

# Volatility & Relationship of Gold & Gold ETF in India

Mr. Ram Raj G<sup>1</sup>

<sup>1</sup> Loyola College

Received: 9 December 2018 Accepted: 1 January 2019 Published: 15 January 2019

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## Abstract

This research article was intended to estimate the volatility and connection between real Gold and Gold Exchange Traded Fund (ETF) in India by using various statistical models. The data for the study period for three years period 2015-2018 acquired from the National Stock Exchange of India's historical statistics and others. The outcome of this study was found that there are a strong positive short-run relationship and long-run equilibrium relation between gold and Gold ETFs. It is unidirectional, and few bidirectional causes and relationship existed in this study. This Study is fit to be analyzed GARCH model to estimate volatility in the Gold price returns; it shows there persist the volatility effect. This study will be helpful to investors in the selection of better investment options.

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*Index terms*— gold ETF, volatility, co-integration, granger causality, correlation, ADF.

## 1 Introduction

Gold is one of the treasurable and oldest metals among the inventions of the humankind. From ancient times, gold is accepted as the medium of exchange and as highly valuable wealth used in India. Times may change still gold stands as a traditional investment for everyone beyond the economic status. There are more than 16,000 tons of gold are available in India, and almost every family possess gold for its sentimental attachment. Gold has three purposes in general, namely -like ornaments, as household investments, and for industrial consumption.

In the 21st century, investors are more sensible enough to avoid high risk. In recent days, as the share prices are volatile, the investors are not anxious to invest their funds in the stock; they prefer investing in gold for its safety and liquidity. Volatility is the deviation of the return around its mean values either in the positive or negative direction. The Estimating of volatility becomes an essential task in the management of the portfolio. In the case of gold, its price always depicts an increasing trend to benefit the investors even during the recession period. However, the investment in gold needs a huge fund due to its excessive demand and less supply. Due to this, small investors find it hard to invest in bullion markets.

To enable the small-time investors to park their fund in the gold market, the Gold Exchange Traded Fund (Gold ETF) scheme introduced in the USA in the year 1993. In India, the ETF method is in vogue since 2007 onwards. The scheme Gold ETFs is just like other stock which is traded generally in the stock markets. It is a kind of mutual fund that is listed and operated in the stock market. They can be bought and traded through the online Demat account. As the system is more accessible and requires a less small amount of fund to invest, the schemes under GTFs are more lucrative for small investors, unlike conventional gold. This study aims to observe the casual relationship and volatility among the natural Gold and Gold ETF.

## 2 II.

## 3 Review of Literature

A very few studies have conducted in the field of gold Exchange traded fund, which is referred to in this segment of review of the literature. (Pandey, 2010) felt that buying Gold ETF is safer, convenient, and adds some tax-oriented benefits when compared with physical gold. (Mishra, Das & Mishra, 2010) attempted the casual

43 relationship between Indian natural gold price and stock market indices return found that there is a long-run  
44 equilibrium relationship exists, and the one-way causal relationship was noticed between Gold price and Stock  
45 market return. (Athma, Prashanta, & k, 2011) Stated that gold investment is less volatile while comparing with  
46 equity share investment. Gold ETF is one of the best methods for portfolio diversification. (Kumar, Kumar, &  
47 Roy, 2012) analyzed the Gold ETFs performance by conducting risk and returns, and proved that Gold ETF had  
48 given good return compared with equity fund. (Nemavathi & Nedunchezian, 2013) Attempted to estimate the  
49 volatility of gold and Gold ETF by using EGARCH model. They concluded the volatility of the fund is based  
50 on their yield performance. (Narend, 2014) Analyzed performance of Gold ETFs by Jensen Alpha Return. They  
51 estimated that ETFs are giving more returns and performing better than physical gold. (Tripath, Parashar &  
52 Singh, 2014) studied the causal relationship between the gold price and other macroeconomic factors, the result  
53 shows that there are Granger Causes that exists in the exchange rate and oil price in India.

54 (Mishra P. K., 2014) stated that gold is the best investment option for an investor in the alternative of other  
55 investments and there was a bidirectional connection between the gold price and stock market return in India.  
56 (Gencer & Musoglu, 2014) empirically analyzed gold price in Turkey by using the GARCH model and result  
57 expressed that market return has an impact on gold price volatility. (Anand, 2017) Found that Gold ETFs are  
58 influenced by gold price in India. In a long-run relationship, gold ETFs are giving more return, so it attracts the  
59 investors to invest in Gold ETF. (Jain & Mary, 2018) Found that gold ETF is a new concept in the investment  
60 portfolio for small investors. Gold ETFs is an easy and convenient way of trading. Investors need not worry  
61 about the security on holding storage and other physical damage like theft and due to natural scarcity of demand  
62 in gold.

63 However, the literature review reveals a certain aspect of the real truth of the research on the existence of  
64 Gold and Gold ETF. This study aims to estimate the short run and long run relationship between gold and Gold  
65 ETFs and its volatility.

### 66 4 III.

### 67 5 Objective of the Study

68 ? To investigate the volatility effect in Real Gold and

69 Gold ETFs;

70 ? To analyze the short run and long run association between Gold and Gold ETFs in India; ? To observe the  
71 impact of Real Gold price return in Gold ETFs return in India.

72 IV.

### 73 6 Research Methodology

74 This study was aimed at estimating the volatility and relationship between Gold and Gold ETF in India. For  
75 this purpose, the top five gold ETFs which are listed in the National Stock Exchange was chosen based on the  
76 returns in the field of Gold ETFs in India. The Gold ETF selected for study are presented in Table 1. This study  
77 is empirical in nature, based on secondary data. The daily historical data from 1 November 2015 to 31 October  
78 2018 (739 Daily Observations) were collected from National Stock Exchange (for GOLD ETF) and World Gold  
79 Council (for Physical Gold) for estimating volatility and relationship of gold and gold old ETF. The return on  
80 the gold price was calculated as the logged difference between time period t and t -1 .

### 81 7 $R_t = \log(P_t) - \log(P_{t-1})$

82 Where  $R_t$  is the daily return of gold price at time t.  $P_t$  denotes the price of gold per gram at time period t, and  
83  $P_{t-1}$  indicates the price of gold per gram in the selected ETFs at time period t-1. For analyzing the data, various  
84 econometrics tools used such as the Augmented Dickey-Fuller test, Granger Causality, Johansen Cointegration  
85 test, and GARCH model and LM-ARCH test were applied by using "Eviews 10" statistical software package.

86 V.

### 87 8 Empirical Results

88 Descriptive Statistics: The descriptive statistics of Gold and Gold Exchange Traded Funds are presented in Table  
89 2. Table 2 displays the summary of statistics of the gold and gold ETF data. As per the table, the mean values of  
90 gold ETFs are varied from each gold funds. Among these funds, IDBIGOLD had a more standard deviation that  
91 means that gold fund more volatile in the market and it has high risk; KOTAKGOLD was less volatile compared  
92 with other gold funds. Gold is very high because of various macroeconomic factors. The skewness for the gold  
93 funds and gold was almost negative (asymmetrical value), and Kurtosis concerned for Gold funds it was found to  
94 be nearly 3 (approximately). The Jarque Bara test for regularity was significance at the level of 5%, indicating  
95 the data used for this study were not normally distributed.

### 96 9 Analysis of Correlation Test:

97 The correlation coefficient is used to measure the extent of the strength and direction of the connotation between  
98 the indices and stock returns in different countries. The analysis of Karl Pearson's Correlation is presented

99 in Table 3. Table ?? shows the result of Multiple Regression Analysis, which is conducted on non-stationary  
 100 data. As per the table, the R-squared value is nearly 96% that means, the independent variable is having a high  
 101 impact on the dependent variable. Almost all the independent variables are significant at 5% level other than  
 102 QGOLDHALF, among those variables HDFC gold ETF has an extremely high coefficient value. Augmented  
 103 Dickey-Fuller Unit Root Test: Before examining the relationship between Gold and Gold ETF, it is crucial to  
 104 check the univariate properties of the data sequence are non-stationary, or they comprise a unit root. For that,  
 105 the ADF unit root test is employed, which was developed by Dickey-Fuller. A time series is said to be stationary;  
 106 that means, the alteration of the series does not symmetrically fluctuate over time. Nonstationary data will lead  
 107 to incorrect values. (Dickey & Fuller, 1979). Unit root was calculated as per the following equation:  $\Delta Y_t = \alpha + \beta Y_{t-1} + \epsilon_t$

108  $1 + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \dots + \beta_p \Delta Y_{t-p} + \epsilon_t$   
 109 Where  $\Delta$  is the first difference operation,  $\beta_1, \beta_2, \dots, \beta_p$  are coefficient to be estimated.  $\epsilon_t = 0$ ,  $\epsilon_t \neq 0$   
 110 is white noise error term, if the estimated slope of coefficient not in this regression (hypothesis) is zero or not.  
 111 if it is zero, then  $\beta$  is nonstationary. The best lag length was taken with the Akaike Information Criterion  
 112 (AIC) and maximum, lag was put to 36. (Gujarati, 2009) The ADF null hypothesis is established as unit root  
 113 in the time series, whereas, the alternative is -there is no unit root and it is stationary, which is observed and  
 114 presented in table 5.

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116 Volume XIX Issue III Version I Year 2019 ( ) B From the table, all the probability value of 'At level' is not  
 117 significant that means the data series is not stationary; it has a unit root. In the first difference, all the index  
 118 probability value is less than 5%, that means it rejects the null hypothesis to accept the alternative, so the data  
 119 is stationary.

## 120 11 Analysis of Granger Causality test:

121 The Granger causality test is directed to inspect the direction of causality amongst Real gold and Gold ETFs.  
 122 This test is applied only to stationary time series data. Granger causality was calculated as per following formula  
 123 (Gujarati, 2009)  $\hat{Y}_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_p Y_{t-p} + \epsilon_t$   
 124  $\hat{Y}_t = \alpha + \beta_1 \hat{Y}_{t-1} + \beta_2 \hat{Y}_{t-2} + \dots + \beta_p \hat{Y}_{t-p} + \epsilon_t$

125 Where  $\hat{Y}_t$  is the difference operator,  $\beta_1, \beta_2, \dots, \beta_p$  are represent as the lagged value of  $Y_t$  and  $\epsilon_t$   
 126  $\epsilon_t$ .  $\epsilon_t = 0$  and  $\epsilon_t \neq 0$  are error terms assumed white noise. The lag length was picked by using Akaike Information  
 127 Criteria (AIC) as the most favourable number. The Granger Causality Test results are presented in Table 6 -  
 128 The table 6, expresses that Granger Causality Test results in which the value of probability is less than 5% that  
 129 means it rejects the null hypothesis, showing that the Axis Gold ETF and HDFC Gold ETF are bidirectionally  
 130 caused with gold, other variables are causing unidirectionally. So, all the data are having cause and relationship  
 131 with Real gold. Particularly the price of real gold has more effect on the rate of Gold ETFs.

132 Results of Co-integration Test: (Johansen, 1990) Cointegration test is the most commonly used method in  
 133 investigative the long-run equilibrium association of the different time series or integration in the financial market.  
 134 The data becomes stationary after the first difference in the ADF test. Following table 7, shows the cointegration  
 135 relation between Real Gold and Gold ETFs. The result of the cointegration test, Trace and Max-Eigen values  
 136 are checked at 5% significant level.

137 Here the null hypothesis is that 'these series are not integrated with the Real Gold Price'. As per the table  
 138 7, all the Gold ETFs are less than 5% level of significance. That means to reject the null hypothesis and accept  
 139 the alternative one. All the Gold ETFs are having a long-run equilibrium relationship with Real Gold Price.  
 140 Estimation of Volatility: GARCH model is useful in analyzing the financial time series such as market indices. A  
 141 unique feature of these models is that the error variance may be correlated over time because of the phenomenon  
 142 of volatility clustering. The AutoRegressive Conditional Heteroskedasticity model was developed by (Engle, 1982) or  
 143 Generalised AutoRegressive Conditional Heteroskedasticity Effect (Bollerslev, 1986). GARCH model was initially  
 144 proposed by Bollerslev the simplest model GARCH (1,1) can be inscribed as (Gujarati, 2009)  $\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$   
 145  $\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$

146 Where  $\sigma_t^2$  is the variance for the time t.  $\alpha_i$  and  $\beta_j$  are coefficients.  $\epsilon_{t-i}$  is the lagged residual from the mean  
 147 equation and,  $\sigma_{t-j}^2$  is the lagged variance from the period t-j.  $\omega$  is the coefficient measuring the impact of real  
 148 gold price on Gold ETFs. Estimated GARCH coefficient and prob value for returns are presented in Table 8.  
 149 From table 8, ARCH and GARCH coefficient were all significant at 5% level, other than KOTAKGOLD Which  
 150 means there is an autoregressive effect in all the Gold ETFs. So, the future is influenced by the past movement  
 151 of gold fund returns and GARCH implies there is strong volatility clustering effect was found in the data. The  
 152 impact of Real gold in Gold ETFs was significance at 5% level. However, the coefficient values are very less that  
 153 means even though it has an impact, but it is not a strong impact over the ETFs. ARCH-LM test: ARCH LM  
 154 tests were conducted to find out whether any autocorrelation was found in the residuals of the GARCH equation,  
 155 which is necessary to verify any arch effect that has remained in the data or not. The null hypothesis of this test  
 156 is that the residuals from the Generalised AutoRegressive Conditional Heteroskedasticity equation do not have the  
 157 ARCH type of heteroskedasticity.

## 12 CONCLUSION

158 Residuals are free from autoregressive heteroskedasticity, the estimated coefficient (Obs\*R-Squared) of the  
 159 ARCH-LM test and its P values are obtainable in Table 9.

### 12 Conclusion

161 This research article was planned to examine the relationship and volatility between real gold and gold ETFs in  
 162 India. For the period of three years from 1 November 2015 to 31 October 2018, with selected Gold Exchanged  
 163 traded funds by using various econometric analysis. The study was found that there is a strong positive  
 164 relationship amongst the real gold and gold ETFs. By measuring the correlation test implies there exist short-run  
 165 relationship and by using Johenson cointegration test, it shows that there is a long-run equilibrium relationship  
 166 also. The data for the study was non-stationary while calculating ADF at first level it was significant at 5%  
 167 level that means the data termed to be stationary. By using the Granger causality analysis, it shows that there  
 168 are a cause and relationship between gold and Gold ETFs either in one way or both the ways. The volatility  
 169 effect and clustering effect was found in the Gold ETFs; all the gold funds are performing almost the same as  
 170 the past period performance. These results help to investors, market research's, companies and other financial  
 171 institutions to make the best decision towards the Gold ETFs. It will also help to increase the Gold ETFs trade  
 in the future. <sup>1 2</sup>

#### 1

| The issuer of the ETF | Name of the ETF                 | Symbol of the ETF | Return |
|-----------------------|---------------------------------|-------------------|--------|
| Axis Mutual Fund      | Axis Gold ETF                   | AXIS GOLD         | 9.45   |
| HDFC Mutual Fund      | HEDFC Gold Exchange Traded Fund | HDFCMFGETF        | 7.64   |
| IDBI AMC              | IDBI Gold Exchange Traded Fund  | IDBI GOLD         | 9.03   |
| Kotak Mutual Fund     | Kotak Gold Exchange Traded Fund | KOTAK GOLD        | 7.73   |
| Quantum Mutual Fund   | Quantum Gold Fund (an ETF)      | QGOLD HALF        | 6.63   |

Source: Bombay Stock Exchange

Figure 1: Table 1 :

#### 2

|             | AXIS GOLD | HDFC MFGETF | IDBI GOLD | KOTAK GOLD | QGOLD HALF | REAL GOLD |
|-------------|-----------|-------------|-----------|------------|------------|-----------|
| Mean        | 2629.91   | 2720.27     | 2739.27   | 261.30     | 1322.21    | 83187.08  |
| Median      | 2629.00   | 2723.75     | 2750.00   | 262.00     | 1325.00    | 83555.39  |
| Max         | 2908.95   | 2939.70     | 3000.00   | 284.75     | 1426.00    | 91428.01  |
| Min         | 2243.60   | 2341.90     | 2335.00   | 225.25     | 1148.60    | 69740.48  |
| Std. Dev.   | 142.24    | 129.91      | 146.00    | 12.573     | 59.339     | 4538.491  |
| Skewness    | -0.6786   | -0.9261     | -0.7008   | -0.8703    | -0.9519    | -0.9046   |
| Kurtosis    | 3.6776    | 3.9573      | 3.1803    | 3.7967     | 3.9789     | 3.8795    |
| Jarque-Bera | 71.066    | 134.229     | 61.663    | 113.151    | 141.502    | 124.96    |
| (Prob)      | (0.000)   | (0.000)     | (0.0000)  | (0.0000)   | (0.0000)   | (0.0000)  |

Figure 2: Table 2 :

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|              | REAL<br>GOLD | AXIS<br>GOLD | HDFC<br>MFGETF | IDBI<br>GOLD | KOTAK<br>GOLD | QGOLD<br>HALF |
|--------------|--------------|--------------|----------------|--------------|---------------|---------------|
| REAL<br>GOLD | 1.0000       | 0.9273       | 0.9752         | 0.9584       | 0.9499        | 0.9621        |

Source: Author's calculation.

Figure 3: Table 3 :

44

| Dependent Variable   | Real Gold   |        |
|----------------------|-------------|--------|
| Independent Variable | Coefficient | Prob   |
| AXISGOLD             | 2.0577      | 0.0228 |
| HDFCMFGETF           | 33.179      | 0.0000 |
| IDBIGOLD             | 9.4062      | 0.0000 |
| KOTAKGOLD            | -81.755     | 0.0000 |
| QGOLDHALF            | -8.0132     | 0.0870 |
| R-Squared            |             | 0.9600 |
| Adj. R-Squared       |             | 0.9597 |
| Durbin-Warson        |             | 0.6075 |

Source: Author's calculation.

Figure 4: Table 4 .Table 4 :

5

|            | At level    | Prob   | 1 st Difference | Prob   |
|------------|-------------|--------|-----------------|--------|
|            | t-Statistic |        | t-Statistic     |        |
| REAL GOLD  | -2.1419     | 0.2284 | -28.9504        | 0.0000 |
| AXISGOLD   | -2.0972     | 0.2460 | -32.7590        | 0.0000 |
| HDFCMFGETF | -2.0305     | 0.2737 | -28.5065        | 0.0000 |
| IDBIGOLD   | -2.0482     | 0.2662 | -19.9737        | 0.0000 |
| KOTAKGOLD  | -2.1085     | 0.2415 | -29.1821        | 0.0000 |
| QGOLDHALF  | -1.8825     | 0.3407 | -27.3636        | 0.0000 |

Source: Author's calculation.

Figure 5: Table 5 :

5

Figure 6: Table 5

6

| Null Hypothesis                             | F-Statistic | Prob    |
|---|-------------|---------|
| AXISGOLD does not Granger Cause REAL GOLD   | 3.3851      | 0.0344  |
| REAL GOLD does not Granger Cause AXISGOLD   | 33.805      | 9.E-15  |
| HDFCFMGETF does not Granger Cause REAL GOLD | 4.5756      | 0.0106  |
| REAL GOLD does not Granger Cause HDFCFMGETF | 59.300      | 1.E-24  |
| IDBIGOLD does not Granger Cause REAL GOLD   | 2.4024      | 0.0912* |
| REAL GOLD does not Granger Cause IDBIGOLD   | 32.613      | 3.E-14  |
| KOTAKGOLD does not Granger Cause REAL GOLD  | 1.1033      | 0.3323* |
| REAL GOLD does not Granger Cause KOTAKGOLD  | 44.931      | 4.E-19  |
| QGOLDHALF does not Granger Cause REAL GOLD  | 2.7437      | 0.0650* |
| REAL GOLD does not Granger Cause QGOLDHALF  | 49.359      | 8.E-21  |

Source: Author's calculation.

Figure 7: Table 6 :

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|            | Hypothesized<br>No. of CE(s) | Trace<br>Statistic | prob   | Max-Eigen<br>Statistic | prob   |
|------------|------------------------------|--------------------|--------|------------------------|--------|
| AXISGOLD   | None At                      | 21.241             | 0.0061 | 14.8393                | 0.0405 |
|            | most 1                       | 6.4020             | 0.0114 | 6.4020                 | 0.0114 |
| HDFCFMGETF | None At                      | 39.338             | 0.0000 | 30.736                 | 0.0001 |
|            | most 1                       | 8.6020             | 0.0034 | 8.6020                 | 0.0034 |
| IDBIGOLD   | None                         | 53.773             | 0.0000 | 46.998                 | 0.0000 |

Figure 8: Table 7 :

8

|            | ARCH            | GARCH           | REAL GOLD       |
|------------|-----------------|-----------------|-----------------|
| AXISGOLD   | 0.0938 (0.0000) | 0.8363 (0.0000) | 0.0002 (0.0295) |
| HDFCFMGETF | 0.0368 (0.0072) | 0.1911 (0.2987) | 0.0004 (0.0032) |
| IDBIGOLD   | 0.0406 (0.0000) | 0.9401 (0.0000) | 0.0008 (0.0000) |
| KOTAKGOLD  | 0.1200 (0.0024) | 0.2277 (0.3040) | 0.0002 (0.1267) |
| QGOLDHALF  | 0.0961 (0.0455) | 0.4087 (0.0241) | 0.0004 (0.0000) |

Source: Author's calculation.

Figure 9: Table 8 :

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9

|            | -LM Test<br>Obs*R-squared | Prob   |
|------------|---------------------------|--------|
| AXISGOLD   | 0.6909                    | 0.4058 |
| HDFCMFGETF | 0.3394                    | 0.5602 |
| IDBIGOLD   | 1.1808                    | 0.2778 |
| KOTAKGOLD  | 0.2631                    | 0.6080 |
| QGOLDHALF  | 0.0065                    | 0.9355 |

Figure 10: Table 9 :



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