International Journal of Business and Management Invention
ISSN (Online): 2319 – 8028, ISSN (Print): 2319 – 801X
www.ijbmi.org || Volume 4 Issue 1 || January. 2015 || PP.32-49

Market Efficiency of Agricultural Commodity Futures in India: A Case of Selected Commodity Derivatives Traded On Ncdex During 2013

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ABSTRACT : *In an agriculture-dominated economy like India, farmers face not only yield risk but also price risk as the Government has reduced its direct market intervention to encourage private participation based on market forces. This has led to increased exposure of agricultural produce to price and other market risks. Commodity futures and derivatives have a vital role to play in the price risk management process, especially in agriculture. Keeping this into consideration, the present paper analyzes the efficiency of agricultural commodity markets by assessing the relationships between futures prices and spot market prices of three agricultural commodities i.e. cotton, turmeric and castor seed in India. The efficiency of the futures market for 3 agricultural commodities, traded at one of the largest commodity exchanges of India, i.e. National Commodity & Derivatives Exchange Ltd, has been explored by using OLS regression analysis and Granger causality tests. Augmented Dickey-Fuller test and Vector Auto Regression model are initially applied to examine whether futures and spot prices are stationary or not and their interdependency level respectively. The hypothesis, that futures prices are fair predictors of spot prices in India or Indian futures market is efficient has been tested using econometric software package. Results show that correlation exists significantly in futures and spot prices for all the selected agricultural commodities. This suggests that there is a long-term relationship between futures and spot prices for all the selected agricultural commodities. The causality test further distinguishes and categorizes the commodities based on direction of relationship between futures and spot prices. The analysis of short-term relationship by causality test indicates that futures markets have stronger ability to predict subsequent spot prices for cotton, turmeric and castor seed. The results of this study are useful for various stakeholders who are actively participating in agricultural commodity markets such as producers, traders, commission agents, commodity exchange participants, regulators and policy makers.*

KEYWORDS: *Commodity Market, Market Efficiency, Futures price, Spot price, agricultural commodity*

I. INTRODUCTION

India has a long history of Futures Trading in Commodities. Trading in Commodity Futures has been in existence in India from the 19th century with organized trading in cotton, through the establishment of Bombay Cotton Association Ltd. in 1875. Over a period of time, various other commodities were allowed to be traded in futures Exchanges. Though, India is a commodity based economy where two-third of the total population depend on agricultural commodities, startlingly has an under developed commodity market and futures market trades are merely used as risk management mechanism. Since commodity "futures" trading was permitted by government in 2003 by lifting prohibition against futures trading in all the commodities and granting recognition to electronic exchanges namely National Multi Commodity Exchange of India (NMCE), Multi Commodity Exchange of India (MCX), National Commodity and Derivatives Exchange (NCDEX) as national multi commodity exchanges, the commodity derivative market in India has witnessed exceptional growth. It was marked that the Indian commodity market expanded almost by 50 times in a span of 5 years from Rs 665.30 billion in 2002 to Rs 33,753.36 billion in 2007. Further, Indian Commodity Exchange (ICEX) and ACE Commodity and Derivative Exchanges were also granted recognition as the fourth and fifth multi commodity exchanges in 2009 and 2010 respectively.

With the establishment of these exchanges, the commodity futures market has witnessed a steady growth rate of about 30% by 2010 and touched a volume of Rs 74,156.13 billion with active and wide participation of traders (ASSOCHAM findings). Though the volume of commodity futures trade increased rapidly since its launch in 2003, the functioning of the futures market came under analysis during 2008-2009 due to price rise. The role of futures market in stabilize spot prices was widely discussed.Generally, it is said that the futures market has two important economic functions such as price risk management and price discovery. Having market participants with various objectives and information, the futures market enables the current futures price to act as an accurate indicator of the spot price expected at the maturity of the futures contract. Only an efficient futures market can perform this function. The market is considered as efficient if the futures price reflects all available information for predicting the future spot price and no participant can make profit consistently (Fama, 1970). Empirical analyses on market efficiency of commodity futures have been conducted mainly for developed countries. The present paper especially focuses on India which is one of the emerging countries with phenomenal growth in its commodity market. It empirically examines whether the market efficient hypothesis holds in the Indian commodity market.

This paper is organized as follows. The next section briefly reviews the related literatures and discusses the contribution of this study. Section III and IV explain about the objective and hypothesis of the study respectively. Section V describes about the sources and properties of the data along with the statistical models. While the sixth section shows the empirical results of the applied models. In the final section, it summarizes the main findings of the study in form of conclusion.

II. REVIEW OF LITERATURE

There are numerous studies that have been explored in the ascertainment of whether the price information is reflected in the spot market or in its underlying futures market under various interval of time since the introduction of futures in Indian commodity market. Derivatives trading in the commodity market have been a topic of enthusiasm of research in the field of finance. There have been contrary views on impact of derivatives trading. A number of studies have been done to study the dynamic relationship between spot price and futures price of commodities. This study adds to the existing literature in this field using the econometric tool Vector Autoregressive model, Granger Causality test and OLS regression model to bring conclusiveness to the subject. A study conducted on "pepper" to examine the price discovery process by applying Granger causality, Co-integration and Error Correction model found that there was a unidirectional causality from Futures to Spot prices in the pepper Futures market (Kushankur Dey, Debasish Maitra, 2012).

A study on the price discovery function of Agricultural Commodities in Indian markets found that there is an efficient price discovery process in place. It also recommended the strengthening of the market regulatory framework. An emphasis on the autonomy of Forwards Market Commission was made. The study also revealed about the need for well developed warehousing and market linkages (Sanjay Sehgal, Namita Rajput, Rajeev Kumar Dua, 2012). So far as the long-term relationship between Futures and Spot Prices for the Agricultural Commodities is concerned, a study on agricultural commodities like Maize, Chickpea, Black Lentil, Pepper, Castor Seed, Soybean and Sugar was conducted and found co-integration in their Futures and Spot prices. There was also a short-term relationship between them and the Futures markets had ability to predict spot prices for Chickpea, Castor Seed, Soybean and Sugar. It was also found that there was a bi-directional relationship in the short run among the Maize, Black Lentil and Pepper (Jabir Ali, Kriti Bardhan Gupta, 2011).

So far as the efficiency of Indian commodity market in terms of price formation of agricultural commodities traded on commodity exchanges is concerned, one study by applying co- integration analysis and GARCH model on agricultural commodities, confirmed that the co- integration between commodity futures and commodity spot market indices is present. It further emphasized that with the information of any one index, hedging can be done on other commodity indices. It also found new information as an important factor to predict the future value of commodities (Ranajit and Asima, 2010).A study on price discovery and volatility has clearly suggested that futures trading in agricultural goods and especially in food items have neither resulted in price discovery nor less of volatility in food prices. Further, it is observed a steep increase in spot prices for major food items along with a granger causal link from futures to spot prices for commodities on which futures are traded (Sen and Paul, 2010).An examination conducted on the role of futures markets in terms of price discovery process and rate of convergence of information from one market to another by taking six commodities- gold, silver, nickel, copper and Gram (Chana) by using a two-regime threshold vector auto-regression (TVAR) and a two-regime threshold auto-regression method.

The result supported the existence of price discovery process in Indian commodity exchanges and a high rate of convergence of information in case of metals and slow convergence of information in case of agricultural commodities has been found between different markets (Vishwanathan and Archana, 2010).In order to determine the direction of information flows between Spot and Futures prices in the agricultural commodities, a study was conducted using Granger Causality test and it was found that Spot prices are generally discovered in Futures Markets. It also argued for establishment of sufficient food grain reserves globally in order to fight the volatility in markets (M Hernandez, Torero, 2009).

So far as the correlation between spot price and futures price is concerned, it is found that the commodity spot and futures prices had closely tracked each other in selected agri-commodities and no significant volatility has been found in the prices of futures and spot contracts of those agricultural commodities (Gurbandani and Rao, 2009). With an aim to analyze the effect of futures trading on inflation, a study emphasized that trading in commodity futures contributed to an increase in inflation as result showed that during the time period of futures trading the spot price of selected commodities and their volatilities had posted remarkable increase (Golka and Tulsi (2008).

A study on hedging efficiency of Indian commodity futures market found that it has failed to provide an efficient hedge against the price risk particularly in agricultural commodities. The results showed the inefficiency of agricultural commodity futures market in terms of price discovery due to the non integration of futures and the spot market. Exchange specific factors attributed to the market imperfection had found like non awareness of futures market among farmers, infrequent trading, thin volume and low market depth, lack of effective participation of members etc. It also suggested about the implementation of Government driven policy measures to raise the commodity futures market as a vibrant segment for price risk management in Indian Agriculture sector (R. Salvadi and P. Ramasundaram, 2008).In an examination about the hedging effectiveness of futures contract on a financial asset and commodities in Indian markets by applying different time series models, it is found that there is presence of necessary co-integration between the spot and derivatives markets and have shown that both stock market and commodity derivatives markets in India provide a reasonably high level of hedging effectiveness (Kumar, Singh and Pandey, 2008).

An analysis on the effectiveness of commodity futures market through regression analysis by taking both spot and future prices of commodities has been done and the result proved the high level of volatility in both spot and futures prices of commodities. Positive coefficients for agricultural commodities in dissimilar equations supported the effectiveness of commodity market in hedging the price risk (Jabir and Kriti, 2007).To determine the interdependency among spot market and futures market and factors for success of futures market, a study stressed that the growth of commodity spot market depends upon the growth of commodity futures market in developing countries and certified warehouses, centralized spot prices and effective margin system were found as the important institutional factors for successful commodity futures market (Bharat and Jatinderbir (2007).

Another study on operational efficiency of commodity futures market in India found co integration of commodity futures and spot prices, enlightening the right direction of achieving the improved operational efficiency at a slow rate. Further, it emphasized that Indian commodity market has lack of liquidity in some commodities like pepper, sugar and groundnuts. In other commodities hedging proves to be effective. For some commodities the volatility in futures price has been considerably less than the spot price indicating an efficient utilization of information (S.M, 2007).So far as function of Indian commodity futures market is concerned, a study observed the dependence of commodity futures market on spot market for price determination along with increasing inflation due to trade volume of commodity futures. The study also concluded that futures market is not performing the function of price discovery and it is a weak market in short run Gurpreet and Gaurav (2006). A study on the efficiency of Indian futures market observed that the wheat futures market is even weak-form inefficient and fails to play the role of spot price discovery. Spot market has found to capture the market information faster and therefore expected to play the leading role. This inefficiency of the futures market may be attributed to the lack of necessary data to truly capture the actual lead-lag relationship between the spot and futures market. It is also suggested that the trading volume in commodity futures market, along with other factors, have a significant impact on country's inflationary pressure (Raizada and Sahi, 2006*)*. On an attempt to investigate the price discovery in six Indian commodity exchanges for five commodities, a study has been conducted by using the daily futures and comparable ready price and also the ratio of standard deviations of spot and futures rates for empirical testing of ability of futures markets to incorporate information efficiently. Besides, the study has empirically analyzed the efficiency of spot and futures markets by employing the

Johansen Co integration Technique. The results showed the inability of futures market to fully incorporate information and confirmed inefficiency of futures market. However, it is concluded that the Indian agricultural commodities futures markets are not yet mature and efficient (Kumar and Sunil, 2004).For determining the efficiency of commodity futures market, one of the studies indicated about the inefficiency of commodity futures market in terms of providing hedge against price risk by observing the difference between futures and spot prices. It instituted many factors like lack of participation of trading members, low market depth and thin volume with Government's interference in Commodity markets etc. as major evils for inefficient price risk management (K.G, 2002). There is enormous amount of literature on the concerned subject considering the world-wide commodity market. However, it is comparatively less in case of agricultural commodities, especially in agricultural based economy like India and also during the pre-mature phase of futures market. In such circumstances, this study carries a significant importance to re-look on the efficiency of agricultural commodity market in India. Therefore, the broad objective of this study is mentioned below.

III. OBJECTIVE OF THE STUDY

To test the market efficiency of selected agricultural commodity derivatives in India.

IV. HYPOTHESIS

(H_0): Agricultural commodity market in India is not efficient.
(H_1): Agricultural commodity market in India is efficient.
In all, 23 Future Contracts for the three commodities (Castor, Cotton and Turmeric) are analyzed for the period of study. Vector Auto Regression) VAR Analysis, Granger Causality test and OLS regression model are used to test the efficiency of the agricultural commodity market in India.

V. DATA AND METHODOLOGY

Data for testing the market efficiency of futures market In India, NCDEX is considered as prime national level commodity exchange for agricultural commodities and hence selected for the study and the time frame chosen for the study is the future contracts expiring during the period January 2013 to December 2013. The sample used in the study consists of three agricultural commodities traded on National Commodity Exchange of India, Mumbai i.e. Cotton, Turmeric and Castor Seeds. The data comprises of daily closing spot and futures prices of the sample commodities during the period (January to Dec of the year 2013) which were obtained from the home page of NCDEX (www.ncdex.com). *Table 1* below presents the details of the sample contracts considered for the study.

Commodity	Contract (No of Months)	No of Observations
Castor seed	January,2013 (5)	71
	February,2013 (5)	76
	March,2013 (5)	77
	April,2013 (5)	78
	May,2013 (5)	74
	June,2013 (5)	77
	July,2013 (5)	78
	August,2013 (5)	80
	September,2013 (5)	78
	October,2013 (5)	74
	November,2013 (5)	67
Cotton	October,2013 (7)	129
	November,2013 (8)	146
	December,2013 (9)	168
Turmeric	April,2013 (7)	107
	May,2013 (8)	123
	June,2013 (8)	129
	July,2013 (8)	135
	August,2013 (5)	81
	September,2013 (5)	84
	October,2013 (5)	79
	November,2013 (5)	75
	December,2013 (5)	74

Daily Price Return on all the commodities, both in spot and futures market, is defined as usual i.e. the first difference in the log of commodity price, such that $R_{S/F,\,t} = ln\,(P_{S/F,\,t}) - ln\,(P_{S/F,\,t-1})$. *P* represents the daily price information of the respective commodities, in Spot (S) or Futures (F) market.

VI. METHODOLOGY FOR TESTING THE EFFICIENCY OF FUTURES MARKET

An efficient agricultural commodity market is one in which the spot market "fully reflects" the available information (Fama 1970); i.e. an efficient futures market should send price signals to the spot market immediately to eliminate supernormal profit from arbitraging on price differences or at maturity, the future prices become equivalent to spot prices except for some transaction costs. With cost-of-carry (stochastic convenient yield) and no-arbitrage profit expectation, the efficiency in Indian agricultural futures markets can be represented as:

$$F_{t,\,t-k} = S_{t,\,t-k} + d_{\,t} \quad \text{---------- (1)}$$

Where $d_{\,t}$ is the cost-of-carry, $F_{t,\,t-k}$ is the futures price at time t for delivery at time t-k, and S_{t-k} is the expected spot price at maturity of the contract, i.e. time t-k. If the cost-of-carry is stationary or zero, th -arbitrage model implies that the futures price is co-integrated with the spot price. Two critical criteria must be met to ensure long-term efficiency of Indian commodity futures markets i.e. S and F must be integrated (stationary) to the same order and they must also be co-integrated, otherwise S and F will tend to drift apart over time.

Stationarity Test : Stationarity test is important because regressing one non-stationary series on another may produce some spurious results. Therefore, the variables expected to be used in a regression model which should posses stationarity. Even if most of the underlying price series are found to be non-stationary, i.e. I (1), their first difference, i.e. the price returns are found to be stationary, i.e. I (0). Therefore, price returns, not the actual prices, are considered to test the interrelationship among the spot and futures market. Augmented Dickey-Fuller (ADF) test has been carried out to test the stationarity of the price series. The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The ADF test is specified here as follows:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + \mu_1 Y_{t-1} + \mu_2 Y_{t-2} + \ldots\ldots\ldots + \mu_p Y_{t-p} + \varepsilon_t \quad \text{..... (2)}$$

where, Y_t represents time series to be tested, b_0 is the intercept term, β is the coefficient of interest in the unit root test, μ_i is the parameter of the augmented lagged first difference of Y_t to represent the p^{th} order autoregressive process, and ε_t is the white noise error term. In carrying out the unit root test, it is required to test the following hypothesis:

H_0: $\alpha=0$ (non stationary)
H_1: $\alpha\neq0$ (stationary)

If the null hypothesis is rejected, this means that the time series data is stationary. The decision criteria involve comparing the computed values of Augmented Dickey-Fuller 'T' statistic with the critical values for the rejection of a hypothesis for a unit root. If the computed ADF statistic is less relative to the critical values, then the null hypothesis of non-stationarity in time series variables can not be rejected.

Vector Autoregressive Model : After testing for stationarity, the second step is to identify the interdependencies among spot prices and futures prices of selected commodities by using VAR model. All variables in a VAR are treated symmetrically in a structural sense and each variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. A VAR model describes the evolution of a set of *k* variables (called *endogenous variables*) over the same sample period ($t = 1 \ldots T$) as a linear function of only their past values. The variables are collected in a $k \times 1$ vector y_t, which has the i^{th} element, $y_{i,t}$, the time *t* observation of the i^{th} variable. A *p-th order VAR*, denoted VAR (*p*), is

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + e_t, \quad \text{---------- (3)}$$

where the *l*-periods back observation y_{t-l} is called the *l*-th *lag* of *y*, *c* is a $k \times 1$ vector of constants, A_i is a time-invariant $k \times k$ matrix and e_t is a $k \times 1$ vector of error term.

Causality Test : The Granger-causality test is used to investigate direction of causation between futures price and spot price. The outcome from the Granger-causality test is utilized to determine whether the variables under study can be used to predict each other or not. Granger proposed that if causal relationship exists between variables, these variables can be used to predict each other. The causality test helps to ascertain whether a uni-directional or bi-directional relationship exists between spot price and futures price. To achieve this, the study employs the granger-causality statistic to test the statistical causality between the spot price and futures price of

3 commodities (Castor, Cotton and Turmeric) as well as to determine the predictive content of one variable beyond that inherent in the explanatory variable itself. The study uses the daily returns of spot (RS_t) and futures (RF_t) of 3 commodities in percentage form for the Granger causality test. More specifically, the Granger causality test involved analyzing the relationship between RS_t and *p* lagged values of RS_t and RF_t by estimating the regression models:

$$RS_t = a_o + \sum_{k=1}^{p} a_{1k}\, RS_{t-k} + \sum_{k=1}^{p} a_{2k}\, RF_{t-k} + e_t$$

---------- *(4)*

$$RF_t = a_o + \sum_{k=1}^{p} a_{1k}\, RF_{t-k} + \sum_{k=1}^{p} a_{2k}\, RS_{t-k} + e_t$$

---------- *(5)*

F-test is used to test whether RF_t does not Granger-cause RS_t by examining the null hypothesis that the lagged coefficients of RF_t are equal to zero. A similar F-test is used to test the opposite effect i.e. whether RS_t does not Granger-cause RF_t.

OLS Regression Analysis

Ordinary Least Squares (OLS) is a statistical technique which attempts to find the function which most closely approximates the data. In general terms, it is an approach to fitting a model to the observed data. In technical terms, the Least Squares method is used to fit a straight line through a set of data-points, so that the sum of the squared vertical distances called *residuals* from the actual data-points is minimized. At a very basic level, the relationship between a continuous response variable (Y) and a continuous explanatory variable (X) may be represented using a line of best-fit, where Y is predicted, at least to some extent, by X. If this relationship is linear, it may be appropriately represented mathematically using the straight line equation as follows.

$$Y = \alpha + \beta x$$ ---------- *(6)*

Where, α indicates the value of Y when X is equal to zero (also known as the intercept) and β indicates the slope of the line (also known as the regression coefficient). The regression coefficient β describes the change in Y that is associated with a unit change in X.

VI. EMPIRICAL FINDINGS

Results of Stationarity Test

The computed values of Augmented Dickey-Fuller 'T' statistic for all twenty three contracts of castor, cotton and turmeric are presented in table 2 below at 5% level of significance. It may be seen from the results of unit root tests for the three selected commodities that both the spot and futures prices are not stationary but become stationary at the first difference. The results are characterized as I (1) or first difference stationary. This satisfies the first criterion of market efficiency definition.

Table No.2 ADF test for stationary

Year	Commodity	Contract (No of Months)	No of Observations	Spot 'T' statistics	Futures 'T' statistics	Critical 'T' at 5%
2013	Castor seed	January,2013 (5)	71	-7.00	-6.74	-3.48
		February,2013 (5)	76	-6.93	-7.45	-3.47
		March,2013 (5)	77	-6.65	-6.71	-3.47
		April,2013 (5)	78	-6.72	-7.01	-3.47
		May,2013 (5)	74	-7.75	-7.73	-3.47
		June,2013 (5)	77	-7.37	-7.37	-3.47
		July,2013 (5)	78	-7.81	-7.87	-3.47
		August,2013 (5)	80	-7.57	-8.14	-3.47

		September,2013 (5)	78	-4.87	-10.60	-3.47
		October,2013 (5)	74	-10.94	-11.10	-3.47
		November,2013 (5)	67	-10.16	-10.06	-3.48
	Cotton	October,2013 (7)	129	-10.86	-11.51	-3.45
		November,2013 (8)	146	-11.44	-12.03	-3.44
		December,2013 (9)	168	-12.68	-12.96	-3.44
	Turmeric	April,2013 (7)	107	-6.80	-9.37	-3.45
		May,2013 (8)	123	-7.50	-10.19	-3.45
		June,2013 (8)	129	-8.08	-10.72	-3.45
		July,2013 (8)	135	-7.81	-7.87	-3.47
		August,2013 (5)	81	-10.49	-10.15	-3.47
		September,2013 (5)	84	-10.34	-10.19	-3.46
		October,2013 (5)	79	-9.60	-8.81	-3.47
		November,2013 (5)	75	-8.22	-8.23	-3.47
		December,2013 (5)	74	-6.46	-8.18	-3.47

Source: Authors' estimations.

As both variables are stationary, VAR (Vector Auto Regression) equations are taken in level form to test the interdependency of the two variables i.e. spot price and futures price of the selected commodities. Prior to estimating VAR equations, it is required to know the optimal lag of endogenous variables (here both variables) used as independent variables in order to have the best valid results. Therefore, test for optimal lags are conducted. Table no.3 shows the obtained log-likelihood (LL), likelihood ratio (LR), final prediction error (FPE) and various information criteria estimates from the models estimated with different lags for all 23 contracts. By theory, a model is better when LL and LR are higher and FPE and ICs are lower. Results show that the optimal lag is 1 for 15 contracts, 2 for 7 contracts and 3 for one contract only.

Commodity	Contract (No of Months)	lag	LL	LR	FPE	AIC	HQIC	SBIC
Castor seed	January,2013 (5)	0	-243.292	-	5.18824	7.32215	7.34819	7.38796
		1	-219.767	47.049*	2.89704*	6.73932*	6.81745*	6.93676*
	February,2013 (5)	0	-221.152	-	1.68696	6.19868	6.22385	6.26192
		1	-200.397	41.51	1.0593*	5.73326*	5.80879*	5.92299*
	March,2013 (5)	0	-212.043	-	1.30981	5.94563	5.97081	6.00888
		1	-194.196	35.693*	.89168*	5.56101*	5.63654*	5.75073*
	April,2013 (5)	0	-212.12	-	1.1177	5.7871	5.8119	5.8493
		1	-200.12	23.994*	.900551*	5.57092*	5.64544*	5.75773*
	May,2013 (5)	0	-189.695	-	0.819763	5.47701	5.50253	5.54125
		1	-178.761	21.869*	.672486*	5.27887*	5.35543*	5.4716*
	June,2013 (5)	0	-214.326	-	1.39556	6.00905	6.03422	6.07229
		1	-198.957	30.737	1.01775*	5.69326*	5.76878*	5.88298*
	July,2013 (5)	0	-215.774	-	1.33731	5.96641	5.99142	6.02916
		1	-199.506	32.536	.955658*	5.63031*	5.70533*	5.81856*
	August,2013 (5)	0	-232.903	-	1.80098	6.26408	6.28876	6.32588
		1	-218.533	28.74*	1.36599*	5.98755*	6.06158*	6.17295*
	September,2013 (5)	0	-235.461	-	2.2934	6.50579	6.53079	6.56854*
		1	-226.928	17.067	2.02572	6.38159	6.45661	6.56984
		2	-220.806	12.245*	1.91194*	6.32344*	6.44848*	6.6372
	October,2013 (5)	0	-223.571	-	2.15787	6.44487	6.47039	6.50911
		1	-214.407	18.327*	1.86207*	6.29734*	6.37389*	6.49007*
	November,2013 (5)	0	-202.924	-	2.29278	6.50551	6.53227	6.57355
		1	-194.236	17.375*	1.97605*	6.35671*	6.43698*	6.56082*
Cotton	October,2013 (7)	0	-238.166	-	0.159918	3.84266	3.86104	3.88791*
		1	-236.234	3.8651	0.165299	3.87574	3.93089	4.0115
		2	-225.16	22.148*	0.14762*	3.76256*	3.85447*	3.98882
	November,2013 (8)	0	-384.721	-	0.79534	5.44677	5.46368*	5.4884*
		1	-381.775	5.8913	0.807248	5.46162	5.51237	5.58651
		2	-374.371	14.808	0.769493	5.41367	5.49826	5.62183
		3	-369.418	9.9048*	.759317*	5.40026*	5.51868	5.69168
	December,2013 (9)	0	-435.659	-	0.736605	5.37005	5.38546*	5.40801*
		1	-434.025	3.2673	0.758312	5.39909	5.44532	5.51297
		2	-426.923	14.205*	.730008*	5.36102*	5.43807	5.55082
Turmeric	April,2013 (7)	0	-389.187		6.82176	7.59587	7.61659	7.64703
		1	-372.378	33.618*	5.31976*	7.34715*	7.40931*	7.50063*
	May,2013 (8)	0	-450.579		6.89371	7.60636	7.62533	7.65307
		1	-433.202	34.752*	5.5059*	7.38155*	7.43845*	7.52168*
	June,2013 (8)	0	-466.824		6.20546	7.50118	7.51957	7.54644
		1	-447.049	39.55	4.82132	7.24878	7.30394*	7.38454*
		2	-441.029	12.039*	4.66833*	7.21647*	7.30839	7.44274
	July,2013 (8)	0	-482.348		5.57822	7.39462	7.41246	7.43852
		1	-457.072	50.551	4.03121	7.0698	7.12332	7.20149*
		2	-449.164	15.816*	3.79793*	7.01014*	7.09932*	7.22962
	August,2013 (5)	0	-287.343		6.29432	7.5154	7.53975	7.57628
		1	-274.024	26.638	4.94153	7.27335	7.3464*	7.45598*
		2	-268.984	10.081*	4.81118*	7.24633*	7.36808	7.55072
	September,2013 (5)	0	-293.817		5.58272	7.39543	7.4193	7.45498
		1	-278.076	31.482*	4.16295*	7.10191*	7.17353*	7.28056*

	October,2013 (5)	0	-270.133		4.86049	7.25689	7.28157	7.31869
		1	-258.419	23.429*	3.95705*	7.05117*	7.1252*	7.23657*
	November,2013 (5)	0	-253.886		4.62879	7.20805	7.23339*	7.27178*
		1	-248.107	11.558*	4.403*	7.15794*	7.23398	7.34915
	December,2013 (5)	0	-232.894		2.81652	6.71125	6.73677	6.77549
		1	-223.248	19.291	2.39721	6.54995	6.62651*	6.74268*
		2	-218.065	10.366*	2.31842*	6.51615*	6.64374	6.83736

Table no. 3: Selection of optimal lag

Source: Authors' estimations.
Note: Lags corresponding to highest number of ' 'marked criterions are considered as optimum lag.*

As the next step, VAR model is estimated for all the contracts. The results of VAR model is presented in Annexure 1. The outcomes of VAR model can be clearly understood from the following table.

Table No. 4: Summary of VAR Model

		castor		Cotton		turmeric	
Contract (No of Months)	Equation of	lag of spot	lag of future	lag of spot	lag of future	lag of spot	lag of future
January,2013	future	n	p				
	Spot	n	p				
February,2013	future	0	0				
	Spot	n	p				
March,2013	future	n	p				
	Spot	n	p				
April,2013	future	0	p			0	0
	Spot	n	p			p	p
May,2013	future	0	0			0	0
	Spot	n	p			0	p
June,2013	future	0	0			0	0
	Spot	n	p			p	p
July,2013	future	0	0			0	0
	Spot	n	p			p	p
August,2013	future	0	0			0	0
	Spot	0	p			n	p
September,2013	future	0	0			0	0
	Spot	0	0			n	p
October,2013	future	0	0	0	0	0	0
	Spot	0	0	0	0	n	p
November,2013	future	0	0	0	P	0	0
	Spot	0	0	p	N	0	p
December,2013	future			p	N	0	0
	Spot			p	N	0	p

n: ignificantly influences dependent variable in negative direction
p: ignificantly influences dependent variable in positive direction
0; oes not significantly influence dependent variable

The above table clearly depicts that there are 3 contracts in which lag of spot influences futures in negative direction. In one contract only i.e. cotton (Nov.) in positive direction. Otherwise there is no influence. But there are 17 contracts in which lag of futures influences spot in positive direction. In two contracts i.e. cotton (Nov. & Dec.) in negative direction. Only in four contracts it has no influence on spot. Thus it can be concluded that lag value of futures has significant influence on spot. To validate this result, test of stability and adequacy has been conducted.

Test of Adequacy of the model: An equation should have enough number of lag values so that any remaining significant lag should not become part of residual. It is ensured by test of no autocorrelation in the residuals. The result of adequacy test is presented in Table 5 below. From the table it can be clearly seen that null hypothesis of no autocorrelation in residuals is not rejected in all the contracts except November contract for Cotton. Thus, it can be recapitulated that the model with optimum lag value is adequate.

Table No. 5: Test of adequacy

Lagrange-multiplier test for adequacy
H0: no autocorrelation at following lag order

Commodity	Contract (No of Months)	lag	chi2	p value
Castor seed	January,2013 (5)	1	2.19	0.70
	February,2013 (5)	1	4.78	0.31
	March,2013 (5)	1	3.76	0.44
	April,2013 (5)	1	1.34	0.85
	May,2013 (5)	1	6.13	0.19
	June,2013 (5)	1	1.58	0.81
	July,2013 (5)	1	4.98	0.29
	August,2013 (5)	1	1.4	0.84
	September,2013 (5)	1	4.56	0.33
		2	4.75	0.31
	October,2013 (5)	1	5.92	0.21
	November,2013 (5)	1	5.31	0.26
Cotton	October,2013 (7)	1	6.98	0.14
		2	9.04	0.06
	November,2013 (8)	1	4.07	0.40
		2	12.16	0.02
	December,2013 (9)	1	0.82	0.93
		2	0.49	0.97
Turmeric	April,2013 (7)	1	4.36	0.36
	May,2013 (8)	1	6.59	0.16
	June,2013 (8)	1	6.29	0.18
		2	2.08	0.72
	July,2013 (8)	1	4.01	0.01
		2	2.23	0.69
	August,2013 (5)	1	3.96	0.41
		2	4.99	0.29
	September,2013 (5)	1	6.76	0.15
	October,2013 (5)	1	4.82	0.31
	November,2013 (5)	1	3.19	0.52
	December,2013 (5)	1	4.61	0.33
		2	7.13	0.13

Source: Authors' estimations.

Test of stability of VAR model: This test is conducted to establish whether the effect of lags die with passage of time. Otherwise, returns of spot/future contracts would be either highly negative or highly positive and so, the

model will explode. The outcome of stability test is given in Table no. 6. As per rule, VAR satisfies stability condition as all the eigenvalues lie inside the unit circle which is clearly depicted in the table below.

Table No. 6: Test of stability

Commodity	Contract (No of Months)	Eigen value	Modulus
Castor seed	January,2013 (5)	.0324 + .4302	0.431
		.0324 - .4302	0.431
	February,2013 (5)	-0.013 + 0.271i	0.271
		-0.013 - 0.271i	0.271
	March,2013 (5)	.053 + .298i	0.303
		.053 - .298i	0.303
	April,2013 (5)	0.034 + 0.197i	0.200
		0.034 - 0.197i	0.200
	May,2013 (5)	-0.358	0.358
		0.054	0.054
	June,2013 (5)	-0.366	0.367
		0.187	0.187
	July,2013 (5)	-0.491	0.491
		0.179	0.179
	August,2013 (5)	-0.480	0.480
		0.197	0.197
	September,2013 (5)	-0.567	0.567
		0.454	0.454
		-0.264 + .367	0.452
		-0.264 - .367	0.452
	October,2013 (5)	-0.416	0.416
		-0.237	0.237
	November,2013 (5)	-0.444	0.444
		-0.207	0.207
Cotton	October,2013 (7)	0.332 + 0.559	0.561
		0.332 - 0.559	0.561
		-0.479 + 0.269	0.549
		-0.479 - 0.269	0.549
		0.363 + 0.099	0.376
		0.363 - 0.099	0.376
	November,2013 (8)	0.600	0.600
		- 0.337 + 0.472i	0.581
		- 0.337 - 0.472i	0.581
		- 0.438	0.438
		0.308	0.308
		- 0.029	0.029
	December,2013 (9)	0.519	0.519
		-.244 + .452	0.514
		-.244 - .452	0.514
		-0.392	0.392
		0.316	0.316
		-0.065	0.065
Turmeric	April,2013 (7)	0.351	0.351
		- 0.129	0.129
	May,2013 (8)	0.275	0.275
		- 0.121	0.121

	June,2013 (8)	0.584	0.584
		-0.443	0.443
		- 0.047 + 0.242i	0.247
		- 0.047 - 0.242i	0.247
	July,2013 (8)	0.574	0.574
		-0.344 + 0.109i	0.361
		-0.344 - 0.109i	0.361
		0.109	0.109
	August,2013 (5)	- 0.487	0.487
		-0.227 + 0.380i	0.443
		-0.227 - 0.380i	0.443
		0.415	0.415
	September,2013 (5)	- 0.222 + 0.259i	0.341
		- 0.222 - 0.259i	0.341
	October,2013 (5)	-0.144 + 0.111i	0.182
		-0.144 - 0.111i	0.182
	November,2013 (5)	-0.255	0.255
		0.119	0.119
	December,2013 (5)	- 0.266 + 0.356i	0.444
		- 0.266 - 0.356i	0.444
		0.419	0.419
		-0.069	0.069

Source: Authors' estimations.

To reiterate the above results a summary of relationship was examined through Granger Causality test and results of Table No. 7 reflect the above inference.

Results of Causality Test

The Granger causality test result is reported in table no.7. The upper and lower rows of the F statistic column reports the null hypotheses that spot price does not Granger-cause futures price and futures price does not Granger-cause spot price respectively. Generally, the null hypothesis that the futures market prices do not Granger-cause the prices in spot market prices is uniformly rejected at 1%, 5% and 10% significance level for 18 out of 23 contracts. The implication is that the futures markets have stronger ability to discover spot prices or spot market prices are influenced by the futures market prices for Castor, cotton and turmeric. The table also reports bidirectional causality relationship (F↔S) results only for two contracts of castor seed during 2013. Only in case of December, 2013 contract of turmeric, it is proved that do spot price Granger-causes futures price. Further, in four contracts, the test shows no directional relationship between the spot and futures prices of castor seed and cotton during the sample period. Thus, examination of the F statistics for all contracts for the above three commodities indicates strong evidence that futures market prices dominate or lead spot market prices or the spot prices for these commodities are discovered in the futures markets.

Table No. 7: Granger Causality Test

Year	Commodity	Contract (No of Months)	Hypothesis	F-statistic	Prob.	Direction	Relation
2013	Castor seed	January,2013 (5)	S /→ F	10.7992*	0.0016	Bidirectional	F↔S
			F /→ S	34.2518*	2.00E-07		
		February,2013 (5)	S /→ F	2.31671	0.1324	Unidirectional	F→S
			F /→ S	17.5377*	8.00E-05		
		March,2013 (5)	S /→ F	4.93233**	0.0295	Bidirectional	F↔S
			F /→ S	25.6354*	3.00E-06		
		April,2013 (5)	S /→ F	1.79774	0.1731	Unidirectional	F→S
			F /→ S	7.03826*	0.0016		
		May,2013 (5)	S /→ F	0.01264	0.9108	Unidirectional	F→S
			F /→ S	8.30833*	0.0052		

		June,2013 (5)	S /→ F	0.0501	0.8235	Unidirectional	F→S
			F /→ S	18.9247*	4.00E-05		
		July,2013 (5)	S /→ F	0.81577	0.3694	Unidirectional	F→S
			F /→ S	13.7158*	0.0004		
		August,2013 (5)	S /→ F	1.75529	0.1892	Unidirectional	F→S
			F /→ S	10.2783*	0.002		
		September,2013 (5)	S /→ F	1.05419	0.3539	No direction	S--X--F F--X--S
			F /→ S	0.30262	0.7398		
		October,2013 (5)	S /→ F	0.15318	0.6967	No direction	S--X--F F--X--S
			F /→ S	0.27643	0.6007		
		November,2013 (5)	S /→ F	0.02106	0.8851	No direction	S--X--F F--X--S
			F /→ S	1.1027	0.2977		
	Cotton	October,2013 (7)	S /→ F	0.30295	0.7392	No direction	S--X--F F--X--S
			F /→ S	0.23984	0.7871		
		November,2013 (8)	S /→ F	0.55029	0.5781	Unidirectional	F→S
			F /→ S	4.0297**	0.0199		
		December,2013 (9)	S /→ F	1.26317	0.2855	Unidirectional	F→S
			F /→ S	3.96235**	0.0209		
	Turmeric	April,2013 (7)	S /→ F	1.43902	0.2331	Unidirectional	F→S
			F /→ S	10.4727*	0.0016		
		May,2013 (8)	S /→ F	0.76974	0.3821	Unidirectional	F→S
			F /→ S	9.32296*	0.0028		
		June,2013 (8)	S /→ F	0.49589	0.6103	Unidirectional	F→S
			F /→ S	8.83199*	0.0003		
		July,2013 (8)	S /→ F	0.81577	0.3694	Unidirectional	F→S
			F /→ S	13.7158*	0.0004		
		August,2013 (5)	S /→ F	1.34729	0.2493	Unidirectional	F→S
			F /→ S	16.2243*	0.0001		
		September,2013 (5)	S /→ F	2.74958	0.1012	Unidirectional	F→S
			F /→ S	20.1085*	2.00E-05		
		October,2013 (5)	S /→ F	0.4695	0.4953	Unidirectional	F→S
			F /→ S	19.7835*	3.00E-05		
		November,2013 (5)	S /→ F	0.26785	0.6064	Unidirectional	F→S
			F /→ S	6.60139**	0.0123		
		December,2013 (5)	S /→ F	3.21066***	0.0775	Unidirectional	S→ F
			F /→ S	2.03626	0.158		

Source: Authors' estimations.

*Note: *1%, **5%, ***10% significance. F-statistic reported.*
In the last column F and S indicate Futures and Spot prices while the symbol → and --X-- respectively indicate
Granger cause and does not Granger cause.

Co integration/OLS regression analysis: It is popular and useful to go for co integration analysis to see relationship among variables in time series data because many of time series variables are not stationary and

with non stationary variables, OLS results may not be valid if variables are not moving in tandem or not co integrated. However, if variables are stationary, then it is more efficient to do OLS regression (in line of Engle-Granger test of co integration) than Co integration analysis through Vector Error correction model using Maximum Likelihood Estimation. As the variables in the present study are stationary, the OLS regression has been used to analyze relationship between current spot and futures prices and returns. The OLS regression results are shown in Table No.8 below. From the table, it can be seen that the results for all the contracts clearly indicate highly significant direct relationship among both the prices and their returns. Thus it can be concluded that spot and futures prices are highly correlated and have causal relationships for current and lagged values of both variables. This satisfies the second criterion of market efficiency definition.

Table No.8: OLS Regression

			Explanatory variable	
Commodity	Contract (No of Months)	Equation for	spot	Future
Castor seed	January,2013 (5)	spot		**0.64** (0.05)
		future	**1.13** (0.098)	
	February,2013 (5)	spot		**0.65** (0.05)
		future	**1.01** (0.074)	
	March,2013 (5)	spot		**0.71** (0.05)
		future	**0.98** (0.066)	
	April,2013 (5)	spot		**0.69** (0.05)
		future	**0.99** (0.06)	
	May,2013 (5)	spot		**0.48** (0.05)
		future	**1.2** (0.14)	
	June,2013 (5)	spot		**0.54** (0.05)
		future	**1.08** (0.1)	
	July,2013 (5)	spot		**0.49** (0.05)
		future	**1.07** (0.12)	
	August,2013 (5)	spot		**0.45** (0.05)
		future	**1.1** (0.12)	
	September,2013 (5)	spot		**0.5** (0.04)
		future	**1.38** (0.1)	
	October,2013 (5)	spot		**0.48** (0.04)
		future	**1.35** (0.11)	
	November,2013 (5)	spot		**0.46** (0.04)
		future	**1.37** (0.12)	
Cotton	October,2013 (7)	spot		**0.82** (0.03)
		future	**1** (0.03)	
	November,2013 (8)	spot		**0.61** (0.04)
		future	**0.97** (0.09)	
	December,2013 (9)	spot		**0.6** (0.11)
		future	**0.96** (0.1)	
Turmeric	April,2013 (7)	spot		**0.35** (0.05)
		future	**0.87** (0.17)	
	May,2013 (8)	spot		**0.40** (0.04)
		future	**0.99** (0.11)	
	June,2013 (8)	spot		**0.43** (0.05)
		future	**0.96** (0.13)	
	July,2013 (8)	spot		**0.46** (0.05)
		future	**0.92** (0.10)	
	August,2013 (5)	spot		**0.34** (0.05)
		future	**0.99** (0.25)	

	September,2013 (5)	spot		**0.31** (0.05)
		future	**1.08** (0.32)	
	October,2013 (5)	spot		**0.29** (0.6)
		future	**0.84** (0.29)	
	November,2013 (5)	spot		**0.35** (0.05)
		future	**1.05** (0.16)	
	December,2013 (5)	spot		**0.31** (0.04)
		future	**1.46** (0.19)	

Source: Authors' estimations.

Note: Coefficients in bold are significant at 1% level of significance.
Std error is given in parentheses.

VII. CONCLUSION

The present paper empirically analyzes whether the growing Indian commodity futures market satisfies market efficiency condition. Based on the theoretical and empirical literature that is reviewed in this study, the Efficient Market Hypothesis in the context of an emerging commodity market namely NCDEX has been investigated. The study examined the efficiency of three agricultural commodity futures traded on NCDEX using daily data of closing price for the period of 12 months. It has examined the hypothesis over 3 lag period in order to analyze whether the NCDEX exhibits a trend of market efficiency overtime. Different statistical tools namely Vector Auto Regression model, OLS regression model and Granger Causality test are used in this study.

The empirical results of the study indicate significant evidence of linear dependency for all three agricultural commodities. The VAR model clearly indicates that the lag value of futures has significant influence on spot. To validate this result, test of stability and adequacy has been conducted and it is proved that the results of VAR model is adequate and stable. The Granger Causality test for the full sample period indicates strong evidence that futures market prices dominate spot market prices or the spot prices for sample commodities are discovered in the futures markets. Finally, the OLS regression analysis has been made and it is found that the spot and futures prices for all the contracts are highly correlated as the corresponding coefficient values are significant at 1% level of significance. Thus, from all the results it can be summarized that both the variables i.e. spot price and futures price of sample commodities are integrated as well as co- integrated proving the fact that the Indian commodity markets for the sample commodities are efficient. There are some limitations inherent in the present study. The study is limited to the period from 1st January, 2013 to 31st Dec, 2013. Further, the number of commodities is limited to only three from only one commodity exchange. Finally, data availability is a major issue. The data that was available was in some cases recorded once and in other cases recorded twice daily. Therefore, only the prices which were nearest to the closing time were chosen. Several natural processes such as seasonal cycles based on harvests, monsoons, depressions, and other weather events would also be expected to have an impact on price discovery efficiency of commodity markets. This factor can be considered for further study in this area.

Annexure 3: VAR (Vector Auto Regression) Model

			INDEPENDENT VARIABLES					
Commodity	Contract (No of Months)	Equation of	One lag of SP	Two lags of SP	Three lags of SP	One lag of FP	Two lags of FP	Three lags of FP
Castor seed	January,2013 (5)	SP	-0.71 (0.00)	-	-	0.8 (0.00)	-	-
		FP	-0.92 (0.00)	-	-	0.78 (0.00)	-	-
	February,2013 (5)	SP	-0.39 (0.02)	-	-	0.59 (0.00)	-	-
		FP	-0.38 (0.12)	-	-	0.37(0.05)	-	-
	March,2013 (5)	SP	-0.51 (0.00)	-	-	0.77 (0.00)	-	-
		FP	- 0.52(0.02)	-	-	0.61(0.00)	-	-
	April,2013 (5)	SP	-0.36 (0.04)	-	-	0.69 (0.00)	-	-
		FP	-0.33 (0.16)	-	-	0.43 (0.03)	-	-
	May,2013 (5)	SP	-0.33 (0.05)	-	-	0.32 (0.00)	-	-
		FP	0.03 (0.91)	-	-	0.03 (0.88)	-	-
	June,2013 (5)	SP	-0.37 (0.02)	-	-	0.49 (0.00)	-	-
		FP	-0.005 (0.98)	-	-	0.19 (0.27)	-	-
	July,2013 (5)	SP	-0.29 (0.05)	-	-	0.39 (0.00)	-	-
		FP	0.24 (0.32)	-	-	-0.02 (0.91)	-	-
	August,2013 (5)	SP	-0.2 (0.19)	-	-	0.36 (0.00)	-	-
		FP	0.35 (0.16)	-	-	-0.08 (0.60)	-	-
	September,2013 (5)	SP	-0.25 (0.25)	0.17 (0.43)	-	0.11 (0.42)	0.07 (0.58)	-
		FP	0.41 (0.24)	0.44 (0.21)	-	-0.39 (0.08)	-0.12 (0.58)	-
	October,2013 (5)	SP	-0.33 (0.08)	-	-	0.06 (0.59)	-	-
		FP	0.13 (0.69)	-	-	-0.32(0.09)	-	-
	November,2013 (5)	SP	-0.41 (0.05)	-	-	0.14 (0.28)	-	-
		FP	0.05 (0.88)	-	-	-0.24 (0.25)	-	-
Cotton	October,2013 (7)	SP	0.01 (0.97)	-0.01 (0.97)	0.28 (0.19)	0.02 (0.96)	0.13 (0.51)	-0.26 (0.19)
		FP	0.17 (0.59)	0.12 (0.59)	0.39 (0.09)	-0.18 (0.56)	-0.04 (0.83)	-0.31 (0.15)
	November,2013 (8)	SP	0.00 (0.99)	0.42 (0.00)	-0.08 (0.56)	0.05 (0.66)	-0.28 (0.01)	0.07 (0.52)
		FP	0.26 (0.12)	0.27 (0.09)	-0.32 (0.05)	-0.18 (0.19)	-0.24 (0.07)	0.28 (0.03)
	December,2013 (9)	SP	-0.01 (0.95)	0.40 (0.00)	-0.09 (0.47)	0.05 (0.62)	-0.26 (0.01)	0.07 (0.43)
		FP	0.17 (0.28)	0.34 (0.02)	-0.27 (0.07)	-0.10 (0.41)	-0.29 (0.01)	0.22 (0.06)
Turmer	April,2013 (7)	SP	0.22 (0.03)	-	-	0.21 (0.00)	-	-

ic		FP	0.22 (0.22)	-	-	0.01 (0.95)	-	-
	May,2013 (8)	SP	0.15 (0.15)	-	-	0.21 (0.00)	-	-
		FP	0.16 (0.37)	-	-	0.00 (0.99)	-	-
	June,2013 (8)	SP	-0.00 (0.99)	0.29 (0.00)	-	0.28 (0.00)	-0.06 (0.44)	-
		FP	0.02 (0.91)	0.17 (0.32)	-	0.05 (0.69)	-0.09 (0.48)	-
	July,2013 (8)	SP	-0.08 (0.51)	0.34 (0.00)	-	0.35 (0.00)	-0.10 (0.18)	-
		FP	-0.12 (0.55)	0.17 (0.28)	-	0.07 (0.55)	-0.03 (0.82)	-
	August,2013 (5)	SP	-0.50 (0.00)	0.11 (0.41)	-	0.34 (0.00)	0.09 (0.28)	-
		FP	-0.19 (0.49)	0.36 (0.15)	-	-0.02 (0.87)	-0.06 (0.73)	-
	September,2013 (5)	SP	-0.45 (0.00)	-	-	0.29 (0.00)	-	-
		FP	-0.41 (0.09)	-	-	0.01 (0.95)	-	-
	October,2013 (5)	SP	-0.33 (0.00)	-	-	0.30 (0.00)	-	-
		FP	- 0.15 (0.48)	-	-	0.04 (0.75)	-	-
	November,2013 (5)	SP	-0.15 (0.28)			0.21 (0.01)		-0.15 (0.28)
		FP	0.13 (0.59)			0.02 (0.92)		0.13 (0.59)
	December,2013 (5)	SP	0.01 (0.96)	-0.02 (0.90)	-	0.14 (0.05)	0.12 (0.09)	-
		FP	0.65 (0.08)	0.05 (0.88)	-	-0.19 (0.24)	-0.06 (0.74)	-

Source: Authors' estimations.

Note: Coefficients in bold are significant at 5% level of significance.
p value is given in parentheses

REFERENCES

[1] Ali, Jabir and Gupta, Kriti Bardhan (2007), "Agricultural Price Volatility and Effectiveness of Commodity Futures Markets in India", Indian Journal of Agricultural Economics. Vol. 62, No.3, pp. 537.

[2] Alphonse, Pascal (2000). Efficient Price Discovery In Stock Index Cash And Futures Markets. Annales d'Economie et de Statistique. Retrieved from:http://annales.ensae.fr/anciens/n60/vol60-08.pdf as on August 13, 2014.

[3] Asche, Frank & Guttormsen, Atle G. (2002). Lead-Lag Relationships between Futures and Spot Prices. Working Paper no. 2/02. Retrieved from: http://bora.nhh.no/bitstream/2330/898/1/A02_02.pdf as on July 25, 2014.

[4] Aydemir, Ogujhan & Demirhan, Erdal (2009). The Relationship between Stock Prices and Exchange Rates Evidence from Turkey. International Research Journal of Finance and Economics. 23, 1-7.

[5] Bose, Suchismita (2007). Contribution of Indian index futures to price formation in the stock market. Money & Finance. Retrieved from: http://ssrn.com/abstract=1017477. 39-56 as on July 20, 2014.

[6] Brooks, Chris (2002), Introductory Econometrics for Finance (3rd ed.). Modeling Long-run Relationships in Finance. 367-436.

[7] Chakrabarty, Ranajit and Sarkar Asima (2010), "Efficiency of the Indian Stock Market with Focus on Some Agricultural Product", Paradigm Vol.14 No. 1, pp. 85-96.

[8] Chan, K (1992). A further analysis of the lead-lag relationship between the cash market and stock index futures market. Review of Financial Studies. 5 (1), 123-152.

[9] Debashish, Sathya Swaroop & Mishra, Bishnupriya (2008). Econometric Analysis of Lead-Lag Relationship between NSE Nifty and its Derivatives Contracts. Indian Management Studies Journal. 12(2), 81-100.

[10] Easwaran R. Salvadi and Ramasundaram P. (2008), "Whether Commodity Futures Market in Agriculture is Efficient in Price Discovery? - An Economics Analysis", Agricultural Economics Research Review, Vol. 21, Conference Issue, pp. 337-344.

[11] Engle, Robert F. & Granger, C.W.G. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. Econometrica. 55 (2), 251-276.

[12] Fama, E. F. 1970. "Efficient Capital Markets: A Review of Theory and Empirical Work." *The Journal of Finance* 25: 387-417.

[13] Floros, Christos & Vougas, Dimitrios V. (2007). Lead-Lag relationship between Futures and Spot Markets in Greece: 1999-2001. International Research Journal of Finance and Economics. 7, 168-174.

[14] Floros, Christos (2009). Price Discovery in South African Stock Index Futures Markets. International Research Journal of Finance and Economics, Retrieved from: http://www.eurojournals.com/irjfe_34_12.pdf as on July 29, 2014.

[15] Iyer, Vishwanathan and Pillai Archana (2010), "Price Discovery and Convergence in the Indian Commodities Market." Indian Growth and Development Review, Vol. 3 No.1, pp.53-61

[16] Jabir Ali, Kriti Bardhan Gupta, "Efficiency in Agricultural Commodity Futures Markets in India: Evidence from co-integration and causality tests", Agricultural Finance Review, Vol. 71 Iss: 2, pp.162 – 178

[17] Johansen, S., 1988. "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control* 12(2–3): 231–254.

[18] Johansen, S., and K. Juselius. 1990. "Maximum Likelihood Estimation and Inference on Cointegration, with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics* 52:169-210

[19] Kaur, Gurbandini and Rao, D.N (2009), "Do the spot prices influence the pricing of futures contracts? An empirical study of price volatility of future contracts of selected agricultural commodities traded on NCDEX (India)",

[20] Kumar, B., Singh, P. and Pandey, A. (2008); Hedging Effectiveness of Constant and Time Varying Hedge Ratio in Indian Stock and Commodity Futures Markets; Working Paper, Indian Institute of Management (Ahmadabad), India.

[21] Kushankur Dey; Debasish Maitra, "Price Discovery in Indian Commodity Futures Market: An Empirical Exercise", International Journal of Trade and Global Markets, 2012, Vol.5, No.1, pp.68 – 87.

[22] Lokare, S. M. (2007), "Commodity Derivatives and Price Risk Management: An Empirical Anecdote from India", Reserve Bank of India Occasional Papers, Vol. 28 No.2, pp. 27-77

[23] Nath, Golka C. and Lingareddy, Tulsi (2008), "Impact of Futures Trading on Commodity Prices", Economic and Political Weekly, Vol. 43 No.3, pp. 18-23.

[24] Raizada, G. and Sahi, G.S. (2006); Commodity Futures Market Efficiency in India and Effect on Inflation; Working Paper, Indian Institute of Management (Lucknow), India

[25] Ramaswami , Bharat and Singh , Jatinder Bir (2007), "Underdeveloped Spot Markets and Futures Trading: The Soya Oil Exchange in India:, electronic copy available on http://ssrn.com/abstract=962835 (accessed 30 September 2012).

[26] Sahi,Gurpreet Singh and Raizada, Gaurav (2006), "Commodity Futures Market Efficiency in India and Effect on Inflation", electronic copy available on http://ssrn.com/abstract=949161 (accessed 30 September 2012).

[27] Sanjay Sehgal, Namita Rajput Rajeev Kumar Dua, "Price Discovery in Indian Agricultural Commodity Market" International Journal of Accounting and Financial Reporting ISSN 2162-3082 2012, Vol. 2.

[28] Sehdevan, K.G. (2002), "Derivative and Price Risk Management: A Study of Agricultural Commodity Futures in India", A Seed Money Project Report of Indian Institute of Management, Lucknow.

[29] Sen, S. and Paul, M. (2010); Trading In India's Commodity Future Markets; Working Paper, Institute for Studies in Industrial Development.