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# MEASURING THE EFFICIENCY OF INDEX FUNDS: EVIDENCE FROM INDIA

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## Abstract

This study aims to analyse the technical efficiency of Index funds using data envelopment analysis (DEA) and to assess the reasons for inefficiency. Based on secondary data collected from the annual reports of the Association of Mutual Funds in India, this study examined the efficiency performance of the top Index funds available to Indian investors from the year 2018 to 2022 using radial measurers (BCC) of data envelopment analysis. The results show that the average efficiency of Index funds was 83.04 percent during the study period, and the average efficiency of index funds was almost stable during the study period. Only 10 percent of the index funds operated efficiently during the study period. The least amount of slack was found in the input "expense ratio". This reiterates that investment risk is the cause of the funds' inefficiency and not the associated expenses. This study is the first of its kind that has assessed the efficiency of the Indian index funds and therefore holds important insights for regulators, policymakers, and practitioners.

**Keywords:** Data envelopment analysis, technical efficiency, Index funds, Mutual Funds, India

**JEL Codes:** D24, L23, L25

## 1. Introduction

A mutual fund is a pool of funds that are professionally managed by a fund manager. A trust that invests money in stocks, bonds, money market instruments, and/or other securities after collecting funds from a group of investors who have similar investment objectives. A scheme's Net Asset Value (NAV) is the income/gains earned from this collective investment, after deducting all necessary expenses and levies. The NAV per unit of a mutual fund scheme acts as a performance indicator. Indian mutual fund industry is doing good in all types of funds. The Indian Mutual Fund Industry's average assets under management (AAUM) was recorded as INR 36,983,270 million in June 2022. The AUM of the Indian mutual fund industry has increased by more than 5.5 times in ten years, from INR 6.80 trillion on April 30, 2012, to INR 38.04 trillion on April 30, 2022. The AUM of the mutual fund industry has increased from INR 19.26 trillion on April 30, 2017, to 38.04 trillion by April 30, 2022, a nearly two-fold increase in just five years.

The industry's AUM achieved the INR 10 trillion mark for the first time in May 2014, and in less than three years, the AUM has increased more than twofold, passing the INR 20 trillion mark for the first time in August 2017. The AUM of the Indian mutual fund industry crossed INR 30 trillion for the first time in November 2020. The Industry's AUM was 38.04 trillion rupees on April 30, 2022. The mutual fund sector reached a milestone of 100 million folios. There were 131.3 million accounts with around 104.7

million folios under Equity, Hybrid, and Solution Oriented Schemes (AMFI, 2022). The Association of Mutual Funds in India (AMFI) is a nodal organization that monitor the performance of mutual funds all over the country. Regarding mutual funds and investments, AMFI offers important information and insights. The Association of Mutual Funds in India (AMFI) is dedicated to the advancement of the mutual fund sector in India along lines of professionalism, ethics, and morality. In order to protect and advance the interests of mutual funds and the individuals who hold their units. There are currently 43 Asset Management Companies registered with SEBI, making up its membership (AMFI, 2022).

Indian Mutual funds are actively and passively managed by fund managers. An actively managed fund is a mutual fund in which the fund manager 'actively' manages the portfolio and regularly monitors the fund's portfolio by using professional judgment, supported by analytical research, to decide which stocks to buy, sell or hold. The fund manager's goal with an active fund is to maximize returns and achieve the fund's benchmark. In contrast, a passively managed fund merely copies the market index. In a passive fund, the fund manager is inactive or passive because he or she does not use judgment or expertise to decide which stocks to buy, sell, or hold. A low-cost, low-maintenance mutual fund that tracks the price movements of a stock market index is known as an index fund. An Index fund is a type of passive investment that replicates the performance of a market benchmark or 'index'. The Fund Manager does not actively choose industries or stocks to include in the fund's portfolio; instead, the Fund Manager merely invests in all the stocks that make up the index to be followed. The fund's stock weighting closely reflects the weighting of each stock in the index. It is a passive investment in which the fund management builds the fund's portfolio by copying the index and attempting to maintain the portfolio in sync with the index at all times (AMFI).

The first index mutual fund was introduced by the company named Vanguard in the year1976. This first index investment was a fund that tracked the S&P 500 Index. This fund, later, was renamed as the Vanguard 500 Index Fund. The S&P 500 is a market capitalization-weighted index that includes the 500 largest US companies. This means, that a company's total free-float outstanding shares are multiplied by its price, and the larger the value, the bigger the stock's weight in the index, and it's as easy as that. The Nifty and Sensex use the same approach with minor exceptions in India. The IDBI Principal was the first asset management company (AMC) to launch an index mutual fund that tracked the Nifty. Later, this plan was renamed as Principal Nifty 100 Equal-Weight Fund. Nifty bees, an index exchange-traded fund that tracks the Nifty 50, was launched by Benchmark AMC in the early development years. The details of top Indian index funds are given in table 1.

To assess the performance of mutual funds, a considerable number of studies have evaluated efficiency of different types of funds. Efficiency is defined as the choice of alternatives which produces the largest outputs with the application of given resources. Efficiency calculates a fund's performance in relation to the best operating fund's performance. To the best of our knowledge of the existing literature, there are only two studies, conducted by Prasanna (2012) and Sharma and Sharma (2018) using the application of DEA in the performance evaluation of the Indian mutual funds. Prasanna (2012) evaluated efficiency of the exchange-traded funds whereas, Sharma and Sharma (2018) evaluated efficiency of open-ended mutual funds (diversified/ large cap funds). Our study is the first it's type to measure the efficiency of the index funds in India using data envelopment analysis. This study investigates the performance of Indian index funds for the period of 2017-18 to 2021-22. This study fills the gap by extending literature on the performance evaluation of index funds in India.

The article is further organized as follows: the second section covers the review of literature on the various studies which have studied the efficiency and productivity of mutual funds and studied the effect of different factors on it. The third section describes the objectives of the study followed by the 'Methodology' section which describes the source of data, sample frame, the rationale for choosing the DEA approach, and empirical models used in this study. The fifth section analyses the results. This section also discusses the findings. The 'Conclusion' section describes the conclusion of the study followed by managerial implications and limitations of the study.

**Table 1: Asset under management (AUM) under various index funds (amount in Rs million; 1 million = Rs. 1,000,000)**

| Sr.no. | Fund | 2018 | 2109 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| 1 | UTI - NIFTY Index Fund-Growth Option-Direct | 3,874.44 | 7,575.46 | 13,721.34 | 25,614.88 | 47,720.60 |
| 2 | HDFC Index Fund-NIFTY 50 Plan - Direct Plan | 1,292.27 | 3,501.70 | 7,273.68 | 17,309.91 | 33,171.67 |
| 3 | HDFC Index Fund-Sensex Plan - Direct Plan | 427.44 | 1,436.25 | 4,885.73 | 13,925.05 | 22,436.54 |
| 4 | ICICI Prudential Nifty Index Fund - Direct Plan Cumulative Option | 1,349.98 | 1,830.35 | 3,368.09 | 9,408.09 | 19,313.02 |
| 5 | HDFC Index Fund-NIFTY 50 Plan - Growth Plan | 1,924.55 | 2,125.62 | 3,502.88 | 8,334.42 | 15,288.20 |
| 6 | SBI NIFTY INDEX FUND - DIRECT PLAN-GROWTH | 1,649.75 | 2,657.91 | 3,993.80 | 6,752.04 | 14,218.52 |
| 7 | UTI - NIFTY Index Fund- Regular Plan - Growth Option | 1,910.25 | 2,400.32 | 3,797.17 | 7,307.78 | 13,415.31 |
| 8 | ICICI Prudential Nifty Next 50 Index Fund - Direct Plan-Growth | 929.52 | 2,437.79 | 4,230.72 | 6,527.80 | 13,213.19 |
| 9 | HDFC Index Fund-Sensex Plan - Growth Plan | 589.78 | 1,642.33 | 2,984.29 | 5,421.37 | 8,102.62 |
| 10 | ICICI Prudential Nifty Index Fund - Cumulative Option | 1,648.96 | 1,817.60 | 2,194.79 | 3,896.31 | 6,734.12 |
| 11 | ICICI Prudential Nifty Next 50 Index Fund - Growth | 654.46 | 1,192.28 | 2,001.00 | 3,290.47 | 5,943.59 |
| 12 | ICICI Prudential Sensex Index Fund - Direct Plan - Cumulative Option | 13.22 | 69.91 | 424.94 | 1,539.61 | 3,779.24 |
| 13 | Franklin India Index Fund- Nifty Plan-Growth | 1,598.56 | 1,644.92 | 1,798.10 | 2,469.70 | 2,778.32 |
| 14 | Nippon India Index Fund - Nifty Plan - Direct Plan Growth Plan - Growth Option | 571.38 | 564.66 | 709.47 | 1,456.40 | 2,245.46 |
| 15 | Aditya Birla Sun Life Nifty 50 Index Fund - Growth - Direct Plan | 1,167.59 | 977.87 | 844.35 | 1,461.79 | 2,178.07 |
| 16 | Nippon India Index Fund - Nifty Plan - Growth Plan - Growth Option | 700.28 | 716.48 | 782.00 | 1,514.16 | 2,176.24 |
| 17 | Nippon India Index Fund - Sensex Plan - Direct Plan Growth Plan - Growth Option | 14.07 | 79.77 | 329.13 | 975.17 | 1,956.62 |
| 18 | Tata Index Fund - Nifty-Direct Plan | 41.99 | 57.40 | 151.14 | 671.80 | 1,465.41 |
| 19 | Franklin India INDEX FUND NIFTY PLAN - Direct - Growth | 288.18 | 363.52 | 606.16 | 1,009.38 | 1,310.14 |
| 20 | IDBI NIFTY Index Fund Growth | 1,326.43 | 1,418.55 | 1,300.94 | 1,632.30 | 1,230.95 |
| 21 | ICICI Prudential Sensex Index Fund - Cumulative Option | 13.43 | 38.00 | 165.45 | 528.72 | 975.91 |
| 22 | Aditya Birla Sun Life Nifty 50 Index Fund - Growth - Regular Plan | 248.39 | 268.36 | 407.94 | 715.86 | 963.51 |
| 23 | Tata Index Fund - Nifty-Regular Plan | 67.67 | 86.84 | 92.98 | 476.50 | 893.24 |
| 24 | Tata Index Fund - Sensex- Direct Plan | 15.74 | 47.84 | 92.89 | 353.16 | 849.19 |
| 25 | IDBI NIFTY Index Fund Growth Direct | 649.35 | 672.83 | 733.40 | 934.95 | 798.76 |
| 26 | UTI Nifty Index Fund - Direct Plan - IDCW | 1,429.96 | 1,098.89 | 514.51 | 379.07 | 511.97 |
| 27 | Nippon India Index Fund - Sensex Plan - Growth Plan - Growth Option | 27.45 | 58.30 | 136.38 | 315.55 | 499.83 |
| 28 | Franklin India INDEX FUND NIFTY PLAN - IDCW | 355.54 | 334.32 | 329.54 | 402.12 | 430.61 |
| 29 | IDBI Nifty Junior Index Fund Growth | 353.18 | 357.77 | 338.60 | 332.50 | 368.13 |
| **Total** | | **2,51,337.89** | **3,74,738.17** | **617,112.97** | **1,249,568.47** | **22,49,689.78** |

*(Source: Annual Report AMFI, 2022)*

## 2. Literature Review

Lin & Liu (2021) used multiplier dynamic data envelopment analysis based on the directional distance function to analyse mutual funds. This model was applied to evaluate the performance of mutual funds in the American market. In this study, the researcher extended the multiplier dynamic data envelopment analysis (DEA) by using directional distance functions (DDF). Siddiqui (2021) evaluated the efficiency of Indian pension funds using the BCC model of data envelopment analysis and the reasons of inefficiency. He also explored the main drivers of efficiency using Tobit regression in the Indian pension funds. Terol et al. (2021) measured the overall efficiency of socially responsible investment and conventional mutual funds by a diversification-consistent DEA model. The proposed approach was illustrated with real data of 144 French MFs and 31 marketed as socially responsible investment MFs. This study presented an application of DEA-based approaches to assess the relative financial and nonfinancial efficiency of Mutual funds. This approach measured the corporate sustainability of the MFs from the rating process carried out by social agencies on the constituent firms.

Hsieh et al. (2020) used a two-stage network data envelopment analysis model to analyse the decision quality and capital management efficiencies of 155 mutual funds in Taiwan for the period 2007-2016. The empirical results showed that fund managers improved their decision quality, but their capital management efficiency decreased. This study also found that 10 mutual funds were performing in decision quality and capital management efficiencies, from which practical suggestions are provided to investors. Tsolas (2020) used a series of two-stage modelling approach for the performance evaluation of precious metal mutual funds. The study evaluated 62 precious metal mutual funds (PMMFs) and explained performance differences between them using weighted additive data envelopment analysis (DEA) and Tobit regression, respectively.

Lu et al. (2019) conducted a network data envelopment analysis with consideration of dynamism to gauge the internal management efficiency and investment performance of 37 investment trust companies in Taiwan. Lina and Li (2019) used directional distance function and diversification DEA models to evaluate the performance of mutual funds in the American market. Galagedera et al. (2018) assessed the overall and stage-level performance of 298 U.S. equity Mutual from inception dates to prior January 2006. Two types of linkages were considered, and a composite measure was produced to measure the overall performance of internal resource use. Andreu et. al (2018) evaluated the efficiency of mutual fund managers using a unique slacks-based manager efficiency index (SMEI).

Galagedera et al. (2017) measured the performance appraisal of U.S equity mutual funds by using the DEA model. Premachandra et al. (2012) analysed the relative performance, especially at the institutional level, using the traditional data envelopment analysis (DEA) models. In this study, a novel two-stage DEA model based on two components was used to analyse the relative performance of 66 large mutual fund families over the period 1993-2008. By decomposing the operations management and portfolio management components of the overall efficiency, the study revealed the best performers, the families which declined in performance, and those which improved over the sampling period. In Indian studies, Prasanna (2012) examined the characteristics and growth trends of 82 exchange-traded funds that were floated and traded on Indian stock exchanges during the period 2006-11. He evaluated the performance using Data Envelopment Analysis (DEA). He found domestic and overseas fund of funds as efficient. However, large funds were not found efficient by him. Sharma and Sharma (2018) evaluated the efficiency of 33 Indian open-ended equity funds for the period 2008-09 to 2012-13. They found an average efficiency score of 88.64 percent in the year 2012-13.

OBJECTIVES: The main objectives of this study are to assess the efficiency of Indian Index funds and to explore the main drivers of inefficiency, and check whether it confirms or contrasts the past findings.

## 3. Data and Methodology

Data for this study has been taken from the annual report of the Association of Mutual Funds in India (AMFI), for the period from 2017-18 to 2021-22. The majority of mutual fund efficiency studies employed mean returns as the output variable and risk (total or systematic), fees, and minimum initial investment as the input factors (Sedzro and Sardano, 1999; Morey and Morey,1999; Choi and Murthi, 2001; Sengupta and Zohar, 2001; Basso and Funari, 2001, Sharma and Sharma, 2018). Return of funds is a common result in DEA research, whereas risk (standard deviation, beta) and expenditure ratio (management fees, administrative expenses) are common inputs (Daraio and Simar, 2006). Annualized fund returns are expense-adjusted returns. The fund's total risk is represented by the standard deviation of returns, but the fund's volatility is represented by the beta coefficient (systematic risk). Even after diversification, systematic risk cannot be mitigated or eliminated (Sharpe, 1966). This study has used return as an outcome variable and standard deviation, beta, and expense ratio as input variables, as in prior studies. Our study's input and output variables are listed in table 2.

**Table 2: Descriptive Statistics for Index Fund (2018 to 2022)**

| Year | | SD | Beta | Expense Ratio | Return |
|---|---|---|---|---|---|
| **2017-18** | **Minimum** | 0 | 0 | 0.0009 | 0.0346 |
| | **Maximum** | 0.1676 | 4.3308 | 0.0130 | 0.1394 |
| | **Average** | 0.1186 | 2.7372 | 0.0065 | 0.1009 |
| | **SD** | 0.0350 | 0.8743 | 0.0043 | 0.0212 |
| **2018-19** | **Minimum** | 0.0648 | 0 | 0.0009 | 0 |
| | **Maximum** | 0.1676 | 4.3308 | 0.0130 | 0.1394 |
| | **Average** | 0.1265 | 6.5943 | 0.0072 | 0.3689 |
| | **SD** | 0.0297 | 1.5936 | 0.0039 | 0.0891 |
| **2019-20** | **Minimum** | 0.1621 | 0.8423 | 0.0009 | 0 |
| | **Maximum** | 0.1676 | 4.3308 | 0.0130 | 0.1394 |
| | **Average** | 0.1709 | 0.9099 | 0.0053 | 0.0115 |
| | **SD** | 0.0107 | 0.0304 | 0.0033 | 0.0105 |
| **2020-21** | **Minimum** | 0.3012 | 0.8771 | 0.0009 | 0.6254 |
| | **Maximum** | 0.1676 | 4.3308 | 0.0130 | 0.1394 |
| | **Average** | 0.3318 | 1.0866 | 0.0055 | 0.7596 |
| | **SD** | 0.0155 | 0.0671 | 0.0032 | 0.0430 |
| **2021-22** | **Minimum** | 0.2038 | 0.9028 | 0.0015 | 0.1695 |
| | **Maximum** | 0.1676 | 4.3308 | 0.0130 | 0.1394 |
| | **Average** | 0.2276 | 1.2976 | 0.0053 | 0.2139 |
| | **SD** | 0.0213 | 1.5439 | 0.0023 | 0.1737 |

Data envelopment analysis (DEA) is a linear programming-based technique for assessing the relative performance of organizational units where comparisons are difficult due to the existence of various inputs and outputs. The constant Return to Scale (CCR) model, Variable Return to Scale (VRS) model, Stochastic Data Envelopment Analysis (SDEA) model, and non-parametric Stochastic Frontier Estimation are some of the DEA models. DEA is a multi-factor productivity analysis methodology for determining the relative efficiency of a set of homogeneous decision-making units (DMUs). DEA identifies a collection of efficient DMUs for each inefficient DMU, which can be used as standards for improving performance and productivity. The Constant Return to Scale (CRS) model and the Variable Return to Scale (VRS) model are the two scales of assumptions used to produce DEA. The model suggested by Charnes, Cooper, and Rhodes (1978) had an input orientation and assumed continuous returns to scale (CRS). Banker, Charnes, and Cooper (1984) proposed a variable return to scale (VRS) model to assess alternate sets of assumptions. The study of DEA begins with a description of the input-oriented CRS model, which was the first to be used widely. This research uses the input-oriented BCC model to determine the VRS (BCC) scores for the years 2015 through 2019.

### 3.1 CCR and BCC Input-oriented Models

It is required to use the BCC-DEA model when employing the ratio form of DEA. Assume that there are n mutual funds and that each mutual fund produces s outputs from m inputs. Let $x_{ik}$ be the amount of $i^{th}$ input consumed by the $k^{th}$ Index fund, $y_{rk}$ be the amount of $r^{th}$ output created by $k^{th}$ the Index fund, $u_{ik}$ be the weight assigned to the $k^{th}$ Index fund's $i^{th}$ input, and $v_{rk}$ be the weight assigned to the $k^{th}$ Index fund's $r^{th}$ output. The $k^{th}$ Index fund's efficiency can thus be expressed as;

$$\theta_k = \frac{\sum_{r=1}^{s} v_{rk} y_{rk}}{\sum_{i=1}^{m} u_{ik} x_{ik}} \qquad k = 1,2\ldots\ldots\ldots, n$$

Where, $q_k \hat{I} [0,1]$

The CCR fractional program may be written as follows;

$$Max \quad q_k = \frac{\sum_{r=1}^{s} v_{rk} y_{rk}}{\sum_{i=1}^{m} u_{ik} x_{ik}}$$

$$s.t \quad \frac{\sum_{r=1}^{s} v_{rk} y_{rj}}{\sum_{i=1}^{k} u_{ik} x_{ij}} £ 1$$

$$u_{ik} v_{rk} ³ 0, \quad " _i = 1,2,\ldots\ldots,m, \quad r = 1,2,\ldots\ldots,s, \quad j = 1,2,\ldots,n$$

After normalizing the numerator of the previous model, we obtain the multiplier model that is shown below.

$$Max \quad \theta_k = \sum_{r=1}^{s} v_{rk} y_{rk}$$

$$s.t \quad \sum_{i=1}^{m} u_{ik} x_{ik} = 1$$

$$\sum_{r=1}^{s} v_{rk} y_{rj} - \sum_{i=1}^{m} u_{ik} x_{ik} \leq 0 \quad \forall_j = 1, 2, ....., n$$

$$u_{ik} v_{rk} \geq 0, \quad \forall_i = 1, 2, ....., m, \quad r = 1, 2, ....., s, \quad j = 1, 2, ...., n$$

The input oriented CCR model, often known as the dual of the aforementioned linear programming (envelopment form), can be explained as follows:

$$Min \quad q_k = f_k - \varepsilon \left( \sum_{i=1}^{m} s^-_{ik} + \sum_{r=1}^{s} s^+_{rk} \right)$$

$$s.t \quad \sum_{j=1}^{n} \lambda_{jk} x_{ij} + s^-_{ik} = f_k x_{ik} \qquad \forall_i = 1, 2, ....., m,$$

$$\sum_{j=1}^{n} \lambda_{jk} y_{rj} - s^+_{rk} = y_{rk} \qquad \forall_r = 1, 2, ....., s,$$

$$\lambda_{jk}, s^-_{ik}, s^+_{rk} \geq 0 \qquad \forall_i = 1, 2, ....., m; j = 1, 2, ....., n; r = 1, 2, 3, ....., s,$$

Where, $f_k$ is unrestricted in sign, $\varepsilon$ is non-Archimedean constant, $\lambda_{jk}$ is the dual variable corresponding to the $j^{th}$ constraint and is known as intensity variable, $s^-_{ik}$ is the slack in the $i^{th}$ input of the $k^{th}$ Index Fund, and $s^+_{rk}$ is the slack in the $r^{th}$ output of the $k^{th}$ Index Fund. On imposing the condition $\sum_{j=1}^{n} \lambda_{jk} = 1, \quad \forall_j = 1, 2, 3, ....., n,$ in the above model, it becomes the input-oriented BCC model.

The examination of DMUs has utilized a variety of frontier models. A fund is called efficient if efficiency score is equal to 1 otherwise it is called inefficient fund. The researchers have utilized both parametric and non-parametric approaches to compare performance. Using DEA-CCR and BCC output-oriented models, Mogha et al. (2014; 2016) assessed the technical effectiveness of Indian hospitals in the private and public sectors. Using a DEA-based dual CCR model, Mogha (2020) assessed the performance of academic departments at a few selected private institutions in India. The examination of DMUs has utilized a variety of frontier models. The researchers have utilized both parametric and non-parametric approaches to compare performance. Using DEA-CCR and BCC output-oriented models, Mogha et al. (2014; 2016) assessed the technical effectiveness of Indian hospitals in the private and public sectors hospital of India using DEA-CCR and BCC output-oriented models. Using a DEA-

based dual CCR model, Mogha (2020) assessed the performance of academic departments at a few selected private institutions in India by using a DEA-based dual CCR model.

The fundamental characteristic of data envelopment analysis is that it is unit invariant, meaning that it does not depend on the units of the input and output variables (Russell, 1988). Pastor and Lovell (1995) assert that the BCC-DEA model is scale-invariant for either the input or the output variables, but not for both. According to Hollingsworth and Smith (2003), the nature of the given data makes the use of ratios necessary because they more properly reflect the production function in DEA than absolute numbers. When ratios are employed as input and output variables, they are advised to use the BCC-DEA model. Therefore, this study adopted the radial (BCC- DEA model, Banker et al., 1984) model of data envelopment analysis due to the nature of the available data. DeaR software, R version 3.6, is used to calculate efficiency estimates.

## 4. Result and Discussion

We have obtained results of the top Indian index funds based on AAUM for the last five-year period from the financial year (F.Y.) 2017–18 to 2021-22 using the specified inputs and outputs. Table 3 clearly shows that only 3 out of 29 Index funds were fully efficient in the year 2017–18. The outcome demonstrates that there was a considerable variation in the efficiency scores of Index funds, with the standard deviation being 25.07% and the average efficiency score for Index funds being 0.486. The ICICI Prudential Sensex Index Fund - Cumulative Option, Franklin India Index Fund- Nifty plan-IDCW, and IDBI Nifty Junior Index Fund were fully efficient, while ICICI Prudential Nifty Next 50 Index Fund - Direct Plan-Growth had the lowest efficiency score of 0.248 during this period.

For the F.Y. 2018-19 table 3, column 4 shows that a total of four Index funds were fully efficient namely Tata Index Fund - Nifty-Direct Plan, ICICI Prudential Sensex Index Fund - Cumulative Option, Franklin India INDEX FUND NIFTY PLAN – IDCW, and IDBI Nifty Junior Index Fund Growth and achieved the first rank, while ICICI Prudential Nifty Next 50 Index Fund - Direct Plan-Growth were least efficient with a score of 0.724. The outcome demonstrates that there was a considerable variation in the efficiency scores of Index funds, with the standard deviation being 8.88%. The average efficiency score for Index funds was 0.8408 this year.

For the FY 2019-20 table 3, Column 5 shows that only three Index funds were fully efficient viz. Tata Index Fund - Nifty-Direct Plan, Tata Index Fund - Sensex- Direct Plan, and Nippon India Index Fund - Sensex Plan - Growth Plan - Growth Option and achieved a score of 1. While ICICI Prudential Nifty Next 50 Index Fund – Growth had the lowest efficiency score of 0.9123 this year. The outcome demonstrates that there was a slight variation in the efficiency scores of Index funds, with the standard deviation being 2.25%. The average efficiency score for Index funds was 0.9676 this year.

For the FY 2020-21 table 3, column 6 shows that only one Index fund was fully efficient, IDBI Nifty Junior Index Fund Growth achieved a score of perfect 1. While Tata Index Fund - Nifty-Direct Plan achieved the lowest efficiency score of 0.805 this year. The outcome demonstrates that there was a slight variation in the efficiency scores of Index funds, with the standard deviation being 4.09%. The average efficiency score for Index funds was 0.9098 this year.

For the FY 2021-22 table 3, column 7 shows that the total of seven Index funds was fully efficient viz. ICICI Prudential Sensex Index Fund - Direct Plan - Cumulative Option, IDBI NIFTY Index Fund Growth, ICICI Prudential Sensex Index Fund - Cumulative Option, Tata Index Fund - Sensex- Direct Plan, Nippon India Index Fund - Sensex Plan - Growth Plan - Growth Option, Franklin India INDEX FUND NIFTY PLAN – IDCW, IDBI Nifty Junior Index Fund Growth. While IDBI NIFTY Index Fund Growth Direct had the lowest efficiency score of 0.6320. The outcome demonstrates that there was a slight variation in the efficiency scores of Index funds, with the standard deviation being 6.55%. The average efficiency score for Index funds was 0.9478 this year.

**Table 3: The Technical Efficiency Score of Index Funds (2018-2022)**

| Sr. no. | Fund | Eff18 | Eff19 | Eff20 | Eff21 | Eff22 | AVG | SD |
|---|---|---|---|---|---|---|---|---|
| 1 | UTI - NIFTY Index Fund-Growth Option- Direct | 0.32 | 0.78 | 0.95 | 0.89 | 0.93 | **0.773** | **0.235** |
| 2 | HDFC Index Fund-NIFTY 50 Plan - Direct Plan | 0.32 | 0.78 | 0.95 | 0.89 | 0.93 | **0.775** | **0.235** |
| 3 | HDFC Index Fund-Sensex Plan - Direct Plan | 0.31 | 0.78 | 0.98 | 0.94 | 0.96 | **0.793** | **0.254** |
| 4 | ICICI Prudential Nifty Index Fund - Direct Plan Cumulative Option | 0.34 | 0.78 | 0.97 | 0.90 | 0.93 | **0.784** | **0.23** |
| 5 | HDFC Index Fund-NIFTY 50 Plan - Growth Plan | 0.33 | 0.79 | 0.95 | 0.90 | 0.94 | **0.78** | **0.234** |
| 6 | SBI NIFTY INDEX FUND - DIRECT PLAN-GROWTH | 0.33 | 0.79 | 0.95 | 0.89 | 0.93 | **0.777** | **0.23** |
| 7 | UTI - NIFTY Index Fund- Regular Plan - Growth Option | 0.32 | 0.78 | 0.95 | 0.89 | 0.93 | **0.775** | **0.235** |
| 8 | ICICI Prudential Nifty Next 50 Index Fund - Direct Plan-Growth | 0.25 | 0.72 | 0.92 | 0.97 | 0.95 | **0.762** | **0.271** |
| 9 | HDFC Index Fund-Sensex Plan - Growth Plan | 0.31 | 0.78 | 0.98 | 0.94 | 0.97 | **0.796** | **0.254** |
| 10 | ICICI Prudential Nifty Index Fund -Cumulative Option | 0.34 | 0.78 | 0.97 | 0.90 | 0.93 | **0.785** | **0.23** |
| 11 | ICICI Prudential Nifty Next 50 Index Fund - Growth | 0.26 | 0.73 | 0.91 | 0.97 | 0.95 | **0.763** | **0.268** |
| 12 | ICICI Prudential Sensex Index Fund - Direct Plan - Cumulative Option | 0.96 | 0.99 | 0.99 | 0.83 | 1.00 | **0.956** | **0.062** |
| 13 | Franklin India Index Fund- Nifty Plan-Growth | 0.37 | 0.80 | 0.97 | 0.91 | 0.96 | **0.803** | **0.226** |
| 14 | Nippon India Index Fund - Nifty Plan - Direct Plan Growth Plan - Growth Option | 0.33 | 0.78 | 0.97 | 0.90 | 0.93 | **0.782** | **0.234** |
| 15 | Aditya Birla Sun Life Nifty 50 Index Fund - Growth - Direct Plan | 0.36 | 0.80 | 0.98 | 0.91 | 0.94 | **0.798** | **0.228** |
| 16 | Nippon India Index Fund - Nifty Plan - Growth Plan - Growth Option | 0.36 | 0.79 | 0.97 | 0.91 | 0.98 | **0.801** | **0.232** |
| 17 | Nippon India Index Fund - Sensex Plan - Direct Plan Growth Plan - Growth Option | 0.30 | 0.78 | 1.00 | 0.95 | 0.97 | **0.8** | **0.26** |
| 18 | Tata Index Fund - Nifty-Direct Plan | 0.34 | 1.00 | 1.00 | 0.81 | 0.94 | **0.815** | **0.25** |
| 19 | Franklin India INDEX FUND NIFTY PLAN - Direct - Growth | 0.35 | 0.79 | 0.97 | 0.91 | 0.94 | **0.793** | **0.229** |
| 20 | IDBI NIFTY Index Fund Growth | 0.41 | 0.80 | 0.98 | 0.90 | 1.00 | **0.816** | **0.217** |
| 21 | ICICI Prudential Sensex Index Fund - Cumulative Option | 1.00 | 1.00 | 0.99 | 0.84 | 1.00 | **0.964** | **0.064** |
| 22 | Aditya Birla Sun Life Nifty 50 Index Fund - Growth - Regular Plan | 0.45 | 0.84 | 0.98 | 0.91 | 0.95 | **0.829** | **0.193** |
| 23 | Tata Index Fund - Nifty-Regular Plan | 0.52 | 0.86 | 0.97 | 0.92 | 0.95 | **0.845** | **0.168** |
| 24 | Tata Index Fund - Sensex- Direct Plan | 0.55 | 0.86 | 1.00 | 0.96 | 1.00 | **0.875** | **0.171** |
| 25 | IDBI NIFTY Index Fund Growth Direct | 0.69 | 0.91 | 0.96 | 0.89 | 0.63 | **0.817** | **0.129** |
| 26 | UTI Nifty Index Fund - Direct Plan - IDCW | 0.79 | 0.92 | 0.96 | 0.89 | 0.94 | **0.9** | **0.058** |
| 27 | Nippon India Index Fund - Sensex Plan - Growth Plan - Growth Option | 0.89 | 0.97 | 1.00 | 0.95 | 1.00 | **0.962** | **0.042** |
| 28 | Franklin India INDEX FUND NIFTY PLAN - IDCW | 1.00 | 1.00 | 0.97 | 0.91 | 1.00 | **0.977** | **0.034** |
| 29 | IDBI Nifty Junior Index Fund Growth | 1.00 | 1.00 | 0.93 | 1.00 | 1.00 | **0.985** | **0.03** |
| | **Average** | **0.49** | **0.84** | **0.97** | **0.91** | **0.95** | **0.83** | **0.19** |
| | **SD** | **0.25** | **0.09** | **0.02** | **0.04** | **0.07** | **0.07** | **0.078** |
| | **Minimum** | **0.25** | **0.72** | **0.91** | **0.81** | **0.63** | **0.762** | **0.03** |
| | **Maximum** | **1.00** | **1.00** | **1.00** | **1.00** | **1.00** | **0.985** | **0.271** |
| | **Total Efficient Fund** | **3.00** | **4.00** | **3.00** | **1.00** | **7.00** | | |
| | **Total Inefficient Fund** | **26.00** | **25.00** | **26.00** | **28.00** | **22.00** | | |

The trend of efficiency scores of Indian Index Funds is shown in figure 1. It swings sharply downwards in 2018 before recovering in the following years and falling again in 2021. Efficient funds are shown in figure 2. Out of all index funds, the IDBI Nifty Junior Index Fund Growth has been found fully efficient for four years. The inefficient funds with the lowest scores are represented in figure 3. The ICICI

Prudential Nifty Next 50 Index Fund - Direct Plan - growth was inefficient in the two years of 2018 and 2019. The results show that the average efficiency of Index funds was 83.04 percent, and that average efficiency levels in this industry were generally stable for the last four years of the study.

Table 4 shows the relative mean slacks (Murthi et al., 1997). It measures the difference between the absolute average slack of input across all funds and the average input value across all funds. The marginal impact of inputs used inefficiently by fund managers is identified by relative mean slacks. The aforementioned table makes it clear that the relative mean slacks in the years 2021–22 were the least and contributed to the efficient frontier being reached by 24.14 percent of Index funds. The highest total during the time of our analysis was that. The relative average slack in the expense ratio for the years 2017–18, 2018–19, and 2019–20 was zero, while larger slacks were seen in the standard deviation. Similar to this, in 2020–21 there was zero relative average slack in the expense ratio, but there was more slack seen in the beta. Although there was relative mean slack in the expense ratio for the financial year 2019-20, 10.34% of the total Index funds were found to be efficient. This was larger than the 3.45 percent observed in the financial year 2020–21 when there was zero relative mean slack in the expense ratio. The "mean-variance efficiency hypothesis" is supported by many studies (Sengupta and Zohar, 2001; Sengupta, 2003; Siddiqui, 2021). According to this hypothesis, the associated risk is the cause of the funds' inefficiency not the associated expenses.

**Table 4: Relative Mean Slacks (2018-22)**

| Year | Standard Deviation | Beta | Expense Ratio | % Age of efficient fund |
|---|---|---|---|---|
| 2107-18 | 0.6821 | 0.000 | 0.031 | 10.34 |
| 2018-19 | 0.6623 | 0.000 | 0.000 | 13.79 |
| 2019-20 | 0.5732 | 0.000 | 0.004 | 10.34 |
| 2020-21 | 0.8367 | 0.065 | 0.000 | 3.45 |
| 2021-22 | 0.7607 | 0.019 | 0.000 | 24.14 |

## 5. Conclusion

The efficiency of the Index Funds has been estimated by the study for the duration from the year 2018 to 2022. Estimates of efficiency were calculated using the BCC Model of Data Envelopment Analysis. According to this study, the average efficiency of the Indian index funds was 0.8303. During the study period, there was only a small variation of 0.0816 in the fund's efficiency scores, indicating general performance stability in Indian index funds. The Indian index funds achieved the maximum of seven efficient funds in any year of our study. Over the previous five years, the number of efficient funds increased from 3 to 7. The marginal impact of inputs on return was then determined by calculating relative mean slacks. The input "expense ratio" included the least amount of slack. This demonstrates that the inefficiency of the Index funds is due to investment risk. The "mean-variance efficiency theory" is supported by this (Sengupta and Zohar, 2001; Sengupta, 2003, Siddiqui, 2021).

## 6. Implications and Limitations of the Study

The Indian mutual fund industry has a large number of operational index funds. This is the first study that has evaluated the efficiency of Indian index funds and assessed the factors of inefficiency. The Indian investors that invest in index funds would find this study useful in making informed decisions before making any investments. Our study provides information on inefficient Index funds on their shortcomings in the aspect of input excess and output shortfall. To lessen/eliminate poor performance, index funds with low-efficiency scores should follow the practices of efficient funds. This study may also be helpful for policymakers, such as the securities and exchange board of India

for index funds, in developing future regulations about distribution channels, commission payments, and channel member operations.

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