

## Examining the Relationship between ETFs and Their Underlying Assets in Indian Capital Market

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**Abstract.** Exchange traded funds (ETFs) have completed a decade of their presence in Indian capital markets although their popularity has grown very recently. Since the ETFs are issued on the basis of their underlying assets, their price movements are supposed to follow those of the underlying index or other assets they represent. The paper evaluates comovement between prices of ETFs in India and those of their underlying assets using the econometric technique of Vector Autoregressions. The findings suggest that while comovements are stronger in equity based ETF, such relation does not exist in commodity based ETF markets. The findings have significant implications on investment style to be adopted by investors in ETF market.

**Keywords:** Exchange Traded Funds, Vector Autoregressions, Comovements

### 1. Introduction

Exchange traded funds, popularly known as ETFs were first developed in USA by State Street Global Advisor together with American Stock Exchange (Amex) in 1993. ETFs are basically financial instruments that track a particular underlying asset such as an index or bullion assets like gold. Like a mutual fund, an ETF is a well diversified portfolio and like a stock, it is traded on a stock exchange [1]. An ETF is created by an asset management company (AMC) inviting Authorised Participants (APs) to subscribe for ETF initial public offerings. The APs include institutional investors, mutual funds, insurance companies, etc. These APs exchange their portfolio of stocks and a cash component for creation units of an ETF. These ETF units bought by APs are then made available to retail investors through stock exchanges. They provide cost efficient ways of diversification for the investor as they can be bought or sold like shares with added advantage that the underlying asset is a diversified portfolio rather than just a single share. Also unlike a mutual fund, there are no fund management fees deducted. Several ETFs have been introduced on Indian stock exchanges. These include Nifty BeES with Nifty index as the underlying, and likewise, Junior BeES and UTI Sunder. Further, some ETFs like Gold BeES are also available where the underlying asset is gold.

### 2. Background of the Study

A major guideline used by investors while trading in ETFs is the movement in the underlying asset itself. Although an ETF may not be priced exactly at NAV of the underlying asset on account of influence of demand and supply forces, ideally, the movements in prices of an ETF in ETF market should be governed by the movements in the underlying in that market to a large extent. If this actually happens then, passive trading in ETF becomes more logical than the active trading which involves more trading costs to an investor. In fact, AMCs introduce ETFs to provide investment returns that closely correspond to the performance and returns of underlying asset. The present study therefore examines if returns in ETFs is significantly influenced by movements in underlying assets. This aspect is examined separately for index based ETF and bullion based ETF so as to provide an insight as to which ETF follows performances close to underlying asset.

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### 3. Data and Methodology

The data for the study consists of daily closing prices of Nifty BeES for the period from March 19, 2007 to March 11, 2011 and Gold BeES for the period from March 19, 2007 to August 17, 2011. The corresponding daily closing prices of respective underlying asset, i.e., Nifty index and physical gold are also collected. The data for Nifty, Nifty BeES and Gold BeES is collected from the website of National Stock Exchange. For each of the ETFs and underlying asset first logarithmic returns have been computed as follows:

$$\ln R_t = \ln P_t - \ln P_{t-1} \quad (1)$$

Where P is the daily closing price of given ETF/underlying asset.

The study applies methodology of Vector Autoregression (VAR) developed by Sims [2]. VAR model is ideal in this situation as it provides a multivariate framework where changes in particular variable are related to changes in its own lags and to changes in other variables and the lags of those variables. The model thus can help in identifying main channels of interactions and simulates the responses of a given market to innovations in other markets. The VAR model can be expressed in its standard form as:

$$\ln R_t = C + \sum_{k=0}^p A_k R_{t-k} + \varepsilon_t \quad (2)$$

Where  $\ln R_t$  is the  $m \times 1$  column vector of daily returns on the ETF/underlying at time  $t$ ,  $C$  is the  $m \times 1$  column vector of constant terms,  $A_k$  are  $m \times m$  matrices of coefficients such that the  $(i, j)$ th component of  $A_k$  measures the effect of change in the  $j$ th market on the  $i$ th market after  $k$  periods,  $\varepsilon_t$  is an  $m \times 1$  column vector of unobserved disturbances assumed to satisfy the usual assumptions of the errors from an OLS regression. Eq. (2) assumes a return generating process where the return of each market (ETF and underlying) is a function of a constant term, its own lagged returns, the lagged returns of other variables in the system, plus an error term  $\varepsilon_{it}$ , which is serially uncorrelated but can be contemporaneously correlated. In other words, the returns of a market incorporates not only its own past information, but also the past information of other markets.

Using VAR model two important questions related to integration of two markets can be answered – one, how fast are the price movements in one market transmitted to other markets; two, how much of movements in one market can be explained by innovations in other market. The first question can be answered by generating impulse response functions (IRFs) which measure the response of different markets to shock of 1 standard error in a particular market; and the second by computing forecast error variance decompositions (FEVD). Before implementing VAR methodology it is necessary to test for stationarity of return variables to avoid the problem of spurious regression (Granger and Newbold [3]; Phillips [4]). The popular Augmented Dickey-Fuller [5] test is used to test the stationarity of the variables.

## 4. Results and Discussion

### 4.1. Stationarity of Variables

The results of ADF test for presence of unit root in time series of variables are presented in Table 1 below. The test results indicate that all the return series are stationary at levels or integrated of order zero i.e. I(0).

**Table 1: Results of Stationarity Test Using ADF Test**

Variable	ADF Test Statistics			
	Without trend	P value	With Trend	P value
LNIFTYR	-29.93828*	0.0000	-29.92327*	0.0000
LNIFTYBEESR	-29.97316*	0.0000	-29.95813*	0.0000
LGOLDR	-25.27815*	0.0000	-25.27493*	0.0000
LGOLDBEESR	-33.13260*	0.0000	-33.13165*	0.0000

Notes: (a) Lag selection for ADF test is automatic based on SIC (Schwartz Information Criterion)  
 (b) MacKinnon (1996) one-sided p values use for rejection of hypothesis of unit root.

- (c) Test critical values are -3.436676, -2.864222 and -2.568250 for 1%, 5% and 10% respectively for test without trend and -3.967261, -3.414318 and -3.129280 at 1%, 5% and 10% respectively for test with trend as deterministic term.
- (d) \* indicated significance at 1% level.

Therefore, VAR model with levels series is constructed.

## 4.2. Correlation Structure

The correlation structure between the returns of ETF and underlying asset is the simplest indicator of the underlying relationship between the two variables. Table 2 below presents this correlation structure for log returns on Nifty BeES and Gold BeES with log returns on their respective underlying holdings viz., Nifty and physical gold.

**Table 2: Correlation Structure Between ETF and Underlying Assets**

Variable	LNIFTYR	Variable	LGOLDR
LNIFTYR	1.000	LGOLDR	1.000
LNIFTYBEESR	0.968	LGOLDBEESR	0.446

It can be seen from Table 2 above that the correlation between returns in Nifty and returns in Nifty BeES is much stronger (0.968) as compared to that between returns in physical gold and Gold BeES (0.446). Thus correlation between ETF and underlying asset in equity market is much stronger than that between ETF and underlying asset in bullion market.

## 4.3. Forecast Error Variance Decomposition (FEVD)

Table 3 and Table 4 below presents the results of FEVD based on VAR analysis of variables under study. Table 3 indicates that forecast error variance in Nifty is not significantly explained by Nifty BeES. On day 1, 100% of error variance in Nifty explained by innovations in Nifty itself. On the other days also, the contribution of Nifty BeES in explaining forecast error variance in Nifty remains significantly lower at about 0.68%. On the other hand, on day 1, more than 95% of error variance in Nifty BeES is contributed by the underlying asset, i.e. Nifty Index. On the remaining days, even though the contribution of Nifty declines, it remains at significantly higher at 92%. About 8% of error variance in Nifty BeES is explained by its own innovations, i.e. developments within the ETF market.

**Table 3. Results of Forecast Error Variance Decomposition (FEVD) for Nifty and Nifty BeES**

Variance Decomposition of LNIFTYR:			
Day	S.E.	LNIFTYR	LNIFTYBEESR
1	0.019890	100.0000	0.000000
2	0.019943	99.74558	0.254425
3	0.019966	99.53580	0.464196
4	0.019986	99.33665	0.663353
5	0.019996	99.33365	0.666345
6	0.019999	99.32639	0.673606
7	0.019999	99.32491	0.675085
8	0.019999	99.32230	0.677704
9	0.019999	99.32146	0.678544
10	0.019999	99.32143	0.678566
11	0.020000	99.32133	0.678671
12	0.020000	99.32131	0.678688
13	0.020000	99.32130	0.678700
14	0.020000	99.32130	0.678702
15	0.020000	99.32130	0.678702

Variance Decomposition of LNIFTYBEESR:			
Day	S.E.	LNIFTYR	LNIFTYBEESR
1	0.018734	95.26671	4.733290

2	0.019089	92.50447	7.495530
3	0.019114	92.30715	7.692849
4	0.019127	92.21846	7.781537
5	0.019133	92.22348	7.776516
6	0.019147	92.16632	7.833681
7	0.019148	92.15356	7.846435
8	0.019149	92.15137	7.848627
9	0.019149	92.15143	7.848568
10	0.019149	92.15145	7.848553
11	0.019149	92.15098	7.849024
12	0.019149	92.15091	7.849089
13	0.019149	92.15090	7.849097
14	0.019149	92.15090	7.849100
15	0.019149	92.15090	7.849100
Cholesky Ordering: LNIFTYR LNIFTYBEESR			

**Table 4. Results of Forecast Error Variance Decomposition (FEVD) for Gold and Gold BeES**

Variance Decomposition of LGOLDR:			
Day	S.E.	LGOLDR	LGOLDBEESR
1	0.015663	100.0000	0.000000
2	0.015982	96.24724	3.752762
3	0.016053	96.16015	3.839852
4	0.016072	96.16853	3.831468
5	0.016099	95.86494	4.135058
6	0.016109	95.86494	4.135056
7	0.016112	95.83789	4.162114
8	0.016112	95.83140	4.168597
9	0.016113	95.83142	4.168578
10	0.016113	95.82844	4.171564
11	0.016113	95.82843	4.171571
12	0.016113	95.82819	4.171810
13	0.016113	95.82809	4.171911
14	0.016113	95.82809	4.171915
15	0.016113	95.82806	4.171945
Variance Decomposition of LGOLDBEESR:			
Day	S.E.	LGOLDR	LGOLDBEESR
1	0.010892	31.62077	68.37923
2	0.011849	37.11480	62.88520
3	0.011862	37.11925	62.88075
4	0.011879	37.29041	62.70959
5	0.011888	37.35617	62.64383
6	0.011898	37.45970	62.54030
7	0.011900	37.46497	62.53503
8	0.011900	37.46473	62.53527
9	0.011900	37.46486	62.53514
10	0.011900	37.46457	62.53543
11	0.011900	37.46482	62.53518
12	0.011900	37.46482	62.53518
13	0.011900	37.46482	62.53518
14	0.011900	37.46483	62.53517

15	0.011900	37.46483	62.53517
Cholesky Ordering: LGOLDR LGOLDBEESR			

The similar situation, however, does not exist in case of gold based ETF. As can be seen from Table 4 above, while forecast error variance in gold market is explained largely by its own innovations (from about 96% to 100% on various days), the innovations in Gold BeES play significant role in determining movements in gold ETF market. The innovations in market for underlying asset gold contributes to 31.62% of error variance in Gold BeES on day 1 which further increases upto 37.46% during subsequent days. On the other hand, its own innovations contribute about 62.54% to 68.38% of error variance in Gold BeES. This is in contrast with the observations made in case of ETF based on equity index above where the underlying asset is able to explain significant of variance in ETF.

#### 4.4. Impulse Response Functions

As stated earlier, the reactions of one market to shocks originating in other market can be traced in VAR framework using impulse response functions (IRFs). Fig.1 and Fig.2 in Appendix explain these reactions between market for ETF and market for underlying asset with respect to equity based and gold based ETFs respectively. As can be seen from Fig.1, the response of Nifty to its own shocks is 0.20 on day 1 and is reduced to zero around 6th day. Its response to shocks originating in ETF market is highly insignificant. However, the response of Nifty BeES to shocks in Nifty is instant and is marginally less than 0.20 on day 1 itself and is reduced to zero around 6th day with significant drop from day 2 onwards. Its response to its own shocks is very low at less than 0.05 on day 1. Thus shocks originating in Nifty are significant and quickly transmitted in Nifty BeES market. On the other hand, it can be seen from Fig.2 that the response of Gold BeES to shocks originating in its own market is higher (0.09) than that for shocks originating in underlying gold market (0.06), albeit marginally.

#### 5. Conclusion

From the above results and discussion it can be concluded that underlying asset does contribute to movements in prices in ETF market. However, significant difference exists between such contributions with respect to equity based ETFs and Gold based ETFs. A more closer relationship exists between Nifty and Nifty BeES as compared to that observed between physical gold prices and Gold BeES. Thus, returns on Nifty BeES may be closer to those on Nifty itself and therefore passive investment style may be advisable for investors dealing in Nifty BeES. On the other hand, investors need to monitor gold ETF market closely since developments in Gold ETF market itself rather than the underlying asset market, are found to be more significant in explaining movements in Gold BeES. Thus, here active investment style may be more useful. Future research can be directed towards identifying the factors influencing the returns on Gold ETF. These may be either the speculative behaviour of investors or macroeconomic fundamentals within the domestic or international territories.

#### 6. References

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## APPENDIX

### Response to Cholesky One S.D. Innovations $\pm 2$ S.E.

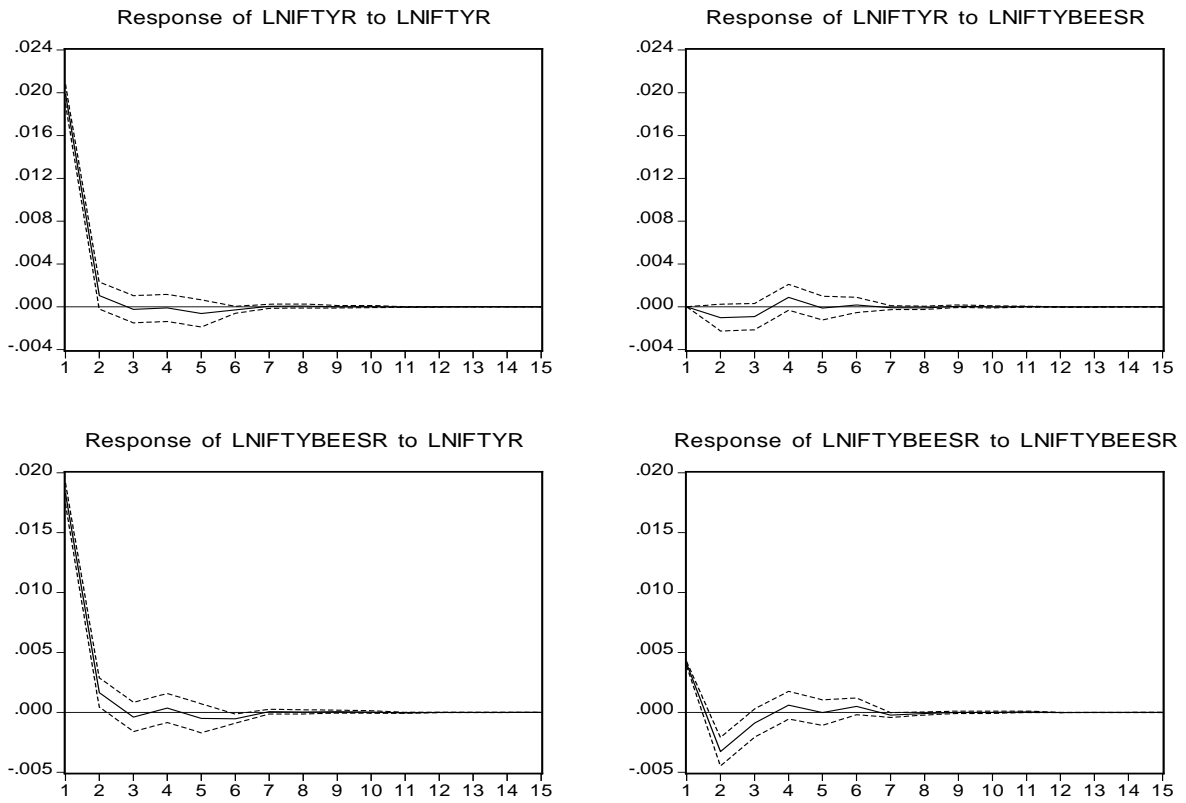


Fig.1.: Results of Impulse Response Function for Nifty and Nifty BeES

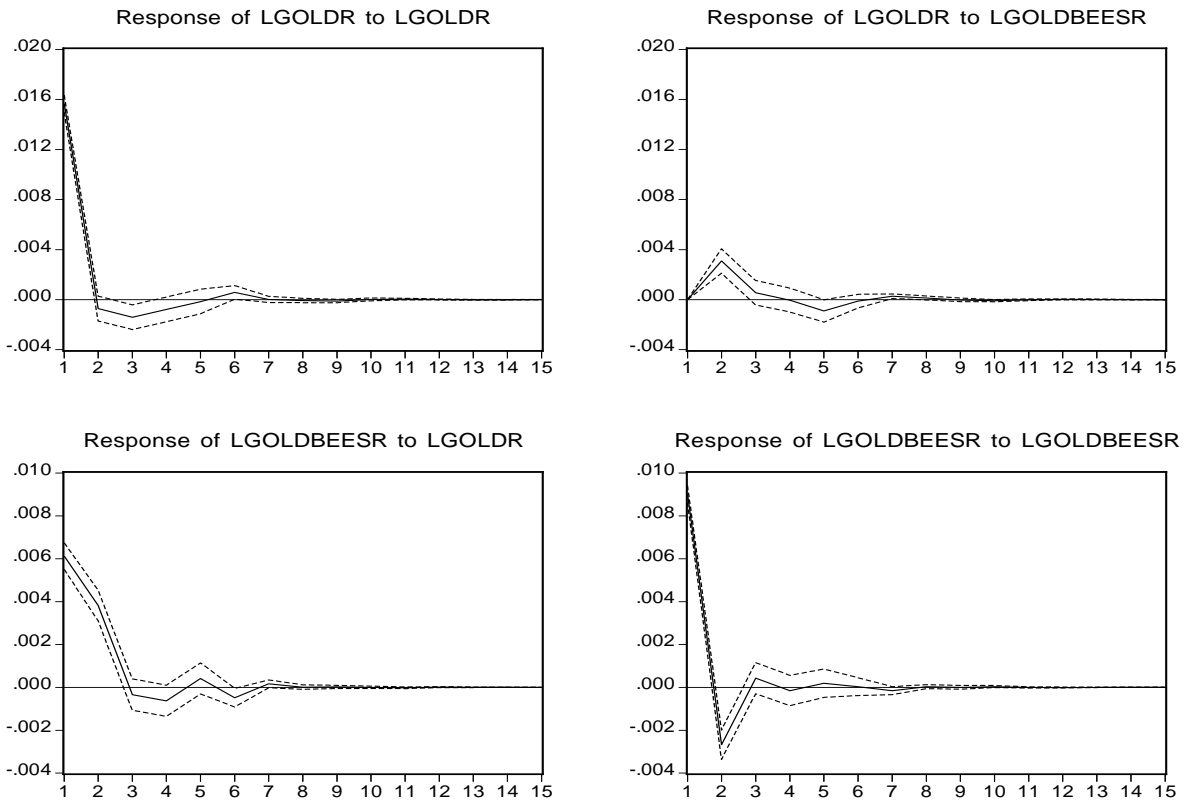


Fig.2.: Results of Impulse Response Function for Gold and Gold BeES