INTERRELATIONSHIP BETWEEN FUTURES PRICE AND SPOT PRICE OF COPPER IN MULTI COMMODITY EXCHANGE (MCX)

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Abstract
The objective of the study was to analyse the interrelationship between future and spot prices of copper in Multi commodity Exchange (MCX). The data were taken from the website of MCX for the period of three years from 2019 to 2021. The various econometric models like ADF and Johansen co integration test is applied in the study to examine spot and future prices relationship. The non – stationarity data were converted to stationary data wherever it was required for the better results. The unit root test confirmed that data are integrated at the first difference 1(1). The cointegration test revealed that copper spot and future prices cointegrated at none and at most one in the contract by indicating long term relationship.
Keywords: Commodity market, Copper, Interrelationship

Introduction

The market price of the asset will get adjusted quickly to new information in efficient market (Fama, 1970). If the future price and spot price is perfectly efficient, all relevant information would rapidly be used by the participants in the market to determine the prices of similar assets. Futures price move along with the price of its underlying assets and, the market information is adjusted immediately without any lag or lead movement in one another (Sushma, Shubha, 2022). Sometimes, the markets are inefficient due to market resistance factors due to trading cost, infrequent trading, restrictions on short sale etc. Hence lead –lag relationship exists between future and spot prices.

The study aims at analysing the extent to which the Indian commodity market is efficient. The literature explaining about inter relationship is not new. However, India is an emerging market which offers trading of agricultural and non-agricultural commodities by facilitating liquidity of the asset. The study considers copper as a commodity to determine the inter relationship since the base metal markets are more volatile and it has more impact on the Indian economy. Recently this metal has gained more attention as an investment option, and traders protect or exploit future price movements and hence copper is considered for this study.

Many studies have explored the inter relationship in various markets. Most of the studies concentrated on developed economies indicating future markets play a important role in determining underlying spot prices (Khan, Ramani, 2014; Hernandez, Torero, 2010; Handika, 2018; Nicolau, Palomba et al,, 2013; Ameur, Ftiti, Louhichi, 2021; Belia, Sehgal, 2013). While studies from emerging markets have also found that future price leads to underlying spot prices(Sushma, Shubha, 2022; Khan, Ramani, 2018; Raghavendra, Velmurugan, 2016; Pradhan et al, 2020; Galan, Garcia, 2021; Mirafiore, 2016). To analyse and understand the interrelationship in an emrging markets, this study aims to determine a relationship between copper futures and spot prices considering three years of data from 2019 -21. Since copper is the most actively traded futures contract in India and international markets, hence

understanding the speed of information flow from one market to another is necessary.

It is observed that not many researchers carried out on interrelationship with respect to copper and hence this study aims to analyse the relationship process. The result of this study may interest academicians, investors and traders interested in the financial market. The outcome of the study can also help other researchers to study other base metals in Indian market and other international market.

The remainder of this paper is organised as follows: A exhaustive review of literature is presented in section 2, the analytical framework is discussed in section 3, econometric analysis and results are presented in section 4 and the conclusion in section 5.

LITERATURE REVIEW

The research paper of (Antonica, Garcia, 2021) analysed the cointegration between the copper future prices and Brexit. The study found that due to the condition of "contango" the future prices enjoy a premium over the spot price in the London stock exchange. The difference in spread between the two prices is affected by the supply and demand as well as social, political and other macro-economic variables. The study revealed that macro-economic factors and its impact on companies are cointegrated with the copper future prices. The study analysed the relationship between future and spot prices of copper in Indian commodity market using correlation and regression analysis. The result of the study showed that the non – stationary data of copper spot and future had close relationship, but stationary data of future and spot prices was not showing significant relationship (Ferojuddin, Ramani,2014). While (Trivedi, Nair, 2018) examined the price discovery function of futures market and arbitrage linkage between spot and futures for gram. The main findings were, the futures market play a vital role in price discovery but the spot market can be taken as a pure price discovery and the arbitrage linkage between the future and spot prices were weak. (Hernandez, Torero, 2010) study the dynamic relationship between spot and future prices of agricultural commodities. The result indicated that spot prices are discovered in futures markets and also found that changes in futures prices lead changes in spot prices. (Handika, Truck,2018) has analysed the relationship between spot and futures prices in Australian electricity markets. After examining historical futures premiums, the study found that Australian electricity markets shows positive and significant risk premiums and futures prices cannot be considered as an estimator of the future spot prices. The research paper of (Nicolau et al, 2013) analysed the relationship between spot prices and futures prices using three commodities namely crude oil, natural gas and gold. The result of the study showed some interactions between spot and futures prices and depend on nature of market and maturity of futures contract. (Jeelan Basha, 2016) has examined the relationship between the future and spot price of Gold. The study concluded that after using the tests like unit root test, cointegration test, there is a long-term relationship between gold futures and spot prices in India. Underlying spot prices of Gold are caused by the effects of futures prices. After revisiting the relationship between spot and futures commodity markets (Ameur and Louhichi, 2021) found a bidirectional relationship between both markets over the short and long term in the futures market which confirms the future market's contribution to price discovery in commodities. (Raghavendra, 2016) has analysed an efficiency and causation between spot and futures markets of soya bean, Chana, Maize, Jeera and Turmeric for the period of 2010 to 2015. The results of regression model indicated that there is a long run equilibrium relationship between futures and spot prices and also lead lag relationships exist between the spot and future markets. The study of (Sushma and Shubha, 2022) examined the relationship between spot and future prices of copper as a base metal in the Indian commodity market

from 2015 – 2019. The statistical analysis of the study revealed that price is first discovered in the spot market and causality test indicated that it is unidirectional in the short run.
According to the previous review of literature it is observed that emerging and developed markets displayed mixed results in various commodities. This implies that spot market lead future market in some cases while it is opposite in few other instances.

3. METHODOLOGY

This section presents the analytical framework of interrelationship between copper future and spot prices using econometric model. In order to process further with the analysis, the variables are converted to natural logarithms.

3.1 Descriptive statistics

The study is empirical nature. To minimize the heteroscedastic nature of the data logarithmic transformation is done. EViews software is used for econometric analysis. Augmented Dicky Fuller test (ADF), Johansen cointegration test and Vector Error Correction Model (VECM) is carried out for analysing the interrelationship.

3.2 Model Specification

The main aim of the study is to examine the interrelationship of spot and future prices in Indian commodity market. The study prefers commodity market because they are more linked to current economic situations. Investors, speculators, hedgers and policy makers interested in commodity market as an alternative investment for hedging against risk in equity market. Hence analysing the interrelation between spot and future prices is more important for investment decisions.
This study adopts ADF test which helps to analyse autocorrelated data and include lag values as per the frequency of dada.
Augmented Dicky Fuller Test:
$\Delta X_t = \alpha_o + \beta X_{t-1} + \sum \delta_i \Delta X_{t-i} + \varepsilon_t$
The present study relies on the Johansen cointegration test as it is widely used to test cointegrating relationships for non-stationarity time series data.
$Y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots \ldots + \beta_k y_{t-k} + u_t$

4. Results and Discussions

The descriptive statistics of copper implies that the average spot price is higher than the average future prices, indicating a contango during the sample periods. The maximum return of copper future from 2019 – 21 is 17.86 while the minimum is 0.23 with an average of 1.76. Spot returns of copper has a maximum return of 13.96 and a minimum of -6.0 with an average of 1.89.

Table 1 Showing descriptive statistics of copper

	Spot price	Future price
Mean	1.89	1.76
SD	4.84	5.73
Min	-6.0	0.23
Max	13.96	17.86
Skew	0.55	0.70
Kurtosis	2.91	3.74

Source: Statistical calculation by author

The highest value of standard deviation indicates the non-stability of price during the sample period. The skewness value of copper in both future and spot prices implies that the series is asymmetrical and right distributed based on the nature of the commodity. This analysis indicates that commodities are also similar to other class of assets in the financial market.

4.2 Stationarity

Before analysing the cointegration, it is necessary to do unit root to assess the stationarity of integration of price series. The copper spot price and future prices are checked for stationarity using the Augmented Dickey Fuller Test (ADF)

H_0: The data have a unit root

From the table 2, it is observed that all the series are consist of stationarity taking the "at level test". Considering the differences, all the series are stationary at 1% significance level for the period. Hence, the null hypothesis is rejected.

Table 2: Results of unit root test (ADF)

At level 1

		Spot price	Future price
With constant	T – statistic	-4.28	-6.49
	Probability	0.00**	0.00**
With constant &Trend	T – statistic	-6.53	-7.95
	Probability	0.00**	0.00**
Without constant &Trend	T – statistic	-7.42	-12.50
	Probability	0.00**	0.00**
At first difference			
With constant	T – statistic	-6.57	-7.94
	Probability	0.00**	0.00**
With constant &Trend	T – statistic	-6.52	-7.80
	Probability	0.00**	0.00**
Without constant &Trend	T – statistic	-7.42	-3.65
	Probability	0.00**	0.02*

Source: Statistical calculation by author.

Note (**) significant at the 1% level; significant at the 5%.

4.3. Cointegration test of copper

After confirming the stationarity of copper future and spot prices, Johansen's cointegration test is carried out to analyse the log run equilibrium relationship between the variable.

H_0: There is no cointegration between future and spot prices of copper

Table 3. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-100	18.27	5.91	6.03	6.12	6.06
2	-86	4.82	9.63	6.16	6.44	6.25
3	-89.7	5.99	16.90	6.60	6.88	6.69
4	-107	8.75	5.84	6.42	6.51	6.45

Source: statistical calculation by authors; indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Table 4. Cointegration test with lag 1 at 5% level of significance

	Model 2	Model 3	Model 4
None*	39.64	45.73	22.52
At most 1*	8.93	7.00	4.41

Source: statistical calculation by authors;
**denotes rejection of the hypothesis at the 0.05 level;*
*** MacKinnon – Haug – Michelis(1999) p- values*

Table 5. Unrestricted Cointegration Rank test (Trace test)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None*	0.6056	39.65	15.49	0.00
At most 1*	0.2372	8.93	3.84	0.00

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
**denotes rejection of the hypothesis at the 0.05 level*
***Mackinnon-Haug-Michelis(1999) p-values*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None*	0.7018	45.73	14.26	0.00
At most 1*	0.1965	7.00	3.84	0.00

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
**denotes rejection of the hypothesis at the 0.05 level*
***Mackinnon-Haug-Michelis(1999) p-values*

From Table 5, the optimum lag length has been identified using the Schewarz information criterion (SIC). The result of the cointegration test is presented in detail in the above table including trace statistics and Maximum eigen value are considered.

The results of no cointegration (None) are rejected as the trace statistics (39.65), and Maximum eigen value (45.73) is more significant than the critical value of 15.49 and 14.26 respectively. At most 1

cointegration exists in the trace statistics (8.93) and Maximum eigen value (7.00) is more significant than the critical value of 3.84. Therefore, H_0 is rejected, and H_a is accepted indicating at most, one cointegrating being present in that period. The markets of copper spot and future prices move together in the given period.

5. Conclusion

This study examines the Interrelationship of spot and future price of the Indian commodity market using copper as the base metal. The researcher has considered monthly average data of closing prices of future and spot prices from 2019-2021. Future research can be carried out on extending the period. The researcher has applied econometric tests like descriptive statistics, unit root and Johansen cointegration to examine spot and future prices relationship. The unit root test confirmed that data are integrated at the first difference 1(1). The cointegration test revealed that copper spot and future prices cointegrated at none and at most one in the contract by indicating long term relationship. The present study can be supported with future research analysing some other commodities in the commodity market and also studying the impact of macro-economic factors on the commodity market.

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