Cointegration and Causality Test of Spot and Contemporaneous Derivative Gold Contract

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Abstract: *Indians are gold frenzied, as Gold has been considered as a global currency, a commodity, an investment avenue and as an object of beauty. India has become the largest purchaser of in the world-wide context and much more than ninety per cent of it is for conversion to jewellery. Gold has ambivalent relationship with India. Gold import has cascading impact on inflation as import weakens the currency which results in paying for more amounts for importing necessary items like oil. The Government of India had allowed trading in gold in Multi Commodity Exchange (MCX). There are two main objective of commodity market price discovery and risk transfer. The first objective of this paper is to empirically test the efficiency of contemporaneous Gold future contract of the month and next month through Johansen Cointegration Test. Second objective is to find out relationship between spot and future Gold contract through Granger Causality Test. Empirical finding reveals that cointegration exist between both the markets and bidirectional relationship between spot and future contract of gold prevails. Since both the markets are integrated, any policy impact on one of segment of market will have impact other segment of market also in long run. The study offers room for conducting further research as in present study only one commodity is empirically tested with limited period data of MCX.*

Key Words: *Price Discovery, Cointegration, Causality Test.*

1. INTRODUCTION:

Indians are gold frenzied as Gold has been considered as a global currency, a commodity, an investment avenue and as an object of beauty. Gold plays a central role in the Indian society and it has emotional, cultural and financial value. For ladies, it is like at any time insurance for difficult times. Rural as well as city resident invest in Gold as financial asset for its unique feature like liquidity, convertibility and acceptability. Indian buys gold for various occasions like weddings, births, birthdays, various festivals, and provides gold to the deities. Although Gold is acquired continuously over the years still Indian Hindu calendar has auspicious days to purchase gold for festivals, like Dhanteras and Akhay Tritya. India is largest importer of the Gold and most of it is consumed in shape of jewellery. Indian investors were keen in investing gold after global meltdown of 2008 as they consider other financial asset became non lucrative at that time. Increased demand of gold led to speculations which in turn result in surge in Gold price. Gold has ambivalent relationship with India (Kumar and Bala 2016). From country's economic perspective Gold import increases the current account deficit. Gold import has cascading impact on inflation as import weakens the currency which results in paying for more amounts for importing necessary items like oil. Higher oil prices increases the prices of almost all the commodities. Government of India is taking several steps to reduce the import of Gold. The Government of India had allowed trading in gold in Multi Commodity Exchange (MCX). There are two main objective of commodity market price discovery and risk transfer. Risk transfer refers to activity whereby hedgers transfer their risk to speculators. Price discovery is process through which the spot prices are determined with the help of derivative market. The price of a commodity is determined by demand and supply forces in the market. The futures market discovers the likely prices of a commodity at future points of time depending on the expectation of supply and demand.

1.1 Types of Gold Contract:

There are four types of Gold contracts Gold, Gold Mini, Gold Guinea, and Gold Petal which are traded on MCX. Gold Contract has trading unit of 1Kg and Gold Mini is of 100 Grams. Contract starts on 6th of every month and expires on 5th of every month. Gold Guinea and gold Petal are contract of smaller denomination. Trading size of Gold Guinea is 8 Gram and Gold petal is 1 Gram. Trading starts on 1st of every month and contract expires on last calendar day of the month, if last calendar day is a holiday then preceding working day

2. LITERATURE REVIEW: Brief literature review on cointegration and causality test is as follows:

Cointegration Analysis

Kumar (2004) examined that there is no integration between spot and future market in India. Cointegration does exist in only few commodities [Easwaran & Ramasundarm (2008); Sahoo and Kumar (2008); Iyer and Pillai (2010) Kushankur. D and Debasish. M (2012)]. Cointegration exist between spot and future commodity market [Sahi (2006), Sehgal et al. (2012) Ranganathan & Anathkumar (2014)]

Causality Test Analysis

Causality test results show that causality flow from future market to spot market which indication flow of information from future to spot market and there is unidirectional relationship[Biswat(2009); Joshep et al.(2014)] bi-directional Granger casualty relationship between spot and future is discovered in spot and future contract [Gupta and Singh (2006) Sehgal et al. (2012) Ghosh (2010).]

3. FORMATION OF PROBLEM:

There is certainly significant evidence that gold has had an unparalleled significance in diverse areas of life from time immemorial. Market efficiency implies cointegration because the same factors that determine the future spot price are reflected in the current futures price, so the two should not drift apart (Beck S 1994). Diverse finding were put forward by different researchers with regard to cointegration and causality between spot and future commodities market. This paper empirically tests relationship between gold spot and future contract.

4. OBJECTIVE OF THE STUDY: Following are the objective of the study

- To test the cointegration between spot and future gold contract of the month and next month traded at MCX
- To study lead lag relationship between the spot and future contract of month and of next month of MCX through Granger Causality test

5. DATA AND METHODOLOGY:

This empirical study is conducted on the secondary data collected from the official website of MCX for spot and near month future price of cotton contract from January 2010 to December 2016. MCX is leading commodity exchange in India with a market share of 84.06% in terms of valie of future commodity traded(Source FMC data 2015). The data analysis is carried out through appropriate statistical and econometric techniques. The long run relationship between the futures and spot prices of Gold contract is examined through the Johansen Co-integration Test. Cointegration Test is applied to non stationary series. The series is said to be stationary when statistical properties of series like mean, variance and autocorrelation are constant over a period of time. When the series has unit root then the series is non stationary. The unit root test is conducted for this paper using Augmented Dickey Fuller test is used.

5.1 Augmented Dickey-Fuller Test

Augmented Dickey fuller Test can be used to determine whether the time series is stationary of not. Testing procedure for Augmented Dickey Fuller test

$\Delta X_t=\alpha+\beta t+\Upsilon X_{t-1}+\delta\Delta X_{t-1}+\ldots\ldots\ldots\ldots..+\delta_{p-1}\Delta X_{t-p+1}+\varepsilon_t$

Where α is constant and β is trend and p is lag order. The dickey fuller test is done on trend, intercept and no trend and no intercept.

For Lag length selection Akaike Information Criterion (AIC) test is used in to find out optimum lag length.

5.2 Johansen Cointegration Test

Johansen (1991,1995) developed VAR based cointegration Test. The null hypothesis in this test is the series does not have cointegration and alternate hypothesis is the series have cointegration. The spot prices of gold and future is taken at level to conduct test of cointegration. The series is said to be cointegrated if the probability value is less than 5%. The Johansen Cointegration Test is tested by Trace Test and Max- Eigen Statistics.. The series is said to be cointegrated if the probability value is less than 5%. Johansen test allows more than one cointegration relationship.

5.3 Granger Causality Test

The Granger (1969) developed Granger Causality Test to answer the question of whether spot (S) causes Future (F) or not. In this paper we examine whether cash Gold prices causes future Gold prices or future Gold prices causes cash gold prices. In First step is to see how much of the current S is explained by past values of S itself and in next step to see whether adding lagged values of F can improve the model and vice versa for whether F causes S.

$S_t=\alpha_0+\alpha_1S_{t-1}+\ldots\ldots+\alpha_lc_{t-l}+\beta_1F_{t-1}+\ldots\ldots\ldots+\beta_tF_{t-l}+\varepsilon_t$

$F_t=\alpha_0+\alpha_1F_{t-1}+\ldots\ldots+\alpha_lF_{t-l}+\beta_1S_{t-1}+\ldots\ldots\ldots+\beta_tS_{t-l}+\mu_t$

6. FINDING AND ANALYSIS: Empirical results of finding are given below

Unit Root Test: The null hypothesis is that the series has unit root and alternate is that series does not have unit root. The test is conducted in three equations for intercept, trend and intercept and no trend no intercept results are given below

Table :1
Results of Future time series (Level)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-2.249106	-1.824338	0.603428
P value	0.1891	0.6927	0.8467

Table :2
Results of Future time series (1st Difference)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-47.83803	-47.86567	-47.82861
P value	0.0001	0.0000	0.0001

Table:3
Result of Spot time series (Level)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-2.218908	-1.731163	0.731274
P value	0.1997	0.7372	0.8726

Table :4
Result of Spot time series (1st Difference)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-44.79346	-44.82530	-44.77761
P value	0.0001	0.0000	0.0001

Table :5
Result of Future Next Month series (Level)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-2.287981	-1.864093	0.558281
P value	0.1760	0.6727	0.8368

Table :6
Result of Future Next Month series (1st Difference)

	Intercept	Intercept and Trend	No Intercept No Trend
T statistic	-46.55362	-46.58478	-46.54433
P value	0.0001	0.0000	0.0001

When test is conducted on level series and in all the cases p value is more than 5%. So the Null hypothesis is accepted that series has unit root in other words series is non-stationary. The series becomes stationary at first difference. Now we can proceed with Johansen Cointegration Test and Granger Causality Test.

6.1 Cointegration Test

As per table 5 given below results of cointegration between spot and future contract of Gold through Trace statistics indicates there are two cointegrated equations. The results are same with Maximum Eigenvalue Test given below in table no. 6.

Table:5 Cointegration between spot and future

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.026164	58.12461	15.49471	0.0000
At most 1 *	0.002402	4.833740	3.841466	0.0279
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

Table:6

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.026164	53.29087	14.26460	0.0000
At most 1 *	0.002402	4.833740	3.841466	0.0279
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				

Cointegration between spot and future Next Month : As per table 7 given below results of cointegration between spot and future contract of Gold through Trace statistics indicates there are two cointegrated equations. The results are same with Maximum Eigenvalue Test given below in table no. 8.

Table 7

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.008241	21.50771	15.49471	0.0055
At most 1 *	0.002422	4.874401	3.841466	0.0273
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

Table 8

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.008241	16.63331	14.26460	0.0207
At most 1 *	0.002422	4.874401	3.841466	0.0273
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				

Results of Granger Causality Test

Table:9

Pairwise Granger Causality Tests Date: 03/02/17 Time: 17:09 Sample: 1 2015 Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
FUTURE does not Granger Cause SPOT	2013	333.162	1E-125
SPOT does not Granger Cause FUTURE		9.96560	5.E-05
FUTURENM does not Granger Cause SPOT	2013	353.600	3E-132
SPOT does not Granger Cause FUTURENM		2.77335	0.0627
FUTURENM does not Granger Cause FUTURE	2013	4.92075	0.0074
FUTURE does not Granger Cause FUTURENM		0.50593	0.6030

The result of causality relationship between spot and future shows that both the null hypothesis is rejected as P value is less than 5%. So future causes spot and spot causes future. So there is bidirectional relationship between spot and future prices of Gold. Causality relationship between spot and next month future results that Next month Future contract causes spot but spot does not causes future of next month. So unidirectional relationship exists and future leads in price discovery. Future next month causes the future of same month but future contract of same month does not have effect on future of next month.

7. CONCLUSION:

Future trading in commodities market is an important platform for price discovery and risk management. The study concludes that the future market is efficient and cointegration exist between the spot market and derivative market. There is bidirectional relationship between spot and future contract of same month but when it is compared with future contract of next month then unidirectional relationship exists and future contract leads in price discovery. The finding of the study has important implication for market participant and policy makers. Since both the markets are integrated, any policy impact on one of segment of market will have impact other segment of market also in long run. The study offers room for conducting further research as in present study only one commodity is empirically tested with limited period data of MCX.

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