

# Impulsiveness in the Prices and Volume Traded of Gold Exchange Traded Funds: An Empirical Evidence from Select Gold ETF's Listed on National Stock Exchange

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## Abstract

**Purpose:** The Study attempts to describe the role of Gold Exchange Traded Funds (ETFs) in portfolio management and how it benefits the investors in terms of price, flexibility and efficiency. The study also attempts to determine the price and volume impulsiveness of the few listed Gold ETFs on NSE. **Design/ Methodology/Approach:** The daily basis data i.e. Opening Price, Closing Price and total Volume traded of 7 listed Gold ETFs is collected from 1st April, 2012 – 31st March 2017. In order to test the data empirically and to discuss the impulsiveness of prices and quantity traded under VAR framework, E-GARCH model is being used. To add robustness to the Co-integration, Granger Causality and VECM were also conducted. **Findings:** The result reveals the presence of impulsiveness in the prices and volume traded of Gold ETFs and investor's portfolio will become more diversified and riskless with the presence of Gold stocks which will be beneficial for retail investors. **Practical Implications:** The result will help investors in creating optimal portfolio allotment, risk management and forecasting volatility as far as Gold ETFs are concerned.

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## 1. Introduction

Exchange Traded Funds is an Investment Fund which is traded on Stock Exchange which holds the assets like stock, commodities and bonds. The value and prices of ETFs is based on the market value of the underlying asset of the ETF. It gives a prospect to investors to get the benefits of cost efficiency, tax efficiency, liquidity etc. which attracts investors and helps them to make optimal portfolio management. There are several types of ETFs which are traded on the stock exchanges, like Gold ETFs, Equity index ETFs, Liquid ETFs etc.

Gold ETFs depends on the Net Asset Value of the underlying Gold asset. They are divided into units which signify Physical Gold. It can be in paper form or dematerialized form. Gold ETFs are traded similarly like a stock of a company. It offers a chance to investors to take part in gold bullion markets without physical delivery of metal.

In 1961, "Central Fund of Canada" was first Gold ETF product, which was a close-ended fund. Later, its article of incorporation was amended in 1983, to provide investors to trade

in gold and silver bullions. Since 1966, Gold ETFs are been listed on Toronto Stock Exchange. In India, Benchmark Asset Management Company Pvt Ltd in 2002 filed a proposal with the Securities Board Exchange of India (SEBI) for first Gold ETF. Initially, it did not get approval from SEBI but later in 2007, it was launched with approval. At present, after Japan, India is world's second fastest growing exchange traded fund market.

Currently, there are 13 Gold ETFs listed on National Stock Exchange, namely:

- Axis Gold ETF (AXISGOLD)
- Birla Sun Life Gold ETF (BSLGOLDETF)
- Canara Robeco Gold ETF (CANGOLD)
- Goldman Sach Exchange Traded Scheme (GOLDBEES)
- HDFC Gold Exchange Traded Fund (HDFCFMGETF)
- ICICI Prudential Gold Exchange Traded Fund (IPGETF)
- IDBI Gold ETF (IDBIGOLD)
- Kotak Gold Exchange Traded Fund (KOTAKGOLD)
- Quantum Gold Fund (QGOLDHALF)
- Reliance Gold Exchange Traded Fund (RELGOLD)
- Religare Gold Exchange Traded Fund (RELIGAREGO)
- SBI Gold (SBIGETS)
- UTI Gold Exchange Traded fund (GOLDSHARE)

As Indian ETF market is growing, there is lot of impulsiveness in the prices and total quantity traded of Gold ETFs, hence, the need of hour is to understand the volatility which can help investors to frame proper portfolio management and to promote Gold ETF market which renders many benefits as far as cost efficient and tax planning is concerned. So, the study objects to understand the impulsiveness of the 7 Gold ETFs out of 13 listed Gold ETFs on NSE.

The objectives of the study are given below:

1. To understand the Performance of Gold ETFs listed on National Stock Exchange.
2. To discover Co-integration between the Opening Price, Closing Price and Total Volume Traded of Gold ETFs listed on National Stock exchange under VAR framework.
3. To evaluate the impulsiveness between Opening Price, Closing Price and Total Volume traded using E-GARCH model.

In the light of above Objectives, the study proposes to test following Research Hypothesis:

1. H1: There exists a Co-integration between Opening price, closing price and volume traded of Gold ETFs listed on NSE.  
H0: There is no existence of Co-integration between Opening price, closing price and volume traded of Gold ETFs listed on NSE.
2. H2: Opening price of Gold ETFs does Granger cause Closing price of Gold ETFs and vice-a-versa.  
H0: Opening price of Gold ETFs does not Granger cause Closing price of Gold ETFs and vice-a-versa.
3. H3: Volume traded of Gold ETFs does Granger cause Opening and Closing price of Gold ETFs.  
H0: Volume traded of Gold ETFs does not Granger cause Opening and Closing price of Gold ETFs.
4. H4: There is an Impulsiveness between Opening price, Closing price and Volume traded of Gold ETFs.  
H0: There is no Impulsiveness between Opening price, Closing price and Volume traded of Gold ETFs.

## 2. Review of Literature

| Author & Year                           | Objectives   | Research & Methodology  | Results  |
|---|--|---|--|
| Ching & Chung et.al (2005) <sup>6</sup> | To understand performance of ETFs operating in Taiwan.   | Existing literature   | Researchers directed that the top 50 Taiwan Tracker funds are cheap as far as prices are concerned and all provide identical returns.  |
| Joel.et.al.(2006) <sup>18</sup>         | To relate the performances of Foreign ETFs and Closed-Ended funds in terms of risk and return. | Sharpe ratio  | Researchers established that ETFs has higher mean and Sharpe ratios. The researchers also determined that passive investment in ETFs is better than active investment in closely held funds.     |
| Madhumita et al. (2008) <sup>22</sup>   | To estimate the performance of mutual funds.   | Existing Literature   | Researchers originated that the equity funds outpaced the benchmark index.   |
| Johnson, W.L. (2008) <sup>19</sup>      | To make a relative study of ETFs of different countries.                                       | Daily and monthly data of ETFs of 20 countries and their index returns were taken from 1997-2006. | The authors found significant explanatory variables in correlation co-efficient between ETFs and underlying assets and also stated that a foreign index positive return is relative to US index. |
| Fisher (2008) <sup>7</sup>              | To highlight that gold ETFs are best option for investment.                                    | Existing literature   | The researcher mentioned that Gold ETFs offers an opportunity to participate in gold bullion market and it has made investment in yellow market very convenient and economical.                  |

|   |   |  |   |
|---|---|--|---|
| Huang and Guedj (2009) <sup>13</sup>    | To investigate the efficiency of ETFs in comparison to Open-Ended Mutual Funds. | Existing Literature  | Authors revealed that ETFs provides best opportunity for investment in narrow and less liquid underlying indexes.   |
| Johnson (2009) <sup>20,34</sup>         | To make a comparative study between Foreign ETFs and domestic ETFs.             | Existing Literature  | The author proposed that underlying index returns and foreign ETFs has tracking errors.   |
| Adjei Frederick (2009) <sup>1</sup>     | To compare the performance of the ETFs and S & P 500 index.                     | Existing Literature  | The author stated that ETFs and S&P index has no significant variance in their performances.  |
| Jack et al. (2009) <sup>15</sup>        | To study and scrutinise the US ETFs   | Daily data was gathered for a specified period   | Researchers pronounced that US ETFs are traded at premium than discount and there are large fluctuations in their daily prices.   |
| Meric et al. (2009) <sup>23</sup>       | To do sectoral comparison of the performance of different Index funds.          | Data was collected from 2007 -2009. Total 38 sector index funds were selected and analysed. Data was analysed using Sharpe and Treynor measures. | Researcher reported the presence of worst bear market in US stock market. They also established that healthcare index funds and consumer sector index funds have best performance whereas worst performance is seen in financial and home construction index funds. |
| Lu, Wang and Zhang (2009) <sup>21</sup> | To analyse the performances of different ETFs.                                  | To study the performance of leverage ETFs, timeline data was collected from 2006-2008.   | Researchers revealed that ETFs provides desired level of returns in short run than long run and in long run, significant deviations are being noticed.  |
| Wong and Shum (2010) <sup>35</sup>      | To examine the performances of global ETFs.                                     | Data of 15 global ETFs from bearish and bullish market was collected from 1999-2007. Sharpe ratios were used to find the results.                | Researchers concluded that in bullish market ETFs provides greater return than in bearish market. Authors also proposed that ETFs returns are not proportional and positive to market volatility.   |
| Noblett, Jackie (2010) <sup>26</sup>    | To analyse performance of Gold ETFs.  | Existing literature  | Researchers suggested that Gold ETF witness substantial flows as investors and institutions get exposure to invest in this yellow metal.  |
| Pandey, Neha (2010) <sup>25</sup>       | To investigate the opportunity to capitalize in Gold ETFs.                      | Existing literature  | Researchers favoured Gold ETFs more appropriate and price effective than buying physical form of metal gold.  |
| Yuexiang et al. (2010) <sup>36</sup>    | To investigate the effectiveness of 50 ETFs of Shanghai stock market.           | Daily basis data for NAVs and prices were gathered. Ganger causality test was used to analyse the data.  | Authors proposed that the market prices and net asset values of ETFs are co-integrated and have unidirectional causality.   |
| Charupat & Miu (2011) <sup>5</sup>      | To understand and analyse the performance of Leverage ETFs.                     | Daily basis data was gathered for specified period.  | Researchers clinched that price volatility is more in comparison to price deviations as a result of rebalancing among Leverage ETFs.  |

|   |   |   |  |
|---|---|---|--|
| Gerasimos (2011) <sup>10</sup>                      | To make comparison of ETFs across developed and developing economies.                                     | Different statistical tools were used to analyse the data like Sharpe and Treynor's ratio, Data Envelopment analysis (DEA) etc.   | Author found that ETFs are Foreseeable and its returns are persistent in short term.   |
| Gerasimos (2011) <sup>11</sup>                      | To study the returns of ETFs.   | Daily returns and NAVs data was gathered for specified period and various statistical tools were applied to analyse the data.   | Author stated that ETFs is traded at a premium from their NAVs and the pattern of their returns can be anticipated.  |
| Patrick (2011) <sup>29</sup>                        | To estimate the ETFs of US and Australia.   | US ETF and Australian ETF data was collected for specified period. Tracking error and expense ratio was applied to analyse the data.  | Author suggested that the magnitude of tracking errors is positively correlated to the expense ratio of ETFs but unfavourably related to the size of ETFs.   |
| Blitz & David (2011) <sup>2,3</sup>                 | To assess the performance of ETFs of emerging markets globally.   | Existing literature   | The researcher pinpointed that ETFs of emerging markets of worldwide exhibits higher tracking error.   |
| Prasanta athma (2011) <sup>30</sup>                 | To examine the pattern of Indian Gold ETFs in terms of performance.                                       | Existing Literature   | The author stated that Gold ETF is an embryonic option to investors for investment. It was also revealed that low volatility of gold prices weakens Indian Rupee against US Dollar and there is emergence of Gold ETF as a strong asset class. |
| Goyal & Joshi (2011) <sup>8</sup>                   | To study the financial performance and analyse the risk behaviour of select Gold ETFs in contrast of NSE. | The data was gathered from NSE website from 2008 to 2010. Sharpe's index, Treynor's ratio were used to analyse the data.  | The researchers determined that the study will be beneficial for the investors who seek the best opportunities in the Gold ETFs.   |
| Houweling (2012) <sup>12</sup>                      | To compare the pattern of Treasury ETFs and Bond ETFs.  | Existing literature   | Author stated that treasury ETFs can easily trace their benchmark, whereas, Corporate bond ETFs fail to track their benchmark.   |
| Chang and Krueger (2012) <sup>4</sup>               | To scrutinize the ETFs and Closed end Funds in terms of performance.                                      | Timeline data was used over the 2002 to 2011 period.  | Authors established that in spite of cost efficient, the performance of ETFs is worse than close ended funds   |
| P. Krishna Prasanna (2012) <sup>28</sup>            | To analyse the ETFs floated in Indian stock market.   | 82 exchange traded schemes were taken floating in Indian stock market was evaluated using DEA.  | Researchers found that large funds were not efficient and it was also inferred that size does not indicate superior performance.   |
| Jayanti. et al (2013) <sup>17</sup>                 | To analyse the NAVs of Gold ETF companies.  | Secondary data was unruffled from NSE for few listed Gold ETF companies from 2010 -2013. Mean, Standard deviation, Variance, Trend analysis, Regression analysis etc. were applied to analyse the data. | The author found that the NAVs of gold ETFs have increased due to capitalization in festive seasons and it offers diversification benefits for the long-term investors.  |
| Mohdsaleem & Matloobullah Khan (2013) <sup>24</sup> | To do comparative study of Physical Gold and Gold ETFs.   | Qualitative Research Methodology  | The author stated that Gold ETFs are tax efficient as compared to physical gold. Author also concluded that future of ETFs market is very bright.  |
| Nemavathi & Nedunchezian (2013) <sup>27</sup>       | To analyse the volatility of Gold ETF and Physical Gold.  | Daily data was gathered for a specified period and tools like standard deviation, Beta and EGARCH was applied to analyse the data.  | Researchers determined that the return of ETFs depends on its volatility.  |

|  |  |  |   |
|--|--|--|---|
| Shefali Sinha and Mahua Dutta (2013) <sup>31</sup> | To analyse the pattern and performance of Goldman Sach ETF.  | Tracking error and trend analysis methods  | The researchers found that Goldman Sachs ETF perform better than Gold.  |
| S.Malathy and Ms.T. Radhulya (2013)                | To outline the performance of Gold ETFs.   | Data for returns, NAVs was collected for a specified period.   | Researchers established that the Gold ETFs does not reflect the movement of spot gold prices.   |
| Goyal (2014) <sup>9</sup>                          | To compare different investment choices.   | The prices of Gold ETFs, NSE 500, Nifty, bank deposits, etc. were taken From 2007 to 2014 from the official NSE website. | The findings revealed that Gold ETFs gives higher returns in comparison to other investment options present in market.  |
| Singh & Kaur (2017) <sup>32</sup>                  | To observe the performance and efficiency of ETFs traded in India and to explore factors that driving the performance of ETFs. | A sample data of 12 equity ETFs from 2011 to 2015 was taken and was analysed using Panel Regression.                     | Result revealed that ETFs displays significant tracking error trying to imitate the returns of their benchmark indices. The result also exposed that the Assets Under Management and volume positively affects the tracking ability of ETFs whereas volatility is reported to have negative impact on the efficiency of ETFs. |

In order to accomplish the objectives and to test the hypothesis, the paper is divided into Six Sections. Section I gives the understanding of ETFs listed on NSE .Section II gives a comprehensive Picture of existing Literature. Section III defines Data and Methodology used to analyse the data. Section IV involves the analysis and explanations of the results, tailed by Section V which inculcates the Conclusion and Policy Implications Section VI will highlight the References used.

### 3. Data and Methodology

This section illuminates Data and Methodological used in the study. The data regarding 7 listed Gold ETFs .i.e Opening Price,

Closing Price and Total Volume Traded has been collected from official Statistical database portal of National Stock Exchange. The time period taken for the same is 1<sup>st</sup> April 2012 to 31<sup>st</sup> March 2017 on a daily basis. First, data properties need to be studied to find co-integration and error correction to form equilibrium. Granger Causality test is performed to test the causality and to test the Stationarity of sample series, Augmented Dickey Fuller (ADF) test is being used. In order to comprehend short term dynamics between opening and closing markets, Vector Error Correction Model (VECM) is being used and to add robustness to VECM results Variance Decomposition Analysis is also done followed by Graphical Representation using Impulse Response method. Additionally, to study Volatility Impulsiveness,

**Table 1.** ADF Result

**Null Hypothesis: Unit root (individual unit root process )**  
**Series: CLOSE\_PRICE, OPEN\_PRICE, VOLUME**  
**Date: 06/13/17 Time: 17:29**  
**Sample: 1 8645**  
**Exogenous variables: Individual effects**  
**Automatic selection of maximum lags**  
**Automatic lag length selection based on SIC: 1 to 17**  
**Total number of observations: 25913**  
**Cross-sections included: 3**

| Method                  | Statistic | Prob.** |
|-------------------------|-----------|---------|
| ADF - Fisher Chi-square | 94.6059   | 0.0000  |
| ADF - Choi Z-stat       | -7.38676  | 0.0000  |

\*\* Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

**Intermediate ADF test results UNTITLED**

| Series      | Prob.  | Lag | Max Lag | Obs  |
|-------------|--------|-----|---------|------|
| CLOSE_PRICE | 0.0171 | 1   | 36      | 8643 |
| OPEN_PRICE  | 0.0137 | 1   | 36      | 8643 |
| VOLUME      | 0.0000 | 17  | 36      | 8627 |

**Table 2.** Johanson's Co-integration Result

Date: 06/13/17 Time: 17:36  
Sample (adjusted): 6 8645  
Included observations: 8640 after adjustments  
Trend assumption: Linear deterministic trend  
Series: CLOSE\_PRICE OPEN\_PRICE VOLUME  
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---------------------------|------------|-----------------|---------------------|---------|
| None *                    | 0.144518   | 2073.691        | 29.79707            | 1.0000  |
| At most 1 *               | 0.079328   | 725.0714        | 15.49471            | 0.0001  |
| At most 2 *               | 0.001268   | 10.95832        | 3.841466            | 0.0009  |

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

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

**Table 3.** Vector Error Correction Model (VECM) Results

Vector Error Correction Estimates  
Date: 06/13/17 Time: 17:43  
Sample (adjusted): 4 8645  
Included observations: 8642 after adjustments  
Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq:                       | CointEq1                             |                                      |                                      |
|---|--------------------------------------|--------------------------------------|--------------------------------------|
| CLOSE_PRICE(-1)                         | 1.000000                             |                                      |                                      |
| OPEN_PRICE(-1)                          | -0.998533<br>(0.00057)<br>[-1755.61] |                                      |                                      |
| VOLUME(-1)                              | -1.07E-05<br>(1.4E-05)<br>[-0.77990] |                                      |                                      |
| C                                       | -0.661133                            |                                      |                                      |
| Error Correction:                       | D(CLOSE_...                          | D(OPEN_PR...                         | D(VOLUME)                            |
| CointEq1                                | -0.493258<br>(0.02601)<br>[-18.9618] | 0.390485<br>(0.03013)<br>[12.9584]   | 9.423979<br>(23.1792)<br>[0.40657]   |
| D(CLOSE_PRICE(-1))                      | -0.009003<br>(0.02238)<br>[-0.40234] | 0.066132<br>(0.02592)<br>[2.55122]   | -8.197472<br>(19.9392)<br>[-0.41112] |
| D(CLOSE_PRICE(-2))                      | 0.012575<br>(0.01644)<br>[0.76515]   | 0.035845<br>(0.01904)<br>[1.88279]   | -1.774030<br>(14.6445)<br>[-0.12114] |
| D(OPEN_PRICE(-1))                       | -0.015642<br>(0.02233)<br>[-0.70039] | -0.091336<br>(0.02587)<br>[-3.53033] | 6.712878<br>(19.9008)<br>[0.33732]   |
| D(OPEN_PRICE(-2))                       | -0.010830<br>(0.01633)<br>[-0.66329] | -0.030050<br>(0.01891)<br>[-1.58877] | 8.401610<br>(14.5489)<br>[0.57747]   |
| D(VOLUME(-1))                           | -1.65E-06<br>(1.1E-05)<br>[-0.14471] | 1.41E-06<br>(1.3E-05)<br>[0.10646]   | -0.651749<br>(0.01015)<br>[-64.1968] |
| D(VOLUME(-2))                           | -2.63E-06<br>(1.1E-05)<br>[-0.23085] | 2.88E-06<br>(1.3E-05)<br>[0.21846]   | -0.332407<br>(0.01015)<br>[-32.7467] |
| C                                       | -0.001951<br>(0.45000)<br>[-0.00434] | 0.014378<br>(0.52128)<br>[0.02758]   | -0.209581<br>(400.976)<br>[-0.00052] |
| R-squared                               | 0.101898                             | 0.076807                             | 0.323456                             |
| Adj. R-squared                          | 0.101169                             | 0.076059                             | 0.322907                             |
| Sum sq. resid                           | 15109739                             | 20275538                             | 1.20E+13                             |
| S.E. equation                           | 41.83333                             | 48.45964                             | 37275.68                             |
| F-statistic                             | 139.9433                             | 102.6183                             | 589.7025                             |
| Log likelihood                          | -44525.04                            | -45795.74                            | -103225.0                            |
| Akaike AIC                              | 10.30619                             | 10.60026                             | 23.89100                             |
| Schwarz SC                              | 10.31273                             | 10.60680                             | 23.89753                             |
| Mean dependent                          | -0.002083                            | 0.013729                             | -0.097778                            |
| S.D. dependent                          | 44.12488                             | 50.41480                             | 45300.35                             |
| Determinant resid covariance (dof adj.) | 2.03E+15                             |                                      |                                      |
| Determinant resid covariance            | 2.03E+15                             |                                      |                                      |
| Log likelihood                          | -189084.1                            |                                      |                                      |
| Akaike information criterion            | 43.76559                             |                                      |                                      |
| Schwarz criterion                       | 43.78766                             |                                      |                                      |

E-GARCH framework is being used. The empirical analysis is based on two-stage estimation. The first and foremost step is to apply VECM test followed by the use the residuals of VECM in the E-GARCH model.

### 4. Analysis and Interpretation of Results

This section highlights the outcomes of data of 7 gold ETFs listed On NSE under VAR framework and also displays the impulsiveness of Opening Price, Closing Price and Volume Traded of Gold ETFs using E-GARCH.

H1: There exists a Co-integration between Opening price, closing price and volume traded of Gold ETFs listed on NSE.

H0: There is no existence of Co-integration between Opening price, closing price and volume traded of Gold ETFs listed on NSE.

The first and foremost step is to examine the stationarity of data and to evaluate the Co-integration between data series, which is being tested using ADF test. The results given in Table 1 and Table 2 portrays significant results. The result of Co-integration test rejects the Null Hypothesis, confirming the existence of atleast one co-integrating relationship in the sample series.

Then, it is necessary to comprehend the short term dynamic forces of the Opening and Closing prices of Gold ETFs using VECM test. The outcomes of VECM test are unveiled in Table 3.

**Table 4.** Variance Decomposition Result

| Variance Decomposition of CLOSE_PRICE: |          |             |            |          |
|--|----------|-------------|------------|----------|
| Period                                 | S.E.     | CLOSE_PR... | OPEN_PR... | VOLUME   |
| 1                                      | 41.83333 | 100.0000    | 0.000000   | 0.000000 |
| 2                                      | 59.07603 | 94.54883    | 5.450651   | 0.000521 |
| 3                                      | 72.41404 | 92.54955    | 7.450085   | 0.000362 |
| 4                                      | 83.83216 | 91.11351    | 8.885787   | 0.000702 |
| 5                                      | 93.91290 | 90.14550    | 9.853760   | 0.000744 |
| 6                                      | 103.0244 | 89.48140    | 10.51785   | 0.000755 |
| 7                                      | 111.3987 | 88.99841    | 11.00078   | 0.000813 |
| 8                                      | 119.1874 | 88.63468    | 11.36448   | 0.000833 |
| 9                                      | 126.4981 | 88.35170    | 11.64745   | 0.000850 |
| 10                                     | 133.4090 | 88.12550    | 11.87363   | 0.000869 |

| Variance Decomposition of OPEN_PRICE: |          |             |            |          |
|---------------------------------------|----------|-------------|------------|----------|
| Period                                | S.E.     | CLOSE_PR... | OPEN_PR... | VOLUME   |
| 1                                     | 48.45964 | 64.38761    | 35.61239   | 0.000000 |
| 2                                     | 64.15417 | 74.21289    | 25.78686   | 0.000258 |
| 3                                     | 76.97084 | 77.84411    | 22.15569   | 0.000192 |
| 4                                     | 87.92554 | 79.68565    | 20.31403   | 0.000324 |
| 5                                     | 97.63272 | 80.90171    | 19.09799   | 0.000304 |
| 6                                     | 106.4608 | 81.72605    | 18.27367   | 0.000277 |
| 7                                     | 114.6095 | 82.32600    | 17.67371   | 0.000285 |
| 8                                     | 122.2158 | 82.78208    | 17.21764   | 0.000278 |
| 9                                     | 129.3756 | 83.14002    | 16.85970   | 0.000272 |
| 10                                    | 136.1594 | 83.42847    | 16.57126   | 0.000271 |

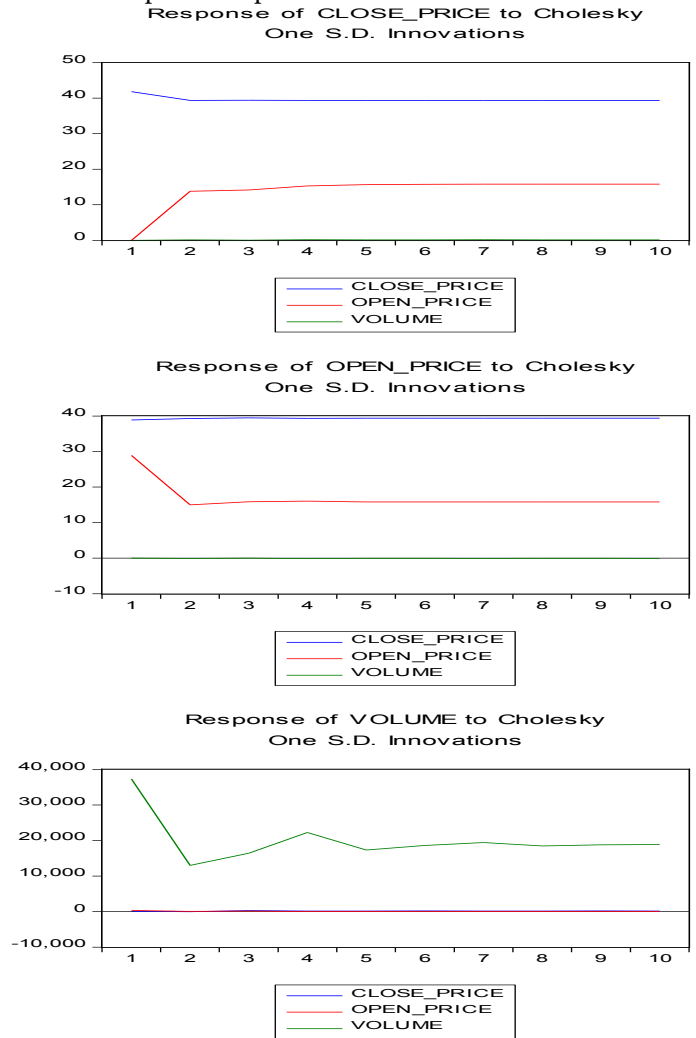
  

| Variance Decomposition of VOLUME: |          |             |            |          |
|-----------------------------------|----------|-------------|------------|----------|
| Period                            | S.E.     | CLOSE_PR... | OPEN_PR... | VOLUME   |
| 1                                 | 37275.68 | 0.000576    | 0.006858   | 99.99257 |
| 2                                 | 39470.01 | 0.000546    | 0.006173   | 99.99328 |
| 3                                 | 42751.13 | 0.005308    | 0.006246   | 99.98845 |
| 4                                 | 48195.83 | 0.004958    | 0.004915   | 99.99013 |
| 5                                 | 51209.21 | 0.005100    | 0.004434   | 99.99047 |
| 6                                 | 54479.85 | 0.005711    | 0.004022   | 99.99027 |
| 7                                 | 57830.58 | 0.005782    | 0.003599   | 99.99062 |
| 8                                 | 60701.15 | 0.005939    | 0.003317   | 99.99074 |
| 9                                 | 63545.45 | 0.006117    | 0.003073   | 99.99081 |
| 10                                | 66292.50 | 0.006209    | 0.002858   | 99.99093 |

Cholesky Ordering: CLOSE\_PRICE OPEN\_PRICE VOLUME

To add robustness to the results, Variance Decomposition Analysis is being applied, Table 4 and Table 5 reveals the results using Impulse Response.

**Table 5.** Impulse Response Result



After VECM test, it is imperative to apprehend the Causality among the sample series. Hence, Granger causality test is being conducted and their results are reported in Table 6.

H2: Opening price of Gold ETFs does Granger cause Closing price of Gold ETFs and vice -a -versa.

H0: Opening price of Gold ETFs does not Granger cause Closing price of Gold ETFs and vice- a -versa.

H3: Volume traded of Gold ETFs does Granger cause Opening and Closing price of Gold ETFs.

H0: Volume traded of Gold ETFs does not Granger cause Opening and Closing price of Gold ETFs.

After Granger Causality Test, now it's important to evaluate empirically the impulsiveness volatility, for which, E-GARCH

**Table 6.** Granger Causality Test Result

Pairwise Granger Causality Tests

Date: 06/13/17 Time: 18:17

Sample: 1 8645

Lags: 2

| Null Hypothesis:                              | Obs  | F-Statistic | Prob.  |
|---|------|-------------|--------|
| OPEN_PRICE does not Granger Cause CLOSE_PRICE | 8643 | 476.498     | 5E-197 |
| CLOSE_PRICE does not Granger Cause OPEN_PRICE |      | 239.602     | 5E-102 |
| VOLUME does not Granger Cause CLOSE_PRICE     | 8643 | 0.14960     | 0.8611 |
| CLOSE_PRICE does not Granger Cause VOLUME     |      | 7.63866     | 0.0005 |
| VOLUME does not Granger Cause OPEN_PRICE      | 8643 | 0.09365     | 0.9106 |
| OPEN_PRICE does not Granger Cause VOLUME      |      | 7.60598     | 0.0005 |

**Table 7.** E-GARCH Result

Dependent Variable: CLOSE\_PRICE

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 06/13/17 Time: 18:05

Sample: 1 8645

Included observations: 8645

Convergence achieved after 45 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

LOG(GARCH) = C(4) + C(5)\*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)  
\*RESID(-1)/@SQRT(GARCH(-1)) + C(7)\*LOG(GARCH(-1))

| Variable           | Coefficient | Std. Error            | z-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| OPEN_PRICE         | 0.999053    | 0.000105              | 9485.355    | 0.0000   |
| VOLUME             | -3.07E-06   | 3.47E-06              | -0.886699   | 0.3752   |
| C                  | 0.214901    | 0.169777              | 1.265782    | 0.2056   |
| Variance Equation  |             |                       |             |          |
| C(4)               | -0.091129   | 0.002864              | -31.82243   | 0.0000   |
| C(5)               | 0.193025    | 0.002169              | 89.00731    | 0.0000   |
| C(6)               | -0.003055   | 0.002219              | -1.376857   | 0.1686   |
| C(7)               | 0.993561    | 0.000340              | 2920.005    | 0.0000   |
| R-squared          | 0.997635    | Mean dependent var    |             | 2565.871 |
| Adjusted R-squared | 0.997635    | S.D. dependent var    |             | 599.9203 |
| S.E. of regression | 29.17766    | Akaike info criterion |             | 9.162441 |
| Sum squared resid  | 7357245.    | Schwarz criterion     |             | 9.168161 |
| Log likelihood     | -39597.65   | Hannan-Quinn criter.  |             | 9.164391 |
| Durbin-Watson stat | 1.906286    |                       |             |          |

**Table 8.** ARCH LM Result

Heteroskedasticity Test: ARCH

|               |          |                     |        |
|---------------|----------|---------------------|--------|
| F-statistic   | 0.745149 | Prob. F(1,8642)     | 0.3880 |
| Obs*R-squared | 0.745257 | Prob. Chi-Square(1) | 0.3880 |

Test Equation:

Dependent Variable: WGT\_RESID^2

Method: Least Squares

Date: 06/13/17 Time: 18:06

Sample (adjusted): 2 8645

Included observations: 8644 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| C                  | 0.990609    | 0.051631              | 19.18616    | 0.0000   |
| WGT_RESID^2(-1)    | 0.009285    | 0.010757              | 0.863220    | 0.3880   |
| R-squared          | 0.000086    | Mean dependent var    |             | 0.999892 |
| Adjusted R-squared | -0.000029   | S.D. dependent var    |             | 4.694971 |
| S.E. of regression | 4.695040    | Akaike info criterion |             | 5.931122 |
| Sum squared resid  | 190499.1    | Schwarz criterion     |             | 5.932756 |
| Log likelihood     | -25632.31   | Hannan-Quinn criter.  |             | 5.931679 |
| F-statistic        | 0.745149    | Durbin-Watson stat    |             | 1.999911 |
| Prob(F-statistic)  | 0.388040    |                       |             |          |

framework is being used, its results in Table 7 shows significant results which rejects the null Hypothesis.

H4: There is an Impulsiveness between Opening price, Closing price and Total Volume traded of Gold ETFs.

H0: There is no Impulsiveness between Opening price, Closing price and Total Volume traded of Gold ETFs.

At last, the standardised residuals of E-GARC are tested to unveils additional ARCH, ARCH Lagrange Multiplier (LM) is being applied, the results of the same is being depicted in Table 8. The result represents that E-GARCH(1,1) captures all the impulsiveness dynamics.

## 5. Conclusion and Policy Implications

The study targets to analyse the volatility and impulsiveness of the prices and volume traded of listed Gold ETFs. The result proposes that the presence of impulsiveness in all 7 selected listed Gold ETFs. The empirical outcome delivers a way to describe the pattern of impulsiveness which will be worthwhile for future empirical research to assess the volatility effects. The results would be helpful for investors to make optimal portfolio management and Gold ETFs would emerge as a Strong Asset for investment in future.

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## Annexure-I

### IMPULSIVENESS IN THE PRICES AND VOLUME TRADED OF GOLD EXCHANGE TRADED FUNDS: AN EMPIRICAL EVIDENCE FROM SELECT GOLD ETF'S LISTED ON NATIONAL STOCK EXCHANGE

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