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Market Efficiency of Agricultural Commodity Futures Market in India

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Abstract:
In India, farmer producers not only face yield risk because of fluctuating monsoon conditions, but also are exposed to high level of price risk especially for agricultural commodities. Direct market intervention by the Government is reduced and to a great extent the prices for commodities are determined by market on the influence of demand and supply of commodities in the market. Such a kind of market controlled mechanism has exposed agricultural commodities to not only price risk but also to market risk as well. Commodity futures as a derivative instrument plays a crucial role in price risk management. In this study, price discovery relationship of two commodities such as cotton and cardamom are studied. Daily data for spot prices and futures prices is collected from the prominent exchanges in India, including MCX and NCDEX for a period from April 2013 to March 2019. For Futures prices near month contract was taken for study. ADF was applied to test the stationarity of the data, results reveal all the data were stationary at first order level. Next to gauge the long run relationship between spot prices and futures prices johansencointegration test was used and to study the short run dynamics VEC models were applied. Test results indicate the existence of bidirectional causality and futures markets are found to be more efficient in discounting new information.

Keywords: *Commodity Market, Futures Prices, Spot Prices, Market Efficiency.*

I. INTRODUCTION

Commodities are identified as a distinct class of assets from the perspective of making investments. Amongst various tradable assets classes, commodity prices generally tend to be more volatile compared to equities or currencies. India being an agrarian economy and two thirds of population directly or indirectly depend upon agriculture for their livelihood. Almost all the agricultural commodities depend upon monsoon and Indian economy is called as a *Gamble of Monsoon*. In such a dynamic environment, derivative products in terms of forwards, futures, options contracts act as boom to farmer producers and other members in the value chain. Bombay cotton association established during 1875 was the first association to be recognised as an organised futures exchange and it was governed by Forwards Market Commission as a governing body in India. Because of volatility of prices traded in commodities market, regulators had banned trading

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in commodities market in 1996. Again during 2002 trading in commodity market was permitted after setting of multi commodity exchange (MCX). Due to boom in commodity prices of wheat and rice during 2007, they were again delisted from trading in exchanges. During 2007, appointment of AbhijitSen experts' committee by Government of India to identify those commodities in futures trading which may influence the level of inflation in essential commodities and proper measures to shield them from futures trading was done. Garbade and Silber (1983) evidences that Price Discovery and Risk Management are the important functions performed by futures markets, in turn they try to transmit price information to members in the value chain. All the members in the value chain either producers, traders, hedgers, speculators or arbitrageurs are keen to find out about the price discovery mechanism that takes place among futures and spot prices by which the market attempts to reach equilibrium price. Predominantly Price discovery studies have focussed in equity markets in developed economies. Studies for price discovery process in commodity market in emerging economies is very limited to a large extent. The objective of this paper is to trace about the price discovery among spot prices and futures prices of Cotton and Cardamom as commodities by applying co integration techniques.

In the present article, Section II discusses about the past literature covering the price discovery in commodity market. Section III discusses in detail about the sources of data and research methodology followed. Section IV discusses about the results of price discovery mechanism and Section V concludes the findings.

II. LITERATURE REVIEW

(McKenzie & Holt, 2002) tested for four agricultural commodities including cattle's, corn, hogs and soybean in futures market by using VECM technique, results revealed was each agricultural market is neutral during long run phase. (Wang & Ke, 2005) studied about price discovery of wheat and soybean in futures market and revealed the existence of long run price relationship for soybean between spot and futures prices, but for wheat the market was found to be inefficient due to lot of influence by government and speculation. (Moosa, 1999)studied about the lead and lag link in the price discovery process through linear and nonlinear models and found that both the markets react to information flow efficiently. (Nicolau & Palomba, 2015) studied about crude oil, natural gas, gold by applying various VAR models found there was no significant influence in price discovery between markets and each market exhibited their own peculiarities. (Joseph, Sisodia, & Tiwari, 2014) studied about equilibrium relationship in the long run by applying ordinary least squares and found there existed significant influence of price actions in one market is reflected on the other market as well. (Dangi, 2014) studied about the price discovery process in silver and found that futures prices had contributed significantly than spot prices in the price discovery. (Gupta et al., 2018) Studied about selected agricultural commodities and the results revealed except for turmeric as commodity, for all other commodities taken for study, the market was not competitive enough in price discovery process. (Kumar, 2014) studied the price detection in silver found that the influence of futures market prices on spot prices of the commodity but the other way round there was no influence. (Kaufmann & Ullman, 2009) examined about the movement of oil prices in different continents and the results state the existence of innovation to price discovery first appear in far month contracts of futures prices. (Arora & Kumar, 2013) studied about the price discovery in copper and aluminium by using vector error correction model and found that price series is cointegrated in first order level and exhibited the absence of short run relationship among the commodities. (Iyer & Pillai, 2010) examined the amount of coincidence of information shared between futures market and spot market by applying vector auto regression and found the flow of information was very quick during the expiration of

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futures contract. (Peri, Baldi, & Vandone, 2013) studied about the price discovery among spot market prices and futures market prices of corn and soybean commodities. Cointegration test results indicate the existence of multiple breaks of price movements during sub periods of the study.

III. METHODOLOGY

The present study is executed with spot market prices and futures market prices pertaining to one month for both Cardamom and Cotton. Data for agricultural commodities are taken from MCX and NCDEX. Market share is the prime reason for choosing the exchanges. Location for choosing spot prices in case of Cardamom is Vandanmedu, for Cotton it is Rajkot.

Table no: 1

Commodities	Futures Market	Data Period	Spot Market
Cotton	MCX	April 2013 to March 2019	Rajkot
Cardamom	NCDEX	April 2013 to March 2019	Vandanmedu

Rationale for using cotton and cardamom in studying the price discovery process is as follows, the total turnover of cotton and cardamom is increasing year on year. Greater trading volume indicates the high amount of liquidity in the market. Even though cotton as a crop is cultivated in more than 80 countries around the globe, India tops in production by obtaining 24%, followed by China and other countries. In the case of cardamom, it is identified as the queen of spices and one of the most highly priced and exotic species traded across the globe. India is one among the prominent producer of cardamom by contributing nearly 80 percent of total output. As exports of both cotton and cardamom are much higher, there prevails much higher vulnerability in prices when compared to prices in international market. Cardamom during the year 2018 witnessed 24% in price volatility. Thus there is a need for futures contract to hedge the price risk. Futures trading in cotton and cardamom is available in MCX, NCDEX and other exchanges as well. Value of the commodity and trading volume perform a crucial part in the process of price discovery. From this perspective we proceed for further analysis of cotton and cardamom prices.

Stationarity Test

First and foremost step is to convert the data to natural logarithm and the same data is then tested for the presence of stationarity by applying ADF test by applying the following equation,

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t=1} + \sum_{i=1}^{m} \alpha_i Y_{t=1} + \varepsilon_t$$

Based on the above equation, data taken for study was transformed into stationary by taking first difference by the following equation, if the data is found to be non-stationary at level form.

$$\Delta X_t = X_t = X_{t=1}$$

Cointegration

There are chances that the time series taken for study may depart in the short run, but due to the impact of arbitrage activity or the influence of macro-economic variables on the market, the association between the variables may turn out during long run. In common, time series data are found to be non-stationary at level form and mostly contains unit root. They are said to be cointegrated if the variables taken for study are non stationary at level form and they try to exhibit integration at the first order level. We use the following two equations for testing Co-integration by using Johansen's approach,

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1 - \hat{\lambda}_t) \quad \text{and}$$

$$\lambda_{max}(r, r+1) = -T. \ln(1 - \hat{\lambda}_{r+1})$$

r represents sum of Cointegrating vectors, at an assessed value of I[th] ordered eigen value from the Π matrix is $\lambda_{i.}$ higher value of λ_i makes (1- λi) higher and adverse, indicating that test statistic shall be greater with higher λ_i calculated with the help of λ_{trace}, λ_{max} indicating Value of λ trace = 0. Null hypothesis of λ_{max} indicates the sum of cointegrating vectors.

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Vector Error Correction Model

VECM is identified as a distinct case of VAR, predominantly trying to define the long run symmetry in the process of price discovery for the variables taken for study. The variables are likely to exhibit long run symmetry after passing through short run alterations. VECM is depicted as follows,

$$\Delta F_t = \alpha + \delta_{e_{t-1}} + \sum_{i=1}^{k} \beta_i \Delta F_{t-1} + \sum_{j=1}^{k} \gamma_i \Delta S_{t-1} + \nu_t$$

$$\Delta S_t = \acute{\alpha} + \delta_{\acute{e}_{t-1}} + \sum_{i=1}^{k} \acute{\beta}_i \Delta F_{t-1} + \sum_{j=1}^{k} \acute{\gamma}_i \Delta S_{t-1} + \acute{\nu}_t$$

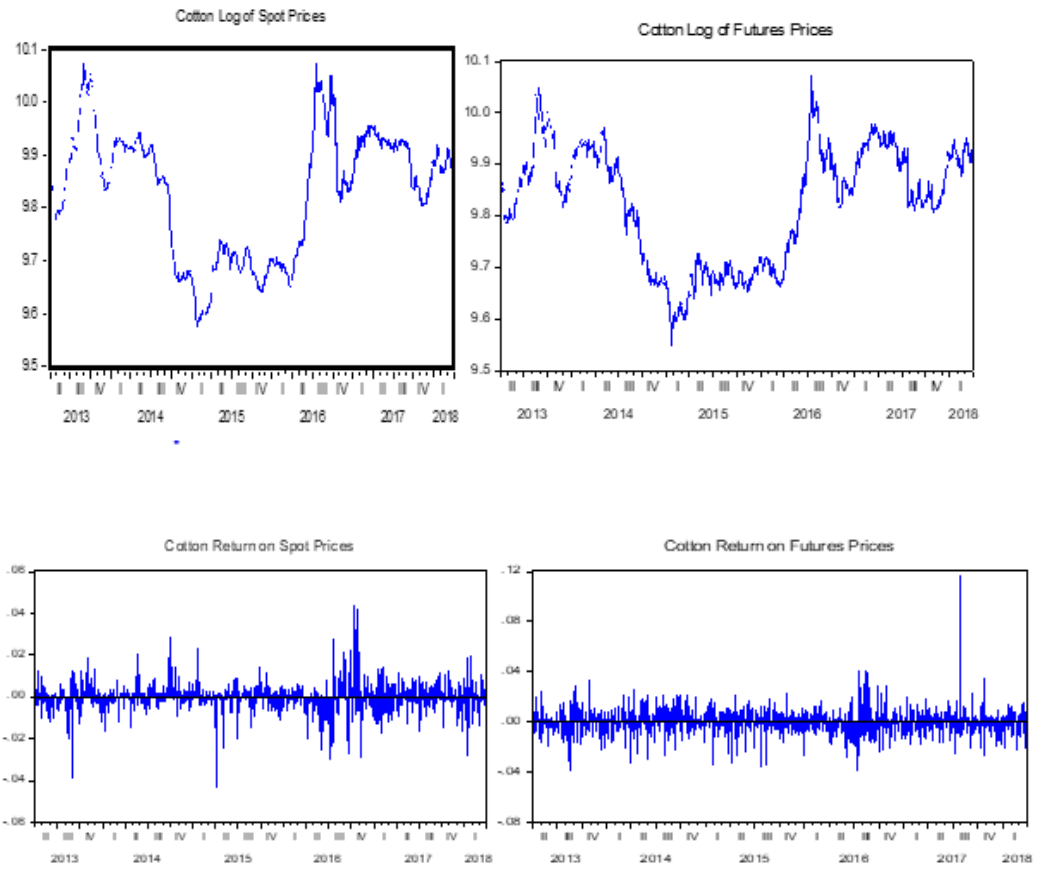
F refers futures prices and S refers spot prices, ν denotes white noise.

Lag Length

Schwartz Information Criterion is used to determine the lag length criterion. When applying SIC there is a possibility to increase the likelihood by adding parameters resulting in overfitting of the model.

Empirical results

Statistical properties of the data should be studied by applying basic statistics, following graph drawn shows the prices including future and spot of cardamom and cotton. The graph given below shows the absence of trend for cotton and cardamom indicating the time series is stationary. To examine other features of the time series taken for study descriptive statistics is studied.



Graphs about Cardamom

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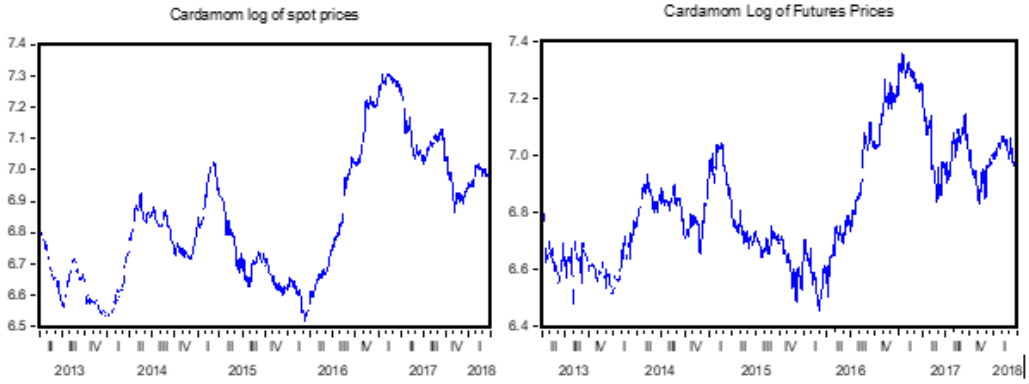

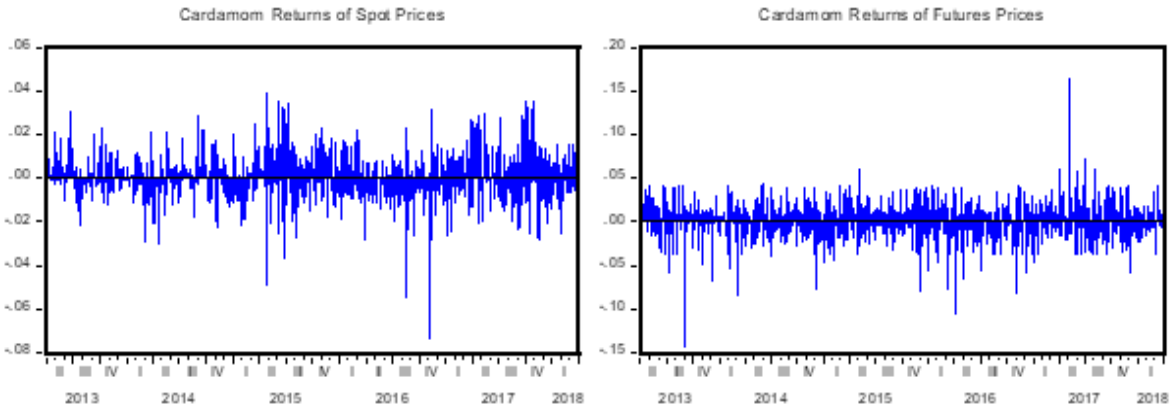

Table No: 1 Descriptive Statistics of Cardamom

	Cardamom				Cotton			
	Futures Prices	Spot Prices	Return of Futures Prices	Return of Spot Prices	Futures Prices	Spot Prices	Return of Futures Prices	Return of Spot Prices
Mean	6.836674	6.843682	0.000126	-3.09E-05	9.819339	9.825548	-7.35E-05	-6.30E-05
Median	6.809205	6.817502	0.000725	0.000000	9.843472	9.852194	0.000483	0.000000
Maximum	7.358449	7.305726	0.163158	0.039437	10.07112	10.07407	0.116207	0.043465
Minimum	6.452680	6.518262	-0.145406	-0.073950	9.546098	9.576371	-0.038975	-0.043402
Std. Dev.	0.207007	0.206974	0.020569	0.010228	0.113519	0.118593	0.010350	0.006709
Skewness	0.493847	0.496365	-0.290496	-0.334117	-0.256848	-0.235043	1.046218	-0.102928
Kurtosis	2.404856	2.255454	9.373933	7.415377	1.824099	1.922006	16.93215	10.66349
Jarque-Bera	68.03823	78.72548	2094.314	1017.878	84.25241	70.70850	10147.45	2999.797
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	8395.436	8397.197	0.154272	-0.037859	12058.15	12055.95	-0.090211	-0.077127
Sum Sq. Dev.	52.57936	52.51981	0.518685	0.128037	15.81174	17.24272	0.131332	0.055093
Observations	1228	1227	1227	1225	1228	1227	1227	1225

Descriptive statistics indicates that no series track normal distribution. Negative Skewness shows the series having high probability of earning negative returns. Cardamom witnesses most variation in prices as its indicated by standard deviation. Skewness indicates that it's positively skewed for cardamom prices and negatively skewed for cotton prices. Kurtosis value less than three indicating both the cotton and cardamom markets are shorter and thinner. Both skewness and kurtosis violate the assumption of normal distribution.

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Table No: 2 ADF test results

	Cotton			Cardamom		
Series	Levels	First Difference	Inference on Integration	Levels	First Difference	Inference on Integration
Futures Prices	-1.178	-36.676*	I(1)	-1.189	-34.678*	I(1)
Spot Prices	-1.578	-28.578*	I(1)	-1.997	-38.764*	I(1)
Return on Futures Prices	-0.834	-34.679*	I(1)	-0.245	-41.501*	I(1)
Return on Spot Prices	-2.126	-18.267*	I(1)	-1.458	-44.510*	I(1)

Null Hypothesis: series have a unit root

*Indicates significance at 1% level. Optimum lag length is determined by SIC for Augmented Dickey-Fuller Test.

ADF test results presented in table 2 reveal that the data are stationary at the first order level and are found to be integrated in the order I (1). As all the series are integrated of same order Johnsen'scointegration test can be applied and the same is displayed in table no: 3

Table No: 3 Johansen Cointegration Test

Commodities	Vector	Trace Test Statistics (λTrace)	Maximal Eigenvalue (λMax)	Trace Statistics at 5% Critical Value	Max. Eigen Value Statistics at 5% Critical Value	Remarks
Cotton	H_o: r=0	29.794	28.129	15.494	14.075	Cointegrated
	H_1: r≥1	1.4762	1.4762	3.841	3.841	
Cardamom	H_o: r=0	45.439	43.618	12.532	12.532	Cointegrated
	H_1: r≥1	1.4873	1.4873	3.762	3.762	

Johansen's cointegration test was applied to test the presence of long run relationship among the variables. Trace test and maximum Eigen value test ratios are applied to confirm the presence of long run relationship. In this Johansen cointegration test null hypothesis was rejected meaning to confirm the existence of long run cointegration among prices in futures market and spot market. Trace and Eigenvalue statistics disclose the presence of at least one cointegrating relationship interpreting both the series move together in the long run. Next step is to establish VECM between series.

Table No: 4 Vector Error Correction Model

	Cotton		Cardamom	
	Futures return	Spot return	Futures return	Spot return
Error correction term	-0.766001 (-11.1116)	0.429870 (10.6318)	-0.873829 (-15.0379)	0.275167 (9.01464)
Futures return(-1)	-0.125387 (-2.18557)*	-0.129970 (-3.86258)*	-0.046925 (-0.96244)*	-0.136118 (-5.31470)*
Futures return(-2)	-0.059256 (-1.58690)	-0.004233 (-0.19326)	0.012168 (0.35313)*	-0.066907 (-3.69632)*
Spot return (-1)	-0.614016 (-10.4918)*	-0.464329 (-13.5274)*	-0.812191 (-11.0167)*	-0.467267 (-12.0656)*
Spot return (-2)	-0.274776 (-5.65498)	-0.225123 (-7.89937)	-0.322511 (-5.45641)*	-0.238291 (-7.67468)*

*Significant at 5% level

Results from the above table reveal the presence of bi directional error correction indicating they are in imbalance in short run, so that prices try to adjust so as to establish the lost equilibrium. Results

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indicate the futures market possess more dominance over information quality that passes from futures market to spot market. Implying the chances of more information spill over happens from future market to spot market for both cotton and cardamom as such.

Table No: 5 Granger Causality test

Excluded	Cardamom			Cotton		
	Chi square	df	p	Chi square	df	p
Dependent Variable: SPOT RETURN FUTURES RETURN	123.6024	2	0.0000	110.6330	2	0.0000
Dependent Variable: FUTURES RETURN SPOT RETURN	28.37566	2	0.0000	32.47694	2	0.0000

2 Lags was chosen on the basis of wald test, indicating the existence of bidirectional causality inshort run. It also implies that two lag of futures return have an influence on spot return of cardamom and cotton.

IV. CONCLUSION

In the order of trying to avoid all the eggs in one basket, commodity markets with various instruments come as a rescue to the interest of investors, hedgers, arbitrageurs, speculators to hedge against risk. In this study time series data on Cotton and Cardamom that are traded in MCX, was analysed to find out the price discovery process among futures market and spot market. Period of the study spans from April 2013 to March 2018. Out of the two commodities selected for the study cotton is highly traded in MCX for the period under study. Results of Vector Error Correction Model indicates the presence of long run relationship between future and spot market and both the markets are efficient in discounting new information received.

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