



Measurement of Tracking Error Based on Category Index - The Hidden Cost of Index Funds

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Abstract: Purpose of the study: The paper aims at finding how effectively the index funds in India are being able to observe the strategy 'indexing', setting tracking error as the critical factor. Background of the study: The belief that financial markets are efficient and it is therefore impossible to consistently beat the aggregate market has led to the emergence of passive portfolio management and index funds. Less efforts have been directed towards measuring the effectiveness of index funds, as regards indexing strategy. This paper is written to fulfill this gap. Methodology: Broad category index has been used to measure the tracking error depicted by the index funds. Various formulae have been used to gauge the measure of tracking error. Results: Tracking error exhibited by the index funds are significantly higher than the level of tracking error, accepted globally. Findings: It is found that buffer cash for redemption pressure and higher management fees of the index funds in India, are the major factors contributing to higher level of tracking error.

Keywords: Tracking Error, Index Funds, Category Index, Passive Investment, India

1. Introduction

It is very difficult, even for highly valued fund managers to beat the market consistently, by obtaining active investment style. Investors who are keen to track the return of a popular index, left with little options due to resource constraints. An index fund which is a variant of mutual fund comes with the solution. Index fund is aimed at replicating the returns given by the benchmark index, set by the fund. It is possible for the fund, as it holds all the stocks (Equity Index Fund) in the same proportion constituting the benchmark index. By restoring to passive investment management style, index funds can keep its investment management costs and other costs on the lower side, making it an alluring avenue for those who want to have return of a popular index. Index funds do not suffer from disadvantages due to increase in fund size. They simply hold on to a market portfolio no matter how large it may get. To the extent the fund grows and new purchases need to be made, these can be done gradually over time through efficient means. Index funds can for instance, take on immediate exposure by buying index

futures so as not to miss on market movement while getting invested. The underlying index portfolio can then be gradually acquired by buying smaller baskets.

Theoretically there should be no difference in return

between index fund and that of its target index. But several factors contributing, it is often observed that index fund is giving lower return than the return of its benchmark index. The difference in return is known as Tracking Error. Monitoring the performance of an index fund boils down to simply observing its Tracking Error. Tracking Error summarizes the extent to which the index fund is able to accurately track the underlying index. Hence the endeavor of the index fund managers is to minimize tracking error. A good index fund is one which closely tracks the performance of the index and therefore exhibiting a very low tracking error. It is important to remember that tracking error is also used to measure the performance of actively managed funds. Chances of having positive Tracking error (excess return) for an index fund are remote.

2. Review of Literature

In the decade of 1960s, results of several studies showed that actively managed funds failed to provide significant excess returns consistently. Literature based on US markets widely confirms the inability of active mutual funds to outperform passive benchmarks such as the S&P 500 or the Wilshire 5000.

Friend et al (1962) had carried out research on the selected 152 mutual fund schemes and found the result that most of

the mutual fund schemes generated average 12.4% annually, which is quite near to the benchmark return of 12.6%. William F & Sharpe (1966), during the period 1944-63 measured the performance of 34 open ended schemes. They found Fund performance and expense ratio were indirectly or inversely related to each other. The study by Dickson & Shoven (1995) revealed that Index funds have an outright tax advantage over actively managed funds. By not trading from security to security, they minimize taxes by deferring or avoiding capital gains. The first index fund could be traced back to 1972. As per the report, commissioned by Barclays Global Investors indexed assets totaled over \$1.5 trillion, by end of the year 2000. Gupta and Choudhary (2000), in their study pointed out that index funds have gained acceptance among investors because it was found that fund managers often did worse than the manipulation, speculation and insider trading. There was no effective regulation and control as in the USA and the UK. Fernandes (2003) evaluated index fund implementation in India and measured the tracking error exhibited by properly managed index funds. The results suggested the possibility of attaining low levels of tracking error under Indian conditions. Narend (2014), made a comparative analysis of the performance ETFs and index funds. The results showed that index funds with S&P BSE SENSEX and CNX Nifty as their benchmark index, underperformed the underlying index, resulting in tracking error. The study concluded the significant effect of higher management fees and transaction costs on tracking error of index funds. The results also revealed lower correlation coefficient (r) of index funds than its beta (β), indicating variance of returns of index funds are lower than variance of returns of their underlying index.

3. Data and Methodology

The index funds with underlying index of both CNX Nifty and SENSEX have been considered for the study. The selection of funds under study to gauge the measure of tracking error, are based on investors' perception of well managed funds. Secondary data have been collected from the website www.morningstar.in, to evaluate tracking error and other critical measures. Past three years data as of 23, June, 2015, have been used for computation of measures like Beta (β) & Coefficient of Determination (R^2).

Various formulae have been utilized to analyze tracking error and the related factors:

- i) Tracking Error Standard Deviation [TESD] = $\sqrt{1/n-1 \sum [y_t - \bar{y}]^2}$: To interpret the extent of tracking error exhibited by the index funds.
- ii) Beta [β] = $COV_{pm}/\sigma_m^2 = [(COV_{pm}) / (\sigma_m * \sigma_p)] * [\sigma_p/\sigma_m] = r * [\sigma_p/\sigma_m]$ and Correlation coefficient [r] = $(COV_{pm}) / (\sigma_m * \sigma_p)$: To gauge the variance of returns of the index funds and the variance of returns of underlying index.

4. Tracking Error Defined

Tracking error is defined as the annualized standard deviation of the difference in returns between the index fund

and its target index. Tracking error is calculated on a daily basis for an open end index fund. At the very first step, returns of the fund (using percentage change in NAV) and target return index are calculated for each day over its previous day. Then difference in return between the fund and target return index is obtained:

$$Y_t = r_t - b_t \quad (1)$$

[Where Y_t is the Tracking error at any point in time t , r_t is the return of the fund and b_t is the return of the corresponding benchmark]

The most commonly used measure summarizing tracking error is *Tracking Error Standard Deviation* (TESD). This is calculated as:

$$[TESD] = \sqrt{1/n-1 \sum [y_t - \bar{y}]^2} \quad (2)$$

[For sample size n , \bar{y} is the mean difference between index fund and benchmark index]

Annualized TESD are mostly used to make comparison easier using constant multiplier depending upon the time period of calculation. Corporate actions (e.g. dividend payment) are always incorporated while calculating tracking error. Tracking error indicates how closely the index fund is tracking the benchmark index. Closer the weightage of the stocks in the portfolio to the index, lower will be the tracking error.

5. Estimation of Tracking Error

Tracking Error of an index fund can be either 'ex-post' or 'ex-ante'. Ex-post tracking error is also called 'realized' tracking error, as it is based on observed or historical data. In contrast an ex-ante measure is predictive in nature. Ex-post tracking error is used to gauge the historical performance of an index fund where as ex-ante models are helpful for the fund managers to control risk. There are various types of ex-ante tracking error models. Most commonly used models use linear regression equations taking suitable risk factors (e.g. β) to form predictions.

Alpha (α), Beta (β), Coefficient of Determination (R^2) and Index Funds

The term alpha (α) simply means the predictive ability of a fund manager. Jensen has used basic model to measure the predictive ability of a fund manager for a given level of risk (β).

$$R_p = \alpha + R_f + \beta(R_m - R_f) + e_t \quad (3)$$

[R_p is the return of the fund, α is the Intercept that measures the predictive ability, R_f is the Risk free rate of return, β measures systematic risk & R_m is the return of market portfolio i.e benchmark index & e_t is the error term]

If the fund manager is able to generate higher returns than the expected return explained by risk level (β) through successful prediction, will generate positive α . Fund managers are priced highly for crating positive α . Beta (β) is an indicator of a fund's (security) systematic risk and it depicts quantum of changes in fund's (security) return due to unit changes in index (market) returns.

Coefficient of Determination (R^2) is an important measure for selection of index funds and it is expressed as a percentage. R^2 is not an absolute measure of performance,

$$\text{Beta } [\beta] = \text{COV}_{pm} / \sigma_m^2 = [(\text{COV}_{pm}) / (\sigma_m * \sigma_p)] * [\sigma_p / \sigma_m] = r * [\sigma_p / \sigma_m] \quad (4)$$

$[\sigma_m^2$ is the variance of benchmark (Category Index) return, σ_m is the SD of benchmark (Category Index) returns, σ_p is SD of fund return, r is the Correlation Coefficient]

There are two types of index funds on the basis of pattern of indexing-i) fully Replicated Index Funds and ii) Sampled Index Funds. Fully replicated funds hold all the constituents of its benchmark index in the same proportion as held in the index. In contrast, sampled funds try to replicate the return of its target index by selecting sample from the index. It is done to reduce the establishment and maintenance cost. For a fully replicated index fund, we would observe: a) a highly stable beta (β) which is very close to, but less than 1, b) Coefficient of Determination (R^2) nearing 100 percent, c) alpha (α) of roughly 0 and d) negligible error variance (Tracking error). Whereas, in case of a sampled fund there may not be a) close to 1 highly stable beta (β), b) Coefficient of Determination (R^2) close to 100 percent and there are possibilities of having c) positive or negative alpha (α) [rarely positive], d) tracking error. These facts can be verified with the results of several empirical tests conducted. It is possible for a fully replicated index funds to do perfect indexation with the remainder after maintaining buffer cash (for redemption), resulting in negligible tracking error. By default presence of active management due to sampling technique, results in significant tracking error for a sampled index fund.

6. Reasons of Tracking Error

There are several reasons for an index fund to underperform or in rare occurrences out perform their benchmark index:

Cash balance: An open end index fund has obligation for redemption requests. This entails the fund to have some cash cushion. Ideally an index fund should have full corpus invested in the underlying index to mimic the index return. Setting aside cash for redemption and for managing inflows into the fund makes less than 100 percent investment in the index. To the extent an index fund maintains buffer cash, induces tracking error.

Expenses of Funds: Returns of a fund is calculated from changes in NAV. Investment management fess and other recurring expenses are charged against the average net asset of a fund. In addition to this a fund has to incur transaction costs at the time of purchase and sale of securities. These expenses are met out the corpus of the fund. So due to transaction costs lead to less investment than collections, resulting in tracking error.

Incorporating dividends: Equity Index returns calculation assumes that dividends are paid on ex-date and are reinvested immediately. There is a substantial time lag between dividend declaration and dividend payment. Hence, Index funds receive money well after ex-date. Due to this delay in receipt of dividend an index fund suffers cash drag and will lag the

but shows the relationship fund's returns to its benchmark index returns-as r (Correlation Coefficient) of an index fund sets up linear relationship with benchmark index.

index in a rising market, inducing tracking error. This ex-date story holds true for other corporate actions (rights, bonus, conversion, etc.) as well.

Volatility of the benchmark index: If an index fund is perfectly aligned with the benchmark index, the volatility of the underlying index will not result in tracking error. In case of a sampled index fund, if the portfolio of the fund does not perfectly mirror the index, volatility of the underlying index inevitably results in tracking error.

Use of sampling strategy: If an index fund uses sampling strategy, it will not buy all the stocks within the benchmark index. Sampled index funds are characterized by this sampling strategy. Due this sampling strategy sampled index funds are bound to have larger than normal tracking error.

7. Index Funds in India and Tracking Error

World famous investors like Warren Buffet and Benjamin Graham have opined in favour of index funds. The Dave Committee on pension reforms in India has recommended that pension funds in India should exclusively use index funds for equity investments. Though index funds in India have grown in terms of number of schemes during the last few years and the strategy 'indexing' is being used for public policy formulation, yet the index funds and indexing have not gained the popularity that it should have, as compared to the other developed countries. In fact in the US market the largest mutual funds schemes are index funds schemes. The possible reason could be that in the US and in other developed countries index funds are far more indicative of the broader market, which is not the case in India. There are two indices available BSE-Sensex and NSE-Nifty representing thirty and fifty stocks respectively. So the very objective of indexing is not properly reflected through Indian index funds. Now the question is - what is the good number as regards tracking error of index funds? As discussed earlier, an ideal index fund is one that has zero tracking error.

Practically it is next to impossible to find an index fund with zero tracking error. Internationally 0.5% is the acceptable number in terms of tracking error of index funds. Most of the Indian index funds have crossed the accepted level and quite a few of them have even crossed 2% mark. Reasons that could be attributed are high level of cash holding due to pressure of redemption and higher expense ratio of the index funds schemes.

The table below shows a snapshot of the tracking error of popular index funds schemes in India. Calculations as regards tracking error, beta and R Squared have done on the basis of category index to reflect the objective of indexing.

Table 1. Tracking Error, β and R^2 of Index Funds.

Scheme	Category Index	Benchmark Index	Tracking Error(%)	Beta(β)	R Squared (R^2)
UTI Nifty Fund Growth	BSE 100	CNX Nifty	1.78	0.96	98.42
HDFC Index Nifty	BSE 100	CNX Nifty	1.85	0.95	98.33
HDFC Index Sensex	BSE 100	BSE SENSEX	2.88	0.89	96.25
ICICI Prudential Index	BSE 100	CNX Nifty	1.75	0.95	98.52
Tata Index Nifty Option A	BSE 100	CNX Nifty	1.82	0.96	98.34
Tata Index Sensex Option A	BSE 100	BSE SENSEX	2.86	0.90	96.17
Franklin India Index Fund NSE Nifty Plan Growth	BSE 100	CNX Nifty	1.90	0.95	98.25
Principal Index Fund-Nifty-Growth	BSE 100	CNX Nifty	1.79	0.95	98.44
Reliance Index Nifty Growth	BSE 100	CNX Nifty	1.76	0.96	98.45
Reliance Index Sensex Growth	BSE 100		2.83	0.89	96.41

Sources: morningstar. in, Data used as of 23,june,2015.

8. Conclusions & Suggestive Remarks

All the index funds depicted higher Coefficient of Determination (R^2) than their Beta (β), signifying that the individual index funds are less volatile than underlying category index. Studies conducted using underlying benchmark index, showed mixed results as regards volatility of returns of index funds and the benchmark index. Index funds are suitable for those who want to capture the return of the market and do not have the resources to choose an actively managed fund or to actively manage their own portfolio. An ideal index fund should provide cost advantage by way of reduced expenses and transaction costs, tracking error should also be kept at the minimum level. Unlike active managers, who make no promises about future returns, index funds promise to replicate the returns of a publicly observable index. If the index rises by 20%, and if the index funds reports 19% returns, then the investor is entitled to be suspicious about how one percent of returns were lost. Index fund management is a challenge because of this level of scrutiny and accountability.

In India some of the best managed index funds exhibit unacceptable level of tracking error that results in substantial hidden cost of passive investment. Buffer cash for redemption substantially induces tracking error, by making $\beta \neq 1$ to the extent of buffer cash. In such a situation, index futures can be used to get exposure to the underlying index and keeping the β in line with the β of the market. By taking position in the futures market, tracking error caused by delays between ex-dividend date and pay date can also be combated. The bottom line is that tracking error should be brought down to the acceptance level so that the objective

‘indexing’ is properly reflected through index funds.

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