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SUBJECT I
FUTURES MARKET IN INDIAN AGRICULTURE AND ITS IMPACT ON PRODUCTION AND PRICES

Price Discovery in India's Agricultural Commodity Futures Markets

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I

INTRODUCTON

Commodity futures market plays an important role in price discovery, the information on which helps the producers to plan their activities on production, processing, storage, and marketing of commodities. It is generally argued that price discovery is more efficient in futures market than spot market (Brockman and Tse, 1995; Yang and Leatham, 1999). The availability and effective dissemination of information helps to stabilise and decreases spot price volatility. Thus, futures trading infuse efficiency in the functioning of a commodity market (Tomek, 1980; Karnade, 2006).

In general, futures prices reflect the collective expectations of market agents about prospective demand and supply of commodities at maturity of futures contract. Since the futures prices are a reflection of futures demand and supply conditions of markets, they provide market signals to the farmers for deciding the appropriate cropping pattern. If future prices are falling, then it implies either future demand would fall or the supplies would ease out and vice versa. Through hedging, farmers can mitigate the price risk that they may face in the spot market with volatile prices. It enables traders to buy the crop during harvest season, paying the farmers with fair prices, which are reflective of its "scarcity value". Storing them until the new harvest and releasing it in small quantities will maintain price stability between crop seasons as being done mostly by the intermediaries. However, even in the well functioning markets, the movement of spot and futures prices would not be perfectly parallel, so it can only reduce risks through executing opposite selling and buying in two markets rather than altogether removing them.

On the contrary, it is argued that futures trading affect the spot markets by increasing price volatility in the spot markets. This is based on the assumption that future markets are thin and thus inefficient and the spot traders tend to follow the

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price signals from the futures. The low trading volume of thinly traded future markets may generate small amount of information, which is of low quality (Carter, 1989). Further, the futures market is characterised by the uncertainty in trading pattern that is caused by the herd tendency of the traders who sell at falling prices and buy at rising prices. The speculation in futures market and its presumed destabilising effect on spot market often forces the government to intervene to make the functioning of commodity derivatives as effective as possible. However, the inconclusive debate on future and spot price relations continues in the literature (Karbuz and Jumah, 1995; Mattos and Garcia, 2004).

In India, there was widespread interest among policy makers, market regulators and academia to study the underlying linkages between futures and spot markets when inflation was over 6 per cent during the fourth quarter of the financial year 2006-07. The increasing inflation was supposedly caused by rising prices of agricultural commodities. The rise in general prices of agricultural commodities was in turn attributed to allowing of futures trading in many agricultural commodities. It was contended by various political parties that price volatility in agricultural futures has led to increase in inflation. Consequently, Government of India constituted an Expert Committee to study the 'Impact of Futures Trading on Agricultural Commodity Prices' under the Chairmanship of Dr. Abhijit Sen in March 2007. The committee found that out of 24 agricultural commodities traded in the futures market, three commodities namely, guar seed, guar gum and mentha oil did not find place in Wholesale Price Index (WPI) basket. Omission of these commodities in WPI calculation is significant as they accounted for about 29.6 per cent of value of total agricultural futures trading. The remaining 21 commodities have a weight of only 11.73 per cent in total WPI basket. Analysing growth in WPI and pre and post futures trade in these 21 commodities, the Committee found no general or definitive association between introduction of futures and spot price volatility.

However, in India the trading of commodity derivatives whose underlying is commodities through organised exchanges is a recent phenomenon and hence very few empirical studies have been undertaken by the researchers in assessing the effect of futures on spot markets. Thus, the present study makes a modest attempt to assess the future and spot price linkages of selected agricultural commodities, viz., pepper, guar seed and chana (gram) through econometric evidence. The selection of these commodities was dictated by availability of consistent data series. The paper is broadly organised into six sections. The second section provides review of literature. The data and methodology are discussed in the third section. Trading of major agricultural commodities through futures market is discussed in the fourth section. The fifth section discusses the future and spot price relations of these commodities through cointegration technique and vector error correction model. The final section contains the concluding remarks.

II

REVIEW OF LITERATURE

Several studies have found that futures trading reduces and also does not increase cash price volatility (Peck, 1976; Weaver and Banerjee, 1990; Darrat and Rahman, 1995). Analysing the interactive nature of Chinese cotton markets with U.S. market, Ge *et al.,* (2008) found that futures prices of cotton in China and U.S.A. are cointegrated and there existed long run equilibrium between New York Board of Trade and Zhengzhou commodity exchange. These two markets efficiently shared price transmission.

Zapata *et al.,* (2005) examined the relationship between sugar futures prices traded in the New York and the world cash prices for the exported sugar. The study found that sugar futures market leads the cash market in price discovery. They also found unidirectional causality from changes in futures to changes in spot prices. Yang and Leatham (1999) analysed price discovery of U.S. wheat futures and cash market separately. It was found that while wheat futures market had equilibrium price in the long run but no equilibrium relationship of prices across wheat cash market was established. Karnade (2006) analysed the linkage between Indian castorseed futures and spot market using cointegration analysis. The study found that futures market at Mumbai and Ahmedabad is cointegrated indicating that price linkage between futures market at Mumbai and Ahmedabad has strengthened overtime. Overall there was unidirectional causality from futures to spot market.

III

DATA AND METHODOLOGY

To have consistent data series, the near month futures prices of Malabar Garbled pepper, Guar Seed and Chana (Gram) including daily futures trading volume, and spot prices were compiled from National Commodities Derivative Exchange (NCDEX) website. The data on futures prices of Malabar garbled pepper and guar seed were available for the period April 2004 and May 2009. However, consistent data on futures contracts of chana are available only from April 2004 to May 2008 due to ban on futures trading in this commodity. The preliminary analysis of the data revealed that spot prices reported by NCDEX are not representative and these data are collected from small sample of traders involved in futures trading. As a result, average wholesale price of Garbled pepper at Kerala, guar seed at Rajasthan and chana at National Capital Region of Delhi were collected corresponding to the period for which futures prices are available. These monthly wholesale prices are compiled and published by Ministry of Agriculture and Cooperation**.**

The efficiency of price discovery in the futures and spot markets was assessed by using Johansen Cointegration analysis and error correction models. Cointegration analysis measures the extent to which two markets have achieved long run

equilibrium. Each series is represented by an error correction model which includes last period's equilibrium error and lagged values of the first difference of each variable. This procedure helps to assess the temporal causality. Further, cointegration takes into account non stationarity and allows for short term and long run adjustment. If future and spot prices are cointegrated, then causality should be present at least in one direction. Cointegrating vectors define long run equilibrium while error correction mechanism characterise the price discovery process, whereby markets attempt to find equilibrium.

When future and spot markets are cointegrated, they are expected to return to long run equilibrium after possible short run adjustments. The cointegrated variables are specified by a Vector Error Correction Model (VECM), in which the error $(\hat{e}_t)$ refers to long run equilibrium. i.e. $\hat{e}_t = F_t - \alpha - \beta S_t$

The VECM is specified as follows

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

$$\Delta S_t = \alpha' + \delta' e_{t-1} + \sum_{i=1}^{k} \beta'_i \Delta F_{t-1} + \sum_{j=1}^{k} \gamma'_i \Delta S_{t-1} + \nu'_t$$

Where, F and S refer to future and spot prices, respectively. ν is white noise.

IV

FUTURES TRADING IN AGRICULTURAL COMMODITIES

After several years of restrictions, Government of India revived commodity futures trading in April, 2003. The permitted list of commodities under Forward Market (Regulations) Act, 1952 was expanded. Sensitive items like rice, wheat and pulses which were earlier listed under prohibited items were allowed for futures trading. Three commodity exchanges at national level and 21 exchanges at regional level were set up for trading purposes. Presently, about 95 commodities were traded at these exchanges. The total volume of futures trade has increased from Rs. 5.7 lakh crores to 40.7 lakh crores between 2004-05 and 2007-08 (Government of India, 2008).

The share of major agricultural commodities traded in futures market is given in Table 1. During 2004-05 and 2005-06, agricultural commodities accounted for the largest volume of futures trade with 68.2 per cent and 55.3 per cent, respectively. In recent years, bullion metals have become dominant commodities. Among agricultural commodities guar seed accounted for over 25 per cent of total value of agricultural futures trading during 2004-05 to 2006-07. Other predominantly traded commodities are soy oil, pepper, chana and mustard seed.

TABLE 1. SHARE OF AGRICULTURAL COMMODITIES IN TOTAL VALUE OF AGRICULTURAL FUTURES TRADING

(per cent)

Commodity	2004-05	2005-06	2006-07	2007-08
(1)	(2)	(3)	(4)	(5)
Soy oil	26.0	9.2	13.4	25.7
Guar seed	33.2	27.7	24.7	13.1
Pepper	2.1	0.7	6.9	11.2
Chana/Gram	4.3	19.7	23.3	9.9
Mustard Seed	5.0	1.4	1.7	9.4
Jeeraseed (Cumin)	0.8	1.0	5.1	7.7
Soy seed	2.5	1.2	2.0	6.5
Turmeric	0.3	0.3	1.1	3.0
Sugar	2.0	2.2	1.0	2.6
Castor seed	3.7	1.0	1.1	2.1
Chillies	0.0	0.6	2.9	1.3
Mentha Oil	0.0	3.5	4.0	1.1
Kapas	8.5	2.6	0.6	1.0
Gur	2.0	1.4	0.8	0.7
Potato	0.0	0.0	1.1	0.6
Rubber	0.7	0.4	0.6	0.5
Guar gum	3.4	3.1	1.0	0.5
Cardamom	0.1	0.0	0.6	0.4
Maize	0.0	0.1	0.4	0.2
Raw jute	1.0	0.5	0.1	0.2
Wheat	0.7	1.3	1.7	0.0
Urad	2.6	16.5	4.1	0.0
Tur	0.0	3.5	0.8	0.0
Rice	0.1	0.1	0.0	0.0
Share of agricultural commodities in total value of futures trade	68.2	55.3	35.8	23.2

Source: Government of India (2008).

V

FUTURE-SPOT PRICE LINKAGES

Before determining the interdependence between futures and spot prices, the stationarity of these two series of pepper, guar seed and chana was tested by using Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests. The estimated equation included a constant and a trend term. Akaike's AIC criterion was used to determine the lag length. To conduct ADF, a lag length of one was sufficient to remove autocorrelation. For PP test, Newey-West truncation lag of three was included. The results of ADF and PP did not reject the null hypothesis about the presence of unit root at the level form for all the three commodities (Table 2). However, both the futures and spot prices were found to be stationary at first difference.

TABLE 2. RESULTS OF UNIT ROOT TESTS

	ADF		Phillips-Perron	
Items	Level Prices	First Difference	Level Prices	First Difference
(1)	(2)	(3)	(4)	(5)
Pepper				
Spot	-1.13	-5.78	-1.65	-3.41
Futures	-1.92	-6.31	-2.08	-6.24
Guar seed				
Spot	-1.52	-8.48	-1.62	-8.83
Futures	-2.15	-9.02	-2.98	-10.28
Chana				
Spot	-1.95	-6.55	-1.27	-7.61
Futures	-2.37	-6.66	-1.90	-3.71

Note: Critical values of ADF test with constant and trend are -4.13, -3.49, -3.17 at 1, 5 and 10 per cent level, respectively. Critical values of the Phillips-Perron test with constant and trend are -4.12, -3.49 and -3.17 at 1, 5 and 10 per cent level, respectively.

Since it is established through ADF and PP tests that both the series have long run relationship, cointegration was tested using Johansen's Maximum Likelihood procedure. The estimation procedure was based on the methodology developed by Johansen (1991) and Johansen (1995). Based on this cointegration test, Error Correction Model was used to determine the effects of shocks in the short run and long run equilibrium. As there are only two series involved, the number of cointegrating vectors can be at most one for each commodity. The eigen values and trace statistics are provided in Table 3. The hypothesis of no cointegrating vector (r=0) can be rejected for all the three commodities as the trace statistics are higher than the critical values at 5 per cent level. Eigen values are lower for at least one cointegrating vector. Thus, it is established that futures and spot market prices of pepper, guar seed and chana are cointegrated.

TABLE 3. COINTEGRATION TEST FOR FUTURES AND SPOT PRICES

	Eigen value		Trace statistics for cointegrating vector	
Item	$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$
(1)	(2)	(3)	(4)	(5)
Pepper	0.4078	0.0090	30.91	0.52
Guar seed	0.2776	0.0293	20.94	1.75
Chana	0.3538	0.0082	19.58	0.36

Note: Critical values of trace statistics at 5 per cent level for $r = 0$ is 15.50 and $r \leq 1$ is 3.84.

Having determined the cointegrating relation between futures and spot market, the parameters of a bivariate cointegrating Vector Error Correction Model (VECM) was estimated. The variables are included in one lag form for pepper and guar seed, and two lags for chana. With these lags, the post estimation diagnostics revealed no evidence of autocorrelation. The results of the estimated models are presented in Table 4. The VECM allows for the short run shocks and estimates the degree of convergence towards the long run relationship.

TABLE 4. ERROR CORRECTION MODEL FOR FUTURES AND SPOT PRICE

	Δspot		Δfutures	
Variables	Coefficient	t value	Coefficient	t value
(1)	(2)	(3)	(4)	(5)
		Pepper		
Equilibrium error	-0.02731	-3.83	-0.09475	-1.02
Δspot (-1)	-0.5327	4.39	1.3509	0.61
Δfutures (-1)	0.2032	2.98	-0.0917	5.04
Constant	37.28123	0.86	-45.016	-0.47
		Guar Seed		
Equilibrium error	-0.02764	-3.65	-0.03569	-0.57
Δspot (-1)	-0.0356	-0.13	0.2094	0.58
Δfutures (-1)	0.0057	2.03	-0.2550	-0.93
Constant	11.97	1.03	8.51	0.55
		Chana		
Equilibrium error	-0.01299	-3.17	-0.0033	-0.11
Δspot (-1)	0.5582	0.44	0.2427	1.96
Δspot (-2)	-0.0422	-2.21	0.1964	1.30
Δfutures (-1)	-0.2631	1.38	1.2306	0.45
Δfutures (-2)	0.3862	1.88	-0.72218	-4.60
Constant	18.50	13.77	11.13	1.06

The coefficient of at least one error correction term was significant for all the three commodities confirming the results of presence of cointegration. The coefficient of the error correction term was negative and significant in the case of spot market equation for pepper, guar seed and chana. This implies that spot prices are stable in the long run and any deviation in their prices due to external shocks that occurred in the short run was well adjusted by the market forces over time. It is interesting to note unidirectional lead-lag relationship existing for actively traded guar seed and thinly traded pepper and chana. The coefficient of error equilibrium was –0.027 in spot market equation for pepper. This indicates that when the average spot price was too high, it immediately falls back toward future prices. That is, the spot price corrects to its previous period's dis-equilibrium by 2.7 per cent. Similar explanation applies to error correction terms of guar seed and chana. These results broadly indicate there exists long run relationships between futures and spot prices and the adjustment towards equilibrium is made by the spot prices.

As regards shot run causality, that is changes in futures (spot) prices with respect to lagged changes in spot (futures), causality was found to be unidirectional. In the spot price model of pepper and guar, the coefficient of the lagged futures price was positive and significant. Similarly, coefficient of two months lagged price of chana was positive and significant. These results imply that price discovery occurred in futures market and is transmitted to spot market. However, in the futures model, the lagged spot prices do not seem to affect the futures prices. The results broadly indicated the better efficiency of price discovery at pepper, guar seed and chana futures market, from where the information flows to spot market.

VI

CONCLUDING REMARKS

The present study attempts to assess the futures and spot price linkages for pepper, guar seed and chana by using Johansen Cointegration analysis and Vector Error Correction Model. With the opening up of commodity futures trading in large number of commodities in 2003, the volume of trade has increased from Rs. 5.7 lakh crores to Rs. 40.7 lakh crores between 2004-05 and 2007-08. However, the share of agricultural commodities has decreased from 68.2 per cent in 2004-05 to 23.2 per cent in 2007-08 due to predominance of trade in bullion metals in recent years. Major agricultural commodities traded in futures market included guar seed, soy oil, pepper and chana.

On price discovery, the significant coefficient of at least one error correction term confirmed the results of presence of cointegration between futures and spot prices of pepper, guar seed and chana. The results of vector error correction model revealed unidirectional lead-lag relationship existing for actively traded guar seed and thinly traded pepper and chana. When the cointegrating relationship was disturbed, it was the spot price which tends to make adjustments towards long run equilibrium. That is, when the spot price was too high, it immediately falls back toward future prices. The results of the model also revealed the existence of unidirectional short run causality. The coefficient of the lagged futures price in the spot price model was positive and significant indicating information flows from futures to spot market. The results of the study broadly revealed that these three agricultural commodity futures influenced the spot prices indicating its better hedge efficiency for producers to hedge their price risk in the futures platform of the exchange.

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