

Relationship between agricultural commodities' futures prices and spot market prices in India

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Abstract - This present study analyses the agriculture market behavior and price effect in Indian Agriculture Commodity Markets. The agricultural commodity market in India has witnessed an extraordinary growth. In past decade the financial system has come across lots of changes globally. What has actually changed is the level of risk and the hedging instruments in the financial system. The study considered daily spot and future prices of two agriculture commodities viz. Cardamom and Jeera trading on MCX and NCDEX during 2013-2017. ADF Test is been applied to examine the existence of unit root, Granger causality test have been applied to test the price discovery i.e., the effect of futures market on the spot market and vice-versa. The commodity market behavior was considered with the help of backwardation and contango. The result of the present research says that the price effect differs from one commodity to another commodity.

The present study suggests that causality can be used in forecasting spot and futures prices. The backwardation and contango helps in identifying the hedging opportunities to the traders in the commodity market. The research field taken for the study is Indian Agriculture Commodity Market.

Keywords: Commodity, Spot Price, Futures rice, Commodity Exchange.

I. INTRODUCTION

The first organized futures commodity trading started in the 17th century in Japan by the samurais called Daimyos. Rice as majorly traded in Japan through auctioning and issuing rice bills. The rice bills would contain all the details of trade like quantity, price and futures date. The purpose of this bill was to lock the price and reduce price risk. This market later was reformed as Dojima Rice Exchange in 1715.

The harvesting season and excess availability of agriculture commodity in the season was the main reason for the development Chicago derivative market in 19th century. The agriculture commodity had low price during the harvest season and very high price during off-season due to less availability to agriculture commodity. The transportation problem and lack of storage facility in rural areas provoked the situation in United States. This made the buyer and seller to get into the contract for delivery of the grains in the futures date, for a specified quantity and specific price. The trading volume increased and accelerated the need for organized exchange. This led to start the Chicago Board of Trade in 1848. The main purpose was to improve quantities and quality of the commodity that were traded. In 1990 CME (Chicago

Mercantile Exchange) was established and now there are many more futures exchanges in the world. In past decade the financial system has come across lots of changes globally. The market has come across various types of risk. However the system has reminded more or less same over the period. What has actually changed is the level of risk and the hedging instruments in the financial system.

There are many derivative instruments developed in the market to hedge the risk and to mitigate the risk in financial market. The trader's interest to diversify the risk has improved the derivative market. Those investors who wanted to safeguard themselves against the price fluctuation derivative market were their platform to trade. The major problem face by producer, manufacturer and trader is price fluctuation in the market.

Commodity market as a volatility effect due to unstable market and homogeneous products traded in the market. The reason for the price effects can be numerous such as unexpected natural catastrophes, exploitation of upcoming resources, national and global political effect, change in the economy and change in industry policies etc.

As many traders and producers of agricultural commodity are facing a very big challenge that is getting a right price for their cultivated crops. On the other side the industries

which use agriculture product as their raw material also need the commodities at a right price to maintain their product price stable. As price fluctuation is the major concern this shows the importance of futures contract which act as an effective tool to reduce the price risk in the future date. The present study tries to understand the relationship between spot and futures market. How futures market can help in hedging the price risk to both the buyer and seller. In the present study there are two commodities considered to check the movements of spot and futures market. Whether spot and futures market have a long run relationship or not?

By trading into the futures contract in order to make profits, speculators capital is required for ensuring liquidity in the commodity market. Futures markets allow speculators participation in a more controlled environment where monitoring and observation of the participants is possible. Hence, futures ensure transparency. Futures also help in standardization of commodity quality, commodity quantity and time of delivery, since these variables are agreed upon by the traders and specified in the futures contract.

II. REVIEW OF LITERATURE

After going through available literature review, a number of studies has been conducted on the price effect of futures and spot on Indian capital market. According to these studies, it is hard to obtain a definite conclusion that the Indian capital market is volatile or not.

Ali, J., & Bardhan Gupta, K. (2011). This paper tries to analyze the efficiency of agricultural commodity markets by assessing the relationships between futures prices and spot market prices of agricultural commodities in India. The efficiency of the futures market for 12 agricultural commodities which is traded in NCDX is analyzed by using Johansen's co-integration analysis and Granger causality tests. This paper tries to examine whether futures and spot prices are stationary or not. This finding propose that there is a long- term relationship between futures prices and spot prices for most of the agricultural commodities like maize, chickpea, black lentil, pepper, castor seed, soybean and sugar. The study of short- term relationship by causality test indicates that futures markets have stronger ability to predict subsequent spot prices. Ali, M. (2015). Agriculture is a way of life, a tradition, which, for centuries, has shaped the thought, the outlook, the culture and the economic life of the people of India Various strategies have been formulated from time to time to improve the lot of farmers, but the economic condition of small and marginal farmers is still very bad, despite a higher economic growth rate. It is because of fact that the serious efforts could not made to ensure a remunerative return to farmers at grass roots level for their produce. The study is based on the primary as well as secondary sources of data. The secondary data were collected from District

Statistical Magazine, District Development Magazine, Census Office, New Delhi, Zila Panchayat Office, Shahjahanpur, District Food & Marketing Office, Shahjahanpur, District Agricultural Marketing Office, Shahjahanpur and District Agricultural Authorities, Shahjahanpur. The present study analyses the geographical conditions of study area as well as the distribution of periodic markets and their role in the transaction of agricultural commodities. An efficient periodic marketing system, well equipped with adequate modern facilities with good socio-economic security is urgently needed for getting the benefit of crops and livestock revolution taking place at global level after increasing influence of WTO in agricultural sector. Inoue, T., & Hamori, S. (2014). Market efficiency of commodity futures has been conducted mainly in developed countries. This paper focuses on Indian market efficiency of commodity futures, one of the emerging countries with phenomenal growth in the commodity market. The paper estimates spot prices and the long run equilibrium relationship between commodity futures and then to check the market efficiency by applying the DOL and FMOLS methods. The sample period is from 2nd January 2006 to 31st March 2011 5 years data. Daily data is used for this period and the number of observations is 1590 in total multi commodity spot and futures prices. This paper uses the multi-commodity prices indices obtained from the website of MCX. The results show that there is cointegration relationship between them, which means that a necessary condition for market efficiency is satisfied. In order to utilize the futures market the Indian govt. will have to enhance its institutional infrastructure for smooth commodity transaction in line with market development rather than to strengthen the restrictions on commodity transactions. They also provide a mechanism by which diverse and scattered opinions of future are considered which reveals information about the futures cash market through futures market. The study focuses on the Indian commodity exchange and its scope for enhancing the futures agriculture commodity market.

PRICE DISCOVERY AND HEDGING EFFECTIVENESS:

The below research paper mainly focuses on the price discovery and hedging effectiveness for the commodities.

Aggarwal, N., Jain, S., & Thomas, S. (2014). This paper tries to examine price discovery and hedging effectiveness of the selected commodity futures and helps to manage risk very efficiently. The paper studies the viewpoint of the hedger to conjecture what factors may progress hedging effectiveness. There is a huge settlement costs caused by delivery centers and an untrustworthiness of warehouse receipts, a mismatch between the grade specified in the futures contract and the actual deliverable quality in the market etc. The data is obtained from three

commodity exchanges – MCX, NCDEX, and NMCE – for the period between 2003-2014. The results reflect that while the commodity futures markets perform the role of price discovery reasonably well, their role in effectively reducing the risk in commodity exposure is not as strong. There is a variation in price discovery as well as hedging effectiveness varies across commodities. However, other than for commodity like sugar and gold, the average information share (IS) of futures is steady across the full period or the more recent period after 2010. Barua, N. A., & Mahanta, D. (2012). This study is a documentation of the growth of commodity markets and the factors leading to price inflation and its discovery. However derivatives trade in agricultural commodities was confronted by a major crisis when the Government of India restricted to trade on futures trading of selected commodities in 2007-08 as part of its anti-inflationary measures. This actual unfolding of events vindicate the position that inflationary pressures stems from a number of factors, including supply side constraint, the global rise in prices of food and oil, the diversion of land for bio-fuel production, loose monetary policy in emerging economies, and the adoption of an expansionary fiscal policy. Hence the study draws a conclusion that the policy of across-the-board restriction of derivatives trading in agricultural commodities appears to be unjustifiable, inequitable, and counter-productive. Guglani, R. K. (2016). This study tries to understand the price and quantity volatility of selected agricultural commodities in Indian market and underline the factors responsible for such fluctuations, the factors responsible for price fluctuations in the spot and futures markets and to examine the price discovery mechanism through regional exchanges and their correlation with the national level commodity exchanges. It is thus not unimportant to point out that the futures markets provide a platform for risk mitigation, price discovery, arbitrage and clearing and settlement. It has been observed that the stakeholders, namely, the farm producers, consumers, processors and traders hedge their positions in the commodity futures with the intention of protecting themselves from the risks of likely adverse price changes in agricultural commodities. The information pertains to selected futures contracts spread over the period of four years between 2006 and 2009. The study noted that the price dissemination and reduction in price volatility could be seen during the expiration periods of the basmati rice futures traded in Indian commodity markets. Moreover, in the Indian context, the non-price measures such as providing basic infrastructure, support and extension services along with adequate credit for increasing agricultural output are far more important in relation to the minimum support prices and other incentives including subsidies.

III. OBJECTIVES OF THE STUDY

- To examine the long term relationship between the spot and the futures prices of selected commodities traded in MCX and NCDEX.
- To examine lead-lag relationship for returns between futures price and spot price of selected commodities.

IV. HYPOTHESIS OF THE STUDY

Lead-lag relationship between futures price and spot price

- H_0 1: The futures prices of Cardamom does not granger cause spot prices of Cardamom in MCX
- H_a 1: The futures prices of Cardamom does granger cause spot prices of Cardamom in MCX
- H_0 2: The futures prices of Jeera does not granger cause spot prices of Jeera in NCDEX
- H_a 2: The futures prices of Jeera does granger cause spot prices of Jeera in NCDEX

Long term relationship between futures price and spot price

- H_0 3: There is no cointegration between futures prices and spot price of Cardamom
- H_a 3: There is cointegration between futures prices and spot price of Cardamom
- H_0 4: There is no cointegration between futures prices and spot price of Jeera
- H_a 4: There is cointegration between futures prices and spot price of Jeera

V. THE DATA

MCX (Multi Commodity Exchange of India Ltd.): It is an independent national commodity exchange which was established in the year 2003 in Mumbai. It is one of the largest commodity exchanges in India which holds about 86% market share of commodity exchange and fall in top 10 commodity exchanges in the world. MCX has options trading in gold and futures trading for agriculture (Mentha oil, cardamom, crude palm oil, cotton, chana, turmeric and others) and non-agricultural commodities (like Metals, bullion, energy etc).

NCDEX (National Commodity & Derivatives Exchange Limited): It's a public limited company which was listed in 23rd April 2003 under companies Act 1956. It has 848 registered members and clients base of about 20 Lakhs and offers trading on more than 49000 terminals across 1,000 centers in India. NCDEX provide various futures contract on agricultural commodities. It has major agricultural commodities traded in its platform.

Agricultural commodity is traded in MCX (Multi Commodity Exchange) and NCDEX (National commodity Derivative Exchange). The commodity which does not have break in trading for more than 3 months is been

considered for the study. On this basis two commodity exchanges has been selected MCX (Multi Commodity Exchange) and NCDEX (National commodity Derivative Exchange). The data is retrieved from Muti Commodity Exchange (MCX) and National Commodity Derivative

Exchange (NCDEX) website two commodities are considered for the present study (Cardamom from MCX and Jeera from NCDEX).A sample detail has been given in below table1.

Sl. No.	Market Selected	Product Traded At	Sample Product	Sample Period
1	Spices	MCX	Cardamom	January 2013- December 2017
2	Spices	NCDEX	Jeera	January 2013- December 2017

VI. ECONOMETRIC MODELS

➤ UNIT ROOT TEST

The first step in times series data is to know the relationship between spot and futures price commodity is to check whether the data is stationary or not. This can be done by applying unit root test to determine whether the data is stationary or not. To deal with autocorrelation problem the ADF (Augmented Dickey-Fuller) test was applied at level series of cardamom and jeera (Spot and Futures price) and found that the data is non stationary at level. Later ADF test was applied at first difference, the output result show that the data is stationary at all the 3 equation in I(1). The Phillips-Perron (PP) non parametric test was also applied to check the stationarity of data and found that data is stationary not at in not station at level but at first difference I(1). All the 3 equation was applied under ADF and PP to check the stationarity of data (Table 2).

$$\Delta Y_t = B_1 + ZY_{t-1} + a_i + e_t \text{ (Eq. 1) } > \text{Intercept Only}$$

$$\Delta Y_t = B_1 + B_2t + ZY_{t-1} + a_i + e_t \text{ (Eq. 2) } > \text{Trend and Intercept}$$

Table2: The result of Augmented Dickey-Fuller (ADF) for first order differenced series of Cardamom and Jeera (Spot and Futures Prices) by using Eviews software.

Commodity	Exogenous	Variable	Coefficient	Std. Error	t-Statistic	Prob. At 5% significance level.
Cardamom Spot	Constant	DSPOT_PRICES(-1)	-0.873634	0.038312	-22.80301	0.0000
Cardamom Spot	Constant, Linear Trend	D(SPOT_PRICES(-1))	-0.874211	0.038336	-22.80365	0.0000
Cardamom Spot	None	D(SPOT_PRICES(-1))	-0.873606	0.038297	-22.8112	0.0000
Cardamom Futures	Constant	D(DFUTURE_PRICES(-1))	-18.61966	1.172318	-15.88278	0.0000
Cardamom Futures	Constant, Linear Trend	D(DFUTURE_PRICES(-1))	-18.62852	1.172873	-15.88282	0.0000
Cardamom Futures	None	D(DFUTURE_PRICES(-1))	-18.61949	1.171848	-15.88899	0.0000
Jeera Spot	Constant	DSPOT_PRICES(-1)	-0.698111	0.04503	-15.50324	0.0000
Jeera Spot	Constant, Linear Trend	D(SPOT_PRICES(-1))	-0.704044	0.045201	-15.57574	0.0000
Jeera Spot	None	D(SPOT_PRICES(-1))	-0.695026	0.044938	-15.46635	0.0000
Jeera Futures	Constant	D(DFUTURE_PRICES(-1))	-3.218218	0.308151	-10.44364	0.0000
Jeera Futures	Constant, Linear Trend	D(DFUTURE_PRICES(-1))	-3.269911	0.310669	-10.52538	0.0000

Jeera Futures	None	D(DFUTURE_PRICES(-1))	-3.207986	0.307644	-10.4276	0.0000
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$\Delta Y_t = ZY_{t-1} + a_i + \epsilon_t$ (Eq. 3) >No Trend, No Intercept

➤ **GRANGER CAUSALITY TEST**

The researcher might be interested in knowing whether changes in one variable cause changes in another variable. This question is clarified with the help of causality tests. Let y_t be a two-dimensional vector $(y_{1t}, y_{2t})'$. If history of y_{1t} is helpful in predicting y_{2t} , it is said that y_{1t} causes y_{2t} . Similarly, if past information about y_{2t} is useful for predicting y_{1t} , then y_{2t} is said to granger cause y_{1t} . Whether Futures prices causes Spot prices or Spot prices causes the futures prices for the selected commodity Cardamom traded in MCX and Jeera traded in NCDEX (Table 3) .

TABLE 3: Pairwise Granger Causality Tests for Cardamom and Jeera Futures and Spot prices, Sample: 1/01/2013 12/29/2017, Lags: 8 and 5 respectively

Commodities	Cardamom			Jeera		
	Obs	F-Statistic	Prob.	Obs	F-Statistic	Prob.
DSPOT_PRICES does not Granger Cause DFUTURE_PRICES	1280	1.70461	0.0929	1158	0.34274	0.8870
DFUTURE_PRICES does not Granger Cause DSPOT_PRICES	1280	1.67911	0.0990	1158	0.44967	0.8137

➤ **COINTEGRATION AND ERROR CORRECTION MODEL**

This test shows the long term equilibrium relationship between the spot price and futures price for the selected commodities. This long run relationship is called cointegration which means spot and futures market move together in the long run. Since spot and futures price represent the prices of same commodity they are expected to be cointegrated. The study uses Johansen's cointegration test considering Trace statistic and Max-Eigen statistic. Johansen cointegration test for general VAR model at series I(1) Table4:

$$A_k(L)x_t = \mu_0 + \Psi D_t + \epsilon_t$$

The VAR in levels can be transformed to a vector error correction model (VECM)

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \dots + \Gamma_{k-1} \Delta x_{t-k-1} + \Pi x_{t-1} + \mu_0 + \Psi D_t + \epsilon_t.$$

TABLE 4: Johansen Cointegration Tests for Cardamom and Jeera Futures and Spot prices, Sample: 1/01/2013 12/29/2017.

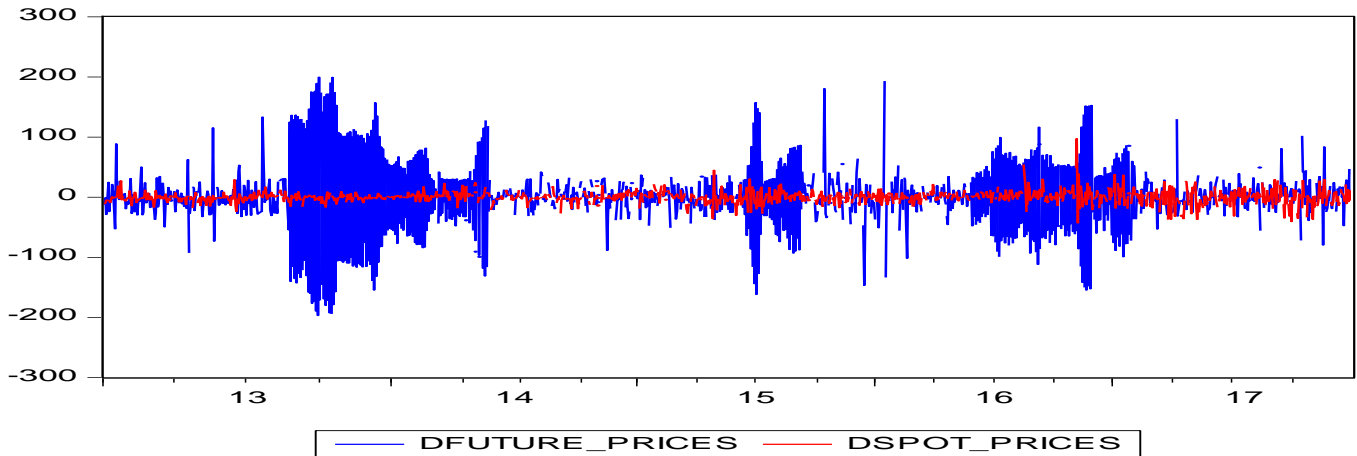
Commodities	Cardamom			Jeera		
	Trace Statistic	0.05 Critical Value	Prob.	Trace Statistic	0.05 Critical Value	Prob.
None *	466.7275	15.49471	0.0001*	711.6193	15.49471	0.0001*
At most 1	181.342	3.841466	0.0000*	148.0687	3.841466	0.0000*
Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value	Prob.	Max-Eigen Statistic	0.05 Critical Value	Prob.
None *	285.3855	14.2646	0.0001*	563.5506	14.26460	0.0001*
At most 1	181.342	3.841466	0.0000*	148.0687	3.841466	0.0000*

* Denotes rejection of the hypothesis at the 0.05 level

VII. RESULTS AND DISCUSSION

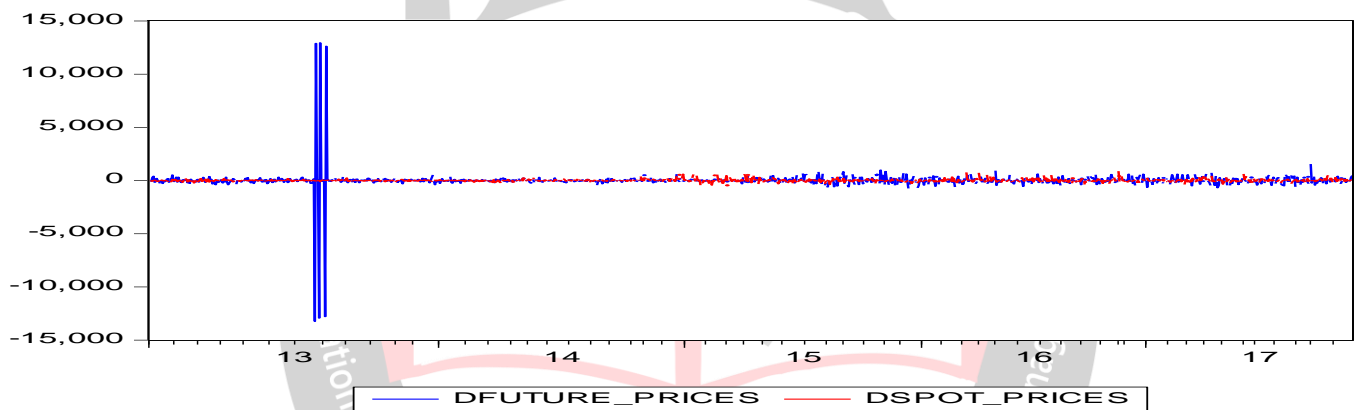
The result of ADF and PP reflects that the Cardamom Spot price and futures prices are non stationary at level but stationary at first difference at 5% significance level. However the Null Hypotheses (the Spot price and futures price of Cardamom is not stationary) is rejected as the probability is 0.000 which means it's less than the significance level 0.05 r 5% and the alternative hypotheses is accepted i.e. Cardamom-Spot and futures price is stationary. Cardamom Futures and Spot price is stationary at first difference.

Graph 1 Stationary at First difference 1(Cardamom)



The result of ADF and PP reflects that the Jeera Spot price and futures prices are non stationary at level but stationary at first difference at 5% significance level. However the Null Hypotheses (the Spot price and futures price of Jeera is not stationary) is rejected as the probability is 0.000 which means it's less than the significance level 0.05 or 5% and the alternative hypotheses is accepted i.e. Jeera-Spot and futures price is stationary.

Graph 2 Stationary at First difference 2(Jeera)



Granger Causality test is to how the relationship between the spot and futures price. Table 3 the result shows that the Cardamom Spot price-Null hypotheses (DSPOT_PRICES does not Granger Cause DFUTURE_PRICES) are not rejected as the probability value is 0.0929 which is higher than 0.05 or 5% significance level. The Cardamom futures price Null hypotheses (DFUTURE_PRICES does not Granger Cause DSPOT_PRICES) is not rejected as the probability value is 0.0990 which is higher than 0.05 significance level. That means the data futures price depends on its own past and spot price depends on own past they don't influence each other.the Cardamom Spot price-Null hypotheses (DSPOT_PRICES does not Granger Cause DFUTURE_PRICES) are not rejected as the probability value is 0.8870which is higher than 0.05 or 5% significance level. The Jeera futures price Null hypotheses (DFUTURE_PRICES does not Granger Cause DSPOT_PRICES) is not rejected as the probability value is 0.8137which is higher than 0.05 significance level. That means the data futures price depends on its own past and spot price depends on own past they don't influence each other.

Johansen cointegration and vector error correction tests which show that there is long run relationship between the spot and futures price for cardamom.johansen cointegration both the test rejects null hypotheses and accepts the alternative hypotheses that both spot and futures market are cointegrated. The analysis also reflects that jeera spot price and futures price has long run causality which means both spot and futures market moves together.

VIII. CONCLUSION

The purpose of this study is to empirically analyze the most important role of futures commodity market in providing price stability through hedging. Existence of cointegration between the futures price and spot prices for all the selected agriculture commodities futures contracts provides evidence that both markets display a parallel (or closely parallel) relationship such that losses in one market are offset either fully or substantially by the gains in the other market. Futures contracts can be good hedging tool only when the commodities are efficiently priced. A detailed analysis of price discovery functions reveals that futures contracts, whenever any information related to the

commodity comes into the market, both the markets reflects simultaneously and contribute to price discovery in most of the cases. However, futures market is able to forecast futures spot price with a fair amount of accuracy taking into account current and futures scenarios at least two months ahead unlike spot market, pointing out that futures market plays a pivotal role in price discovery for next to near month contracts. This could be attributed to screen-based trading in derivative markets to a diverse group of participants on a platform where information flow and assimilation are instantaneous. This will amplify the signals and adjust the commodity prices which in turn will influence the responses from the stakeholders to determine futures production and consumption. On the other hand, physical markets of agricultural commodities are widely scattered and dominated by small-scale farmers and traders with limited access to information resulting in information asymmetry. Thus, it can be inferred that overall futures market is efficient in discovering prices and in maintaining long-run equilibrium relationship with the cash market.

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