A Study on Agricultural Commodity Market Efficiency in India In Relation with Spot and Future Markets

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Abstract

This paper aims to examine the market which reacts first in India by assessing the relationship between spot and future prices of agricultural commodities such as Chana, Jeera, Maize, Soya bean, and Turmeric for a period from November 2019 to March 2020 traded in NCDEX, The results suggest the existence of long-run equilibrium relationships between futures and spot prices which suggests that for the commodities - Maize and Soybean, both the spot and future markets price plays the leading role in the price discovery process and said to be informationally efficient and reacts more quickly to each other.

Introduction

The agricultural production system in India has undergone profound changes over the decades due to the adoption of green revolution technologies coupled with the price support policy of the government. After independence, various policy initiatives undertaken for protecting the agriculture sector affected the growth in agricultural commodities markets adversely. The Essential Commodities Act 1955 envisaged price and movement protection applicable to various agricultural commodities, particularly food grains such as paddy, wheat, coarse grains, and pulses to protect the interests of producers as well as of consumers. During the process of economic liberalization, it felt that there is a need to reorient policies and regulations in agricultural commodities. The Khusro Committee recommended the reintroduction of futures trading in most of the major commodities. The Government of India constituted another committee headed by Professor K.N. Kabra in June 1993 on Forward Markets, which also emphasized the need for the introduction of futures trading in 17 commodity groups covering a wide range of agricultural commodities. It also recommended strengthening of the Forward Markets Commission (FMC) and various amendments in Forward Contracts (Regulation) Act 1952 to bring fairness and efficiency in futures trading operations.

The National Agriculture Policy announced in July 2000 envisaged external and domestic market reforms by putting in place a mechanism of futures trade/market and dismantling of all control and regulations in the agricultural commodity market. As a result, the Government of India issued notifications on April 1, 2003, and permitted futures trading (except options trading) for a wide range of agricultural commodities.

Distress sale of agricultural commodities immediately after harvesting due to lack of farmers' capacity to wait for the opportune time for getting remunerative prices and also because of the uncertainty involved in possible future prices has always been one of the major concerns for producers as well as consumers. Futures contracts help in performing two essential management functions, i.e. price discovery and price risk management for the specific commodity.

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Price discovery is the process of revealing information about future spot prices through future markets. It is useful for producers as they get a fair idea about the amounts likely to prevail at the next point of time and hence, can allocate their limited available resources among various competing commodities for optimizing their profits. It also provides food processors and consumers with an idea about prices at which the specific commodity would be available at a future point of time. Although futures trading in a large number of agricultural commodities reintroduced in India in the year 2003, the government is always skeptical about its efficiency and likely impact on the price movement of agricultural commodities. The ban on futures trading of some major agricultural commodities in February 2007 makes it imperative to explore whether the futures market has been able to achieve its above-stated objectives of price discovery and risk management or not. Thus, understanding the influence of one market on the other and role of each market segment in price discovery is the central question in market microstructure design and has become an increasingly important research issue among academicians, regulators and practitioners alike as it provides an idea about the market efficiency, volatility, hedging effectiveness, and arbitrage opportunities if any.

The essence of the price discovery function hinges on whether new information is reflected first in changes in future prices or changes in spot prices. Hence, there exists a lead-lag relationship between spot and futures markets by information dissemination. All the information available in the market place immediately incorporated in the prices of assets in an efficient market. So, new information disseminating into the market should be reflected immediately in spot and futures prices simultaneously. It will lead to perfect positive contemporaneous co-movement between the prices of those markets, and there will be no systematic lagged response and therefore, no arbitrage opportunity. This prediction arises directly from the Cost of Carry (COC) model of future pricing which postulates that

$$F_t = S_t\, e^{(r-y)\,(T-t)}$$

where Ft is the futures price of the commodity at time t,S_t is the spot price of the commodity at time t,r is the interest rate foregone while carrying the underlying commodity, y is the price fluctuation on the commodity and T-t is the remaining life of the futures contract.

Above Equation justified by a "no-arbitrage" assumption since $F_t > S_t\, e^{(r-y)\,(T-t)}$ would enable traders or farmers to profit by selling futures and buying at the spot. In contrast, $S_t\, e^{(r-y)\,(T-t)} > F^t$ would allow profits by buying futures and short selling at the spot. The assumptions that underlie these arguments are that future and spot markets are perfectly efficient, and that transaction costs are zero. This simple version of the model also assumes that the interest rate and addition to price are constant over the life of the futures contract. However, in practice, they will vary, as will (r – y), the net cost of carry of the underlying commodity. Most importantly, in the real world, the existence of market frictions such as transaction costs, margin requirements, short-sale constraints, liquidity differences, and non-synchronous trading effects may induce a lead-lag relationship between the futures contract and its underlying spot market. Besides, if there are economic incentives for traders to use one market over the other, a price discovery process between the two markets is likely to happen. It implies that futures and spot market prices are inter-related and can traced under different market frictions through price discovery mechanism.

Accordingly, there exist diversified theoretical arguments about the causal relationship between spot and futures markets by information dissemination. The main arguments in favor of futures market lead spot market are mainly due to the advantages provided by the futures market includes higher liquidity, lower transaction costs, lower margins, ease leverage positions, rapid execution and greater flexibility for short positions. Such advantages attract larger informed farmers or traders and make the futures market to react first when market-wide information or primary stock-specific information arrives. Thus, future prices lead the spot market prices.

Besides, the low-cost contingent strategies and a high degree of leverage benefits in futures market attracts larger speculative traders from a spot market to a more regulated futures market segments, leading to a reduction in informational asymmetries of the spot market through reducing the amount of noise trading, helping price discovery, improving the overall market depth, enhancing market efficiency, and increase market liquidity.

In such a situation, the spot market will react first when market-wide information or primary stock-specific information arrives. Hence, the spot market leads the futures market. Besides, there exists a bidirectional relationship between the futures and spot markets through the price discovery process, where both the spot and futures markets are said to be informationally efficient and react more quickly to each other. However, frictions in markets, in terms of transaction costs and information asymmetry, may lead to return and volatility spillovers between spot and futures markets. Besides being of academic interest, understanding information flow across markets is also vital for hedgers for hedging and devising cross-market investment strategies. This paper analyzes the issue of price on futures and spot markets which are of interest to traders, financial economists, and analysts. Although futures and spot markets react to the same information, the primary question is which market reacts first in agricultural commodity markets in India by assessing the relationship between the spot and futures prices of Chana, Jeera, Maize, Soybean and Turmeric commodities traded in NCDEX for the period from November 2019 to March 2020.

Literature Review

There have been a number of studies that have analyzed efficiency of commodity markets in developed countries.

Lucia Baldi, Massimo Peri, Daniela Vandone(2011)investigates the long-run relationship between spot and futures prices for corn and soybeans, for the period January 2004 September 2010. They apply cointegration methodology in the presence of potentially unknown structural breaks in the commodities prices, and we then study the causality relationships between spot and futures prices within each specific subperiod identified, intending to analyze where changes in spot and futures price originate and how they spread.

Archana Singh, Narinder Pal Singh(2014)review the available literature on commodity futures market efficiency and related issues viz. the effect of seasonality on commodity futures market efficiency, the inflationary impact of commodity futures trading and the impact of commodity futures trading on spot market volatility. The review shows that the results produced in available literature are often conflicting: the efficiency hypothesis is supported only for specific markets and only over some periods.

Dr. P. Chellasamy, Anu. K. M(2015)analyzes the relationship between spot and futures prices of commodities namely Crude oil, Silver, Zinc, Gold, and Copper in Indian Commodities Market. Econometric methods such as the ADF unit root test, Johansen Cointegration Test and Granger causality test used to ascertain the relationship between Spot Price Returns and Future price returns of Commodities in Multi Commodity Exchange India Ltd. The Study Period was from 01.01.2014 to 28.2.2015. It found that all the variables exhibited stationary. The results of the study gave evidence that the Prices of the commodities during the study period were Independent.

Shashi Gupta, Himanshu Choudhary, D. R. Agarwal(2018)has conducted the study with eight commodities which include two agricultural commodities, two industrial commodities, two precious metals, and two energy

commodities. Sophisticated statistical methods like restricted cointegration and vector error correction model (VECM) used to analyze the spot and futures price time series. Restricted cointegration test shows that near-month futures prices for all the commodities cointegrated with the spot prices. Still, futures prices of all the commodities are inefficient to predict the future spot price.

Objective of the Study

1. To test the market efficiency of selected agricultural commodity derivatives in India.
2. To determine the relationship between spot and future price return of commodity market.

Data Source and Methodology

The study based on secondary data, which has collected from the commodity market and its publications. We used daily data of spot and futures prices of Chana, Jeera, Maize, Soybean and Turmeric for the period from November 2019 to March 2020 collected from National Commodity and Derivative Exchange (NCDEX).

In this study, the techniques used for analysis are the unit root test which is the Augmented Dickey-Fuller (ADF) test, Johansen Co-integration test, and VEC Model about analyzing the Lead-Lag relationship between Spot and Future Markets.

Augmented Dickey-Fuller test used to verify the stationarily of the data series. Johansen's Cointegration test is employed to examine the long-run relationship among the variables after they integrated in identical order. And VEC Model employed for short-run causality/ relationship between the spots and futures prices. VECM model allows the existence of long-run equilibrium error correction in prices in the conditional mean equations. Following equations are used to estimate the error term for the level series of spot and futures series which are non-stationary and integrated of order one.

$$R_{st} = \alpha_s + \sum_{i=1}^{m} \beta_{si} R_{st-i} + \sum_{j=1}^{n} \gamma_{Fj} R_{Ft-j} + \lambda_s Z_{t-1} + \varepsilon_{st}$$

$$R_{Ft} = \alpha_F + \sum_{i=1}^{m} \beta_{Fi} R_{st-i} + \sum_{j=1}^{m} \gamma_{Fj} R_{Ft-j} + \lambda_F Z_{t-1} + \varepsilon_{Ft}$$

Where, R_{st} and R_{Ft} are spot and future market prices of individual agricultural prices at time t, ε_{st} and ε_{Ft} are white noise disturbance terms. The analysis of unit root, co-integration and VECM tests for different commodities were performed using econometric software EViews Version 7.

FINDINGS

Graphical Representation

Figures 1-5 shows the daily spot and future price movement of 5 agricultural commodities i.e. Chana, jeera, maize, soybean and turmeric.

As we see the below figures, the movement of the future price of agricultural commodities and the underlying spot market are in the same direction. Which means there is the probability of having an influence by prices of future on the commodity spot market.

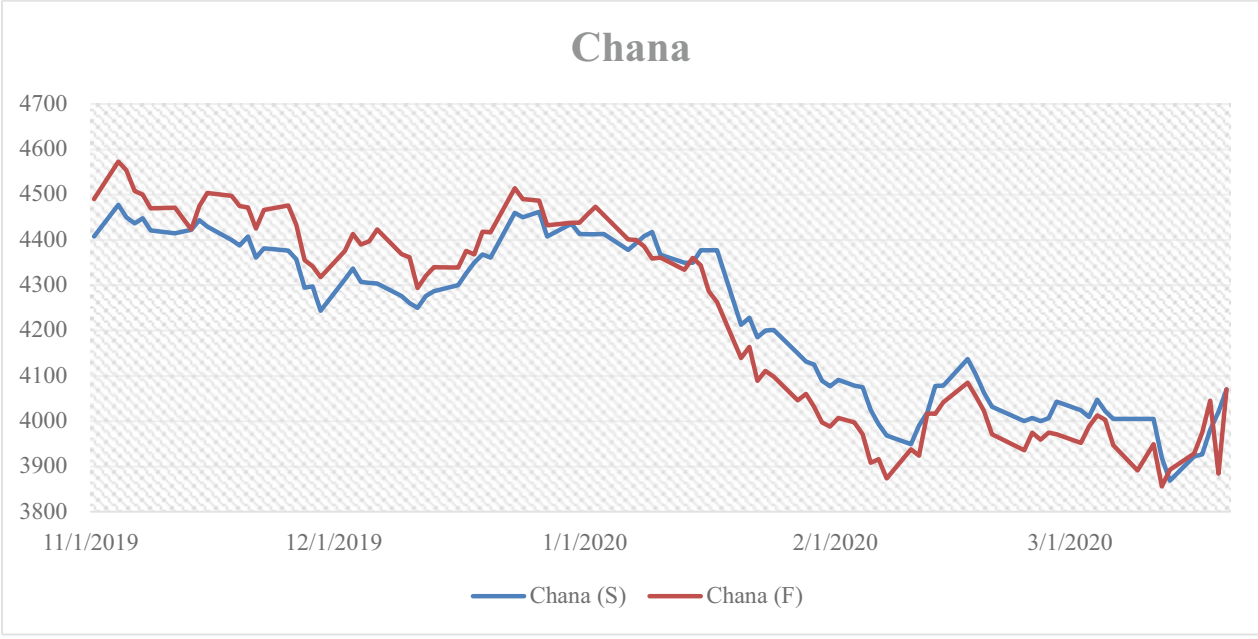

Figure 1: Spot and Future price movement of Chana

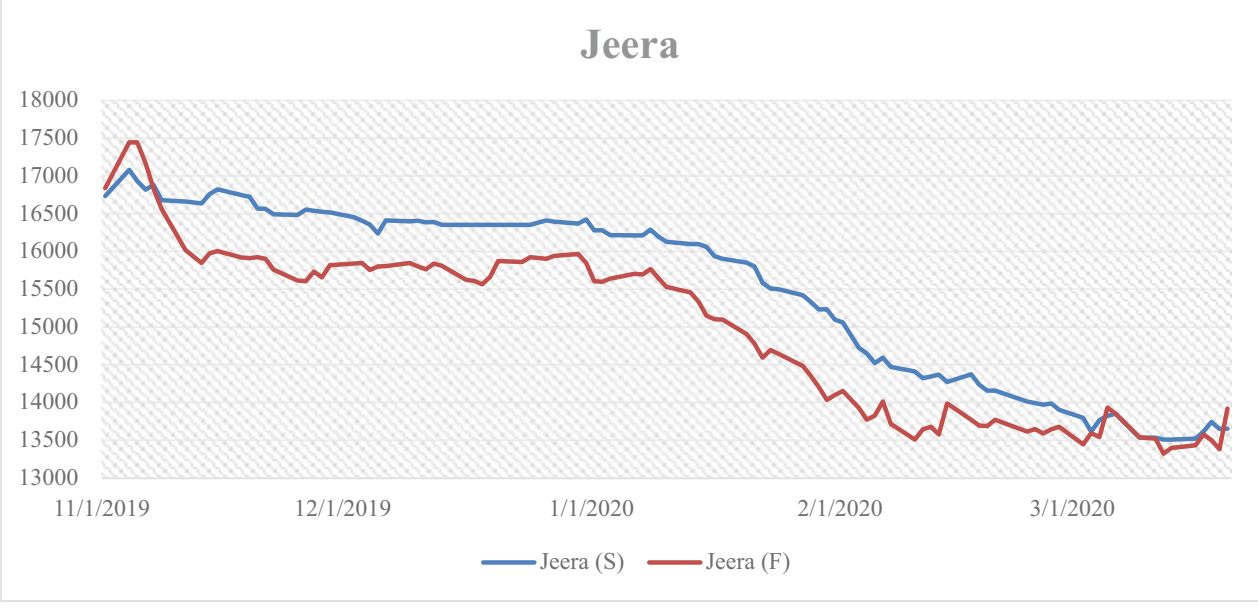

Figure 2: Spot and Future price movement of Jeera

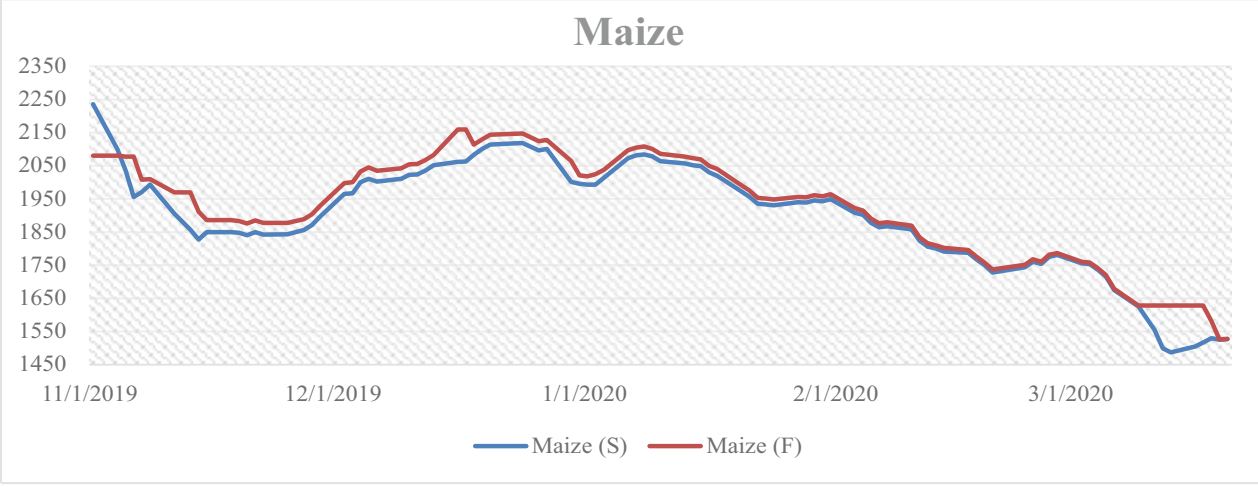

Figure 3: Spot and Future price movement of Maize

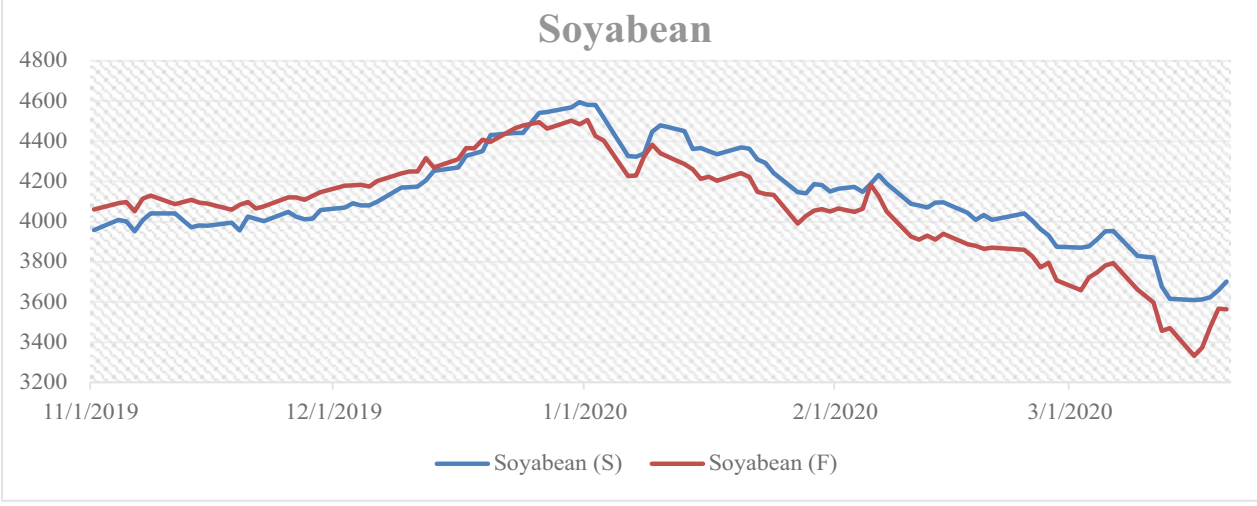

Figure 4: Spot and Future price movement of Soybean

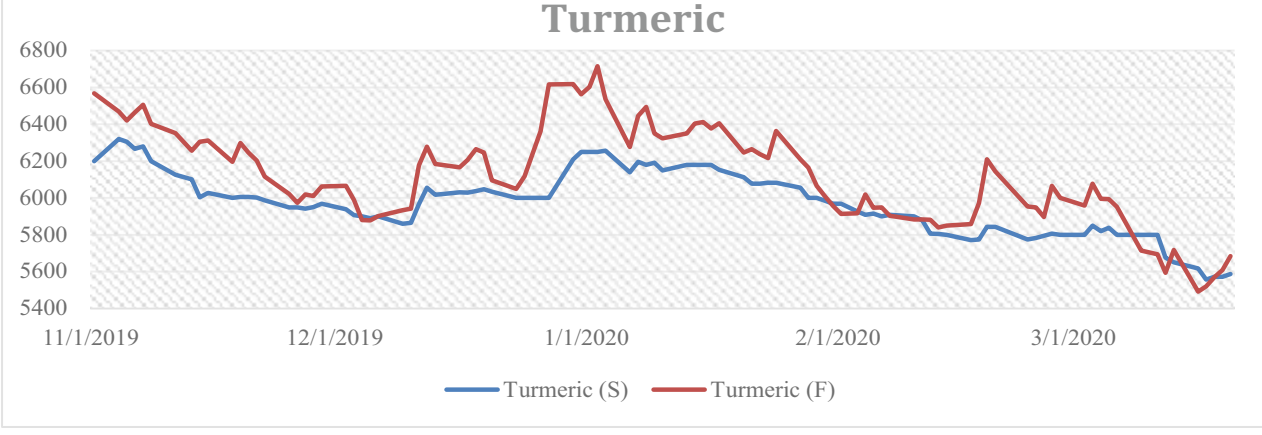

Figure 5: Spot and Future price movement of Turmeric

Descriptive Statistics

Table 1 represents descriptive statistics of 5 agricultural commodities where we observe their mean, standard deviation, skewness, kurtosis and Jarque-Bera with their probability. The mean spot prices of Chana, jeera and soybean are more than their mean future prices except maize and turmeric. Standard deviation which measures volatility shows that the future price of Chana, soybean and turmeric are more volatile compared to their spot price. Whereas in the case of jeera and maize, spot price is more volatile than future price. Jarque-Bera tests normality, here Chana, jeera, maize and soybean attained normality at 5% level except turmeric. Kurtosis of the normal distributed is 3 for maize spot and soybean futures whereas all other commodities it is below 3. Finally, skewness i.e. asymmetry of the distribution of the series is negative for all the commodities.

TABLE 1:

Commodity	Market	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Chana	Spot	4227.648	176.6878	-0.289922	1.579502	9.612301	0.008179
	Future	4226.418	223.4128	-0.180013	1.390369	11.108830	0.003870
Jeera	Spot	15508.320	1148.9080	-0.524803	1.668552	11.737230	0.002827
	Future	14969.130	1102.5700	0.018844	1.841183	5.489133	0.064276
Maize	Spot	1897.394	164.7944	-0.753862	3.134656	9.356405	0.009296
	Future	1926.133	158.6070	-0.625944	2.589606	7.087232	0.028909
Soybean	Spot	4125.520	233.1859	-0.038373	2.775409	0.230019	0.891358
	Future	4069.510	267.3411	-0.701461	3.181272	8.170946	0.016815
Turmeric	Spot	5972.319	176.5320	-0.198929	2.675792	0.798774	0.584043
	Future	6119.980	266.4603	-0.078248	2.586325	1.075560	0.670731

* 5% level significant
Sources: Calculated by using EViews 7

Table 1: Descriptive Statistics of different Agricultural Commodities

Unit Root Test

To examine the co-integration of spot and future prices of selected commodity series, it's necessary to first examine the stationarity in each series. This can be done by Unit root properties in each commodity series. Here, we use the Augmented Dickey-Fuller (ADF) test to examine whether the sample commodity series are stationary. It used with intercept, with intercept and trend, and without intercept and trend. Table 2 represents the ADF test result for spot and future prices of selected commodities. Panel A shows the results of unit root test in level series, where null hypothesis is accepted i.e. there is unit root. Means series are non-stationary. Panel B shows the results of unit root test in first difference series, where all series become stationary after first difference i.e. I (1).

TABLE 2:

		ADF Test		
		Intercept	**Intercept and Trend**	**No Intercept and Trend**
Panel A: Level				
Chana	Spot	0.7299	0.6098	0.2842
	Future	0.6574	0.6323	0.1085
Jeera	Spot	0.987	0.615	0.0012
	Future	0.5688	0.6957	0.0597
Maize	Spot	0.9265	0.8984	0.2031
	Future	0.9783	0.9662	0.0952
Soybean	Spot	0.8514	0.9387	0.4703
	Future	0.9503	0.8047	0.3042
Turmeric	Spot	0.8715	0.8777	0.1372
	Future	0.34	0.4276	0.2882
Panel B: First-difference				
Chana	Spot	0.0000	0.0000	0.0000
	Future	0.0001	0.0000	0.0000
Jeera	Spot	0.0001	0.0000	0.0000
	Future	0.0000	0.0000	0.0000
Maize	Spot	0.0000	0.0000	0.0000
	Future	0.0000	0.0000	0.0000
Soybean	Spot	0.0000	0.0000	0.0000
	Future	0.0000	0.0000	0.0000
Turmeric	Spot	0.0000	0.0000	0.0000
	Future	0.0000	0.0000	0.0000

* 5% level significant
Sources: Calculated by using EViews 7

Table 2: Unit root test results

Johansen Co-integration Test

After testing the precondition of non-stationary time series (i.e. the series were stationary at their first difference), Johansen co-integration test has been carried out to determine the existence of a long-run relationship between spot and future price of the selected commodities. Johansen co-integration test results seen in the Table 3, there is evidence of single cointegrating vectors at 5% level of significance according to the Trace statistics and Max-Eigen statistics i.e. between (a) Chana spot and future price, (b) Jeera spot and future price, (c) Maize spot and future price and (d) Turmeric spot and future price whereas there is no co-integration between spot and future price's soybean.It indicates that the H0 of zero can be rejected using the 95% critical value. This means that all the selected commodities spot and future price are co-integrated with 1 co-integrating vector except soybean.

TABLE 3:

Commodity	H0: vector (r)	Trace Statistics	p value	Max-Eigen Statistics	p value
Chana	r = 0	16.97200	0.0298	14.92505	0.0393
	r ≤ 1	2.046941	0.1525	2.046941	0.1525
Jeera	r = 0	18.20133	0.0191	18.14249	0.0116
	r ≤ 1	0.058837	0.8083	0.058837	0.8083
Maize	r = 0	27.58391	0.0005	27.36196	0.0003
	r ≤ 1	0.221951	0.6376	0.221951	0.6376
Soybean	r = 0	9.694654	0.3050	7.526450	0.4289
	r ≤ 1	2.168204	0.1409	2.168204	0.1409
Turmeric	r = 0	26.45352	0.0008	25.11441	0.0007
	r ≤ 1	1.339110	0.2472	1.339110	0.2472

* 5% level significant
Sources: Calculated by using EViews 7

Table 3: Johansen co-integration test results

Vector Error Correction Model (VECM)

After co-integration test, we use Vector error correction model (VECM) to identify the short-term co-integration relationship. Table 4 presents the VECM results where each commodity has two regression equation i.e. spot equation (ΔS) and future equation (ΔF) with their respective coefficients of cointegration equation (i.e. error correction term), lagged spot and future and constant.

Error correction term (ECT) is negative and significant at 5% level of significance in the spot equation (ΔS) for all selected commodities, indicates that future price has long-run causality on spot price. Only Jeera shows the joint role of spot and futures market for price discovery in the long run because ECT is significant in both spot (ΔS) and future (ΔF) equation.In spot equation (ΔS) of jeera, maize and soybean indicates that all the lagged future prices jointly influence the spot prices. This implies that future price has short run causality on spot price whereas in Chana and turmeric spot equation there is no jointly influence of lagged future price on spot prices. In future equation (ΔF) of all selected commodities has not any short run causality.

The results of VECM evidence, prima facie, is in line with traditional thinking, that 'informed' investors trade in futures (derivatives) segment as they offer leverage benefits and trades of informed investors cause permanent shifts in prices and hence more price discovery in the futures market. The change in the past lag values of spot and futures prices seems to have an impact on current and futures price change, which is the sign of market inefficiency.

TABLE 4:

Commodity	Regression Eq.	Coint. Eq. (ECT)	$\Delta SPOT_{t-1}$	$\Delta SPOT_{t-2}$	ΔFUT_{t-1}	ΔFUT_{t-2}	C
Chana	ΔS	-0.339664	0.067119	0.129472	-0.084859	-0.013753	-3.776076
		0.0006	0.6289	0.3696	0.4896	0.9199	0.2870
	ΔF	0.168367	0.292322	0.089355	-0.508674	0.046686	-6.758390
		0.0905	0.1212	0.6458	0.0027	0.8003	0.1590
Jeera	ΔS	-0.049259	-0.092641	0.046864	0.178439	-0.174281	-34.88048
		0.0150	0.3655	0.6402	0.0030	0.0029	0.0003
	ΔF	-0.171419	0.323987	0.278689	0.040891	-0.111358	-18.80561
		0.0008	0.1007	0.1493	0.7164	0.3099	0.2935
Maize	ΔS	-0.222864	0.489517	0.043398	-0.249546	0.346741	-1.696289
		0.0112	0.0000	0.6722	0.0416	0.0046	0.4688
	ΔF	-0.143192	0.196760	-0.023750	0.157597	0.147958	-3.079659
		0.1120	0.0987	0.8236	0.2121	0.2354	0.2070
Soybean	ΔS	-0.096926	-0.205932	-0.300365	0.411686	0.273944	-1.006986
		0.0121	0.1243	0.0144	0.0004	0.0225	0.8144
	ΔF	0.068353	0.203181	-0.093388	-0.056050	-0.020811	-5.637026
		0.2115	0.2473	0.5564	0.7048	0.8935	0.3187
Turmeric	ΔS	-0.198071	-0.066272	0.020816	0.073980	-0.020630	-7.474629
		0.0051	0.5543	0.8310	0.1722	0.6858	0.0694
	ΔF	-0.202088	-0.137064	0.194058	0.205803	-0.096269	-6.690602
		0.1165	0.6347	0.4403	0.1406	0.4639	0.5246

* 5% level significant
Sources: Calculated by using EViews 7

Table 4: VECM Results

Conclusion

The study investigated both the efficiency and causal relationship of agricultural commodities market. By using sophisticated statistical method to analyze time series, examines the market which indicate the presence of informational inefficiency in Indian commodity futures market which contribute to short-term biases in prices. The statistically significant value of past prices of spot and futures confirm the short-term inefficiency. In an emerging Indian economy, it is quite obvious to have initial birth pangs for a nascent futures market. The significant value of ECT of futures prices suggests that commodity futures are the most important indicator of commodity price movements.

Bibliography

- MSV. Prasad, G. Chaitanya Eswara Naidu, B. Sandya Sri (2019)," Assessing Investors' Knowledge about Commodity Trading in India", International Journal of Innovative Technology and Exploring Engineering (IJITEE).
- Shashi Gupta, Himanshu Choudhary, D. R. Agarwal (2018)," An Empirical Analysis of Market Efficiency and Price Discovery in Indian Commodity Market", Global Business Review.
- Hariharan R & Dr. B.A. Karunakara Reddy (2018), "a study on Indian commodity market with special reference to commodity exchange", International journal of research Science& Management.
- Raghavendra RH, Velmurugan PS and Saravanan A (2016), "Relationship between Spot and Futures Markets of Selected Agricultural Commodities in India: An Efficiency and Causation Analysis", Journal of Businessand Financial Affairs.
- Dr Shree Bhagwat, Angad Singh Maravi (2016), "A Study of Commodity Market V/S Multi Commodity Exchange of India Limited (MCX)", International Journal of Research in Management, Economics and Commerce.
- Dr P. Chellasamy, Anu. K.M (2015), "An empirical study on commodity derivatives market in India", EPRA International Journal of Economic and Business Review.
- S. Sathya, (2015), "A Comparative Study on Equity, Commodity, Currency Derivatives in India - Evidence from Future Market with special reference to BSE Ltd, Mumbai", International Journal of scientific research and management (IJSRM).
- Archana Singh, Narinder Pal Singh (2014), "commodity futures market efficiency and related Issues: a review of existing literature", Asian Journal of Business and Economics.
- Takeshi INOUE and Shigeyuki HAMORI, (2012), "Market Efficiency of Commodity Futures in India", Institute of Developing Economics.
- Lucia Baldi, Massimo Peri, Daniela Vandone, (2011), Spot and Future Pricesof Agricultural Commodities: Fundamentals and Speculation", Department of Science Economic and Statistic.