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RESEARCH ARTICLE

Application of Variance Decomposition Model in Pricing Analysis of Agriculture Commodity Spot and Future Market

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Abstract

India's commodity markets are expanding quickly because of globalisation, which began in earnest in 1991. These markets underwent significant evolution in conjunction with other financial markets due to changes in legislation, such as SEBI controlling regulation of commodity market of India in 2015. The objective of the paper is to compare spot and futures pricing to seek price discovery for the selected commodities, which were only used in the agricultural industries. The present paper emphasized the causality direction amongst the spot-futures pricing. In this investigation, secondary quantitative data were used. The data was gathered through the website, annual reports, and the Bloomberg Database. The data was collected in the form of a time series with a daily frequency. The study covered a variety of agricultural goods, including guar gum, chana, guar seed, jeera, coriander, soybean, barley, turmeric, castor seed and wheat. A VAR model and models for variance decomposition are applied to analyze data. The empirical analysis demonstrated that spot markets controlled most agricultural commodities when compared to their future markets. Any new information that affected market pricing for agricultural commodities was reflected in the spot prices, which also affected the pricing of the commodities in the future.

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Introduction

A large portion of the population in India's economy still works in agriculture, making it primarily an agricultural nation. 60% of the active people in India's rural areas work in agriculture, which has helped to reduce rural poverty using technology, input supplies, and market access (Shah, 2002; Himanshu *et al*., 2013). The market for commodity derivatives in India is off to a strong start. Potential markets for items like raw jute and jute products, such as edible oil seeds, appeared later (Kolamkar, 2003 and Ahuja, 2006). The danger of price volatility has increased for market players due to the opening of the Indian commodity markets. Market-based risk management tools and procedures are required to manage the growing risks, and futures markets offer a crucial tool in this category (World Bank 1996). Reducing farmers' transaction costs and making sure they didn't have to travel too far to sell their produce were the main goals of controlling the commodity markets. A well-

developed commodity mark*et al*so offers options for risk diversification, which helps investors manage their portfolios effectively. India's exports largely consist of agricultural goods. Setting minimum support prices results in a significant government intervention in agricultural commodity pricing. The Futures Market Commission (FMC) in India is regulating the country's commodity exchanges. FMC and the SEBI merged on September 28, 2015. In 2002, the Indian Government reinstated the commodities futures contract after being abolished in 1966 Volatility spillover or risk spillover from one market to another market or one asset to another asset in an important drawback in the commodity derivatives market. In a competitive environment information transmission is a key factor in price discovery. Similarly, risk also transmits from one segment to another segment. Jobst (2007) has focused on the development of derivative markets in emerging economies to mitigate the price risk and diversification benefits by investing in various asset class. The study has reviewed the recent development in the equity derivatives market in Asia and reveals a critical debate about market microstructure and prudential supervision.

LITERATURE REVIEW

Numerous research studying the lead and lag relationship between spot and futures prices of various commodities have been conducted in India and internationally. These studies' major objective was to determine which market reacts earliest when important news enters the market. Various research on the price discovery connection for agricultural commodities have produced varying conclusions. Shree and Singh (2016) highlighted the expansion and present status of the Indian market for commodity derivatives. It is considered that due to derivatives market expansion, the risk has increased in the finance industry. The derivatives market offers various risk management tools which help traders in managing their risk. It is characterised by considerable market volatility in terms of contract volume and price. Contrary to commodities derivatives, there is a significant amount of trade in currency and interest rate futures. Mukherjee and Goswami (2017) investigated the daily return volatility pattern of a few selected commodity futures in India and investigated how much the Samuelson hypothesis is satisfied by the a few selected commodity futures. For the selected commodity futures, except for potato futures, they discovered the existence of long memory and sustained volatility. It was found that mature market was present for the crude-oil and gold futures. Gupta *et al*. (2018) investigated the price discovery and the long-term efficiency of the futures market.

Futures commodities were determined to be the very important estimator of changes in commodity prices. For market traders, the outcomes have a significant impact. They can use the future prices to find it and profit by transferring the new equilibrium to the spot market. Kaura *et al* (2018) found that most commodities were shown to have spillover effects in both directions, with spillovers from futures returns to spot returns being more noticeable than the reverse. The Indian futures market is responsible for increased price effectiveness and spot market volatility. Mishra *et al* (2020) examined volatility spillover and price discovery in the future and spot agriculture commodity markets in India. All nine commodities were shown to have price discovery, with six of them (soybean seed, turmeric, coriander, castor seed, chana and guar seed) having the futures market leading the spot market. Price discovery occurs on the spot market for commodities cotton seed and jeera. They demonstrated that the futures and spot markets had reciprocal spillover effects. Consequently, it was perceived that the Indian futures market is effective in determining the agri-commodities price. Richter M, Sorensen C (2002) examined the volatility in the soybean future and spot markets. It was discovered that seasonality patterns can be seen in spot price and volatility levels for commodities. S Sehgal, N Rajput, RK Dua (2012) examined the spot market volatility of seven agricultural commodities and future market volatility was evaluated (guar seeds, turmeric, black pepper, soya bean, barley, castor seed and maize). They discovered that unanticipated futures trading volume is high for five agricultural commodities out of seven and is creating spot price volatility (Guarseed, Turmeric, Maize, Soyabean and Castor Seed). The commodity named pepper showed the inverted effect with spot volatility impact on futures

volatility and no causal association is shown by barley agricultural commodity. Sendhil *et al* (2013) studied how effective the futures market of wheat, maize, chickpeas and barley was for price volatility, price transmission and price discovery. They discovered that the futures market is more effective in deciding wheat and maize prices. All markets, except for the barley market, are determined to be co-integrated. Future market prices and volume have shown significant volatility in the wheat and barley markets. The spot prices are inclined by future prices of all the commodities. Price volatility has shown that spot prices outperform future prices. Srinivasan P (2012) verified the presence of enduring equilibrium amongst commodity market futures and spot prices. They suggested that information is moving from commodity spot markets to futures markets. In all MCX commodities markets, the BEKK model predicts the occurrence of bi-directional volatility spillovers, but they are mostly from the spot to the futures market.

Shree and Singh (2016) attempted to focus on the development and present status of Commodity Derivatives Market in India. The emergence and growth of the derivatives market has been witnessed by increased risk in the financial market. The commodity derivatives are the first instrument used to secure the farmers by protecting them against price risk. A large volume of derivatives trading is linked to currency and interest rate derivative as compared to commodity derivatives. However, the commodity derivative market is very large as compared to the underlying physical commodity market. India has a long presence in commodity derivatives trading. Jiang, Huayun, *et al*. (2017) studied the U.S. and China, which are two of the biggest players in the world agricultural market. The literature documents that volatility in the U.S. agricultural futures market spills over significantly to that of China. The results confirm the existence of significant spillovers from the U.S. to China for four commodities, primarily generated by the shorter-term volatility components in the U.S., and provide evidence for the increasing pricing power of the Chinese market. Mukherjee and Goswami (2017) examines the pattern of daily return volatility of select commodity futures in India and explores the extent to which the select commodity futures satisfy the Samuelson hypothesis. The study sheds light on significant characteristics of the daily return volatility of the commodity futures under analysis. The results suggest the existence of a developed market for the gold and crude oil futures (with volatility clustering) and show that the maturity effect is only valid for the gold futures. Gupta, Choudhary and Agarwal (2018) attempts to empirically investigate the long-term market efficiency and price discovery in Indian commodity futures market. The presence of short-term biases in the Indian futures market is evidenced in the results of VECM model indicating the presence of informational efficiency. The statistically significant value of past prices of spot and futures confirm the short-term inefficiency and biasness. The significant value of error correction term (ECT) of futures prices suggests that commodity futures are the most important indicator of commodity price movements.

Kaura, Kishor and Rajput (2018) investigated the issue of price discovery and volatility spillovers in the context of the non-agricultural sector of Indian commodity market using econometric models. The results of GARCH test prove that there are bidirectional spillover effects in most commodities, and spillovers from futures returns to spot returns are more prominent than the other way around. The results imply that the futures market in India is playing its role in improving pricing efficiency and also influences the spot market volatility.

Bouri Elie *et al*. (2019) studied the volatility relation between commodities and sovereign risk of BRIC. They used the GARCH-quantile regression with a dummy variable. The authors studied whether the contemporaneous and lagged volatility of the commodity/energy markets can help predict the volatility of Brazil, Russia, India, China (BRIC) sovereign risk in the quantiles. The study reveals the importance of the mid-2014 energy price decline for the volatility dynamics of BRIC sovereign risk; after mid-2014, the volatility of the sovereign risk has increased in Brazil and Russia, while it has decreased in India. Mukherjee and Goswami (2019) investigated the pattern of volatility in daily returns from select Commodity Futures and Stock market in India. One

Commodity Future from each group of futures is chosen for the study which are Potato, Gold, Crude oil and Mentha Oil. S&P CNX Nifty is selected as a representative of stock market. The results obtained point to the fact that Crude Oil and Gold futures market is almost similar to the functioning of the stock market in India. R L, M. and Mishra, A.K. (2020) studied the price discovery and spillover effect are prominent indicators in the commodity futures market to protect the interest of consumers, farmers and to hedge sharp price fluctuations. This paper aims to investigate empirically the price discovery and volatility spillover in Indian agriculture spot and futures commodity markets. The Granger causality tests indicate that futures markets have stronger ability to predict spot prices. Supporting these, the results from EGARCH volatility test reveal that there exist mutual spillover effects on futures and spot markets. Thus, it could be inferred that futures market is more efficient in the price discovery of agricultural commodities in India.

Rastogi and Agarwal (2020) found the volatility spillover effects across spot, futures and option markets. The NIFTY 50 index is taken into observation. The study period is from January 8, 2010 to October 25, 2019. Bivariate BEKK-GARCH model was implemented to find the volatility spillover effects among these markets. Later CCC-GARCH model was used to find the close proximity between the markets to check the robustness of our volatility spillover results obtained from bivariate BEKK-GARCH and the results from CCC GARCH supports the BEKK-GARCH results. Kar (2021) suggested that improved price risk management and price discovery had been made possible by the shift to agricultural commodities futures markets. These markets guarantee price risk reduction and compensatory returns, but they also help reduce the negative risks connected to agricultural loans, which makes credit to agriculture easier to come by. Moreover, they play a crucial function in stimulating the spot markets and instigating the varied expansion of Indian agriculture in harmony with the demand trends. Therefore, it is necessary to implement enabling regulations to streamline the supply chain and bolster the agricultural commodities futures markets. Manogna and Mishra (2023) found that price discovery occurs in the spot and mandi markets, resulting in futures pricing. Mandi price returns were observed to harm spot returns for jeera, coriander, and chana as well as futures returns for cotton and guar seeds. A short-term association was found between all three markets. Prices for these commodities can be predicted from the prices in the other three marketplaces. The cottonseed, guar seed, jeera, and rape mustard seed cases showed a one-way causal relationship between the mandi marketplaces and the other two markets.

Garg *et al.* (2023) looked into the lead-lag relationship, volatility spillover between spot and future prices. It is found that the NCDEX spot and futures market is dominant in the mechanism of price discovery and that it has a unidirectional or bidirectional link with the E-NAM spot prices. Moreover, the bivariate GARCH model indicated that most commodities, except for bajra, barley, and jeera, which have no volatility spillover, had a volatility spillover from E-NAM spot prices to NCDEX futures and spot markets.

Supriya and Mamilla (2023) investigated how seasonality and volatility affect agricultural commodities' price discovery. It is found that the futures market for agricultural commodities, such as soybeans and maize, is more adept at price discovery than the cash market.

Liquidity and institutional constraints impeding price discovery and attributes variations in efficient prices to trades, Garbade and Silber (1983); Zapata and Fortenbery (1996); Yang and Bessler (2001); Brockman and Tse (1995); Hasbrouck (199I); Mattos and Garcia (2006). Henriksen *et al.* (2019) highlight market connectedness and spillovers in the green energy market for hedging and diversification. Stoll & Whaley (1990) find that S&P 500 and MM index futures returns lead stock market returns by about five to ten minutes, even after accounting for infrequent trading effects. Regular futures contracts dominate in price discovery, while mini futures and cash index markets play minor roles., Choy & Zhang (2010).

Kwaller *et al.* (1987) and Chan (1992) find an asymmetric lead-lag relationship between spot and futures markets for MMI and S&P 500 Index, with strong evidence that futures markets lead

spot markets and weaker evidence for the reverse. Praveen and Sudhakar (2006) find unidirectional causality from spot prices to futures trading volume in crude oil on MCX, India. Schwarz & Szakmary (1994) affirm the Indian commodity futures market's powerful price discovery function across selected commodities, indicating its efficiency.

Investors benefit from diversification through financial instruments, both with physical commodities and commodity futures, affirming commodities as valuable diversification investments, Belousova & Dorfleitne (2012). Speculative activity reduces noise in futures markets while enhancing their role in price discovery, Bohl *et al.* (2020). Commodity price changes originate in the futures market due to informed investors and speculators favoring lower costs and higher leverage. This information is then transmitted to the spot market via arbitrageurs, explaining the nonlinear relationship, Ameur *et al.* (2020). Futures prices are good predictors of spot prices in the heating oil market, significantly contributing to past price changes even when accounting for variables like crude oil prices, inventory levels, and weather, Bopp and Sitzer (1987). Price discovery, where futures markets quickly absorb and transmit new price-relevant information. Early studies used dynamic models in price levels or differenced prices, while later studies employ co-integration models, Brooks *et al.* (2001) observe that the spot index lags behind futures contracts for FTSE 100, German DAX, NSA (Nikkei Stock Average), and Greece's FTSE/ASE-20 and FTSE/ASE Mid 40 index futures. McMillan & Speight (2001) highlight that commodity futures markets facilitate risk

Futures market shocks dominate in explaining spot market variation, with minimal contribution from spot market disturbances to futures market variability. The competitive market conditions lead to the convergence of commodity spot prices to production costs and both spot and futures prices contribute to long-run equilibrium dynamics. suggest commodities markets as alternative investments. Pati & Padhan (2009; Pindyck (2001); Talbi *et al.*(2020); Chang & Lee (2015); Cheng & Xiong (2014; Chhajed & Mehta (2013)

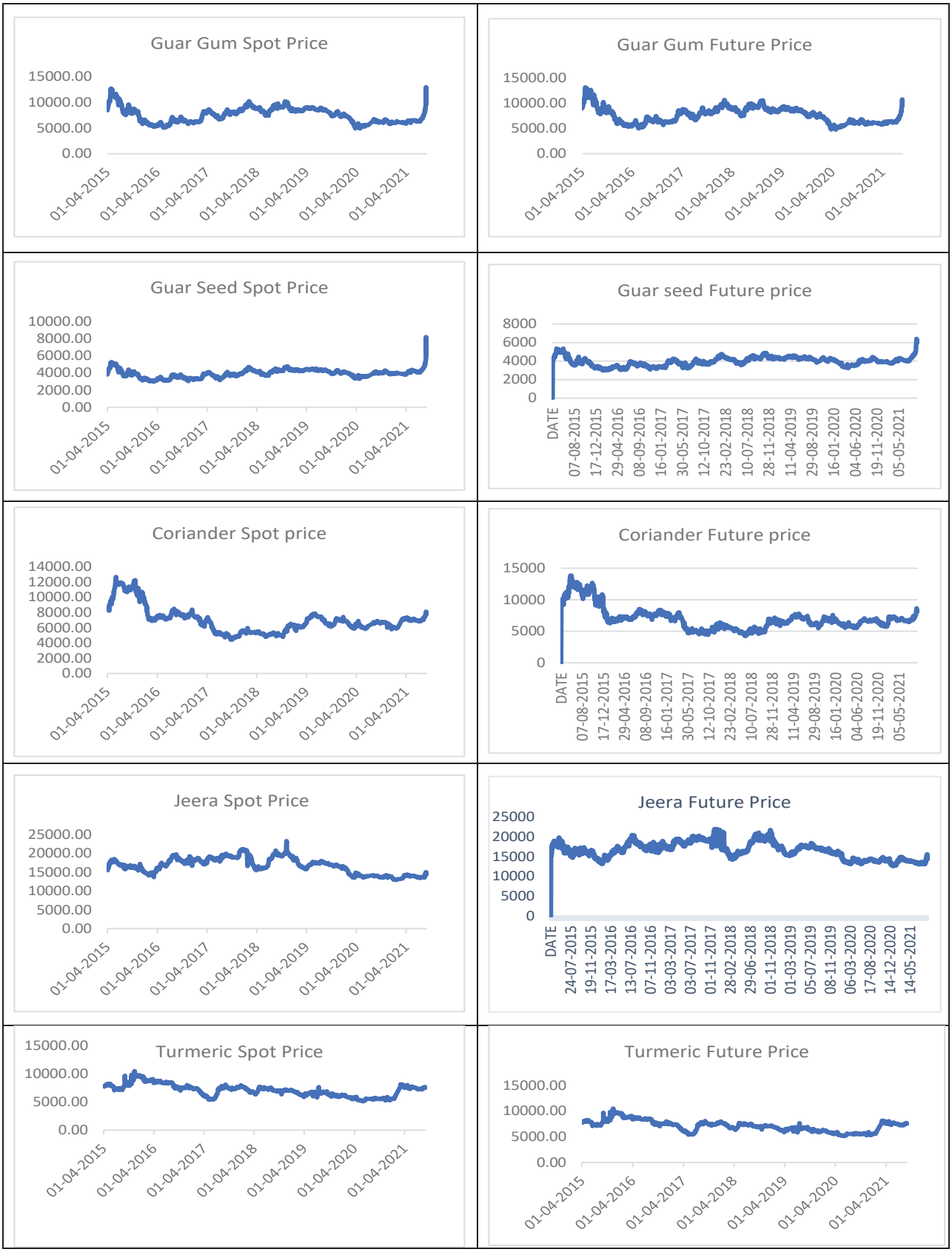
Causality in commodities markets aids hedging or speculation and is useful for forecasting commodity prices, Dash & Andrews (2010); Debasish & Kushankur (2011). Global GDP and real interest rates as macroeconomic determinants of real commodity prices , Frankel & Rose (2010);Yang & Leatham (1999). GARCH models to examine volatility interactions among S&P oil sector stock indices and oil prices, Hammoudeh *et al.* (2004). Global virtual reserve to prevent disproportionate spikes in grain spot prices, Hernandez & Torero (2010); Vasantha & Mallikarjunappa (2015).

Spot-futures price interactions for wheat, soybeans, and corn, Hernandez and Torero (2010). Single direction causal relation from futures to spot prices for pepper traded on NMCE, India, Debasish and Kushankur (2011). Error correction occurs in both future and spot markets, with futures markets adjusting more quickly, Malhotra *et al.* (2013); Sehgal *et al.* (2013).

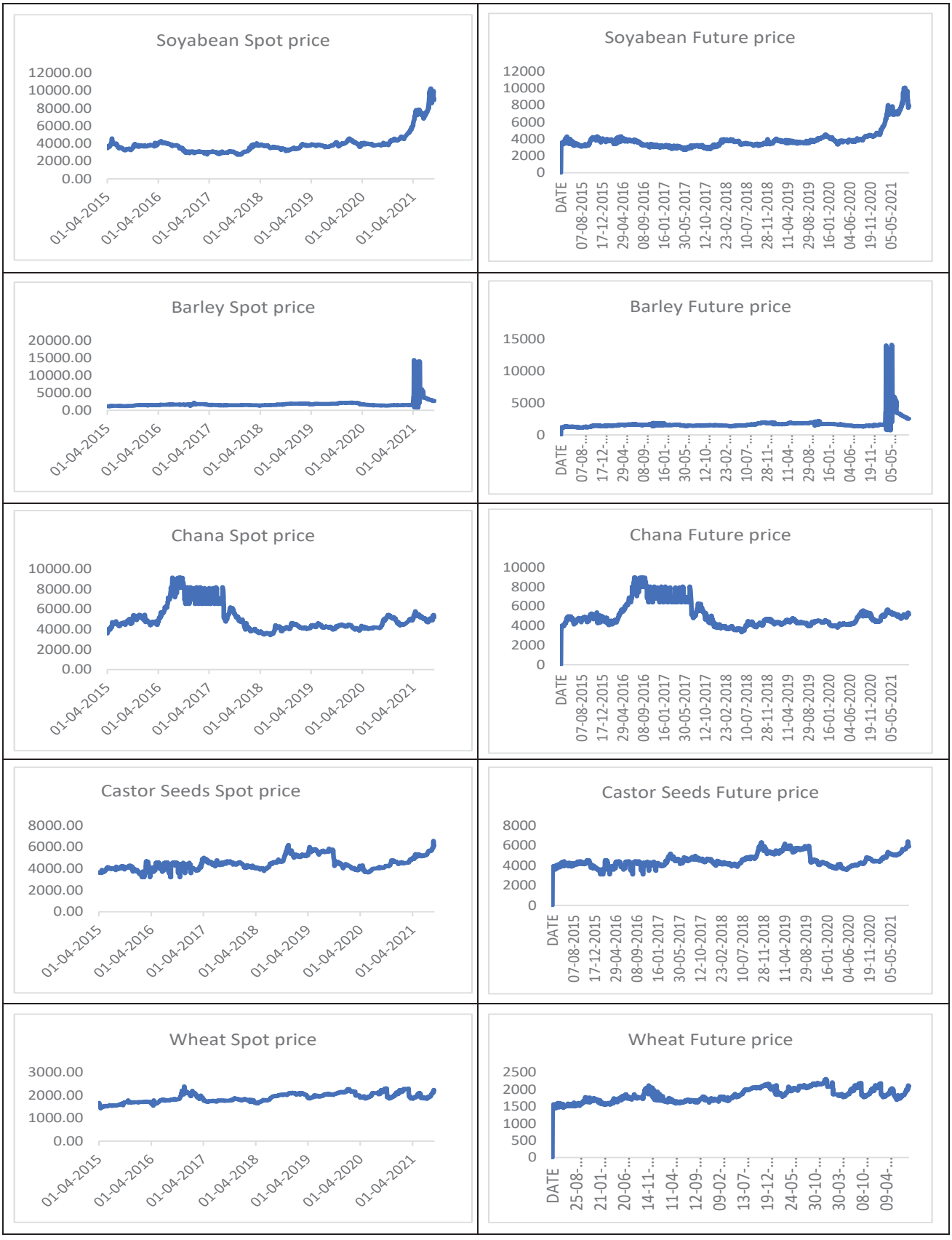
Unidirectional linear causality from energy futures markets to exchange rates, as well as nonlinear causal dependence between commodity futures returns and both stock market returns and implied volatility, Andreasson *et al.* (2016); Joseph *et al.* (2015). Two distinct regimes; one supporting the efficiency hypothesis and another rejecting it. Their findings hold significant implications for producers, hedgers, speculators, and policymakers, Arouri *et al.* (2013). The 2008 global financial crisis affected price clusters and data-generating mechanisms, suggesting inconsistencies across the analysis period, Aslan *et al.* (2018).

Error correction in both spot and futures markets for chili futures on NCDEX, India. Varied price discovery mechanisms across commodities in India, with futures markets often prominent but some spot markets more active. Asymmetric and unidirectional causality from futures to spot markets for all commodities, with strong predictability in normal conditions but declining in extreme market conditions, Sharma and Sharma (2018); Raghavendra *et al.* (2016); Inani (2018); Jena *et al.* (2019).

Long-run efficiency in near-month futures prices for most commodities but not for next-to-near months with low trading volume, Kumar & Pandey (2013). a strong unidirectional relationship



Graph 1: Guar Gum,Guar Seed, Coriandar, Jeera, Turmeric Spot &Future Price Trends.



Graph 2: Soyabeen, Barley, Chana, Castor Seeds and Wheat Spot &Future Price Trends.

Table 1: Descriptive Analysis

Name of Commodity	Mean	Standard deviation	Min, Max	Skewness, kurtosis	Jarque-Bera
GUAR GUM Spot	7548.6	1469.9	4908.4, 13000	0.452, 2.832	55.4**
GUAR SEED Spot	3960.9	472.4	2964.0, 6410.0	0.433, 4.042	120.3**
CORIANDER Spot	7014.0	1734.3	4423.4, 12686.2	1.293, 4.370	5.2**
JEERA Spot	16795.0	2062.2	12934.8, 23302.5	-0.074, 2.074	57.4**
TURMERIC Spot	7107.8	1050.4	5117.2, 10490.8	0.213, 2.671	19.02**
SOYABEAN Spot	3953.4	1200.9	2725.2, 10253	2.864, 11.767	7175.790**
BARLEY Spot	1769.2	863.2	798.400, 14432.01	8.681, 111.587	791064.7**
CHANA Spot	5074.8	1263.6	3400.000, 9162.010	1.309, 3.853	496.439**
CASTOR SEED Spot	4481.8	603.8	3188.9, 6577.9	0.690, 2.829	126.8**
WHEAT Spot	1885.8	184.9	1424.440, 2391.650	0.008, 2.271	34.753**

from futures to spot prices in Indian commodities markets, indicating the futures market's powerful price discovery function, Joseph *et al.* (2014).

Karyotis & Alijani (2016) discussed the causal relationship between derivative markets, hedging techniques, financial yields, price volatility, and spillover effects in food and soft commodities markets. Volatility clustering in gold and crude oil futures markets, with the maturity effect only valid for gold futures, Mukherjee & Goswami (2017). Commercial and long positions have a greater impact on price levels and volatility than non-commercial traders' activities, Mayer *et al.* (2017). A bidirectional relationship in coriander, jeera, soybean, sugar M grade, and wheat, suggesting efficiency in India's agricultural commodity futures market, Lakshmi (2018). A long-run equilibrium relationship between spot and futures prices for aluminum, copper, gold, and silver, Pradhan *et al.* (2021).

Methodology

The study's main goal was to comprehend the spot and future price behaviour of agricultural commodities on Indian commodity exchanges, along with their historical spot and future price behaviour and price discovery process amongst the spot and future prices in some actively traded agricultural commodities on NCDEX. The study covered agricultural products such guar gum, jeera, guar seed, turmeric, castor seed, barley, soybean, chana, and wheat. The data were analysed using a VAR model and models for variance decomposition.

The lead-lag relationship between the commodity spot and future series of the chosen agricultural commodities is examined using the VAR approach (Sims, 1980). The VAR technique examines the influence of the spot and upcoming returns on the commodity markets on the chosen endogenous variable in the VAR system. To fix if a lead-lag association occurs, the VAR technique of time series presupposes that each chosen time series variable is endogenic variable in the equation. The VAR system used in the study can be expressed as

$$x_{1t} = \alpha_t + \beta_{1t} * X_{1t-1} + \beta_{2t} * Y_{1t-1} \cdots \cdots + e_t$$

$$y_{1t} = \alpha_t + \beta_{1t} * X_{1t-1} + \beta_{2t} * Y_{1t-1} \cdots \cdots + e_t$$

Here, in the VAR system, X and Y stand for the current and future series of the chosen variables. Finding the ideal lag length for the spot and future series of the agricultural commodity is the first step in the VAR approach. For accurate findings, the order of the included variables is also essential. Various lag length criteria are applied to analyse the lag length (SC, AIC and HQ). Commodity spot and the future market returns are arranged according

to the progression of these variables' growing endogeneity.

GARCH, EGARCH and TGARCH Models are used to measure the volatility in agricultural commodities derivatives market. The study is conducted with the limitation of remorse availability of accurate data.

The simplest model specification is the GARCH (1,1) model:

Mean Equation $r_t = \mu + \varepsilon_t$

Variance Equation $\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$

Where $\omega > 0$ *and* $\alpha_1 \geq 0$ *and* $\beta_1 \geq 0$, *and*

r_t = return of the asset at time t, μ = average return ε_t = residual returns, defined as: $\varepsilon_t = \sigma_t z_t$

Where z_t is standardized residual returns (i.e. *iid* random variable with zero mean and variance 1), and α^2_t is conditional variance. For GARCH (1,1), the constraints $\alpha \geq 0$ and $\beta_1 \geq 0$ are needed to ensure α^2_t is strictly positive. The conditional variance equation is specified as a function of three terms:

- *A constant term:* ω
- *News about volatility from the previous period, measured as the lag of the squared residual from the mean equation:* ε_{t-1}^2 *(the ARCH term)*
- *Last period forecast variance:* σ_{t-1}^2 *(the GARCH term)*

The conditional variance equation models the time-varying nature of volatility of the residuals generated from the mean equation. This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted average of a long-term average (the constant), the forecast variance from the last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). The general specification of GARCH is, GARCH (p, q) is as:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_i \sigma_{t-1}^2$$

where p is the number of lagged α^2 terms and q is the number of lagged ε^2 term

Data Analysis

This section addresses the spot and future market price behaviour of agricultural commodities which are trading on Indian commodity bourses.

Historical Pattern of the Spot and Future Prices of Agriculture Commodities

Various agricultural products such as guar gum, coriander, guar seed, jeera, soyabean, turmeric, barley, chana, wheat, and castor seed etc. are included in the study. The graph1 and graph 2 below illustrate the historical trends in daily spot and forward pricing for these chosen agricultural commodities from 2015 through 2021.

Descriptive Statistics

In Table 1 was presented a descriptive analysis of the agricultural commodities that were included, such as guar gum spot, guar gum future, guar seed spot, guar seed future, coriander spot, coriander future, jeera spot, jeera future, turmeric spot, turmeric future, barley spot, barley future, chana spot, chana future, castor seed spot, castor seed future, wheat spot and wheat future.

During the chosen period, the GUAR GUM spot, one of the active agri-commodities on the commodity exchange, was determined to have a mean of 7548.605 and median is 7598.20. The GUAR GUM spot price ranges from 4908.35, its lowest value, to 13000, its highest. The spot price of GUAR GUM has a standard deviation of 1469.866, showing that there are fluctuations. Because of the index's low skewness (0.452) and high kurtosis (2.832), Jarque Bera (55.421**) concluded that the distribution was not normal. During the chosen period, the GUAR SEED spot, an active agricultural commodity on the commodities exchange, was determined to have a mean of 3960.885 and a median of 3980.000.

The GUAR SEED spot price ranges from 2964.000 to 6410,000 at its lowest and highest points, respectively. The spot price for GUAR SEEDs has a standard deviation of 472.392, showing that there are fluctuations. Because of the index's low skewness (0.433) and high kurtosis (4.042), Jarque Bera (120.278**) concluded that the distribution was not normal. The median of the CORIANDER spot, an active agricultural commodity on the commodity exchange, was discovered to be 6795.490, with mean of 7013.950. The spot price for CORIANDER ranges from 4423.380 to 12686.180 as its minimum and maximums. The spot price for CORIANDER has

a standard deviation of 1734.308, showing that there are fluctuations. According to Jarque Bera (5.231**), the index has a high level of skewness (1.504) and kurtosis (4.370), and as a result, the distribution is not normal. During the chosen period, it was discovered that the JEERA spot, a fairly active agricultural commodity on the commodities exchange, had mean of 16795.03 and median of 16917.23. The JEERA spot price ranges from 12934.79 to 23302.46 as its minimum and maximums. The JEERA spot price has a standard deviation of 2062.188, which indicates that there are fluctuations in the price. Despite the index's low skewness (-0.074) and high degree of kurtosis (2.074), Jarque Bera (57.454**) concluded that the distribution was not normal. During the chosen period, the TURMERIC spot, an active agricultural commodity on the commodities exchange, was determined to have mean of 7107.767 and median of 7280.520. The spot price for TURMERIC ranges from 5117.200 to 10490.800 as its minimum and maximums. The spot price for TURMERIC has a standard deviation of 1050.402, which indicates that there are fluctuations. Because of the index's low skewness (0.213) and high level of kurtosis (2.671), Jarque Bera (19.042**) concluded that the distribution was not normal.

During the chosen period, the SOYABEAN spot, one of the active agricultural commodities on the commodity market, was determined to have mean of 3953.417 and median of 3771.500. The current price of soybeans has a minimum of 2725.190 and a high value of 10253.000. The Soybean Spot Price's standard deviation is 1200.941, showing that there are fluctuations in the spot price. Since the index exhibits a high amount of skewness (2.864) and kurtosis (11.767), Jarque Bera (7175.790**) concludes that the distribution is not normal. During the chosen period, the BARLEY spot, an active agricultural commodity on the commodities exchange, was determined to have mean of 1769.233 and median of 1573.425. The spot price for BARLEY ranges from 798.400 to 14432.01 as its minimum and maximums. The spot price for BARLEY has a standard deviation of 863.160, which indicates that there are fluctuations. Because of the index's high skewness (8.681) and high level of kurtosis (111.587), Jarque Bera (791064.700**) concluded that the distribution was not normal. The median of the CHANA spot, an active agricultural commodity on the commodity exchange, was discovered to be 1263.614, with mean of 5074.755. The CHANA spot price ranges from 3400.000 to 9162.010 as its minimum and maximums. The CHANA spot price has a standard deviation of 1263.614, showing that there are fluctuations in the price. Because of the index's high skewness (1.309) and high level of kurtosis (3.853), Jarque Bera (496.439**) concluded that the distribution was not normal. During the chosen period, the CASTOR SEED spot, an active agricultural commodity on the commodity exchange, was determined to have mean of 4481.786 and median of 4394.310. The spot price for CASTOR SEEDS ranges from 3188.900 to 6577.900 as its minimum and maximums. The spot price for CASTOR SEEDS has a standard deviation of 603.828, which indicates that there are fluctuations. Because of the index's low skewness (0.690) and high level of kurtosis (2.912), Jarque Bera (126.836**) concluded that the distribution was not normal. During the chosen period, the WHEAT spot, an active agricultural commodity on the commodities exchange, was determined to have mean of 1885.847 and median of 1882.045. The WHEAT Spot Price ranges amongst a low value of 1424.440 and a maximum of 2391.650. WHEAT's current price has a standard deviation of 184.904, which indicates that there are fluctuations in the price. Because of the index's low skewness (0.008) and high level of kurtosis (2.271), Jarque Bera (34.753**) concluded that the distribution was not normal.

ADF Unit Root Test

The study looks at the stationary and non-stationary behaviour of the agricultural commodities under study. The ADF unit root test is used to see the unit root presence in daily data of the agricultural commodities from July 2015 to August 2021. Most agricultural commodity series are found to have a unit root in their behaviour in the literature. Therefore, these series have to be converted into stationary series in order to conduct additional hypothesis testing. It is claimed that any inferences drawn from non-stationary agricultural commodity data are invalid. The outcomes of the ADF test are exhibited in Table 2.

Table 2: ADF Unit Root Test

Agriculture Commodity Series	ADF Stats (*p* value)	
	At Level	At First Difference
GUAR GUM SPOT	-2.1 (0.537)	-29.8 (0.000)
GUAR GUM FUTURE	-2.3 (0.432)	-49.4 (0.000)
GUAR SEED SPOT	-1.9 (0.652)	-33.9 (0.000)
GUAR SEED FUTURE	-2.3 (0.443)	-51.3 (0.000)
CORIANDER SPOT	-1.002 (0.942)	-1.002 (0.000)
CORIANDER FUTURE	-1.79 (0.710)	-37.99 (0.000)
JEERA SPOT	-2.19 (0.493)	-35.8 (0.000)
JEERA FUTURE	-2.2 (0.469)	-21.2 (0.000)
TURMERIC SPOT	-2.022 (0.588)	-36.951 (0.000)
TURMERIC FUTURE	-2.902 (0.161)	-30.499 (0.000)
SOYABEAN SPOT	0.475 (0.999)	-13.207 (0.000)
SOYABEAN FUTURE	-0.66 (0.974)	-38.04 (0.000)
BARLEY SPOT	-3.5 (0.038)	-11.6 (0.000)
BARLEY FUTURE	-3.6 (0.029)	-11.7 (0.000)
CHANA SPOT	-2.1 (0.549)	-9.7 (0.000)
CHANA FUTURE	-2.16 (0.509)	-10.33 (0.000)
CASTOR SEED SPOT	-3.45 (0.045)	-26.24 (0.000)
CASTOR SEED FUTURE	-3.42 (0.049)	-50.01 (0.000)
WHEAT SPOT	-3.822 (0.015)	-42.6 (0.000)
WHEAT FUTURE	-3.406 (0.050)	-31.4 (0.000)

The Table 2 showed that all series of selected agricultural commodities are non-stationary at level (1) as p-value was more than 0.05. The selected agricultural commodities series became stationary after their first log difference translation. According to the findings, the included agricultural commodity time series have unit root problem. After taking the first difference, now the series are stationary to be used for further analysis.

Correlation Results

The correlation test was used to find the linear association amongst the selected agricultural commodities i.e., guargum spot series, guargum future series, guar seed future series, guarseed spot series, coriander spot series, coriander future series, jeera spot series, jeera future series, turmeric spot series, turmeric future series, barley spot series, barley future series, chana spot series, chana future series, castor seeds spot series, castor seeds future series, and wheat spot series. In the study, the Pearson coefficient of correlation is estimated. The null hypothesis is that no meaningful association amongst the chosen agricultural commodities. The Pearson correlation coefficient and its p value are used to analyse the hypothesis. The correlation analysis's findings are demonstrated in the following Table 3.

Table 3: Correlation Results

Correlation	Price	Returns
GUAR GUM	.990 (0.000)	.500 (0.000)
GUAR SEED	.978 (0.000)	.440 (0.000)
CORIANDER	.968 (0.000)	.392 (0.000)
JEERA	.932(0.000)	.367 (0.000)
TURMERIC	.941 (0.000)	.499 (0.000)
SOYABEAN	.988 (0.000)	.313 (0.000)
BARLEY	.989 (0.000)	.975 (0.000)
CHANA	.991(0.000)	.632 (0.000)
CASTOR SEEDS	.980 (0.000)	.795 (0.000)
WHEAT	.905 (0.000)	.350 (0.000)

The findings contradict the claim that "there is no meaningful link amongst the chosen Agri spot and future commodities prices." The findings showed a strong positive significant association amongst the spot price for agricultural commodities and future commodity prices. Future prices for goods used in agriculture rise as spot prices do.

Causality amongst Commodity Spot and the Future Market

The causal link amongst spot and future agricultural commodity market for commodities is covered in this section. This section analyses and discusses the Block Exogeneity Granger Causality Test and also the Variance Decomposition Test. The many chosen commodities are subjected to the causality technique.

Amongst spot and future agricultural commodity markets for agricultural commodities, the VAR model is used. The variance decomposition analysis is also included in this VAR model.

Table 4: Lag Length Criteria

	Proposed lag period					
Commodity	**Log Likelihood**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
GUAR GUM	7	7	7	7	5	6
GUAR SEED	7	7	8	7	5	7
CORIANDER	7	8	7	8	3	7
JEERA	7	8	8	7	5	7
TURMERIC	7	7	8	7	4	5
SOYABEAN	7	8	7	8	**3**	6
BARLEY	7	7	7	7	7	7
CHANA	7	8	7	7	5	8
CASTOR SEEDS	7	7	7	7	4	6
WHEAT	7	7	8	8	4	5

Table 4 showed the lags of agricultural commodities spot and future market which are calculated with the help of lag length criteria. The lag length for every commodity is chosen using the Hannan Quin and Schwartz criteria. The recommended lag lengths for various commodities vary. The Block exogeneity test investigated the lead vs lag association amongst future and spot returns of agri-commodities. The findings of the Block exogeneity test were presented in Table 5.

Table 5: Block Exogeneity Model

Commodity	**Dependent variable: Spot Market Returns**	**Dependent variable: Future Market Returns**
	Chi-square	**Chi-square**
GUARGUM	36.8**	248.65**
GUAR SEED	84.9**	138.27**
CORIANDER	7.93**	96.08**
JEERA	45.088**	99.86**
TURMERIC	6.86**	46.63**
SOYABEAN	15.585**	71.64**
BARLEY	130.08**	16.67**
CHANA	6.05**	200.86**
CASTOR SEEDS	7.29**	65.6**
WHEAT	2.15**	77.84**

The results showed that value of chi-square stats of guargum in the direction of future to spot returns was 36.8 which reflected that a causal relationship was present amongst both markets. The chi-square stats of guargum in the direction of spot to future returns was 248.65, it showed stronger causal link amongst spot and the future agricultural commodity market. The results clearly showed that a high degree of causation was in existence amongst the spot and future agricultural commodity market of guargum agricultural commodity. The future and spot market of guarseed are associated with each other in both the directions. The value of chi-square stats of guarseed was 84.9 from future to spot returns which reflected that a causal relationship was present amongst both markets. The chi-square stats of guarseed from spot to future returns was 138.27, it showed stronger causal link amongst spot and the future agricultural commodity market. The results clearly showed that a high degree of causation was in existence amongst the spot and future agricultural commodity market of guarseed agricultural commodity. The causality exists amongst the coriander future and spot market. In case of coriander agricultural commodity, unidirectional causality from future to spot returns is negligible, chi square statistics was 7.93 which demonstrates the absence of causal association amongst both the markets. A significant causal association found amongst both the markets

from future to spot returns. The chi-square stats of coriander agricultural commodity from spot to future returns was 96.08, it showed stronger causal link amongst spot and the future agricultural commodity market in the director of future to spot returns.

The future and spot market of jeera were associated with each other in both the directions. The value of chi-square stats of jeera was 45.088 from future to spot returns which reflected that a causal relationship was present amongst both markets. The chi-square stats of jeera from spot to future returns was 99.86, it showed stronger causal link amongst spot and the future agricultural commodity market. The results clearly showed that a high degree of causation was in existence amongst the spot and future agricultural commodity market of jeera agricultural commodity. In case of turmeric agricultural commodity, unidirectional causality from spot to future is negligible, chi square statistics was 6.86 which demonstrates the absence of causal association amongst both the markets. A significant causal association found amongst both the markets from spot to future returns. The chi-square stats of turmeric agricultural commodity from future to spot returns was 46.63, it showed stronger causal link amongst spot and the future agricultural commodity market in the direction of future to spot returns. Regarding soyabean agricultural commodity, unidirectional causality from future to spot returns is substantial, chi square statistics was 15.585 which demonstrates the causal association amongst both the markets. A significant causal association found amongst both the markets from spot to future returns. The chi-square stats of soyabean agricultural commodity from future to spot returns was 71.64, it showed stronger causal link amongst spot and the future agricultural commodity market in the direction of future to spot returns.

The future and spot market of barley were associated with each other in both the directions. The value of chi-square stats of barley was 130.08 in the direction of future to spot returns which reflected that a strong causal relationship was present amongst both markets. The chi-square stats of barley from spot to future returns was 16.67, it showed causal link amongst spot and the future agricultural commodity market. The results clearly showed that a high degree of causation was in existence amongst the spot and future agricultural commodity market of barley agricultural commodity. Since there is no causal connection amongst the future and the spot markets for CHANA, the amount of the unidirectional causation from spot to future market returns is shown to be minor (Chi Square Statistics = 6.054). Significant causal relationship amongst spot and future returns (Chi Square Statistics = 200.851) is present, demonstrating a more direct causal link amongst spot and future agricultural commodity market. There is no causal association amongst future and the spot market returns because the degree of the causation is assessed to be minimal (Chi Square Statistics = 7.288) for CASTOR SEEDS. Significant causal relationship is present amongst spot and future returns (Chi Square Statistics = 65.622), indicating a stronger causal link amongst spot and the future market. Finally, the results for WHEAT showed that there was unidirectional causation from spot to future market returns, but that the magnitude of the causation from future to spot agricultural commodity market returns was insignificant (Chi Square Statistics = 2.149), indicating that there was no causation from future to spot agricultural commodity market. Furthermore, significant causal link amongst spot and future returns (Chi Square Statistics = 77.836) exists, indicating a stronger link amongst spot and the future market.

Variance Decomposition

The variance percentage in all the series under study which occurs due to other series lagged values and also the lagged values of its own is represented by variance decomposition function. The causality amongst the returns of the spot and the future market of selected agricultural commodities was further analyzed. The results of the VDF study for 10 delays were shown in Table 6.

The spot market returns of the agricultural commodity GUARGUM are described by its own lagged behaviour by 96.211% and by future returns of GUARGUM by just 1.987%. However, it was discovered that the future market returns of

Table 6: Variance Decomposition Function of All Selected Agricultural Commodities

Variance Decomposition of DLOG(SPOT):				Variance Decomposition of DLOG(FUTURE):		
Commodity	**S.E.**	**Dlog (Spot)**	**Dlog (Future)**	**S.E.**	**Dlog (Spot)**	**Dlog (Future)**
GUARGUM	0.034	96.211	1.987	0.032	32.198	65.843
GUAR SEED	0.017	94.957	3.899	0.017	27.231	71.969
CORIANDER	0.02	98.031	0.626	0.056	15.321	84.623
JEERA	0.043	95.624	3.062	0.012	13.062	86.847
TURMERIC	0.0127	97.247	0.438	0.053	22.790	75.095
SOYABEAN	0.0193	98.411	0.864	0.022	10.743	87.329
BARLEY	0.122	95.062	4.769	0.129	88.124	11.026
CHANA	0.014	98.522	0.213	0.033	42.582	57.613
CASTOR SEEDS	0.051	98.034	0.347	0.029	65.032	34.767
WHEAT	0.026	97.651	0.124	0.034	12.154	87.923

the agricultural commodity GUARGUM were only 32.198% owing to spot returns of GUARGUM and were instead explained by 65.843% using its own lagged behaviour. In the instance of GUAR SEED, the spot market returns of the agricultural commodity are described by its own lagged behaviour by 94.957% and by future returns of GUAR SEED by just3.899%. However, it was discovered that the future market returns of the agricultural commodity GUAR SEED could be explained by its own lagged behaviour by 71.969% and by spot returns of GUAR SEED by only 27.231%. For the CORIANDER commodity, the spot market returns of the agricultural commodity are explained by its own lagging behaviour by98.031% and by future returns of CORIANDER by just 0.626%. However, it was discovered that the future market returns of the agricultural commodity CORIANDER were only 15.321% attributable to spot returns and were instead explained by 84.623% using its own lagged behaviour. However, it was discovered that the future market returns of the agricultural commodity GUAR SEED could be explained by its own lagged behaviour by 71.969% and by spot returns of GUAR SEED by only 27.231%. For the CORIANDER commodity, the spot market returns of the agricultural commodity are explained by its own lagging behaviour by98.031% and by future returns of CORIANDER by just 0.626%. However, it was discovered that the future market returns of the agricultural commodity CORIANDER were only 15.321% attributable to spot returns and were instead explained by 84.623% using its own lagged behaviour. The future market returns of the agri-commodity TURMERIC were only 22.790% owing to spot returns and were instead explained by 75.095% of their own lagged behaviour.

For the agricultural commodity SOYABEAN, the results showed that spot market returns of SOYABEAN are described by its own lagged behaviour by98.411% and by future returns of SOYABEAN by just 0.864%. However, it was discovered that the future market returns of the agricultural commodity SOYABEAN could be explained by 87.329% using its own lagged behaviour and only 10.743% using spot returns of SOYABEAN. With the aid of its own lagged behaviour, BARLEY's spot market returns are found to be explained by 95.062% and its future returns by only 4.769%, respectively. However, it is discovered that the future market returns of the agricultural commodity BARLEY can only be explained by 11.026% using its own lagged behaviour and 88.124% using the spot returns of BARLEY. In the case of CHANA, the spot market returns of the agricultural commodity are explained by 98.522% by its own lagged behaviour and by CHANA's expected future returns by only 0.213%. However, it was discovered that the future market returns of the agricultural commodity CHANA could be explained by 57.613% using its own lagged behaviour and only 42.582%

using CHANA's spot returns. For CASTOR SEEDS, the spot market returns of the agricultural commodity are explained by its own lagged behaviour by 98.034% and by future returns by CASTOR SEEDS by just 0.347%.

However, the future market returns of the agro commodity CASTOR SEEDS could only be described by 34.767% using its own lagged behaviour and 65.032% using CASTOR SEEDS' spot returns. The spot market returns of the WHEAT agricultural commodity are finally described by 97.651% using its own lagged behaviour and just 0.124% using the expected future returns of WHEAT. The future market returns of the agricultural commodity WHEAT, however, were found to be described by 87.923% using its own lagged behaviour and just 12.154% using spot returns of WHEAT.

4.7 Volatility Analysis of Guar Gum using GARCH, EGARCH and TGARCH Model

The ARIMA (1,1) forecasting models is applied in order to extract the residuals of the forecasting models. The ARCH LM test examine the presence of volatility or the volatility clustering effects in the error terms of the forecasting equation used for Guar Gum commodity. The behaviour of the error terms for the spot and future commodity returns of Guar Gum forecasting models is shown is Table 7.

Table 7 reported the results of the ARCH LM test, GARCH (1,1) model and EGARCH (1,1) model for the Guar Gum agri-commodity for the selected time period. Table 7 indicates that the F stats (396.99) and Obs*R^2 (317.07) measure are found significant. Thus, the results of ARCH LM test indicates the presence of significant volatility clustering in the residuals of the forecasting equation with spot market of Guar Gum agri-commodity as the dependent variable. Further the GARCH model indicates the *significant ARCH effects* (coefficient = 0.062, z stat = 15.61) and *GARCH effects* (coefficient = 0.932, z stat = 292.74). The T-Garch effect confirms the presence of asymmetric effects (asymmetric coeff= -0.02**) indicating that negative news have more influence on volatility as compared to positive news on the guar gum commodity. In case of EGARCH model, the size effect (coefficient = 0.13, z stat = 19.02) as well as sign (asymmetric) effect (coefficient = 0.32, z stat = 4.93) of ARCH coefficient is found to be significant. The positive sign effect indicates that the volatility in the stock returns increases with positive lagged residual term. In other words, the positive shock if any increases the volatility in the Guar Gum agri-commodity in the next period. The volatility persistence, which is measured with the help of GARCH coefficient (coefficient = 0.985, z stat = 318.51) is found to be highly significant indicating that the existing volatility have more chances to continue in the next period. Thus, it can be concluded that Guar Gum agri-commodity returns are volatile due to news and volatility persistence.

Table 8: Volatility analysis – Guar Seed Spot Price

ARCH LM Heteroscedasticity test		**GARCH (1,1) Test**			**EGARCH (1,1) Model**			**T-GARCH (1,1)**		
F statistics	Obs* R^2	IV	Coeff	Z stats	IV	Coeff	Z stats	IV	Coeff	Z stats
682.2**	475.7**	C	0.000127	7.162**	Constant	-0.538	-8.158**	C	0.00001	6.67**
Volatility Clustering Exists Garch Coeff		ARCH Coeff	0.118	16.03**		0.22	14.986**	E^2_{t-1}	0.145	14.09**
		0.849	73.497**		0.06	6.036**	E^2_{t-1} (-ve)	-0.088	-6.38**	
						0.953	133.06**	Garch coeff	0.868	70.54**

IV=Independent variables

Volatility Analysis of Guar Seed using GARCH, EGARCH and TGARCH Model

Table 8 reported the results of the ARCH LM test, GARCH (1,1) model and EGARCH (1,1) model for the Guar Seed agri-commodity for the selected time period.

Table 8 indicates that the F stats (682.2) and Obs*R^2 (475.7) measure are found significant. Thus, the results of ARCH LM test indicates the presence of significant volatility clustering in the residuals of the forecasting equation with spot market of Guar Seed agri-commodity as the dependent variable. Further the GARCH model indicates the *significant ARCH effects* (coefficient = 0.118, z stat = 16.03) and *GARCH effects* (coefficient = 0.849, z stat = 73.49). The T-Garch effect confirms the presence of asymmetric effects (asymmetric coeff = -0.088**) indicating that negative news has more influence on volatility as compared to positive news on the guar seed commodity. In case of EGARCH model, the size effect (coefficient = 0.22, z stat = 14.98) as well as sign (asymmetric) effect (coefficient = 0.06, z stat = 6.03) of ARCH coefficient is found to be significant. The positive sign effect indicates that the volatility in the stock returns increases with positive lagged residual term. In other words, the positive shock if any increases the volatility in the Guar Seed agri-commodity in the next period. The volatility persistence, which is measured with the help of GARCH coefficient (coefficient = 0.953, z stat = 133.06) is found to be highly significant indicating that the existing volatility have more chances to continue in the next period. Thus, it can be concluded that Guar Seed agri-commodity returns are volatile due to news and volatility persistence.

Volatility Analysis of Coriander using GARCH, EGARCH and TGARCH Model

Table 9 reported the results of the ARCH LM test, GARCH (1,1) model and EGARCH (1,1) model for the Coriander agri-commodity for the selected time period.

Table 9 indicates that the F stats (110.5) and Obs*R^2 (103.3) measure are found significant. Thus, the results of ARCH LM test indicates the presence of significant volatility clustering in the residuals of the forecasting equation with spot market of Coriander agri-commodity as the dependent variable. Further the GARCH model indicates the *significant ARCH effects* (coefficient = 0.152, z stat = 8.61) and *GARCH effects* (coefficient = 0.631, z stat = 35.92). The T-Garch effect confirms the presence of asymmetric effects (asymmetric coeff = 0.061**) indicating that positive news has more influence on volatility as compared to negative news on the coriander commodity. In case of EGARCH model, the size effect (coefficient = 0.50, z stat = 15.17) as well as sign (asymmetric) effect (coefficient = -0.001, z stat = -0.07) of ARCH coefficient is found to be significant. The positive sign effect indicates that the volatility in the stock returns increases with positive lagged residual term. In other words, the positive

Table 9: Volatility analysis – Coriander Spot Price

ARCH LM Heteroscedasticity test		**GARCH (1,1) Test**			**EGARCH (1,1) Model**			**T-GARCH (1,1)**		
F statistics	Obs* R^2	IV	Coeff	Z stats	IV	Coeff	Z stats	IV	Coeff	Z stats
110.5**	103.3**	C	0.00072	19.90**	Constant	-12.119	-70.517**	C	0.00071	18.19**
		ARCH Coeff	0.152	8.61**	$\frac{\lvert e_{t-1}\rvert}{\sqrt{\sigma^2_{t-1}}}$	0.5s	15.174**	E^2_{t-1}	0.113	4.83**
Volatility Clustering Exists		Garch Coeff	0.631	35.929**	$\frac{e_{t-1}}{\sqrt{\sigma^2_{t-1}}}$	-0.001	-0.07	E^2_{t-1} (-ve)	0.061	1.89
					$\log(\sigma^2_{t-1})$	-0.446	-20.71**	Garch coeff	0.639	33.83**

shock if any increases the volatility in the Coriander agri-commodity in the next period. The volatility persistence, which is measured with the help of GARCH coefficient (coefficient = -0.446, z stat = -20.71) is found to be highly significant indicating that the existing volatility have more chances to continue in the next period. Thus, it can be concluded that Coriander agri-commodity returns are volatile due to news and volatility persistence.

Conclusion and Discussion

The empirical analysis demonstrates that spot market dominates most agri-commodities than future market. The spot prices of agri-commodities, which also affect the future pricing of the commodities, replicate the effect of any fresh information that enters the market on the price of agricultural commodities. There is evidence of both unidirectional and bidirectional causation (guargum, guar seeds, coriander, jeera, soyabean, and barley, turmeric, castor seeds, chana and wheat). Usually, spot and future prices are used to report the lead-lag connection, but it can also be bidirectional (Shakeel & Purankar, 2014; Ali & Gupta, 2011). The agricultural commodities future market is unable to establish prices due to factors such as farmers' lack of understanding of futures trading, inconsistent trading, the slow expansion of the spot market and other market weaknesses (Easwaran & Ramasundaram, 2008). But for six commodities (turmeric, coriander, guargum, barley, wheat and soyabean). For four commodities (jeera, castor seed, chana, and guar seed), the spot market performs better than the futures market, which outperforms the latter (Inani, 2018). According to the findings of the VDF analysis, the lagged behaviour of the commodity itself for both spot and the future market returns used to explain the market returns for eight different commodities. The volatility persistence, which is measured with the help of GARCH coefficient is found to be highly significant indicating that the existing volatility have more chances to continue in the next period. Thus, it can be concluded that Guargum, Guar Seed and Coriander agri-commodity returns are volatile due to news and volatility persistence (Mishra; 2020).

The current study is unique in focusing solely on selected Agri-commodities only. Also, the data covers period from the time SEBI took over as a regulator of commodity markets, i.e., post 2015 period and it also touches the pre-pandemic and post pandemic periods of 2020 and 2021. As the market dynamics have changed rapidly in last 5 years, the dimensions of research are also evolving and changing in line with it. The present research topic has been taken with a motivation to throw light on fresh view on lead–lag relationship between future and spot prices using the latest data testing the role that futures market plays in price discovery and volatility spill overs. There are very few studies that have explored the efficiency of the agricultural commodity spot and futures markets in India using both price discovery and volatility and spill over in a detailed manner, especially at the individual agriculture commodity level. The Findings of this research would benefit all the stakeholders namely, investors, exchanges like NCDEX, MCX, SEBI, Brokers and Sub-Brokers in their own pursuit of relevant objectives. This would overall contribute and lead to growth of Indian Economy in times to come.

The findings of this study are beneficial for numerous motives. It primarily edifies regulators on the function of futures market in risk management because it was discovered to be a trailing variable in agricultural commodities. The market players can control their exposure to the agricultural commodity market and take advantage of arbitrage possibilities that may arise as a result of mispricing of the agricultural commodities by understanding the dynamics of the spot and the future markets. Thirdly, the report aids researchers looking into information and pricing efficiency for the agricultural market. The findings contribute to our understanding of how prices are formed and how information is passed from one market to another. There are more research opportunities for a thorough investigation of price volatility in commodity future markets to better understand their price behaviour in spot and the future markets. The study examines the future-spot price link that exists in the commodity market, which will help farmers, traders, and producers of commodities make informed decisions and minimise risk.

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