Price Discovery and Causality in the NSE Futures Market

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Abstract

The study investigates the causal relationship between the spot and futures on individual securities. The objectives of the study are examined by employing Johansen's cointegration test and vector error correction model (VECM). The daily closing data is taken from November 9, 2001 to September 29, 2005 for the analysis. The results revealed that futures leads the spot in case of 9 individual securities, spot leads the futures in case of 7 individual securities and the feedback relation takes place between two markets in case of 9 individual securities.

I. Introduction

Futures contracts were originally developed as new financial instruments for price discovery and risk transfer. The essence of the price discovery function depends on whether new information is reflected first in futures markets or cash markets. Both markets contribute to the discovery of a unique and common unobservable price that is the efficient price. Price discovery and information flow across cash and futures markets is an area that has received good deal of attention from academician, regulators and practitioners alike. This is due to the fact that the issue is inextricably bound up to key central notions in financial theory, notable market efficiency and arbitrage. In perfect efficient markets, profitable arbitrage should not exist as price adjusts simultaneously and fully to incoming information. Therefore, new information disseminating into the market should be immediately reflected into the cash and futures prices by triggering trading activity in one or all of the markets simultaneously. So that there should be no systematic lagged responses long enough to profitably exploit, given the transaction costs involved.

The theoretical relationship between cash and futures prices can be explained by the cost-carry-model. According to this view, futures prices depend on the cash prices of the asset from the

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present to the delivery date of the futures contracts. The continuous time representation of the theoretical fair value estimate of the stock futures price is fairly approximately by the net cost-of-carry model. Symbolically, it can be explained as:

$$F_t=S_te^{(r-d)\,(T-t)} \qquad (1)$$

Where, F_t is the futures prices at time t, S_t is the cash prices at time t. r-d is the net cost of carring the underlying stocks in the cash markets that is the rate of interest cost r less the rate at which dividend yield accrues to the cash market portfolio holder d. T is the expiration date of the futures markets. So T-t is the time remaining in the futures contract life. Here, in this formulation the riskless rate of interest and the dividend yield on the underlying stocks in the cash markets are assumed to be known, constant and continuous rate.

In the equation (1), when the futures price is above the level implied by the right-hand side of (1), a riskless arbitrage profit equal to the difference between the futures price and the cash price plus the cost-of-carry. A long arbitrage profit of $Ft-S_te^{(r-d)\,(T-t)}$ can be earned by selling the futures contracts and buying the stocks in the cash market. On the other hand, when the futures prices falls bellow the right- hand side of (1), a short arbitrage profit of $S_te^{(r-d)\,(T-t)} - F_t$ can be earned by buying the futures and selling in the cash market and investing the sale proceeds at the riskless rate.

One empirical implication of cost-carry-model is that only contemporaneous values of the parameters enter in the model. Therefore, price adjustments are instantaneous in the perfectly efficient and continuous cash and futures markets. The observed relation between price changes in the two markets will be noisy due to market imperfections and not simultaneous. In addition, if there are economic incentives for traders to use one market over the other, a lead-lag relation between price changes in the two markets is likely to happen (Zou and Pinfold,2001).

After the brief theoretical discussion of cash and futures market price, a review of related literatures concerning the price discovery and causality between cash and futures market has been examined to identify the gap of the study. Stock index futures contracts were first studied by Zeckhouser and Niederhofter(1983) who investigated daily changes of the S&P 500 index and its futures contracts. A similar kind of correlation technique was employed by Finnerty and Park(1987), who examined the hypothesis that Major Market Index(MMI) futures price changes determine cash index changes. It was concluded that correlation analysis provides only unidirectional results without any evidence for a causal relationship.

Kawaller et. al.(1987) examined the intraday price relationship between the S&P 500 futures and index prices by employing the 3SLS regression. The analysis revealed that futures price movements consistently lead the index movements by up to 45 minutes. Meanwhile, the lead from cash market prices rarely extended beyond one minute. The researchers concluded that the futures markets serves as a vehicle for price discovery. Herbst, et.al. (1987) too observe that the S&P 500 and value live futures lead the spot index between 0 to 16 minutes.

Harris,C (1989) examined the relationship between S&P 500 index and futures during the October 1987 stock market crash using five-minute data. A correlation technique and weighted least squires (WLS) model have been employed for examining the objective of the study. The analysis revealed that the S&P 500 cash index displayed more autocorrelation that the futures and the futures market leads the spot market.

An ARMA(p,q) process has been used by Stoll and Whaley(1990) to study the intraday price relationship between S&P 500 and the Major Market Index(MMI) futures. The study revealed that there is a strong evidence of the futures market leading the stock market. Similar conclusions are drawn by Kutner and Sweeney(1991); Tang, Mak and Choi(1992); Kawaller, Koch and Koch(1993); Ghosh(1993) and Puttonen(1993).

Abhyankar, A.H. (1995) made an attempt to analyse the lead–lag relationship between hourly returns in the FT-SE 100 stock index futures and cash index. The author evaluated the lead-lag relations for periods of differential transactional costs, spot volumes and volatility, good and bad news (increased by the size of returns). An AR (2) and Exponential GARCH (1,1) model has been used to analyse the study by taking hourly data for period 1986 through 1990. The empirical results revealed that the futures lead of the spot index reduced, when transaction costs for underlying asset fell. It also observed that futures market leads spot market returns during periods of high volatility

Turkington and Walse (1999) examined the high frequency causal relationship between Shares Prices Index (SPI) futures and the All-Ordiaries Index (AOI) in Australia. The empirical analysis was evaluated by using the cost-of-carry model, ARMA (p,q), Bivariate VEC,VAR models and impulse response functions. The study found that SPI futures and the spot AOI index are integrated. It showed a strong evidence of bi-directional causality (or feed back) between the two series. The impulse response functions support these results.

Chris et.al. (2001) examined to estimate the lead-lag relation between the FTSE 100 stock index futures and the FTSE 100 index. Cointegration and error correction model, ARMA model and vector auto regressive model have been employed to examine the objectives of the study. The result indicate that futures lead the spot market attributable to faster flow of information into the futures market mainly due to lower transaction costs.

Tan, Juat-Hong (2002) analysed the temporal causal relationships between spot and futures markets using daily closing prices for both Malaysian stock composite index(MSCI) and Kuala lumpur futures index (KLFI). The Johansen procedure was used to test for cointegration. The standard Granger F-statistic, Hsiao's sequential approach (HSM), including the error correction variable for testing the short and long run causality were employed to evaluate the casual nexus between spot and futures markets. The empirical analysis indicated that both MSCI and KLFI series are cointegrated. The empirical regression from standard regression causality and HSM revealed a bidirectional relationship for the short-run period; while the ECM provides the evidence that the stock index futures (KLFI) leads the Malayasian Composite Index (MSCI).

Kavussanos, et. al (2003) investigated the casual relationship between futures and spot prices in the freight futures markets employing the Vector Error Correction Model (VECM) and General Impulse Response(GIR). The study compared the forecasting performance of the VECM with that of Vector Auto Regressive (VAR), Auto Regressive Integrated Moving Average (ARIMA) and Random Walk (RW) models. The results found that futures price tend to discover new information more rapidly than spot prices and information from the futures prices can be used to generate more accurate forecasts of the spot prices.

At the national level, an attempt is made to investigate the empirical relationship between NSE 50 futures and NSE 50 index by Thenmozhi, M (2002). She examined the lead-lag relationship between stock index futures and spot index returns. The daily closing price returns of Nifty spot and futures index from 15th June 2000 to 25th July 2002 has been used for the study. The data sources were retrieved from the National Stock Exchange (NSE) Website. The lead lag relationship between spot and index futures were examined by using simultaneous equation modeling, ordinary least squares and two stage least squares regression. The lead lag analysis shows that futures market is faster than spot market in disseminating information and futures returns lead the spot index returns.

Raju and Karande (2003) examined the price discovery between the S & P CNX Nifty and its corresponding futures. Cointegration technique and Error correction model has been employed for examining the objectives. Daily closing values of index futures and BSE 100 index were comprised for June 2000 through October 2002. All the required data information's were collected from website of NSE. The analysis revealed that the futures market (and not the spot market) responds the deviation from equilibrium and price discovery occurs in the both futures and the spot market.

However, the existing literature reveals the following lacunae: Firstly, All of the studies have adopted index futures for the purpose of analyse the price discovery and causality between the spot and futures price. Therefore, there exists a scope for further analyse by employing the stock futures on individual securities. This can give the detail analysis of price discovery between the spot and futures on each individual security. Secondly, Most of the studies were investigated by employing the Granger Causality, Engle-Granger's co-integration and Johansen's cointegration test. At the national level, simultaneous equation model and Engle- Granger's cointegration techniques were employed by earlier authors. It revealed that Johansen's cointegration test and vector error correction model (VECM) are the superior techniques for examine the causality between the spot and futures. Thirdly, It is important for investors and traders for trading in the leading market in the short-run. Because they can make arbitrage profit by trading in the leading market. The Johansen's VECM estimates the leading market between cash and futures markets. It also reveals the possibility for long-run equilibrium between two markets which gives the chance for equilibrium price for investors and traders after adjusting the short-run price fluctuations.

On the above background, the present article investigates the causal nexus between spot and futures prices on individual securities. The rest of paper is organised as follows: After the brief introduction of the subject, section-II presents the methodology and data of the study. Section-III contains the empirical results and discussions of the study. Finally, concluding remarks are presented in section-IV.

II. Methodology

Johansen's (1988) cointegration approach and Vector Error Correction Model (VECM) have been employed to investigate the causal nexus between spot and futures prices. Before doing cointegration analysis, it is necessary to test the stationary of the series. The Augmented Dickey-Fuller (ADF), 1979 and Phillips-Perron (PP), 1988 tests are employed to infer the stationary of the series. If the series are non stationary in levels and stationary in differences, then there is a chance of cointegration relationship between them which reveals the long run relationship between the series. Johansen's cointegration test has been employed to investigate the long-run relationship between spot and futures prices. The causal relationship between spot and futures prices is investigated by estimating the following Vector Error Correction Model (VECM) (Johansen, 1988):

$$\Delta X_t = \sum_{i=1}^{p-1} \Gamma_i X_{t-i} + \Pi X_{t-1} + \varepsilon_t ; \varepsilon_t = \begin{pmatrix} \varepsilon_{S,,t} \\ \varepsilon_{F,t} \end{pmatrix} \approx N(0, \Sigma) \tag{2}$$

Where $X_t = (S_t \ F_t)'$ is the vector of spot and futures prices, each being I (1) such that the first differenced series are I (0); Δ denotes the first difference operator; Γ_i and Π are 2×2 coefficient matrices measuring the short-and long-run adjustment of the system to change in X_t and ε_t is 2×1 vector of white noise error terms.

There are two likelihood ratio tests that can be employed to identify the co-integration between the two series. The variables are cointeregrated if and only if a single cointegrating equation exists. The first statistic λ_{trace} tests the number of cointegrating vectors is zero or one, and the other λ_{max} tests whether a single cointegrating equation is sufficient or if two are required.

In general, if r cointegrating vector is correct. The following test statistics can be constructed as:

$$\lambda_{\text{Trace}}(\text{r}) = -T \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right) \tag{3}$$

$$\lambda_{\text{Max}}(\text{r, r+1}) = -T \ln\left(1 - \hat{\lambda}_{r+1}\right) \tag{4}$$

Where, n is the number of separate series to be examined, T is the number of usable observations and ($\hat{\lambda}_i$) are the estimated eigen values (also called characteristic roots) obtained from the (i+1) × (i+1) 'cointegrating matrix.'

The first test statistic (λ_{trace}) tests whether the number of distinct cointegrating vectors is less than or equal to r. The second test statistic (λ_{max}) tests the null hypothesis that the number of cointegrating vectors is r against an alternative hypothesis that it is r+1. Johansen and Jueselins (1990) provide the critical values of these statistics. The rank of Π may be tested using the λ_{max} and λ_{trace}. If rank (Π) =1, then there is single cointegrating vector and Π can be factored as $\Pi=\alpha\beta'$, where α and β′ are 2×1 vectors. Using this factorisation β′ represents the vector of cointegrating parameters and α is the vector of error correction coefficients measuring the speed of convergence to the long-run steady state.

If spot and futures prices are cointegrated, then causality must exist in at least one direction (Granger, 1986). To test the causality, the following expanded VECM may be estimated using OLS in each equation.

$$\Delta S_t = a_{S,0} + \sum_{i=1}^{p-1} a_{S,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} b_{S,i} \Delta F_{t-i} + \alpha_S Z_{t-1} + \varepsilon_{S,t} \tag{5}$$

$$\Delta F_t = a_{F,0} + \sum_{i=1}^{p-1} a_{F,i} \Delta S_{t-i} + \sum_{i=1}^{p-1} b_{F,i} \Delta F_{t-i} + \alpha_F Z_{t-1} + \varepsilon_{F,t} \tag{6}$$

where $a_{S,0}$, $a_{F,0}$ are intercept terms; $a_{S,i}$, $b_{S,i}$, $a_{F,i}$, $b_{F,i}$ are the short-run coefficients and $Z_{t-1}= \beta' X_{t-1}$ is the error correction term from equation (2).

In terms of the VECM of equation (5) & (6), F_t Granger Causes S_t if some of the $b_{S,i}$, coefficients, i =1,2,----, p-1 are not zero and α_S, the error correction coefficient in the equation for spot prices, is significant at conventional levels. Similarly, S_t Granger causes F_t if some of the $a_{F,i}$ coefficients, i =1,2,---, p-1 are not zero and α_F is significant at the conventional levels. These hypotheses can be tested using t-tests for the significance of the error correction coefficients and F-tests on the joint significance of the lagged estimated coefficients. If both S_t and F_t Granger cause each other, then there is two-way feedback relationship between the two markets. Therefore, the error correction coefficients, α_S and α_F serve two purposes: to identify the direction of causality between spot and futures prices and to measure the speed with which deviations from the long-run relationship are corrected by changes in the spot and futures prices.

The VECM equation (5) & (6) provides a framework for valid inference in the presence of I (1) variable. The Johansen (1988) procedure has several advantages. First, this procedure provides more efficient estimates of the cointegrating relationship than the Engel and Granger (1987) estimator (Gonzalo, 1994). Second, Johansen (1988) tests are shown to be fairly robust to presence of non-normality (Cheung and Lai, 1993) and heteroscedasticity disturbances (Lee and Tse, 1996). Finally, in contrast to the Engel and Granger (1987) procedure, inference on the model and hence tests of Granger causality do not depend on the ordering of the variables in the conitegrating regression.

The data information for futures prices on individuals securities have been collected from NSE website for the study. The spot prices data of individual securities have been collected from PROWESS database. In India, futures contract are allowed to be traded on a total 31 securities. The study has selected 25 securities for analysis in order to availability of data at NSE website. The data for study is the daily closing value of the spot and futures on individual securities. The futures on individual securities commenced from November 9, 2001 and hence futures on securities and spot prices are considered from November 9, 2001 to September 29, 2005. During the sample period, the futures on securities trades from 9:55 A.M. to 3:30 P.M. . The futures on individual securities analysed here uses data on the near month contract as they are mostly heavily traded. Though it would be better to consider using high frequency data rather than daily prices, the daily closing prices are taken due to non-availability of high frequency data i.e. hourly or minute by minute data. The data has been analysed using E views package.

III. Empirical Results and Discussions

The test of stationarity developed by Dickey and Fuller (1979) and Fillips and Perron (1988) have been performed for the series. Results of unit root tests are presented in Table (1). ADF and PP tests are conducted to test the unit root for spot prices on individual securities in the Table-1(i) and Table-1(ii) simultaneously. Both tests reveal the non stationary their levels and stationary their first difference. In Table-1(iii) and Table1-(iv) indicate the unit root tests for futures on individual securities. Table-1(iii) shows the ADF tests in which the series are non stationary at their levels and stationary at their first difference. PP test also showed the same results as ADF in Table-1(iv). All the results of unit root tests for spot and futures prices on individual securities rejected the null hypothesis of unit root at their first difference.

The results of cointegration tests of Johansen (1988) have also been performed for spot and futures prices on individual securities in Table (2). They indicate that one cointegration relationship exists between spot and futures markets in case of each individual security. Johansen's λ_{max} and λ_{trace} statistic reveal the spot and futures prices on each individual security stand in a long-run relationship between them, thus justifying the use of a Vector Error Correction Model (VECM) for showing short run dynamics.

The VECM results have been presented in Table-3(i), Table-3(ii) and Table-3(iii).In VECM, various lag selection tests have been performed indicating that about twenty lags may be considered in the estimated model. While such a long lag structure may be satisfactory on a pure statistical background. It appears (i) that a long lag structure decreases the economic appeal of considering the error correction term as a measure of the true market price correction, (ii)that it makes little difference in the residual estimates (Alhonse,2000). The results retained and presented here based on VECM with two lags for ACC, BAJAJAUTO, BHEL, BPCL, BSES, CIPLA, DRREDDY, GRASIM, HINDALCO,INFOSYTCH, L&T, M&M, MTNL, RANBAXY, STROPTICAL and SBIN; three lags for HDFC; four lags for GUJAMBCEM, HINDLEVER, SATYAM AND TELCO; five lags for ITC; six lags for VSNL; eight lags for RELIANCE and twelve lags for DIGITALEQP. The VECM results reveal that there is causality from futures to spot in case of 9 individual securities such as: ACC, BAJAJAUTO, BPCL, DRREDDY, GUJAMBCEM, HDFC, SATYAM, TELCO and RELIANCE. The causality from spot to futures in case of 7 individual securities such as: CIPLA, RANBAXY, HINDLEVER, VSNL, DIGITALEQP, INFOSYSTCH and STROPTICAL. The results also indicate that the feedback relation between two markets in case of 9 individual securities such as: BHEL, BSES, GRASIM, HINDALCO, L&T, M&M, MTNL, SBIN and ITC. The F-test of the VECM in all cases reveal the jointly significance of the lagged estimated coefficients except GUJAMBCEM, INFOSYSTCH AND DIGITALEQP.

IV. Conclusion

The study has investigated that the price discovery and causality between spot prices on individual securities and their futures separately. ADF and PP tests have found that the spot and futures prices on individual securities are non-stationary in levels, but stationary in first difference. The Johansen cointegration test for them indicated that each pair of series are cointegrated which lead to the conclusion of the existence of long-run equilibrium between spot and futures prices.

The Johansen's VECM results reveal that the futures lead the spot in case of 9 individual securities. Therefore, futures markets play an important role for price discovery. The spot leads the futures in case of 7 individual securities which show that the spot markets play an important role for price discovery. The feedback relation takes place in case of 9 individual securities. It could say that the spot and futures may have an important price discovery role. Thus, a temporal causality exists between them.

Table-1(i)
Unit Root Test for Spot Prices on Individual Securities

Individual Securities	Augmented Dickey-Fuller Test (ADF)			
	Intercept	Intercept&Trend	Intercept	Intercept&Trend
	Levels		Difference	
ACC	1.438079	-0.986588	-14.26295*	-14.45538*
BAJAJAUTO	1.218268	-0.894677	-12.79967*	-12.90803*
BHEL	2.137930	-0.593588	-14.27019*	-14.52897*
BPCL	-2.013768	-2.500454	-12.99697*	-12.99348*
BSES	3.164646**	1.289275	-9.301938*	-9.773642*
CIPLA	-1.659087	-2.403537	-13.59279*	-13.58527*
DIGITALEQP	-1.741943	-1.885588	-10.97705*	-10.96735*
DRREDDY	-1.865826	-1.929747	-15.11043*	-15.10205*
GRASIM	-0.497921	-2.144815	-12.84961*	-12.84473*
GUJAMBCEM	-1.836551	-1.522483	-13.96839*	-14.00878*
HDFC	-0.446297	-1.482042	-15.80876*	-15.95202*
HINDALCO	-1.599512	-1.003059	-13.56979*	-13.63325*
HINDLEVER	-1.876276	-1.440372	-14.29324*	-14.35341*
INFOSYSTCH	-1.969469	-2.454940	-14.76794*	-14.76281*
ITC	-2.279375	-2.945739	-13.80948*	-13.84509*
L&T	0.020466	-1.794328	-10.70365*	-10.77357*
M&M	-1.367741	-2.249264	-15.15497*	-15.16059*
MTNL	-2.011368	-2.060704	-14.53238*	-14.52910*
RANBAXY	-1.898572	-1.559625	-14.01360*	-14.06616*
RELIANCE	0.763126	-1.366315	-13.44508*	-13.56473*
SATYAM	-0.303304	-1.712275	-15.29059*	-15.31625*
SBIN	0.674173	-1.586912	-13.33622*	-13.40987*
STROPTICAL	-0.956815	-2.272092	-7.615282*	-7.594924*
TELCO	2.281829	0.445045	-8.916114*	-9.283939*
VSNL	-1.896856	-1.466191	-9.859251*	-9.965654*

Note: *Significant at one percent level,
** Significant at five percent level,

Table-1(ii)
Unit Root Test for Spot Prices on Individual Securities

Individual Securities	Phillips-Perron (PP) Test			
	Intercept	Intercept&Trend	Intercept	Intercept&Trend
	Levels		Difference	
ACC	1.499013	-1.001284	-31.63645*	-31.77960*
BAJAJAUTO	1.171735	-0.921218	-30.86830*	-30.93595*
BHEL	2.202987	-0.555338	-28.92096*	-29.08404*
BPCL	-1.998695	-2.432565	-30.98535*	-30.97409*
BSES	3.194811**	1.171630	-20.17014*	-20.40718*
CIPLA	-1.597849	-2.337051	-30.10928*	-30.09454*
DIGITALEQP	-1.869276	-2.001556	-24.19675*	-24.17608*
DRREDDY	-1.866283	-1.926104	-29.80280*	-29.78766*
GRASIM	-0.422293	-2.058993	-28.34577*	-28.33351*
GUJAMBCEM	-1.848205	-1.539855	-30.80701*	-30.82648*
HDFC	-0.418708	-1.452027	-33.56054*	-33.67531*
HINDALCO	-1.635666	-0.987491	-31.16460*	-31.20565*
HINDLEVER	-1.904999	-1.523082	-29.43986*	-29.46440*
INFOSYSTCH	-2.051887	-2.589253	-30.49045*	-30.48173*
ITC	-2.379436	-3.154735	-30.96051*	-30.97867*
L&T	0.035807	-1.803243	-23.63665*	-23.67347*
M&M	-1.374688	-2.249695	-30.79679*	-30.79079*
MTNL	-2.032414**	-2.079774	-28.45463*	28.43989*
RANBAXY	-1.875895	-1.523137	-29.80350*	-29.82880*
RELIANCE	0.767015	-1.277400	-30.49067*	-30.54616*
SATYAM	-0.494628	-1.808771	-31.39093*	-31.38943*
SBIN	0.750756	-1.519438	-28.83875*	-28.87820*
STROPTICAL	-0.701681	-2.074674	-18.14421*	-18.12509*
TELCO	2.411616	0.485929	-22.90067*	-23.14899*
VSNL	-2.487055	-2.170137	-19.69483*	-19.82991*

Note: *Significant at one percent level,
** Significant at five percent level,

Table-1(iii)
Unit Root Test for Stock Futures on Individual Securities

Individual Securities	Augmented Dickey-Fuller (ADF) Test			
	Intercept	Intercept&Trend	Intercept	Intercept&Trend
	Levels		**Difference**	
ACC	1.301821	-1.107053	-14.04367*	-14.21533*
BAJAJAUTO	1.199085	-0.904035	-12.37988*	-12.48897*
BHEL	2.101807	-0.592431	-13.67515*	-13.92898*
BPCL	-2.042515	-2.512807	-13.12003*	-13.11757*
BSES	3.164646**	1.289275	-9.144235*	-9.576272*
CIPLA	-1.656060	-2.404714	-13.54688*	-13.53935*
DIGITALEQP	-1.740228	-1.887663	-11.02515*	-11.01530*
DRREDDY	-1.878881	-1.942814	-15.07410*	-15.06523*
GRASIM	-0.474349	-2.113859	-12.81232*	-12.80769*
GUJAMBCEM	-1.875054	-1.575891	-14.01026*	-14.04966*
HDFC	-0.421036	-1.439993	-15.44804*	-15.59099*
HINDALCO	-1.604125	-1.006092	-13.57088*	-13.63392*
HINDLEVER	-1.876571	-1.455791	-13.97803*	-14.03968*
INFOSYSTCH	-1.971572	-2.458160	-14.67332*	-14.66741*
ITC	-2.292798	-2.974001	-13.89989*	-13.93571*
L&T	-0.006057	-1.800039	-10.55310*	-10.61844*
M&M	-1.373485	-2.299424	-14.90748*	-14.91209*
MTNL	-3.012536**	-3.056003	-14.53717*	-14.53403*
RANBAXY	-1.914253	-1.579241	-13.81939*	-13.87133*
RELIANCE	0.697939	-1.417107	-13.20478*	-13.31813*
SATYAM	-0.335320	-1.736435	-14.94573*	-14.97237*
SBIN	0.607636	-1.665840	-13.34962*	-13.41766*
STROPTICAL	-0.942265	-2.259947	-7.663115*	-7.643479*
TELCO	2.232294	0.400992	-8.800686*	-9.154342*
VSNL	-1.913213	-1.434111	-9.814084*	-9.931435*

Note: *Significant at one percent level,
** Significant at five percent level,

Table-1(iv)
Unit Root Test for Stock Futures on Individual Securities

Individual Securities	Phillips-Perron(PP) Test			
	Intercept	Intercept&Trend	Intercept	Intercept&Trend
	Levels		Difference	
ACC	1.342480	-1.130267	-31.57650*	-31.70125*
BAJAJAUTO	1.198965	-0.868935	-30.68581*	-30.75245*
BHEL	2.201333	-0.523723	-28.74036*	-28.89603*
BPCL	-2.036950	-2.472694	-30.13013*	-30.13013*
BSES	3.194811**	1.171630	-19.92972*	-20.14657*
CIPLA	-1.594716	-2.333844	-30.02574*	-30.01103*
DIGITALEQP	-1.862945	-1.996815	-24.52310*	-24.50245*
DRREDDY	-1.858038	-1.921580	-30.12237*	-30.10732*
GRASIM	-0.403628	-2.036508	-28.54788*	-28.53574*
GUJAMBCEM	-1.873752	-1.577128	-30.80701*	-30.82648*
HDFC	-0.418154	-1.458896	-32.83274*	-32.94556*
HINDALCO	-1.650354	-0.997853	-30.93037*	-30.96999*
HINDLEVER	-1.881505	-1.484512	-29.29487*	-29.31906*
INFOSYSTCH	-2.045296	-2.587840	-30.41911*	-30.41061*
ITC	-2.394379	-3.193347	-31.12012*	-31.13839*
L&T	-0.003488	-1.820980	-24.09906*	-24.13152*
M&M	-1.378331	-2.289584	-31.09147*	-31.08489*
MTNL	-2.061134	-2.104586	-27.90723*	-27.89260*
RANBAXY	-1.875599	-1.525320	-30.25536*	-30.28135*
RELIANCE	0.714096	-1.321844	-30.96017*	-31.01382*
SATYAM	-0.498739	-1.797614	-31.85094*	-31.84941*
SBIN	0.673313	-1.611916	-29.29197*	-29.32939*
STROPTICAL	-0.699258	-2.085778	-18.50526*	-18.48593*
TELCO	2.389290	0.468880	-22.88746*	-23.12674*
VSNL	-2.535893	-2.115060	-19.98923*	-20.14161*

Note: *Significant at one percent level,
** Significant at five percent level,

Table-2
Cointegration Tests of Johansen

Null Hypothesis	Alternative Hypothesis	Eigen Value	Statistic	5% Critical Value	1% Critical Value
ACC					
		λ_{trace} test			
r = 0	r > 0	0.046698	51.90516	25.32	30.45
r ≤ 1	r > 1	0.005453	5.325279	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.046698	46.57988	18.96	23.65
r ≤ 1	r = 2	0.005453	5.325279	12.25	16.26
BAJAJAUTO					
		λ_{trace} test			
r = 0	r > 0	0.042797	46.23730	25.32	30.45
r ≤ 1	r > 1	0.003725	3.634737	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.042797	42.60256	18.96	23.65
r ≤ 1	r = 2	0.003725	3.634737	12.25	16.26
BHEL					
		λ_{trace} test			
r = 0	r > 0	0.059471	66.00718	25.32	30.45
r ≤ 1	r > 1	0.006435	6.288109	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.059471	59.71907	18.96	23.65
r ≤ 1	r = 2	0.006435	6.288109	12.25	16.26
BPCL					
		λ_{trace} test			
r = 0	r > 0	0.057200	63.92681	25.32	30.45
r ≤ 1	r > 1	0.006710	6.557372	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.057200	57.36944	18.96	23.65
r ≤ 1	r = 2	0.006710	6.557372	12.25	16.26
BSES					
		λ_{trace} test			
r = 0	r > 0	0.082984	62.58212	25.32	30.45
r ≤ 1	r > 1	0.020863	12.24965	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.082984	50.33247	18.96	23.65
r ≤ 1	r = 2	0.020863	12.24965	12.25	16.26

Null Hypothesis	Alternative Hypothesis	Eigen Value	Statistic	5% Critical Value	1% Critical Value
CIPLA					
		λ_{trace} test			
r = 0	r > 0	0.085699	93.15602	25.32	30.45
r ≤ 1	r > 1	0.006029	5.890429	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.085699	87.26559	18.96	23.65
r ≤ 1	r = 2	0.006029	5.890429	12.25	16.26
DIGITALEQP					
		λ_{trace} test			
r = 0	r > 0	0.065938	44.61333	25.32	30.45
r ≤ 1	r > 1	0.006002	3.617902	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.065938	40.99542	18.96	23.65
r ≤ 1	r = 2	0.006002	3.617902	12.25	16.26
DRREDDY					
		λ_{trace} test			
r = 0	r > 0	0.069316	73.75221	25.32	30.45
r ≤ 1	r > 1	0.003878	3.784623	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.069316	69.96759	18.96	23.65
r ≤ 1	r = 2	0.003878	3.784623	12.25	16.26
GRASIM					
		λ_{trace} test			
r = 0	r > 0	0.066253	71.52281	25.32	30.45
r ≤ 1	r > 1	0.004871	4.755790	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.066253	66.76702	18.96	23.65
r ≤ 1	r = 2	0.004871	4.755790	12.25	16.26
GUJAMBCEM					
		λ_{trace} test			
r = 0	r > 0	0.058533	60.78420	25.32	30.45
r ≤ 1	r > 1	0.003460	3.303423	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.058533	57.48078	18.96	23.65
r ≤ 1	r = 2	0.003460	3.303423	12.25	16.26

Null Hypothesis	Alternative Hypothesis	Eigen Value	Statistic	5% Critical Value	1% Critical Value
HDFC					
		λ_{trace} test			
r = 0	r > 0	0.077522	83.93971	25.32	30.45
r ≤ 1	r > 1	0.005473	5.345741	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.077522	78.59397	18.96	23.65
r ≤ 1	r = 2	0.005473	5.345741	12.25	16.26
HINDALCO					
		λ_{trace} test			
r = 0	r > 0	0.071853	75.22468	25.32	30.45
r ≤ 1	r > 1	0.002664	2.597956	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.071853	72.62672	18.96	23.65
r ≤ 1	r = 2	0.002664	2.597956	12.25	16.26
HIDLEVER					
		λ_{trace} test			
r = 0	r > 0	0.055684	59.52708	25.32	30.45
r ≤ 1	r > 1	0.003815	3.722481	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.055684	55.80460	18.96	23.65
r ≤ 1	r = 2	0.003815	3.722481	12.25	16.26
INFOSYSTCH					
		λ_{trace} test			
r = 0	r > 0	0.034233	40.20576	25.32	30.45
r ≤ 1	r > 1	0.006425	6.278269	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.034233	33.92749	18.96	23.65
r ≤ 1	r = 2	0.006425	6.278269	12.25	16.26
ITC					
		λ_{trace} test			
r = 0	r > 0	0.053925	64.41396	25.32	30.45
r ≤ 1	r > 1	0.010710	10.47752	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.053925	53.93643	18.96	23.65
r ≤ 1	r = 2	0.010710	10.47752	12.25	16.26

Null	Alternative	Eigen Value	Statistic	5% Critical	1% Critical

Hypothesis	Hypothesis			Value	Value
L&T					
		λ_{trace} test			
r = 0	r > 0	0.068141	49.24272	25.32	30.45
r ≤ 1	r > 1	0.007561	4.781491	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.068141	44.46123	18.96	23.65
r ≤ 1	r = 2	0.007561	4.781491	12.25	16.26
M&M					
		λ_{trace} test			
r = 0	r > 0	0.025442	30.20398	25.32	30.45
r ≤ 1	r > 1	0.005225	5.102830	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.025442	25.10115	18.96	23.65
r ≤ 1	r = 2	0.005225	5.102830	12.25	16.26
MTNL					
		λ_{trace} test			
r = 0	r > 0	0.083904	94.72834	25.32	30.45
r ≤ 1	r > 1	0.009576	9.372266	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.083904	85.35607	18.96	23.65
r ≤ 1	r = 2	0.009576	9.372266	12.25	16.26
RANBAXY					
		λ_{trace} test			
r = 0	r > 0	0.047428	51.03641	25.32	30.45
r ≤ 1	r > 1	0.003801	3.709671	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.047428	47.32674	18.96	23.65
r ≤ 1	r = 2	0.003801	3.709671	12.25	16.26
RELIANCE					
		λ_{trace} test			
r = 0	r > 0	0.050842	55.13692	25.32	30.45
r ≤ 1	r > 1	0.004419	4.313201	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.050842	50.82372	18.96	23.65
r ≤ 1	r = 2	0.004419	4.313201	12.25	16.26

Null Hypothesis	Alternative Hypothesis	Eigen Value	Statistic	5% Critical Value	1% Critical Value
SATYAM					
		λ_{trace} test			
r = 0	r > 0	0.060213	64.69178	25.32	30.45
r ≤ 1	r > 1	0.004307	4.203923	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.060213	60.48786	18.96	23.65
r ≤ 1	r = 2	0.004307	4.203923	12.25	16.26
SBIN					
		λ_{trace} test			
r = 0	r > 0	0.050632	55.15953	25.32	30.45
r ≤ 1	r > 1	0.004662	4.551686	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.050632	50.60784	18.96	23.65
r ≤ 1	r = 2	0.004662	4.551686	12.25	16.26
STROPTICAL					
		λ_{trace} test			
r = 0	r > 0	0.145189	77.86063	25.32	30.45
r ≤ 1	r > 1	0.046374	18.09148	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.145189	59.76915	18.96	23.65
r ≤ 1	r = 2	0.046374	18.09148	12.25	16.26
TELCO					
		λ_{trace} test			
r = 0	r > 0	0.101604	63.25875	25.32	30.45
r ≤ 1	r > 1	0.012584	6.686453	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.101604	56.57230	18.96	23.65
r ≤ 1	r = 2	0.012584	6.686453	12.25	16.26
VSNL					
		λ_{trace} test			
r = 0	r > 0	0.071065	34.34098	25.32	30.45
r ≤ 1	r > 1	0.012063	4.854403	12.25	16.26
		λ_{max} test			
r = 0	r = 1	0.071065	29.48658	18.96	23.65
r ≤ 1	r = 2	0.012063	4.854403	12.25	16.26

Table-3(i)
The Vector Error Correction Model (VECM)

	C	$\hat{e}_{t-1}$	ΔF_{t-1}	ΔF_{t-2}	ΔS_{t-1}	ΔS_{t-2}	F
ACC							
ΔF_t	0.3912*	-0.1726***	0.2225	0.0214	-0.2396	-0.1268	3.0950
	[2.5215]	[-1.7906]	[1.4093]	[0.1406]	[-1.4748]	[-0.8117]	
ΔS_t	0.3948*	-0.0141	0.3940*	0.0462	-0.4091*	-0.1533	3.9186
	[2.6294]	[-0.1511]	[2.5827]	[0.3136]	[-2.6047]	[-1.0153]	
BAJAJAUTO							
ΔF_t	1.4148*	-0.1918*	0.2068***	0.0065	-0.1948***	-0.0795	2.5749
	[2.9306]	[-2.6568]	[1.8516]	[0.0597]	[-1.7656]	[-0.7540]	
ΔS_t	1.3619*	-0.0283	0.4318*	0.1674	-0.3941*	-0.2286*	4.2763
	[2.7567]	[-0.3833]	[3.7779]	[1.5115]	[-3.4898]	[-2.1174]	
BHEL							
ΔF_t	1.2215*	0.1682	-0.3495**	-0.4962*	0.4231*	0.3055**	9.1882
	[3.3644]	[1.1594]	[-1.9921]	[-3.1618]	[2.4373]	[1.9676]	
ΔS_t	1.2160*	0.4412*	-0.0356	-0.3890*	0.1095	0.2011	10.080
	[3.3313]	[3.0237]	[-0.2023]	[-2.4653]	[0.6272]	[1.2884]	2
BPCL							
ΔF_t	0.2409	-0.1804**	0.1451	-0.1103	-0.1042	0.0732	1.9492
	[0.8360]	[-1.9765]	[1.2592]	[-1.0417]	[-0.8849]	[0.6863]	
ΔS_t	0.2427	0.0565	0.4778*	0.0303	-0.4490*	-0.0706	6.5192
	[0.8676]	[0.6382]	[4.2689]	[0.2954]	[-3.9261]	[-0.6825]	
BSES							
ΔF_t	0.9377*	-0.5469*	0.4329**	0.1850	-0.2505	-0.3693**	9.1030
	[2.8573]	[-3.3358]	[2.3572]	[1.1357]	[-1.3593]	[-2.2863]	
ΔS_t	0.9113*	-0.2239	0.7483*	0.3073***	-0.5421*	-0.5015*	10.633
	[2.7437]	[-1.3494]	[4.0254]	[1.8642]	[-2.9055]	[-3.0679]	0
CIPLA							
ΔF_t	-0.6374	0.1376	-0.2097	-0.5867***	0.2515	0.6202***	1.1282
	[-0.5588]	[0.4061]	[-0.5312]	[-1.6515]	[0.6354]	[1.7429]	
ΔS_t	-0.6348	0.4405	0.0227	-0.4811	0.0184	0.5156	1.4134
	[-0.5577]	[1.3019]	[0.0577]	[-1.3568]	[0.0465]	[1.4518]	
DRREDDY							
ΔF_t	-0.2256	-0.1126	0.2618	0.0972	-0.2295	-0.1475	1.0744
	[-0.3359]	[-0.7392]	[1.3528]	[0.5408]	[-1.1808]	[-0.8250]	
ΔS_t	-0.2111	0.1441	0.4658**	0.1874	-0.4093**	-0.2414	3.7426
	[-0.3154]	0.9492]	[2.4158]	[1.0459]	[-2.1143]	[-1.3554]	
GRASIM							
ΔF_t	1.0993**	0.0115	-0.2543	-0.3113**	0.3586**	0.1755	6.3268
	[2.1097]	[0.0954]	[-1.5609]	[-2.0494]	[2.2119]	[1.1603]	
ΔS_t	1.0937**	0.2474**	-0.0503	-0.2795***	0.1592	0.1417	6.5963
	[2.0954]	[2.0476]	[-0.3084]	[-1.8376]	[0.9804]	[0.9351]	

Note: *Significant at one percent level,
** Significant at five percent level,
*** Significant at ten percent level.

	C	$\hat{e}_{t-1}$	ΔF_{t-1}	ΔF_{t-2}	ΔS_{t-1}	ΔS_{t-2}	F
HINDALCO							
ΔF_t	-0.4847	-0.3027	0.1323	-0.6206**	-0.1221	0.6346	2.4645
	[-0.3416]	[-1.3737]	[0.4824]	[-2.4419]	[-0.4426]	[2.4877]	
ΔS_t	-0.4868	-0.0431	0.3044	-0.5064**	-0.2963	0.5201**	1.7007
	[-0.3432]	[-0.1956]	[1.1098]	[-1.9932]	[-1.0742]	[2.0393]	
INFOSYSTCH							
ΔF_t	-0.37475	0.1362	-0.44898	-0.7191***	0.4729	0.6951***	0.9551
	[-0.0721]	[0.5766]	[-1.1196]	[-1.8715]	[1.1881]	[1.8219]	
ΔS_t	-0.3770	0.26496	-0.1711	-0.5963	0.1969	0.567808	0.8411
	[-0.0718]	[1.1107]	[-0.4227]	[-1.5372]	[0.4899]	[1.47432]	
L&T							
ΔF_t	0.4936	-0.2961	-0.4344	-0.9215*	0.4822***	0.8260*	5.5474
	[1.4617]	-1.4651]	[-1.6336]	[-3.6902]	[1.7704]	[3.2639]	
ΔS_t	0.4941	-0.1084	-0.0983	-0.6606*	0.1505	0.5690**	3.0284
	[1.4943]	[-0.5480]	[-0.3777]	[-2.7013]	[0.5644]	[2.2960]	
M&M							
ΔF_t	0.2954	-0.2308	-0.0166	-1.0778*	0.0259	1.0739*	4.7015
	[0.6665]	[-1.5074]	[-0.061]	[-4.0857]	[0.0937]	[4.0292]	
ΔS_t	0.29032	-0.1235	0.2128	-0.8704*	-0.1945	0.8623*	3.2605
	[0.6611]	[-0.8141]	[0.7878]	-3.3301]	[-0.7103]	[3.2656]	
MTNL							
ΔF_t	-0.0075	-0.0939	0.5243*	-0.0672	-0.4101*	-0.0838	8.1845
	[-0.0715]	[-0.7092]	[2.8939]	[-0.3915]	[-2.2501]	[-0.4905]	
ΔS_t	-0.0059	0.1320	0.7047*	-0.0144	-0.5875*	-0.1344	11.2796
	[-0.0566]	[1.0029]	[3.9165]	[-0.0847]	[-3.2461]	[-0.7923]	
RANBAXY							
ΔF_t	-0.1986	0.0202	-0.6512**	-0.4371***	0.6904**	0.4217	1.8288
	[-0.2408]	[0.1077]	[-2.3310]	[-1.6467]	[2.4621]	[1.5809]	
ΔS_t	-0.1937	0.1948	-0.4320	-0.3234	0.4774***	0.3113	1.0602
	[-0.2360]	[1.0426]	[-1.5540]	[-1.2245]	[1.7109]	[1.1728]	
SBIN							
ΔF_t	0.7317**	-0.1589	-0.4242	-0.5264**	0.5182***	0.4678***	3.8135
	[2.1517]	[-1.0576]	[-1.6136]	[-2.0698]	[1.9043]	[1.7761]	
ΔS_t	0.7364**	-0.0222	-0.2398	-0.4368***	0.33037	0.3742	3.0710
	[2.2499]	[-0.1541]	[-0.9479]	[-1.7848]	[1.2613]	[1.4765]	
STROPTICAL							
ΔF_t	-0.2454	0.4324	-0.7865	-0.5771	0.8735***	0.5553	1.0548
	[-1.3061]	[0.8168]	[-1.5895]	[-1.4687]	[1.7463]	[1.3969]	
ΔS_t	-0.2422	1.0219**	-0.6188	-0.6152	0.6955	0.6079	1.6164
	[-1.3404]	[2.0075]	[-1.3006]	[-1.5284]	[1.4459]	[1.5900]	

Note: *Significant at one percent level,
** Significant at five percent level,
*** Significant at ten percent level.

Table-3(iii)
The Vector Error Correction Model (VECM)

INDIVIDUAL SECURITIES	RELIANCE		VSNL		ITC		DIGITALEQP	
	ΔF_t	ΔS_t	ΔF_t	ΔS_t	ΔF_t	ΔS_t	ΔF_t	ΔS_t
C	0.5187*** [1.8786]	0.5366** [1.9622]	-0.2501 [-1.0146]	-0.2269 [-0.8820]	-0.5845 [-0.3043]	-0.5847 [-0.3053]	0.8931 [1.2853]	0.8902 [1.2507]
$\hat{e}_{t-1}$	-0.0476 [-0.2800]	0.1171 [0.695]	0.4762* [2.6320]	0.6714* [3.5544]	-0.7019** [-2.0113]	-0.5454 [-1.5674]	0.0869 [0.3224]	0.2633 [0.9529]
ΔF_{t-1}	-0.2294 [-0.9200]	-0.0247 [-0.1002]	-0.2834 [-1.1853]	-0.1476 [-0.5914]	-0.5806 [-1.1168]	-0.3986 [-0.7690]	-0.6493** [-1.9159]	-0.1832 [-0.5279]
ΔF_{t-2}	-0.1733 [-0.6900]	-0.0582 [-0.2342]	-0.1653 [-0.7061]	-0.0420 [-0.1720]	-0.1558 [-0.2998]	-0.0916 [-0.1767]	-0.5563 [-1.5810]	-0.2865 [-0.7948]
ΔF_{t-3}	-0.282463 [-1.13329]	-0.248067 [-1.00490]	-0.302297 [-1.32477]	-0.012525 [-0.05258]	-0.422172 [-0.82979]	-0.347019 [-0.68403]	-0.627714 [-1.77498]	-0.5851 [-1.6153]
ΔF_{t-4}	0.0974 [0.3944]	0.0934 [0.3816]	0.0112 [0.0524]	0.1141 [0.5078]	0.0051 [0.0103]	0.0234 [0.0472]	-0.6076*** [-1.7355]	-0.5471 [-1.5255]
ΔF_{t-5}	-0.049 [-0.2003]	-0.0630 [-0.2602]	0.0155 [0.0762]	0.0879 [0.4140]	-0.9886** [-2.0954]	-0.9426** [-2.0036]	-0.6485*** [-1.8714]	-0.5792 [-1.6317]
ΔF_{t-6}	-0.4739** [-1.9719]	-0.4534** [-1.9049]	-0.4233** [-2.2006]	-0.3399*** [-1.6925]			-0.5417 [-1.5948]	-0.4538 [-1.3046]
ΔF_{t-7}	-0.2510 -1.0838]	-0.2604 [-1.1356]					-0.5850*** [-1.7496]	-0.5184 [-1.5135]
ΔF_{t-8}	-0.2957 [-1.3566]	-0.3595*** [-1.6649]					-0.3641 [-1.0872]	-0.3386 [-0.9871]
ΔF_{t-9}							-0.6166*** [-1.8464]	-0.5802*** [-1.6963]
ΔF_{t-10}							-0.6574** [-1.9257]	-0.5909*** [-1.6897]
ΔF_{t-11}							-0.6862** [-2.0311]	-0.5596 [-1.6172]
ΔF_{t-12}							-0.2772 [-0.9116]	-0.2362 [-0.7582]
ΔS_{t-1}	0.2496 [0.9930]	0.0582 [0.2339]	0.2714 [1.1872]	0.1499 [0.6281]	0.5904 [1.1316]	0.4086 [0.785]	0.6423** [1.9217]	0.1991 [0.5818]
ΔS_{t-2}	0.0982 [0.3886]	-0.0308 [-0.1233]	0.2249 [1.0081]	0.1019 [0.4374]	0.1157 [0.2218]	0.0502 [0.0966]	0.4816 [1.3901]	0.2099 [0.5917]
ΔS_{t-3}	0.3363 [1.3382]	0.2925 [1.1752]	0.2667 [1.2304]	-0.0068 [-0.0304]	0.4279 [0.8377]	0.3526 [0.6923]	0.6350 [1.8221]	0.5898*** [1.6522]
ΔS_{t-4}	-0.0531 [-0.2129]	-0.0553 [-0.2241]	-0.0515 [-0.2532]	-0.1561 [-0.7353]	-0.0151 [-0.0310]	-0.0338 [-0.0677]	0.6027*** [1.7461]	0.5391 [1.5246]
ΔS_{t-5}	0.0653 [0.2648]	0.0697 [0.2855]	-0.0542 [-0.2802]	-0.0999 [-0.4946]	1.0148** [2.1391]	0.9686** [2.0475]	0.6343*** [1.8571]	0.5721 [1.6354]
ΔS_{t-6}	0.4255*** [1.7524]	0.4006*** [1.6658]	0.4851* [2.6529]	0.4075** [2.1349]			0.5449 [1.6265]	0.4510 [1.3154]
ΔS_{t-7}	0.2309 [0.9883]	0.2398 [1.0364]					0.5135 [1.5578]	0.4441 [1.3151]
ΔS_{t-8}	0.3397 [1.5435]	0.3993*** [1.8317]					0.3667 [1.1108]	0.3370 [0.9964]
ΔS_{t-9}							0.6009*** [1.8252]	0.5686*** [1.6861]
ΔS_{t-10}							0.6696** [1.9917]	0.6016*** [1.7469]
ΔS_{t-11}							0.7109** [2.1459]	0.5879*** [1.7325
ΔS_{t-12}							0.2551 [0.8557]	0.2104 [0.6893]
F	1.4704	1.5591	1.6316	2.465	1.7331	1.2601	0.7852	0.5797

References

Abhyankar, A.H. (1995), "Return and Volatility dynamics in the FT-SE 100 stock index and stock index futures markets", *Journal of Futures Markets*, 15 (4), pp 457-488.

Alphonse, P. (2000), "Efficient price discovery in stock index cash and futures markets", *Annales D'Economie et de Statistique –N^0* 60, pp 177-188.

Chris, B., Alistar, G.H. and **Stuart, T**.(2001) "A trading strategy based on the lead-lag relationship between the spot index and future contracts for the FTSE 100", *International journal of forecasting*, 17, pp31-44.

Cheung, Y. and **Lai, K.** (1993), "Finite sample sizes of Johansen's Likelihood Ratio Tests for Cointegration", *Oxford Bulletin of Economics and Statistics* 55, pp 313-328.

Dickey, D. and **Fuller, W.** (1979), "Distribution of the Estimators for Autoregressive Time Series With a Unit Root", *Journal of the American Statistical Association*, pp 427-431.

Engel, R.F. and **Granger, C.W.J.** (1987), "Cointegration and error correction representation, estimation and testing", *Econometrica*, Vol. 55, pp 251-276.

Finnerty, J. and **H. Park.** (1987)," Stock index futures: Does the tail way the dog?" *Financial Analysts Journal*, 43, pp57-61.

Ghosh, A. (1993)," Cointegretation and error correction models: Intertemporal causality between index and future price", *The journal of Future markets*, 2, pp 193-198.

Gonzalo, J. (1994), "Five Alternative Methods of Estimating Long-Run Equilibrium Relationship", *Econometrica* 60, pp 203-233

Granger, C. (1986), "Developments in the Study of Cointegrated Variables", *Oxford Bulletin of Economics and Statistics*, 48, pp 213-227

Harris, C. (1989), "The October 1987 S&P 500 Stock-Futures Basis", *The Journal of Finance*, Vol., XLIV, No.1, pp 77-99.

Herbst, A. and **E. Maberly**. (1992), "The information role of end-of-the-day returns in stock index futures", *Journal of futures markets*, 12, pp 595-601.

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economics Dynamic and control* 12, pp 231-254.

Johansen,S. and **Juselius, K.** (1990), Maximum likehood estimation and inference on cointegration with application to the demand for money", *Oxford Bulletin of Economics and Statistics*, pp 181-211.

Kavussanos, M. and **Nomikos, N.K.** (2003), "Price Discovery, Causality and Forecasting in the Freight Futures Market", *Review of Derivatives Research*, 6, pp 203-230.

Kawaller,I.G., Koch,P.D. and **Coch,T.N.** (1987), "The Temporal Price Relationship between S&P 500 Futures and the S&P 500 Index", *The Journal of Finance*, Vol.-XLIL, No.5. pp 1309-1329.

Kutner, T. W. and **Sweency, R.J.** (1991), "Causality tests between the S&P 500 cash and futures markets (Research on the Standard and Poor's 500 Stock-Price Index)", *Quarterly Journal of Business and Economics*, 30, No.2, pp 51-74.

Lee, T. and **Tse, Y.** (1996), "Cointegration Tests with Conditional Heteroscedasticity", *Journal of Econometrics*, 73, pp 401-410.

Phillps, P. and **Perron, P.** (1988), "Testing for a Unit Root in Time Series Regressions", *Biometrica*, 75, pp 335-376.

Puttonen, V.(1993) "Short sales restriction and the temporal relationship between Stock index and cash derivatives markets", *Journal of future markets*,13(6), pp 645-664.

Raju, M.T. and **Karande, K.** (2003), "Price Discovery and Volatility on NSE Futures Market", *SEBI Bulletin*, Vol 1 (3), pp 5-15.

Stoll, H. R. and **Whaley, R.E.** (1990), "The Dynamics of Stock Index and Stock Index Futures Return", *Journal of Financial and Quantitative Analysis*, Vol.25, No.4, pp 441-467.

Tang, G.N. Mak **S.C, and Choi, D.F.S.** (1992), "The causality between stock index future and cash index prices in Hong Kong", *Applied financial economics*, Vol.13,pp 711-742.

Tenmozhi, M. (2002), "Futures Trading, Information and Spot Price Volatility of NSE-50 Index Futures Contract", *NSE Working Paper*, pp 1-44.

Turkington, J. and **Walsh, D.** (1999), "Price discovery and Causality in the Australian Share Price index Futures Market", *Australian Journal of Management*, Vol.24, No.2, pp 97-113.

Zeck Lauser, R. and **V. Niederoffer.** (1983) "The performance of market index futures contracts", *Financial analysts journal*, Jan-Feb, PP, 59-65.

Zou, L. and **Pinfold, J.** (2001)," Price functions between NZSE 10 index,index futures and TENZ, A cointegration approach and error correction model", *Working Paper Series*, No.01.10, Department of commerce, Massey University, Auckland, pp,1-31.

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