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Price Discovery in Indian Spot and Future markets of Gold and Silver

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ABSTRACT

Last twenty years have exposed the corporate world to many financial risks due to policy of liberalization and globalization policy across the world. In today's dynamic business environment risk management has become very critical for the survival of MNCs. Therefore the emergence of derivative markets in India is attributed to the need of effective and less costly risk management tools for predicting the price of underlying assets. To reduce the extent of financial risks by providing commitment of price of an asset at future date is the basic feature of these financial instruments which had made them popular in the recent times. Commodity future trading was permitted in 2003 after which commodity derivatives market in India has witnessed a phenomenal growth. The functioning of future market came under scrutiny during 2008-2009 due to price rise and the role of futures market in stabilizing spot prices was widely discussed and studied. Some studies reveal that the future trading in commodities give rise to inflation in the market while other do not suggests any such linkages. This study analyses the market behavior and price discovery in Indian Commodity Markets and factors affecting it. The study considered average daily spot and future prices of Gold and Silver from 2006 to 2012. ADF test, Johansen Co-integration Test and **VEC Granger causality** test has been used to test the price discovery i.e., the effect of future market on spot market and vice-versa. This will help in identifying the hedging opportunities in the volatile market. The research field taken for the study is Indian Commodity Market.

1. Introduction

Commodity future trading has witnessed phenomenal growth after they were introduced in India in 2003. Significant developments took place in 2003-04 in terms of commodity futures market. The government issued a notification on April 1, 2003 withdrawing all previous notifications which prohibited futures trading in a large number of commodities in the country. The functioning of future market came under scrutiny during 2008-2009 due to price rise and the role of futures market in stabilizing spot prices was widely studied. They have become efficient tools for risk management, price discovery and for efficient trading in the market. In static sense price discovery is the process by which market try to reach at an equilibrium price. Price discovery in broader sense means how information is produced and transmitted across markets. Future and spot commodity markets react to almost same information but the question is which market reacts first and from which market volatility spills over to other market. According to M.T Shihabudhan and Puja Padhi, 2010 the price discovery in future markets is more efficient thus helps in providing future expected spot price. Price Discovery is the process through which markets attempt to reach equilibrium prices. In the static sense, price discovery implies existence of equilibrium prices. In the dynamic sense, price discovery process describes how information is produced and transmitted across the market (Leatham & Yang, 1999). Price discovery is an important function of commodity market. A market with highest price discovery is most likely to trade fastest, given a common commodity shock, and thus provide highest level of pricing guidance to market entities that trade slower and thus get a high proportion of their information from leading markets. (Ivanov & Jose, 2011).

2. Literature Review and Gap Analysis

Cornell and Reinganum (1981) and French (1983) found empirically that the differences between futures and forward prices for metals and foreign exchange were small and were not explained by models of the daily vs. terminal settlement features. M.T. Raju and Kiran Karande (2003) found that the futures market responds fast to deviations from equilibrium and the price discovery occurs in both the futures and the spot market. Zhong, Maosen, Ali F. Darrat and Rafael Otero (2004) concluded that the futures price index was a useful price discovery vehicle and futures trading had been a source of instability for the spot market. Praveen and Sudhakara (2006) attempted to study a comparison of price discovery between stock market and the commodity future market. They have taken Nifty future traded on National Stock Exchange (NSE) and gold future on Multi Commodity of India (MCX). The result empirically showed that the one month Nifty future did not have any influence on the spot Nifty, but influenced by future Nifty itself. The casual relationship test in the commodity market showed that gold future price influenced the spot gold price, but not the contrary. So this implies that information is first disseminated in the future market and then later reflected in the spot market. Mukherjee and Mishra (2006), by looking at six months intraday data from April 2004 to September 2004, find that neither Nifty index futures nor Nifty spot index lead and there were found strong contemporaneous and bi-directional relationship among the index and index futures market in India. Karande (2006) reported that the futures price leads the spot price in price discovery between crude oil and castor seed. Fu and Qing (2006) have examined the price discovery process and volatility spillovers in Chinese spot-futures markets through Johansen co-integration, VECM and bivariate EGARCH model.

The empirical results indicated that the models provided evidence to support the long-term equilibrium relationships and significant bidirectional information flows between spot and futures markets in China, with futures being dominant. Liu and Zhang (2006) have studied the price discovery of spot and future prices in Chinese copper, aluminum, rubber, soybean and wheat markets. However, the lad lags relationship between spot and future markets in Indian Commodity Derivatives are quite limited. For a few commodities, the volatility in the future price has been lower than the spot price indicating an inefficient utilization of information. Sahi G.S (2006) analysed the impact of introducing futures contracts on the volatility of the underlying commodities and observed the destabilizing effect of futures trading on spot prices of commodities. R.Salvadi Easwaran and P. Ramasundaram (2008) indicated that the futures and spot markets are not integrated in agricultural commodities and the market volume and depth are not significantly influenced by the return and volatility of futures and spot markets. Pravakar (2009) examined the efficiency and future trading price nexus for five top selected commodities (gold, copper, petroleum crude, soya oil and chana). Results suggested that the market is efficient for all five commodities. Brajesh (2009) investigated the relationship between futures trading activity and spot market. If future prices are falling, it indicates that either future demand would fall or future supply would ease. Biswat Pratap Chandra (2009) concluded that futures and spot markets are co integrated and sharing a long run relationship with a causality flow from futures markets to spot markets indicating information flow from futures to spot markets. Pantisa Pavabutr and Piyamas Chaihetphon (2010) examined the price discovery concluding that futures prices of both standard and mini contracts lead spot price. Vishwanathan Iyer and Archana Pillai (2010) found evidence for price discovery in the futures market in five out of six commodities including gold. Sarkar A. K and Shailesh Rastogi (2011) found that the introduction of gold and silver futures in India has increased the depth of the market and has helped in the price discovery in the spot market but without impacting price volatility. N. Kumar & Arora, 2011, studied the price discovery of gold traded in MCX through Augmented Dickey Fuller test, Johansen's Cointegration test and Granger Causality test. In the study closing prices of futures and spot price of gold are taken into account for a period of June 2005 – December 2009. From the analysis, it has been found that futures market is performing the price discovery process. Ivanov & Jose, 2011, examined the relative price discovery between futures and cash prices in 30 Indices and commodity markets based on Gonzalo and Grauper permanent transitory methodology. With exception of feeder cattle and Wheat Minneapolis, the price discovery is occurring in futures market. A cross section of variability of Informational shares reveals that information share of futures market is lower when trading volume is lower or if the commodity is an energy commodity or agricultural commodity or if it has traded in ETF. (Srinivasan & Ibrahim, 2012) studied the Price Discovery and Asymmetric Volatility Spillovers in Indian Spot-Futures Gold Markets in NCDEX. The study revealed that there is long run equilibrium relationship between spot and futures prices. The study states that spot prices perform the price discovery function. A Bivariate ECM-EGARCH (1,1) model is applied to find out the volatility spillovers between the markets. The study revealed that Significant volatility spill over exists between the markets but spillovers from spot to futures are more significant than the reverse direction, which means that the information flow from spot to futures is stronger. Kushankur D and Debasish M (2012) inferred that unidirectional causality from futures to spot prices has been observed in the Indian pepper futures market and the adjustment of innovations or shocks in the futures market is relatively faster than that of the spot market. Srinivasan P (2012) observed that there is a flow of information from spot to futures commodity markets and bidirectional volatility spillover persists between the markets. Isha Chhajed and Sameer Mehta (2013) suggests that the price discovery mechanism is quite different for different commodities but it has suggested that causality can be used in forecasting spot and futures prices and most of the commodities showed bi-directional causality between spot and future prices. Sridhar, Dr. Sumathy, Sudha, Charles Ambrose (2016) the Granger causality test shows that there is no bi-causal relationship between futures and spot prices. Hence the future and spot price does not showing the cause and effect relationship. The Error Correction Estimates show that spot price does not cause by itself but it is not influences the future price lags. On the other hand, future price does not cause by itself nor influences the spot price in two lags hence, future price Granger causes the spot price in small level. The spot price serves as a price discovery tool for silver. Overall, the findings suggest that, spot price movement can be used as price discovery vehicle for futures market transactions. Dr. S. Nirmala and K. Deepthy (2016) observed that for gold there is a unidirectional causal relationship from future to spot market in long run, while there is a bidirectional relationship in short run. In the case of silver, there is a bidirectional causal relationship between spot and futures in long run, and a unidirectional relationship from futures to spot in short run.

Although a lot of studies have been done on commodity markets in developed countries like US and UK but in India limited research has been done in this field. The main reason attributed to this fact is very short history of organised commodity trading in India which started only in 2003. Some studies which tried to examine the relationship between spot and future prices for various types of selected agriculture commodities as also for financial assets, empirical evidence in this regard suggest a mix response. While going through different studies we have noticed that no comprehensive empirical study has been done in finding the relationship between spot and future prices in the long run. Also, which market acts as price discovery centre is not yet clear from the literature we reviewed. The literature suggests that in India much research is concentrated on agriculture commodities but not significant research have been carried on price discovery in commodities like metal, energy commodities.

3. Objectives

1. To study the affect of different factors effecting price in the spot and future commodity markets.
2. To study the price discovery process of Gold future and spot price contracts.
3. To study the price discovery process of Silver future and spot price contracts.

4. Research Methodology

The study is based on secondary data. Daily closing prices of futures and spot price of gold and silver are collected from 01-01-2006 to 31-12-2012 from MCX Website. Eviews software has been used to study the price discovery behaviour. Augmented Dickey Fuller Test (ADF Test) has been used to check the stationarity of data. It has been noticed that the data has a unit root which means it is not stationary at level. Whole data is converted into stationary time series by taking its first difference. Cointegration technique has been used to analyse long term relationship between future and spot markets. Johansen Co-integration Test has been performed to test the long run co-integration between the spot and future prices of gold and silver. VAR Lag Order SC criteria has been performed to select appropriate lag length for the analysis. Vector Error Correction Granger Causality Test has been performed to analyse lead lag relationship between the spot and future prices of two commodities. It is a statistical concept of causality that predicts one time series based on other.

5. Hypothesis

H_1: There exists relationship between future prices and spot prices of commodities.

H_2: No lead-lag relationship exists between spot and future prices of commodities.

H_3: Price leader has no impact on price discovery in other market.

6. Fundamentals behind the Price of Gold and Silver

Indian love for gold and silver has a long history. Like many other commodities the prices of gold and silver are driven by demand and supply factors. Devdutt Pattanaik in his research paper “Sacred Gold” has explained the logical and cultural background of Indian people towards gold. It is tangible, portable, beautiful precious metal with low storage cost high liquidity used as an ornament as well as a storehouse of value. Savings and per capita income has a direct correlation with the demand of gold and hence its price. Kannan during his analysis of gold demand from 1980-2009 observed that the main drivers of its demand were real income levels of population who consider it as an alternative for saving, investment and uncertainty. He also observed that for higher income level groups platinum acts a substitute for gold but for the majority it’s a way of life in India particularly for lower and middle income population. The prices of commodities depend upon macro variable like economic growth of a country and on extraordinary events in the country like natural calamities, war and depression etc. Silver is considered close alternative to gold and over the years its price stability in comparison to many bullions have made it more stable and safe investment. Price of silver has strong positive correlation with the prices of gold and crude oil as statistically proved by Charmi Shah. More than 50% of demand of silver comes from industry which has an important bearing on it price. Dr. Sindhu 2013 has found that the price of gold has an inverse relationship with the value of US dollar and repo rate and has positive correlation with the prices of crude oil and inflation rate. Speculations has a positive effect on the prices of gold and silver as they at times create false or over hyped sentiment in order to stimulate the price movement in a particular direction and hence play a critical role in price discovery of commodities.

7. Data Analysis

Time series analysis can only be performed on stationary data otherwise the results will be misleading and absurd. Data is stationary when its mean and variance are constant over time and hence do not have unit root. We have performed Augmented Dickey Fuller Test to find out unit root in spot and future prices of gold and silver. Table 1,2,7 and 8 reveal that the data has a unit root at level in both the commodities. We converted the non-stationary data into stationary data by taking their first difference. Test statistics of table 3,4,9 and 10 shows that the series are stationary at their first level as the p-value in all the cases in less than .05 hence null hypothesis is rejected thus proving that the series are now stationary. Selection of appropriate lag has been done by using VAR Lag Order Selection criteria particularly SC value. Table 5 and 11 give the test statistics of Johansen Co-integration Test being performed to check the long run co-integration between the spot and future prices of both the commodities independently. This test can be analysed by way of Trace value as well as Eigen value. In case of both gold and silver null hypothesis has been rejected which means that the spot and future prices of both the commodities have a long run integration. VEC Granger causality test statistic is used to find the price discovery behavior in both the markets. From this test we can predict whether spot prices cause future prices or vice versa. From table 6 it has been analysed that the p-value is less than .05 in both the cases. Hence, null hypothesis that spot price do not Granger cause future price and future price do not Granger cause spot price has been rejected in case of gold. It reveals that the information flows from spot market to future markets as well as from future markets to spot markets thus there exists a bi-directional relationship in price discovery. Table 12 which shows the VEC Granger causality test statistics for silver also highlights the similar results. In case of silver we have found a bi-directional relationship for price discovery. Since the price of gold has an effect on the prices of silver as it is considered second best alternative for investment. We performed VEC Granger Causality Test (Table 13) between the spot and future prices of gold and silver to know the causal relationship between the prices of one commodity on the price of other commodity. From the table 13 it can be concluded that the future and spot price of gold has a casual relationship with the future prices of silver and vice versa. Hence it is inferred from the table that spot prices of silver granger cause spot prices of gold but future price of silver do not granger cause spot prices of gold. Contrary to our thinking we have found that future and spot prices of gold does not granger cause spot prices of silver but granger cause future prices of silver.

8. Conclusion

It is argued that the price discovery in commodity future markets is more efficient than the cash markets. Spot and future prices of any commodity are a very dynamic and are affected by numerous micro and macro variables. Same is true for the prices discovery behavior of future and spot markets of gold and silver. From the analysis we came to the conclusion that there exist a bi-directional relationship between the spot and future markets of gold and silver. Information flows from one market to another and got adjusted in the price of the commodity. We have found no lead lag relationship between the two markets; it

seems both react to the new information in the similar way. Therefore, it can be inferred that the price discovery function is performed by future markets which are used to predict the spot prices of gold and silver.

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Tables

(A) Price Discovery in Gold

I. Augmented Dickey-Fuller Test

Table: 1

Null Hypothesis: SPOG has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, max lag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.329413	0.9798
Test critical values:	1% level	-3.433224	
	5% level	-2.862696	
	10% level	-2.567431	

*MacKinnon (1996) one-sided p-values.

Table: 2

Null Hypothesis: FPOG has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, max lag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.423521	0.9839
Test critical values:	1% level	-3.433224	
	5% level	-2.862696	
	10% level	-2.567431	

*MacKinnon (1996) one-sided p-values.

Table: 3

Null Hypothesis: D(SPOG) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, max lag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-48.34380	0.0001
Test critical values:	1% level	-3.433225	
	5% level	-2.862696	
	10% level	-2.567432	

*MacKinnon (1996) one-sided p-values.

Table: 4

Null Hypothesis: D(FPOG) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, max lag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-47.71789	0.0001
Test critical values:	1% level	-3.433225	
	5% level	-2.862696	
	10% level	-2.567432	

*MacKinnon (1996) one-sided p-values.

II. Johansen Co-integration Test

Table: 5

Series: FPOGD SPOGD

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.120152	271.8821	15.49471	0.0001
At most 1	5.91E-05	0.125539	3.841466	0.7231

Trace test indicates 1 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	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.120152	271.7566	14.26460	0.0001
At most 1	5.91E-05	0.125539	3.841466	0.7231

Max-eigen value test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

III. VEC Granger Causality/Block Exogeneity Wald Tests

Table: 6

Dependent variable: D(FPOGD)

Excluded	Chi-sq	df	Prob.
D(SPOGD)	8.456056	2	0.0146
All	8.456056	2	0.0146

Dependent variable: D(SPOGD)

Excluded	Chi-sq	df	Prob.
D(FPOGD)	289.4982	2	0.0000
All	289.4982	2	0.0000

(B) Price Discovery in Silver

I. Augmented Dickey-Fuller Test

Table: 7

Null Hypothesis: SPOS has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, max lag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.616783	0.8645
Test critical values:	1% level	-3.433224	
	5% level	-2.862696	
	10% level	-2.567431	

*MacKinnon (1996) one-sided p-values.

Table: 8

Null Hypothesis: FPOS has a unit root

Exogenous: Constant

Lag Length: 4 (Automatic - based on SIC, maxlag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.696940	0.8456
Test critical values:	1% level	-3.433228	
	5% level	-2.862698	
	10% level	-2.567432	

*MacKinnon (1996) one-sided p-values.

Table: 9

Null Hypothesis: D(SPOS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=25)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-49.86704	0.0001
Test critical values:	1% level	-3.433224	
	5% level	-2.862696	
	10% level	-2.567431	

*MacKinnon (1996) one-sided p-values.

Table: 10

Null Hypothesis: D(FPOS) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=25)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-50.65363	0.0001

Test critical values:	1% level	-3.433224
	5% level	-2.862696
	10% level	-2.567431

*MacKinnon (1996) one-sided p-values.

II. Johansen Co-integration Test

Table: 11

Series: SPOSD FPOSD
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.055129	121.0620	15.49471	0.0001
At most 1	0.000291	0.617139	3.841466	0.4321

Trace test indicates 1 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	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.055129	120.4449	14.26460	0.0001
At most 1	0.000291	0.617139	3.841466	0.4321

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

III. VEC Granger Causality/Block Exogeneity Wald Tests

Table: 12

Dependent variable: D(SPOSD)

Excluded	Chi-sq	df	Prob.
D(FPOSD)	288.7791	5	0.0000
All	288.7791	5	0.0000

Dependent variable: D(FPOSD)

Excluded	Chi-sq	df	Prob.

D(SPOSD)	37.19481	5	0.0000
All	37.19481	5	0.0000

(C) Price Discovery between Gold and Silver

Table: 13

VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(FPOGD)

Excluded	Chi-sq	df	Prob.
D(FPOSD)	10.65908	2	0.0048
D(SPOGD)	10.23965	2	0.0060
D(SPOSD)	14.39162	2	0.0007
All	25.38429	6	0.0003

Dependent variable: D(FPOSD)

Excluded	Chi-sq	df	Prob.
D(FPOGD)	17.72079	2	0.0001
D(SPOGD)	15.05734	2	0.0005
D(SPOSD)	14.59165	2	0.0007
All	36.39457	6	0.0000

Dependent variable: D(SPOGD)

Excluded	Chi-sq	df	Prob.
D(FPOGD)	336.3403	2	0.0000
D(FPOSD)	4.679319	2	0.0964
D(SPOSD)	6.004696	2	0.0497
All	359.8237	6	0.0000

Dependent variable: D(SPOSD)

Excluded	Chi-sq	df	Prob.
D(FPOGD)	1.955245	2	0.3762
D(FPOSD)	288.9977	2	0.0000
D(SPOGD)	2.560292	2	0.2780
All	300.7490	6	0.0000