Analysing Cause & Effect Lag Relationship between Spot & Future Returns of Agro Commodities

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Abstract
Derivatives market help in reducing volatility in spot markets due to increase in the information flow from future market to the spot market. Also, it attracts the speculators to the spot market and take alternate positions at lower cost. This helps in reducing volatility in spot markets. Derivative markets perform many functions like Price Discovery, reducing volatility spillover, hedging and risk management. The objective of the study was identified to study the causal or lead and lag relationship and analyse Cause & Effect Lag Relationship between Spot & Future Returns of sampled Agro commodities. Ten agricultural commodities frequently traded on NCDEX i.e. Mustard Seed, Refined Soy Oil, Crude Sunflower Oil, Refined Castor Oil, Groundnut, Raw Yellow Peas, Moong, Bajra, Paddy (Basmati) & Maize Feed were considered in the study. Sampled commodities were selected based on March, 2018 observed trading volumes from two major commodity groups of NCDEX, namely Cereals & Spices and Oil & Oil seeds and duration of the study was for 6 years i.e. April 2018 to August 2024. Vector Auto Regression (VAR) Model: VAR model is used to study the causal or lead and lag relationship between spot and future market of the commodities. The Block exogeneity Granger's causality test along with impulse response function and variance decomposition variance estimates were analyzed. The causality method is applied to the different selected commodities. During the period of study Spot and future prices of all the agro commodities showed fluctuations. Mean spot prices were greater than mean future prices for all agri-commodities except Mustard Seed, Groundnut and Paddy (Basmati) during the period of study. ADF Unit root test showed that time series was not stationary at level 0. However, the time series became stationary at first log transformation for all 10 commodities. There exists high positive significant correlation between the Agri spot and future commodity prices which showed that during the period of study they were moving in the same direction. There exists Bi-directional causality between spot and future market returns in 5 commodities, namely, Mustard Seed, Refined Soy Oil, Refined Castor Oil, Crude Sunflower Oil and Raw Yellow Peas. Uni-directional causality from spot to futures market was observed in case of Groundnut, Bajra, Paddy (Basmati) and Maize Feed. Upon going through the research process, it was observed clearly that

there is a great scope for improvement, both at policy and implementation levels for the overall development of Commodity Derivative markets in India. Be it the policy makers, traders, farmers or investors, all of them need to participate and work towards a system which is not only robust for them but for the Economy as well.

Key words: Agro Commodities, Cause & Effect Lag Relationship, Spot & Future Returns, NCDEX

Introduction
Volatility or risk spillover from one market or asset to another market or asset is an important drawback in commodity derivatives market. As we know, in a competitive environment information transmission is a key factor in price discovery. Similarly, risk also transmits from one segment to another segment. Derivatives market help in reducing volatility in spot markets due to increase in the information flow from future market to the spot market. Also, it attracts the speculators to the spot market and take alternate positions at lower cost. This helps in reducing volatility in spot markets.

The traders are in the role of hedgers, arbitragers, and speculators in the derivatives market. Commodity exchanges are specially created markets where futures trading occurs through an organized method by allowing efficient competition between customers and providers. The major commodity exchanges in India which allow trading of derivatives in both agro and non-agro commodities:
- Multi Commodity Exchange of India Ltd. (MCX)
- National Commodity & Derivatives Exchange Limited (NCDEX)
- National Multi Commodity Exchange of India Limited (NMCE)

Review of Literature
Christoffersen, Lunde & Olesen (2017) examined the commodity future prices and volatility dynamics in the post-financialization period. They found a strong factor structure for daily commodity volatility as compared to factor structure in returns. There were common elements between commodity market volatility and stock market volatility connected with business cycles. There was effect of 2008 financial crisis during 2008-2010, after which it returned to the pre-crisis levels. Tiwari, Nasreen, Shahbaz, & Hammoudeh, (2024) It was found that there is an efficient transmission of information between spot and futures markets but it is the spot market which leads to the flow of information to futures. This in turn causes greater spill-over of volatility. The spot market has a greater impact on the volatility of futures market, indicating that informational efficiency of oilseeds spot market is stronger than that of the respective futures market. Furthermore, Books, web links, NCDEX website were looked into to strengthened the understanding for the study.

Research Methodology
The objectives of the study were identified to study the causal or lead & lag relationship and analyse Cause & Effect Lag Relationship between Spot & Future Returns of sampled Agro commodities.

Sampling Design
The sampling design approach followed in the study:
- Population of the study: Agricultural Commodities traded on NCDEX
- Sampling Design: Ten agricultural commodities frequently traded on NCDEX i.e. Mustard Seed, Refined Soy Oil, Crude Sunflower Oil, Refined Castor Oil, Groundnut, Raw Yellow Peas, Moong, Bajra, Paddy (Basmati) & Maize Feed

- Data Collection: Secondary data from NCDEX
- Sample size: Selected ten agricultural commodities were selected based on March, 2018 observed trading volumes from two major commodity groups of NCDEX, namely Cereals & Spices and Oil & Oil seeds and duration of the study was for 6 years i.e. April 2018 to August 2024.

Tools used for Data Analysis
Various appropriate statistical tools i.e. ADF, VAR, BEG were applied. Augmented Dickey Fuller (ADF) Test was used to test whether the time series data is stationary or not. Stationarity of data implies that data should be independent of time period and not influenced by it like seasonal rainfall data is non-stationary data. Vector Auto Regression (VAR) Model was used to study the causal or lead and lag relationship between spot and future market of the commodities. The Block Exogeneity Granger's causality test along with impulse response function and variance decomposition variance estimates were analyzed. The causality method was applied to the different selected commodities.

Sampled Agro Commodities of Study
The following agro commodities were considered in the study:

1.   Bajra

2.   MOONG

3.   MAIZE FEED INDUSTRIAL GRADE

4.   PADDY (BASMATI) - PUSA 1121

5.   Unprocessed Whole Raw Yellow Peas

6.   GROUNDNUT

7. CRUDE SUNFLOWER OIL

8. REFINED CASTOR OIL

9. REFINED SOY OIL

10. MUSTARD SEED

Data Analysis and Interpretation
The data analysis results of the various techniques applied are summarized below:

ADF unit root test
ADF test was applied on the included Agri commodity time series before further applying the techniques for analysis. The results reported that the all the included Agro commodity time series were non-stationary or random walk at level (p-value less than 0.05). However, the first log difference transformation of the selected Agri commodity series made them stationary.

Causality between Commodity Spot and Future Market
The VAR methodology was used with identifying the optimum lag length of the included spot and future series of the Agri commodity. **Table-1** below reported the results of lag length selection criteria for incorporating the lags of the spot and future markets of included Agri commodities.

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Table-1
Lag lengths under Various Criteria

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| Commodity | Suggested lag period | | | | | |
	Log Likelihood	LR	FPE	AIC	SC	HQ
Mustard Seed	8	8	8	8	4	7
Refined Soy Oil	8	8	8	8	4	5
Crude Sunflower Oil	8	7	7	7	2	6
Refined Castor Oil	8	7	8	8	7	7
Groundnut	8	8	8	8	3	6
Raw Yellow Peas	8	7	7	7	**4**	5
Moong	8	8	8	8	8	8
Bajra	8	7	8	8	7	7
Paddy (Basmati)	8	8	8	8	3	6
Maize Feed	8	6	6	6	3	4

The Schwartz criteria and Hannan Quin criteria was adopted for selecting the lag length for all the commodities. The different commodities have different suggestions of lag length. This was followed by applying the Block exogeneity test in order to examine the cause and effect (lead lag relationship between spot and future returns of the included Agro commodities. **Table-2** reported the results of Block Exogeneity Test.

Table-2
Block Exogeneity Test

| Commodity | Dependent variable: Spot Market Returns | | Dependent variable: Future Market Returns | | Conclusions |
	Excluded	Chi-square	Excluded	Chi-square	
Mustard Seed	Future Market Returns	36.771**	Spot Market Returns	248.654**	Bidirectional causality exists
Refined Soy Oil	Future Market Returns	84.862**	Spot Market Returns	138.267**	Bidirectional causality exists
Crude Sunflower Oil	Future Market Returns	7.928**	Spot Market Returns	96.082**	Bidirectional causality exists
Refined Castor Oil	Future Market Returns	45.078**	Spot Market Returns	99.859**	Bidirectional causality exists
Groundnut	Future Market Returns	6.858**	Spot Market Returns	46.626**	Uni-directional causality exists from spot to future
Raw Yellow Peas	Future Market Returns	15.575**	Spot Market Returns	71.638**	Bidirectional causality exists
Moong	Future Market Returns	130.082**	Spot Market Returns	16.662**	Uni-directional causality exists from future to spot

Bajra	Future Market Returns	6.054**	Spot Market Returns	200.851**	Uni-directional causality exists from spot to future
Paddy (Basmati)	Future Market Returns	7.288**	Spot Market Returns	65.622**	Uni-directional causality exists from spot to future
Maize Feed	Future Market Returns	2.149**	Spot Market Returns	77.836**	Uni-directional causality exists from spot to future

The results indicated bidirectional causality between spot and future market returns of five commodities, namely, Mustard Seed, Refined Soy Oil, Crude Sunflower Oil, Refined Castor Oil and Raw Yellow Peas. In these commodities, the causality from spot to future market returns was found more significant than from the future to the spot market returns.

Unidirectional causality from spot to future market returns was found for Groundnut, Bajra, Paddy (Basmati)s and Maize Feed. The causality from future to spot market returns was found to be insignificant indicating no causal relationship from future to the spot market returns. However, for Moong, unidirectional causality from future to spot market returns was found. The causality from spot to future market returns was found to be insignificant indicating no causal relationship from spot to the future market returns.

Variance Decomposition
The causality between spot and future market returns of included Agro Commodities was further examined using Variance decomposition function which explains the proportion of variance in the included series due to the lagged values of the other included series as well as its own lagged values. **Table-3** shows the result of the VDF analysis for 10 lags:

Table-3
Variance Decomposition Function Commodities

Variance Decomposition of DLOG(SPOT):				Variance Decomposition of DLOG(FUTURE):		
Commodity	S.E.	Dlog (Spot)	Dlog (Future)	S.E.	Dlog (Spot)	Dlog (Future)
Mustard Seed	0.021	97.650	2.349	0.029	33.008	66.991
Refined Soy Oil	0.0193	95.076	4.923	0.0259	29.535	70.464
Crude Sunflower Oil	0.018	99.373	0.626	0.040	16.010	83.989
Refined Castor Oil	0.014600	96.752	3.247	0.031288	14.474	85.525
Groundnut	0.020	99.499	0.500	0.036	23.881	76.118
Raw Yellow Peas	0.016	99.052	0.947	0.036	11.075	88.924
Moong	0.175	94.432	5.567	0.168	89.267	10.732
Bajra	0.026	99.673	0.326	0.036	41.601	58.398
Paddy (Basmati)s	0.026	99.541	0.458	0.031	64.975	35.024
Maize Feed	0.012648	99.860	0.139	0.025631	11.725	88.274

The results of VDF analysis reported that the spot and future market returns of majority of commodities is explained to a very large extent with the help of its own lagged behavior than due to the returns of the other market. However, in case of future market returns of Moong and Paddy (Basmati)s, it was found to be explained to a small extent with the help of its own lagged behavior and a large extent due to the returns in the other market.

Summary & Recommendations

During the period of study Spot and future prices of all the agro commodities showed fluctuations. Mean spot prices were greater than mean future prices for all agri-commodities except Mustard Seed, Groundnut and Paddy (Basmati) during the period of study. ADF Unit root test showed that time series was not stationary at level 0. However, the time series became stationary at first log transformation for all 10 commodities. There exists high positive significant correlation between the Agri spot and future commodity prices which showed that during the period of study they were moving in the same direction. There exists Bi-directional causality between spot and future market returns in 5 commodities, namely, Mustard Seed, Refined Soy Oil, Refined Castor Oil, Crude Sunflower Oil and Raw Yellow Peas. Uni-directional causality from spot to futures market was observed in case of Groundnut, Bajra, Paddy (Basmati) and Maize Feed. However, unidirectional causality from future to spot market returns was observed in case of Moong. VDF analysis found that in all commodities, except Moong and Paddy (Basmati), a significant proportion of spot market returns variance is explained by its own lagged behavior than by the variance of futures market returns. Only in case of Moong and Paddy (Basmati)s, it was found that future market returns are affected more by the spot market returns than lagged behavior of future market returns. The price discovery process is efficient in commodity markets and there exists bi-directional causality between spot and future markets. There is higher causality in the direction from spot to future market, highlighting a more active spot market explaining its own variance to a very large extent.

In case of Mustard Seed, the volatility is found to be uni-directional, only from future market to spot market. Also, the volatility coming from future to spot market is absorbed on the same day and there is no spill over to the next day spot market. In all other commodities, the following findings were found: 1. The volatility in the future market has a bi-directional influence between the future market and spot market of the commodity. 2. Any new information which comes in the market results in a significant volatility spill over in the direction of future market to the spot market. 3. The volatility spill over from future market on the next day movement in spot market is also found significant.

Upon going through the research process, it was observed clearly that there is a great scope for improvement, both at policy and implementation levels for the overall development of Commodity Derivative markets in India. Be it the policy makers, traders, farmers or investors, all of them need to participate and work towards a system which is not only robust for them but for the Economy as well.

There should be more emphasis on proper training and education of various stakeholders in Commodity markets, like Farmers, Traders and Investors. This would go a long way in generating their interest in market platforms used by NCDEX and other markets. As spot and future markets get better integrated both in terms of scope and geographical coverage, it would help in economic development of India as over 60% of its population is still engaged in Agriculture, with more scientific price discovery process between these markets in place. Volatility in agricultural markets is a known devil due to the nature of the commodities (seasonal and dependent on rainfall). Volatility shall exist in both spot and future markets of commodities. The only way it can be managed well in the interests of stakeholders by having a larger segment of the market

participants on the online trading platforms and the latest information is always available to them. Proper Government Regulation with a long-term perspective is another need for strategic development of Commodity Future markets. Bringing commodity markets under the regulation of SEBI was one such move. A long-term policy for systematic development of commodity future markets should be framed on the lines of financial markets.

The negative effects of pure speculative players should be managed by Regulators like it is done for financial markets. This would help in managing short term commodity pricing and supplies distortions due to hoarding of commodities. Development of Commodity derivative markets in India need more capital and for doing this, Government should encourage investment in this sector. One direct way of getting more investment in the markets is to provide a better online marketing platform to foreign investors and speculators to invest in these markets. This would also need adequate regulatory support and protection from SEBI. India being a pre-dominantly agricultural country, it has potential both in size and capacity to absorb the volatility in commodity future market. A proper design and use of this capacity would help the farmers to get a proper price both in spot and future markets and manage their risks using derivative markets effectively. This would directly contribute to the growth of GDP in India. As commodity future markets are in the nascent stage as compared to financial markets, SEBI can put these markets on a higher learning curve by putting in their experience with the growth of financial markets. This would reduce the development timeline for Commodity future markets to a great extent and also protect the interests of vulnerable small and individual investors in commodity future markets.

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