An Empirical Analysis of Price Discovery in Silver Spot-Futures Market: Evidence from Multi Commodity Exchange of India Limited (MCX)

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Introduction

Commodity derivative trading has seen an unparalleled growth since beginning of this century. Investment in commodity derivatives is becoming the most sought-after investment alternative for investors in the recent past. The Economic benefits of the derivative trading in commodities are increasingly being recognised by the stakeholders of the market. Commodity Derivatives such as Futures contracts perform two important functions of price discovery and risk management with reference to the given commodity. India had a vibrant futures market in commodities but it was discontinued in the mid 1960's, due to war and natural calamities. The economic liberalization in the early nineties laid the foundation of the Indian commodity trading. The Government of India allowed the re-introduction of commodity futures in India in 2002 and by the beginning of the year, there were about 20 commodity exchanges in India, trading in total 42 commodities. The Forward Markets Commission (FMC), established under the Forward Contracts (Regulation) Act, 1952 is the agency which regulated commodity derivatives trading in India until it got merged with Securities and Exchange Board of India (SEBI) on 28th September 2015. Commodity Markets can be classified into Spot and Future markets. Spot markets are markets where the trading of commodities takes place immediately or within a day while Future markets are markets where future contracts are bought and sold. Futures contract is a contract to buy or sell a set of commodities at a selected future date in a designated future month at a specified price established upon by the buyer and seller of the futures contract. Risk transfer and price discovery are the two major contributions of futures markets to the organisation of economic activity (Evans. 1978; Silber,1981; Working,1962). Risk Transfer refers to hedgers using futures contracts to shift price to others. Price discovery refers to use of futures prices for pricing cash market transactions (Gardbade & Silber, 1983; Lake, 1978; Working, 1948; Wiese, 1978). Price Discovery is the process through which markets attempt to reach equilibrium prices (Schreiber & Schwartz, 1986; working, 1948). Price discovery implies the presence of equilibrium price i.e the process describes how information is produced and transmitted across the markets. In addition, it also impounds information to all the market participants. The significance of both these contributions depends upon a close relationship between the prices of futures contracts and cash (spot) commodities. Theoretically when two markets for the same asset are faced with the same information arriving simultaneously, the two markets should react at the same time in a similar fashion. If the two markets do not react at the same, one market will then lead the other. When such a lead- lag relation appears in the case of price adjustments, the leading market is viewed as contributing a price discovery function for that sector (Bose,2008).

Review of Literature

While Reviewing the related literature, it was found that there are only a few research studies having been taken place in this area. Further, it was noted that the studies lay contradictory views. A few related studies are reviewed and listed here

Garbade and Silber (1982) examine seven types of agriculture and precious metals commodities and observed that futures markets accounts 75% of new information dominate spot market in price discovery.

Adrangi, Chatrath and David (2000) evidence a strong bi-causal relationship between the two contracts and silver contract is found to bear the majority of the burden of convergence to the gold-silver spread.

Liu and Zhang (2006) have studied the price discovery of spot and future prices in Chinese copper, aluminium, rubber, soybean and wheat markets.

However, the lead lag relationship between spot and futures markets in Indian commodity derivatives are quite limited.

Karande (2006) reported that futures price leads the spot price in price discovery between crude oil and castor seed.

Rachana Kumari Bansal and Y.C. Zala (2015) analyzed the futures and spot price relations in Castor ---

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2013 traded on National Commodity Derivative Exchange of India Ltd (NCDEX). The ADF (Augmented Seed. The study used the daily data of spot and futures prices of castor seed from July 2004 to December Dickey Fuller) test has been used to check the stationarity of the time series data and data was found to be stationary after taking first difference. The spot and futures prices were found to be co-integrated by using Johansen Co-integration test. The result of Granger causality test shows unidirectional Granger Causality from futures to spot markets. This further indicates the efficiency of castor futures market.

Joshy. K.J and Ganesh L (2015) analyzed the price discovery process of gold and examined the long run dynamic relationship between spot and futures markets as well as volatility impact of futures price on spot price and of spot price on future price. The study used the daily data of spot and futures prices of gold traded on NCDEX during 2008 to 2012. The ADF (Augmented Dickey Fuller) test has been used to check the stationarity of the time series data and data was found to be stationary after taking first difference. The spot and futures prices of gold market were found to be co-integrated by using Johansen Co-integration test. Vector Error Correction Model (VECM) was used to analyze the price discovery process whose results show the dominance of spot market in price discovery process. Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model was used to examine the volatility impact whose results imply that both futures as well as spot do not have significant impact in the price volatility of gold in India.

Raghavendra RH, Velmurugan PS and Saravanan A (2016) The relationship between spot and future prices of five agricultural commodities such as Soybean, Chana, Maize, Jeera and Turmeric was assessed. The study used daily data of spot and future prices traded in NCDEX from January 2010 to March 2015. Augmented Dickey- Fuller (ADF) test and Phillips-Perron (PP) test were used to test stationarity of data and Johansen Co-integration test and Regression Model were employed to analyze the Lead-Lag relationship between Spot and Future Markets of the selected agricultural commodities. The results show the existence of equilibrium relationships between futures and spot prices for 5 agricultural commodities viz., Soya bean, Chana, Maize, Jeera and Turmeric in the long run that were taken under this study. The results also confirms the presence of unidirectional relationship from future market to spot market prices for two agricultural commodities, viz., Soybean and Chana and bidirectional relationship between commodity for three selected agricultural commodities viz, Maize, Jeera and Turmeric.

In general, the focus of research is to determine whether the cash market leads the futures market or vice versa or whether bidirectional causality exists between the two markets. The presence of lead-lag relationship may indicate how well the two markets are linked together. It also provides information on how quickly one market reacts to the new information from the other market. Investors make use of this information in their decision-making process.

Objectives of the Study

1.To establish the dynamic linkage between spot-future markets in Indian Commodity Markets.

2.To establish the role of commodity futures market in performing the function of price discovery in India.

Hypothesis

H01: There is no significant long-term equilibrium relationship between commodity futures and spot prices.

H02: There is no significant Granger Causality from commodity futures prices to spot prices.

Research Methodology

Sources of Data

This study has been conducted purely based upon the secondary data, which has been collected through website of MCX and SEBI.

Period of the Study

This study used daily closing prices of standard Gold futures and spot contract with trading unit of 10 kg. The sample period is from 1st January, 2009 to 31st December, 2018. The daily closing price on near month contract are used to represent the commodity future price for the whole period.

The prices of near month contract can be objectively used as an efficient predictor of the cash prices, provided that the value of basis on the maturity date of one-month contract becomes zero (Garbade and Sibler-1983). The well-known rationale behind the use of nearby contract is that it is the most actively traded contract.

The Economic tools which have been applied include

a) Statistical description of data with diagnostic test of normality.
b) Augmented Dickey Fuller (ADF) tests of stationarity of variables.
c) Granger Causality test
d) Johannsen's tests for Cointegration
e) Vector Error Correction Model (VECM)

Once the stationarity of the data series is tested, then the cointegration analysis can be worked out to discover the long run relationship between spot and futures commodity market. If both the variables such as spot and futures market are cointegrated. A Vector error Correction model can be used for the analysis.

Data Analysis and Results

Co-movement of Future and Spot Price of commodity silver

To assess the relationship between spot and future prices of commodity, graphical representation of the spot and future prices is one of the ways to give an indication of the direction of relationship between them.

Figure 1: Spot and Future Price Movement of Silver on MCX from 2009-2018

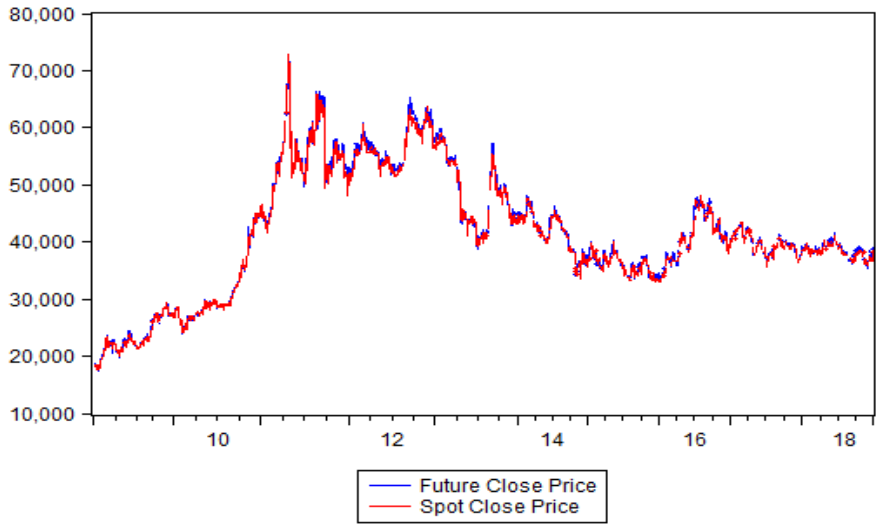

Figure 1 presents the Spot and Future Price Movement of Silver from 2009-2018 traded on MCX. As can be seen from the figure, spot and future prices of Silver move together on the exchange during the entire period.

Descriptive Statistics

To know the distribution pattern and also the performance of the Commodities descriptive analysis of future prices and spot prices is examined.

Table 1: Descriptive Statistics of Daily Returns of Silver Spot and Futures (2009-2018)

Silver	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Jargue-Bera Statistics
Spot	0.027356	0.002223	7.969703	-14.40287	1.466634	-0.547133	11.14598	7529.51* (0.000)
Future	0.027761	0.044981	9.181023	-17.20286	1.592429	-0.907812	16.12347	19563.37* (0.000)
No. of Observation: 2675; Note: * - Indicates significance at 1% level.								

The Table 1 shows the descriptive statistics of daily returns of spot and future price of commodity silver. The analysis has been carried out with the closing returns rather than closing prices to get a more meaningful comparative picture of the movement of the prices on MCX. It can be seen that the rate of return from future market is greater than spot market for commodity silver. The volatility as given by the

standard deviation is higher for future markets as compared to spot market. Negative skewness is observed in the returns of spot and futures of commodity silver which indicates a distribution with an asymmetric tail extending towards more negative values. The Kurtosis data points for both data series lies above three which indicates leptokurtic behaviour of the data featuring sharper longer and fatter tails on both the ends. Besides, the spot and futures return series is not normal according to the Jarque-Bera test, which rejects normality at the 1% level.

Augmented Dickey Fuller (ADF) Test

The Augmented Dickey Fuller (ADF) Test is a well-known test used for testing stationarity of time series data. Unit root test can be performed by including constant term (i.e. intercept) or both constant and trend or none.

Table 2: ADF Test Results of Silver

Series	Intercept		Intercept and Trend		No Intercept or Trend	
	t-stat	Prob.	t-stat	Prob.	t-stat	Prob.
A. LEVEL						
Spot	-2.17264	0.5042	-2.17264	0.5042	-0.03873	0.6699
Future	-2.28951	0.1755	-2.14114	0.5219	-0.02038	0.6759
B. FIRST DIFFERENCE						
Spot	-52.3873	0.0001 *	-52.4107	0.0000 *	-52.3907	0.0001 *
Future	-56.482	0.0001 *	-56.503	0.0000 *	-56.4861	0.0001 *
Note *: p value denote significance at 5% level of significance.						

The results from table 2 reveal that spot and future price series of commodity Silver, is stationary only at first difference as probability value at first difference is less than 5 %

Granger Causality Test

Granger Causality Test indicates that whether there is a causal relationship between the spot and future prices. In the present study, Granger causality test has been used to assess the direction of relationship between spot and futures prices of commodity Silver.

Table 3: Granger Causality Test

Null Hypothesis	Number of Observations	F-statistic	Prob.
Future Price does not Granger Cause Spot Price	2670	452.403	0.000
Spot Price does not Granger Cause Future Price		1.57728	0.163
Note *: p value denote significance at 5% level of significance.			

The table 3 presents the results of Granger Causality. The results disclose that there is only a unidirectional causality from futures returns to spot returns of commodity silver.

Johansen's Test of Co-integration (1991)

The price linkage between future market and spot market is examined using Cointegration (Johansens,1991) analysis. Co-integration is used to determine the existence of long run equilibrium relationship among time series variables.

Table 4: Estimation of Lon-run association between commodities Futures and Spot Prices

Johansen co-integration Test							
LSP LFP – Silver- Near Month Contracts							
Hypothesized No. of CE(s)	Eigenvalue	Trace Test			Max-Eigen Value Test		
		Statistic Value	Critical Values	Prob.**	Statistic Value	Critical Values	Prob.**
None *	0.056853	164.3462	15.49471	**0.0001**	156.2255	14.2646	**0.0001 ***
At Most 1 *	0.003038	8.120675	3.841466	**0.0044**	8.120675	3.841466	**0.0044 ***
[Trace test and Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level;							

* Rejection of the Null hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values]

Table 4 Shows the results of Johannsen's test of Cointegration. Taking into account the results from both test (p-value < 0.05). There is presence of one Cointegration equation between spot and future prices of silver.

Vector Error Correction Model

Vector Error Correction Model explains the direction of causality that Spot and Futures Market can have in the short run and in the long run. This error correction mechanism will help to keep the prices of spot and the price of future at equilibrium for both spot and future markets. Vector Error Correction Model is also called Restricted Vector Autoregressive Model as it is used for non-stationary time series which are co-integrated that is non-stationary time series having long run equilibrium relationship. The optimal lag length is 6 days for commodity silver as per Schwarz Information criterion (SIC)

Table 5: Vector Error Correction Estimates for commodity Silver

Error Correction	D(LSP)	D(LFP)
ECT	-0.25159 [-10.0019] **(0.0000)***	0.120393 [3.19977] (0.0014)
D (LSP)t-1	-0.35708 [-12.4301] **(0.0000)***	-0.070022 [-1.62955] (0.1033)
D (LSP)t-2	-0.26011 [-9.25251] **(0.0000)***	-0.028661 [-0.68160] (0.4956)
D (LSP)t-3	-0.20196 [-7.49596] **(0.0000)***	-0.0374 [-0.92798] (0.3535)
D (LSP)t-4	-0.13025 [-5.23438] **(0.0000)***	0.01684 [0.45244] (0.651)
D (LSP)t-5	-0.0494 [-2.34468] (0.0191)	0.003035 [0.096295] (0.9233)
D (LSP)t-6	0.000471 [0.031538] (0.9748)	0.021281 [0.952565] (0.3409)
D (LFP)t-1	0.405531 [15.1124] **(0.0000)***	0.023847 [0.594106] (0.5525)
D (LFP)t-2	0.360421 [13.26372] **(0.0000)***	0.086615 [2.130971] (0.0332)
D (LFP)t-3	0.235251 [8.734581] (0.0000)	0.04183 [1.038304] (0.2992)
D (LFP)t-4	0.136478 [5.81464] (0.0000)	0.069315 [1.812335] (0.0700)
D (LFP)t-5	0.136478 [5.81464] (0.0000)	-0.01126 [-0.32069] (0.7485)

D (LFP)t-6	0.012412 [0.63515] (0.5254)	0.038252 [1.308619] (0.1908)
Constant	0.000181 [0.879906] (0.379)	0.000239 [0.77897] (0.4361)

Table 5 shows the Error Correction Term (ECT) of Spot and Future prices of Silver. The ECTs of Ln Spot prices of commodity Silver is negative in sign (-0.251589) and significant ($p < 0.05$). This implies that there is a long -run causality running from futures prices to spot prices which enable the spot market to adjust to the short-run deviation from long-run equilibrium path with 25% speed of adjustments.

Conclusion

It is concluded that there is a long-run association, that is, equilibrium between spot and future prices of commodity Silver. The result from unit root tests indicate that Silver Spot-Futures prices are not stationary at their levels. But they are stationary at their first difference. results of Granger Causality test disclose that there is only a unidirectional causality from futures returns to spot returns of commodity silver. Cointegration test reveals that there is long-run relationship between spot and futures prices. VECM results found that the future market leads the spot market and future prices tend to discover new information more rapidly than spot prices.

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