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EFFEICENCY OF COTTTON FUTURES – EVIDENCE FROM COINTEGRATION, VECM ANALYSIS & CAUSALITY TEST

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ABSTRACT

Purpose- Globalisation has inevitably led to price volatility in the agricultural sector, which is the backbone of the Indian economy. Significant reduction of direct market intervention by the Government, and increased private sector participation has led to market uncertainty which consequently emphasizes the relevance of futures market. The research paper aims to empirically examine the efficiency of commodity derivative markets with specific reference to Cotton, as an individual agricultural commodity which is actively traded in the Multi Commodity Exchange (MCX).

Methodology-The price discovery process between the endogenous variables of spot and future prices of cotton, has been assessed and explored through a series of formal statistical tests, namely Augmented Dickey Fuller Test, Cointegration, Grangar Causality and Vector Error Correction. The hypothesis is that futures markets is efficient in price discovery and sends price signals to the spot market and this is analyzed through EVIEWS econometric software package. The study makes use of secondary data collected by the author from MCX website from 2015 to 2019.

Findings – The tabulated results is indicative of the existence of the cointegration & unidirectional relationship fron future market to spot market of cotton.

Practical Implications – The inferences derived from the study shall be useful for all the stakeholders who are active in the agricultural commodity markets.

Originality- This is one such study which has been made on an individual commodity level based on secondary data for a period of 5 years.

Keywords: Market efficiency, Cointegration, Commodity Derivative Market, Spot Price, Future Price

I. INTRODUCTION

Indian economy has witnessed a slow yet steady transition in the agricultural sector, with the introduction of the National Agricultural Strategy, technological revolution and direct state intervention policy in the form of price support activities like the procurement prices, minimum support prices, subsidies for purchasing seeds, fertilizers, pesticides, etc(Arora,2013). This need

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based action propaganda was essential to feed the burgeoning population growth, thereby addressing food crisis and food insecurity in the economy. India's stride towards a self reliant food economy, has happened over the decades (Chand,2019). Infact, in the present context the vision for New India that is "Sabka Saath,Sab ka Vikas", is very much dependent on the transformation of agricultural sector, which provides employment to approximately 44.2 percent of the workforce(NSO,2019).

Even though the government regulations still influence the production, distribution and consumption of many agricultural commodities, yet at the same time with economic liberalization and to this effect the policy on Agreement on Agriculture with the WTO, there has been a significant policy shift from reduced direct support to agriculture to market-oriented approach. This brought into light the importance of commodity economy and with the constitution of the Khusro Committee (1980) followed by Kabra Committee (1993), futures' trading was reintroduced in a number of agro commodities. Here it is important to mention that India has had historical background in trading of commodities futures from the 19th century and the first organized trading was that of cotton. Then various other commodities were allowed to be traded over a period of time in future exchanges. The commodity derivative market in India was in rudimentary form then but it experienced tremendous growth when the Government lifted prohibition and allowed futures trading in all commodities in 2003 and granted recognition to NCDEX (Nation Commodity and Derivatives Exchange),National Multi Commodity Exchange Of India(NMCEI) and MCX(Multi Commodity Exchange Of India(MCX) as national multi commodity exchanges. However, currently there are twenty-one regional level and four national level commodity exchanges in India, which trade in agricultural commodities. Even though there has been a rise in the volume of commodity futures trade ever since it has been launched, yet in recent times it has been and it is being widely discussed regarding the functioning of futures market in terms of price discovery and price risk management. With frequent fluctuations in domestic and international prices, leading to agricultural price instability, many small and marginal farmers often resort to distressed sale of commodities when they fail to get remunerative prices .This has remained a major concern for farmers across the country and is one of the plausible reasons for agrarian crisis. Hence, it becomes essential to explore the market efficiency of commodity futures markets, particularly in regard to agri commodities which shall help the producers and consumers to optimize profits.

The present paper intends to examine the market efficient hypothesis in Indian economy with regard to individual agricultural commodity i.e Cotton.

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The paper flows in the following path. The next discussion reviews the previous research studies and findings. The third section discusses the scheme of data and methodology adopted for the current research. The next section elaborates on the empirical findings and the last section concludes on the results and discussion.

II. LITERATURE REVIEW

There is a considerable amount of empirical and theoretical literature on the performance and efficiency of Indian commodity market (Sahadevan,2002;Kabra,2007:Easwaran and Ramasundaram,2008 ;Inani,2017).Most of the studies have been made in the context of non-agricultural commodities in comparison to the agri commodities traded in the trading exchanges. Volatility and uncertainty in prices is one such theme which has been extensively discussed by the researchers. The fact cannot be ignored that the welfare of the farmers can be negatively affected due to price fluctuations which is very critical to agricultural performance (World Bank,1997).Futures market is one such alternative option which can solve the issue of price uncertainty as it performs the dual function of price discovery and price risk management (Garbarde and Silber,1983). It is a medium of managing risk for the traders who can fix prices even before the transactions are actually performed for the physical commodities (Aulton, Ennew and Rayne, 1997). However, an empirical analysis on market efficiency is much necessary which can add value to the functionality of the futures market (Shanmugam and Garg, 2009; Gupta, Choudhary and Agarwal,2018). There have been numerous studies to assess the cause and effect relationship between the spot and future prices of commodities but the paper focuses primarily on the agricultural commodities.

The recent studies for agricultural commodities in Indian commodity derivative market reveal that futures market is efficient and performs its price discovery function very well(Singh et all,2009;Elumalai et al.2009;Sehgal et al 2012).In one such specific study, (Ali and Gupta, 2011)examined the granger causality and cointegration relationship between spot and futures prices of 12 agricultural commodities; and they concluded cointegration in most of the cases except for rice and wheat. The outcome of Granger Causality test was that future markets led the spot prices for sugar, chick pea, castor seed, and soybean as compared to pepper, maize and lentil. In a similar study (Mukherjee ,2011) has made an empirical study to analyse the impact of futures trading in 9 major agricultural commodities(Spices, oilseeds, cereals, pulses and others) over a period of 7 years from 2004 to 2010 and found that futures market have a comparative advantageous position in disseminating information and thereby strongly suggested in favour of strengthening commodity futures market. He used Multiple Regression Model, Vector Auto Regression (VAR) model and Generalized Autoregressive Conditional Heteroscedasticity(GARCH) Model, ADF

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Test and other Descriptive Measures, for his research study. In addition to this, a study has been made in Chinese agricultural futures market as well.(Wang and Bingfanke ,2005) in their research study have tried to examine the futures market efficiency of agricultural commodities using Johansen Cointegration Test and the results suggested a long -term equilibrium relationship between the futures price and spot price for Soya beans and weak form of efficiency in short term. The futures market for wheat was found to be inefficient which may have been due to over speculation and government intervention. In this regard, Sahadevan (2002) is reflective of the revival policy options and growth constraints for Indian agricultural commodity markets. He is suggestive of the fact that the major hurdle in the development of the agricultural commodities market is the governmental intervention in influencing the prices of many commodities. Hence, the need assessment warrants the government to be focused and pragmatic in its approach so that the Indian agricultural futures market for commodities like rice and wheat can reap the advantages of price risk management.

Specific mention is also given to studies made on individual agricultural commodity in India. (Dey and Maitra,2012),in their study have used Granger Causality test, Cointegration and Vector Error Correction Model, to examine the price discovery efficiency of " pepper "futures market. The results indicated unidirectional causal relationship between spot and future prices. In another such study (Samal,2017) has used Vector Autoregression (VAR) model and Granger Causality tests, in an effort to analyse the price discovery efficiency of Cotton futures market in India. The results of this particular study indicated that futures market cannot discover spot prices though the VAR model was suggestive of a dominant lag value of futures over the spot prices of cotton.

Likewise, there are a handful of studies on Cotton futures efficiency in India both internationally and nationally. Hence, the paper is an attempt to add to the existing body of literature on a detailed time frame analysis on Cotton futures and this paper shall supplement the results concluded by (Samal,2017) .

III. OBJECTIVE

To examine the market efficiency of cotton futures trading in Indian economy

IV. HYPOTHESIS

H_0 : Cotton Futures Market is not efficient.

H_1 : Cotton Futures Market is efficient.

In other words, the cotton futures market is efficient in price discovery for hedging purposes.

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V. DATA & METHODOLOGY

Data

For the purpose of study one of the leading agri commodity derivative market of India, Multi-Commodity Exchange of India (MCX) was chosen and in that concerned exchange one of the highest trading agri commodity, Cotton was chosen. Daily closing Spot prices (SP) and Future prices (FP) relating to the contracts for five years starting from 2015 to 2019 were taken. Details of observations stated in Table 1. Total number of observations for the study was 1683.

Year	2015	2016	2017	2018	2019
Observations	292	345	351	351	344

Methodology

Indian commodity markets are often criticized for influencing spot markets in an adverse way for its manipulative and speculative activities. Financial Markets are considered to be efficient if the price of the security reflects all the information available in the public domain which means future price are unbiased indicators of the future spot price. So to examine the market efficiency of the futures market there shall be long term convergence between future and spot prices. Following methods are adopted for proving the hypothesis:

First, the time series data tasted for the stationarity using Augmented Dickyfuller method (ADF). Because regressing non stationary time series produces spurious result.

Second, co-integration between variables is a necessary condition for market efficiency. If the time series are integrated at first order, then Johansen co-integration test can be performed to find out the co-integration. Johansen co-integration test is sensitivity towards lag length. So unrestricted VAR was performed to determine the lag length.

Third, Vector Error Correction model (VECM) done to determine short rum association between future and spot prices. If the time series are co-integrated, then Vector Error Correction Model (VECM) allows existence of Error Correction Term (ECT), which will indicate the long rum association. Existence of ECT won't allow the variable to drift apart in the long run. Also by observing the significance of the coefficients of lagged variables the short run association can be inferred.

Fourth, to validate results of VECM, the Granger Causality test performed to satisfy the causal relation of future and spot price and direction of the information flow between spot and futures market.

VI. EMPIRICAL ANALYSIS

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Table 1 displays the results ADF test on the time series of spot and future prices from 2015 to 2019. It can be observed that 't' statistics in absolute terms at level is lower than the critical 't' at 5% significance. So the Null hypothesis that time series having unit root at level cannot be rejected. However at first difference the 't' statistics in absolute terms at level is higher than the critical 't' at 5% significance. So the Null hypothesis that time series having unit root at level can be rejected at the first difference. Hence the price series of futures and spot are stationary at first difference i.e I(1).

Table 1 : ADF Unit Root Test for Future and Spot Price

Year	No of Observations	't' Statistics (Levels)		't' Statistics (1st Difference)		Critical 't' at 5%	Lag Length	Inference
		Spot	Futures	Spot	Futures			
2015	292	-1.42	-2.53	-13.04	-17.31	-2.87	2	I (1)
2016	345	-1.07	-1.21	-12.27	-18.52	-2.87	3	I (1)
2017	351	-2.36	-2.15	-13.79	-18.34	-2.87	3	I (1)
2018	351	-0.89	-1.7	-15.56	-20.16	-2.87	2	I (1)
2019	344	-1.002	-1.43	-15.6358	-18.6	-2.88	2	I (1)

Source: Authors' own calculation

Prior to cointegration test optimal lag was selected by conducting Unrestricted VAR. The lag length suggested under various criteria was displayed in Table 2. The lag length suggested under maximum criteria was taken as optimal lag length. Results of Johansen cointegration test is in Table 3. For all the years from 2015 to 2019, null hypothesis (r=0) is rejected at 5% significance; however null hypothesis $r \leq 1$ is accepted for all the years. Therefore there exists at least one cointegrating vector for spot and future price for all the years. Now, the empirical evidence is clearly evident of cointegrating relationship between cotton spot price and commodity future price. Hence there is a price discovering mechanism existing in spot and futures market.

Results of VECM displayed in table 4. It can be observed that the ECT for spot equation is greater than the future equation in all the cases. ECT is known as speed of adjustment and shows long rum association and the rate at which prices adjusted towards equilibrium. As the coefficients of ECT of spot prices are greater than that of the future prices, spot prices adjust at a greater degree towards the equilibrium. This proves that the future prices acts as leader which the spot price follow. So this means that future prices are reflecting all available information. Analysis of lag values of future and spot price to determine the short run association also reveals that in all the years lag 1 value of spot is significant, indicating adjustment of spot prices to the future price in the short run.

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Table 2: Selection of Lag Length

Contract	Lag	Log-Likelihood	Likelihood Ratio	Final Prediction Error	Akaike's Information crtiterion	Hannan & Quinn Information Criterion	Schwarz's Bayesian Information Criterion
2015	0	-4252.659	NA	3.53E+10	29.96239	29.98808	29.97269
	1	-3470.285	1548.219	1.47E+08	24.48088	24.55797	24.51179
	2	-3455.354	29.33654*	1.36e+08*	24.40390*	24.53239*	24.45541*
2016	0	-5679.391	NA	1.51E+12	33.71745	33.74012	33.72649
	1	-4452.829	2431.286	1.06E+09	26.46189	26.5299	26.489
	2	-4410.755	82.8994	8.50E+08	26.23593	26.34929*	26.28111*
	3	-4405.423	10.44106*	8.43e+08*	26.22803*	26.38673	26.29129
2017	0	-5706.463	NA	9.79E+11	33.2855	33.30788	33.29441
	1	-4538.455	2315.584	1.10E+09	26.49828	26.56541	26.52502
	2	-4520.282	35.81647	1.02E+09	26.41564	26.52752*	26.46021*
	3	-4514.19	11.93455*	1.00e+09*	26.40344*	26.56008	26.46584
2018	0	-5782.001	NA	1.52E+12	33.72596	33.74833	33.73487
	1	-4467.83	2605.355	7.32E+08	26.08647	26.1536	26.11321
	2	-4441.423	52.04476*	6.42e+08*	25.95582*	26.06770*	26.00038*
2019	0	-5313.208	NA	1.89E+11	31.63814	31.66086	31.6472
	1	-4300.844	2006.65	4.66E+08	25.63598	25.70414	25.66315
	2	-4274.306	52.28586	4.08e+08*	25.50182*	25.61543*	25.54711*

Source: Authors' own calculation

**indicates selection of optimal lag under various criteria*

Table 3 : Result of Johansen Cointegration Test

Year	Hypothesis		t-statistics	
	Null Hypothesis	Alternative Hypothesis	λ trace	λ max
2015	r = 0	r ≥ 1	26.75237*	24.54283*
	r ≤ 1	r ≥ 2	2.209536	2.209536
2016	r = 0	r ≥ 1	16.45038*	14.40658*
	r ≤ 1	r ≥ 2	2.043803	2.043803
2017	r = 0	r ≥ 1	17.99089*	11.41762
	r ≤ 1	r ≥ 2	6.573274*	6.573274
2018	r = 0	r ≥ 1	17.17236*	14.69905*
	r ≤ 1	r ≥ 2	2.473308	2.473308
2019	r = 0	r ≥ 1	21.11810*	20.24124*
	r ≤ 1	r ≥ 2	0.876858	0.876858

Source: Authors' own calculation

**indicates significance at 5% level*

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Table 4 : Results of VECM Model

	2015		2016		2017		2018		2019	
	F_t	S_t	F_t	S_t	F_t	S_t	F_t	S_t	F_t	S_t
ECT	**-0.09***	**0.04***	0.02	**0.06***	0.01	**0.02***	-0.01	**0.03***	**-0.09***	**0.04***
F_{t-1}	0.03	**0.13***	8.18E-05	**0.25***	1.67E-02	**0.12***	-8.16E-02	**0.178***	0.03	**0.23***
F_{t-2}			-0.001	0.04	-0.03	-0.07				
S_{t-1}	0.03	0.14*	-0.06	0.13*	-0.07	0.22*	0.05	0.05	0.04	0.04
S_{t-2}			0.09	0.15*	0.13	0.15*				
Const.	1.43	1.33	9.51	3.85	-1.25	-4.95	8.84	-0.09	-12.66	-9.47

Source: Authors' own calculation
**indicates significance at 5% level*

The outcome of VECM model was examined through Granger Causality test and summerised in table 5. The null hypothesis Spot price does not granger cause future price and vice versa was tasted. The F-statistic and corresponding probability value can be observed. From 2015 to 2018, it clearly demonstrates the future price granger causing the spot price (F →S) at 5% significance. In 2019, there is a bidirectional causal effect (F ←→ S) indicating information flow happening from both future and spot market to the other.

Table 5 : Granger Causality Test Results for cotton

Year	Hypothesis	F-statistics	Probability	Direction	Relation
2015	S/-->F	1.05817	0.3484	Unidirectional	F →S
	F/-->S	17.447	7.00E-08*		
2016	S/-->F	0.85484	0.4648	Unidirectional	F →S
	F/-->S	24.8047	2.00E-14*		
2017	S/-->F	1.92513	0.1252	Unidirectional	F →S
	F/-->S	6.69439	0.0002*		
2018	S/-->F	0.1565	0.8552	Unidirectional	F →S
	F/-->S	22.979	4.00E-10*		
2019	S/-->F	3.40053	0.0345*	Bidirectional	F ←→ S
	F/-->S	31.3808	3.00E-13*		

Source: Authors' own calculation
**indicates significance at 5% level*
Note - S/-->F indicates spot does not granger cause future and F/-->S indicates future does not granger cause spot

VII. CONCLUSIONS

The study aimed at investigating Indian agri commodity market through one of the most traded agri futures i.e cotton. ADF test demonstrated that both future and spot price series are integrated

of first order. Johansen cointegration test confirmed future price of the cotton is cointegrated with spot price for all the years. Further it was found that in all the years there exists error correction term in most of the years in the long run. Further there was also short rum association between prices. Vector Error Correction Model clearly established that price of cotton futures lead the spot price of cotton. Granger causality test strongly concluded the finding of the VECM. Thus it is clearly established that the Future price of cotton influences the cotton or in other words the future market sends price signal to the spot market. This will help in offsetting the price volatility of cotton by trading in futures. Hence cotton futures market is efficient in price discovery.

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