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Gold Exchange Traded Fund - Price Discovery and Performance Analysis

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Abstract

The paper aims to examine the price discovery process and the performance of Gold Exchange Traded Funds especially with respect to two Gold ETFs, namely, Goldman Sachs Gold Exchange Traded Scheme (GoldBeEs) and SBI Gold Exchange Traded Scheme (SBIGETS), for the period 2009 – 2016. The study has employed Johansen cointegration and Johansen's Vector Error Correction Model (VECM) for the price discovery analysis. The results of VECM reveal that the spot prices lead the Gold ETFs price during the study period. Tracking Error analysis shows that Gold ETFs have neither outperformed nor underperformed the spot price. Price Deviation analysis indicates that Gold ETFs are trading on an average lower than the spot price of gold. The entire analysis reveals that although the price discovery takes place in the spot market, Gold ETFs have performed as well as physical gold and the slight difference in price with that of Gold is only because of certain fees, which are applicable in the management of Gold ETFs.

Keywords: Gold Exchange Traded Funds; price discovery; price deviation.

JEL classification: G130.

1. INTRODUCTION

Exchange Traded Funds (ETF) popularity has increased manifold in the recent years. ETFs have properties similar to that of mutual funds, and have an added feature of beinglisted and traded in the Stock Exchanges like shares. Gold Exchange Traded Fund (Gold ETF) is an Exchange-Traded Fund (ETF) that tracks the price of gold. It represents physical goldin dematerialized form, which is transparent, regulated and has liquidity. A Gold ETF invests 90 to 100 percent of the funds in standard gold bullion and up to 10 percent in money market instruments. Authorised participants who are appointed by the fund house deposit pure gold and purchase units from the mutual funds in the beginning stage. It is the authorized participants who facilitate the secondary market trading of Gold ETFs in the stock exchange.

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Gold ETFs generates returns similar to that of physical gold. The Net Asset Value (NAV) of the ETF units is as per the value of gold held by the fund and changes with the price.

Gold ETFs offer investors a mode of investment in the gold bullion market without the necessity of taking physical delivery of gold and to trade it on a stock exchange. The instrument provides numerous advantages like convenience in trading, affordability, liquidity and purity. It also provides diversification opportunity along with tax efficiency, ability to short sell and has low management fees. These advantages have made the global demand for Gold-backed ETFs and similar productsto skyrocket. It is estimated that the global demand is 531.9 t. In India the first Gold ETF, the “Gold Benchmark Exchange Traded Scheme” (GoldBeES) was launched by Benchmark Asset Management Company. Ever since the popularity of Gold ETFs have increased and as of December, 2016, there were 13 Gold ETFs listed in the National Stock Exchange in India. According to Association of Mutual Funds in India (AMFI), as on December 2016, the Asset Under Management (AUM) for Gold ETFs stood at Rs. 5519 crores. 98.6 percent of the investors in Gold ETFs belong to retail category, followed by Institutions (1.4 percent).

Very few studies have been conducted in India regarding the price discovery process in Gold ETF. The purpose of the study is to check the role of Gold ETFs in price discovery and also to conduct an analysis of the performance of Gold ETFs in India. In the analysis of price discovery process, the stationarity of variables were checked using Augmented Dickey Fuller (ADF) test. The cointegration between spot and ETF prices were checked using Johansen’s cointegration test. Appropriate lag length criteria were also ascertained. Johansen’s (1988) Vector Error Correction Model (VECM) was applied to examine the long-run relationship between Gold ETFs price and spot prices of gold. The Impulse Response Function and Variance Decomposition analysis between Gold ETFs and spot prices of gold were also used. The performances of Gold ETFs were studied using the Tracking Error and Pricing Deviations.

The findings of the study show that Gold ETFs in India do not influence the MCX spot prices of gold. The price discovery occurs in the spot market and not in the ETF market. Tracking Error analysis showed that Gold ETFs have neither outperformed nor underperformed the spot price. Price Deviation analysis indicated that Gold ETFs are trading on an average lower price than the spot gold. This price deviation, however, could be due to reduction in fund assets as a result of fund expenses. It can be inferred that, in the long run, the investors in Gold ETFs will get returns similar to that of the spot gold.

2. REVIEW OF LITERATURE

Price discovery refers to the use of futures prices for pricing cash market transactions (Working, 1948; Wiese, 1978). The method of ascertaining the fundamental price of a security or commodity is known as Price discovery. Price discovery helps in setting up a reference (futures) price from which the spot price can be derived. It depends on whether information is reflected first in changed futures price or in changed spot price. Hence, depending on the timing of dissemination of information, there exists a lead lag between the spot and futures market. An efficient market immediately incorporates any new information on the price of the asset. So the prices in both spot and futures market should absorb the new information immediately and reflect it in the price of assets. But it is not so because of the existence of market imperfections like such as transaction costs, margin requirements, short sale constraints, liquidity differences and non-synchronous trading.

Subrahmanyam (1991) gave the rationale that uninformed liquidity traders prefer to trade in baskets of securities like financial futures and ETFs as it has lowest transaction cost.In an efficient market all the markets should absorb new information at the same time. But frictions like magnitude of transaction costs and short sale restrictions affect the dissemination of information in the market. It has been seen that the futures impound information faster than stock markets. As a result, a question arises whether the price discovery function has shifted to ETFs (Deville, 2008). Also, with the arrival of commodity ETFs like Gold ETF, there has been a change in the investment pattern of the investors – both institutional and retail. Ivanov (2013) is of the view that with the introduction of commodity ETFs,the price discovery process has shifted in the commodity markets. Schlusche (2009) in their study concluded that price discovery does not take place in ETF market but in futures market.

Tse *et al.* (2006) found that the price discovery process is done to a large extent by the ETFs. Skouratova *et al.* (2009) are of the opinion that ETFs play a major role in price discovery, and this is more than that of the Futures market. This was reconfirmed by Ivanov (2013), who examined the relationship associated with the price discovery process of gold, silver, and oil ETFs, their underlying spot commodities and their respectives futures contract in US. It was observed that in the gold and silver market, the price discovery function had shifted from futures market to ETF. It is possible that the price discovery function of the futures market is weakening in the current scenario where ETFs market is dominating. Narend and Thenmozhi (2013) examined the mechanism associated with price discovery process related to the US listed and Indian Gold ETFs. The results depicted that both the markets have contradictory experience because in US, ETFs play a vital role in the price discovery process of gold, but in India the price discovery process is carried out by the spot market, and ETFs do not influence the price of gold.

The tracking error and performance of ETFs is an another important strand of literature where lot of studies have been done (Wong and Shum, 2010). Tracking error may cause the performance of the fund to be different from that of the underlying asset. According to Svetina (2010), though the ETFs perform better than mutual funds, it is prone to tracking errors. The Tracking errors are less for shorter holding period but increase for longer holding period (Charupat and Miu, 2011). Aber *et al.* (2009) analyzed the price volatility and tracking ability of four ETFs by using the three measures,that are, the premium and discount position, daily return, and tracking error. They also compared ETFs and index mutual funds by tracking the same index and observed that the index funds were better than their corresponding ETFs in terms of tracking error. A similar study was conducted by Shin and Soydemir (2010) who undertook tracking error analysis for 26 ETFs by using three methods, namely, Jensen's model, serial corelation test and runs test, and panel regression analysis. The study demonstrated ETFs in Asian markets have greater tracking error relative to US.

Naylor *et al.* (2011) studied the price efficency of Gold and Silver Exchange Traded Funds and observed that during adjustment of returns for risk; though there was inefficiency, the abnormal returns disappeared. Buetow and Henderson (2012) concluded that the returns of majority of the ETFs were almost the same as their benchmark indices. Charteris (2013) explored the deviation in price of ETFs from four domestic and three South African countries. It was seen that out of seven ETFs, five were trading at a premium and two at a discount of their net asset value. The price deviations disappeared after two trading days, indicating that the ETFs were effectively priced.

Jena *et al.* (2018) used wavelet multiple correlation and multiple cross- correlation to study the varying comovements in gold futures trading in three of the world's largest derivative exchanges COMEX (New York), SGE (Shanghai), and MCX (India); and the world's largest spot OTC market, LBMA (London). The study indicated that there are stronger interactions between gold futures and spot market at different time scales. In particular, it was seen that at lower frequencies, i.e. four to six months, the degree of integration is very high and weak in high frequencies such as one week. It was also confirmed that COMEX and LBMA are the leaders in the world markets for gold at different scales.

Buckle *et al.* (2018) analyzed the price discovery process for three major US indices - S&P 500, NASDAQ and Dow Jones, their futures and ETFs for over a period of eleven years using their intra-day price observations. Information share (IS), permanent and transitory decomposition (PT), and weighted price contribution (WPC) were used for the analysis. The PT analysis showed that the price discovery process has shifted to Index ETFs from the futures contracts while the WPC analysis show that price discovery takes place in spot market, which in turn indicates that ETFs might have adjusted prices actively to premarket information and activities.

Lau *et al.* (2017) used spillovers and volatility transmission to study the relationship between white precious metals and gold, oil and global equity. The study uncovered that over a period of 10 years there has been several channels of transmission across the selected ETF markets. It also emphasized the role of Gold ETFs as the most influential market in the sample.

Many other studies have also been conducted in India in this area. Purohit and Malhotra (2015) who studied the performance, tracking error, and pricing efficiency of Indian ETFs. The analysis indicated that ETFs do not fully replicate the underlying benchmark. Moreover, there is significant tracking error and the results revealed the presence of discount and pricing inefficiencies. On the contrary, a study by Goyal and Amit (2011) examined the performance of Gold ETFs in India by comparing it with the index of NSE for the period 2008-2010. They found that the prices of ETFs have less variation compared to the index of NSE. A similar study of Indian ETFs was done by Prasanna (2012), who found that Gold ETFs performed better than the equity market during 2005 – 2011, with an incremental returns of 13 percent more returns than the equity market. Eswara (2015) investigated the performance of Gold ETFs for the post crash period. The results indicated that the performance of Gold ETFs during the crash phase is better and superior to many other mutual funds, funds of funds, and other ETFs.

A fair review of literature shows that there are contradictory views about the price discovery function of Gold ETFs. Further, only a few studies have been conducted about the Gold ETFs price discovery process in India. Therefore the present study attempted to investigate the price discovery process and performance of two of the oldest Gold ETFs in India – Goldman Sachs Gold Exchange Traded Scheme (GoldBeEs) and SBI Gold Exchange Traded Scheme (SBIGETS).

3. METHODOLOGY

Nature and data Sources

The study has been conducted for two Gold ETFs – the GoldBeEs and SBIGETS. The data regarding Gold ETFs have been retrieved from the website of NSE and for Spot Gold from Multi Commodity Exchange (MCX). The daily closing prices of Gold ETFs were studied for a period of seven years from October 1, 2009 to September 30, 2016. Throughout this study, Spot and Gold ETF returns are defined as continuously compounded or log returns (hereafter returns) at time t, R_t, is calculated as follows:

$$R_t = \log (P_t / P_{t-1}) = \log P_t - \log P_{t-1}$$

where P_t and P_{t-1} are the daily closing prices of the gold ETFs and its corresponding underlying spot market at days, t and t−1, respectively.

Price discovery

This Study examines the price discovery method in Gold ETF and spot market prices of Gold Market in India. The stationarity of the data series is checked using Augmented Dickey Fuller (1979) test. Besides, the long run relationship between the variables is examined using Johansen cointegration test. Also, Vector Error Correction Mechanism (VECM) is used to know the short run dynamics.

Performance of Gold ETF

In this study, the Performance of Gold ETFs is measured by two metrics namely, Tracking Error and Pricing Deviation.

Tracking Error

Tracking Error (TE) is defined as the average daily volatility of the difference between the return of the ETF and the return of the tracked benchmark (ESMA, 2012). The difference in returns of the ETF and the return of the underlying asset is measured by the tracking error. It shows how successful the ETF has been in achieving its objectives. Tracking errors over a period of time could significantly affect the performance of the ETF. Tracking Errors are caused due to Management Fees, Transaction Cost, Dividend and cash holding and replication strategy. Tracking Error can be measured in several ways as suggested by Frino and Gallagher (2001) and Larsen and Resnick (1998). In this study, two measures have been used for measuring tracking error namely, 1. The average absolute difference in returns of the Gold ETF and the underlying asset - Spot Gold (TE_1) , 2. Standard deviation of the difference in returns between the Gold ETFs and the underlying asset - Spot Gold (TE_2). The tracking error of Gold ETF and its underlying asset is tested by conducting T-test to test the significance of the means.

1. Average Absolute Difference in Returns (TE_1)

$$TE_1 = \frac{1}{T}\sum_{t=1}^{T} | r_t^{ETF} - r_t^{I} |$$

where:

r_t^{ETF} = the return of the ETF on day t;

r_t^{I}= the return of the underlying benchmark asset on day t and

T = the length of the time period under consideration.

2. Standard Deviation of the difference in returns between the index portfolio and the underlying benchmark asset return (TE_2)

$$TE_2 = \sqrt{\frac{1}{T-1}\sum_{t-1}^{T}[(r_t^{ETF} - r_t^{I})] - (\bar{r}^{ETF} - \bar{r}^{I})]^2}$$

where:

$\bar{r}^{ETF}$ = Sample mean returns on the ETF over the time period under consideration

$\bar{r}^{I}$ = Sample mean returns on the underlying benchmark asset over the time period under consideration

Pricing Deviation

Pricing deviation (PD) is defined as the difference between log price of the underlying asset and the log price of the ETF (DeFusco *et al.*, 2011). The pricing will be efficient and there will not be any deviation if the price of the ETF closely follows the NAV of the ETF. One of the main reasons for pricing deviation is the marketing inefficiency caused by the Authorised Participants in the creation and redemption process. In normal course, the price deviation is measured as the difference between NAV and the price of the tracked asset. But in the case of ETF, unlike a mutual fund where trading takes place at the NAV at the end of the trading day, the trading occurs throughout the day at the market determined price. Therefore in this study the methodology suggested by DeFusco *et al.* (2011), is used for calculating Pricing Deviation.

Pricing Deviation can be defined as follows:

$$PD_t = S_t - F_t$$

where:

t = time

S_t = The price of the market index

F_t = The price of the ETF

The Pricing Deviation of Gold ETFs is tested by conducting T-test.

4. PRICE DISCOVERY ANALYSIS

Aim

Price discovery between Spot and Gold ETFs

GoldBeEs

Augmented Dickey Fuller (1979) test was used for examining unit roots and its result are shown in Annex 1. According to the Augmented Dickey Fuller test results, the null hypothesis of non-stationary for Spot and GoldBeEs prices are not rejected at levels. But all the variables are significant at one per cent level, when the series are first differenced. It signifies that the price series of spot and of GoldBeEs are stationary and integrated at the order of one I (1).

It is more appropriate to apply Johansen Cointegration test (Johansen 1991, 1995) as all the variables are integrated of order one, The results of Schwarz Information Criteria (SIC) indicated that the suitable lag length was three (Annex 2). Therefore, the number of lags required in the Cointegration test was taken as three (p=3). Appropriately, the long-run relationship between price of spot gold and price of GoldBeEsfor the period under study is examined using Johansen's Cointegration test and the results are presented in Annex 3.

The existence of a long-run relationship between GoldBeEs and spot market prices of gold in India is confirmed by the Johansen cointegration test results. The use of a Error Correction Model (ECM) for showing short-run dynamicsis justified as the analysis shows that GoldBeEs and spot prices of gold stand in a long-run relationship between them. Consequently, the short-run dynamic relationship between GoldBeEs and spot markets of gold in India for the period understudy is tested using the Error Correction Model.The results of the same are presented in Table no. 1. The presence of long-run equilibrium relationship between spot and GoldBeEs price series during the period understudy was revealed by the results of error correction model which showed that the error correction coefficients of spot and GoldBeEs equation are statistically significant at one percent level. Most significantly, the lags of GoldBeEs prices in spot equation are found to be statistically insignificant. On the other hand, the lags of spot price in GoldBeEs equation are statistically significant at one percent levels, indicating that spot price lead the GoldBeEs price. Thus, it can be concluded that the spot prices lead the prices of GoldBeEs during the study period.

Table no. 1 – Result of Error Correction Model for GoldBeEs and Spot market

Variables	Spot Equation	GoldBeEs Equation
ECM(-1)	-0.689293* [-3.15721]	1.276965* [5.88646]
Spot(-1)	-0.419098** [-2.32262]	-0.955237* [-5.32781]
Spot(-2)	-0.371012* [-2.81153]	-0.631963* [-4.81972]
Spot(-3)	-0.272780* [-3.55364]	-0.366263* [-4.80208]
GoldBeEs (-1)	-0.348018 [-1.84871]	0.238906 [1.27723]
GoldBeEs (-2)	-0.137119 [-0.99976]	0.151800 [1.11390]
GoldBeEs (-3)	0.041396 [0.52298]	0.134998 [1.71642]
C	-1.28E-05 [-0.04181]	-3.97E-06 [-0.01308]
R-squared	0.395650	0.405769
F-statistics	113.9128*	118.8156*

Note: * & ** - denote the significance at one and five per cent level, respectively.

The test of inverse roots of the AR characteristic polynomial has been used for confirming the stability of the Error Correction model. Generally AR test method is used for error correction model testing. When all the reciprocals of root model in error correction model is less than 1it can said that the model is stationary. Otherwise, the model is non-stationary and the result is invalid. The location mapping of each characteristic root has been made and it can be seen from Annex 4 that all the characteristic roots are less than one, indicating that the model in this study is stationary and the result is valid.

Table no. 2 – Variance Decomposition Analysis for GoldBeEs and Gold Spot Market

Variance Decomposition of SPOT			
Period	**S.E.**	**SPOT**	**GoldDBeEs**
1	0.010703	100.0000	0.000000
2	0.011082	98.31980	1.680201
3	0.011569	98.24175	1.758247
4	0.012359	98.14775	1.852252
5	0.013355	98.40586	1.594135
6	0.013907	98.27535	1.724646
7	0.014517	98.23630	1.763698
8	0.015165	98.24829	1.751711
9	0.015769	98.27191	1.728094
10	0.016317	98.26837	1.731628
11	0.016867	98.26933	1.730673
12	0.017405	98.27326	1.726739
Variance Decomposition of GoldBeEs			
Period	**S.E.**	**SPOT**	**GoldBeEs**
1	0.010635	86.57890	13.42110
2	0.010945	87.22885	12.77115
3	0.011396	88.20167	11.79833
4	0.012103	89.30205	10.69795
5	0.013099	90.84673	9.153274
6	0.013616	91.08491	8.915093
7	0.014187	91.65583	8.344174
8	0.014799	92.21645	7.783553
9	0.015376	92.69282	7.307184
10	0.015896	93.04259	6.957413
11	0.016417	93.36423	6.635773
12	0.016929	93.66110	6.338898

Table no. 2 presents the result of the variance decomposition analysis. In terms of variance decomposition, a shock to GoldBeEs price accounts for about 2 percent of the variation in spot price during the entire 12-days time period, while the spot innovation contributes up to 7 percent of the GoldBeEs price over the same period. This reveals that the unidirectional relationship runs from spot price to GoldBeEs price in India, as suggested by the earlier findings of error correction model.

According to Hasbrouck (1995), information share of a market is defined as the proportional contribution of that market to price innovation variance. Using Hasbrouck (1995) information share methodology, it can be seen that in GoldBeEs, the average information share of spot price of gold is 95.97 percent while that of ETF (GoldBeEs) is 4.03 percent. Thus the information share reveals that more information flows from spot price to GoldBeEs price. So it is in line with our other analysis findings, which show the dominant role of spot in price discovery. Figure no. 1 reports impulse responses. It indicates how a one-time positive shock of one standard deviation (using the orthogonal Cholesky decomposition) to the GoldBeEs price endures on the spot price behavior of GoldBeEs, and vice versa. It shows that the initial shock given to the spot price influences the GoldBeEs price positively over time, and not the other way round. This confirms the unidirectional relationship runs from spot price to GoldBeEs prices in India, as suggested by the earlier findings of error correction model and Variance Decomposition Analysis.

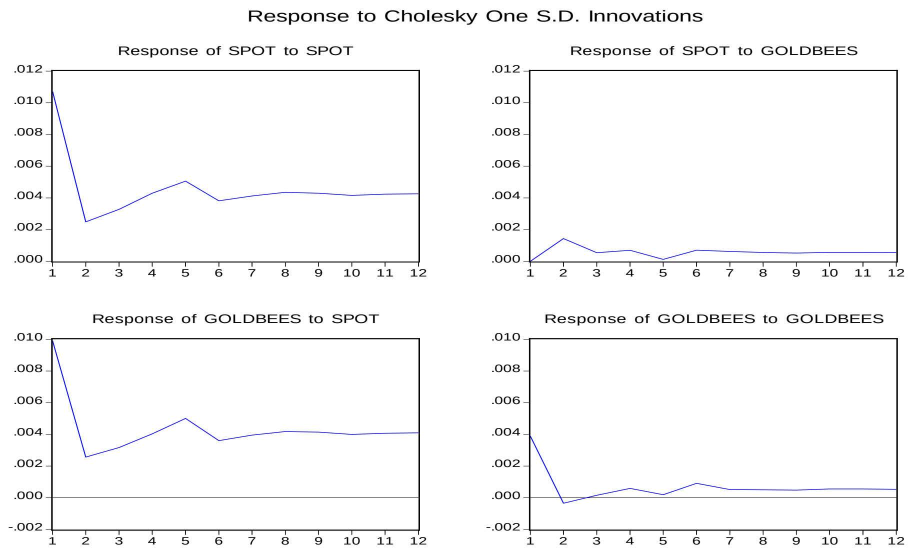

Figure no. 1 – Impulse Response Function for GoldBeEs and Gold Spot Market

SBIGETS

The study employed Augmented Dickey Fuller (1979) test for unit roots and its result are shown in Annex 5. According to the Augmented Dickey Fuller test results, the null hypothesis of non-stationary for spot and SBIGETS prices are not rejected at levels. But all the variables are significant at one per cent level, when the series are first differenced. It signifies that the price series of spot and of GoldBeEs are stationary and integrated at the order of one I (1).

It is more appropriate to apply Johansen Cointegration test (Johansen 1991, 1995) as all the variables are integrated of order one, The Johnansen's approach is affected by the lag length used in Error Correction Model (ECM) (Stock and Watson, 1993) and to the sample-ending point. Hence, an optimal lag length (p) must be chosen using VAR Lag Length Criteria. Also, it is necessary that the optimal lag length of initial VAR be selected before estimating the ECM model with associated cointegrating vector. The lag length criteria was computed by using Likelihood Ratio (LR), Final Predict Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan-Quinn information criteria (HQ) and presented in Annex 6. The results of Schwarz Information Criteria (SIC) indicated that the suitable lag length was four. Therefore, the number of lags required in the Cointegration test was taken as four (p=4). Appropriately, the long-run relationship between price of spot gold and price of SBIGETSfor the period under study is examined using Johansen's Cointegration test and the results are presented in Annex 7.

The presence of one cointegrating vector between the SBIGETS price and spot market prices of Gold respectively is revealed by the results of Johansen's maximum eigen value and trace statistic. The existence of a long-run relationship between spot price of gold and SBIGETS in India is confirmed by the Johansen cointegration test. The use of a Error Correction Model (ECM) for showing short-run dynamics is justified as the analysis shows that SBIGETS and spot prices of gold stand in a long-run relationship between them.

Table no. 3 – Result of Error Correction Model for SBIGETS and Gold Spot Market

Variables	Spot Equation	SBIGETS Equation
ECM(-1)	-0.439303** [-2.14959]	1.738114* [8.91939]
Spot(-1)	-0.545222* [-3.02267]	-1.208081* [-7.02392]
Spot(-2)	-0.532050* [-3.72067]	-0.845031* [-6.19738]
Spot(-3)	-0.467130* [-4.62357]	-0.558307* [-5.79535]
Spot(-4)	-0.210132* [-3.70005]	-0.236935* [-4.37534]
SBIGETS (-1)	-0.279817 [-1.42691]	0.517511* [2.76764]
SBIGETS (-2)	-0.071115 [-0.45716]	0.320643** [2.16172]
SBIGETS (-3)	0.093127 [0.85730]	0.214679** [2.07260]
SBIGETS (-4)	-0.016788 [-0.28507]	0.025260 [0.44983]
C	-2.94E-06 [-0.00987]	-6.76E-06 [-0.02382]
R-squared	0.427825	0.501270
F-statistics	100.9419*	135.6877*

Note: * & ** - denote the significance at one and five per cent level, respectively.

Consequently, the short-run dynamic relationship between SBIGETS and spot markets of gold in India for the period understudy is tested using the Error Correction Model. The results of the same are presented in Table no. 3. Schwarz Information Criteria (SIC) revealed that 4 is the optimal lag length of SBIGETS and spot price series of Gold to be used in the error correction model. The presence of long-run equilibrium relationship between spot and SBIGETS price series during the period understudy was revealed by the results of error correction model which showed that the error correction coefficients of spot and SBIGETS equation are statistically significant at one percent level. Most significantly, the lags of SBIGETS prices in spot equation are found to be statistically insignificant. On the other hand, the lags of spot price in SBIGETS equation are statistically significant at one percent levels, indicating that spot price lead the SBIGETS price. Thus, it can be concluded that the spot prices lead the prices of SBIGETS during the study period.

The test of inverse roots of the AR characteristic polynomial has been used for confirming the stability of the Error Correction model. Generally AR test method is used for error correction model testing. When all the reciprocals of root model in error correction model is less than 1it can said that the model is stationary. Otherwise, the model is non-stationary and the result is invalid. The location mapping of each characteristic root has been made and it can be seen from Annex 8 that all the characteristic roots are less than one, indicating that the model in this study is stationary and the result is valid.

Table no. 4 shows the output of the variance decomposition analysis. In terms of variance decomposition, a shock to SBIGETS price accounts for about 2 percent of the variation in spot price during the entire 12-days time period, while the spot innovation contributes up to 15 percent of the SBIGETS price over the same period. This reveals that the unidirectional relationship runs from spot price to SBIGETS price in India, as suggested by the earlier findings of error correction model.

Table no. 4 – Variance Decomposition Analysis for SBIGETS and Spot Market of Gold

Variance Decomposition of SPOT			
Period	**S.E.**	**SPOT**	**SBIGETS**
1	0.010426	100.0000	0.000000
2	0.010644	99.07548	0.924516
3	0.010932	98.73973	1.260269
4	0.011363	98.63335	1.366652
5	0.011856	98.45317	1.546825
6	0.012657	98.32361	1.676392
7	0.013020	98.26322	1.736783
8	0.013421	98.27924	1.720762
9	0.013849	98.34133	1.658673
10	0.014262	98.41137	1.588629
11	0.014700	98.42680	1.573203
12	0.015074	98.44059	1.559409
Variance Decomposition of SBIGETS			
Period	**S.E.**	**SPOT**	**SBIGETS**
1	0.009941	73.97252	26.02748
2	0.010372	72.48942	27.51058
3	0.010617	73.65870	26.34130
4	0.010972	75.16250	24.83750
5	0.011383	76.89821	23.10179
6	0.012096	79.32419	20.67581
7	0.012400	80.15420	19.84580
8	0.012750	81.17983	18.82017
9	0.013125	82.20046	17.79954
10	0.013492	83.13269	16.86731
11	0.013878	83.97558	16.02442
12	0.014206	84.64963	15.35037

According to Hasbrouck (1995), information share of a market is defined as the proportional contribution of that market to price innovation variance. Using Hasbrouck (1995) information share methodology, it can be seen that in SBIGETS (Table no. 4), the average information share of spot price of gold is 91.54 percent while that of ETF (SBIGETS) is 8.46 percent. This structure information share reveals that more information flows from spot price to SBIGETS price. So it is in line with our other analysis findings, which show the dominant role of spot in price discovery.

Figure no. 2 reports impulse responses. It indicates how a one-time positive shock of one standard deviation (using the orthogonal Cholesky decomposition) to the SBIGETS price endures on the spot price behavior of Gold, and vice versa. It shows that the initial shock given to the spot price influences the SBIGETS price positively over time, and not the other way round. This confirms the unidirectional relationship runs from spot price to SBIGETS price in ETF market in India, as suggested by the earlier findings of error correction model and Variance Decomposition Analysis.

The findings of the study are conforming to the findings of previous studies (Narend and Thenmozhi, 2013; Ivanov, 2013) regarding price discovery in the ETF market.

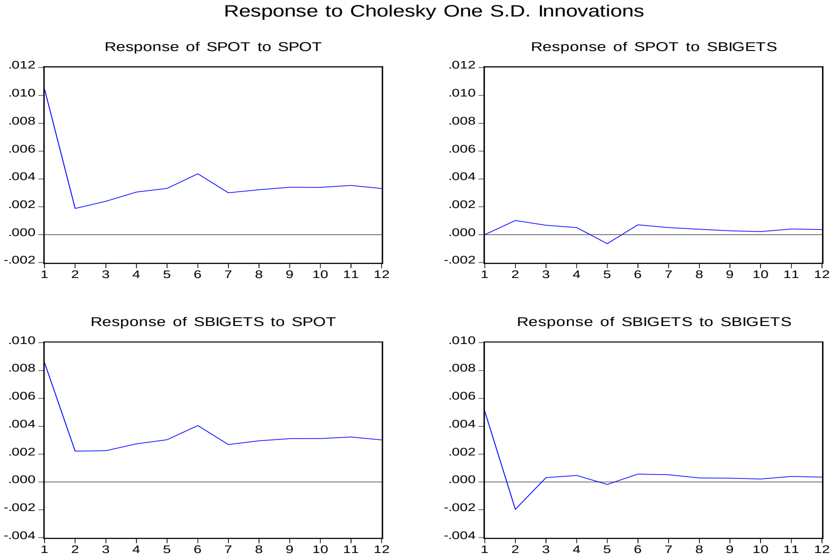

Figure no. 2 – Impulse Response Function for SBIGETS and Gold Spot Market

5. PERFORMANCE ANALYSIS OF GOLD ETF

Hypothesis:
H_0: There is no Tracking Error of Gold ETFs with respect to their spot prices.
H_1: There is Tracking Error of Gold ETFs with respect to their spot prices.

Table no. 5 – Descriptive Statistics for Spot Gold Prices and Indian Gold ETFs

	N	Mean	Std. Dev.	Min	Max
Spot Price of Gold	1717	2593.8858	452.47738	1555.40	3294.30
GoldBeEs	1717	2447.6669	394.09736	1539.83	3083.75
SBIGETS	1717	2499.7645	406.03415	1562.51	3164.15

The descriptive statistics for the Gold ETFs understudy and spot gold is given in Table no. 5. It can be seen that the central tendency for both the Gold ETFs are almost similar and slightly lower than that of spot price of gold.

The performance of Gold ETFs can be gauged by the extent of the tracking error. The performance of the Gold ETFs as measured by tracking error is shown in Table no. 6. For the analysis of tracking error, the sample period is partitioned into yearly intervals for seven years. The tracking error using TE_1 for GoldBeES and SBIGETS for the period under study are 0.376 and 0.448 respectively. This is indicative that various market frictions like transaction costs, benchmark volatility and replication strategy are responsible for the underperformance of the Gold ETFs. It can be seen from the results that, in both GoldBeEs and SBIGETS, there is considerable variability in tracking error over time. The daily tracking error for the entire sample of GoldBeEs ranges from 0.000 to 5.653 and for SBIGETS from 0.001 to 6.983. The tracking error in terms of TE_2 provides similar results. It is 0.569 for GoldBeEs and 0.685 for SBIGETS.

Although it is seen from Table no. 6 that there is significant tracking error, there is no significant bias in all the periods under study. In all the periods under study, the mean arithmetic differences in returns are negligible and are not statistically significant based on t-test. Hence the null hypothesis can be accepted and can be concluded that there is no tracking error of Gold ETFs with respect to their spot prices. This is indicative of the fact that Gold ETFs have neither outperformed nor underperformed the spot price. So in the long run the investors will get returns similar to that of the spot returns. The findings are similar to that of the studies conducted by Buetow and Henderson (2012).

Table no. 6 – Tracking Error of Gold ETFs

	Period	N	Absolute Return Difference				Return Difference		
			Mean (TE_1)	SD	Min	Max	Mean	P Value	SD (TE_2)
GoldBeEs	2009 -2010	245	0.300	0.286	0.003	1.707	-0.004	0.896	0.416
	2010 -2011	248	0.324	0.407	0.000	2.733	-0.004	0.895	0.521
	2011 -2012	248	0.234	0.290	0.002	2.921	-0.006	0.795	0.373
	2012 -2013	246	0.262	0.273	0.001	1.451	-0.007	0.772	0.379
	2013-2014	244	0.362	0.320	0.002	1.451	-0.009	0.800	0.484
	2014-2015	242	0.738	0.700	0.005	5.653	-0.003	0.951	1.0182
	2015-2016	244	0.415	0.344	0.007	1.860	-0.004	0.915	0.540
	2009 -2016 ALL	**1717**	**0.376**	**0.428**	**0.000**	**5.653**	**-0.005**	**0.702**	**0.569**
SBIGETS	2009 -2010	245	0.332	0.297	0.002	1.736	-0.004	0.897	0.447
	2010 -2011	248	0.403	0.725	0.001	6.983	-0.002	0.963	0.830
	2011 -2012	248	0.312	0.382	0.001	3.520	-0.005	0.875	0.493
	2012 -2013	246	0.395	0.420	0.001	2.445	-0.013	0.731	0.577
	2013 - 2014	244	0.495	0.439	0.002	2.343	-0.005	0.877	0.662
	2014 -2015	242	0.738	0.681	0.006	4.915	-0.002	0.981	1.005
	2015 -2016	244	0.467	0.403	0.001	2.622	-0.008	0.833	0.618
	2009 -2016 ALL	**1717**	**0.448**	**0.517**	**0.001**	**6.983**	**-0.005**	**0.741**	**0.685**

Hypothesis:

H_0: There is no Pricing Deviation of Gold ETFs with respect to their spot prices.

H_1: There is Pricing Deviation of Gold ETFs with respect to their spot prices.

Table no. 7 – Pricing Deviation of Gold ETFs

	N	Price Deviation	P Value	Std.Dev.	Min	Max
GoldBeEs	1717	0.024	0.000	0.012	-0.004	0.049
SBIGETS	1717	0.015	0.000	0.0122	-0.027	0.042

Table no. 7 shows the price deviation of the Gold ETFs based on the sample period under study. The Pricing Deviation for GoldBeEs and SBIGETS are 0.024 and 0.015 respectively. Price deviations are significant for both the Gold ETFs with $p < .05$. Hence the null hypothesis is rejected and it can be concluded that there is price deviation of Gold ETFs with respect to their spot prices. This indicates that the Gold ETFs are trading on average lower than the spot price of gold.

On comparing both the parameters i.e. tracking error and price deviation studied for analyzing the performance of Gold ETFs, it seems that both the results are contradictory as tracking error is insignificant and pricing deviation is significant. But both are relatively small and the tracking error and Pricing deviations study different characteristics of ETFs (DeFusco *et al.*, 2011). ETFs unlike other investment instruments are intended to have a price, which is based on a proportion of the underlying asset. On the other hand, pricing deviation shows how far the ETFs have been able to achieve this proportion. This explanation does not hold true for commodity ETFs like Gold ETFs. The significant price deviation, which has been found in GoldBeEs and SBIGETS, is due to reduction in fund assets as a result of fund expenses. Another reason is that Gold ETFs not only hold gold bars, but also debt instruments and cash for some liquidity, so that also makes a difference to the fund assets.

6. CONCLUSIONS

This study examines the price discovery process and performance of Gold ETFs, namely, GoldBeEs and SBIGETS. Johansen's Cointegration technique followed by the Vector Error Correction Model (VECM) was used for examining the price discovery process in the Gold ETFs and Gold Spot market. Augmented Dickey Fuller test for testing units revealed that price series of spot and Gold ETFs markets of gold are stationary and integrated at the order of one I(1). The existence of a long-run relationship between Gold ETFs prices and spot gold prices in India was confirmed by the Johansen cointegration test. The results of VECM reveal that the spot prices lead the Gold ETFs price (for both GoldBeEs and SBIGETS) during the study period. The Variance Decomposition Analysis, Hasbrouck (1995) information share methodology and impulse response function also confirm the result received from VECM. Thus, the studies show that the Gold ETFs in India do not influence the MCX spot prices of gold and price discovery is being done in the spot market and not in the ETF market.

Tracking Error analysis shows that Gold ETFs have neither outperformed nor underperformed the spot price. Price Deviation analysis indicates that Gold ETFs are trading on an average lower than the spot price of gold. But this price deviation is due to reduction in fund assets as a result of fund expenses. It can be said that, in the long run, the investors in Gold ETFs will get returns similar to that of the spot returns. Further, investors in gold can benefit from using the spot market prices as it impounds new information faster than the Gold ETF. It is quite likely, that with development of the Gold ETF market over a period of time, the price discovery will shift to Gold ETF as in the case of markets in developed countries (Narend and Thenmozhi, 2013). Further, it is a major challenge for investors to invest in the capital markets during volatile conditions. Since derivatives act as a tool for hedging, investors can reduce their risk and increase their profits through the use of derivatives. In order to obtain the best results, awareness should be created among the investors regarding the use of derivatives. Losses in risky and volatile market can be minimised through the use of derivatives. However, as of now India is one of the largest consumers of physical gold in the world, and the trading volume in MCX spot gold is much higher and ETFs are yet to catch up.

References

Aber, J. W., Li, D., and Can, L., 2009. Price volatility and tracking ability of ETFs. *Journal of Asset Management, 10*(4), 210-221.

Buckle, M., Chen, J., Guo, Q., and Tong, C., 2018. Do ETFs lead the price moves? Evidence from the major US markets. *International Review of Financial Analysis, 58*, 91-103. http://dx.doi.org/10.1016/j.irfa.2017.12.005

Buetow, G. W., and Henderson, B. J., 2012. An Empirical Analysis of Exchange-Traded Funds. *The Journal of Portfolio Management, 38*(4), 112-127. http://dx.doi.org/10.3905/jpm.2012.38.4.112

Charteris, A., 2013. The Pricing efficiency of South African exchange traded funds. *Investment Analysis Journal, 78*, 17-26.

Charupat, N., and Miu, P., 2011. The Pricing and Performance of Leveraged Exchange-Traded Funds. *Journal of Banking & Finance, 35*(4), 966-977. http://dx.doi.org/10.1016/j.jbankfin.2010.09.012

DeFusco, R. A., Ivanov, S. I., and Karels, G. V., 2011. The exchange traded funds' pricing deviation: Analysis and forecasts. *Journal of Economics and Finance, 35*(2), 181-197. http://dx.doi.org/10.1007/s12197-009-9090-6

Deville, L., 2008. Exchange Traded Funds: History, Trading,and Research. In C. Zopounidis, M. Doumpos and P. M. Pardalos (Eds.), *Handbook of Financial Engineering* (pp. 67-98): Springer. http://dx.doi.org/10.1007/978-0-387-76682-9_4

Dickey, D. A., and Fuller, W. A., 1979. Distribution of the Estimations for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 47*, 427-431.

ESMA, 2012. Guidelines for competent authorities and UCITS management companies. *ESMA's guidelines on ETFs and other UCITS issues*. https://www.esma.europa.eu/sites/default/files/library/2015/11/2012-832en_guidelines_on_etfs_and_other_ucits_issues.pdf.

Eswara, M., 2015. An empirical study on performance of gold ETFs in India-post crash period. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.2679686

Frino, A., and Gallagher, D. R., 2001. Tracking s&p 500 index funds getting your ioney's worth? *Journal of Portfolio Management, 28*(1), 44-55. http://dx.doi.org/10.3905/jpm.2001.319822

Goyal, A., and Amit, J., 2011. Performance Appraisal of Gold ETFS in India. *Journal of Elixir Finance, 32*, 2057-2060.

Hasbrouck, J., 1995. One Security, Many Markets:Determining the contributions to Price Discovery. *The Journal of Finance, 50*(4), 1175-1199. http://dx.doi.org/10.1111/j.1540-6261.1995.tb04054.x

Ivanov, S. I., 2013. The influence of ETFs on the price discovery of gold, silver and oil. *Journal of Economics and Finance, 37*(3), 453-462. http://dx.doi.org/10.1007/s12197-011-9205-8

Jena, S. K., Tiwari, A. K., and Roubaud, D., 2018. Comovements of gold futures markets and the spot market: A waveket analysis. *Finance Research Letters, 24*, 19-24. http://dx.doi.org/10.1016/j.frl.2017.05.006

Johansen, S., 1988. Statistical Analysis and Cointegrating Vectors. *Journal of Economic Dynamics & Control, 12*(2-3), 231-254. http://dx.doi.org/10.1016/0165-1889(88)90041-3

Johansen, S., 1991. Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica, 59*(6), 1551-1580. http://dx.doi.org/10.2307/2938278

Johansen, S., 1995. *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford: Oxford University Press. http://dx.doi.org/10.1093/0198774508.001.0001

Johansen, S., and Juselius, K., 1990. 'Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210. http://dx.doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Larsen, G. A., and Resnick, B. G., 1998. Empirical Insights on Indexing: How Capitalization, Stratification and Weighting Can Affect Tracking Error. *Journalof Portfolio Management, 25*(1), 51-60.

Lau, M. C., Vigne, S. A., Wang, S., and Yarovaya, L., 2017. Return spillovers between white precious metal ETFs: The role of oil,gold and global equity. *International Review of Financial Analysis, 52*(C), 316-332. http://dx.doi.org/10.1016/j.irfa.2017.04.001

Narend, S., and Thenmozhi, M., 2013. *Performance and Price Discovery of Gold Exchange Traded Funds*: Available at SSRN. http://dx.doi.org/10.2139/ssrn.2370337

Naylor, M., Wongchoti, U., and Gianotti, C., 2011. Abnormal Returns in Gold and Silver Exchange Traded Funds. *Journal of Index Investing, 2*(2), 1-34.

Prasanna, K. P., 2012. Performance of Exchange Traded Funds in India. *International Journal of Business and Management, 7*(23), 122-141. http://dx.doi.org/10.5539/ijbm.v7n23p122

Purohit, H., and Malhotra, N., 2015. Pricing Efficiency & Performance of Exchange Traded Funds in India. *The IUP Journal of Applied Finance, 21*(3). https://ssrn.com/abstract=2671810.

Schlusche, B., 2009. Price Formation in Spot and Futures Markets: Exchange Traded Funds versus Index Funds. *Journal of Derivatives, 17*(2), 26-40. http://dx.doi.org/10.3905/JOD.2009.17.2.026

Shin, S., and Soydemir, G., 2010. Exchange-Traded Funds, Persistence in Tracking Errors and Information Dissemination. *Journal of Multinational Financial Management, 20*, 214-234.

Skouratova, E., Tse, Y., and Martinez, V., 2009. Market competition in crude oil futures. http://www.fma.org/Texas/Papers/Price_Discovery_Crude_Oil_Futures.pdf.

Stock, J. H., and Watson, M. W., 1993. A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. *Econometrica, 61*(4), 783-820. http://dx.doi.org/10.2307/2951763

Subrahmanyam, A., 1991. A Theory of Trading in Stock Index Futures. *Review of Financial Studies, 4*(1), 17-51. http://dx.doi.org/10.1093/rfs/4.1.17

Svetina, M., 2010. Exchange Traded Funds: Performance and Competition. *Journal of Applied Finance (JAF), 20*(2), 130-145.

Tse, Y., Bandyopadhyay, P., and Shen, Y. P., 2006. Intraday Price Discovery in the DJIA Index Markets. *Journal of Business Finance & Accounting, 33*(9-10), 1572-1585. http://dx.doi.org/10.1111/j.1468-5957.2006.00639.x

Wiese, V., 1978. Use of Commodity Exchanges by Local Grain Marketing Organizations. In A. Peck (Ed.), *Views from the Trade*. Chicago: Board of Trade of the City of Chicago.

Wong, K. H., and Shum, W. C., 2010. Exchange-traded funds in bullish and bearish markets. *Applied Economics Letters, 17*(16), 1615-1624. http://dx.doi.org/10.1080/13504850903085035

Working, H., 1948. Theory of the inverse carrying charge in futures markets. *Journal of Farm Economics, 30*(1), 1-28. http://dx.doi.org/10.2307/1232678

ANNEX 1

Augmented Dickey-Fuller Test Results

Variables	ADF Test Statistics			
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
	Level		First Difference	
Spot	-2.173621	-0.980721	-34.98003*	-35.07665*
GoldBeEs	-2.168418	-0.949873	-35.44394*	-35.54809*

Note: * – indicates significance at one percent level. Optimal lag length is determined by the Schwarz Information Criterion (SIC).

ANNEX 2

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3797.176	NA	6.91e-06	-6.206339	-6.197984	-6.203195
1	8895.097	10170.83	1.67e-09	-14.53654	-14.51148	-14.52711
2	8958.522	126.3323	1.51e-09	-14.63372	-14.59195	-14.61800
3	8982.000	46.68663	1.47e-09	-14.66558	-14.60709*	-14.64357
4	8995.250	26.30590	1.44e-09	-14.68070	-14.60551	-14.65240*
5	9002.075	13.52672	1.44e-09	-14.68532	-14.59342	-14.65074
6	9007.620	10.97170	1.43e-09	-14.68785	-14.57923	-14.64697
7	9010.448	5.586869	1.44e-09	-14.68593	-14.56061	-14.63877
8	9017.422	13.75477*	1.43e-09*	-14.69080*	-14.54876	-14.63734

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5 percent level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

ANNEX 3

Results of Johansen Cointegration test for GoldBeEs and Spot Market of Gold

Vector (r) Hypothesis (H_0)	Eigen Value	Likelihood Ratio Tests	95 Per cent Critical Value	Inference
		Trace test Statistics (λ_{trace})		
H_0: r = 0	0.066647	88.99281**	25.87211	
H_1: r $\geq$ 1	0.003551	4.365062	12.51798	Cointegrated
		Maximal Eigen value (λ_{max})		
H_0: r = 0	0.066647	84.62774**	19.38704	
H_1: r $\geq$ 1	0.003551	4.365062	12.51798	Cointegrated

Notes: r is the number of cointegrating vectors under the null hypothesis. Critical values are noted from Johansen and Juselius (1990) and ** - denote the significance at five per cent level, respectively.

ANNEX 4

Diagnostic Checks for Error Correction Model

Roots of Characteristic Polynomial	
Root	Modulus
1.000000	1.000000
-0.094042 - 0.625913i	0.632939
-0.094042 + 0.625913i	0.632939
0.201852 - 0.566004i	0.600920
0.201852 + 0.566004i	0.600920

Roots of Characteristic Polynomial	
Root	**Modulus**
-0.553844	0.553844
-0.429517 - 0.293074i	0.519977
-0.429517 + 0.293074i	0.519977

VEC specification imposes 1 unit root(s).

ANNEX 5

Augmented Dickey-Fuller Test Results

Variables	ADF Test Statistics			
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
	Level		First Difference	
Spot	-2.173621	-0.980721	-34.98003*	-35.07665*
SBIGETS	-2.175481	-0.901957	-37.53763*	-37.66171*

Note: * – indicates significance at one percent level. Optimal lag length is determined by the Schwarz Information Criterion (SIC).

ANNEX 6

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3683.631	NA	8.32e-06	-6.020656	-6.012301	-6.017511
1	8523.980	9656.952	3.06e-09	-13.92965	-13.90458	-13.92022
2	8615.262	181.8172	2.65e-09	-14.07238	-14.03061	-14.05666
3	8650.203	69.48191	2.52e-09	-14.12298	-14.06450	-14.10097
4	8675.931	51.07809	2.43e-09	-14.15851	-14.08332*	-14.13022*
5	8681.714	11.46080*	2.43e-09	-14.16143	-14.06952	-14.12684
6	8685.622	7.732627	2.43e-09	-14.16128	-14.05266	-14.12040
7	8689.676	8.008873	2.43e-09	-14.16137	-14.03604	-14.11420
8	8693.741	8.017032	2.43e-09*	-14.16147*	-14.01944	-14.10802

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5 percent level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

ANNEX 7

Results of Johansen Cointegration test for SBIGETS and Gold Spot Market

Vector (r) Hypothesis (H_0)	Eigen Value	Likelihood Ratio Tests	95 Per cent Critical Value	Inference
		Trace test Statistics (λ_{trace})		
H_0: r = 0	0.050431	67.98925**	25.87211	
H_1: r $\geq$ 1	0.003703	4.547862	12.51798	Cointegrated
		Maximal Eigen value (λ_{max})		
H_0: r = 0	0.050431	63.44139**	19.38704	
H_1: r $\geq$ 1	0.003703	4.547862	12.51798	Cointegrated

Notes: r is the number of cointegrating vectors under the null hypothesis. Critical values are noted from Johansen and Juselius (1990) and ** - denote the significance at five per cent level, respectively.

ANNEX 8

Diagnostic Checks for Error Correction Model

Roots of Characteristic Polynomial	
Root	**Modulus**
1.000000	1.000000
-0.562968 - 0.404221i	0.693057
-0.562968 + 0.404221i	0.693057
0.171472 - 0.664242i	0.686018
0.171472 + 0.664242i	0.686018
-0.579178	0.579178
0.175713 - 0.525335i	0.553942
0.175713 + 0.525335i	0.553942

VECVEC specification imposes 1 unit root(s).