

# Evaluating Index Fund Performance and Measuring Tracking Error in India

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## Abstract

Exchange Traded Funds or popularly known as ETFs is very popular in foreign markets, but in India it is still at its initial growth phase. This paper examines the characteristics and performance indicators of all 40 exchange traded funds floated and traded on Indian stock market. The study reveals that on an average the ETFs coming under the index categories, reported better performance than Gold ETFs. Further, it was inferred that international ETFs were found to be most appropriate and efficient that traces the underlying benchmark more accurately.

**Key words:** Index Fund, Tracking Error

## Introduction

An index fund is like a mutual fund that invests in securities of the target or benchmark index in the same proportion or weightage of the securities as it bears to the target index or benchmark index. The investment objective of an index fund is to achieve returns in commensurate to that of the target index or benchmark index. While constructing an index fund, an investment manager attempts to replicate the investment results of the target index by holding all the securities in the same proportion as maintained by the target index. It is like making replica of the index in terms of type of securities, weightage etc. Even if index funds are designed to provide returns that closely track the benchmark index, they carry all the risks associated with the type of assets the funds holds. Indexing of the fund ensures that the return of the given fund will not stray far from the returns of the index that fund mimics. However, evidence indicates mismatch of the returns of the index with that of the fund. This mismatch or the difference in the returns of the index with that of the fund is known as tracking error.

Tracking error is defined as the annualized standard deviation of the difference in returns between the index fund and its target index. Therefore, it is required for an index fund manager to calculate tracking error on a daily basis especially when it is an open-ended fund. That is the reason lower the tracking error, closer are the returns of the fund to target index. Tracking error is always calculated against the total return index which measures the returns on the index portfolio, inclusive of dividend. To measure how closely the fund is tracking the index, depends on how close the weightage of stocks in the portfolio are to the weightage of the stocks in the index. Consequently, closer the

weightage of the stocks in the portfolio to the index, lower will be the tracking error. The factors that affect tracking error are inflows/outflows in the fund, corporate actions, change of index constituents and the level of cash maintained in the fund for liquidity purposes. Further, the costs that routinely get subtracted from fund returns expenses like transaction costs including brokers' commission, bid-ask spread etc get subtracted from the returns of the fund. Higher expenses incurred, greater will be the tracking error.

The concept and functioning of ETF is at the very nascent stage in India; while on an average, during 2006-2011, Indian ETFs comprised of only 1.4% of the total mutual fund industry assets. In comparison, in the US, ETF comprises of about 9% of the mutual fund industry. In 2001, Benchmark was the first company to launch the first ETF in India - Nifty BeES, which was listed on the NSE for trade. In 2007, Benchmark also launched the first Gold Exchange-Traded Fund.

AMFI categorizes ETFs in India into 4 categories:

- i) Fund of funds overseas (FOF Overseas);
- ii) Fund of funds domestic (FOF Domestic);
- iii) Gold ETFs;
- iv) Other ETFs.

### Literature Review

Jorion (2003) explored the risk and return relationship of active portfolios subject to a constraint on tracking-error volatility (TEV). The study reflected that tracking-error volatility TEV-constrained portfolios are described by an ellipse on the traditional mean-variance plane. This finding yielded a number of new insights. Because of the flat shape of this ellipse, adding a constraint on total portfolio volatility can substantially improve the performance of the active portfolio. In general, plan sponsors should concentrate on controlling total portfolio risk.

Honghui et al. (2006) in their research paper showed that index fund investors lose a significant amount because of the predictability and timing of index changes coupled with fund managers' objective of minimizing tracking error. Changes by indexing firms to remove the cause of loss to investors would be the most effective way of protecting fund investors from index arbitrage. To provide the necessary flexibility to fund managers, investors should rely on overall risk and return of the portfolio for performance evaluation instead of focusing on tracking error. Because advance knowledge of changes allows arbitrageurs to time those changes, they recommend that indexing firms reduce the predictability and advance knowledge of index changes as much as possible. In addition, the turnover associated with

index changes should be reduced to limit both the opportunity for arbitrage and the transaction costs associated with index changes.

Stein (1999) explained tracking error in more depth and helped investors to understand the concept and establish their performance expectations. Author also outlined Parametric's portfolio management policy on tracking a target benchmark. Further, research found out that one should be cautious about his estimates and in implementing portfolios. The research routinely re-evaluated and re-estimated the risk models, and used a variety of risk models based on alternative thought processes.

Saldanha (2013) found in a study that if the benchmark is appropriate then suitable tracking error boundaries will usually ensure that the portfolio is generally modeled along the same lines as the benchmark and failure to control tracking error within such bounds may indicate anomalous portfolio management behavior. From that point of view, it is another weapon in the risk manager's armory. An obvious point was that if the benchmark is inappropriate then tracking error is misleading and potentially damaging portfolio management device. The research concluded that for an active manager who is benchmark cognizant and who explicitly defines a suitable benchmark and an outperformance target, tracking error is a reasonable metric to consider. That is, provided it is utilized in conjunction with other metrics and the imposition of hard maximum (or minimum) tracking error limits is avoided. It is then the job of the risk manager to determine if measured tracking error outside of a desired range is appropriate.

Cai and Houge (2008) were the first among many existing available literatures in the given subject as their study is among the first to evaluate the long-term performance of index composition changes. They examined annual additions and deletions of the small-cap Russell 2000 from mid-1979 through 2004. Their results suggested that index construction methodology may provide a structural incentive for portfolio managers to drift or deviate from their benchmark styles. To the extent that portfolio managers are evaluated on the basis of their index-adjusted returns, this study highlights the importance of understanding how index rebalancing can also affect inferences about a fund manager's ability. Fund managers who outperform their benchmarks may not necessarily have exhibited skill at discovering underlying inefficiencies in the market; they may have exploited structural inefficiencies in the construction of their benchmarks.

Meade and Salkin (1989) noted that fund managers can passively invest in index funds and concentrate on actively managing the remainder of their funds. Their research went in detail at the use of statistical selection methods in the construction of index funds and the measurement of the

ability of these funds to track the underlying index and emphasis was placed on the relevance of the horizon of the investor to the choice of measure of tracking error. Four different methods of index-fund construction were described and applied to Japanese stock-market data. The analysis of the data demonstrated a rational approach to the choice of method for the construction of index funds. Namely, the imposition of the constraint of capitalization weighting led to a deterioration in performance. Similarly, the imposition of a stratification constraint led to a slightly greater deterioration in performance and the imposition of both constraints led to the worst overall performance.

Johnson et al. (2013) have examined the factors that influence tracking error and tracking difference, and applied metrics to a selected 65 Exchange Traded Funds (ETFs) to eight popular equity indices. They found that the ETFs they studied have done a very good job of limiting tracking error. ETFs using synthetic replication produced lower tracking error than those using physical replication. However, there was less of a direct relationship between tracking difference and a fund's replication method. They also found that tracking error and tracking difference can vary considerably over time and are very sensitive to the time horizon that is selected for their calculation.

Ananth et al. (2002) examined the issue of index rebalancing, focusing on the dramatic return movements associated with the change of the S&P 500 index composition on July 19, 2002 and replaced seven non-US companies with seven US companies. They examined the liquidity and return patterns in these 14 stocks following the announcement date on July 9, 2002. They showed that by adopting a trading strategy that spreads out trades in the period before the reconstitution date, trading costs can be dramatically reduced without bearing significant tracking error risk and these differences can significantly improve the net performance of investment funds. More generally, these results indicated that trading strategies that provide guaranteed market-on-close prices have hidden costs to investment managers.

Tucker (2011) in their research studied about how to define a concentrated fund, and how to identify whether it is really active or not and thus justifying active management fees. It showed that funds with high active share, high tracking error and, thus, high idiosyncratic risk had been found to have been more likely to outperform. Finally, the paper highlighted that alignment of interests between fund manager and investor is important, as is manager experience in ultimately choosing a concentrated fund.

Kostovetsky (2003) studied about explicit and implicit costs incurred by ETFs and compared to the costs of index mutual funds. The research developed a simple one-period model that was useful in examining the major differences between

ETFs and index funds, depending on investor trading preferences, tax implications, and other characteristics; and concluded that the key areas of difference between the two instruments are management fees, shareholder transaction fees, taxation efficiency, and other qualitative differences. It concluded that tracking error is difficult to model because there isn't a true benchmark for comparison.

Fernandes (2003) in his study looked at the performance of index funds in India and found that index management requires supreme care in data management – by fund managers in terms of providing daily NAVs, dividend and expenses related data, and by index providers in terms of providing a neat time-series of daily index values and impact cost data for various basket sizes. The study showed that incorrect handling of data can result in significant exaggerated values of tracking error. Using a comparable period of performance, researcher found that the tracking error for index funds in India ranges between 0.68% to 10.97%.

Assuming that an investor is interested in utilizing an index fund, the hurdle faced is that of tracking error. It is argued that in developing countries, where the equity market is illiquid, the tracking error of index funds can be fairly large, thus diminishing the benefits from indexation. It is the efficiency of the fund manager and his team to minimize the tracking error so that the returns of their fund is higher. An Index Fund with high tracking error is not preferred by the investors. As a result they may exit from the fund and it will affect the assets' size of the fund which again may affect the performance of the fund manager because he may be required to hire portion of his assets in liquid form to fulfill the redemption requisitions. Waghmare and Tatake (2012) in their paper attempted to focus on one important aspect of Index Funds i.e. Tracking Error and found that sometimes it can be observed that tracking error of a particular Index Fund is high because tracking error is high. It is like a vicious circle.

Veeraiah and Kumar (2014) analyzed the performance of Indian owned mutual funds and compared their performance. The performance of these funds was analyzed using a five year NAVs and portfolio allocation. Findings of the study reveals that, mutual funds out performs naive investment. Mutual funds as a medium-to-long term investment option are preferred as a suitable investment option by investors. The poor performance of many mutual fund schemes may be mostly attributed to the quality of personnel involved and their skill of fund management. Since, mutual fund has a different methodology for investment it should try to go for thorough product promotion.

K Raj Kumar (2011) studied trends and progress of ETFs and index funds in India and evaluated the performance of ETFs v/s index funds in India. The study was based on secondary data and covering the period of five years from 2005 to 2009 and found that ETFs have given better opportunity for the small investors in terms of diversified portfolio with a small amount of money; low expense ratio, reduced tracking error, lower risk and volatility as compared to index funds.

Ghosh et al. (2012) tried to look into the insight of the clear cut advantages of ETF and the various methods that could be adopted to make this unique instrument popular. Their findings suggested that ETFs are cost efficient, investor friendly investment vehicle without human bias. This concept is accepted in the developed world but still now not accepted in the developing world. As the retail investors lack channels to gather both relevant knowledge and information so ETF is a better option to replicate better risk adjusted return.

Prasanna (2012) examined the characteristics and growth pattern of all the 82 exchange traded schemes floated and traded on Indian stock markets, and evaluated their performance using Data Envelopment Analysis (DEA). Data Envelopment Analysis ranked domestic and overseas fund of funds as efficient funds, which were floated by foreign Asset Management Companies (AMCs) and the AMCs with joint ventures in India. Among the foreign AMCs, Franklin Templeton was found to offer the most efficient fund. These efficient funds are found to have higher Sharpe ratios, indicating that the DEA ranking is in broad consensus with the evaluation done using Sharpe ratios. However large funds were not found to be efficient funds. This infers that the fund size does not indicate superior performance.

Narend (2014) examined the performance of exchange traded funds and index funds since the period of their respective inception till July 2013 in terms of three parameters: a) tracking error b) active returns and c) Jensen's alpha. Overall, the study revealed that, in India, index funds have done better than ETFs in terms of a lower tracking error and a higher Jensen's alpha while ETFs have performed better in terms of active returns.

G. Sethu et al. (2002) in their study concluded that even if the fund manager invests only in the index, there are various reasons why tracking error would still be present. These factors include the quantum of units sold and repurchased, and the underlying index volatility. Their computations indicate substantial tracking error arising out of these uncontrollable factors.

## Research Methodology

### Motivation and Goals of the Study

The index fund industry is still at its nascent stage in India and therefore little is known about the extent of tracking error found in index funds. Further, as the sector itself is very young in India, relatively little data is available. Therefore, it is important to utilize this limited evidence in order to understand the limitations of indexing in India. The present paper helps in assessing the extent to which index fund deliver on their promise of exactly tracking the index. As of now, there is a lack of clarity on the extent to which index fund in India are able to accurately track the index. The present work produces some empirical facts on this evidence. Further, index fund may increasingly play a major role in public policy formulation. For instance, the Dave Committee has recommended that equity investments by pension funds should exclusively done using index funds. Similar application can be applied to insurance sector also. What is most important for us is to accurately measure tracking error in Indian context. The paper is concerned with measuring and understanding the tracking error of index fund in India. The paper addresses the following objectives.

### Objectives of the Study

- To check the tracking error of different Index Fund and its respective passive portfolio.
- To find out the flow of deviation between the market and passive portfolio return and risk.
- To understand the probable reasons for the same error happening in all the sample size.

### Research design: Descriptive And Exploratory Study

#### Sample size considered for the Study

- 14 Gold ETF
- 4 Banking ETF
- 19 Index ETF
- 1 Liquid ETF
- 2 International ETF

**Data Collection: Secondary data collected from [www.nseindia.com](http://www.nseindia.com) and [www.bseindia.com](http://www.bseindia.com).**

Period of the Study

From 17th December,2013 to 16th December,2014

By calculating the standard deviation of the difference in the portfolio and benchmark returns over time. The formula is as follows:

$$TE = \sqrt{\frac{\sum_{t=1}^n (R_t - R_{it})^2}{N-1}}$$

Where:

TE = Tracking Error  
 $R_p$  = Return of Manager or Fund  
 $R_b$  = Return of Benchmark  
 N = Number of Return Periods

## Descriptive Statistics

Various research instruments such as descriptive statistics consisting of mean, standard deviation, skewness and kurtosis etc; Kolmogorov-Smirnova test to check normality of the data was applied. Mean is the average value of the series, obtained by adding up the series and dividing by the number of observations. Standard deviation is known as the root mean square deviation for the reason that it is the square

root of the mean of the squared deviation from the arithmetic mean. It measures the absolute dispersion. Skewness is a measure of symmetry, or more precisely, the lack of symmetry. A distribution of a data set is symmetric if it looks the same to the left and right of the centre point. The skewness for a normal distribution is zero, and any symmetric data should have skewness near zero. Negative values for the skewness indicate that data that are skewed left and positive values for the skewness indicate that data that are skewed right. Kurtosis is more commonly defined as the fourth cumulated divided by then square of the variance of the probability distribution. For the data to be normal the condition is that mean, median and mode should be equal and skewness should be equal to 3 and kurtosis should be zero. The Jarque-Bera test is a [goodness-of-fit](#) test of whether sample data have the [skewness](#) and [kurtosis](#) matching a [normal distribution](#).

**Table 1 Descriptive Statistics**

ETF Scheme	Mean	S.D.	Kurtosis	Skewness	C.V.	Jarque-Bera	N
R* shares Nifty ETF	0.2332	2.9576	6.2546	1.0200	12.6820	393.1336	218
Birla Sun Life Nifty ETF-growth Fund	0.2140	2.0662	1.7468	-0.2164	9.6564	28.4734	211
Goldman Sachs s&p CNX Nifty	0.1783	3.3436	3.4860	0.1581	18.7496	111.2930	218
ICICI PRUDENTIAL NIFTY ETF	0.1859	2.9733	7.7799	0.4112	15.9956	591.6333	232
ICICI PRUDENTIAL CNX 100 ETF	0.2231	3.8226	4.7325	0.0752	17.1341	183.0933	196
R* shares consumption Fund	0.1596	4.6838	12.5520	1.6288	29.3467	931.9128	133
R* Dividend opportunity ETF	0.3321	5.0172	3.5577	0.6164	15.1089	62.0238	105
Canara Robeco MF GOLD ETF	-0.0967	1.2265	13.4264	-2.2488	-12.6863	918.9426	110
HDFC GOLD ETF	-0.0266	0.8230	10.3408	1.5759	-30.9107	1183.2711	243
IIFL NIFTY ETF	0.1373	1.5709	6.0520	0.8262	11.4450	396.8520	242
SBI GOLD ETF	-0.0400	0.7551	2.2180	0.1530	-18.8807	50.7565	243
R* CNX NIFTY FUND	0.1896	3.1217	8.7165	1.2285	16.4653	717.6151	210
QUANTUM INDEX-ETF	0.1391	0.8119	1.3579	-0.1898	5.8372	17.3962	210
ICICI PRUDENTIAL SPICE FUND	0.1939	2.6362	4.6352	1.5549	13.5932	36.3486	28
Quantum GOLD ETF	-0.0470	0.7740	2.8051	-0.3498	-16.4818	84.6233	243
KOTAK NIFTY ETF	0.1099	0.7570	1.0238	0.1326	6.8897	11.2794	242
GOLDMAN SACHS NIFTY ETF	0.1179	0.7819	1.3677	0.2950	6.6299	22.4667	243
GOLDMAN SACHS INFRA ETF	0.1112	2.4245	3.3371	0.6274	21.7975	127.1052	240
GOLDMAN SACHS MF-CPSE ETF	0.1351	1.6828	4.7609	1.1059	12.4517	191.7573	167
GOLDMAN SACHS NIFTY JUNIOR ETF	0.1583	1.2032	0.8385	-0.0553	7.5989	7.2431	243
GOLDMAN SACHS BANKING INDEX ETF	0.1947	1.3331	1.7186	0.3887	6.8478	36.0265	243
GOLDMAN SACHS GOLD ETF	-0.0475	0.7076	3.4026	0.0260	-14.9015	117.2511	243

<b>GOLDMAN SACHS GOLD ETF</b>	-0.0475	0.7076	3.4026	0.0260	-14.9015	117.2511	243
<b>KOTAL GOLD ETF</b>	-0.0473	0.7639	4.2915	0.7743	-16.1447	210.7468	243
<b>AXIS GOLD ETF</b>	-0.0455	0.9494	4.5200	0.6591	-20.8532	224.4530	243
<b>ICICI PRUDENTIAL GOLD ETF</b>	-0.0424	0.9740	1.4405	0.7069	-22.9474	41.2465	243
<b>MOTILAL OSWAL MOST SHARES M50 ETF</b>	-0.0014	2.3680	125.6704	-9.5328	-1730.7999	163585.0544	243
<b>MOTILAL OSWAL MOST SHARES NASDAQ 100 ETF</b>	0.0727	1.4399	7.3142	0.4868	19.7941	533.1105	<b>235</b>
<b>UTI GOLD ETF</b>	-0.0100	0.8355	4.0009	0.4980	-83.5289	172.1186	243
<b>BIRLA SUNLIFE GOLD ETF</b>	-0.0422	1.2557	1.0343	0.2252	-29.7696	12.7801	241
<b>RELIGARE INVESCO GOLD ETF</b>	-0.0444	1.1223	2.2588	0.4495	-25.2533	59.8431	243
<b>R* GOLD ETF</b>	-0.0464	0.8284	4.4483	0.7529	-17.8707	223.3035	243
<b>MOTILAL OSWAL MOST SHARES M100 ETF</b>	0.1946	1.4576	1.2295	-0.3199	7.4889	19.4499	243
<b>R*SHARES BANKING ETF</b>	<b>0.2485</b>	2.4015	7.6984	1.4555	9.6636	663.2743	235
<b>IDBI GOLD ETF</b>	-0.0459	1.0640	0.8384	-0.0738	-23.1618	7.3073	242
<b>GOLDMAN SACHS HANG SENG ETF</b>	0.0302	2.2976	2.1743	0.3944	76.0245	50.6027	227
<b>KOTAK MAHINDRA MF</b>	0.2080	1.8913	1.2163	0.1193	9.0925	15.4913	242
<b>GOLDMAN SACHS PSU BANK ETF</b>	<b>0.2393</b>	2.2940	4.5114	0.9196	9.5859	240.3169	243
<b>MOTILAL OSWAL MOST SHARES GOLD ETF</b>	-0.0510	0.9520	4.0372	0.8793	-18.6537	195.5363	242
<b>RELIGARE INVESCO NIFTY ETF</b>	0.2154	2.4912	3.9510	-0.7688	11.5679	110.0915	147

From the table 1 it can be inferred that data are not normally distributed. Further, it can be found that R\* Shares Banking ETF has provided highest mean return followed by GOLDMAN SACHS PSU BANK ETF and R\* shares Nifty ETF; whereas Canara Robeco MF GOLD ETF has reported lowest return during the analysis period. The risk as measured by standard deviation was found to be highest in R\* Dividend opportunity ETF followed by R\* shares consumption Fund and ICICI PRUDENTIAL CNX 100 ETF. Further, the result indicates that overall all gold ETFs have reported remarkably lowest mean return as compared to other fund categories. International ETFs have reported positive mean return during the analysis. Most ETFs shows positive skewness, indicating the returns do not have a long left tail. Values of Kurtosis more than 3 indicates that distribution was peaked relative to normal. Now before moving ahead, it is required to check whether given data are stationary or not and auto correlation exists in it or not. For that Augmented Dicky Fuller Test, Box-Ljung Statistic and Darwin-Watson test was applied.

Augmented Dickey-Fuller Test to check Stationary of the Data

Unit root test was used to examine whether the return series was stationary or not. For this purpose, the Augmented Dickey-Fuller (ADF) test was employed.

Where Null Hypothesis was assumed to be that data or series are not stationary and Alternative hypothesis was that data are stationary. This test reflects that if the data are stationary then it is fit for the further tests. Below shows the hypothesis framed to check whether data are stationery or not.

H0: The data or series of Index fund are not stationary

H1: The data or series of Index Fund are stationary

**Table 2 Augmented Dickey Fuller Test**

Sr. No.		Augmented Dickey - Fuller Test		Mackinnon critical Value
		t-Stat	P-value	
1	R* shares Nifty ETF	-20.775	0.000	1% level: - 3.471
2	Birla Sun Life Nifty ETF-growth Fund	-20.112	0.000	5% level: - 2.882
3	Goldman Sachs s&p CNX Nifty	-22.981	0.000	10% level: - 2.572
4	ICICI PRUDENTIAL NIFTY ETF	-19.888	0.000	
5	ICICI PRUDENTIAL CNX 100 ETF	-22.620	0.000	
6	R* shares consumption Fund	-23.071	0.000	
7	R* Dividend opportunity ETF	-15.465	0.000	
8	Canara Robeco MF GOLD ETF	-19.000	0.000	
9	HDFC GOLD ETF	-22.856	0.000	
10	IIFL NIFTY ETF	-17.359	0.000	
11	SBI GOLD ETF	-19.888	0.000	
12	R* CNX NIFTY FUND	-19.332	0.000	
13	QUANTUM INDEX-ETF	-18.816	0.000	
14	ICICI PRUDENTIAL SPICE FUND	-20.239	0.000	
15	Quantum GOLD ETF	-17.391	0.000	
16	KOTAK NIFTY ETF	-20.876	0.000	
17	GOLDMAN SACHS NIFTY ETF	-19.998	0.000	
18	GOLDMAN SACHS INFRA ETF	-21.654	0.000	
19	GOLDMAN SACHS MF-CPSE ETF	-19.443	0.000	
20	GOLDMAN SACHS NIFTY JUNIOR ETF	-20.389	0.000	
21	GOLDMAN SACHS BANKING INDEX ETF	-19.443	0.000	
22	KOTAK BANKING ETF	-21.234	0.000	
23	GOLDMAN SACHS GOLD ETF	-22.013	0.000	
24	KOTAL GOLD ETF	-23.004	0.000	
25	AXIS GOLD ETF	-22.543	0.000	
26	ICICI PRUDENTIAL GOLD ETF	-19.776	0.000	
27	MOTILAL OSWAL MOST SHARES M50 ETF	-18.567	0.000	
28	MOTILAL OSWAL MOST SHARES NASDAQ 100 ETF	-19.566	0.000	
29	UTI GOLD ETF	-20.877	0.000	
30	BIRLA SUNLIFE GOLD ETF	-21.764	0.000	
31	RELIGARE INVESCO GOLD ETF	-18.346	0.000	
32	R* GOLD ETF	-18.569	0.000	
33	MOTILAL OSWAL MOST SHARES M100 ETF	-19.456	0.000	
34	R*SHARES BANKING ETF	-19.997	0.000	
35	IDBI GOLD ETF	-23.098	0.000	
36	GOLDMAN SACHS HANG SENG ETF	-22.300	0.000	
37	KOTAK MAHINDRA MF	-22.560	0.000	
38	GOLDMAN SACHS PSUBANK ETF	-21.679	0.000	
39	MOTILAL OSWAL MOST SHARES GOLD ETF	-22.340	0.000	
40	RELIGARE INVESCO NIFTY ETF	-21.450	0.000	

(Source: Author's calculation)

The ADF test of all ETF showed that the t-statistics were less than the critical values at 1, 5 and 10% levels of significance. This confirmed that all the return series had unit root, thus rejecting the null hypothesis meaning the given data set are stationary.

After checking stationary of the data, next step is to apply Box-Ljung Statistic and Darwin-Watson test to check

autocorrelation and serial correlation in data.

The hypothesis to check autocorrelation tests are as follows:

- H0: There is no autocorrelation in ETF
- H1: There is autocorrelation in ETF

**Table 3 Box-Ljung Statistic**

ETF SCHEME	Lag	Autocorrelation	Box-Ljung Statistic	
			Sig. <sup>b</sup>	
RELNIFTY	1	-0.338	0.000	Ho is rejected
BSLNIFTY	1	-0.315	0.000	Ho is rejected
SHARIABEES	1	-0.421	0.000	Ho is rejected
INIFTY	1	-0.381	0.000	Ho is rejected
ICNX100	1	-0.468	0.000	Ho is rejected
RELCONS	1	-0.249	0.004	Ho is rejected
RELDIVOPP	1	-0.311	0.001	Ho is rejected
CRMFGETF	1	0.087	0.356	Ho is not rejected
HDFCMFGETF	1	-0.049	0.444	Ho is not rejected
IIFLNIFTY	1	-0.204	0.001	Ho is rejected
SBIGETS	1	-0.014	0.821	Ho is not rejected
RELCNX100	1	-0.432	0.000	Ho is not rejected
QNIFTY	1	0.117	0.087	Ho is not rejected
ISENSEX	1	-0.345	0.054	Ho is not rejected
QGOLDHALF	1	-0.111	0.083	Ho is not rejected
KOTAKNIFTY	1	0.129	0.044	Ho is rejected
NIFTYBEES	1	0.127	0.047	Ho is rejected
INFRABEES	1	-0.251	0.000	Ho is rejected
CPSEETF	1	0.15	0.050	Ho is rejected
JUNIORBEES	1	0.063	0.320	Ho is rejected
BANKBEES	1	0.03	0.636	Ho is not rejected
GOLDBEES	1	0.01	0.881	Ho is not rejected

KOTAKGOLD	1	0.028	0.661	Ho is not rejected
AXISGOLD	1	-0.218	0.001	Ho is rejected
IGOLD	1	-0.192	0.003	Ho is rejected
M50	1	0.043	0.504	Ho is not rejected
N100	1	-0.278	0.000	Ho is rejected
GOLDSHARE	1	0.067	0.290	Ho is not rejected
BSLGOLDETF	1	-0.252	0.000	Ho is rejected
RELIGAREGO	1	-0.324	0.000	Ho is rejected
RELGOLD	1	-0.13	0.042	Ho is rejected
M100	1	-0.087	0.171	Ho is not rejected
RELBANK	1	-0.321	0.000	Ho is rejected
IDBIGOLD	1	-0.279	0.000	Ho is rejected
HNGSNGBEES	1	-0.243	0.000	Ho is rejected
KOTAKPSUBANK	1	0.101	0.116	Ho is not rejected
PSUBANKBEES	1	-0.043	0.502	Ho is not rejected
MGOLD	1	-0.268	0.000	Ho is rejected
RELGRNIFTY	1	-0.24	0.003	Ho is rejected

(Source: Author's calculation)

From the Box-Ljung Statistic, it can be inferred that all data are not free from the effect of autocorrelation and out of 40; auto correlation exists for 16 index funds.

The Durbin-Watson test checks for serial correlation which indicates the likelihood that the deviation (error) values for the regression have a first order auto regressive component and the regression model assumes that the error deviations are uncorrelated. A number that tests for autocorrelation in the residuals from a statistical regression analysis. The

Durbin-Watson statistics is always between 0 and 4. A value of 2 means that there is no autocorrelation in the sample; while values approaching 0 indicates positive autocorrelation and values toward 4 indicate negative autocorrelation.

- H0: There is no serial correlation between errors(deviation)
- H1: There is serial correlation between errors(deviation)

**Table 4 Durbin –Watson Statistics**

ETF SCHEME	DURBIN WATSON <i>d</i> -value	ETF SCHEME	DURBIN WATSON <i>d</i> -value
GOLDSHARE	<b>1.912</b>	INFRABEES	2.592
CRMFGETF	1.979	IDBIGOLD	2.595
KOTAKGOLD	1.994	IIFLNIFTY	2.603
HDFCMFGETF	<b>2.001</b>	RELDIVOPP	2.605
M50	<b>2.01</b>	BSLNIFTY	2.621
GOLDBEES	2.034	RELIGAREGO	2.653
SBIGETS	2.073	M100	2.724
QGOLDHALF	2.252	RELNIFTY	2.729
RELGOLD	2.319	QNIFTY	2.772
BANKBEES	2.394	KOTAKNIFTY	2.781
RELCONS	2.409	JUNIORBEES	2.818
HNGSNGBEES	2.456	NIFTYBEES	2.83
IGOLD	2.457	INIFTY	2.847
AXISGOLD	2.465	SHARIABEES	2.859
RELIGARENIFTY	2.482	RELBANK	2.884
BSLGOLDETF	2.542	RELCNX100	2.895
N100	2.545	CPSEETF	2.896
MGOLD	2.552	ISENSEX	2.941
PSUBANKBEES	2.553	ICNX100	<b>2.95</b>
KOTAKPSUBANK	2.591		

(Source: Author's calculation)

**Tracking Error Calculation**

Tracking Error for the 40 ETF has been calculated to know the ETF which is performing its best and has generated

return very close as underlying benchmark. The data has been taken from 17 December, 2013 to 16 December, 2014:

**Table 5 Tracking Errors of ETFs**

Sr. No.	ETF Scheme	Tracking Error	Return	Risk	$\alpha$	Beta ( $\beta$ )
1	R* shares Nifty ETF	2.9421	0.2332	2.9576	0.1593	0.5732
2	Birla Sun Life Nifty ETF-growth Fund	2.2374	0.2140	2.0662	0.2111	0.0217
3	Goldman Sachs s&p CNX Nifty	3.3630	0.1783	3.3436	0.1330	0.4086
4	ICICI PRUDENTIAL NIFTY ETF	2.9012	0.1859	2.9733	0.0873	0.8133

5	ICICI PRUDENTIAL CNX 100 ETF	3.9077	0.2231	3.8226	0.2029	0.1462
6	R* shares consumption Fund	4.7697	0.1596	4.6838	0.1610	-0.0085
7	R* Dividend opportunity ETF	<b>4.9329</b>	0.3321	5.0172	0.2888	0.8239
8	Canara Robeco MF GOLD ETF	4.0875	-0.0967	1.2265	-0.0821	-0.1586
9	HDFC GOLD ETF	2.0221	-0.0266	0.8230	-0.0230	-0.1169
10	IIFL NIFTY ETF	1.5155	0.1373	1.5709	0.0636	0.6344
11	SBI GOLD ETF	1.9433	-0.0400	0.7551	-0.0375	-0.0794
12	R* CNX NIFTY FUND	3.1724	0.1896	3.1217	0.1510	0.2896
13	QUANTUM INDEX-ETF	0.5471	0.1391	0.8119	0.0455	0.7308
14	ICICI PRUDENTIAL SPICE FUND	1.5055	0.1939	2.6362	0.0704	1.0999
15	Quantum GOLD ETF	1.9477	-0.0470	0.7740	-0.0446	-0.0771
16	KOTAK NIFTY ETF	0.3636	0.1099	0.7570	0.0117	0.8458
17	GOLDMAN SACHS NIFTY ETF	<b>0.2413</b>	0.1179	0.7819	0.0097	0.9358
18	GOLDMAN SACHS INFRA ETF	2.3677	0.1112	2.4245	0.0607	0.5676
19	GOLDMAN SACHS MF-CPSE ETF	0.4830	0.1351	1.6828	0.0144	0.9390
20	GOLDMAN SACHS NIFTY JUNIOR ETF	0.7869	0.1583	1.2032	0.0310	0.8358
21	GOLDMAN SACHS BANKING INDEX ETF	0.5477	0.1947	1.3331	0.0116	0.9155
22	KOTAK BANKING ETF	0.5603	-0.6643	1.5189	0.2433	0.8715
23	GOLDMAN SACHS GOLD ETF	1.8728	-0.0475	0.7076	-0.0461	-0.0431
24	KOTAL GOLD ETF	1.9475	-0.0473	0.7639	-0.0448	-0.0797
25	AXIS GOLD ETF	2.0042	-0.0455	0.9494	-0.0436	-0.0628
26	ICICI PRUDENTIAL GOLD ETF	2.0920	-0.0424	0.9740	-0.0387	-0.1194
27	MOTILAL OSWAL MOST SHARES M50 ETF	2.1218	-0.0014	2.3680	-0.1611	1.3816
28	MOTILAL OSWAL MOST SHARES NASDAQ 100 ETF	1.6955	0.0727	1.4399	0.0721	0.0082
29	UTI GOLD ETF	1.9742	-0.0100	0.8355	-0.0076	-0.0788
30	BIRLA SUNLIFE GOLD ETF	2.1871	-0.0422	1.2557	-0.0397	-0.0797
31	RELIGARE INVESCO GOLD ETF	2.0299	-0.0444	1.1223	-0.0439	-0.0167
32	R* GOLD ETF	1.9664	-0.0464	0.8284	-0.0440	-0.0746
33	MOTILAL OSWAL MOST SHARES M100 ETF	1.1235	0.1946	1.4576	0.0358	0.8500
34	R*SHARES BANKING ETF	2.2822	0.2485	2.4015	0.1135	0.6526
35	IDBI GOLD ETF	2.1194	-0.0459	1.0640	-0.0427	-0.1049
36	GOLDMAN SACHS HANG SENG ETF	2.2584	0.0302	2.2978	0.0323	0.6062
37	KOTAK MAHINDRA MF	1.0744	0.2080	1.8913	0.0246	0.8065
38	GOLDMAN SACHS PSUBANK ETF	1.6294	0.2393	2.2940	0.0511	0.8313
39	MOTILAL OSWAL MOST SHARES GOLD ETF	1.9708	-0.0510	0.9520	-0.0499	-0.0359
40	RELIGARE INVESCO NIFTY ETF	2.6364	0.2154	2.4912	0.1844	0.1641

(Source: Author's calculation)

Table 5 shows the calculation of tracking error of the ETFs to know how the given ETFs traces the benchmark index whose replica was prepared. R\* Dividend opportunity ETF has reported highest tracking error meaning it has failed to replicate a benchmark to a maximum possible manner as it has incurred highest tracking error; while Goldman Sachs Nifty ETF has reported lowest tracking error showing its efficiency to be at par with the given index. Further, it was observed that gold ETFs were not good enough to track the index. It was also

decided to measure the performance of these ETFs based on other parameter named alpha. Alpha shows potential of a security or a portfolio which can generate positive return even if there is no movement at all in the market. Beta shows risk due to market and therefore the kind of risk which cannot be diversified away.

In order to test performance of ETFs, various indicators were applied named Sharpe's Measure, Treynor's Measure, Jensen's Measure, Information Ratio and M2 Measure.

**Table 6 Performance Indicator**

Sr. No	ETF Scheme	Sharpe's Measure	Treynor's Measure	Jensen's Measure	Information Ratio	M <sup>2</sup> Measure
1	R* shares Nifty ETF	0.071441126	0.368624853	0.149987297	0.054159852	-0.04719439
2	Birla Sun Life Nifty ETF-growth Fund	0.092951051	<b>8.841838736</b>	0.189639058	0.094342241	-0.03022414
3	Goldman Sachs s&p CNX Nifty	0.046779204	0.382827323	0.120054732	0.039553563	-0.0502374
4	ICICI PRUDENTIAL NIFTY ETF	0.05514548	0.201604173	0.083200491	0.030088887	-0.05373123
5	ICICI PRUDENTIAL CNX 100 ETF	0.052629248	1.376012207	0.184175905	0.051920179	-0.06582132
6	R* shares consumption Fund	0.02939584	-16.16577974	0.138852952	0.033745804	-0.11107104
7	R* Dividend opportunity ETF	0.061817843	0.376433228	<b>0.284899316</b>	0.058537237	0.04292489
8	Canara Robeco MF GOLD ETF	-0.096694822	0.747876056	-0.107488355	-0.020084567	-0.39818888
9	HDFC GOLD ETF	-0.058982519	0.415342176	-0.047467904	-0.011368478	-0.10723469
10	IIFL NIFTY ETF	0.073421753	0.181788785	0.055571366	0.041954434	-0.03561592
11	SBI GOLD ETF	-0.081990436	0.780047154	-0.061180972	-0.019309466	-0.14547588
12	R* CNX NIFTY FUND	0.053712576	0.578988021	0.135435657	0.047599944	-0.06477903
13	QUANTUM INDEX-ETF	0.144318494	0.160316873	0.03962029	0.08320791	0.02132732
14	ICICI PRUDENTIAL SPICE FUND	0.065251867	0.156397474	0.072580972	0.046756974	0.03860586
15	Quantum GOLD ETF	-0.088992194	0.893604508	-0.068166439	-0.022877978	-0.15711342
16	KOTAK NIFTY ETF	0.116190519	0.10399322	0.008280541	0.032069658	-0.0014335
17	GOLDMAN SACHS NIFTY ETF	0.122799238	0.102602807	0.008309418	0.04026308	0.00410083
18	GOLDMAN SACHS INFRA ETF	0.0368367	0.157335889	0.051267381	0.025655506	-0.01471515
19	GOLDMAN SACHS MF-CPSE ETF	0.067285383	0.120575549	0.013063283	0.029814096	0.00908347
20	GOLDMAN SACHS NIFTY JUNIOR ETF	<b>0.113381649</b>	0.163216671	0.027443444	0.039447823	-0.00445452
21	GOLDMAN SACHS BANKING INDEX ETF	<b>0.129590438</b>	0.188708782	0.009705816	0.021103144	-0.00532256

21	<b>GOLDMAN SACHS BANKING INDEX ETF</b>	<b>0.129590438</b>	0.188708782	0.009705816	0.021103144	-0.00532256
22	<b>KOTAK BANKING ETF</b>	-0.451787658	-0.787360338	0.240470712	0.434201468	0.28478468
23	<b>GOLDMAN SACHS GOLD ETF</b>	-0.098082738	1.612000777	-0.069005804	-0.024639547	-0.17222271
24	<b>KOTAL GOLD ETF</b>	-0.090632433	0.868124844	-0.068498769	-0.023020516	-0.15983965
25	<b>AXIS GOLD ETF</b>	-0.071040702	1.073298482	-0.066866679	-0.021739768	-0.12727646
26	<b>ICICI PRUDENTIAL GOLD ETF</b>	-0.066081901	0.539019476	-0.063262159	-0.018512499	-0.11903449
27	<b>MOTILAL OSWAL MOST SHARES M50 ETF</b>	-0.009833742	-0.01685491	-0.152769411	-0.075940445	-0.1015569
28	<b>MOTILAL OSWAL MOST SHARES NASDAQ 100 ETF</b>	0.03529844	6.21925377	0.05040001	0.042546114	-0.02030146
29	<b>UTI GOLD ETF</b>	-0.038205354	0.40527316	-0.031195578	-0.003825089	-0.07270121
30	<b>BIRLA SUNLIFE GOLD ETF</b>	-0.051046376	0.804238638	-0.063353053	-0.018146216	-0.09416253
31	<b>RELIGARE INVESCO GOLD ETF</b>	-0.059127861	3.966387856	-0.066206215	-0.021637879	-0.10747626
32	<b>R* GOLD ETF</b>	-0.082415356	0.915732076	-0.06758747	-0.022393934	-0.14618214
33	<b>MOTILAL OSWAL MOST SHARES M100 ETF</b>	0.118494114	0.203188005	0.032556666	0.031904578	-0.03337115
34	<b>R*SHARES BANKING ETF</b>	0.094354651	0.347235124	0.105927335	0.04975117	-0.05703241
35	<b>IDBI GOLD ETF</b>	-0.06377391	0.647100735	-0.066878222	-0.020129656	-0.11550406
36	<b>GOLDMAN SACHS HANG SENG ETF</b>	0.003614387	0.013696991	0.023692871	0.014311744	0.02870501
37	<b>KOTAK MAHINDRA MF</b>	0.09839186	0.230731278	0.020372643	0.022907778	-0.0098608
38	<b>GOLDMAN SACHS PSUBANK ETF</b>	0.094765374	0.261498092	0.047359468	0.031334616	-0.01653857
39	<b>MOTILAL OSWAL MOST SHARES GOLD ETF</b>	-0.076630857	2.034131006	-0.07262066	-0.025327545	-0.1369109
40	<b>RELIGARE INVESCO NIFTY ETF</b>	0.077647784	1.178900617	0.166113407	0.069957133	-0.08482644

(Source: Author's calculation)

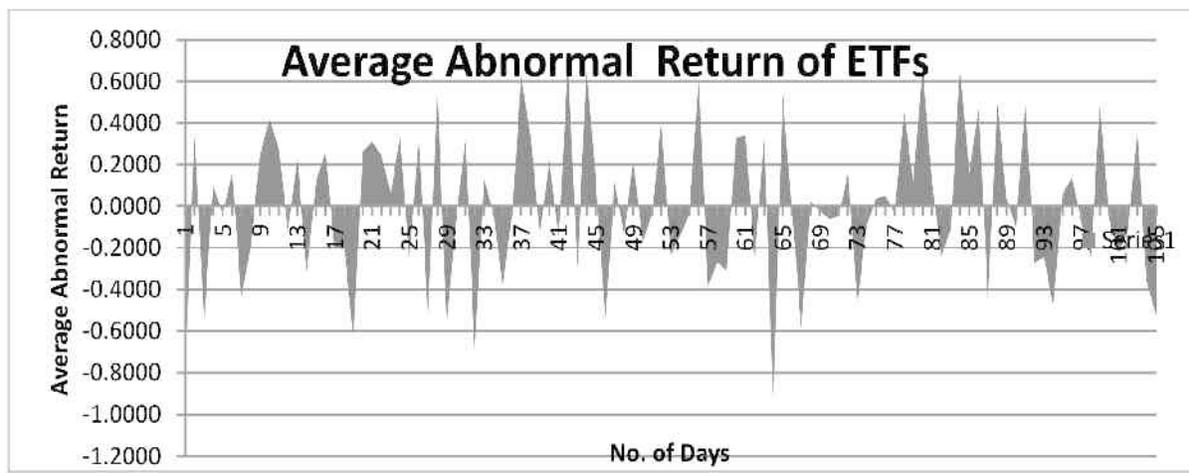
It is very ironical revealing from this table that almost all ETFs have negative or very poor Sharpe ratio. That means their return to volatility ratio  $(R_p - R_f) / \sigma_p$  is reasonably poor. Only GOLDMAN SACHS NIFTY JUNIOR ETF and GOLDMAN SACHS BANKING INDEX ETF have provided somewhat comparatively better Sharpe ratio. Comparing based on Treynor method  $(R_p - R_f) / \beta_p$  shows how much fund provides compared to risk free security. Treynor's method takes in to account systematic risk, while Sharpe method considers total risk while evaluating portfolio. Birla Sun Life Nifty ETF-growth Fund has shown highest performance as per Treynor method. Jensen method measures alpha of the portfolio; here R\* Dividend opportunity ETF has provided highest Jensen result.

### Abnormal Return of ETF

It is important to know the abnormal return provided by the ETFs as they are composed keeping in mind given benchmark index and so must be at par with the market at least. Here market model was applied to find out daily abnormal return and very surprising results were obtained. It can be revealed from the figure that for the period considered (here 105 days), abnormal return hovers around -0.7424 to 0.6764 and none of the ETFs have provided absolutely zero abnormal return on a single day.

Below the figure is displayed which shows Cumulative Abnormal return of ETF over 105 days of time horizon during 17 December 2013 to June 2014:

**Figure 1 Average Abnormal Return of ETF**



(Source: Author’s calculation)

**Table 7 Cumulative Abnormal Return (CAR)**

Event Window	CAR
From 1 to 3	-0.9609
From 1 to 10	-0.7061
From 1 to 15	-0.5151
From 1 to 30	-0.6246
From 1 to 45	0.7043
From 1 to 60	0.1029
From 1 to 75	-0.9625
From 1 to 90	1.3246
From 1 to 105	0.2408

(Source: Author’s calculation)

From the above table, it was observed that cumulative abnormal return provided by all the ETFs is negative for event date of 1 to 3 to till 1 to 30. Afterwards for a period of 1 to 45 to 1 to 60 days, it shows slight positive CAR and afterwards it shows zigzag pattern. The tendency of the CAR over a differ rent time window shows deviations of index fund from abnormal return of zero and thus represents room for tracking error.

**Major Findings and Conclusion**

While some funds show unacceptably high tracking error, the consistency in performance of the better run funds suggests that it is possible to attain fairly low levels of tracking error under Indian context. It can be inferred that Nifty and banking Index based funds found to be having lowest tracking error; while Gold ETFs didn't perform better in terms of mean return whereas, international ETFs found

to be most efficient. Most Nifty EFFs found to be efficient in this test.

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