

# Testing of Long run Association between Crude Oil and Gold Commodities: An Empirical study in India

<sup>1</sup>Rajesh R, <sup>2</sup>Dr. A. SatyaNandini

<sup>1</sup>Assistant Professor, Department of Management Studies, CHRIST (Deemed to be University), Bengaluru, India

<sup>2</sup>Professor, Department of Management Studies, B.M.S. College of Engineering, Bengaluru, India.

## Article Info

Volume 82

Page Number: 2902 - 2906

Publication Issue:

January-February 2020

## Article History

Article Received: 14 March 2019

Revised: 27 May 2019

Accepted: 16 October 2019

Publication: 18 January 2020

## Abstract:

Commodity markets and its research have achieved a significant position in emerging trends in financial research. Various studies have reported a general relationship between commodity and stock market. Crude oil and gold are prominent and highly traded commodity products. The inter relationship among these two commodity products identification was the need of the hour. Hence collected the crude oil and gold index close prices from MCX website and carried out econometric testing. ADF test revealed the data to be stationary at one difference and the data was found to be normal. Further cointegration, granger causality, impulse response test the long-run relationship and the price shocks effects among them.

**Keywords:** Commodity market, Crude Oil, Gold, Price Shocks, Cointegration, Impulse response, Granger Causality, Econometrics.

## I. INTRODUCTION

Recent developments and joint movements in crude oil and gold have induced interest in finding the relationship and linkages between these commodities. Crude oil and Gold are the most important representatives of commodity market where, Crude oil is the most traded raw material and Gold is the most traded bullion or precious metal. These two commodity products play a vital role in shaping the economy. The first linkage between these two commodity products took place during 1933 where Middle East acquired gold in exchange of crude oil.

In the year 2008 due to global crisis on economic and finance, the large commodity products both Crude oil and Gold faced a sharp price collapse. Later after 2009, both crude oil and gold experienced a price movement and recovery. Many instances support the statement that both crude oil and gold prices follow parallel behaviour patterns.

This paper tries to throw light upon the crude oil and gold price long run relationship by studying the co-movement arrangement among these commodities. We conduct an empirical analysis of the variables

with the use of various statistical and econometric tools.

## II. LITERATURE REVIEW

(Dutt & Sehgal, 2018) authors found the relationship and linkage between gold spot and futures market prices. Authors used five international markets data and used statistical and econometrical models to examine the price spillover process. The paper concludes that linkage and relationship between Indian and global commodity exchanges were sever until 2013 however it is noticing inverse relationship post 2013. Author suggests a need for strong re-establishment of price and volatility linkages.

(Bhatia, et al. 2018) used hedge ratios and portfolio weights and found a dynamic conditional correlation between crude oil and gold. Authors used DCC-GARCH model to build the relationship among commodity products.

(Reboredo, 2013) author assesses the characteristics of gold as a hedge against crude oil price movements. He uses copulas linked approach to analyse the interdependence among these markets. Testing provides a positive and significant

dependence between gold and crude oil and concludes his argument as gold cannot be used as a hedging instrument against crude oil price actions.

(Lee & Yuan, 2012) used the threshold cointegration test to investigate the long-run associations and used TECM-GARCH with GED to examine the causality relationship between WTI crude oil and gold prices in the futures market found a unidirectional relationship between WTI Crude oil and Gold.

(Zhang & Wei, 2010) tried to identify the long and short run relationship between crude oil and gold of US market for price discovery mechanism. Author found a stable trend and progressive relationship between the commodity products. Both the product prices were able to express the absence of significant non-linear granger causality, which proves the ability for direct price discovery mechanism.

(Šimáková, 2001) contributed a theoretical paper on the relationship between crude oil and gold. Authors routes from the history and builds a conceptual reasons and validation for these two commodity products' relationship. Author further describes the characteristic and causes of price movements.

## 2.1 Research Gap:

From the literatures it is found that the authors were attracted with European markets and other developed economies and fewer researches were carried out in developing economies like India. India being an emerging economy with huge prospects, the establishment of relationship of major commodities is very important for economic development. We further make the research novel by conducting gold and crude oil market co-movement with reference to Indian commodity markets.

## III. Objective

- To determine the long run relationship between Crude Oil and Gold in India.

## IV. METHODOLOGY

### 4.1 Research Design:

This paper uses causal research design to analyse the level of the association between iCOMDEX Gold & iCOMDEX Crude oil.

### 4.2 Sampling design:

The population considered for the study is the index values of commodities. Non-probability sampling design is adopted to select a sample from the population of iCOMDEX Gold and iCOMDEX Crude Oil from MCX website Jan 2012 to Jan 2019.

### 4.4 Data analysis techniques:

The following Statistical and Econometric Techniques are used for data analysis

- Augmented Dickey-Fuller Unit Root Test
- Normality Test
- Cointegration Test
- Granger Causality Test.
- Impulse response Test

### 4.6 Limitations of the Study:

- Relationship is determined between the indices and not on the individual commodity prices.
- Only two commodity indices are used in the study.
- Study is limited to indicators within the country.

## VI. ANALYSIS AND INTERPRETATION

### 5.1 Unit Root Test

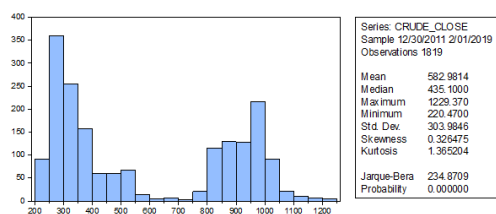
Table 1  
Unit Root Test

| Variables | Levin, Lin, and Chu |
|-----------|---------------------|
|           | Intercept           |
| Crude Oil | -28.43<br>(0.00)    |
| Gold      | -44.36<br>(0.00)    |

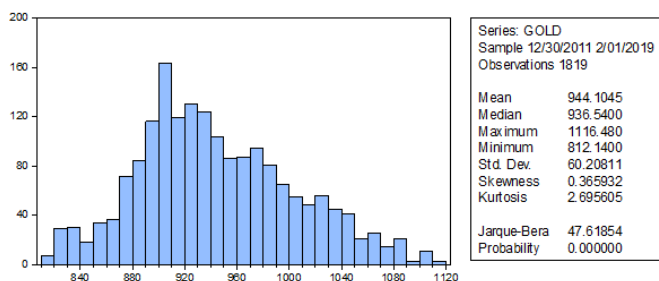
The log price series relating to both crude oil and gold were non-stationary at level. Non-stationary data are usually not preferred in financial models since it provides spurious and unreliable results and it also leads to poor forecasting. Hence stationary at first difference is observed and it is found to be stationary. Thus variance, and autocovariance remain the same; they are time invariant.

## 5.2 Normality Test

**Table 2**  
Normality Test of Crude Oil



**Table 3**  
Normality Test of Gold



The normality of the data is tested with the above histogram. Observation of the histogram for both crude oil and gold showed that it is well distributed and forms a balanced bell-shape. The Jarque-Bera test value also indicates the balanced distribution of data.

## 5.3 Long Run Test

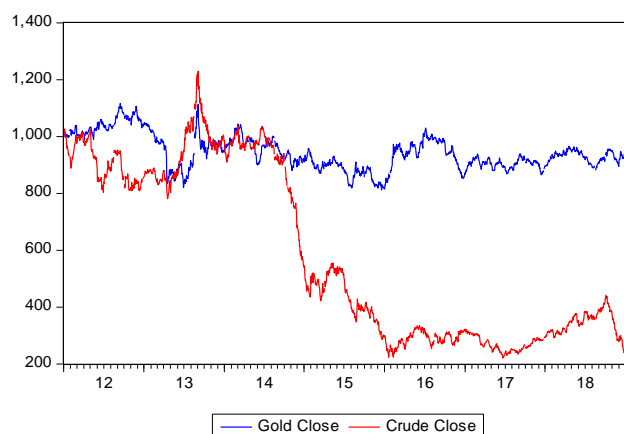
Various literatures suggest that Long Run test can be analysed using OLS or Johansen Cointegration or using ARDL test. However the selection of test is

decided upon the suitability of data fit. Since the data set is stationary at 1<sup>st</sup> difference we choose Johansen cointegration test to find long run association between crude oil and gold commodities.

**Table 4**  
Johansen Cointegration Test

|   |            |           |                |         |
|---|------------|-----------|----------------|---------|
| Date: 02/13/19 Time: 15:52                              |            |           |                |         |
| Sample (adjusted): 1/06/2012 2/01/2019                  |            |           |                |         |
| Included observations: 1814 after adjustments           |            |           |                |         |
| Trend assumption: Linear deterministic trend            |            |           |                |         |
| Series: GOLD CRUDE                                      |            |           |                |         |
| Lags interval (in first differences): 1 to 4            |            |           |                |         |
| Unrestricted Cointegration Rank Test (Trace)            |            |           |                |         |
| Hypothesized  |            | Trace     | 0.05           |         |
| No. of CE(s)  | Eigenvalue | Statistic | Critical Value | Prob.** |
| None  | 0.006491   | 13.09324  | 15.49471       | 0.1114  |
| At most 1   | 0.000705   | 1.280177  | 3.841466       | 0.2579  |
| Trace test indicates no cointegration at the 0.05 level |            |           |                |         |
| * denotes rejection of the hypothesis at the 0.05 level |            |           |                |         |
| **MacKinnon-Haug-Michelis (1999) p-values               |            |           |                |         |

**Table 5**  
Crude Oil and Gold Cointegration Graph



Cointegration test reveals that there is no long run relationship among crude oil and gold price movements. This effect could be a result of several reasons, as discussed earlier in the theoretical framework. This is an expected result as the theoretical framework explained that crude oil and gold has lost its co-movement since 2013. Hence crude oil and gold indices are not cointegrated.

## 5.4 Granger Causality Test

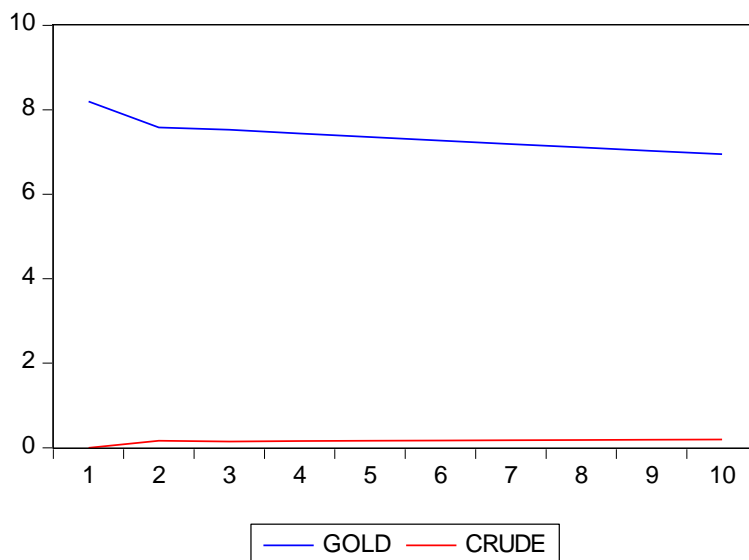
**Table 5.5**  
Granger Causality Test

| Pairwise Granger Causality Tests  |      |        |
|-----------------------------------|------|--------|
| Date: 02/13/19 Time: 15:53        |      |        |
| Sample: 12/30/2011 2/01/2019      |      |        |
| Lags: 5                           |      |        |
| Null Hypothesis:                  | Obs  | F-Stat |
| CRUDE does not Granger Cause GOLD | 1814 | 0.929  |
| GOLD does not Granger Cause CRUDE |      | 0.941  |

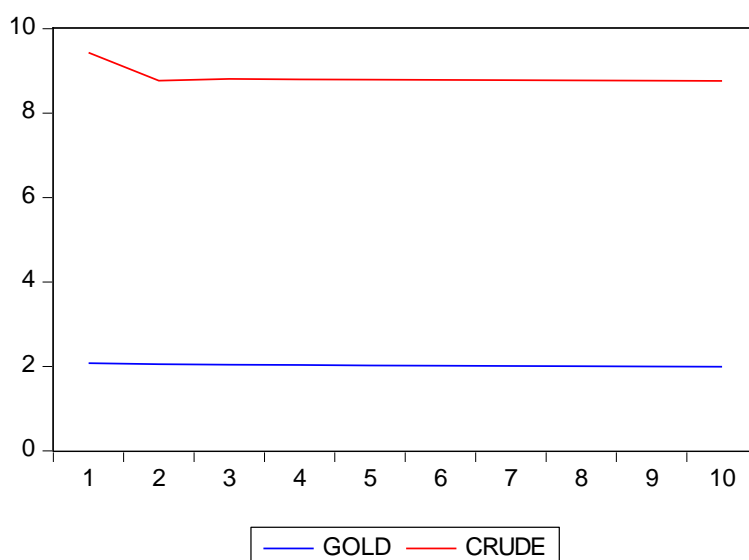
Both Crude oil and Gold Granger cause each other. This is result is contradicting with cointegration results. However literature says whenever the data do not cointegrate, it always granger cause. Hence the results are validated with the use of literature and books.

### 5.5 Impulse Response of Crude and Gold

Response of GOLD to Cholesky  
One S.D. Innovations



Response of CRUDE to Cholesky  
One S.D. Innovations



Using impulse response functions we analyse the influence of crude oil index shocks on gold index. The impulse response report revealed that gold price reacted significantly and positively to oil prices; however this influence is only in the short-run, with the influence disintegrating over the long run. The decay in the plot illustrates that, as time passes, the effects of a shock in crude oil and gold decay to 0.

## V. CONCLUSION

Analysis of both liquid and metal precious elements is always an interesting research. This paper attempted to check the relationship using econometric tools.

Hence started to check data fitness and found both crude oil and gold indices are stationary at 1 difference with the use of ADF test. Since both are at same levels, analysis and further testing becomes more feasible.

Then checked the normality test and found both indices to be normal which proves the data and its results to be more reliable.

Cointegration test reveals absence of long run relationship among crude oil and gold price movements.

Granger causality test exposed that crude oil and gold granger cause each other. This is not contradicting; literatures and studies have proved that disintegrating results always granger causes each other.

Further impulse response function analysed the impact of price shock among crude oil and gold and results proved that both crude oil and gold positively responded to the initial shocks and later it moved to constant position.

Overall, the paper concludes that crude oil and gold doesn't prove long run relationship however on short run it has a relationship.

This knowledge of crude oil and gold price co-movement will be more beneficial for portfolio managers and traders those aspire to have a diversified portfolio and mitigate the risk on price volatility.

The results and recommendation are arrived only based on sample data.

## V. REFERENCES

Bhatia, Vaneet, Satyasiba Das, S. K. M. (2018). CRUDE OIL HEDGING WITH PRECIOUS METALS : A DCC-GARCH APPROACH, 22(1), 1–8.

Dutt, M., & Sehgal, S. (2018). Domestic and International Information Linkages between Gold Spot and Futures Markets : An Empirical Study for India, 1–

17. <https://doi.org/10.1177/0972622518761745>

Lee, Y., & Yuan, C. (2012). The asymmetric long-run relationship between crude oil and gold futures, 6(1), 9–15.

Reboredo, J. C. (2013). Is gold a hedge or safe haven against oil price movements? Resources Policy, 38(2), 130–137. <https://doi.org/10.1016/j.resourpol.2013.02.003>

Šimáková, J. (2001). Analysis of the Relationship between Oil and Gold Prices, 651–662.

Zhang, Y., & Wei, Y. (2010). The crude oil market and the gold market : Evidence for cointegration , causality and price discovery. Resources Policy, 35(3), 168–177. <https://doi.org/10.1016/j.resourpol.2010.05.003>