



## **Price Efficiency and Volatility in Agri Commodities Market in India: An Empirical Investigation**

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### **Abstract**

The agriculture is seasonal industry which creates higher price volatility and makes agriculture a very risky enterprise. Price discovery is facilitated by trading of commodity futures and consequently instability in the price of the underlying is reduced. In this study endeavor has been made to assess the futures trading impact on Indian market regarding agricultural commodities. The information regarding the daily prices of spot and futures markets, for 5 years (January 2011 – December 2015), for four agricultural commodities, which is taken from four diverse categories of agricultural products i.e. Castor seed (as Oil Seed), Chana (as Pulses), Kapas(as Fibre), Turmeric (as Spices) are integrated into various econometric models to analyze the concerned purpose. This study inspects the efficiency of price and effects of unpredictability spillover in agricultural commodity market of India by means of test of Johansen Cointegration, VECM and bivariate model of EGARCH(1,1) with respect to selected commodities of NCDEX. The empirical findings extensively signify that futures market of agriculture commodity is more proficient in terms of price efficiency and information dissemination as compared to the spot market. In addition, the study outcomes demonstrate that the spillover of information occurs from future to spot market along with this, the future market contain the potential to depict the most up-to-date information. The study results have realistic propositions for financiers and market partakers because they desire to circumvent price risk aligned with the unfavorable movement of prices. Financiers may make use of the futures price, which have a propensity to ascertain latest information more speedily than the spot prices. Furthermore, the policy makers who can better understand the interdependence of these markets will be able to coordinate the stability of financial markets easily.

**Keywords:** Price Discovery, Volatility Spillover, Cointegration, VECM, EGARCH Model

**JEL Classification:** G13, G14, C51 & F31

**Paper Classification:** Research Paper

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### **Introduction**

In order to develop agriculture sector in the Indian economy the major role is performed by commodity market as it performs two imperative tasks of discovery and risk management of price. In India, the commodities futures market has experienced an astonished boom in terms of modern exchanges, number of commodities permitted for derivatives trading in addition to the

value of futures trading since 2002. The matter of discovery of price and unpredictability spillover is of greater significance to investors, traders, analysts and economists.

It is usually apparent that commodity markets are unpredictable. As the commodity market is unstable so the need arises to hedge the risk. Manufacturers and customers frequently discover techniques of hedging risk. For this purpose, derivative markets have turned out to be progressively more prevalent. In derivative market different instruments are traded which consists of financial instruments but the most powerful and important instrument among them is futures contract.

Price innovation is the procedure through which markets use the information in order to reach at stability (Working, 1948). Evaluating in a static opinion, price invention entails the subsistence of stable price but in a vibrant judgment, price detection procedure depicts the creation of information and transition crossways the markets. The information regarding price discovery is of vital importance because the firms occupied with activities like manufacturing, advertising and dealing with produce extensively use this information. The core of the discovery purpose regarding futures market focuses on innovative information that it is revealed initially in altered futures or spot price (Hoffman, 1931). This is conservatively asserted that market of futures is aptly designated similar to the leading spot of price innovation.

Numerous studies recommended that market of futures perform a vital job in price innovation intended for the fundamental cash market (Lien and Tse, 2000). There is a systematic relation in the prices of spot and futures market in short term in addition to long term which is implied by the function of price discovery. In the framework of co integration, the price discovery function entails the existence of a symmetrical relation which binds the two prices collectively. If there is any deviation from the balanced price, one market or both should adjust to correct the discrepancy. In the market which is entirely competitive, issue of discovery of price is further imperative for each economic representative for instance manufacturers, wholesalers etc. Since the entire mediators are working in the merchandise market and they take decision for their produce on the base of activities concerned with the price in the market irrespective of buyers or sellers. Eventually, better judgment leads to the best possible distribution of scarce resources (Manfredo and Sanders, 2008).

The fundamental feature of agricultural markets is price volatility which is most likely the foremost cause of threat in Indian agricultural trade. As numerous manufacturing judgments are made before hand regarding sale of products but still there usually subsist a definite amount of doubt regarding the value which will be acknowledged for ultimate goods (OECD, 2009).

In this study volatility is regarded as the unpredictability regarding the series of price just about its mid value i.e. the propensity for individual observation of price which shows a discrepancy distant away from its mean value. According to European Commission (2009) and Matthews (2010) two types of instability originated from the literature i.e. historical volatility which is also known as realized volatility and an implied volatility which is regarding future. The observable past prices or the historical prices are the basis of historical volatility. Despite of the fact, anticipation of futures prices is the basis of implied volatility. Implied volatility keeps up a correspondence to the prospect of markets that in future how unstable a price be determined when calculated by price options value. This study is concerned with measuring only historical volatility.

Despite the fact that goods markets in rising economies similar to India have been mounting by leaps and bounds, commodities and derivatives have not been researched efficiently. As numerous agricultural commodities are produced and consumed in India, so at present it is the

time for India to attain a primary position at international level in leadership of price. So, it is empirically vital to look at the task performed by the futures market of commodities in volatility and efficiency of price of selected agricultural commodities in India.

### Literature Review

In the literature considerable attention has been devoted to explore the futures-spot price relationships and volatility spillover. The current section summarizes both theoretical and pragmatic findings on price efficiency and instability in the spot and futures market from the perspective of countrywide and international. The analysis of the previous studies is presented chronologically so as to obtain an inclusive picture.

Taylor (1974) studied live cattle futures trading. The study made a comparison of price variance between a specified period when there exists futures trading and when there does not exist futures trading and he originated that immovability of the spot price was highly stable in comparison to future price when futures market was in subsistence. Garbade and Silber (1983) discovered price detection mechanism of storable agricultural produce. The study used daily prices of both the markets (spot and futures) to accomplish the purpose and concluded that futures market governs the spot market. Brorsen and Oellermann (1989) showed both hypothetical and practical models in the study which recommended that a successful futures market for cattle improves the efficiency of spot market, conversely short run risk regarding the spot price also increases. The reality that volatility has enlarged (even if only in short term) could be a key aspect in considering why producers of cattle observe the futures market as unfavorably influencing spot price.

Oellermann et al. (1989) as well as Schroeder and Goodwin (1991) analyzed the price efficiency for contracts of Livestock, furthermore originated that information is captured by futures markets first and subsequently it is transferred to the markets of spot. Brockman and Tse (1995) scrutinized the price efficiency method for four Canadian futures market with regard to agricultural commodities. For this purpose the study used Cointegration, the Hasbrouck (1995) information model and model of Vector Error Correction. It established that the market of futures show the way to the market of spot and therefore the price innovation was primarily determined by the market of futures. Thomas and Karande (2001) analyzed the price discovery mechanism in futures market of Castor seed at regional exchanges of Mumbai and Ahmedabad. The study found that Mumbai and Ahmedabad market do not respond in the identical manner to identical piece of information. In Mumbai market, futures price rule the prices of spot. Conversely, in Ahmedabad market there was no lead-lag association between both of the prices. Yang and Leatham (2001) examined futures markets for commodities i.e. storable and non storable for price discovery. It found that price discovery function is not exaggerated by asset storability, although futures markets predictions may be biased by asset storability. It established that market of futures performs a leading task in both of the commodities.

Moosa (2002) analyzed price discovery mechanism for Crude oil. With the intention to accomplish the purpose of the study it made reassessment of Garbade and Silber (1983) model. It experienced that market of futures is capable to execute role of price discovery to the extent of only sixty percent in case of crude oil. Batra (2004) evaluated time-varying instability of Indian stock market as a result of economic liberalization commencing from the year 1979 till 2003. The study utilized EGARCH model, methodology of Pagian and Sussounav (2003), augmented GARCH models to observe the unpredictability and the effect of leverage. By means of models of vector error correction and EGARCH, the pragmatic facts confirmed that price index of futures

perform like a constructive vehicle of price discovery and trading of futures have also been a cause of volatility for the spot market.

Kumar and Sunil (2004) established that futures market of the Indian agricultural commodities is inefficient to discover price for spot market. Zhong, Darrat and Otero (2004) examined the process of price invention of Mexican stock index futures. It took daily observations from 15 April 1999 to 24 July 2002 for the study. Its practical verification concluded that futures price index performs like a powerful vehicle for price innovation process. Mattos and Garcia (2004) explored the lead-lag affiliation in prices of spot and futures of agricultural markets of Brazil. For this purpose the study employed data regarding futures and spot prices on daily basis of Corn, Live cattle, Coffee, Soybeans, Cotton and Sugar and the study brought into being mixed results. The study found that there exist cointegration in futures and spot market of live cattle and Coffee. In addition, the investigation discovered that there is no cointegrating association in corn, cotton and soybean markets because these markets are traded sparsely.

Tse and Xiang (2005) in a study originated that although crude and gas futures contracts account for below one percent of the amount of standard contracts on NYNEX E-Mini futures, they chip in for more than 30% of the price discovery. Zapata, Fortenbery and Armstrong (2005) explored affiliation among eleven prices of futures which operated in New York and spot prices of Sugar exported all over the world. The study concluded that market of futures for Sugar serves as an effective vehicle for cash market. The study revealed that causality exists from future to spot price but not from spot to futures. The study also found that there is cointegration between both prices of sugar. It also suggests that future contract of Sugar reduces market price risk on the whole which cash market participants face when sale is done at world price. Yang and Leatham (2005) examined the lead lag affiliation involving activities of future trading and volatility of cash price for some chief commodities of agriculture. The study applied forecast error variance decompositions and test of Granger causality. The outcome of the results showed that there is an unanticipated and unidirectional increase in futures trading volume which is the reason of increase in volatility of cash price.

Sahi and Gurpreet (2006) studied the impact of beginning of trading in futures on the instability of the fundamental commodities in India. The pragmatic consequences of the study recommended that with the introduction of trading in futures the nature of unpredictability has not changed in the underlying commodities. Nevertheless a weaken consequence was established from futures price to spot in case of few commodities. Additionally test of Granger Causality outcomes demonstrated there is an enhancement in volatility of cash price attributable to an unpredictable boost in futures activity. Fu and Qing (2006) scrutinized the price efficiency technique of futures and spot markets in China and established a long-standing balanced affiliation which exists between two markets and bidirectional flow of information. The study showed that futures market acts as a useful tool of price innovation. Bose (2007) established that countrywide stock markets are unpredictable while judged against developed markets and futures market of Indian commodity is not stable and accusation of speculative movement have been made.

Lokare (2007) found that even though nationwide commodity market is yet to attain lowest significant liquidity in commodities i.e. (Sugar, Pepper, Gur and Ground nut), nearly all of them demonstrated a proof of co-integration among spot and future prices enlightening the precise route of attaining the enhanced operational effectiveness. Additionally prevarication confirms to be effectual regarding some commodities. Though, for few commodities, the unpredictability in price of futures has been significantly lesser as compared to spot price demonstrating an

unorganized exploitation of information. Azizan et al. (2007) scrutinized unpredictability spillovers in futures market of Malaysia of Crude palm oil. The study used bivariate model of ARMA(p,q)-EGARCH(p,q). For this purpose, the study employed daily data of futures and spot price for Crude palm oil and established that there is bidirectional transmission of information between both of the markets.

Roy and Kumar (2007) looked into lead-lag connection among prices of spot and futures of Indian wheat market. The study used Johansen Cointegration test to accomplish the purpose and found that subsequent to the commencement of the futures market the cointegration across spot markets had increased manifold. Roy (2008) analyzed 32 futures contracts of wheat in India. The study found that futures market of wheat is finely associated with spot markets in India. The study found that there is causality in both directions in the selected contracts during the study period. As well as, Roy (2008) also dogged that the futures market of wheat is proficient in having an effect on the spot prices of wheat. Ge et al. (2008) investigated interaction among cotton markets of China and US. The study used Granger Causality test to know the connection linking the two markets. The study found the cointegration in cotton futures prices of both the countries and bidirectional Granger Causality is also found between these two futures market. There is also well-organized sharing of price transmissions in these two markets.

Nath and Reddy (2008) found a boost in Indian commodity prices when future trading is done in the chosen commodities. Iyer and Pillai (2010) used two-regime Threshold Vector Autoregression(TVAR) to investigate whether futures market performs a principal role in the process of price innovation and concluded that futures price performs a principal role in the process of price innovation. Shihabudheen and Padhi (2010) discovered mechanism of discovery of price and effect of instability spillovers for Silver, Gold, Castor seed, Jeera, Sugar and Crude oil in Indian commodity market. The study results sustained that except in case of Sugar, futures price perform as a proficient vehicle of price innovation in the case of all selected commodities. It also established that there is existence of unpredictability spillover from futures to spot in all cases with the exception of Sugar.

Pavabutr and Chaihetphon (2010) studied the gold futures contracts traded at the Multi Commodity Exchange of India (MCX) from 2003 to 2007 for price discovery by making use of Vector Error Correction Model (VECM) which demonstrate that futures prices of standard and mini contracts show the way to spot price. The study findings showed that both the futures contracts reveal a stronger persuasion over spot prices in the short and long period. Dash and Andrews (2010) analyzed behavior of Indian commodity market and effects of causality among spot and futures prices. The study used a sample consisting of twenty-one commodities which were vigorously traded on NCDEX during Jan 2005 - Apr. 2007 and found that the pattern is quite different for different commodities. Gilbert and Morgan (2010) studied 19 commodities during 1970-2009, analyzed that instability has been lesser during previous two decades in comparison to previous time, excluding Rice. It established that unpredictability during the period 2006-08 is quite in order with past practices. Singhal et al. (2011) studied whether there exists a noteworthy impact of futures trading on instability of spot prices or there exists no such impact with respect to three commodities i.e. Sugar, Chana and Turmeric. The study used GARCH (1,1) method, the study established the confirmation of grouped instability. It was assessed that high unpredictability in the preceding stage will continue to be elevated during the current stage. Sehgal, Rajput and Dua (2012) studied ten commodities and price detection is definite for selected commodities only with the exception of Turmeric. Kumar and Shollapur (2015) studied the price activities regarding returns in addition to instability among the spot and futures markets for three commodities i.e. Soy oil, Soy bean, Mustard seed and Chana. The study employed models of VECM and EGARCH to evaluate the data. The

study brings into being subsistence of long-standing balance association among the futures and spot prices, with the futures leading the spot. In short run, futures returns appear to have a stronger impact on the spot returns in most of the commodities.

## Research Gap

The matter of price unpredictability and price innovation has been broadly researched for equity markets and stock markets but very few studies are based on agricultural market. Most of the studies focus on developed markets like US etc but still not a great amount of work has been done for emerging countries for example India. Innovative Indian futures markets of commodities typically comprise thin volumes, lower depth of market and deficiency of intense spot markets, meager delivery arrangement, restrictions of policies, and other market imperfections.

## Contribution of the Study

This study possesses worth because it make possible to discover which of the two markets is more proficient in dispensation and reflecting of latest information. The study pays attention on the performance of spot or future prices as a proficient vehicle of price detection and is enormously helpful for dealers to prevaricate their market threat. Apart from this, the study endow with constructive insights to the arbitrageurs, so that they can devise their tactics of trading on the basis of imperfections prevailing in the market. In addition to this, the study is enormously useful for the depositors and portfolio managers so that they can develop efficient strategies for trading and prevarication in context of the commodity market in India.

## Data and Methodology

**Type of study:** This study is descriptive.

**Sample and sampling technique:** The sample commodities for this study comprise four agricultural commodities taken from four different categories i.e. Castor seed (as Oil seed), Chana (as Pulses), Turmeric (as Spices), and Kapas (as Fibre). These commodities are operated on National Commodity Derivative Exchange of India limited (NCDEX) of India, Mumbai. These commodities are chosen because they are among the top traded commodities in terms of volume and value on NCDEX according to FMC annual report 2013-2014. The time period selected for the study is January 2011 to December 2015. The data involves daily prices of spot and futures. If data on a particular day is not available for a particular commodity then that particular period from the price series has been removed. While processing data modification in terms of removing the missing values and repetition in the trading days have been done. Also in instances where spot open price is missing, it is assumed that previous day closing price becomes the opening price for next day. In this study closing spot prices and near month futures prices are used. Near month contract of futures of respective commodity is chosen for the study, because they are heavily dealt as judged against subsequent month or distant month futures contracts. In this study future market is chosen to discover price innovation due to its highly competitive nature, this market has turned out to be an imperative profitable tool to decide prices based on estimated amount regarding supply and demand of today and tomorrow. Futures market prices depend on an uninterrupted surge of information from the world and consequently require an elevated amount of transparency.

**Method of data collection:** This study uses secondary data which is collected from the website of NCDEX which is available for public domain.

**Variables:** There are basically two types of variables as follows:



Independent Variable: Commodity future prices

Dependent Variable: Commodity spot prices

**Statistical tools:** In this study required tests are executed to ascertain in detail price innovation mechanism and instability spillover. Firstly, this study tests whether the series of futures and spotprice are cointegrated but prior to test cointegration it is crucial to examine the stationarity level of price series. This study used Augmented Dickey Fuller (ADF) 1981 analysis and Phillips and Perron (1988) analysis to analyze the stationary level of the time series. The null supposition of ADF and PP analysis assumes that time series are non stationary. After scrutinizing stationarity level of price series, cointegration test and VECM is applied on the data collected. At last, to study the volatility spillover effect this study used bivariate EGARCH model.

### Objectives of Study

- To know the impact of commodity future trading on price discovery of commodity spot prices.
- To know the volatility spillover effect between agriculture commodity spot and future prices.

### Price Discovery and Volatility Spillover

#### Stationarity Test

Augmented Dickey–Fuller test (ADF) is an analysis of stationarity level in time series. When this test is applied on the sample price series a negative number comes out which is called Augmented Dickey–Fuller (ADF) statistic. When the ADF test statistic value is judged against its corresponding critical value and test statistic value comes out smaller than critical value then the null supposition is rejected and if test statistic value comes out more than critical value then the null supposition can't be rejected. Results of stationarity test are presented in Table 1.

**Table 1: Table showing Data Stationarity Test for Sample Commodities**

	Levels	ADF critical values	ADF test statistics	PP critical values	PP test statistics
<b>Castor seed spot prices</b>	1 percent Level	-3.434404	-2.150283	-3.434404	-2.159386
	5 percent level	-2.863217		-2.863217	
	10 percent level	-2.567711		-2.567711	
<b>Castor seed future prices</b>	1 percent Level	-3.434406	-2.222761	-3.434404	-2.197870
	5 percent level	-2.863219		-2.863217	
	10 percent level	-2.567712		-2.567711	
<b>Turmeric spot prices</b>	Levels	ADF critical values	ADF test statistics	PP critical values	PP test statistics
	1 percent Level	-3.434417	-1.263729	-3.434404	-1.280828
	5 percent level	-2.863223		-2.863217	
	10 percent level	-2.567714		-2.567711	
<b>Turmeric future prices</b>	1 percent Level	-3.434404	-1.767378	-3.434404	-1.789252
	5 percent level	-2.863217		-2.863217	
	10 percent level	-2.567711		-2.567711	

	Levels	ADF critical values	ADF test statistics	PP critical values	PP test statistics
<b>Kapas spot prices</b>	1 percent Level	-3.434404	-3.032210	-3.434404	-3.171709
	5 percent level	-2.863217**		-2.863217**	
	10 percent level	-2.567711*		-2.567711*	
<b>Kapas future prices</b>	1 percent Level	-3.434406	-2.149178	-3.434404	-2.110541
	5 percent level	-2.863219		-2.863217	
	10 percent level	-2.567712		-2.567711	
<b>Chana spot prices</b>	Levels	ADF critical values	-1.420892	PP critical values	-1.401018
	1 percent Level	-3.434409		-3.434404	
	5 percent level	-2.863220		-2.863217	
	10 percent level	-2.567712	-2.567711		
<b>Chana future prices</b>	1 percent Level	-3.434404	-1.674502	-3.434404	-1.686041
	5 percent level	-2.863217		-2.863217	
	10 percent level	-2.567711		-2.567711	

The Table above shows the ADF 1981 and PP analysis applied on sample price series. The null supposition of ADF test and PP test presupposes that unit root exists in the sample series. In the above table comparison have been done between the test statistics and the relevant critical value at various percentage levels and \*\*\*, \*\* and \* explains rejection of null hypothesis means no unit root exist at 1 percent, 5 percent and 10 percent level of significance.

## Johansen Cointegration Test

Cointegration procedure helps to establish the existence of long standing balanced correlation between both prices. The cointegrating vector discovers the presence of long standing stability at the same time error correction dynamics illustrates the price innovation procedure which facilitate the markets to reach stability. The cointegration methodology fundamentally moves on with mobile character of price series and reduces the divergence which occurs from the divergence of long-standing equilibrium. The cointegration of futures and spot price entails existence of causality as a minimum in one direction.

The thought of cointegration was initially introduced by Granger, though it has numerous imperative flaws. If the variables are more than two, the technique of Granger has no organized method for assessment of several cointegrating vectors separately. Although there is merely single cointegration association, then its examination becomes ineffective on account of the loss of information. This is the reason that technique of Engle Granger presupposes that all the variables are potentially endogenous. Consequently, the single equation approach of Engle-Granger to examine for cointegration would give the wrong impression about results. That's why the approach developed by Johansen and Juselius is well thought-out better than Engle-Granger method. This is because, this approach gives a multivariate framework and permits for more than one cointegration vector and thereby prevents any loss of effectiveness.

Here, best possible lag length is chosen in accordance with Akaike information criterion. Further it is implicit that there is no linear deterministic trend in sample series. The results of Johansen Cointegration test applied on selected commodities are shown in Table 2.

**Table 2: Table showing Results of Johansen Cointegration Test**

Indices	No of co-integrating equations (CE)	Lag Length	Max-Eigen Statistic	Trace Statistic	0.05 Critical Value	Prob.**
Castor seed	$r = 0$	1-4 (in first difference of two series)	51.05415	55.64116	15.49471	0.0000*
	$r \leq 1$		4.587014	4.587014	3.841466	0.0322*
Turmeric	$r = 0$	1-4 (in first difference of two series)	42.49296	44.96387	15.49471	0.0000*
	$r \leq 1$		2.470902	2.470902	3.841466	0.1160
Kapas	$r = 0$	1-4 (in first difference of two series)	15.91699	21.48359	15.49471	0.0055*
	$r \leq 1$		5.566599	5.566599	3.841466	0.0183*
Chana	$r = 0$	1-4 (in first difference of two series)	54.65186	56.41430	15.49471	0.0000*
	$r \leq 1$		1.762438	1.762438	3.841466	0.1843

*Trace test indicates 1 cointegrating eqn(s) at the 0.05 level*

*\* denotes rejection of the null hypothesis at the 0.05 level*

*The table shows the Johansen's cointegration test's output.*

In the table Maximal Eigen value and Trace test statistics facilitate in understanding outcome of Johansen's cointegration test. Maximum Eigen value and Trace test statistics specify existence of single cointegrating vector at five percent significance level between both price series. From these two it can be construed whether the null hypothesis at  $r=0$  can be rejected or can't be rejected at  $r=1$ . From the table it can be noticed that in cases of all the commodities i.e. Castor seed, Turmeric, Kapas and Chana, Maximal Eigen value and Trace Statistic are more when compared to critical value at  $r=0$  it means null hypothesis is rejected. Taken as a whole, Johansen's test results hold up both the prices, futures and spot, go ahead in the long period. In addition results can be interpreted with the help of p value. In all the cases p value at  $r=0$  is less than 0.05. Here, the null supposition is rejected. Rejection of null hypothesis means that one cointegration association is present between both prices i.e. spot and futures. It can also be inferred from the table that both prices of the commodities distribute general long-run information between themselves. The cointegration consequences substantiate on the whole that there exists a price innovation procedure in the commodity market.

The cointegration test explains that if both the commodity markets are inventive as well as efficient then the commodities in these markets react inexplicably towards the information regarding price formation in the short period. It means a particular market which is deviating from equilibrium is not dynamic to access the latest information and implement improved know-how. But in the long run both the markets achieve equilibrium because in long run both the markets have ample time to adopt better technology and access the new information.

## Vector Error Correction Model

This model shows the degree of disequilibrium in spot and futures markets from one period to other which is rectified in the subsequent period. This model also shows the comparative degree of correction that occurs in both markets in order to achieve stability. The Vector Error Correction Model result demonstrates dynamics of short run in the price series as well as the movements of price in the spot and futures markets.

The best possible lag length in this model is chosen in accordance with Akaike's Information Criteria. For the complete phase, coefficients of the error correction terms are statistically considerable, in the equations of spot and future markets. This means that if both of the markets try their level best and make corrections to reinstate the equilibrium condition at the stage in the coming period when their price relationship diverges from the long-run cointegrated equilibrium.

**Table 3: Table showing Results of Vector Error Correction Model**

Commodities	Castor seed		Turmeric		Kapas		Chana	
	$\Delta ST$	$\Delta FT$	$\Delta ST$	$\Delta FT$	$\Delta ST$	$\Delta FT$	$\Delta ST$	$\Delta FT$
<b>Equilibrium error</b>								
<b>Coefficient</b>	-0.104	0.039	-0.019	0.012	-0.014	-0.002	-0.016	0.0436
<b>Std. error</b>	(0.009)	(0.009)	(0.002)	(0.005)	(0.003)	(0.001)	(0.005)	(0.006)
<b>t-statistics</b>	[-11.273]	[ 4.258]	[-7.013]	[ 2.463]	[-3.724]	[-2.059]	[-3.123]	[ 6.530]
<b>prob.</b>	0.000*	0.000*	0.000*	0.013*	0.000*	0.039*	0.001*	0.000*
<b>Spot(-1)</b>								
<b>Coefficient</b>	0.0553	0.029	0.108	0.141	0.020	0.009	0.168	-0.062
<b>Std. error</b>	(0.024)	(0.024)	(0.024)	(0.046)	(0.025)	(0.007)	(0.025)	(0.033)
<b>t-statistics</b>	[ 2.241]	[ 1.188]	[ 4.345]	[ 3.079]	[ 0.793]	[ 1.286]	[ 6.591]	[-1.880]
<b>prob.</b>	0.025*	0.234	0.000*	0.002*	0.427	0.198	0.000*	0.060
<b>Spot(-2)</b>								
<b>Coefficient</b>	0.052	0.025	0.153	0.073	0.020	0.014	-0.081	0.075
<b>Std. error</b>	(0.024)	(0.024)	(0.024)	(0.046)	(0.025)	(0.007)	(0.025)	(0.033)
<b>t-statistics</b>	[ 2.113]	[ 1.028]	[ 6.168]	[ 1.601]	[ 0.789]	[ 1.881]	[-3.192]	[ 2.269]
<b>prob.</b>	0.164	0.000*	0.817	0.800	0.576	0.000*	0.107	0.673
<b>Future (-1)</b>								
<b>Coefficient</b>	-0.036	0.112	-0.003	0.006	0.047	0.171	0.031	-0.010
<b>Std. error</b>	(0.026)	(0.026)	(0.014)	(0.026)	(0.085)	(0.025)	(0.019)	(0.025)
<b>t-statistics</b>	[-1.389]	[4.261]	[-0.230]	[ 0.252]	[0.558]	[ 6.691]	[ 1.611]	[-0.421]
<b>prob.</b>	0.034*	0.304	0.000*	0.109	0.430	0.060	0.001*	0.023*
<b>Future (-2)</b>								
<b>Coefficient</b>	-0.061	0.025	0.019	0.035	0.030	-0.015	-0.067	0.076
<b>Std. error</b>	(0.026)	(0.026)	(0.014)	(0.025)	(0.085)	(0.025)	(0.019)	(0.025)
<b>t-statistics</b>	[-2.333]	[ 0.976]	[ 1.388]	[ 1.349]	[ 0.359]	[-0.610]	[-3.433]	[ 3.038]
<b>prob.</b>	0.019*	0.329	0.165	0.177	0.719	0.541	0.000*	0.002*
<b>Constant</b>								
<b>Coefficient</b>	2.978	2.187	0.710	1.687	0.583	0.240	0.670	0.510
<b>Std. error</b>	(2.195)	(2.208)	(3.422)	(6.331)	(1.263)	(0.380)	(1.017)	(1.317)
<b>t-statistics</b>	[ 1.356]	[ 0.990]	[ 0.207]	[ 0.266]	[ 0.461]	[ 0.631]	[ 0.658]	[ 0.387]
<b>prob.</b>	0.174	0.322	0.835	0.789	0.644	0.678	0.510	0.698

From the table it can be seen that in equation of spot market for Castor seed the error equilibrium coefficient is 0.0553 which shows that when the standard spot price became too high, it instantly falls back towards future price in order to establish equilibrium. To be precise, the spot price makes corrections in its preceding period's disequilibrium by 5 percent. Similar explanation can be applied to coefficient of other commodities.

By and large, the table outcome of this model exposes that the Error Correction coefficients of both equations of Castor seed are statistically significant, signifying the subsistence of long-run stability affiliation among spot and futures price series of Castor seed market and the information flow is largely equal in both markets.

Further, the outcomes show that the Error Correction coefficients of both equations of Turmeric are statistically significant, signifying the presence of long-run stability affiliation among spot

and futures price series of turmeric market and showed that the strength of the relationship from futures to spot is stronger than spot to futures.

Moreover, the findings indicate that the Error Correction coefficients of both equations of Kapas are statistically significant, signifying the presence of long-run stability affiliation among spot and futures price series of Kapas market and showed that the strength of the connection from spot to futures is stronger than from futures to spot.

Moreover, the findings indicate that the Error Correction coefficients of both equations of Chana are statistically significant, signifying the presence of long-run stability affiliation among spot and futures price series of Chana market and showed that the flow of information is largely equal in both markets.

Generally, elements of vectors stipulate that both markets correct to the latest balanced price subsequent to a price divergence. From above table it is certain that the future market enjoys supremacy over the spot market in the light of the fact that the futures market's coefficient are higher in magnitude which entails that future price makes larger amendments to achieve the equilibrium back. The futures market also provides the efficient price discovery. The results divulge that terms of error correction in case of future market in most of the commodities/indices is larger in amount rather than spot market. It shows that future price creates higher modifications in order to bring back the equilibrium. Or it can say, future price governs the spot price.

## EGARCH Model

Volatility spillovers divulge that as the futures trading is a bigger program of trading and has tentative nature so trading in it could exaggerate instability in the fundamental spot market, possibly because of its nature. The hypothesis of volatility spillovers entails analysis for lead-lag associations among instabilities in spot and futures markets. If it is presupposed an ARMA model which means Autoregressive Moving Average Model which is proposed for the divergence of error, then the model is a Generalized Autoregressive Conditional Heteroskedasticity Model. If it is desired to know the impact of futures on unsteadiness of spot price, then irregularity in the prices of spot and futures is examined by means of GARCH model and EGARCH model. Under this GARCH (p,q) model the constrained inconsistency based on the square left over in the previous p phase and the constrained inconsistency in the previous q phase. But some limitations are there in GARCH (1, 1) model. The main limitation is that it contravenes the non-negativity situations by the technique of assessment. Another limitation of GARCH model is that it cannot provide justification concerning effects of influence where it presupposes good news and bad news have the identical impact on unpredictability. Additionally, GARCH model does not allow for feedback concerning the conditional variance and the conditional mean.

The exponential GARCH model permits for varied reaction in the unpredictability which comes from positive shock and negative shocks. EGARCH permits for varied values in the GARCH parameters which are based on the direction of shock. As a result, instability may be larger consequent to a negative shock rather than positive shock. This behavior is experienced in commodity markets from time to time. The EGARCH model is a logarithmic conversion of the GARCH model. EGARCH model has two main repercussions. The first implication is that the underlying constraints are enforced to be positive, as it expects them to be. The log is characterized on numbers which are positive. The second repercussion is that the EGARCH permits for an asymmetric consequence in the reaction to positive and negative shocks. The EGARCH model is

believed as somewhat more multifaceted model in comparison to that of the GARCH (p; q) model. EGARCH (1, 1) model has a distinguishing attribute, i.e., conditional variance is reproduced to incorporate the influence of volatility. That's why the study used this model.

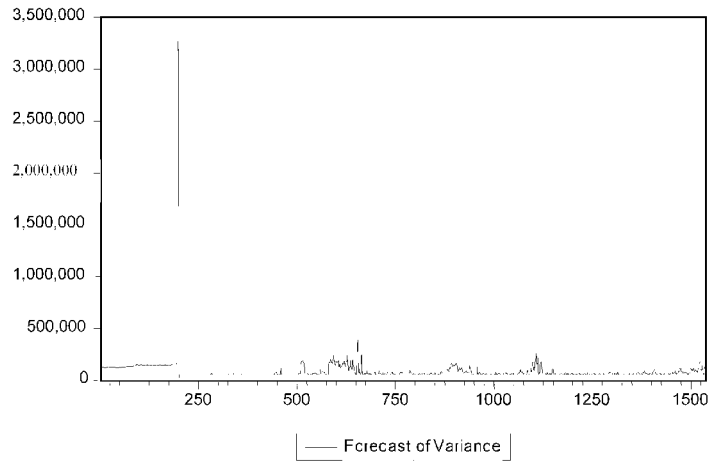
**Table 4: Table showing EGARCH Model for volatility spillover**

Variance Equation	Castor seed		Turmeric		Kapas		Chana	
	Spot	Future	Spot	Future	Spot	Future	Spot	Future
$\omega$								
Coefficient	14.3334	-0.0899	16.0013	-0.2702	2.3481	0.8914	0.7404	1.5216
Standard error	0.4733	0.0749	0.1765	1.1231	0.2019	0.1118	36.5447	2.9503
z-Statistic	30.281	-1.2003	90.7090	-0.2406	11.6268	7.9676	0.0202	0.5157
Prob.	0.0000	0.2300	0.0000	0.8099	0.0000	0.0000	0.9838	0.6060
$\alpha$								
Coefficient	0.8459	-0.8156	0.7459	0.1409	-19.9430	-0.0700	3.7516	-0.4074
Standard error	3.3110	1.4930	4.3879	8.3568	1.9422	7.7376	22.3439	2.3631
z-Statistic	0.2554	-0.5462	0.1700	0.0168	-10.2679	-0.0090	0.1679	-0.1724
Prob.	0.7983	0.5849	0.8650	0.9865	0.0000	0.9928	0.8667	0.8631
$\gamma$								
Coefficient	0.8358	1.0587	0.7648	0.2347	20.9124	0.3861	-0.7103	0.9239
Standard error	3.3122	1.4930	4.3879	8.3456	1.9623	7.7378	19.1406	2.3420
z-Statistic	0.2523	-0.7091	0.1742	0.0281	10.6567	0.0499	-0.0371	0.3945
Prob.	0.8008	0.4782	0.8616	0.9776	0.000	0.9602	0.9704	0.6932
$\beta$								
Coefficient	0.0116	0.9913	0.0259	0.9944	0.7505	0.9100	0.7622	0.8731
Standard error	0.0234	0.0049	0.0075	0.0620	0.0215	7.7378	1.8980	0.1825
z-Statistic	0.4945	20.1257	3.4608	16.0256	34.9068	0.0499	0.4015	4.7830
Prob.	0.6209	0.0000	0.0005	0.0000	0.0000	0.9602	0.6880	0.0000

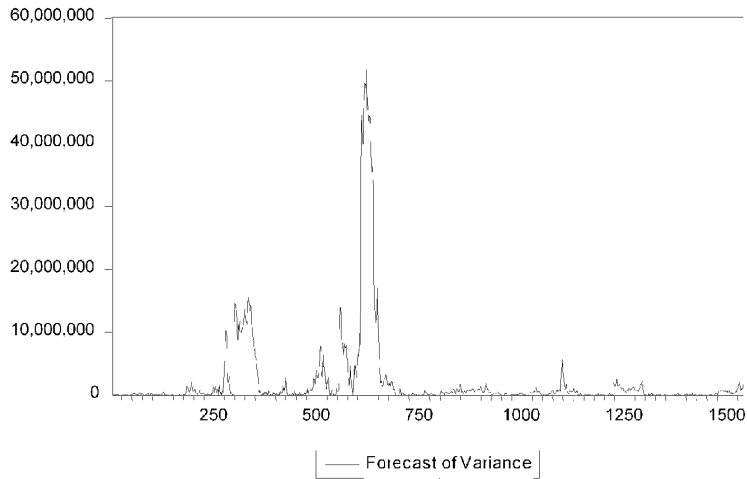
The model of EGARCH has been applied in evaluating impact of unpredictability spillover involving spot and future market for concerned commodities. The effect of Volatility Spillover implies that if on a particular day volatility appears in one market it will influence the instability of the other market on subsequent day. From table 4 the directions of volatility spillover can be seen in Castor seed, Turmeric, Kapas and Chana are from future to spot market because the coefficient of spot is greater as compared to the coefficient of future market in most of the cases. If there is an increase in the flow of information of future, unpredictability in fundamental spot market will mount. This entails that as rate of information flow increases volatility of the asset price will grow up. This means bad news effect is greater than good news effect for spot to futures.

This was the historical view of volatility which is based on past prices. Now this study forecasts future unpredictability by forecasting variance graph. Forecast makes use of the projected ARCH model to discover static and dynamic forecasts of the mean, its standard error of forecast, and the conditional variance. Static forecast calculates a series of one-step forward forecasts, by using the actual values, rather than forecasted values for lagged reliant variables, if available. The one-step forward static forecasts are more accurate in comparison to the dynamic forecasts because, for every time, the actual value is applied in structuring the forecast. Static forecasting necessitated that data for exogenous and endogenous variables are experimental for surveillance in the estimated sample. Static forecasting executes a sequence of one-step forward estimate of the reliant variable which is divided by the estimated residual standard deviation for all time using the actual value of the lagged endogenous variable.

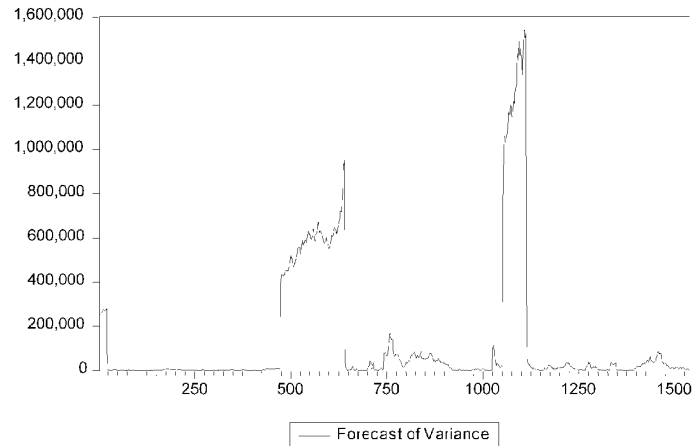
**Figure 1: Forecast of variance of Castor seed**

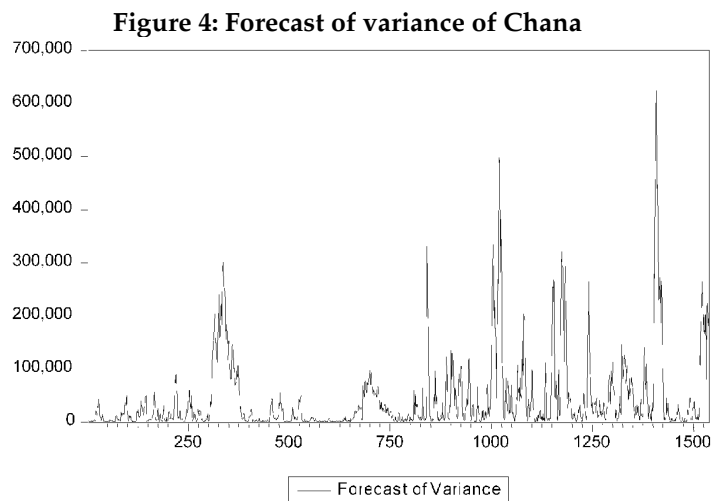


**Figure 2: Forecast of variance of Turmeric**



**Figure 3: Forecast of variance of Kapas**





According to the graph it can be predicted that there is less unpredictability in trading of Castor seed. The graph of turmeric shows there is moderate risk in case of trading in Turmeric. The graph of Chana and Kapas shows the high unpredictability in trading of Chana as well as in Kapas. So there is less risk in trading of turmeric and castor seed but high risk in trading of Chana and Kapas.

### Limitations of the study

The study has various limitations:

1. The period considered for the study was only five years since the product was launched on the NCDEX exchange.
2. The data included in the study were daily closing prices both spot and futures where as more definite results could be produced by using intra-day data.
3. The study was based on only four agriculture commodities but there are various agricultural commodities traded on NCDEX.

### Scope of the study

1. Agricultural commodities are based much on rain fall, seasons and government support in terms of subsidies and support price extended by government to assist the farmers.
2. Further there is scope of doing such research and testing the conclusion for other national commodity exchange like MCX, NMCE, ICEX, UCE etc.
3. A number of natural processes for example seasonal cycles which are dependent on harvests, monsoons, depressions, events regarding weather also have an impact on price detection in commodity markets; this is one more area that requires to be studied.
4. The storability of asset also performs a significant job in price detection. This issue can also be thought-out for further study in this area.

### Concluding Remarks

The most imperative purpose of commodity market of India is to create worth for the traders because commodity market provides a mechanism which protects the trader's business from undesirable changes in price of the commodities. Traders or exporters can easily evade their price risk by using futures market through mechanism of price efficiency. In addition, the study

of unpredictability interdependence offers helpful insights keen on how the transmission of information is done and how the information is dispersed among futures and spot markets. The economy which is free from arbitrage, a direct link exists among instability of prices and the flow of information. If in futures market the surge of information is increased then unpredictability in the fundamental spot market will also grow up. The derivative instruments accessible for the underlying commodities considerably influence the unpredictability of the spot market. It can be concluded from Johansen Cointegration test and VECM that futures market of commodity are more efficient in terms of price detection and information dissemination as compared to spot market. The cointegration outcomes prove the existence of long-run association among spot and futures series of Castor seed, Turmeric, Kapas, Chana respectively. The Vector Error Correction Model confirms bidirectional causality among spot and futures series of Castor Seed, Turmeric, Kapas, Chana suggesting that spot and future markets of the selected agricultural commodity performs the foremost role through price innovation procedure in India. In addition, from EGRACH model the study outcomes demonstrated that spillovers of information occur from futures to spot market and the future market has the potential to depict all innovative information. The results of the study have realistic propositions for financiers as well as market partakers who desire to circumvent their risk. Financiers may make use of the futures market price, which have a propensity to determine innovative information more speedily than spot prices, to implement more effectual prevarication tactics. Furthermore, the policy makers who can better understand the interdependence of these markets will be able to coordinate the stability of financial markets easily.

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