TIME SERIES ANALYSIS OF SPOT AND FUTURE COMMODITY MARKET IN INDIA DURING COVID – 19

ABSTRACT

Derivatives are innovative financial instruments in the 21st century to help the market participants in mitigating the risk. Commodity derivatives are not new to the world, but reentered with new face into the fray. In India, derivatives are introduced at first on index and followed by securities and commodities phase wise for the betterment of the markets and the price discovery. The present study explores the association and trend between the Spot and Futures Commodity Derivatives Market in India before and during the Covid – 19 pandemic. The study uses descriptive, trend analysis and correlation analysis. The analysis done by using the MCX four major agriculture and non-agriculture commodities such as Cotton, Mentha oil, Crude oil and Natural gas spot as well as future price. Indian commodity futures market can be used as hedging tool with financial instruments for diversifying the risk during crisis period.

Keywords: *Time series analysis, Commodity derivatives, Spot price, Future price, Covid -19 pandemic*

1.INTRODUCTION

"Indian commodity derivatives market has remained on a steady growth path during the last year or so, despite the frequent disruptions from the Covid-19 pandemic and the resultant lockdowns. Notwithstanding the uncertainty resulting from the emerging new variants of Covid-19 and the operational constraints from lockdowns, India's commodity derivatives market has remained resilient and expanded its scope with successful launch of new products, backed by supportive regulatory and robust trading systems. Rapid vaccination drives have helped in containing the spread of the pandemic, helping in lifting lockdowns and returning to normalcy in economic activities across the country". [4]

"Global economic recovery, though still perceived to be uneven, has provided the necessary boost for trade in commodities, particularly those in the energy and industrial metals segments, during the last one year, owing to rise in demand across the globe. According to the World Bank's Commodity Markets Outlook October 2021, the prices of energy, especially natural gas and base metals, have witnessed a significant increase in 2021 compared to that in the previous year". [4]

"Indian commodity markets also witnessed a surge in energy and base metal prices as the global volatility trends percolated to domestic markets. Consequently, trade volumes in energy and base metals derivative segments increased as stakeholders in these commodities sought to hedge their risk exposure using derivatives traded on domestic exchanges" [4].

"Commodity futures market was volatile in USA, U.K. and India. The comparison between US, U.K and Indian futures markets reveals the policy makers have to follow the clue from U.S and U.K regulation to promote and encourage investments in commodity derivatives market" [5,10]. "The agricultural commodity futures in India and found that in spite of development of commodity futures market, farmers could not gain leverage from the market, as there is no integration between spot and futures market. They further found that due to lack of infrastructure and warehousing, regional exchanges could not penetrate to rural India" [3,7].

"Performance of Commodity Derivatives Market in India by using growth in volume and value of commodity derivatives market and found the linearity in growth trend" [9,11]. The presence of nonlinearity in returns is considered as evidence against the efficiency of Indian commodity markets theory which characterizes data as random walk or more strictly a martingale [13] and confirmed the long run efficiency of commodity futures prices and inefficiency of futures prices in short run [8]. Most of the studies conducted by many researchers focused on impact of futures on volatility, risk management, price discovery, hedging, and market efficiency [1,2] and relation between return and trading volume, lead-lag relationship between trading activity and cash price volatility before and after introduction of futures market, but no study was found with regard to assessing the trend in crisis period and future prospects on performance of the market. Hence, the present paper is undertaken as a modest attempt to dwell on such untapped aspects. The study proposed with the objective of studying the agricultural and non-agricultural commodities price in terms of trend for the major agricultural and non-agricultural markets in India and to suggest measures to protect the investors from wide price fluctuations during shock period.

2. METHODOLOGY

The study employed secondary data of agricultural and non – agricultural commodity spot and future price. The daily price data of spot and future commodity market were collected from MCX. The study selected agricultural and non-agricultural commodities such as Cotton,

Mentha oil, Crude oil and Natural gas are from declaration of novel corona virus by WHO on 24 March 2020 to till three months contract period.

2.1. Trend analysis

An attempt has been made to estimate trend co-efficient for selected agricultural commodities in India during the study period by fitting a linear regression model. The linear model fitted is as follows.

$$Y = \alpha + \beta t + e \qquad (1)$$

Where 'Y' is selected variables,

't' is the time

'α and βt' are the parameters (intercept and co-efficient respectively)

e is the error term.

2.2. Correlation Analysis

Correlation analysis has been performed to determine the spot and future price relationship. The correlation coefficients were measured to assess the strength of association between spot and future price of the selected assets [6]. The calculation of correlation coefficient was measured using equation.

$$r = \frac{\Sigma\,(x-x)(y-y)}{\sqrt{\Sigma(x-x)^2(y-y)^2}} \qquad (2)$$

3. RESULTS AND DISCUSSION

The collected secondary data was analyzed using linear trend model and the results are presented below. Table 1 explain about the summary statistics for the selected commodities. In spot market, comparing before and after the spread of Covid – 19 pandemic, Cotton and Mentha oil shown higher volatility during covid – 19 pandemic while Crude oil and Natural gas shown higher volatility before the spread of covid – 19 pandemic. In future market, comparing before and after the spread of Covid – 19 pandemic, Cotton, Mentha oil and Crude oil shown higher volatility before the spread of covid – 19 pandemic while Natural gas shown higher volatility during covid - 19 pandemic.

Table 1 Summary Statistics for selected variables

Variables	Before Covid -19 Pandemic				During Covid - 19 Pandemic			
Spot Market	**Mean**	**Std Deviation**	**Min**	**Max**	**Mean**	**Std Deviation**	**Min**	**Max**
Cotton	18888.92	355.87	18070.00	19570.00	16623.61	**1084.74**	15410.00	18070.00
Mentha Oil	1343.12	47.89	1284.70	1430.10	1248.35	**74.70**	1074.10	1295.10
Crude Oil	3573.32	**768.02**	1511.00	4561.00	2123.43	627.06	887.00	3060.00
Natural Gas	138.14	**11.24**	119.00	163.50	133.98	8.73	117.00	161.30
Future Market								
Cotton	19486.62	**509.06**	17120.00	19800.00	16319.34	445.52	15170.00	17150.00
Mentha Oil	1216.54	**80.32**	1060.80	1425.60	1116.58	77.38	1000.00	1284.20
Crude Oil	3634.92	**726.91**	1739.00	4532.00	2392.95	465.55	1436.00	3094.00
Natural Gas	140.24	9.61	124.50	163.50	140.30	**12.99**	121.40	175.60

Table 2 represents the estimates of trend coefficient in spot market. Before the spread of covid – 19 pandemic, Mentha oil and Crude oil observed higher R^2 of 85 and 79 per cent while lesser during covid – 19 pandemic of about 64 and 71 per cent for Mentha oil and Crude Oil respectively. But cotton shown increased R^2 from 57 to 62 per cent before to during Covid – 19 pandemic. Pre Covid – 19 pandemic period in spot market, all the selected commodities shown negative sign moving in decreasing trend with statistically significant. While during Covid – 19 pandemic in spot market, except all crude oil alone shown positive sign moving in increasing trend with statistically significant.

Table 2 Estimates of Trend Co-efficient in Spot Market

Before Covid -19 Pandemic					
Variables	**A**	**βt**	**R^2**	**P-Value**	**S/NS**
Cotton	19358.86	-14.24	0.57	0.000	S
Mentha Oil	1420.33	-2.34	0.85	0.000	S
Crude Oil	4767.69	-36.19	0.79	0.000	S
Natural Gas	153.94	-0.48	0.65	0.000	S
During Covid - 19 Pandemic					
Variables	**A**	**βt**	**R^2**	**P-Value**	**S/NS**
Cotton	18120.21	-48.28	0.62	0.000	S
Mentha Oil	1353.06	-3.38	0.64	0.000	S
Crude Oil	1200.85	30.25	0.71	0.000	S
Natural Gas	134.52	-0.02	0.00	0.786	NS

*(S-Significant, NS-Not Significant) ***P<0.01 and **P<0.05*

Table 3 represents the estimates of trend coefficient in future market. Before the spread of covid – 19 pandemic, Mentha oil and Crude oil observed higher R^2 of 89 and 79 per cent while lesser during covid – 19 pandemic of about 38 and 78 per cent for Mentha oil and Crude Oil respectively. But cotton shown increased R^2 from 5 to 32 per cent before to during Covid – 19 pandemic. Pre Covid – 19 pandemic period in future market, all the selected commodities shown negative sign moving in decreasing trend with statistically significant. While during Covid – 19 pandemic in future market, except all crude oil alone shown positive sign moving in increasing trend with statistically significant.

Table 3 Estimates of Trend Co-efficient in Future Market

Before Covid -19 Pandemic					
Variables	**A**	**βt**	**R^2**	**P-Value**	**S/NS**
Cotton	19682.65	-5.94	0.05	0.077	S
Mentha Oil	1348.93	-4.01	0.89	0.000	S
Crude Oil	4759.93	-34.09	0.79	0.000	S
Natural Gas	151.37	-0.34	0.44	0.000	S
During Covid - 19 Pandemic					
Variables	**A**	**βt**	**R^2**	**P-Value**	**S/NS**
Cotton	16760.67	-14.24	0.32	0.000	S
Mentha Oil	1199.90	-2.69	0.38	0.000	S
Crude Oil	1676.75	23.48	0.78	0.000	S
Natural Gas	142.32	-0.06	0.01	0.496	NS

*(S-Significant, NS-Not Significant) ***P<0.01 and **P<0.05*

The correlation analysis is used to examine the relationship between spot and future price in commodity market. Table 4 revealed the correlation between spot and future price commodity wise before covid – 19 pandemic. Mostly all commodity spot and future price pairs shown highly positive correlation. Highly correlated spot and future pair is Crude oil (99.8%) followed by Natural gas (95.8%), Mentha oil (93.7%) and Cotton (50.1%). Remaining cross commodity combination also shown positive correlation. Hence it can be concluded from the analysis that all the selected commodities are moving in same direction and having reciprocal impact on each and every opponent commodity.

Table 4 Correlation Analysis between Spot and Future Price Before Covid – 19 Pandemic

Variables	**Crude Oil (S)**	**Crude Oil (F)**	**Natural gas (S)**	**Natural gas (F)**	**Cotton (S)**	**Cotton (F)**	**Mentha Oil (S)**	**Mentha Oil (F)**

Crude Oil (S)	1.000							
Crude Oil (F)	***0.998***	1.000						
Natural gas (S)	0.683	0.669	1.000					
Natural gas (F)	0.527	0.510	***0.958***	1.000				
Cotton (S)	0.813	0.821	0.513	0.336	1.000			
Cotton (F)	0.520	0.531	0.152	0.050	***0.501***	1.000		
Mentha Oil (S)	0.737	0.729	0.855	0.762	0.658	0.037	1.000	
Mentha Oil (F)	0.858	0.853	0.806	0.680	0.762	0.254	***0.937***	1.000

Note: S and F means Spot and Future Price

The correlation analysis is used to examine the relationship between spot and future price in commodity market. Table 5 revealed the correlation between spot and future price commodity wise during covid – 19 pandemic. Commodity spot and future price pairs shown positive correlation but lesser than before Covid – 19 pandemic. High positive correlation exhibited in Cotton (82.2%) followed by Natural gas (79.3%), Crude oil (74.5%) and Mentha Oil (56.8%). Remaining cross commodity combination also shown negative correlation. Thus, the selected commodities are moving in opposite direction. Negatively correlated commodity is sign for choosing the portfolio diversification to minimize risk. Thus, stated commodity market have better performance for all the stakeholders [12].

Table 5 Correlation Analysis between Spot and Future Price During Covid – 19 Pandemic

Variables	Crude Oil (S)	Crude Oil (F)	Natural gas (S)	Natural gas (F)	Cotton (S)	Cotton (F)	Mentha Oil (S)	Mentha Oil (F)
Crude Oil (S)	1.000							
Crude Oil (F)	***0.745***	1.000						
Natural gas (S)	-0.253	0.120	1.000					
Natural gas (F)	-0.280	-0.060	***0.793***	1.000				
Cotton (S)	-0.668	-0.629	-0.199	-0.410	1.000			

Cotton (F)	-0.408	-0.445	-0.215	-0.412	***0.822***	1.000		
Mentha Oil (S)	-0.751	-0.709	0.247	0.441	0.370	0.193	1.000	
Mentha Oil (F)	-0.763	-0.499	0.301	0.110	0.631	0.599	***0.568***	1.000

Note: S and F means Spot and Future Price

4. CONCLUSION

The following conclusion were found from the results and discussions. Before the covid – 19 pandemic, Cotton, Crude oil and Natural gas have shown higher future price than spot price that reveals the contango effect means when an asset's price is expected to rise over time. That results in an upward-sloping forward curve. During Covid – 19 pandemic, Cotton, Mentha oil and Natural gas have shown higher spot price than future price reveals backwardation effect occur as a result of a higher demand for an asset currently than the contracts maturing in the coming months through the futures market. Traders use backwardation to make a profit by selling short at the current price and buying at the lower futures price. The trend results shown except crude oil other commodities shown high negative value means declining trend, crude oil observed increasing trend from pre to during covid -19 pandemic period. The correlation results revealed the positive to negative relation from pre to during covid – 19 pandemic. Hence it can conclude the relationship change over the time thus Indian commodity futures market can be used as hedging tool with financial instruments for diversifying the risk during crisis period.

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