute term than that of the futures on spot, indicates that when the co-integrated series is in disequilibrium in the short run, it is the spot price which makes greater adjustment to re-establish the equilibrium. That implies the future price leads the spot price in price discovery. From the companies, which exhibit bidirectional causality, it can be inferred from the ECT, that in case of 19 companies, except – HINDUNLVR and RELINFRA, it is the futures which leads the spot prices in price discovery process. In case of HINDUNLVR and RELINFRA, it is the spot which leads the futures market.

In case of four companies, BHEL, BPCL, M&M and SBIN, there is found to have unidirectional causality between futures and spot market prices. Out of these four, BHEL, BPCL and M&M, it is the spot market which is leading the futures market. This implies that the information first reflects in spot market which then is mirrored in the futures market prices. Hence, in case of these companies, it is the spot market which leads the futures market and act as price discovery vehicle. However, in case of SBIN, there is found to be unidirectional causality between futures and spot market prices, where it is the futures market is leading the spot market prices. In this case, the information arrives first in the futures market, which then leads the spot market.

These results of causal nexus between futures and spot market are found to be consistent with the results arrived earlier using Granger causality test which suggested

the bi-directional causality in case of 19 companies and unidirectional relationship in case of balance four companies.

The VECM furnishes further information regarding short

run association between the co-integrating vectors. The Wald statistic furnishes the information relating to the short run association between the vectors of the selected companies. Table 8 furnishes the results of VECM relating to short run association between the vectors.

Table 8: Results of VECM depicting other statistics of VECM

S. No.	Company Name	Wald Statistic Chi-Square	P Value	LM Test statistic	P Value	ARCH Test statistic	P Value
1	ACC	9.485187	0.0087	1.910998	0.3846	6.667196	0.1546
2	AMBUJA	7.278650	0.0264	4.063751	0.1311	5.528041	0.2373
3	BHEL	16.16981	0.0003	1.554426	0.4597	7.529594	0.1104
4	BPCL	30.67996	0.000	0.014021	0.9930	4.877798	0.3001
5	CIPLA	4.547717	0.1029	0.847097	0.6547	6.401438	0.1711
6	DRREDDY	12.66593	0.0018	1.842264	0.3981	0.951500	0.9171
7	GRASIM	6.466301	0.0394	1.003918	0.6053	18.00422	0.1200
8	HDFC	0.464380	0.7928	3.799081	0.1496	3.990751	0.4073
9	HDFCBANK	0.532499	0.7662	2.849882	0.2405	4.000565	0.4059
10	HINDALCO	0.518075	0.7718	1.586881	0.4523	4.716954	0.3176
11	HINDUNILVR	3.784877	0.1507	2.493566	0.2874	27.02979	0.000
12	ICICBANK	5.613202	0.0604	6.241283	0.0641	22.76346	0.0001
13	INFOSYS	1.774040	0.4119	1.729435	0.4212	6.783213	0.1478
14	ITC	0.305720	0.8582	0.836100	0.6583	7.216574	0.1249
15	M&M	13.76691	0.0010	0.337157	0.8449	0.847768	0.9319
16	RANBAXY	14.45741	0.0007	0.893699	0.6396	1.115128	0.8919
17	RELIANCE	2.253822	0.3241	1.536381	0.4639	7.581004	0.1082
18	RELIANCEINFRA	6.020368	0.0493	8.041692	0.1790	131.7920	0.0000
19	SBIN	0.535321	0.7652	6.731102	0.3450	32.87058	0.0000
20	TATAMOTORS	9.339254	0.0094	1.508702	0.4703	1.749195	0.7818
21	TATAPOWER	4.224619	0.1204	0.755430	0.6854	1.272868	0.8660
22	TATASTEEL	1.464705	0.4808	0.034992	0.9827	5.234560	0.2641
23	WIPRO	2.333008	0.3115	0.123758	0.9400	9.306888	0.0539

Source: Computed by Researcher

The null hypothesis in this test is that there is no short run association between the vectors. From the p value of the test statistic, it can be made out that, the existence of short run association is proven in case of companies like ACC, AMBUJA, BHEL, BPCL, DRREDDYS, GRASIM, M&M, RANBAXY and RELIANCEINFRA and TATAMOTORS where as in case of other companies, there is found to be no short run association.

The models adopted for the test are found to be perfect as these models are free from serial correlation and ARCH effect. A model to be perfect fit should be free from the serial correlation and the ARCH effect. The first fitness test is to check for the absence of serial correlation. The null

hypothesis in this test is that there is no serial correlation. With the aid of the p values in the table, it is clear that the null hypothesis can be accepted, thus making the tests free from serial correlation.

The next test run is to check the absence of heteroscedasticity. This is done using the BPG test statistic for ARCH effects. The null hypothesis in this test is that there is no ARCH effect. Again, from the p values provided in the table, it is clear that the model is free from any ARCH effect. Hence, it can be said that the VECM is best suitable for obtaining information about the long run and short run association between the co-integrating vectors.

Testing of Hypotheses

The hypotheses formulated to achieve the objectives set forth were:

1. H01: There exists a lead-lag relationship between futures and spot prices in the Indian derivatives market.
2. H02: Futures prices have a significant role in price discovery mechanism, thereby making the markets efficient.

From the results obtained using Johansen's co-integration and Granger causality, it is proved that there exists a lead lag relationship between futures and spot prices in case of companies selected. Using these tests, it is proved that there is a long run association between futures and spot prices in case of stocks adopted for the study. The co-integration between futures and spot prices in the long run is an prelude for the process of price discovery. The existence of co-integration ensures that there is long run equilibrium between these two series. Hence, the first hypothesis is accepted in case of all the companies selected.

The presence of long run relationship between futures and spot implies that futures prices provide information about the fluctuations in the spot market, indicating an efficient market. The second hypothesis that futures have a significant role in the price discovery mechanism is

tested using the results obtained from Granger causality test. Granger Causality results prove the existence of a bidirectional causality between futures and spot prices in case of nineteen companies. These companies are – ACC, AMBUJA, CIPLA, DRREDDYS, GRASIM, HDFC, HDFCBK, HINDALCO, HINDUNLVR, ICICIBK, INFY, ITC, RANBAXY, RELIANCE, RELINFRA, TATAMOTORS, TATAPOWER, TATASTEEL, and WPRO. In case of four companies, BHEL, BPCL, M&M and SBIN, unidirectional causality is proved. Again for BHEL, BPCL and M&M, the unidirectional causality is found from spot to futures. For SBIN, the unidirectional causality is established from futures to spot. Hence, the hypotheses of futures having a significant role in price discovery are accepted only in the case of 18 companies. In case of remaining five companies, the hypotheses cannot be accepted.

The results obtained from Granger causality and Johansen's co-integration tests, are further verified using VECM. From the results evident in VECM tests, the hypotheses that futures have a significant role in price discovery, thereby making the market efficient is accepted in case of 17 companies where futures leads the spot prices.

The acceptance or rejection of hypothesis is presented in Table 9

Table 9: Testing of Second Hypotheses

Acceptance of Hypotheses	Rejection of Hypotheses
ACC, AMBUJA, CIPLA, DRREDDYS, GRASIM, HDFC, HDFCBK, HINDALCO, ICICIBK, INFY, ITC, RANBAXY, RELIANCE, SBIN, TATAMOTORS, TATAPOWER, TATASTEEL, and WPRO.	BHEL, BPCL, HINDINLVR, M&M, RELINFRA

Conclusion

Derivatives trading have immensely become popular in the Indian markets right from the time of its introduction. This is mostly due to economic functions like price discovery, portfolio diversification, hedging, arbitrage etc. rendered by these markets. The movements of the spot market prices are largely influenced by speculation, hedging and arbitrage which take place in the futures market. Hence, the mechanics of influence of one market over other and the role enacted by futures market in price discovery is a very crucial question which is of great interest to academicians, regulators and policy makers.

There exists diversified theoretical arguments' relating to the causal relationship between futures and spot markets

by information dissemination. In this study, the question pertaining to the role of futures enacted in the price discovery process is analysed. With the help of selected 23 companies, the study concludes with the findings that there exists a bidirectional and contemporaneous relationship between the futures and spot prices in case of nineteen companies and the presence of unidirectional relation in case of other three companies. This findings are in line with earlier studies of Ryoo & Smith (2004), Kenourgios (2004), Chang & Lee (2008), Thenmozhi M (2002), Raju & Karande (2003) Sah & Kumar (2006), Mukherjee & Mishra (2006) and Mallikarjunappa & Afsal (2010) pertaining to Indian bourses.

References

- Acworth, W. (2012). *FIA annual survey*. Futures Industry.
- Bhalla, V. K. (2012). *Investment management*. New Delhi: S Chand & Company Ltd.
- Cheng, L. T., Jiang, L., & Ng, R. W. (2004). Information content of extended trading for index futures. *The Journal of Futures Markets*, 24(9), 861-886.
- Darrat, A. F., & Rahman, S. (1995). Has futures trading activity caused stock price volatility. *Journal of Futures Market*, 15, 537-557.
- Engle, F. R., & Granger, G. W. (1987). Co-integration and error correction: Representation, estimation and testing. *Econometrica*, 55, 251-276.
- Gujarathi, D. N., Porter, D. C., & Gunasekhar, S. (2015). *Basic Econometrics(5th Ed.)*. New Delhi: Tata McGraw-Hill.
- Illueca, M., & Lafuente, J. A. (2003). The effect of spot and futures trading on stock market volatility: Non parametric approach. *Journal of Financial Futures*, 23, 1-19.
- (2003). *Indian Securities Market Review*. Mumbai: National Stock Exchange .
- (2004). *Indian Securities Market Review*. Mumbai: National Stock Exchange.
- (2005). *Indian Securities Market Review*. Mumbai: National Stock Exchange.
- (2006). *Indian Securities Market Review*. Mumbai: National Stock Exchange.
- (2007). *Indian Securities Market Review*. Mumbai: National Stock Exchange.
- (2008-2015). *Indian Securities Market Review*. . Mumbai: National Stock Exchange.
- Jian, Y., Bessler, D. A., & Dand, L. J. (2001). Asset Storability and price discovery in commodity futures market - A new look. *The Journal of Futures Market*, 21(8), 279-300.
- Kenourgios, D. (2004). Price discovery in the athens derivatives exchange: Evidence for the FTSE/ASE -20 futures market. *Economic and Business Review*, 6(3), 229-243.
- Khan, S. U., & Huazi, S. T. (2009). single stock futures trading and stock price volatility: Empirical analysis. *Pakistan Development Review*, 4(48 Part II), 553 - 563.
- Mukherjee, K. N., & Mishra, R. K. (2006). Lead Lag relationship between Equities and Stock Index Futures Market and its Variation around Information Release: Empirical Evidence from India. *NSE Research Paper, NSE*.
- (2001-2015). *NSE Fact Book*. Mumbai: National Stock Exchnage .
- Raju, M. T., & Karande, K. (2003). Price discovery and volatility on NSE futures market. *SEBI Bulletin*, 1(3), 5-15.
- Ryoo, H.-J., & Smith, G. (2004). The impact of stock index futures on the Korean stock market. *Applied Financial Economics*, 14, 243-251.
- Schwert, G. (1990). Stock Volatility and the Crash of 87. *Review of Financial Studies*, 3, 77-102.
- Sha, A. N., & Kumar, A. A. (2006). Price discovery in cash and futures market: The case of S&P Nifty and Nifty futures. *The ICFAI Journal of Applied Finance*, 12(4), 55-63.
- Smith, C. W. (1989). Market volatility: Causes and consequences. *Cornell Law Review*, 953- 962.
- T, M., & M, A. E. (2010). Price discovery process and volatility spillovers in spot and futures markets: Evidence of individual stocks. *Vikalpa*, 35(2), 49-62.
- Thenmozhi, M. (2002). Futures Trading, Information and Spot Price Volatility of NSE -50 Index Futures Contract. *NSE Research Paper*.