

# 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 been rationalized in 2003 and futures contracts trading has seen upturn in terms of volume and value surge with very swift growth during that decade. It raised itself to compete in the global market with international giants, such as NYMEX, CBOT, LME, etc., and became the top fifth exchange in terms of number of contracts in gold, second in silver, copper and natural gas. It is found that the trading in commodity derivatives is about three times more than in physical market, whereas, it is more than ten times in advanced economies. In spite of reaching global standards, the market is facing the challenges due to lack of infrastructure, warehousing, inadequate risk mitigating instruments, etc. If the regulators take cognizance of these issues, Indian commodity derivatives market will become definitely an icon among the world commodity derivatives market.

At present 21 commodity futures exchanges are working in the country, out of which, six are at national level and fifteen at regional level. All these exchanges are under the regulatory system of Forward Market Commission (FMC), Government of India. By and large, the market has staged a spectacular growth of trading in terms of volume and value of commodity trading. It

is very clear through the statistics that 53 commodities notified and permitted for futures trading in 2003 by forward market commission that moved to 113 in agricultural, and non-agricultural commodities futures contracts.

Most of the studies conducted by many researchers focused on impact of futures on volatility, risk management, price discovery, hedging, and market efficiency, 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.DATA SOURCE AND 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.

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

Where ‘Y’ is selected variables,

‘t’ is the time

‘ $\alpha$  and  $\beta$ ’ 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 climate – crop production relationship and climate – crop yield relationship. The correlation coefficients were measured to assess the strength of association between crop production, crop yield and climate variability of selected crops. (Gujarati 2022) the calculation of correlation coefficient was measured using equation.

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

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

<b>Before Covid -19 Pandemic</b>					
<b>Variables</b>	<b><math>\alpha</math></b>	<b><math>\beta t</math></b>	<b><math>R^2</math></b>	<b>P-Value</b>	<b>S/NS</b>
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
<b>During Covid - 19 Pandemic</b>					
<b>Variables</b>	<b><math>\alpha</math></b>	<b><math>\beta t</math></b>	<b><math>R^2</math></b>	<b>P-Value</b>	<b>S/NS</b>
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	$\alpha$	$\beta t$	$R^2$	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	$\alpha$	$\beta t$	$R^2$	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)	<b>0.998</b>	1.000						
Natural gas (S)	0.683	0.669	1.000					
Natural gas (F)	0.527	0.510	<b>0.958</b>	1.000				
Cotton (S)	0.813	0.821	0.513	0.336	1.000			
Cotton (F)	0.520	0.531	0.152	0.050	<b>0.501</b>	1.000		
Mentha Oil (S)	0.737	0.729	0.855	0.762	0.658	0.037	1.000	

<b>Mentha Oil (F)</b>	0.858	0.853	0.806	0.680	0.762	0.254	<b>0.937</b>	1.000
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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.

**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)
<b>Crude Oil (S)</b>	1.000							
<b>Crude Oil (F)</b>	<b>0.745</b>	1.000						
<b>Natural gas (S)</b>	-0.253	0.120	1.000					
<b>Natural gas (F)</b>	-0.280	-0.060	<b>0.793</b>	1.000				
<b>Cotton (S)</b>	-0.668	-0.629	-0.199	-0.410	1.000			
<b>Cotton (F)</b>	-0.408	-0.445	-0.215	-0.412	<b>0.822</b>	1.000		
<b>Mentha Oil (S)</b>	-0.751	-0.709	0.247	0.441	0.370	0.193	1.000	
<b>Mentha Oil (F)</b>	-0.763	-0.499	0.301	0.110	0.631	0.599	<b>0.568</b>	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 that Indian commodity futures market can be used as hedging tool with financial instruments for diversifying the risk during crisis period.

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