PERFORMANCE EVALUATION OF INDEX FUNDS IN INDIA

Thesis submitted to Goa University for the Award of the Degree of

DOCTOR OF PHILOSOPHY

In

COMMERCE

By

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DECLARATION

I, Mr. Dhabolkar Pinkesh Dharma, declare that the thesis titled **"Performance Evaluation of Index Funds in India"** submitted to Goa University, Goa for the award of the degree of Doctor of Philosophy in Commerce is the outcome of original and independent work undertaken by me under the supervision and guidance of Prof. Y.V. Reddy, Senior Professor, Goa Business School, Goa University.

This research work has not previously formed the basis for the award of any Degree, Diploma, Certificate, or any such similar title to the candidate of this university or any other universities. I have duly acknowledged all the sources used by me in the preparation of this thesis.

Date: Mr. Dhabolkar Pinkesh Dharma

Place: Goa University, Taleigao, Goa.

CERTIFICATE

This is to certify that the thesis titled "Performance Evaluation of Index Funds in India" for the award of Ph.D. Degree in Commerce is the bonafide record of original work done by Mr. Dhabolkar Pinkesh Dharma under my guidance and supervision. This thesis has not formed the basis for an award of any Degree/ Diploma/ Certificate/ Associateship/ Fellowship or any such similar title to the candidates of this university or any other universities.

Date: Prof. Y.V. Reddy

Place: Goa University, Taleigao, Goa (Research Guide)

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DHABOLKAR PINKESH DHARMA

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List of Abbreviations

ADF	Augmented Dickey Fuller
ADTV	Average Daily Traded Volume
AMFI	Association of Mutual Funds in India
AUM	Asset Under Management
BSE	Bombay Stock Exchange
ETF	Exchange Traded Fund
FEM	Fixed Effects Model
MM	Market Maker
NAV	Net Asset Value
NSE	National Stock Exchange
REM	Random Effects Model
SEBI	Securities and Exchange Board of India
TER	Total Expense Ratio
VAR	Vector Autoregression
VECM	Vector Error Correction Model

Chapter I

Introduction

The present section introduces the research topic, highlights the need for this research study, and provides the scope of the study. The objectives of the study, research methodology focusing on every objective, and necessary hypotheses developed for the study have been incorporated. This section also provides the study's significance, and finally, the organization of chapters, which will guide the remaining part of the thesis.

1.1 Introduction to Index funds

The first stock market index, the Dow Jones Industrial Average, was published in 1896 by Charles Dow, which thereafter became the benchmark for all stock investors. But it was only in 1976 that John Bogle established the Vanguard Group and introduced the first index fund to the public (Ferri, 2002). Further research in the finance area led to the introduction of index-tracking exchange-traded funds in 1993. Understanding how index funds evolved requires the knowledge of a brief history of the mutual fund industry. The first properly incorporated mutual fund was the Massachusetts Investors Trusts (MIT) established in 1924. This was the first open-ended fund allowing extra shares to be created to meet investor demand. The trust was also the first to share redemption (Groves, 2011). In the 1950s, academic researchers began to search for an 'efficient portfolio' of stocks; this is the group of stocks that earn the highest return per risk level. The studies found that the most efficient portfolio was the market itself (Ferri, 2002).

Efficient market hypothesis, a higher total expense ratio of active mutual funds, and their inability to perform consistently have shaped investors' desire for index investing (Carhart, 1997a; Goel et al., 2012). One cannot invest directly in the stock market index; hence indexing strategy was introduced. Indexing is a passive investment strategy. It requires the fund manager to construct a securities portfolio that mimics the chosen stock market index, intending to replicate the index's performance. An index fund tries to mirror a market index selected as closely as possible by investing in all the stocks that comprise that index in proportions equal to the weightage of those stocks in the index.

The infamous 1987 stock market crash led to the creation of stock baskets that permit trading a basket of stocks in one trade. That paved the way for creating a new type of investment vehicle called exchange-traded fund (ETF). The American Stock Exchange petitioned the Securities Exchange Commission to create the first Standard & Poor's Depository receipt in 1993, generally abbreviated as SPDR Index 500 and better known as Spider. Spider has become so popular over the years that it is also the world's largest ETF with assets worth $314 billion at the end of 2019.

Advantages of indexing

Along with reducing the risk associated with the market, index fund offers many advantages to the investors. Firstly, the investor can indirectly invest in a portfolio of blue-chip stocks that comprise the market index. Second, they offer diversification across a multiplicity of sectors since index stocks are generally a basket of stocks. Added to these is the moderately low cost of management. Index funds are appropriate for conservative long-term investors looking at moderate risk, moderate return arising out of a well-

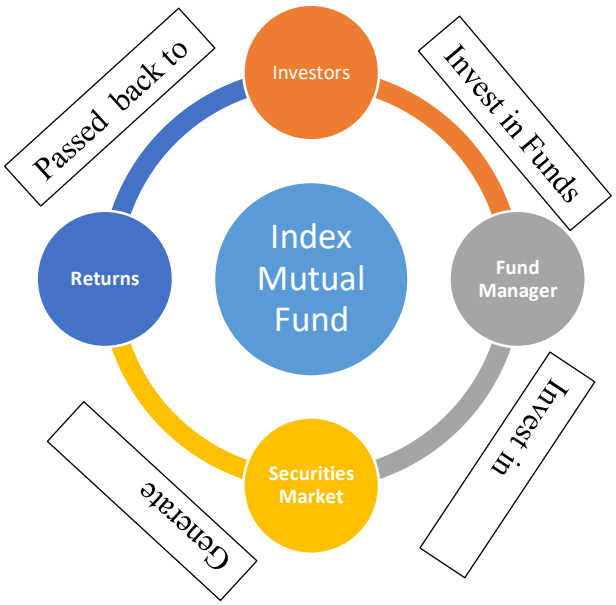
diversified portfolio. Index fund investing help investors who are not actively following markets by allowing them index-based returns. They strive to provide broad market exposure, low concentration risk, transparency, low operating expenses, and little portfolio turnover compared to conventional funds that follow active strategy. The portfolio of an index fund substantially changes only when the benchmark index change.

1.2 Index Funds kinds

1.2.1 Index Mutual Fund

An index mutual fund is a mutual fund scheme that invests in a portfolio of stocks constructed in such a manner to track the performance of a target market, sector, commodity, bond, or other indices. Index mutual funds accept cash deposits from investors and channelize those funds to the purchase of shares that constitute a chosen index to mimic the target index. For example, the S&P CNX Nifty 50 is an index that tracks 50 companies' performance across various sectors of the Indian economy and offers investment managers exposure to the Indian market in one portfolio. Thus, funds tracking S&P CNX Nifty 50 invest in the constituent shares in the same proportion.

Figure 1. Index mutual fund investment process



Source: www.investcare.in

Fund Manager:

A fund manager is critical for the selection and performance of index mutual funds, they are responsible for implementing a fund's investing strategy and plays a decisive role managing index fund portfolio.

1.2.2 Exchange Traded Fund

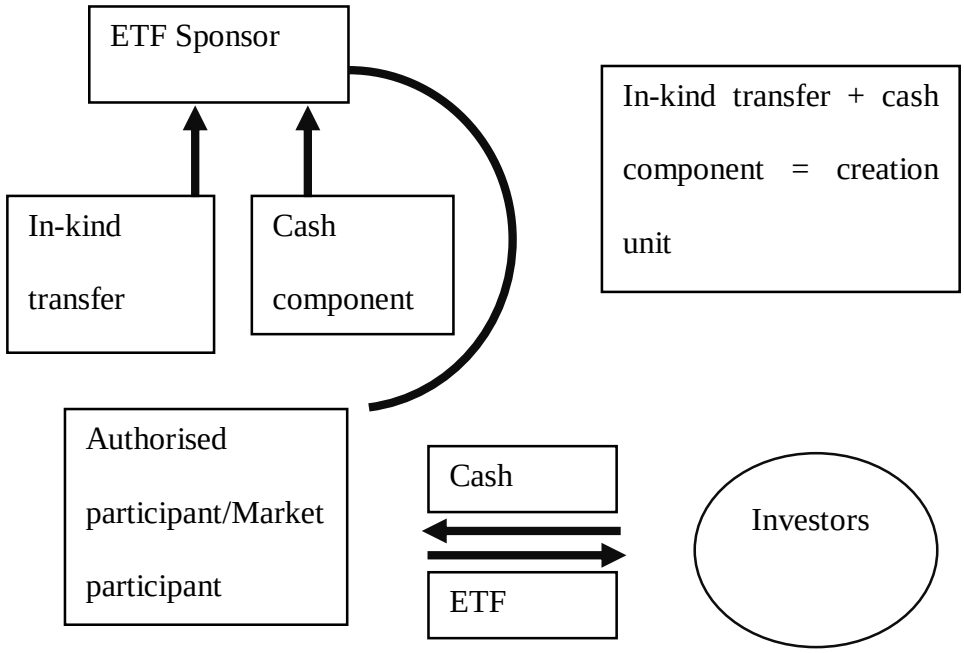
ETFs are necessarily index funds that are listed and traded on stock exchanges like stocks. An ETF unit is a claim on a basket of securities that track a particular stock market index. It is a stock that reflects the composition of a chosen market index; each ETF share is a claim on a trust that holds a specified pool of assets. An accredited financial institution (market maker or authorized participant) creates ETF shares by depositing a securities

portfolio with a trust and receiving ETF shares in return. The created ETF shares, in turn, are sold to other investors in the secondary market.

ETF Creation / Redemption Mechanism

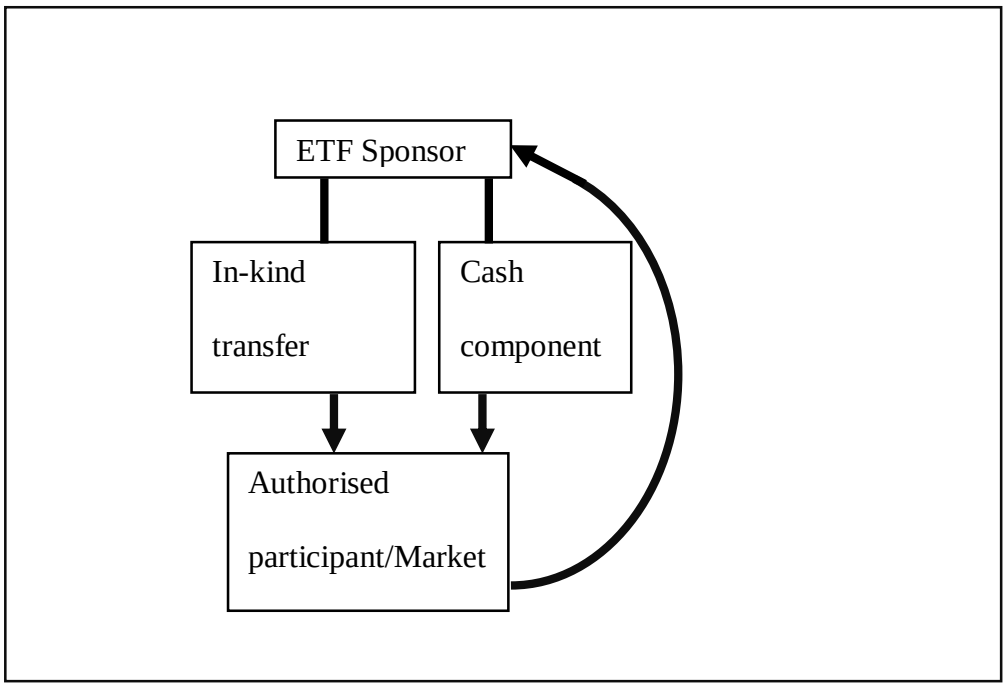
When an ETF scheme provider wants to create new shares, whether to launch a new product or to meet increasing market demand, it approaches an authorized participant (AP). An AP may be a market maker or any other large financial institution with a lot of buying power. The MM/APs have to acquire the shares that the ETF provider wants in its portfolio. For instance, if an ETF is designed to track the BSE Sensex index, the AP will buy shares that constitute the BSE Sensex index, in the exact proportion, and deliver those shares to the ETF provider. In exchange the provider gives the AP a block of equally valued ETF shares, called a creation unit. The ETF share price is based on their net asset value and not the market value at which ETF happens to be trading. It is beneficial for both parties; the ETF provider gets the stocks it needs to track the index, and the AP receives ETF shares to resell on the stock exchange for a profit. The redemption process work in reverse.

Figure 2. Classic in-kind ETF share creation



Source: Groves, F., 2011, p. 50.

Figure 3. Classic in-kind ETF share redemption



Source: Groves, F., 2011, p. 51.

ETF Sponsor:

An ETF sponsor is the fund manager or the financial company that creates and administers an exchange traded fund.

Authorized Participant:

An authorized participant (AP), also known as a market maker, is an organization that has the right to create and redeem shares of an exchange traded fund.

Types of ETFs:

1. Equity ETFs

Equity ETFs are investment products that combine stock investment flexibility and the simplicity of equity mutual funds. ETFs trade on the Stock Exchange's cash market, like any other stock that can be bought and sold continuously at the exchange at market prices. Equity ETFs are investment instruments based on equity indices and invest in securities in the same proportion as the underlying index.

2. Gold ETF

A Gold ETF aims to track the domestic physical gold price. It is a passive investment instrument that is based on gold prices and invests in gold bullion. Gold ETF units represent physical gold, which may be in paper or dematerialized form. Each gold ETF unit is equal to one gram of gold, which is backed by physical gold of high purity. Gold ETFs combine the flexibility of stock investment and the simplicity of gold investments.

Gold ETFs, like any other company stock, can be bought and sold continuously at market prices. The direct gold pricing facilitates complete transparency on the portfolio of a Gold

ETF. A further advantage is created due to its unique creation-redemption mechanism; and have much lower expenses than physical gold investments.

3. Debt ETF

Debt ETFs investment products enable investors exposure to fixed-income securities. Debt ETFs invest mainly in bonds issued by the government. It combines debt investments' merits with the flexibility of stock investment and the simplicity of mutual funds. Like any other company stock, Debt ETFs can be traded continuously on the exchange at market prices.

Debt ETFs are based on debt indices and invest in debt securities in the same proportion as the benchmark index. Because of its index mirroring feature, there is complete transparency on the holdings of an ETF.

4. World Indices ETF

World Indices ETFs are the passive investment instruments that provide domestic investors to take exposure to international indices. These ETFs invest mainly in shares of foreign companies. Such ETFs are suitable to diversify your investment to insulate your investment portion in case of any sharp correction in domestic markets.

1.3 Difference between index mutual fund and ETF

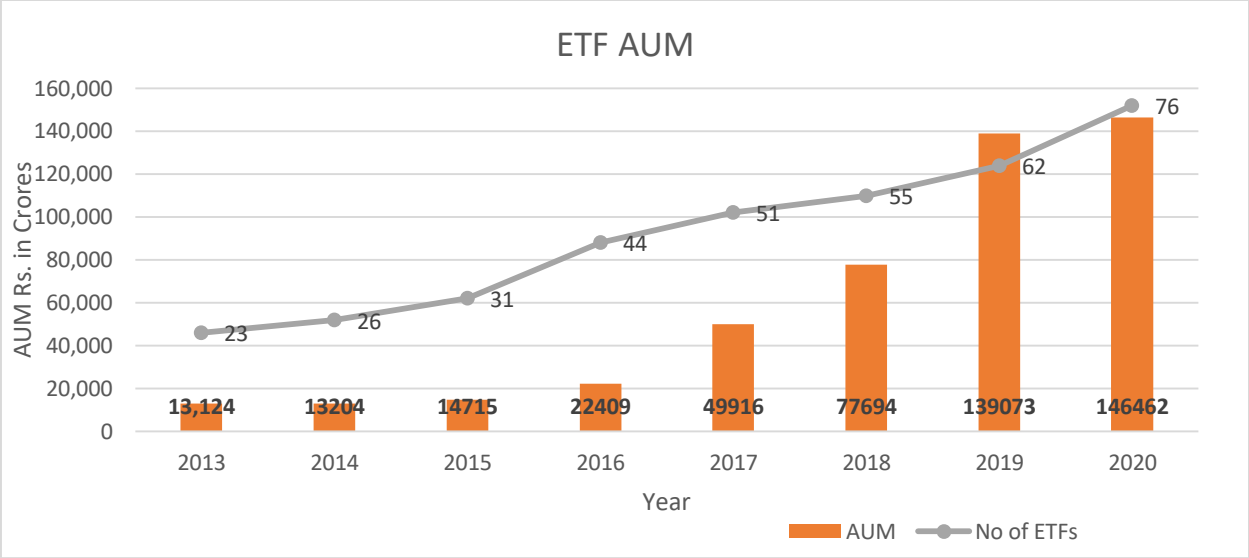
The investment decision between an index mutual fund and ETF is one of the major conundrums while deciding between the two. Though both these products look quite similar, there are differences between them. One of the main differences between the two is that you can buy an ETF share through a brokerage, like stocks, not through a fund management company that sells index mutual funds. Being listed on the stock exchanges,

ETFs provide real-time trading, unlike index mutual funds, which are traded at the end of the day at closing NAV. Index mutual fund units can only be purchased directly from the funds at the NAV price and have a minimum investment specified amount. ETFs can be bought and sold anytime on the stock exchanges, at the prevailing market price and does not have a minimum investment set amount. ETFs do not have a minimum holding period, whereas index mutual funds have a time limit imposed on selling units and levy a penalty on selling the units early. Unlike index mutual funds, ETF investors can sell short or buy on margin.

1.4 Indian Index Funds Industry

In recent years Indian stock markets have also seen a surge in funds' flow to passively managed index funds. The Principal Index Fund Nifty is the oldest surviving index mutual fund in India launched in July 1999, renamed to Principal Nifty 100 Equal Weight Fund in April 2018. According AMFI, there are 32 index mutual fund schemes covering an asset under management of ₹ 8089 Crores as of December 2019. In India, 'Nifty BeEs' was the first ETF introduced in December 2001 by The Benchmark Asset Management Company, subsequently taken over by Nippon India Mutual Fund. There are four types of ETFs available –Equity ETFs, Debt ETFs, Commodity ETFs, and Overseas Equity ETFs. The total number of ETFs in India has increased from one in 2001 to seventy-six till 2020, covering an asset under management of ₹ 1,46,462 crores as of 31st May 2019. As per AMFI, the significant investment in the ETF segment comes from institutional investors and only 8 % from individual investors.

Figure 4. Asset Under Management (AUM) of ETFs in India. (₹ in Crores)



Source: Compiled from AMFI newsletters.

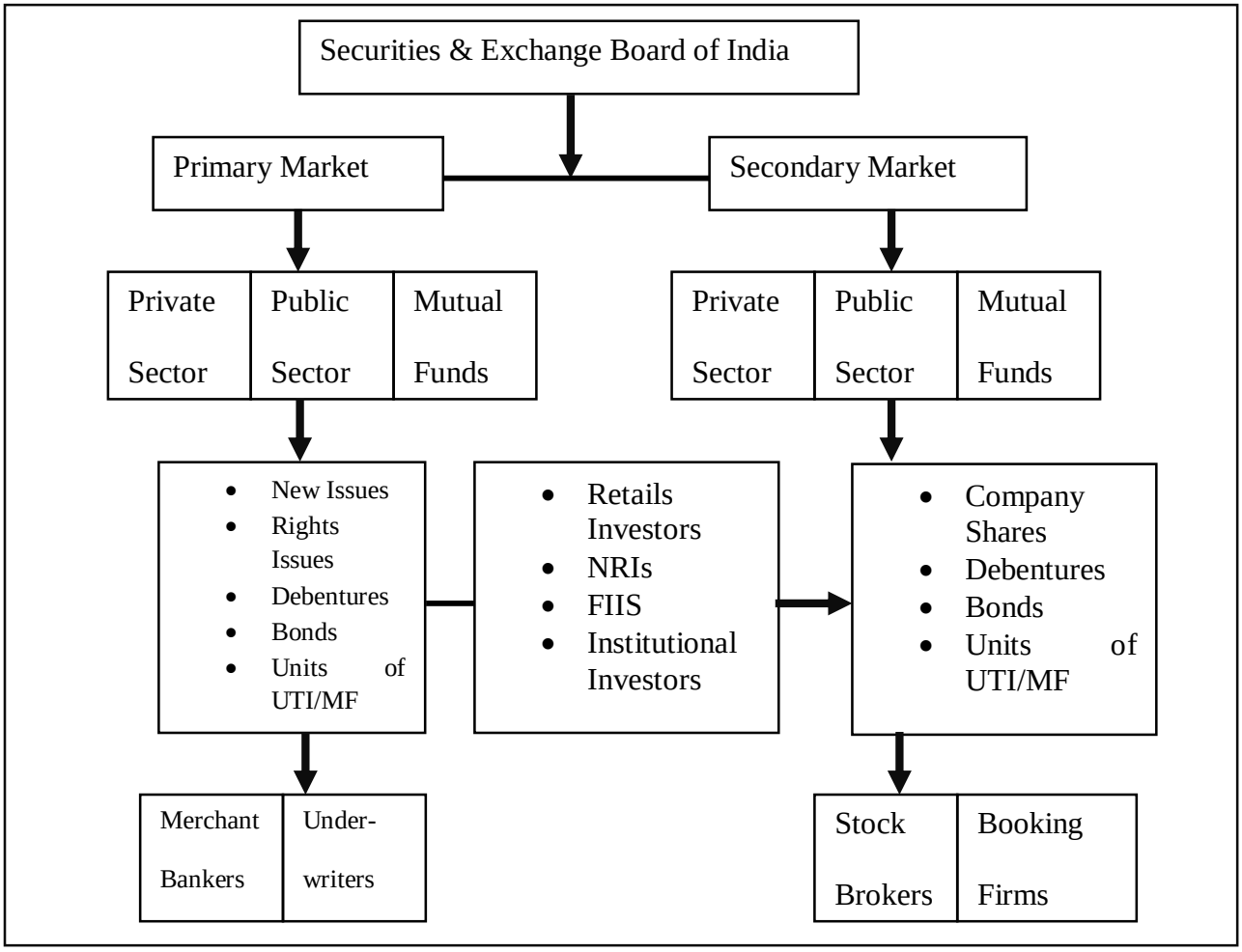
1.5 Regulatory framework in India

Securities and Exchange Board of India (SEBI)

SEBI is a statutory body of the Indian Government that was established in April 1992. It was introduced to regulate and bring transparency in the Indian capital markets. It lays focus on monitoring and regulating India's securities market to safeguard investors' interest and aims to inculcate a safe investment environment by implementing several rules and regulations and formulating investment-related guidelines. It acts as a regulator for all the capital market participants. Its core purpose is to provide such an environment for the financial market enthusiasts that facilitate the securities market's efficient and smooth working.

Whether promoted by public sector or private sector entities, including those promoted by foreign entities, all mutual funds are governed by the same SEBI Regulations. There is no distinction in regulatory requirements for these mutual funds, and all are subject to monitoring and inspections by SEBI.

Figure 5. Regulation of Securities Markets by SEBI



Source: Sadhak, H., 1996, p. 32

1.6 Background of the Study

An index fund is the most successful idea that has flown from finance literature to the fund industry in recent times. A Stock Market Index provides information about price

movements in the financial, commodities, or other markets. Stock market indices are meant to capture the overall behavior of the equity markets. An index is created by selecting a group of stocks representing the whole market or a specified sector or segment of the market. Each index has its calculation methodology and is expressed in terms of change from a base value. An index is a compilation of stocks constructed in such a manner to track the performance of a particular market, sector, commodity, bond, or another asset. For example, the S&P CNX Nifty is an index that tracks performance of the fifty companies across various sectors of the Indian economy and offers investment managers exposure to the Indian market in one portfolio. Similarly, S&P BSE SENSEX constitutes 30 stocks representing well-established and financially sound companies across key sectors.

Index, as a tool, is used by investors and financial managers to describe the market and to compare the return on specific investments. The market indices provide a historical perspective on the performance of stock markets, providing investors with more insight into their investment decisions. A Market Index is a mathematical construct, and as such, it may not be invested in directly, but many Index Funds attempt to track the performance of an Index. This form of investing allows investors to do as well as the markets and not significantly underperform the market.

An index mutual fund is a type of mutual fund with a portfolio constructed to track or match the components of a market index. Index mutual funds are mutual funds that accept cash deposits from investors and channel those funds to the purchase of stocks that constitute the chosen index in an attempt to mimic a benchmark index. Exchange-traded funds (ETFs) are unit investment trusts designed to mimic the market index. An ETF is a basket of stocks that reflects the composition of an index; each ETF share is a claim on a

trust that holds a specified pool of assets. ETF shares are created when an authorized financial institution deposits a portfolio of securities with the Trust and receives ETF shares in return, which in turn are sold to other investors in the secondary market.

Open-ended Index mutual funds are traded at the end of the day at net asset value, unlike ETFs, which trades throughout the market hours at a price close to the actual NAV of the scheme. The objectives and characteristics of ETF are similar to Index mutual funds managed by asset management companies. The difference between these two asset classes is that ETFs are traded on the stock exchanges, and hence investors can derive the benefit of trade-in ETF just like any ordinary stocks. ETFs are more tax-efficient than index mutual funds due to their in-kind creation and redemption process, which also facilitates arbitrage and pricing efficiency. ETFs are more transparent compared to index mutual funds as their holdings are declared every day, unlike mutual funds whose holdings are reported every six months. Most ETFs charge lower annual expenses than index mutual funds. However, as with stocks, one must pay a brokerage to buy and sell ETF units, which can be a significant drawback for those who trade frequently or invest regular sums of money.

At the global level, Index funds have done exceedingly well by offering whole new opportunities to retail and institutional investors. The first index fund was introduced in the year 1976, in the U.S., since then it has escalated to a sizable portion throughout the world market. Although the growth of index funds was sluggish initially, the subsequent growth has been phenomenal. According to ETFGI, the assets managed by ETFs globally amounted to approximately 6.18 trillion U.S. dollars at the end of December 2019. In India, the Nifty Benchmark Exchange Traded Scheme (Nifty BeES) was the first ETF to be introduced in 2001, subsequently taken over by Goldman Sachs Asset Management

Company. In the year 2014, the Government of India had used ETFs as a tool for dis-investment of Public Sector Undertakings, the issue which was oversubscribed by Rs. 1000 crores. The Index fund industry in India got further boost with the Central Government's consent to Employee's Provident Fund Organization to invest up to 5% of its incremental income in ETFs, and to allow for exempted Provident Funds' to invest from 5% up to 15% in ETFs. It is important to note that ETFs, as well as Index mutual funds in India, track the benchmark indices. Given that ETFs and index mutual funds track a similar index in India, it would be riveting to investigate a comprehensive comparative analysis on both the index fund classes.

1.7 Need for the study:

Indexing, as a passive investment strategy, has gained immense momentum in both overseas and Indian markets. In recent years Indian stock markets have also seen a surge in the flow of funds to passively managed index funds. As per AMFI, there are 32 index mutual fund schemes covering an asset under management of Rs. 8089 Crores as of March 2020. The total number of ETFs in India has increased to seventy-six, covering an AUM of Rs. 1,46,462 crores as of March 2020.

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ETFs and index mutual funds both track similar indices in India; a comprehensive analysis of both the index fund classes will have paramount financial and regulatory implications.

1.8 Scope of the study:

The study covers all equity index funds listed in India. As the market indices consider dividend adjustment based on its announcement, we consider only growth funds and regular plans for our study.

All the funds in existence for more than two years are considered for the study. The tracking error and tracking performance of the index funds are examined from the fund's inception until March 2020.

The study also examined the role of performance parameters, along with fund characteristics like the expense ratio, age of the fund, fund size, in the growth of the index fund asset under management covering a period from March 2014 to March 2020 and investigated a sample size of 20 index mutual fund schemes and 42 ETFs schemes listed in India. The study also evaluated the pricing efficiency and liquidity of ETFs listed in India.

The study considers secondary data; the NAV of the funds were sourced from the website of AMFI and respective fund house. The historical closing total returns index values of the chosen market index were sourced from the website of the National Stock Exchange of India Ltd. (NSE) and Bombay Stock Exchange (BSE).

1.9 Objectives of the study:

Objective I:

To study the comparative performance of select index mutual funds and ETFs in India.

Sub Objectives:

1.1: To examine the tracking performance of select index mutual funds and ETFs in India.

1.2: To examine the tracking error of select index mutual funds and ETFs in India.

Objective II:

To analyze the determinants of fund flow to select index mutual funds and ETFs in India.

Sub Objectives:

2.1: To identify the determinants of fund flow to index mutual funds and ETFs in India.

2.2: To analyze the determinants of fund flow to index mutual funds and ETFs in India.

Objective III:

To study the pricing efficiency of select ETFs in India.

Sub Objectives:

3.1: To study the pricing efficiency of select ETFs in India.

3.2: To study the price discovery process of select ETFs in India.

Objective IV:

To measure the liquidity of select ETFs in India.

1.10 Hypothesis Development

Hypothesis framed to support the analysis concerning objective 1:

Hypothesis to test the tracking performance of index funds using regression analysis.

H_{1a}: There is no significant replication of the chosen market index by index mutual fund.

H_{1b}: There is no significant replication of the chosen market index by exchange traded fund.

Hypothesis to test the stationarity of index fund return and index return

H_{2a}: Index mutual fund return has a unit root.

H_{2b}: Exchange traded fund return has a unit root.

H_{2c}: Benchmark index return has a unit root.

Hypothesis framed to support the analysis concerning objective 2:

Hypothesis supporting FEM and REM in examining the determinants of fund flow to index mutual fund and ETFs.

H_{3a}: There exists no significant impact of underlying index performance on fund flows to index mutual funds.

H_{3b}: There exists no significant impact of underlying index performance on fund flows to ETFs.

H_{3c}: There exists no significant impact of tracking error on fund flows to index mutual funds.

H_{3d}: There exists no significant impact of tracking error on fund flows to ETFs.

H_{3e}: There exists no significant impact of total expense ratio on fund flows to index mutual funds.

H_{3f}: There exists no significant impact of total expense ratio on fund flows to ETFs.

H_{3g}: There exists no significant impact of fund age on fund flows to index mutual funds.

H_{3h}: There exists no significant impact of fund age on fund flows to ETFs.

H_{3i}:There exists no significant impact of AUM on fund flows to index mutual funds.

H_{3j}: There exists no significant impact of AUM on fund flows to ETFs.

Hypothesis for model selection using the Hausman Test:

$H_{4:}$ Random Effects Model is appropriate

Hypothesis framed to support the analysis concerning objective 3:

Hypothesis to test the stationarity of price deviation series

H_5: The price deviation series has a unit root.

Hypothesis to test the persistence of arbitrage for selected ETF

H_6: The arbitrage persistence of the ETF in the Indian market does not disappear in a day.

Hypothesis to test the stationarity of NAV and Market price of ETF

H_{7a}: ETF NAV has a unit root.

H_{7b}: ETF market price has a unit root.

Hypothesis to test the long term co-integration between NAV and market price of ETF

H_8:The market price and NAV of ETFs do not have any long-run relationship.

Hypothesis to test the lead-lag relationship between NAV and market price of ETF.

H_9: Historical information of NAV cannot be used for predicting future price discovery of ETF.

1.11 Tools and Techniques Employed

Summary Statistics

Summary statistics are used to analyze and understand the nature of the variables. The study made use of the mean, standard deviation, skewness, and kurtosis. Mean is a mathematical average, and it is the most popular measure of central tendency. The mean of a series of measure is equal to the sum of the measures divided by their number. It is the average most often referred to in widespread usage. Standard deviation is the commonly used measure of the dispersion of a series. Standard deviation measures the variations in the data set. A low standard deviation indicates that value doesn't vary much from the mean of the data set. Skewness is a measure of the symmetry in distribution. In skewness, we know that the data set is symmetrical if $\boldsymbol{\beta_1}$ is equal to 0, positively skewed if $\boldsymbol{\beta_1}$ is more than 1, and negatively skewed if $\boldsymbol{\beta_1}$ is less than 1. Kurtosis is a statistical measure that defines how heavily the tails of distribution differ from normal distribution tails. It identifies whether the tails of a given distribution contain extreme values. Skewness essentially measures the symmetry of the distribution, while kurtosis determines the heaviness of the distribution tails.

Correlation Analysis

The primary objective of correlation analysis is to measure the strength or degree of linear association between two quantitative variables. The correlation coefficient measures the power of the (linear) relationship between two variables and the relationship's direction. The correlation coefficient denoted by ‘r’ ranges between -1 and +1. As the correlation coefficient value moves towards 0, the relationship between the two variables will be weaker, and vice-versa. A higher correlation coefficient signifies two or more variables have a strong relationship with each other, while the lower value means the variables are hardly related.

Augmented Dickey-Fuller test

The study also uses the Augmented Dickey-Fuller test (ADF) to check unit root presence in the time series. In statistics, a unit root test examines whether the time series is nonstationary and possesses a unit root. A time series with a unit root shows a systematic pattern that is unpredictable. In statistics and econometrics ADF test tests the null hypothesis and shows that a unit root is present in a time series sample; that is, time series is nonstationary. The alternative hypothesis is that the time series is stationary. If a time series is stationary, it's mean, and variance remains the same no matter at what point it is measured; that is, they are time-invariant.

Regression Analysis

The regression analysis determines the statistical relationship between two or more variables. In simple regression, there are two variables, one variable (defined as the independent) is the reason for another's behavior (defined as the dependent variable). Regression is a statistical method to deal with the formulation of a mathematical model

depicting relationships amongst variables that can be used to predict the dependent variable's values, given the values of the independent variable.

Auto-regression model

An autoregression model forecasts the variable of interest using a linear combination of past values of the variable. As the regression model uses data from the same input variable at previous time steps, it is referred to as autoregression (regression of self) model. The autoregressive model of order p can be written as follows.

$$D_t = \Phi_0 + \Phi_1 D_{t-1} + \Phi_2 D_{t-2} + \ldots\ldots\ldots\ldots + \Phi_p D_{t-p} + \epsilon_t$$

Where ϵ_t is the white noise. This is like a multiple regression but with lagged values of D_t as predictors.

Panel regression model

Panel data regression provides information on individual behavior, both across individuals and over time. The data and model have both cross-sectional and time-series dimensions. In panel data regression, there are three types of models: the pooled model, the fixed effects model (FEM), and the random-effects model (REM). Each model has its specifications. The Pooled model has constant coefficients, referring to both intercepts and slopes. One of the major problems with this model is that it does not distinguish between the various index funds we have. In other words, by pooling all the index funds, we deny the heterogeneity or individuality that may exist among the selected index funds.

The FEM and REM are the classical tests for panel data analysis. The FEM allows for heterogeneity or individuality among the chosen index funds by allowing each fund to have its intercept value. The term fixed effect is because although the intercept may differ across

index funds, intercept does not vary over time; that is, it is time-invariant. On the other hand, the REM assumes that there is a single common intercept term as well as intercepts of individual funds, which randomly vary from the common intercept.

Hausman specification test

To test for consistency between the FEM and REM, we employ the Hausman specification test on the estimated coefficients of both the model. In panel data analysis, this diagnostic test helps you to choose between the panel data models. The Hausman specification test examines a more efficient panel data model against a less efficient but consistent model. The null hypothesis of the test is the coefficients estimated by the REM are the same as the ones estimated by the FEM. If the p-value is insignificant, then it is safe to use the REM; if not, we should use the FEM.

Johansen cointegration test

The Johansen cointegration test tests the cointegrating relationships between several time series data. The cointegration occurs when two or more nonstationary time series have a long-run equilibrium and move together so that their linear combination results in a stationary time series and share an underlying common stochastic trend. The test assesses a cointegrating relationship's validity, using a Maximum Likelihood Estimates (MLE) approach. The null hypothesis for the Johansen cointegration test is that there are no cointegrating equations. The alternate test hypothesis is that the number of cointegrating relationships is at least one.

Vector Error Correction Model

The study makes use of the Vector Error Correction Model (VECM), which is a restricted Vector Autoregression (VAR) designed for use with nonstationary series known to be cointegrated. The VAR is a statistical model used to capture the relationship between multiple quantities as they change over time. The vector error correction model has cointegration relations built into the specifications to restrict the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Çetin et al., 2015).

The VECM provides the error correction coefficient for both the variables. The higher the error coefficient, the greater the amplitude of deviation from the long-run equilibrium. This signifies that the variable with a lower error coefficient is more efficient in reaching the long-run equilibrium, leading to the subsequent variable. Being the lead indicator, the variable with a lower error coefficient will move to the point of equilibrium long before the other variable. With this, the lead variable's historical information can be used to effectively predict the moment of the lag variable.

Amihud's ILLIQ (2002)

The study used Amihud's (2002) price impact measure ILLIQ to capture the level of illiquidity and determine the relationship between returns and illiquidity over time. This proxy provides a measure of price impact. For individual stock, the illiquidity ratio ($ILLIQid$) is given by:

$$\boldsymbol{ILLIQ} = \frac{\mathbf{1}}{\boldsymbol{N}} \sum_{\boldsymbol{t-1}}^{\boldsymbol{T}} \frac{|\boldsymbol{r_t}|}{\$\boldsymbol{V_t}}$$

Where :

r_t is the return on stock on day t and $\$V_t$ is the dollar volume on the same day. The dollar volume is derived by the number of shares multiplied by the respective day's closing price.

1.12 Significance of the Study

The present study examines how well the index tracking index mutual funds and ETFs are able to mimic the chosen market index based on tracking performance and TE. The research will also contribute to the ongoing fund flow literature by examining performance and fund characteristics' role to passively managed index funds in India. The results have implications for the investors, market regulators, fund distributors, and fund houses. Our empirical results provide vital information to investors regarding index funds' performance and characteristics and those that effectively impact their flows. Our study can guide portfolio managers and fund distributors to better understand what drives index funds investors' decisions and fine-tune their decisions.

The present study also investigates Indian equity ETFs' pricing efficiency employing an autoregression model over its price deviation and understanding the lead-lag relationship between ETF price and NAV. The study considers a large pool of index mutual funds that track different indices, including foreign market indices. The study aims to contribute significantly to the finance literature and assist market regulators, fund houses, market makers, and research analysts in evaluating the Indian index fund market.

1.13 Organization of study:

Chapter I focus on the introduction to index funds, the need for the study, the scope of the study, the study's objectives, research methodology, hypotheses development, the significance of the study, and the organization of the study.

Chapter II elaborates literature review of tracking performance and tracking error of index funds, literature review of fund flows to index funds, literature review of pricing efficiency of ETFs, liquidity of ETFs, and research gap.

Chapter III incorporates results and discussion pertaining to tracking performance and tracking error of index funds.

Chapter IV incorporates results and discussion pertaining to fund flow determinants to index funds.

Chapter V incorporates results and discussion pertaining to pricing efficiency and price discovery of ETFs.

Chapter VI incorporates results and discussion of measuring ETF liquidity.

Chapter VII summarizes the conclusion, policy implications of the study, the study's contribution, limitations of the study, and scope for future research.

Chapter II

Review of Literature

2.1 Literature Review of tracking performance and tracking error

At a global level, indexing is a popular investment strategy, and various studies have been undertaken to analyze the performance of index funds.

Dellva (2001) documents ETFs increasing popularity compared to conventional mutual funds by comparing them in terms of trading, creation and redemptions, cost comparisons, and tax efficiency. The study examined the index mutual funds and ETFs tracking the S&P 500 index by decomposing and comparing their cost loads. The study found that transaction costs limit ETF attractiveness for small investors, but have a significant advantage because of the lower expense ratios than those of counterparts.

Bergstresser & Poterba (2002) reported the pre-tax and after-tax return on select index funds and concluded that pre-tax and after-tax returns on the index funds were slightly more significant than those on the ETFs.

Kostovetsky (2003) examined investor choice between ETFs and index mutual funds and highlights that the fundamental differences arise from management fees, transaction fees, and tax efficiency. The study constructs one-period and multi-period models and found that small investors prefer index mutual funds to ETFs. The research also indicates that ETFs become more economical than index mutual funds based on a more extended holding period.

Gastineau (2004) compared the performance of ETFs and mutual funds that track the same underlying indices. The period of the study was from 1994 to 2002. The research found that irrespective of the benchmark index, ETFs underperforms their counterpart. The author partly attributes this to the lack of aggressiveness on the manager's part to align ETF to the underlying index when faced with index composition changes.

Gallagher and Segara (2006) examined the performance and trading characteristics of ETFs in Australia. The research investigated classical equity ETFs' ability to track underlying benchmarks and compare the tracking error volatility between index-tracking market traded instruments and equity index funds operated off the market. The research provides a comparison between the magnitude of tracking error between the two similar passive instruments and an analysis of the variation in performance between the fund and index due to market frictions. The study documents the tracking errors of comparable equity index funds significantly higher than the ETFs.

Chen et al. (2009) examined the performance of Taiwan equity index funds using Jensen's model. The findings indicate that it is relatively easier for fund managers to mimic the small index fund portfolios than the larger ones.

Elton et al., (2010) examined Spider's performance, which tracks the S&P 500 index and compared Spider with other indexing methods using returns and concluded that Spider underperforms the S&P index and additional low-cost index funds.

Wong & Shum (2010) studied the performance of 15 ETFs of different countries across bearish and bullish market from 1999 to 2007. The study indicates that ETFs always provide higher returns in a bullish market and also shows that ETF returns are not

proportional to the market returns. Study also indicates that ETFs tracking same index do not perform exactly the same and highlights the role of active fund management.

Blitz & Swinkels (2010) evaluated the performance of index mutual funds and ETFs that are listed in Europe by analyzing the fund performance by comparing the return of index funds and their benchmark indexes. The study found that European index funds underperform their benchmarks by 50 to 150 basis points per annum.

Kenneth et al. (2014) evaluated the performance of ETFs in the emerging markets using risk and return measures and tracking error, and found that there are significant variations involved in the tracking process of the ETFs; and ETFs are sensitive to their characteristics such as geographic location and economic features.

Rompotis (2013) examined the performance of an ETF and index mutual fund tracking the Athens stock exchange index using tracking error. The result showed that the mean tracking error of ETF is equal to 0.228, and that of index mutual fund is 0.209, which is more favorable for the index mutual fund.

Garg (2013) evaluated the performance of ETFs and index mutual funds in India that track the same benchmark index. The sample includes a set of five ETFs and index mutual funds from the period ranging from June 2006 to December 2009. The performance of index funds was evaluated based on risk and return comparison of funds and indices, replication strategy, and tracking error of the funds. The study found that ETF fund managers have been able to provide better performance than their index mutual fund counterparts. The study indicated a better portfolio replication strategy adopted by ETF managers, lower

levels of tracking errors, and effectiveness in performance over long term investment period.

Narend (2014) evaluated the performance of ETFs and index mutual funds in India using tracking error, active returns and Jensen's alpha. The data comprised of 3 ETFs and 12 index mutual funds from the inception of the funds up to 31st July 2013. The study revealed that index funds had done better than ETFs in terms of a higher Jensen's alpha and a lower tracking error while ETFs have outperformed index mutual funds with respect to active returns.

Tang et al. (2018) examined the tracking performance and tracking error of New Zealand exchange traded funds. Regression models and Johansen's cointegration test were used to investigate tracking performance, and tracking error was measured based on the standard deviation of the differences between the return on the ETF and its underlying index. The study shows that ETFs have substantially different exposure to their underlying indexes and show considerable variations in the tracking error.

2.2 Literature Review of determinants of fund flows to index funds

Several studies tried to examine whether fund flows are related to fund attributes and influential characteristics. Santini & Aber (1998) investigated aggregate money flows to and from the equity mutual fund industry. The study made use of 127 open-end equity mutual funds for the period of 1973 to 1985. The study found that new money flows were negatively related to the real long term interest rate, and positively associated with stock market performance and personal disposable income. On similar lines, Sirri & Tufano (1998) document a negative relation between fund flows and total fund expenses.

Fant (1999) investigates the aggregate investment behavior of mutual fund shareholders by analyzing the interaction of their demand for equity securities with stock returns using vector autoregressions. The period of the study is from 1984-95. The study found that returns indicate no relationship between flows and lagged flows of any component.

Ferreira et al.(2012) investigated the flow-performance relationship of mutual funds across 28 countries. The sample consists of 16,000 open-ended and actively managed equity funds in 28 countries over 2001 -2007. Mutual fund performance was measured using raw returns and risk-adjusted returns, Jensen's alpha. The study finds a significant relationship between flow performance relationships across countries. The study also provides an important implication of the flow performance relationship for mutual fund managers' risk-taking behavior.

Clifford, Fulkerson, and Jordan (2014) investigated the factors that drive flows to exchange traded funds using a data set of 500 ETFs from 2001 to 2010. The study found that ETF flow decreases with increases in fund size, expenses, and turnover. The study also found

ETF flows are smaller for larger funds and funds with higher expenses. On the other hand, market activity and the price/NAV ratio are important determinants of ETF flows, but cannot affect mutual fund flows.

Casavecchia (2016) studies the weak sensitivity of investors flows to poor fund performance based on the fund managers' incentives to herd in the U.S. market. The data was analyzed using panel data analysis, and the sample period ranges from 1993 to 2010. The study found that investors do not evaluate underperforming managers too harshly if they follow conventional actions, whereas they systematically punish managers for taking bold steps.

Othman (2018) examined the fund flows past performance relationship of Islamic equity funds (IEF) investors in comparison with conventional equity funds (CEF) investors in Malaysia. A panel data analysis was used for 20 individual IEF and CEF funds from 2011 to 2013, which found that key factors influencing the fund flow to IEF is the management expense ratio, and fund size in the case of IEF.

Marzuki and Worthington (2015) examined the fund flow- performance relationship for equity and conventional equity funds in Malaysia. The study made use of panel regression models to estimate the flow-performance relationship from the period 2001 to 2009. The study documents positive relationship between fund flows and past performance in Malaysian Equity funds, and there is no significant difference between Islamic Equity Funds and Conventional Equity Funds in this regard. The study also finds that investors direct fund flows to better performing funds but is rather more reluctant to punish poorer-performing funds by withdrawing funds.

Ivanov (2016) identified the factors that impact the exchange traded fund net fund flow changes on a daily basis. A total of 1,212 different ETFs with a proprietary daily net fund flow data and logistic regressions were studied because the majority of the ETFs have zero daily net fund flow changes. The study did not find support for the feedback trading hypothesis, but some support was found for the contrarian investor hypothesis on a daily basis. The study also failed to conclude that tracking error prompts net fund flows.

Shu, Yeh, and Yamada (2002) examined the impact of fund performance and management fees on mutual fund flow in Taiwan. Barber et al. (2005) examined the effects of expenses on mutual fund flows and documents consistent negative relations between fund flows and front end load fees but no relation between fund flows and operating expenses.

Rudman (2008) investigated the factors and dynamics behind cash flow into and from General Equity Trusts from September 1996 to September 2001 in South Africa. The study using a regression analysis found a significant positive relationship between contemporaneous returns of the General Equity unit trusts and the equity market. The study also found interest rates, fee structures, risk, and fund size to be significant determinants of the cash flows.

Ben Belgacem and Hellara (2011) examined the ability of fund characteristics such as past performance, fund size, management fees, fund age, and net asset value to explain the future performance of the Tunisian mutual fund. The sample was split according to the investment objective, and a dynamic panel data model was used to analyze the data for the period of 1999 to 2006. The study found that past performance and fund size significantly influence future performance for all fund categories.

In Japan, Shinozawa and Vivian (2015)investigated the determinants of fund flows to investment trusts using the pooled regression model. The study used past performance, distribution channels, and fund fees as an explanatory variable of 95 open-ended equity mutual funds in Japan. The period of the study was from January 2001 to December 2007. The study found that substantial variation in the fund flow is explained by its past returns. The study also found the funds which are part of a large financial group are more sensitive to its performance.

Makni, Benouda, and Delhoumi (2016) examined the characteristics of Islamic funds and those that impact their performance. A negative relationship between fund expense ratio and fund flows in U.S. mutual fund was also documented by Salganik-Shoshan (2017)

On lines of active mutual funds, some studies also explored the sensitivity of fund flows to the fund attributes of passive investments. A positive correlation was found between fund flows and performance by Goetzmann and Massa (1999) by examining three passive mutual funds that track the S&P 500.

Elton, Gruber, and Busse (2004)explored the impact of tracking error of funds that track the S&P 500 index.

Thomas and Matthews (2014) investigated KiwiSaver investor behavior, particularly concerning the unique default feature of the scheme. The study period is from 2009 to 2011; by using simple panel data regression analysis, the study found that Kiwisaver members are chasing performance and seeking to avoid fees. The study also found a negative relation of funds with fund bank ownership.

Li, de Haan, and Scholtens (2018)investigated the cyclicality of international fund flows to equity and bond funds employing correlation and regression analysis using monthly data for 70 countries. The study found that the fund flows are positively related to domestic financial markets' performance and found fund flows to be pro-cyclical ahead of the business cycle.

Arbaa and Varon (2019) find no empirical evidence of the convex flow-performance relationship among Israel's provident funds. Their study also documents a negative correlation between tracking error and fund flows.

2.3 Literature Review of pricing efficiency and price discovery of ETFs

DeFusco, Ivanov, and Karels (2011) studied the pricing deviations of Spider, Diamonds, and Cubes from the price of the underlying index. The study applied summary statistics, simple OLS regression, and VECM model to analyze the data. The study found that their price deviation is predictable and nonzero.

Marshall, Nguyen, and Visaltanachoti (2013) analyzed the SPDR S&P 500 and iShares Core S&P 500 ETF for the period of February 2001 to August 2010. The study found that spreads increase just before arbitrage opportunities, consistent with a decrease in liquidity. The study also finds that the ETFs have a daily return correlation of 0.99 and deviations correct back following mispricing.

Charupat and Miu (2011) examined the informational efficiency of prices of 273 ETFs that actively trade on the NYSE Arca, based on short-horizon return predictability from past order flows. The study found that price adjustments to new information for ETFs occur in about 30 minutes. The research also shows that the speed of convergence to market efficiency of ETFs is not only significantly driven by volume, but also by the probability of informed trading.

Hilliard (2014) studied the ETF premium/discount process and determinants of domestic equity, international equity, commodity, taxable bond, currency, and municipal bond ETFs domiciled in the United States from April 2010 to April 2011. The study found that emerging market ETFs tend to have more significant and more persistent premiums than developed market ETFs. The study also documents illiquidity of underlying assets, higher

volatility of the emerging markets, higher bid-ask spreads, and other market frictions as factors for the mispricing of ETFs.

Kreis and Licht (2018) analyzed deviations in the European ETF markets using gross and net returns of a long-short trading strategy in the capital asset pricing model. The study found a positive gross excess returns for the long-short strategy in all sample periods.

Lin, Chan, and Hsu (2006) investigated the pricing efficiency of Taiwan Top 50 Tracker Fund (TTT) using the deviation of price from the NAV and the absolute value of mispricing. The study found TTT tends to sell at a premium; however, the premium is not significant.

Kayali (2007) investigated the pricing deviations of price from NAV of the Dow Jones Istanbul 20 (DJIST), the ETF tracking the Dow Jones Turkey Titans 20 Index's performance over the 241 day period of its trading in 2005. The study found the DJIST trades at a smaller discount on average, and premiums or discounts do not persist over time and disappear within two days.

Shin and Soydemir (2010) estimated tracking errors from 26 ETFs utilizing three different methods and found that tracking errors are significantly different from zero and display persistence. The study also found using serial correlation tests, runs tests, and panel regression analysis more remarkable persistence in ETFs price deviation.

Shanmugham and Zabiulla (2012) examined the pricing efficiency and relative performance of Nifty BeES, tracking S&P CNX Nifty using data for seven years, from 2002 to 2008. The performance results indicate the superior security price forecasting ability of the portfolio manager. The study also documents that the price divergence

disappears within three days, and the market price and the fund's NAV get aligned due to the arbitrage mechanism.

Charteris (2013) examined domestic and foreign ETFs' pricing efficiency listed in South Africa and found that two out of seven funds were trading at a discount and remaining at a premium. The study also suggests that differences, however, do not persist for more than two trading days.

Charteris et al. (2014) investigated the extent to which ETFs premiums and discounts motivate feedback trading in emerging markets using a sample of index ETFs. The study provides evidence denoting that feedback trading grows significant in the presence of lagged premiums, and more widespread when lagged premiums increase in magnitude.

Swathy (2015) investigated five ETFs' pricing efficiency of Benchmark/Goldman Sachs asset management company listed on NSE, India. The study period is from 2010 to 2015. The data were analyzed using regression analysis and found that premiums and discounts do not persist over time and found the ETF market efficient.

Baş and Sarıoğlu (2015) evaluated the performance and pricing efficiency of the ETFs operating in the Turkish capital markets. The study examines the tracking error and pricing efficiency of 16 ETFs between 2005 and 2013. The performance was measured using the arithmetic mean, absolute mean, and tracking error. The pricing efficiencies were computed using the average premium and discount and found to be efficient.

Aditya and Desai (2015) examined the pricing efficiency and price discovery of 17 equity index ETFs listed in India. The period of the study was from the inception of the fund to September 2014. The study found that NAV leads the market price in information

transmission and price discovery process for all ETFs. The result showed that Indian ETFs take a minimum of 4 days and a maximum of 10 days for the differential between the NAV and price to disappear.

Kumar (2015) investigated the pricing efficiency of CPSE ETF listed on the National Stock Exchange India. The researcher employed simple linear regression to understand the relationship between net asset value and the ETF's market price. The researcher also made use of descriptive statistics to analyze pricing efficiency and conclude that during the study period, on average CPSE ETF traded at a discount, but the discount was economically insignificant for the market participant to profit from the arbitrage opportunity.

2.4 Literature Review of measuring ETF liquidity

Liquidity of ETFs, which is an edge over index mutual funds, is also an important parameter considered to measure the performance of ETFs. Calamia & Riva (2013) measured the liquidity of European Equity ETFs using three widely used low-frequency liquidity estimators, namely, closing spreads, closing prices, and daily trading volume. The study concluded that ETFs' liquidity is negatively correlated with their trading volume and positively correlated with the volatility of their underlying basket.

Similar study in the European market was conducted by Roncalli & Zheng (2014) both daily and intraday. The study documents that liquidity varies considerably between ETF provides.

Czauderna et al., (2015) investigated how liquidity affects market returns and, in turn, whether liquidity is determined by past returns by making a study of German exchange traded funds. The part of the paper investigates the availability of alternative measures, which can be used as illiquidity proxies.

Marshall et al., (2018) examined the performance of liquidity proxies in ETFs. find that despite the differences between ETF and stock liquidity, proxies such as Daily Spread, High-Low, Close-High-Low, and Amihud all do a good job of capturing changes ineffective and quoted spread transaction costs. However, no proxies accurately reflect movements in price impact or the level of actual transaction costs.

Amihud (2002) using the Illiq ratio shows that over time, expected market illiquidity positively affects ex ante stock excess returns which suggests that expected stock excess

return partly represents an illiquidity premium. The Iilliq measure used is the average across stocks of the daily ratio of absolute stock return to dollar volume.

Kumar and Misra (2015) measured the liquidity of Indian MidCap stocks using Amihud and trading volume as proxies. The study discusses various characteristics of liquidity and its influencing power on return and asset pricing. The study found that Indian MidCap stocks have a varying degree of liquidity.

Goyenko, Holden, and Trzcinka (2009) investigated how well low-frequency measures capture high-frequency measures of transaction cost using a sample of 400 randomly selected stocks over the period 1993 to 2005. The study suggests using the Amihud measure for capturing price impact.

Fong, Holden, and Trzcinka (2017) identified high quality liquidity proxy based on low-frequency daily data. The primary sample included forty-two exchanges in thirty-eight countries. The study found Amihud, closing percent quoted spread impact, High-Low impact as the best monthly cost per dollar volume proxy, and the daily version of Amihud as the best daily cost per dollar volume proxy.

Bogdan, Bareša, and Ivanović (2012) explored the impact of various liquidity variables on liquidity ratio using secondary and primary data from the Croatian stock market. Liquidity was measured using Amihud's liquidity ratio. The study found the firm's size, number of issued stocks, and achieved volume affects liquidity ratio.

Marshall, Nguyen, and Visaltanachoti (2012) examined the performance of liquidity proxies in the commodities market. The study found Amihud, Amivest, and Effective tick proxies useful for commodity liquidity studies over a long time period and those that lack

access to high-frequency data. The study suggests using the Amihud measure for measuring liquidity in their low-frequency analysis.

2.5 Research Gap:

The literature review shows that most of the studies on the performance of index funds are restricted to developed markets, and studies are still at the infancy stage in India. The present study makes an attempt to study the performance of the index funds in India based on performance and tracking error.

Understanding the flow performance relationship is an important indicator for investors and market regulators. Several studies document the relationship between fund characteristics, past performance and flow to conventional mutual funds. However, very few studies explore fund flows to passively managed index funds. There are various reasons to consider that there are different motivations for investors in deciding between conventional and index funds. The main reason is that passive investors expect index funds to effectively track their benchmark index, regardless of their price behavior.

The literature review also shows that a considerable amount of research has been done on ETFs' pricing efficiency in developed markets, but developing country markets remain mostly unattended. The present study attempts to investigate the pricing efficiency of Indian equity ETFs employing an autoregression model over its price deviation, and also attempts to understand the lead-lag relationship between ETF price and NAV using the vector error correction model (VECM). Our study considers a large pool of ETFs that track different indices and will bridge the gap by extending the sample to all the equity ETFs listed in India

Chapter III

Comparative Performance of Select Index Mutual Funds and ETFs in India.

3.1 Data and Methodology

The study considers all equity index funds listed in India, which exist for more than two years. The sample comprises of 20 index mutual funds and 42 ETFs. As the index funds aim to mimic the performance of the chosen market index, tracking performance and tracking error is calculated against the Total Returns Index, which shows the returns on the index portfolio, inclusive of dividends. As such only growth funds were considered for the study.

The study considers secondary data, the net asset value (NAV) of the funds were sourced from the website of AMFI and respective fund house. The historical closing total returns index values of the chosen market index were sourced from the NSE and BSE website. The required data was collected from the inception of the funds or depending on the availability of data till March 2020.

3.2 Tracking Performance:

Tracking performance is the index fund's ability to provide returns that commensurate returns of the market index and highlights the fund manager's ability to construct a portfolio that replicates the chosen market index. The returns provided by index funds are dependent on the returns of the chosen market index. To understand the tracking performance of the

ETFs, we use the well-known market model by regressing the index fund returns with the tracking index returns based on the following null hypothesis:

H_{1a}: There is no significant replication of the chosen market index by an index mutual fund.

H_{1b}: There is no significant replication of the chosen market index by an exchange-traded fund.

The daily NAV return of index fund and the return of its chosen benchmark index were computed using formula (1) and (2), respectively.

$$R_{if} = \frac{NAVt - NAVt-1}{NAVt-1} \quad *100 \quad (1)$$

$$R_i = \frac{Index\ t - Index\ t-1}{Index\ t-1} *100 \quad (2)$$

Where R_{if} is the percentage return on index fund portfolio and R_i represents percentage return of the target index. NAV_t represents NAV of the index fund on dat t and $Index_t$ represents index closing value on day t. The study uses summary statistics to understand the nature of data, and the ADF test to check the presence of unit root in the time series. In statistics, a unit root test tests whether the time series is non-stationary and possesses a unit root. If a time series has a unit root, it shows a systematic pattern that is unpredictable. The ADF test tests the following null hypothesis.

H_{2a}: Index mutual fund return has a unit root.

H_{2b}: Exchange traded fund return has a unit root.

H_{2c}: Benchmark index return has a unit root.

3.3 Tracking Error:

The T.E. is defined as the annualized standard deviation of the difference in returns between the index fund and its target index. It measures the difference between returns from the index fund to that of the index. The lower the tracking error, the closer are the returns of a fund to that of an index and vice versa. The developed markets' studies have found that index mutual fund and ETFs have similar tacking error records (Rompotis, 2008). According to Frino and Gallagher (2001), the primary factors driving index fund TE are transaction costs, fund cash flows, benchmark volatility, fund cash flows, and index composition changes. These factors lead to an increase in the TE and highlight the fund manager's performance in minimizing it. T.E. is measured similarly to the methodology used by Yadav and Pope (1994), Frino and Gallagher (2001), and Narend and Scholar (2014).

$$TE = \sqrt{\frac{1}{n-1} \sum_{t=1}^{n} (e_{fund} - e_{index})^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where e_{fund} represent the returns of the index fund and e_{index} represents the returns of the fund's underlying benchmark index. The daily tracking error was computed and then annualized for index funds.

Table 1. Profile of selected index mutual funds (Obj 1).

Sr. No.	Fund Name	Issuer	Underlying Index	Inception
01	Birla sunlife Nifty index fund	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	17-09-2002

02	Franklin India Nifty index fund	Franklin Templeton Mutual Fund	NIFTY 50 TRI	04-08-2000
03	HDFC Index Fund-Nifty 50	HDFC Mutual Fund	NIFTY 50 TRI	17 -07-2002
04	HDFC Index Fund-Sensex plan	HDFC Mutual Fund	S&P BSE Sensex TRI	17-07-2002
05	ICICI Prudential Nifty index fund	ICICI Prudential Mutual Fund	NIFTY 50 TRI	26-02-2002
06	ICICI Prudential Nifty Next 50	ICICI Prudential Mutual	NIFTY Next 50 TRI	25-06-2010
07	ICICI Prudential Sensex	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	21-09-2017
08	IDBI Nifty index fund	IDBI Mutual Fund	NIFTY 50 TRI	25 -06-2010
09	IDBI Nifty Junior Index Fund	IDBI Mutual Fund	NIFTY Next 50 TRI	20-09-2010
10	IDFC NIFTY fund	IDFC Mutual Fund	NIFTY 50 TRI	30-04-2010
11	LIC Nifty index fund	LIC Mutual Fund	NIFTY 50 TRI	28-11-2002
12	LIC Sensex index fund	LIC Mutual Fund	S&P BSE Sensex TRI	05-12-2002
13	Principal Nifty 100 Equal Weight Fund	Principal Mutual Fund	Nifty 100 Equal Weighted TRI	27-07-1999
14	Nippon India Index Fund - Nifty	Nippon India Mutual Fund	NIFTY 50 TRI	28-09-2010
15	Nippon India Index Fund – Sensex	Nippon India Mutual Fund	S&P BSE Sensex TRI	28-09-2010

16	SBI Nifty index fund	SBI Mutual Fund	NIFTY 50 TRI	17 -01-2002
17	Tata Nifty Index Fund	Tata Mutual Fund	NIFTY 50 TRI	25 -02-2003
18	Tata Sensex Index Fund	Tata Mutual Fund	S&P BSE Sensex TRI	25-02-2003
19	Taurus Nifty Index Fund	Taurus Mutual Fund	NIFTY 50 TRI	19 -06-2010
20	UTI Nifty index fund	UTI Mutual Fund	NIFTY 50 TRI	06-03-2000

Source: Author's compilation

Table 2. Profile of selected ETFs (Obj 2).

Sr. No.	Fund Name	Issuer	Underlying Index	Inception
1	Aditya Birla Sun Life Nifty ETF	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	21-Jul-11
2	Aditya Birla Sun Life Sensex ETF	Aditya Birla Sun Life Mutual Fund	S&P BSE Sensex TRI	14-Jul-16
3	Axis Nifty ETF	Axis Mutual Fund	NIFTY 50 TRI	21-Jun-2017
4	Edelweiss ETF - Nifty Bank	Edelweiss Mutual Fund	NIFTY Bank TRI	15-Dec-15
5	Edelweiss ETF - Nifty 50	Edelweiss Mutual Fund	NIFTY 50 TRI	08-May-15
6	HDFC Nifty 50 ETF	HDFC Mutual Fund	NIFTY 50 TRI	09-Dec-15
7	HDFC Sensex ETF	HDFC Mutual Fund	S&P BSE Sensex TRI	09-Dec-15

8	BHARAT 22 ETF	ICICI Prudential Mutual Fund	S&P BSE Bharat 22 TRI	28-Nov-17
9	ICICI Prudential Midcap Select ETF	ICICI Prudential Mutual Fund	S&P BSE Midcap Select TRI	04-Jul-17
10	ICICI Prudential Nifty 100 ETF	ICICI Prudential Mutual Fund	NIFTY 100 TRI	20-Aug-13
11	ICICI Prudential Nifty ETF	ICICI Prudential Mutual Fund	NIFTY 50 TRI	20-Mar-13
12	ICICI Prudential Nifty Low Vol 30 ETF	ICICI Prudential Mutual Fund	NIFTY 100 Low Volatility 30	03-Jul-17
13	ICICI Prudential NV20 ETF	ICICI Prudential Mutual Fund	NIFTY 50 Value 20 TRI	17-Jun-16
14	ICICI Prudential Sensex ETF	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	10-Jan-03
15	IDFC Nifty ETF	IDFC Mutual Fund	NIFTY 50 TRI	07-Oct-16
16	IDFC Sensex ETF	IDFC Mutual Fund	S&P BSE Sensex TRI	07-Oct-16
17	Invesco India Nifty ETF	Invesco Mutual Fund	NIFTY 50 TRI	13-Jun-11
18	Kotak Nifty ETF	Kotak Mahindra Mutual Fund	NIFTY 50 TRI	02-Feb-10
19	Kotak PSU Bank ETF	Kotak Mahindra Mutual Fund	NIFTY PSU Bank TRI	08-Nov-07
20	Kotak Sensex ETF	Kotak Mahindra Mutual Fund	S&P BSE Sensex TRI	06-Jun-08
21	LIC MF ETF-Nifty 50	LIC Mutual Fund	NIFTY 50 TRI	20-Nov-15
22	LIC MF ETF -Nifty 100	LIC Mutual Fund	NIFTY 100 TRI	17-Mar-16

23	LIC MF ETF -Sensex	LIC Mutual Fund	S&P BSE Sensex TRI	30-Nov-15
24	Motilal Oswal M50 ETF	Motilal Oswal Mutual Fund	NIFTY 50 TRI	28-Jul-10
25	Motilal Oswal Midcap 100 ETF	Motilal Oswal Mutual Fund	NIFTY Midcap 100 TRI	31-Jan-11
26	Motilal Oswal Nasdaq 100 ETF	Motilal Oswal Mutual Fund	Nasdaq 100	29-Mar-11
27	Quantum Nifty ETF	Quantum Mutual Fund	NIFTY 50 TRI	10-Jul-08
28	Nippon India ETF Bank BeES	Nippon Mutual Fund	NIFTY Bank TRI	27-May-04
29	Nippon India ETF Infra BeES	Nippon Mutual Fund	NIFTY Infrastructure TRI	29-Sep-10
30	Nippon India ETF Junior BeES	Nippon Mutual Fund	NIFTY Next 50 TRI	21-Feb-03
31	Nippon India ETF Nifty 100	Nippon Mutual Fund	NIFTY 100 TRI	22-Mar-13
32	Nippon India ETF Nifty BeES	Nippon Mutual Fund	NIFTY 50 TRI	28-Dec-01
33	Nippon India ETF NV20 ETF	Nippon Mutual Fund	NIFTY 50 Value 20 TRI	08-Jun-15
34	Nippon India ETF PSU Bank BeES	Nippon Mutual Fund	NIFTY PSU Bank TRI	25-Oct-07
35	Nippon India ETF Sensex	Nippon Mutual Fund	S&P BSE Sensex TRI	24-Sep-14
36	SBI-ETF BSE 100	SBI Mutual Fund	S&P BSE 100 TRI	16-Mar-15
37	SBI-ETF Nifty 50	SBI Mutual Fund	NIFTY 50 TRI	23-Jul-15

38	SBI-ETF Nifty Next 50	SBI Mutual Fund	NIFTY Next 50 TRI	16-Mar-15
39	SBI-ETF Nifty Bank	SBI Mutual Fund	NIFTY Bank TRI	20-Mar-15
40	SBI –ETF Sensex	SBI Mutual Fund	S&P BSE Sensex TRI	08-Mar-13
41	UTI NIFTY ETF	UTI Mutual Fund	NIFTY 50 TRI	03-Sep-15
42	UTI SENSEX ETF	UTI Mutual Fund	S&P BSE Sensex TRI	03-Sep-15

(Authors compilation)

3.4 Empirical Results and Discussion

Table 3. Results of summary statistics of daily returns of index mutual fund.

Sr. No.	Fund Name	Obs	Mean	Std dev	Skewness	kurtosis
01	Birla Sunlife Nifty index fund	3997	0.07	1.54	0.12	22.73
02	Franklin India Nifty index fund	4863	0.04	1.41	-0.2	14.52
03	HDFC Index Fund-Nifty 50	3439	0.03	1.41	-0.05	16.54
04	HDFC Index Fund-Sensex plan	3422	0.03	1.44	-4.09	110.32
05	ICICI Prudential Nifty index fund	1485	0.002	0.01	-1.91	27.18
06	ICICI Prudential Nifty Next 50	2218	0.03	1.13	-0.76	13.02
07	ICICI Prudential Sensex	619	-2.8	0.01	-2.35	31.55
08	IDBI Nifty index fund	2398	0.02	1.06	-1.04	16.84

09	IDBI Nifty Junior Index Fund	1488	0.03	1.14	-1.38	14.82
10	IDFC NIFTY fund	2439	0.02	1.06	-0.94	15.34
11	LIC Nifty index fund	3395	-0.003	2.21	-27.29	122.93
12	LIC Sensex index fund	3401	0.03	1.43	0.19	15.8
13	Principal Nifty 100 Equal Weight Fund	4786	0.05	1.47	0.02	13.55
14	Nippon India Index Fund - Nifty	2330	0.01	1.06	-1.05	16.49
15	Nippon India Index Fund – Sensex	1780	0.02	1.01	-1.56	24.57
16	SBI Nifty index fund	4429	0.05	1.39	-0.19	15.69
17	Tata Nifty Index Fund	4173	0.03	2.21	-22.73	101.1
18	Tata Sensex Index Fund	3443	0.03	1.42	0.09	15.61
19	Taurus Nifty Index Fund	2406	0.02	1.04	-1	16.07
20	UTI Nifty index fund	3597	0.04	1.44	-0.04	15.22

Source: Author’s compilation

Table 3 shows the summary statistics of the return series of selected index mutual funds. The summary statistics show each index fund's number of observations, its mean return, standard deviation, skewness, and kurtosis of the data series. The mean implies average returns during the period. Standard deviation measures the variations in the data set. A low standard deviation indicates that value doesn’t vary much from the data set's mean and is favorable for the study. Skewness essentially measures the symmetry of the distribution, while kurtosis determines the heaviness of the distribution tails.

Table 4. Results of summary statistics of daily returns of ETFs.

Sr. No.	Fund Name	Obs	Mean	Std dev	Skewness	kurtosis
01	Aditya Birla Sun Life Nifty ETF	2086	0.03	1.44	-0.54	11.7
02	Aditya Birla Sun Life Sensex ETF	912	0.006	1.07	-2.35	35.58
03	Axis Nifty ETF	659	-0.01	1.19	-2.44	31.57
04	Edelweiss ETF - Nifty Bank	1056	0.02	1.36	-1.94	31.41
05	Edelweiss ETF - Nifty 50	1198	0.01	1.06	-2.11	29.59
06	HDFC Nifty 50 ETF	1046	0.01	1.07	-2.18	31.63
07	HDFC Sensex ETF	1061	0.02	1.07	-2.16	33.48
08	BHARAT 22 ETF	576	-0.07	1.38	-1.7	19.2
09	ICICI Prudential Midcap Select ETF	880	-0.004	1.24	-1.59	20.11
10	ICICI Prudential Nifty 100 ETF	1487	0.03	1.02	-1.89	26.54
11	ICICI Prudential Nifty ETF	1616	0.03	1.04	-1.74	24.51
12	ICICI Prudential Nifty Low Vol 30 ETF	669	-0.14	3.99	-23.48	587.66
13	ICICI Prudential NV20 ETF	931	0.02	1	-1.11	22.98
14	ICICI Prudential Sensex ETF	3442	0.18	10.49	33.19	318.88
15	IDFC Nifty ETF	774	0.006	1.13	-2.48	31.64
16	IDFC Sensex ETF	852	0.01	1.08	-2.42	39.31
17	Invesco India Nifty ETF	1485	0.02	1.03	-1.88	27.33
18	Kotak Nifty ETF	1953	-0.01	2.28	-31.08	128.6

19	Kotak PSU Bank ETF	1490	-0.01	2.22	1.54	26.08
20	Kotak Sensex ETF	2870	0.03	1.38	0.2	19.97
21	LIC MF ETF-Nifty 50	1066	0.01	1.06	-2.18	31.68
22	LIC MF ETF -Nifty 100	966	0.01	1.06	-2.35	33.35
23	LIC MF ETF –Sensex	879	0.01	1.1	-2.39	35.81
24	Motilal Oswal M50 ETF	2375	0.02	1.11	-0.93	14.24
25	Motilal Oswal Midcap 100 ETF	1491	0.03	1.19	-1.64	16.99
26	Motilal Oswal Nasdaq 100 ETF	1022	0.06	1.33	-0.61	15.72
27	Quantum Nifty ETF	2850	0.02	1.06	-1.95	26.32
28	Nippon India ETF Bank BeES	838	-0.09	3.4	-22.09	580.2
29	Nippon India ETF Infra BeES	838	-0.009	1.24	-1.08	17.69
30	Nippon India ETF Junior BeES	838	0.002	1.18	-1.62	18.7
31	Nippon India ETF Nifty 100	726	-0.004	1.14	-2.44	32.46
32	Nippon India ETF Nifty BeES	832	-0.1	3.31	-24.4	655.12
33	Nippon India ETF NV20 ETF	1164	-0.05	2.83	-27.8	868.2
34	Nippon India ETF PSU Bank BeES	838	-0.18	3.86	-14.5	355.6
35	Nippon India ETF Sensex	1352	0.01	1.05	-1.94	29.28
36	SBI-ETF BSE 100	691	-0.006	1.17	-2.41	31.52
37	SBI-ETF Nifty 50	1142	0.007	1.07	-2.02	29.66

38	SBI-ETF Nifty Next 50	1235	0.01	1.16	-1.52	16.52
39	SBI-ETF Nifty Bank	1215	0.01	1.39	-1.76	26.43
40	SBI –ETF Sensex	1492	0.03	1.08	-1.64	26.11
41	UTI NIFTY ETF	1096	0.01	1.07	-2.13	30.15
42	UTI SENSEX ETF	1073	0.02	1.09	-2.02	31.15

(Authors compilation)

Table 4 shows the summary statistics of the return series of selected index mutual funds. The summary statistics show each index fund's number of observations, its mean return, standard deviation, skewness, and kurtosis of the data series. The mean implies average returns during the period. Standard deviation measures the variations in the data set. A low standard deviation indicates that value doesn't vary much from the data set's mean and is favorable for the study. Skewness essentially measures the symmetry of the distribution, while kurtosis determines the heaviness of the distribution tails.

Table 5. Results of the ADF test for the return series of index mutual fund and their underlying index.

Fund Name	ADF t -stat	p -value	Index	ADF t -stat	p -value
Birla Sunlife Nifty index fund	-46.94	0.00	NIFTY 50 TRI	-45.64	0.00
Franklin India Nifty index fund	-65.78	0.00	NIFTY 50 TRI	-63.63	0.00
HDFC Index Fund-Nifty 50	-55.6	0.00	NIFTY 50 TRI	-53.16	0.00
HDFC Index Fund-Sensex plan	-56.16	0.00	S&P BSE Sensex TRI	-56.87	0.00
ICICI Prudential Nifty index fund	-15.96	0.00	NIFTY 50 TRI	-15.96	0.00
ICICI Prudential Nifty Next 50	-42.82	0.00	NIFTY Next 50 TRI	-42.78	0.00

ICICI Prudential Sensex	-9.51	0.00	S&P BSE Sensex TRI	-9.57	0.00
IDBI Nifty index fund	-47.34	0.00	NIFTY 50 TRI	-47.64	0.00
IDBI Nifty Junior Index Fund	-35.59	0.00	NIFTY Next 50 TRI	-35.63	0.00
IDFC NIFTY fund	-47.77	0.00	NIFTY 50 TRI	-45.81	0.00
LIC Nifty index fund	-36.33	0.00	NIFTY 50 TRI	-36.64	0.00
LIC Sensex index fund	-55.02	0.00	S&P BSE Sensex TRI	-55.09	0.00
Principal Nifty 100 Equal Weight Fund	-49.99	0.00	Nifty 100 Equal Weighted TRI	-48.92	0.00
Nippon India Index Fund - Nifty	-46.54	0.00	NIFTY 50 TRI	-46.59	0.00
Nippon India Index Fund – Sensex	-14.87	0.00	S&P BSE Sensex TRI	-14.93	0.00
SBI Nifty index fund	-63.00	0.00	NIFTY 50 TRI	-63.05	0.00
Tata Nifty Index Fund	-34.76	0.00	NIFTY 50 TRI	-34.64	0.00
Tata Sensex Index Fund	-56.02	0.00	S&P BSE Sensex TRI	-56.05	0.00
Taurus Nifty Index Fund	-47.4	0.00	NIFTY 50 TRI	-47.03	0.00
UTI Nifty index fund	-57.55	0.00	NIFTY 50 TRI	-57.41	0.00

Source: Author's compilation

As reflected in Table 5, the ADF test results indicate data to be stationary at level as both the null hypothesis (H_{2a} and H_{2c}) get rejected at a 1% level of significance. The ADF test results indicate that returns of all index mutual funds and returns of their underlying index are stationary and favorable for further analysis.

Table 6. Results of the ADF test for the return series of ETFs and their underlying index.

Fund Name	ADF t -stat	p - value	Index	ADF t -stat	p - value
Aditya Birla Sun Life Nifty ETF	-56.2	0.00	NIFTY 50 TRI	-44.52	0.00
Aditya Birla Sun Life Sensex ETF	-11.66	0.00	S&P BSE Sensex TRI	-11.8	0.00
Axis Nifty ETF	-9.76	0.00	NIFTY 50 TRI	-9.94	0.00
Edelweiss ETF - Nifty Bank	-30.93	0.00	NIFTY Bank TRI	-31.06	0.00
Edelweiss ETF - Nifty 50	-12.26	0.00	NIFTY 50 TRI	-12.29	0.00
HDFC Nifty 50 ETF	-13.14	0.00	NIFTY 50 TRI	-13.77	0.00
HDFC Sensex ETF	-13.24	0.00	S&P BSE Sensex TRI	-13.24	0.00
BHARAT 22 ETF	-9.01	0.00	S&P BSE Bharat 22 TRI	-9.01	0.00
ICICI Prudential Midcap Select ETF	-29.08	0.00	S&P BSE Midcap Select TRI	-29.04	0.00
ICICI Prudential Nifty 100 ETF	-13.55	0.00	NIFTY 100 TRI	-13.58	0.00
ICICI Prudential Nifty ETF	-16.27	0.00	NIFTY 50 TRI	-16.28	0.00
ICICI Prudential Nifty Low Vol 30 ETF	-10.51	0.00	NIFTY 100 Low Volatility 30	-10.59	0.00
ICICI Prudential NV20 ETF	-12.23	0.00	NIFTY 50 Value 20 TRI	-12.51	0.00
ICICI Prudential Sensex ETF	-67.29	0.00	S&P BSE Sensex TRI	-57.86	0.00
IDFC Nifty ETF	-10.5	0.00	NIFTY 50 TRI	-10.52	0.00

IDFC Sensex ETF	-11.3	0.00	S&P BSE Sensex TRI	-10.52	0.00
Invesco India Nifty ETF	-16.03	0.00	NIFTY 50 TRI	-16.06	0.00
Kotak Nifty ETF	-44.22	0.00	NIFTY 50 TRI	-43.25	0.00
Kotak PSU Bank ETF	-38.01	0.00	NIFTY PSU Bank TRI	-37.99	0.00
Kotak Sensex ETF	-50.77	0.00	S&P BSE Sensex TRI	-51.1	0.00
LIC MF ETF-Nifty 50	-13.42	0.00	NIFTY 50 TRI	-13.41	0.00
LIC MF ETF -Nifty 100	-12.43	0.00	NIFTY 100 TRI	-12.42	0.00
LIC MF ETF -Sensex	-11.68	0.00	S&P BSE Sensex TRI	-11.6	0.00
Motilal Oswal M50 ETF	-46.511	0.00	NIFTY 50 TRI	-47.08	0.00
Motilal Oswal Midcap 100 ETF	-35.87	0.00	NIFTY Midcap 100 TRI	-35.86	0.00
Motilal Oswal Nasdaq 100 ETF	-40.69	0.00	Nasdaq 100	-22.14	0.00
Quantum Nifty ETF	-15.44	0.00	NIFTY 50 TRI	-15.92	0.00
Nippon India ETF Bank BeES	-28.83	0.00	NIFTY Bank TRI	-10.54	0.00
Nippon India ETF Infra BeES	-10.97	0.00	NIFTY Infrastructure TRI	-10.98	0.00
Nippon India ETF Junior BeES	-9.72	0.00	NIFTY Next 50 TRI	-9.71	0.00
Nippon India ETF Nifty 100	-10.52	0.00	NIFTY 100 TRI	-10.6	0.00
Nippon India ETF Nifty BeES	-28.9	0.00	NIFTY 50 TRI	-11.41	0.00
Nippon India ETF NV20 ETF	-34.14	0.00	NIFTY 50 Value 20 TRI	-12.5	0.00

Nippon India ETF PSU Bank BeES	-29.6	0.00	NIFTY PSU Bank TRI	-29.5	0.00
Nippon India ETF Sensex	-15.2	0.00	S&P BSE Sensex TRI	-15.2	0.00
SBI-ETF BSE 100	-10.3	0.00	S&P BSE 100 TRI	-10.3	0.00
SBI-ETF Nifty 50	-11.92	0.00	NIFTY 50 TRI	-11.89	0.00
SBI-ETF Nifty Next 50	32.93	0.00	NIFTY Next 50 TRI	-12.03	0.00
SBI-ETF Nifty Bank	-34	0.00	NIFTY Bank TRI	-34.09	0.00
SBI –ETF Sensex	-34.02	0.00	S&P BSE Sensex TRI	-34.09	0.00
UTI NIFTY ETF	-13.53	0.00	NIFTY 50 TRI	-13.58	0.00
UTI SENSEX ETF	-13.25	0.00	S&P BSE Sensex TRI	-13.25	0.00

Source: Author's compilation

As reflected in Table 6, the ADF test results indicate the data to be stationary at level as both the null hypothesis (H_{2c} and H_{2c}) get rejected at a 1% level of significance. The ADF test results indicate that all ETF returns and returns of their underlying index are stationary and favorable for further analysis.

Table 7. Regression results showing tracking performance of index mutual funds.

Sr. No	Fund Name	Coefficient	Durbin-Watson test	R-squared	p-value
01	Birla Sunlife Nifty index fund	0.92	2.76	0.79	0.00
02	Franklin India Nifty index fund	0.94	2.96	0.91	0.00
03	HDFC Index Fund-Nifty 50	0.96	2.76	0.98	0.00

04	HDFC Index Fund-Sensex plan	0.84	2.24	0.73	0.00
05	ICICI Prudential Nifty index fund	0.98	2.24	0.99	0.00
06	ICICI Prudential Nifty Next 50	0.97	1.85	0.99	0.00
07	ICICI Prudential Sensex	0.97	1.97	0.99	0.00
08	IDBI Nifty index fund	0.98	3.16	0.98	0.00
09	IDBI Nifty Junior Index Fund	0.98	1.9	0.99	0.00
10	IDFC NIFTY fund	0.98	2.42	0.99	0.00
11	LIC Nifty index fund	0.66	1.1	0.19	0.00
12	LIC Sensex index fund	0.95	2.68	0.94	0.00
13	Principal Nifty 100 Equal Weight Fund	0.95	2.72	0.88	0.00
14	Nippon India Index Fund - Nifty	0.99	2.05	0.99	0.00
15	Nippon India Index Fund – Sensex	0.97	1.92	0.99	0.00
16	SBI Nifty index fund	0.96	3.1	0.97	0.00
17	Tata Nifty Index Fund	0.98	1.27	0.41	0.00
18	Tata Sensex Index Fund	0.97	2.77	0.99	0.00
19	Taurus Nifty Index Fund	0.97	2.23	0.98	0.00
20	UTI Nifty index fund	0.8	1.9	0.64	0.00

Source: Author's compilation

Table 7 shows the regression analysis result where index mutual fund return is the dependent variable, and the index return is the independent variable. In regression analysis,

the regression coefficient measures the degree of dependence of one variable on the other. It tells us about how much the dependent variable is expected to increase when the independent variable increases by one unit. As the p values are significant at 1% level, we reject our null hypothesis (H_{1a}) and ascertain that index mutual funds in India significantly replicate the performance of the underlying index. Table 7 also shows the Durbin-Watson statistic test, which tests the presence of autocorrelation. In the Durbin-Watson statistic test, the values are always between 0 and 4. A value close to 2 signifies no autocorrelation in the sample, and regression is not a spurious regression. R^2 is a statistical measure of how close the data are to the fitted regression line. In general higher the R^2, the better the model fits the data.

Table 8. Regression results showing the tracking performance of ETFs.

Sr. No	Fund Name	Coefficient	Durbin-Watson test	R-squared	p-value
01	Aditya Birla Sun Life Nifty ETF	0.96	2.98	0.55	0.00
02	Aditya Birla Sun Life Sensex ETF	0.97	1.98	0.97	0.00
03	Axis Nifty ETF	0.84	1.89	0.71	0.00
04	Edelweiss ETF - Nifty Bank	0.99	1.98	0.99	0.00
05	Edelweiss ETF - Nifty 50	1.00	1.4	0.99	0.00
06	HDFC Nifty 50 ETF	0.99	1.62	0.99	0.00
07	HDFC Sensex ETF	0.99	1.87	0.99	0.00
08	BHARAT 22 ETF	0.98	1.82	0.99	0.00

09	ICICI Prudential Midcap Select ETF	0.98	3.05	0.99	0.00
10	ICICI Prudential Nifty 100 ETF	0.98	1.9	0.99	0.00
11	ICICI Prudential Nifty ETF	0.98	1.89	0.98	0.00
12	ICICI Prudential Nifty Low Vol 30 ETF	0.98	2.27	0.99	0.00
13	ICICI Prudential NV20 ETF	0.99	1.65	0.99	0.00
14	ICICI Prudential Sensex ETF	0.99	1.99	0.94	0.00
15	IDFC Nifty ETF	0.98	2.02	0.99	0.00
16	IDFC Sensex ETF	0.98	2.06	0.99	0.00
17	Invesco India Nifty ETF	0.99	1.5	0.99	0.00
18	Kotak Nifty ETF	0.99	2	0.16	0.00
19	Kotak PSU Bank ETF	0.99	2	0.99	0.00
20	Kotak Sensex ETF	0.96	2.67	0.93	0.00
21	LIC MF ETF-Nifty 50	0.99	2.04	0.99	0.00
22	LIC MF ETF -Nifty 100	0.99	1.78	0.99	0.00
23	LIC MF ETF -Sensex	0.95	3.34	0.91	0.00
24	Motilal Oswal M50 ETF	1.00	1.66	0.98	0.00
25	Motilal Oswal Midcap 100 ETF	0.99	1.67	0.99	0.00
26	Motilal Oswal Nasdaq 100 ETF	0.19	2.09	0.04	0.00
27	Quantum Nifty ETF	1.00	2.17	0.96	0.00

28	Nippon India ETF Bank BeES	1.00	2	0.17	0.00
29	Nippon India ETF Infra BeES	0.99	2.19	0.99	0.00
30	Nippon India ETF Junior BeES	0.99	2.34	0.99	0.00
31	Nippon India ETF Nifty 100	0.99	1.45	0.99	0.00
32	Nippon India ETF Nifty BeES	1.00	2	0.11	0.00
33	Nippon India ETF NV20 ETF	1.00	2	0.13	0.00
34	Nippon India ETF PSU Bank BeES	1.00	2	0.37	0.00
35	Nippon India ETF Sensex	0.99	1.94	0.99	0.00
36	SBI-ETF BSE 100	0.99	2.11	0.99	0.00
37	SBI-ETF Nifty 50	1.00	1.99	0.99	0.00
38	SBI-ETF Nifty Next 50	0.99	2	0.99	0.00
39	SBI-ETF Nifty Bank	1.00	2.06	0.99	0.00
40	SBI –ETF Sensex	0.96	2.93	0.86	0.00
41	UTI NIFTY ETF	0.99	1.52	0.99	0.00
42	UTI SENSEX ETF	0.99	2.03	0.99	0.00

Source: Author's compilation

Table 8 presents the regression analysis result, where ETF return is the dependent variable, and the index return is the independent variable. In regression analysis, the regression coefficient measures the degree of dependence of one variable on the other. It tells us about how much the dependent variable is expected to increase when the independent variable

increases by one unit. For our study, coefficients are used as an indicator of the fund's tracking performance. A coefficient equal to unity reflects a full replication strategy of ETFs, which implies fund investment in all the target index components in the same weightage as represented by the index. As the p values are significant at a level of 1%, we reject our null hypothesis (H_{1b}) and hence ascertain that ETFs in India significantly replicate the performance of the underlying index. The tracking difference stamps from the fact that ETF creation requires maintaining a cash component and includes fund expenses. The regression coefficient provides evidence that Indian ETFs have done well to keep tracking differences to a minimal level and have shown a significant ability to mimic the target index portfolio. From the 42 equity ETFs sample, the Motilal Oswal Nasdaq 100 ETF is the only ETF with the least regression coefficient (0.19). The significant difference in the tracking performance may imply a non-full replication strategy wherein the fund may implement some selection techniques to pick the best-performing stocks of the index portfolio. Table 8 also presents the Durbin-Watson statistic test, which tests the presence of autocorrelation. In the Durbin-Watson statistic test, the values are always between 0 and 4. A value close to 2 signifies no autocorrelation in the sample, and regression is not a spurious regression. R squared is a statistical measure of how close the data are to the fitted regression line and measures the strength of the relationship between your model and the response variable on a convenient 0 – 100% scale. In general higher the R^2, the better the model fits the data.

Table 9. Results showing the measured tracking error of index mutual funds.

Rank	Fund Name	Tracking index	T.E.
1	ICICI Prudential Nifty index fund	NIFTY 50 TRI	0.023

2	ICICI Prudential Sensex	S&P BSE Sensex TRI	0.024
3	IDBI Nifty Junior Index Fund	NIFTY Next 50 TRI	0.032
4	Nippon India Index Fund - Nifty	NIFTY 50 TRI	0.036
5	ICICI Prudential Nifty Next 50	NIFTY Next 50 TRI	0.046
6	IDFC NIFTY fund	NIFTY 50 TRI	0.058
7	Nippon India Index Fund – Sensex	S&P BSE Sensex TRI	0.058
8	IDBI Nifty index fund	NIFTY 50 TRI	0.121
9	Taurus Nifty Index Fund	NIFTY 50 TRI	0.122
10	Tata Sensex Index Fund	S&P BSE Sensex TRI	0.143
11	HDFC Index Fund-Nifty 50	NIFTY 50 TRI	0.163
12	SBI Nifty index fund	NIFTY 50 TRI	0.237
13	LIC Nifty index fund	NIFTY 50 TRI	0.246
14	LIC Sensex index fund	S&P BSE Sensex TRI	0.346
15	Tata Nifty Index Fund	NIFTY 50 TRI	0.375
16	Franklin India Nifty index fund	NIFTY 50 TRI	0.412
17	Principal Nifty 100 Equal Weight Fund	Nifty 100 Equal Weighted TRI	0.497
18	Birla Sunlife Nifty index fund	NIFTY 50 TRI	0.714
19	HDFC Index Fund-Sensex plan	S&P BSE Sensex TRI	0.781
20	UTI Nifty index fund	NIFTY 50 TRI	0.905

Source: Author's compilation

Table 9 ranks the index mutual funds based on their TE. It shows the rank, fund name, tracking index, and the measured TE. The TE highlights the accuracy with which the index fund manager is able to adjust for the factors that deviate index fund returns from its

underlying index. It is the difference between returns from the index mutual fund to that of the target index. A lower TE indicates the ability of the fund manager to construct a portfolio that mimics the index. For index mutual funds, the study found the ICICI Prudential Nifty Index fund's tracking error to be lowest at 0.023, followed by ICICI Prudential Sensex at 0.024, IDBI Nifty Junior Index Fund (0.032), Nippon India Index Fund-Nifty (0.036). The highest TE of 0.905 is found to be for UTI Nifty Index Fund, followed by 0.781 of HDFC Index Fund-Sensex.

Table 10. Results showing the measured tracking error of ETFs.

Rank	ETF Name	Tracking index	T.E.
1	Invesco India Nifty ETF	NIFTY 50 TRI	0.006
2	LIC MF ETF -Nifty 100	NIFTY 100 TRI	0.007
3	Nippon India ETF Nifty 100	NIFTY 100 TRI	0.008
4	HDFC Nifty 50 ETF	NIFTY 50 TRI	0.009
5	UTI NIFTY ETF	NIFTY 50 TRI	0.01
6	ICICI Prudential Nifty Low Vol 30 ETF	NIFTY 100 Low Volatility 30	0.014
7	LIC MF ETF-Nifty 50	NIFTY 50 TRI	0.014
8	Nippon India ETF Junior BeES	NIFTY Next 50 TRI	0.014
9	Motilal Oswal Midcap 100 ETF	NIFTY Midcap 100 TRI	0.016
10	Nippon India ETF Infra BeES	NIFTY Infrastructure TRI	0.016
11	Nippon India ETF Sensex	S&P BSE Sensex TRI	0.02
12	UTI SENSEX ETF	S&P BSE Sensex TRI	0.02
13	ICICI Prudential Nifty 100 ETF	NIFTY 100 TRI	0.021
14	HDFC Sensex ETF	S&P BSE Sensex TRI	0.022

15	Edelweiss ETF - Nifty Bank	NIFTY Bank TRI	0.026
16	Nippon India ETF Bank BeES	NIFTY Bank TRI	0.029
17	Edelweiss ETF - Nifty 50	NIFTY 50 TRI	0.031
18	IDFC Nifty ETF	NIFTY 50 TRI	0.031
19	IDFC Sensex ETF	S&P BSE Sensex TRI	0.031
20	Nippon India ETF NV20 ETF	NIFTY 50 Value 20 TRI	0.038
21	ICICI Prudential NV20 ETF	NIFTY 50 Value 20 TRI	0.052
22	SBI-ETF Nifty 50	NIFTY 50 TRI	0.053
23	SBI-ETF Nifty Bank	NIFTY Bank TRI	0.053
24	Nippon India ETF Nifty BeES	NIFTY 50 TRI	0.063
25	SBI-ETF Nifty Next 50	NIFTY Next 50 TRI	0.065
26	BHARAT 22 ETF	S&P BSE Bharat 22 TRI	0.066
27	Nippon India ETF PSU Bank BeES	NIFTY PSU Bank TRI	0.07
28	ICICI Prudential Midcap Select ETF	S&P BSE Midcap Select TRI	0.098
29	SBI-ETF BSE 100	S&P BSE 100 TRI	0.109
30	Kotak PSU Bank ETF	NIFTY PSU Bank TRI	0.129
31	ICICI Prudential Nifty ETF	NIFTY 50 TRI	0.156
32	Aditya Birla Sun Life Sensex ETF	S&P BSE Sensex TRI	0.171
33	Quantum Nifty ETF	NIFTY 50 TRI	0.208
34	ICICI Prudential Sensex ETF	S&P BSE Sensex TRI	0.238
35	Motilal Oswal M50 ETF	NIFTY 50 TRI	0.252
36	LIC MF ETF –Sensex	S&P BSE Sensex TRI	0.318

37	Kotak Sensex ETF	S&P BSE Sensex TRI	0.356
38	SBI –ETF Sensex	S&P BSE Sensex TRI	0.37
39	Axis Nifty ETF	NIFTY 50 TRI	0.666
40	Aditya Birla Sun Life Nifty ETF	NIFTY 50 TRI	1.065
41	Kotak Nifty ETF	NIFTY 50 TRI	2.041
42	Motilal Oswal Nasdaq 100 ETF	Nasdaq 100	2.071

Source: Author's calculation

Table 10 ranks the ETFs based on their TE. It shows the rank, fund name, tracking index, and the measured TE. The T.E. highlights the accuracy with which the index fund manager is able to adjust for the factors that deviate index fund returns from its underlying index. It is the difference between returns from the ETF to that of the target index. Incase of ETFs, the study found the tracking error of the Invesco India Nifty ETF to be the lowest at 0.006, followed by that of LIC MF ETF Nifty 100 at 0.007, Nippon India ETF Nifty 100 (0.008), HDFC Nifty 50 ETF (0.009) and UTI Nifty 50 ETF (0.01). The highest TE of 2.071 was found for Motilal Oswal Nasdaq 100 ETF, followed by 2.041 for Kotak Nifty ETF, and 1.065 for Aditya Birla Sun Life Nifty ETF.

Table 11. Mean tracking error of select index funds

Index fund	Mean tracking error
Index mutual funds	0.266
Exchange traded funds	0.109

Source: Author's calculations

Table 11 shows the mean tracking error of the index mutual funds and ETFs. The mean TE of ETF (0.109) is lower than that of Index mutual fund (0.266). The lower TE indicates the

index fund's ability to provide returns in the long term that will commensurate with the tracking index and do well as the market.

Table 12. Results showing the top 10 index funds with the lowest tracking error.

Rank	Fund Name	Tracking index	Tracking Error
1	Invesco India Nifty ETF	NIFTY 50 TRI	0.006
2	LIC MF ETF -Nifty 100	NIFTY 100 TRI	0.007
3	Nippon India ETF Nifty 100	NIFTY 100 TRI	0.008
4	HDFC Nifty 50 ETF	NIFTY 50 TRI	0.009
5	UTI NIFTY ETF	NIFTY 50 TRI	0.010
6	ICICI Prudential Nifty Low Vol 30 ETF	NIFTY 100 Low Volatility 30	0.014
7	LIC MF ETF-Nifty 50	NIFTY 50 TRI	0.014
8	Nippon India ETF Junior BeES	NIFTY Next 50 TRI	0.014
9	Motilal Oswal Midcap 100 ETF	NIFTY Midcap 100 TRI	0.016
10	Nippon India ETF Infra BeES	NIFTY Infrastructure TRI	0.016

Source: Authors compilation

Table 12 shows the top 10 index funds with the lowest TE from the sample of 62 index funds. The table shows the rank, fund name, tracking index, and the measured TE. The absence of an index mutual fund in the top 10 index tracking fund based on the measured TE indicates ETFs' superior tracking ability compared to its counterpart. Although index mutual funds do not appear in the top 10 funds with the lowest TE, it is the ETF that has the highest TE of 2.071 (Motilal Oswal Nasdaq 100 ETF), followed by 2.041 (Kotak Nifty

ETF). The highest TE in the index mutual fund is 0.905 for the UTI Nifty Index Fund, followed by 0.781 of HDFC Index Fund-Sensex.

3.5 Conclusion

The study examines how well the index mutual funds and ETFs in India can mimic the chosen market index based on tracking performance and tracking error. Indexing is a passive investment strategy, and unlike active funds, does not aim to outperform the market index. Index funds being passive in nature, charge lower expenses than active mutual funds so that investors earn returns similar to that of a market index. Though all index funds passively track their target index, most ETFs have shown higher regression coefficients and lower TE than index mutual funds. The average tracking error of ETFs is 0.109, and that of index mutual funds is 0.266. Hence, it can be inferred that the ETF fund managers, on average, have shown a better ability to mimic index returns than their counterparts. The lower tracking error and higher regression coefficients of ETFs stem from its in-kind creation of units, which are then traded on an exchange. On the other hand, an index fund manager creates a portfolio once the money flows and after adjusting for the cash drag to meet the daily redemption orders. Index mutual fund is a passive fund strategy that, except for outperforming the market, retains all other traditional mutual funds features, allowing a systematic investment plan (SIP)—thereby making it difficult for the fund manager to buy underlying shares in exact proportion. In contrast, ETF being a stock, such investment plans are not available, and thus the fund has to take care only of its expense ratio. Therefore, even though most ETFs have shown lower TE, both products can cater to different investors' classes.

Chapter IV

Determinants of Fund Flow to select Index Mutual Funds and ETFs in India.

4.1 Introduction

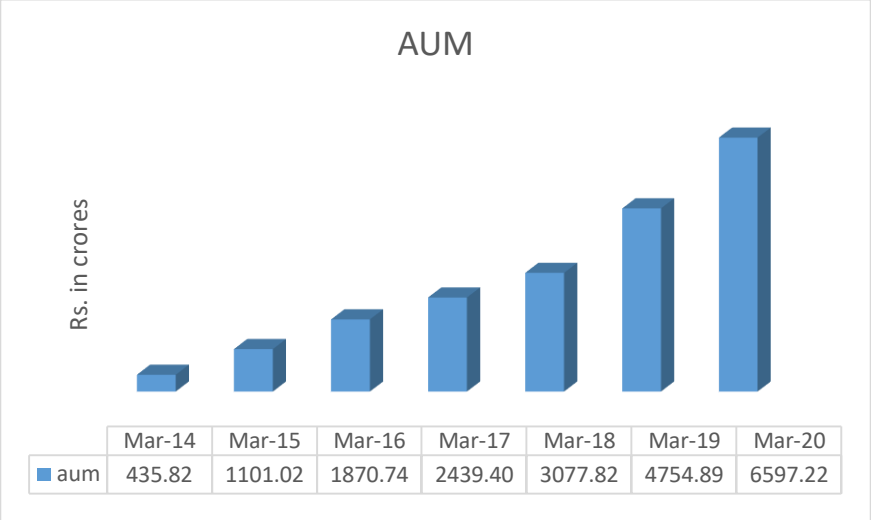
Indexing, as a passive investment strategy, has gained immense momentum in both overseas and Indian markets. At the global level, Index funds have done exceedingly well by offering whole new opportunities to retail and institutional investors. The first index fund was introduced in 1972, in the U.S., since then it has strengthened to a sizable portion throughout the world market. Although the growth of index funds was slow initially, the subsequent growth has been phenomenal. End of 2019, the assets managed by index funds at the global level have crossed through a $ 10tn level (The Morningstar). Passive investing looks more of a win-win for all stakeholders. Compared to an index fund, no economic benefit accrues to the average investor using actively managed equity mutual funds (Frino & Gallagher, 2001). Recent studies in the area have proved that except few, mutual funds have failed to outperform the market index (Carhart 1997; Elton et al. 1996; Goel, Sharma, and Mani 2012; Muruganandan 2011). In the presence of passive investing, fund houses can bring down the expenses incurred in research and fund manager's salaries. It also becomes easy for market regulators to keep track of fund portfolio and performance.

An index mutual fund is a mutual fund scheme that invests in a portfolio of stocks constructed in such a manner to track the performance of a target market, sector, commodity, bond, or other indices. Index mutual funds accept cash deposits from investors

and channelize those funds to the purchase of shares that constitute a chosen index in an attempt to mimic the benchmark index. For example, the S&P CNX Nifty 50 is an index that tracks the performance of 50 companies across various sectors of the Indian economy and offers investment managers exposure to the Indian market in one portfolio. Thus, funds tracking S&P CNX Nifty 50 invest in the constituent shares in the same proportion. Index fund investing help investors who are not actively following markets by allowing them index-based returns. Index funds strive to provide broad market exposure, low concentration risk, transparency, low operating expenses, and little portfolio turnover compared to conventional funds. The portfolio of an index mutual fund substantially changes only when the benchmark index change. Though Index funds strive to deliver returns similar to the benchmarked index, it still carries all the risk associated with the type of asset the fund holds. Indexing only ensures that the returns do not stray far from that of the target index.

In recent years Indian stock markets have also seen a surge in funds' flow to passively managed index funds. According to the Association of Mutual Funds in India (AMFI), there are 32 index mutual fund schemes covering an asset under management of ₹ 8089 Crores as of December 2019.

Figure 6. AUM of index mutual funds in the sample.



Source: Author's compilation

The statutory disclosure norm by the market regulator SEBI (Securities Exchange Board of India) from March 2014 makes it mandatory for all the Indian mutual funds to display scheme and geography wise monthly Asset Under Management (AUM) data on its website. This monthly AUM report provides valuable fund flow information providing insights into past investment trends. Understanding the flow performance relationship is an important indicator for investors and market regulators. Several studies document the relationship between fund characteristics, past performance and flow to conventional mutual funds (Barber et al., 2005; Ben Belgacem & Hellara, 2011; Del et al., 2009; Ferreira et al., 2012; Lynch, 2003; Salganik-Shoshan, 2017; Santini & Aber, 1998; Shu et al., 2002; Sirri & Tufano, 1998). However, very few studies (Arbaa & Varon, 2019b; E. J. Elton et al., 2004; WN Goetzmann & Massa, 1999; Levy & Lieberman, 2016) explore fund flows to passively managed mutual funds. There are various reasons to consider that there are different motivations for investors in deciding between conventional and index funds. The main

reason is that passive investors expect index funds to effectively track their benchmark index, regardless of their price behavior.

Similarly, when compared with the active style, passive investment style weakens the relationship between flows and returns(Levy & Lieberman, 2016). The study of past flows will help us to understand whether index mutual fund investors display selection skills when buying and selling funds units. The study has particular relevance, given the dominant role played by passive investors in current financial markets. Our study aims to address this research gap by framing the following two research questions:

Q1. Do index fund investors consider past performance in their fund selection process?

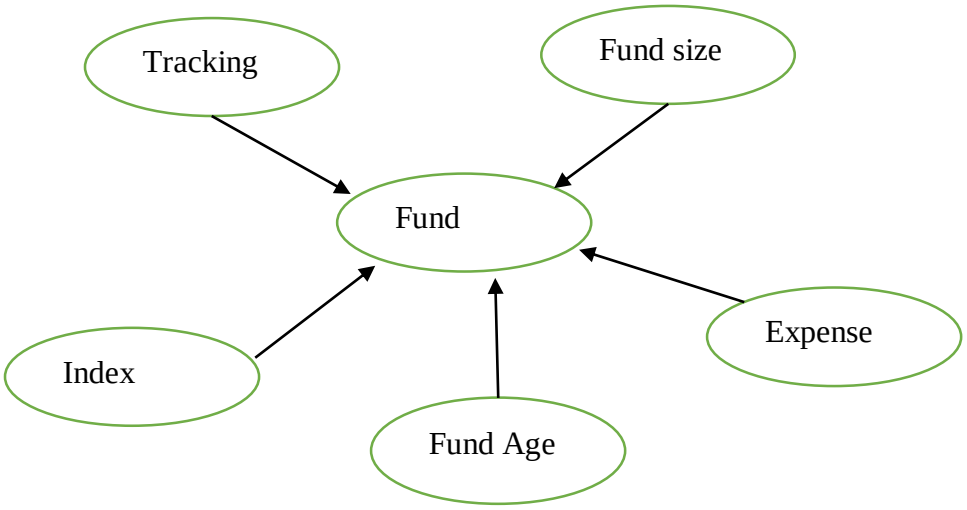
Q2. Do index fund investors consider fund characteristics other than performance when making investment decisions?

To address the above questions, we conduct an empirical study by making use of 20 equity index funds and 42 ETFs listed in India using monthly fund flows data over a period of seven years, from 2014 to 2020, with an objective of identifying the determinants of fund flows to index mutual funds.

The literature on mutual fund flows suggests the use of micro and macro approaches in determining the flow of funds. In the micro (intrinsic) approach, fund flows are analyzed on an individual basis, while the latter deals with macroeconomic variables and aggregate inflow and outflow of the mutual fund industry. In the micro approach, fund flow sensitivity with fund characteristics and past performance has been examined (Ferreira et al., 2012; WN Goetzmann & Massa, 1999; Sirri & Tufano, 1998). On the other hand, several studies (Krishnamurthy et al., 2018; Rudman, 2008; Santini & Aber, 1998)

examined the relationship between macroeconomic variables and aggregate mutual fund industry flows. Our study explores the micro variables and fund flow sensitivity of index funds in India. The literature has shown that performance and attributes could positively or negatively correlate with fund flows. We construct the research model shown in Figure 1 from the theory developed in the literature review.

Figure 7. Conceptual framework of fund flow determinants



Source: Author's Compilation

4.2 Identified variables

Fund flow

According to the standard literature, fund flow is defined as the percentage growth in total AUM between the beginning and end of period t. We measure monthly fund flows (dependent variable) according to Sirri & Tufano (1998) methodology:

$$Fund\ Flow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} X (1+R_{i,t})}{TNA_{i,t-1}}$$

……(1)

where $TNA_{i,t}$ represents the total assets of fund i at month t and $R_{i,t}$ represents the prior month's returns of the fund.

Index return

Index return as an independent variable that may affect flows to the fund. Index fund manager attempts to replicate the performances of its benchmark index. It is the theoretical return on a portfolio of a chosen market index of an index mutual fund. Each stock market index or sectorial index has its calculation methodology. It comprises of a group of stocks that represent the whole market or a specified sector or segment of the market which results in a varied performance of an index. As such, we expect a positive relationship of fund flows with the historical performance of the benchmark index.

The daily theoretical yield of index mutual fund's benchmark index is expressed by equation (2)

$$R_i = \frac{Index\ t - Index\ t-1}{Index\ t-1} \quad \ldots\ldots\ldots(2)$$

Where R_i represents the return on the chosen benchmark index, and index $_t$ represents the closing value of the stock market index on day t.

The following null hypothesis was framed:

$H_{3a:}$ There exists no significant impact of underlying index performance on fund flows to index mutual funds.

$H_{3b:}$ There exists no significant impact of underlying index performance on fund flows to ETFs

Tracking Error

An index fund's performance is quoted in terms of tracking error (Frino & Gallagher, 2001; Meade & Salkin, 1989). The difference between the returns of the benchmarked index and index mutual fund is tracking error. The fund manager's role is to minimize the tracking error, lower the tracking error; better is the fund manager's performance, and higher should be the flow of funds to the scheme. Studies have found different tracking error levels for funds tracking the same indices, substantiating the role of fund managers and other factors on index funds' performance. Elton et al. (2005) examined the S&P 500 index performance in the US market. Blitz et al. (2012) examined European index funds' performance by comparing index funds' returns and benchmark indices. Similar studies were conducted in India by Swati Garg and Y. P. Singh (2013), S. Narend (2014), and Dhabolkar and Reddy (2019). They found varying levels of performance for funds tracking the same index. Several factors may influence the magnitude of tracking error, but the principal reason is that the benchmarked index is measured as a "paper" portfolio, which assumes transactions occur at any time without any cost (Frino & Gallagher, 2001).

We use the method followed by (Pope and Yadav, 1994; and Frino and Gallagher, 2001) to measure tracking error. The monthly tracking error is calculated as the absolute difference between an index fund's returns and its chosen benchmark index ($e_{pt} = R_{if} - R_i$), where the monthly average absolute T.E. is calculated as follows.

The daily NAV return of an index mutual fund is expressed by equation (3).

$R_{if} = \frac{NAVt - NAVt-1}{NAVt-1}$

……(3)

Where the NAV $_t$ represents the net asset value of the index fund on day t.

$R_i = \frac{Index\ t - Index\ t-1}{Index\ t-1}$ *100 …..(4)

$T.E. = \frac{\sum_{t-1}^{n} |e_{pt}|}{n}$ …… (4)

The following null hypothesis was framed:

$H_{3c:}$ There exists no significant impact of tracking error on fund flows to index mutual funds.

$H_{3d:}$ There exists no significant impact of tracking error on fund flows to ETFs.

Total Expense Ratio

The TER is a measure of the total cost of a fund to the investor. Total cost includes various fees like purchase, redemption, auditing, and other fund management expenses. The TER, calculated by dividing the total annual cost by the fund's total assets averaged over that year, denoted as a percentage. It has been examined in previous research which, among others, includes Sirri and Tufano (1998), Blume & Edelen (2004), Odean and Zheng (2005), and Shoshan (2017).

The following null hypothesis was framed:

$H_{3e:}$ There exists no significant impact of total expense ratio on fund flows to index mutual funds.

$H_{3f:}$ There exists no significant impact of total expense ratio on fund flows to ETFs.

Fund Age

Another characteristic that may also affect fund flows is fund age. Ben Belgacem and Hellara (2011) provide direct evidence that there is a positive relationship between the fund's age and performance, indicating the existence of economies of experience. It also suggests that old funds enjoy better visibility. Fund age is estimated as natural logarithms of the months from the inception of the fund.

The following null hypothesis was framed:

$H_{3g:}$ There exists no significant impact of fund age on fund flows to index mutual funds.

$H_{3h:}$ There exists no significant impact of fund age on fund flows to ETFs.

Fund Size

The net assets represent the fund size under management for that month (in natural logarithms). The literature suggests that fund size may positively or negatively impact future performance and thereby on fund flows due to increasing or decreasing returns to scale (Belgacem and Hellara, 2011; Ferreira *et al.*, 2012). Funds with large asset sizes have the advantage of spreading fixed overhead expenses over a large asset base, which may lead to the fund's better performance.

The following null hypothesis was framed:

$H_{3i:}$ There exists no significant impact of AUM on fund flows to index mutual funds.

$H_{3j:}$ There exists no significant impact of AUM on fund flows to ETFs.

4.3 Data and Methodology

We propose to study only classical equity index funds listed in India. As the market indices consider dividend adjustment based on its announcement, we consider only growth funds with regular plans. The above conditions left us with a sample of 20 equity index mutual fund and 42 ETFs, the characteristics of which are presented in Table 12 and Table 13, respectively. The AMFI provides monthly AUM data only from March 2014. Hence, we consider a period from March 2014 to March 2020 to examine the determinants of fund flows to index mutual funds and ETFs. The monthly AUM data required to calculate fund flows, and the daily NAV of the selected index mutual funds schemes were sourced from the official website of AMFI. The daily closing prices of the benchmark index required to calculate index returns were sourced from the official website of the National Stock Exchange and Bombay Stock Exchange. The total expense ratio of the scheme required was sourced from the official website of the respective fund house.

A panel regression analysis was used to capture the fund flow determinants and is represented as the equation (5):

$$FF_{i,t} = \propto_0 + \beta_1 indexRet_{i,t} + \beta_2 age_{i,t} + \beta_3 \text{total exp.} ratio_{i,t} + \beta_4 size_{i,t} + \beta_5 TE_{i,t} + \epsilon_{i\prime t} \quad \ldots\ldots\ldots (5)$$

Where,

$FF_{i,t}$ represents the fund flows of the fund,

$indexRet_{i,t}$ represents the underlying benchmark returns,

$TE_{i,t}$ represents the monthly tracking error of the fund,

$age_{i,t}$ represents the natural log of monthly age of scheme,

total exp.$ratio_{i,t}$ denotes the natural log of expense ratio,

$size_{i,t}$ represents the natural log of the size of the fund of the AUM,

and $\epsilon_{i,t}$ represents the error term.

To test for consistency between the FEM and REM, we employed the Hausman specification test on the estimated coefficients of both the model. In panel data analysis, this diagnostic test helps you to choose between the panel data models. The Hausman test checks a more efficient model against a less efficient but consistent model to make sure that the more efficient model also gives consistent results. In the Hausman test, the null hypothesis is the following:

H_4: Random Effects Model is appropriate

If the p-value is insignificant, then it is safe to use the REM; if not, then we should use the FEM.

Econometric techniques like panel regression analysis, and the Hausman specification test, is done using the EViews 10 econometrics package.

Table 13. Profile of selected index mutual funds (obj 2).

Sr. No.	Index mutual fund	Issuer	Underlying Index	Inception Date
01	Birla sunlife Nifty index fund	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	17-09-2002
02	Franklin India Nifty index fund	Franklin Templeton Mutual Fund	NIFTY 50 TRI	04-08-2000
03	HDFC Index Fund-Nifty 50	HDFC Mutual Fund	NIFTY 50 TRI	17 -07-2002
04	HDFC Index Fund-Sensex plan	HDFC Mutual Fund	S&P BSE Sensex TRI	17-07-2002
05	ICICI Prudential Nifty index fund	ICICI Prudential Mutual Fund	NIFTY 50 TRI	26-02-2002
06	ICICI Prudential Nifty Next 50	ICICI Prudential Mutual	NIFTY Next 50 TRI	25-06-2010
07	ICICI Prudential Sensex	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	21-09-2017
08	IDBI Nifty index fund	IDBI Mutual Fund	NIFTY 50 TRI	25 -06-2010
09	IDBI Nifty Junior Index Fund	IDBI Mutual Fund	NIFTY Next 50 TRI	20-09-2010
10	IDFC NIFTY fund	IDFC Mutual Fund	NIFTY 50 TRI	30-04-2010
11	LIC Nifty index fund	LIC Mutual Fund	NIFTY 50 TRI	28-11-2002
12	LIC Sensex index fund	LIC Mutual Fund	S&P BSE Sensex TRI	05-12-2002
13	Principal Nifty 100 Equal Weight Fund	Principal Mutual Fund	Nifty 100 Equal Weighted TRI	27-07-1999

14	Nippon India Index Fund - Nifty	Nippon India Mutual Fund	NIFTY 50 TRI	28-09-2010
15	Nippon India Index Fund – Sensex	Nippon India Mutual Fund	S&P BSE Sensex TRI	28-09-2010
16	SBI Nifty index fund	SBI Mutual Fund	NIFTY 50 TRI	17 -01-2002
17	Tata Nifty Index Fund	Tata Mutual Fund	NIFTY 50 TRI	25 -02-2003
18	Tata Sensex Index Fund	Tata Mutual Fund	S&P BSE Sensex TRI	25-02-2003
19	Taurus Nifty Index Fund	Taurus Mutual Fund	NIFTY 50 TRI	19 -06-2010
20	UTI Nifty index fund	UTI Mutual Fund	NIFTY 50 TRI	06-03-2000

Source: Author's compilation

Table 13 shows the profile of selected index mutual funds for the study. It indicates the fund name, issuer, underlying index, and the date of inception.

Table 14. Profile of selected ETFs (Obj 2).

Sr. No.	Fund Name	Issuer	Underlying Index	Inception
1	Aditya Birla Sun Life Nifty ETF	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	21-Jul-11
2	Aditya Birla Sun Life Sensex ETF	Aditya Birla Sun Life Mutual Fund	S&P BSE Sensex TRI	14-Jul-16
3	Axis Nifty ETF	Axis Mutual Fund	NIFTY 50 TRI	21-Jun-2017
4	Edelweiss ETF - Nifty Bank	Edelweiss Mutual Fund	NIFTY Bank TRI	15-Dec-15

5	Edelweiss ETF - Nifty 50	Edelweiss Mutual Fund	NIFTY 50 TRI	08-May-15
6	HDFC Nifty 50 ETF	HDFC Mutual Fund	NIFTY 50 TRI	09-Dec-15
7	HDFC Sensex ETF	HDFC Mutual Fund	S&P BSE Sensex TRI	09-Dec-15
8	BHARAT 22 ETF	ICICI Prudential Mutual Fund	S&P BSE Bharat 22 TRI	28-Nov-17
9	ICICI Prudential Midcap Select ETF	ICICI Prudential Mutual Fund	S&P BSE Midcap Select TRI	04-Jul-17
10	ICICI Prudential Nifty 100 ETF	ICICI Prudential Mutual Fund	NIFTY 100 TRI	20-Aug-13
11	ICICI Prudential Nifty ETF	ICICI Prudential Mutual Fund	NIFTY 50 TRI	20-Mar-13
12	ICICI Prudential Nifty Low Vol 30 ETF	ICICI Prudential Mutual Fund	NIFTY 100 Low Volatility 30	03-Jul-17
13	ICICI Prudential NV20 ETF	ICICI Prudential Mutual Fund	NIFTY 50 Value 20 TRI	17-Jun-16
14	ICICI Prudential Sensex ETF	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	10-Jan-03
15	IDFC Nifty ETF	IDFC Mutual Fund	NIFTY 50 TRI	07-Oct-16
16	IDFC Sensex ETF	IDFC Mutual Fund	S&P BSE Sensex TRI	07-Oct-16
17	Invesco India Nifty ETF	Invesco Mutual Fund	NIFTY 50 TRI	13-Jun-11
18	Kotak Nifty ETF	Kotak Mahindra Mutual Fund	NIFTY 50 TRI	02-Feb-10
19	Kotak PSU Bank ETF	Kotak Mahindra Mutual Fund	NIFTY PSU Bank TRI	08-Nov-07

20	Kotak Sensex ETF	Kotak Mahindra Mutual Fund	S&P BSE Sensex TRI	06-Jun-08
21	LIC MF ETF-Nifty 50	LIC Mutual Fund	NIFTY 50 TRI	20-Nov-15
22	LIC MF ETF -Nifty 100	LIC Mutual Fund	NIFTY 100 TRI	17-Mar-16
23	LIC MF ETF -Sensex	LIC Mutual Fund	S&P BSE Sensex TRI	30-Nov-15
24	Motilal Oswal M50 ETF	Motilal Oswal Mutual Fund	NIFTY 50 TRI	28-Jul-10
25	Motilal Oswal Midcap 100 ETF	Motilal Oswal Mutual Fund	NIFTY Midcap 100 TRI	31-Jan-11
26	Motilal Oswal Nasdaq 100 ETF	Motilal Oswal Mutual Fund	Nasdaq 100	29-Mar-11
27	Quantum Nifty ETF	Quantum Mutual Fund	NIFTY 50 TRI	10-Jul-08
28	Nippon India ETF Bank BeES	Nippon Mutual Fund	NIFTY Bank TRI	27-May-04
29	Nippon India ETF Infra BeES	Nippon Mutual Fund	NIFTY Infrastructure TRI	29-Sep-10
30	Nippon India ETF Junior BeES	Nippon Mutual Fund	NIFTY Next 50 TRI	21-Feb-03
31	Nippon India ETF Nifty 100	Nippon Mutual Fund	NIFTY 100 TRI	22-Mar-13
32	Nippon India ETF Nifty BeES	Nippon Mutual Fund	NIFTY 50 TRI	28-Dec-01
33	Nippon India ETF NV20 ETF	Nippon Mutual Fund	NIFTY 50 Value 20 TRI	08-Jun-15
34	Nippon India ETF PSU Bank BeES	Nippon Mutual Fund	NIFTY PSU Bank TRI	25-Oct-07

35	Nippon India ETF Sensex	Nippon Mutual Fund	S&P BSE Sensex TRI	24-Sep-14
36	SBI-ETF BSE 100	SBI Mutual Fund	S&P BSE 100 TRI	16-Mar-15
37	SBI-ETF Nifty 50	SBI Mutual Fund	NIFTY 50 TRI	23-Jul-15
38	SBI-ETF Nifty Next 50	SBI Mutual Fund	NIFTY Next 50 TRI	16-Mar-15
39	SBI-ETF Nifty Bank	SBI Mutual Fund	NIFTY Bank TRI	20-Mar-15
40	SBI –ETF Sensex	SBI Mutual Fund	S&P BSE Sensex TRI	08-Mar-13
41	UTI NIFTY ETF	UTI Mutual Fund	NIFTY 50 TRI	03-Sep-15
42	UTI SENSEX ETF	UTI Mutual Fund	S&P BSE Sensex TRI	03-Sep-15

Source: Author's compilation

Table 14 shows the profile of selected ETFs for the study. It indicates the fund name, issuer, underlying index, and the date of inception

4.4 Empirical Results and Discussion

Table 15. Summary statistics of selected variables of index mutual fund

Unit	Fund flows (%)	Index return (%)	T. E.	T.E.R (%)	Size (Rs. in crores)	Age in months
Mean	6.34	0.10	0.01	0.93	129.81	128.64
Maximum	2988.04	3.60	0.27	1.9	1192.88	227
Minimum	-97.44	-1.30	-0.06	0.17	0.30	1

Std. Dev.	95.95	0.40	0.01	0.52	166.74	56.34
Skewness	28.14	0.77	4.16	0.39	2.63	-0.28
Kurtosis	856.66	9.29	57.7	2.02	12.36	1.75
Observation	1352	1352	1352	1352	1352	1352

Source: Author's compilation

Table 15 presents the summary statistics of the variables used for examining the determinants of fund flows to index mutual funds. We use mean, not to compare variables, but to indicate the average of each variable. The standard deviation indicates the variation in data over the period. Skewness refers to a measure of symmetry. The study found positive Skewness for data in case of fund flows, index return, tracking error (T.E.), total expense ratio (T.E.R.), and size. Only for age in months data was found to be negatively skewed. Kurtosis focuses on the flatness of the data. It assumes all the bell-shaped curves to be symmetrical but with different heights. Data sets with high kurtosis tend to have heavy tails and light tails for data sets with low kurtosis. We have 1352 monthly observations for fund flows, Index return, tracking error, total expense ratio, size of the fund, and age of the fund. It is pertinent to note that the mean tracking error of the chosen sample is 0.10; it indicates superior replication of index performance by the index mutual funds in India. The mean of the total expense ratio is 0.93%, which shows that index mutual funds are an attractive option for investors looking for passive returns. We use summary statistics to understand the nature of the data for each variable before proceeding for the advanced analysis.

Table 16. Results of pair-wise correlation coefficients of index mutual fund variables

Variables	Fund flows	Index return	Tracking error	Fund Age	Expense ratio	Fund size
Fund flows	1					
Index return	0.021	1				
Tracking error	-0.005	0.255	1			
Fund Age	0.035	-0.050	0.093	1		
Expense ratio	-0.009	0.006	-0.072	-0.347	1	
Fund Size	0.018	-0.012	0.121	0.497	-0.349	1

Source: Author's compilation

Table 16 presents the correlation matrix for fund attributes of index mutual fuds. The correlation coefficient matrix helps us to understand the primary relationship between the variables. The results reveal a positive relationship of fund flows with index return, fund age, and fund size. The negative correlation of tracking error, total expense ratio, and average NAV with fund flows reveal the preference of index investors in India. The positive correlation of tracking error with fund age and fund size signifies the increase in tracking error with an increase in fund size and fund age. The positive correlation between fund age and fund size reveals the ability of older index mutual funds to attract higher fund flows. The correlation matrix also provides evidence that older funds with an increase in fund size are able to reduce their total expense ratio. The NAV was found to be negatively correlated with fund flows, fund age, expense ratio, and fund size.

Table 17. Result of the fixed effects model for determinants of index mutual fund

Variables	Coefficient	P-value	Existence of significant impact
Constant	0.558	0.00***	
Index return	−0.237	0.76	No
Tracking error	1.386	0.46	No
Age	0.002	0.00***	Yes
Expense ratio	−0.2008	0.00***	Yes
Size	0.002	0.00***	Yes

Note: *** and ** signifies 1% and 5% level of significance, respectively

Source: Author's compilation.

Table 17 exhibits the results of the FEM for determinants of fund flows to index mutual funds. It highlights the variables, coefficient, P-values, and existence of significant impact based on P-values.

Table 18. Result of the random effects model for determinants of index mutual fund

Variables	Coefficient	P-value	Existence of significant impact
Constant	0.559213	0.04**	
Index return	−0.240572	0.76	No
Tracking error	1.39995	0.47	No
Age	0.00190348	0.00***	Yes

Expense ratio	−0.200981	0.00***	Yes
Size	0.00164697	0.00***	Yes

Source: Author's compilation Note: *** and ** signifies 1% and 5% level of significance, respectively

Table 18 exhibits the results of the REM for determinants of fund flows to index mutual funds. It highlights the variables, coefficient, P-values, and existence of significant impact based on P-values.

Table 19. Result of Hausman specification test for model selection for determinants of index mutual fund

Hausman test	X^2 Value	P value	Appropriate model
	1.96393	0.374574	REM

Source: Author's compilation

Table 19 exhibits the Hausman specification test values for best model selection amongst FEM and REM to interpret the results for fund flows' determinants to index mutual funds. With a P-Value of 0.37, we fail to reject our null hypothesis (H_4), and therefore the REM is considered to be appropriate for the analysis. Though the results of the FEM and REM presented, based on the Hausman specification test result, the study discusses test results only of the REM.

Performance-Flow relationship for index mutual fund

The study uses index return and tracking error of the index mutual funds to understand the flow-performance relationship. The panel regression result indicates statistically insignificant p-values for index return and tracking error (Failed to reject null hypothesis

H_{3a} and $H_{3c)}$. It reveals that investors are indifferent to the past performance of the index mutual funds and documents that the index mutual fund's historical performance does not play any significant role in attracting new flows. The result is probably due to less education amongst the Indian investors about index mutual funds' working vis a vis conventional funds. This result is consistent with Arbaa and Varon (2019a) findings, who found empirical evidence for no convex flow-performance relationship for passive fund investments.

Fund characteristics and fund flows of index mutual funds

The panel regression found the fund age, total expense ratio, and fund size of the index mutual fund statistically significant at a 1 percent significance level (Rejection of null hypothesis H_{3e}, $H_{3g,}$ and H_{3i}). The significant negative coefficient confirms that the index mutual funds with lower expense ratios attract more fund flows and vice-versa. As indexing is a passive investment strategy and does not require the fund manager to outperform the market, the investors prefer the funds with lower expenses while investing their money. This result is in line with Ben Belgacem & Hellara, (2011); Othman, (2018); Salganik-Shoshan, (2017); Sirri & Tufano, (1998)

The significant positive relationship between fund age and fund flows depicts that older funds attract more flows to index mutual funds. This result is consistent with findings of Ben Belgacem & Hellara, (2011). The fund size is statistically significant at 1 percent level, and the coefficient indicates that it has a positive relationship to fund flows. It also shows that a greater fund size could attract more investor attention and, at the same time, influence investors to put more money into the funds. This finding is consistent with Ben Belgacem

and Hellara (2011); Othman, Asutay, and Jamilan (2018). Experienced funds with a higher AUM base can better take care of their operating expenses, thereby attracting higher funds.

Table 20. Summary statistics of selected variables of ETFs

Unit	Fund flows (%)	Index return (%)	T. E.	T.E.R (%)	Size (Rs. in crores)	Age in months
Mean	10.82	0.75	-0.02	0.002	1079.0	55.65
Maximum	1696.2	25.79	79.26	1.15	4929	212.0
Minimum	-99.38	-21.53	-89.97	0.08	0.80	1
Std. Dev.	70.41	3.98	2.98	0.52	429.74	44.75
Skewness	12.74	0.3	-4.84	2.28	27.05	1.17
Kurtosis	235.52	5.54	739.21	6.12	57.21	1.04
Observation	1773	1773	1773	1773	1773	1773

Source: Author's compilation Note: *** and ** signifies 1% and 5% level of significance, respectively

Table 20 presents the summary statistics of the variables used for examining the determinants of fund flows to ETFs. We use the mean, not to compare variables, but to indicate the average of each variable. The standard deviation indicates the variation in data over the period. Skewness refers to a measure of symmetry. The study found positive Skewness for data in case of fund flows, index return, age, total expense ratio (T.E.R.), and size. Only for TE data was found to be negatively skewed. Kurtosis focuses on the flatness of the data. It assumes all the bell-shaped curves to be symmetrical but with different heights. Data sets with high kurtosis tend to have heavy tails and light tails for data sets with low kurtosis. We have 1773 monthly observations for fund flows, Index return,

tracking error, total expense ratio, size of the fund, and the fund's age. It is pertinent to note that the mean tracking error of the chosen sample is -0.02; it indicates superior replication of index performance by India's index mutual funds. The mean of the total expense ratio is 0.002%, which shows that ETFs are an attractive option for investors looking for passive returns. We use summary statistics to understand the nature of each variable's data before proceeding for the advanced analysis.

Table 21. Results of pair-wise correlation coefficients ETFs variables

Variables	Fund flows	Index return	Tracking error	Fund Age	Expense ratio	Fund Size
Fund flows	1					
Index return	-0.0313	1				
Tracking error	-0.0018	-0.0284	1			
Fund Age	-0.0458	-0.0143	-0.0162	1		
Expense ratio	-0.0091	0.0234	0.1012	0.0006	1	
Fund Size	-0.0069	0.0092	-0.0057	-0.0701	-0.0902	1

Source: Author’s compilation

The correlation matrix for fund characteristics presented in Table. 21 shows the relationship values between the variables selected for the study. The performance and characteristics variables show a negative correlation with the fund flows. The interrelations suggest that tracking error of an ETF scheme increases with an increase in expense ratio and a decrease in fund size. As funds mature, they tend to shrink in fund size and also reduced tracking error.

Table 22. Result of the fixed effects model for determinants of ETFs

Variables	Coefficient	p-value	Existence of significant impact
Constant	0.128026	0.04**	
Index return	0.00165198	0.65	No
Tracking error	−0.000121905	0.97	No
Age	−0.000472528	0.73	No
Expense ratio	−3.39799	0.08*	Yes
Size	−1.38444e-06	0.15	No

Source: Author's compilation Note: *** and ** signifies 1% and 5% level of significance, respectively

Table 21 exhibits the results of the FEM for determinants of fund flows to ETFs. It highlights the variables, coefficient, P-values, and existence of significant impact based on P-values.

Table 23. Result of the random effects model for determinants of ETFs

Variables	Coefficient	p-value	Existence of significant impact
Constant	0.371964	0.00***	
Index return	0.00192786	0.70	No
Tracking error	−4.98521e-05	0.94	No
Age	−0.000459366	0.22	No
Expense ratio	−18.029	0.03*	Yes
Size	−4.11568e-05	0.77	No

Source: Author's compilation Note: *** and ** signifies 1% and 5% level of significance, respectively

Table 23 exhibits the results of the REM for determinants of fund flows to index mutual funds. It highlights the variables, coefficient, P-values, and existence of significant impact based on P-values.

Table 24. Hausman specification test for model selection for determinants of ETFs

Hausman test	X^2 Value	P value	Appropriate model
	5.6237	0.466633	REM

Source: Author's compilation

In panel data analysis, the Hausman specification test helps to choose between the panel data models. In the Hausman test, the null hypothesis is that the preferred model is random effects, and the alternate hypothesis is that the preferred model as fixed effects. The result of the Hausman specification test is presented in Table 23. As we get a statistically insignificant p-value of 46.66% using the Hausman test, we fail to reject our null hypothesis (H_4) and select the REM. Though the FEM and REM results presented, based on the Hausman specification test result, the study discusses test results only of the REM.

The study made use of the benchmark index return and the tracking error as the performance indicators of ETFs. Unlike active mutual funds, ETF aims not to outperform the market index but replicate its performance. For index returns, the p-value of 0.70 signifies no significant effect on fund flows. The p-value of 0.94 shows that tracking error has no significant impact on fund flows. With the statistically insignificant p-values for index return and tracking error, we fail to reject our null hypothesis (H_{3b} and H_{3d}); it shows

that investors are indifferent to the ETFs' past performance. It also shows that the ETFs' historical performance does not play any significant role in attracting new flows to ETF schemes in India. To understand the relationship between ETF characteristics and fund flows, we used fund age, expense ratio, and fund size. The p-value of 0.22 for the fund age shows no significant effect on fund flows and provides no evidence that experienced ETFs are more persistent in achieving fund flows. In line with this, the panel regression also found no evidence of younger ETFs achieving higher fund flows; thus, we fail to reject our null hypothesis (H_{3h} and H_{3j}). With a 0.03 p-value, the panel regression finds the total expense ratio as the only statistically significant determinant at a 5 % level of significance thereby rejecting our null hypothesis (H_{3f}). The coefficient of -3.3979 indicates a negative relationship between the total expense ratio with fund flows. It confirms the fact that the ETF schemes with lower expense ratios attract higher fund flows and vice-versa. One of the benefits of investing in ETF schemes is that they offer lower operating costs than traditional open-end funds. These findings are partly in line with the results of Thenmozhi (2016) and Othman (2018), which found the expense ratio to be a key factor influencing flows to funds. For fund size, the p-value is 0.77. It shows that large or small AUM base plays no significant role in determining fund flows to ETFs. In the case of mutual funds, literature documents a positive relationship with fund size and flows (Belgacem & Hellera, 2011; Rudman, 2008) but fails to show any effect on ETFs, which follows a passive nature of investing.

4.5 Conclusion

The study examined the determinants of fund flows to index mutual funds and ETFs in India. The study investigated the impact of fund performance represented by tracking error

and theoretical returns of the target index; and fund attributes like the fund's size, age of the fund, and total expense ratio on net flows to index funds in India.

For index mutual funds, the study reveals that the total expense ratio is a significant factor that attracts investments, and fund managers must do well to reduce the total expense ratio. The research also shows that older index mutual funds with large asset size were able to attract more fund flows. It also indicates that a greater fund size could attract more investor attention and, at the same time, influence investors to put more money into the funds.

In ETFs' case, it is clear that lower operating cost is vital to attract higher fund flows, and ETFs should focus on decreasing their expense ratio. The insignificant tracking error and index returns also highlight the non-cognizance of investors towards performance measures of ETFs.

The panel regression indicates investors' insensitivity to index fund performance, which shows that fund managers are not rewarded for their ability to mimic the benchmark portfolio. And it is the total expense ratio that attracts investor attention for both the index-tracking funds.

Our result indicates a more passive approach of index investors, one which displays indifference to target index returns and tracking error, as a broad passive approach implies.

Index fund is a relatively newer product in India. Investors, after the opportunity to learn about index funds may alter how they evaluate various factors when buying index funds. As the index fund investing gains momentum in the Indian market and with the introduction of exchange-traded fund schemes, the future investors are bound to consider its comparative performance before investing. With the increasing popularity of index

funds, our findings can help investors, fund managers, and financial advisers understand the factors that drive investors' decisions in the index fund industry.

Chapter V

Pricing Efficiency and Price Discovery of ETFs in India

5.1 Introduction

ETF has two prices, NAV price and a market price. The key to understanding how ETFs work is the creation/redemption mechanism. When an ETF company wants to create new shares of its fund, whether to launch a new product or meet increasing market demand, it approaches authorized participant (AP). An AP may be a market maker, a specialist, or other large financial institution with a lot of buying power. It is the market maker's duty to acquire the shares that the ETF wants to hold. For instance, if an ETF is designed to track the NSE Nifty 50 index, the AP will buy shares in all the NSE Nifty 50 constituents in the exact proportion as the index and then deliver those shares to the ETF provider. In exchange, the provider gives the AP a block of equally valued ETF shares, called a creation unit. Market maker delivers a certain amount of underlying securities, and receives the same value in ETF shares, price based on their net asset value and not the market value at which ETF happens to be trading. It is beneficial for both parties; the ETF provider gets the stocks it needs to track the index, and AP receives ETF shares to resell on the exchange for a profit. The redemption process work in reverse. The AP can remove ETF shares from the market by purchasing enough shares to form a creation unit and then delivering those shares to the ETF issuer. In exchange, the AP receives the same value in the underlying securities of the fund. The creation/redemption process is vital for the ETF. The process keeps ETF share prices trading in line with the fund’s underlying net asset value. Because an ETF trades like a stock, its price will fluctuate during the trading hours, due to market

demand and supply. For instance, when ETF shares' demand increases, the ETF's share price may rise above the value of its underlying securities. When this happens, it is the AP who intervenes. Recognizing the overpriced ETF, the market maker might buy up the underlying shares that compose the ETF and then sell ETF shares on the open market. This exercise help drive the ETF's share market price back toward net asset value, while the market maker earns a risk-free arbitrage profit.

Likewise, suppose the ETF starts trading at a discount to the securities it holds. In that case, the AP can buy ETF shares equal to the creation unit on the cheap and redeem them for the underlying securities, which can be resold on the exchange. By buying up the undervalued ETF shares, the AP drives the ETF market price back towards the NAV while making a risk-free arbitrage profit. The arbitrage mechanism helps keep an ETF's market price in line with its underlying portfolio's net asset value. With multiple market makers watching most ETFs, ETF market prices typically stay in line with its net asset value.

5.2 Premium/Discount, Arbitrage, and Pricing Efficiency

ETF trades at a premium if it's market price is higher than the NAV, and at a discount if the market price is lower than the NAV. This price difference may have significant repercussions to investors, as it represents a cost if they buy overvalued ETF shares or sell undervalued ETF shares (Charteris, 2013). Pricing efficiency is the speed at which the AP corrects the deviations between ETFs NAV and market price. Gutierrez, Martinez, and Tse (2009) indicated that a perfectly efficient market provides greater liquidity, lower transaction costs, and fewer restrictions, which plays a vital role in price discovery into the stock market index and its derivatives. Thus, the present study investigates the pricing efficiency of Indian equity ETFs employing an autoregression model over its price

deviation and tries to understand the lead-lag relationship between ETF price and NAV using the vector error correction model (VECM).

5.3 Data and Methodology

The study investigates the pricing efficiency of domestic equity index ETFs listed on the National Stock Exchange and Bombay Stock Exchange. Figure 1 shows the substantial inflow of funds to the ETFs, especially from 2017 to 2020, which may significantly impact ETFs' performance. As such, we study the selected ETFs' pricing efficiency for three years, i.e., from April 2017 to March 2020. Table 1 shows the characteristics of the select ETFs.

The daily closing price of ETFs was sourced from the National Stock Exchange and Bombay Stock Exchange. The daily Net Asset Value of ETFs was sourced from the Association of Mutual Funds in India (AMFI).

The data cleaning process was undertaken for missing values, and the price deviation series, for further research, was calculated as the difference between the daily closing price of an ETF and its daily NAV.

The arbitrage persistence was captured to check for the pricing efficiency of ETFs. Arbitrage is the simultaneous buying and selling securities to take advantage of a price difference. The presence of arbitrage is denoted by the price deviation between the ETF market price and its NAV. The price deviation is equated as (1)

$$D = P_t - NAV_t \quad \ldots\ldots (1)$$

Where,

D = price deviation

P_t = closing price of the ETF and,

NAV_t = NAV of the ETF

If D is negative, the fund is said to be trading at a discount to its NAV and, at a premium, if it is contrary.

First, we used summary statistics to analyze and understand the nature of the obtained price deviation series. The summary statistics show the number of observations for each ETF, its mean deviation amount, minimum deviation amount, maximum deviation amount, standard deviation, skewness, and kurtosis of the data series. The mean implies average price deviation during the period. Standard deviation measures the variations in the data set. A low standard deviation indicates that value doesn't vary much from the mean of the data set and is favorable for the study. Skewness is a measure of the symmetry in distribution. In Skewness, we know that the data set is symmetrical if $\boldsymbol{\beta_1}$ is equal to 0, positively skewed if $\boldsymbol{\beta_1}$ is more than 1, and negatively skewed if $\boldsymbol{\beta_1}$ is less than 1. Kurtosis is a statistical measure that defines how heavily the tails of distribution differ from the tails of a normal distribution. It identifies whether the tails of a given distribution contain extreme values. Skewness essentially measures the symmetry of the distribution, while kurtosis determines the heaviness of the distribution tails.

The data being in the time series's nature, we performed the Augmented Dickey-Fuller (ADF) test to check if the deviation series is stationary or non-stationary. If the time series has a unit root, it shows a systematic pattern that provides unpredictable results. The following null hypothesis was framed:

H_5: The price deviation series has a unit root.

To measure the persistence of premium/discount, the premium/discount series so obtained (i.e., the difference between the closing price and NAV) was regressed against its lagged value. The following equation was used for the same (2) :

$$D = \Phi_0 + \Phi_1 D_{t-1} + \epsilon_t \quad \ldots\ldots (2)$$

An insignificant value for Φ_1 indicates that the premium or discount does not persist and disappears within one trading day. A significant value would suggest that deviation persist and can be taken advantage of by the investors. The persistence of deviation was analyzed using an autoregression model and by adding additional lagged values of the obtained price deviation as the explanatory variable (Charteris, 2013; Kayali, 2007). Because the regression model uses data from the same input variable at previous time steps, it is known as autoregression (regression of self) model. The autoregression model with two lags would be as follows:

$$D = \Phi_0 + \Phi_1 D_{t-1} + \Phi_2 D_{t-2} + \ldots\ldots\ldots\ldots + \Phi_p D_{t-p} + \epsilon_t \quad \ldots\ldots (3)$$

The AP of the fund does the creation and deletion of ETF units in the primary market; hence, the premium/discount, if any, should disappear within one trading day. If the price deviation persists for two or more days, investors can take advantage of these differences(Charteris, 2013). The following null hypothesis is framed:

H_6: The arbitrage persistence of the ETF in the Indian market does not disappear in a day.

To understand any long-run relationship between the NAV and the price of ETFs, we made use of the co-integration technique. Two time series are co-integrated if both are integrated of the same order, or there is a linear combination of the two-time series. When the price

and the NAV are not stationary at levels but are stationary at the first difference, then both are said to be integrated at the same order. The following null hypothesis was framed to test the presence of unit root:

H_{7a}: ETF NAV has a unit root.

H_{7b}: ETF market price has a unit root.

Using the Johansen co-integration test, the study finds a co-integration relationship between the two price series. The order lag selection was based on Akaike information criteria. As both the price and NAV variables were transformed into their log form to correct the trend, the researchers used no-constant and no-trend models in the co-integration tests. The examine the long term co-integration, the following null hypothesis was framed:

H_8: The market price and NAV of ETFs do not have any long-run relationship.

The study made use of the VECM analysis to examine the short-term dynamics between the integrated variables. Having identified the cointegrating vector's presence between the market price and NAV using the Johansen co-integration test, the VECM was applied to determine the lead and lag indicators among NAV and market price. The **Law of one price** (LOOP) necessitates the market price and NAV to be equal, but it is vital to identify how market price and NAV move back to equilibrium. This process is known as the **price discovery process** (Aditya & Desai, 2015). The VECM provides the error correction coefficient for both the variable's market price and NAV. The higher the error coefficient, the greater the amplitude of deviation from the long-run equilibrium. This signifies that the variable with a lower error coefficient is more efficient in reaching the long-run equilibrium

and hence leads the subsequent variable. Being the lead indicator, the variable with a lower error coefficient will move to the point of equilibrium long before the other variable. With this, the lead variable's historical information can be used effectively to predict the lag variable's moment. The following null hypothesis was framed:

H_9: Historical information of NAV cannot be used for predicting future price discovery of ETF.

Table 25. Profile of Selected ETFs (Obj 3).

Sr. No.	ETF	Issuer	Underlying Index	Inception Date
01	Aditya Birla Sun Life Nifty ETF	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	21-Jul-11
02	Edelweiss ETF - Nifty 100 Quality 30	Edelweiss Mutual Fund	NIFTY 100 Quality 30 TRI	25-May-16
03	Edelweiss ETF - Nifty Bank	Edelweiss Mutual Fund	NIFTY Bank TRI	15-Dec-15
04	Edelweiss ETF - Nifty 50	Edelweiss Mutual Fund	NIFTY 50 TRI	08-May-15
05	HDFC Nifty 50 ETF	HDFC Mutual Fund	NIFTY 50 TRI	09-Dec-15
06	HDFC Sensex ETF	HDFC Mutual Fund	S&P BSE Sensex TRI	09-Dec-15
07	ICICI Prudential Nifty 100 ETF	ICICI Prudential Mutual Fund	NIFTY 100 TRI	20-Aug-13
08	ICICI Prudential Nifty ETF	ICICI Prudential Mutual Fund	NIFTY 50 TRI	20-Mar-13
09	ICICI Prudential NV20 ETF	ICICI Prudential Mutual Fund	NIFTY 50 Value 20 TRI	17-Jun-16
10	ICICI Prudential Sensex ETF	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	10-Jan-03
11	IDFC Nifty ETF	IDFC Mutual Fund	NIFTY 50 TRI	07-Oct-16
12	IDFC Sensex ETF	IDFC Mutual Fund	S&P BSE Sensex TRI	07-Oct-16
13	Invesco India Nifty ETF	Invesco Mutual Fund	NIFTY 50 TRI	13-Jun-11
14	Kotak Banking ETF	Kotak Mahindra Mutual Fund	NIFTY Bank TRI	04-Dec-14
15	Kotak Nifty ETF	Kotak Mahindra Mutual Fund	NIFTY 50 TRI	02-Feb-10
16	Kotak PSU Bank ETF	Kotak Mahindra Mutual Fund	NIFTY PSU Bank TRI	08-Nov-07
17	Kotak Sensex ETF	Kotak Mahindra Mutual Fund	S&P BSE Sensex TRI	06-Jun-08

18	LIC MF Exchange Traded Fund-Nifty 50	LIC Mutual Fund	NIFTY 50 TRI	20-Nov-15
19	LIC MF Exchange Traded Fund-Nifty 100	LIC Mutual Fund	NIFTY 100 TRI	17-Mar-16
20	LIC MF Exchange Traded Fund-Sensex	LIC Mutual Fund	S&P BSE Sensex TRI	30-Nov-15
21	Motilal Oswal M50 ETF	Motilal Oswal Mutual Fund	NIFTY 50 TRI	28-Jul-10
22	Motilal Oswal Midcap 100 ETF	Motilal Oswal Mutual Fund	NIFTY Midcap 100 TRI	31-Jan-11
23	Motilal Oswal Nasdaq 100 ETF	Motilal Oswal Mutual Fund	Nasdaq 100	29-Mar-11
24	Quantum Nifty ETF	Quantum Mutual Fund	NIFTY 50 TRI	10-Jul-08
25	Nippon ETF Bank BeES	Nippon Mutual Fund	NIFTY Bank TRI	27-May-04
26	Nippon ETF Hang Seng BeES	Nippon Mutual Fund	HangSeng	09-Mar-10
27	Nippon ETF Infra BeES	Nippon Mutual Fund	NIFTY Infrastructure TRI	29-Sep-10
28	Nippon ETF Junior BeES	Nippon Mutual Fund	NIFTY Next 50 TRI	21-Feb-03
29	Nippon ETF Nifty 100	Nippon Mutual Fund	NIFTY 100 TRI	22-Mar-13
30	Nippon ETF Nifty BeES	Nippon Mutual Fund	NIFTY 50 TRI	28-Dec-01
31	Nippon ETF NV20 ETF	Nippon Mutual Fund	NIFTY 50 Value 20 TRI	08-Jun-15
32	Nippon ETF PSU Bank BeES	Nippon Mutual Fund	NIFTY PSU Bank TRI	25-Oct-07
33	Nippon ETF Sensex	Nippon Mutual Fund	S&P BSE Sensex TRI	24-Sep-14
34	SBI-ETF BSE 100	SBI Mutual Fund	S&P BSE 100 TRI	16-Mar-15
35	SBI-ETF Nifty 50	SBI Mutual Fund	NIFTY 50 TRI	23-Jul-15
36	SBI-ETF Nifty Next 50	SBI Mutual Fund	NIFTY Next 50 TRI	16-Mar-15
37	SBI-ETF Nifty Bank	SBI Mutual Fund	NIFTY Bank TRI	20-Mar-15
38	UTI NIFTY Exhcange Traded Fund	UTI Mutual Fund	NIFTY 50 TRI	03-Sep-15
39	UTI SENSEX Exchange Traded Fund	UTI Mutual Fund	S&P BSE Sensex TRI	03-Sep-15

Source: Author's compilation

5.4 Empirical Results and Discussion

Table 26. Summary statistics for the ETF price deviation from NAV

Price Deviation	No. of Obs	Mean	Standard Dev	Minimum Dev (₹)	Maximum Dev (₹)	β1	β2
Aditya Birla Sun Life Nifty ETF	676	-2.439	4.36	-13.03	13.18	0.66	4.20
Edelweiss ETF - Nifty 100 Quality 30	638	0.937	14.77	-35.28	50.62	0.14	3.11

Edelweiss ETF - Nifty Bank	439	24.642	210.19	-360.610	623.830	0.61	2.72
Edelweiss ETF - Nifty 50	520	432.340	877.97	-1531.600	2286.800	0.40	2.13
HDFC Nifty 50 ETF	692	0.368	3.36	-9.68	14.38	0.23	3.31
HDFC Sensex ETF	587	9.703	48.71	-208.61	443.76	1.78	22.79
ICICI Prudential Nifty 100 ETF	692	0.010	0.88	-4.53	13.40	10.62	15.83
ICICI Prudential Nifty ETF	692	-0.018	0.20	-0.80	1.35	1.62	11.52
ICICI Prudential NV20 ETF	674	0.048	0.35	-0.41	5.25	11.17	14.81
ICICI Prudential Sensex ETF	654	0.559	4.17	-25.90	60.69	8.59	12.90
IDFC Nifty ETF	637	-0.549	1.70	-5.10	15.72	1.64	21.88
IDFC Sensex ETF	437	0.516	10.59	-32.68	54.95	0.09	7.66
Invesco India Nifty ETF	504	-10.607	34.27	-109.72	204.81	1.57	15.63
Kotak Banking ETF	692	0.038	1.19	-3.59	17.26	6.53	91.08
Kotak Nifty ETF	692	-2.027	41.03	-910.17	3.84	-22.09	49.57
Kotak PSU Bank ETF	692	-0.033	2.97	-43.450	12.461	-7.67	109.24
Kotak Sensex ETF	663	-0.272	2.68	-7.94	34.86	4.85	65.62
LIC MF Exchange Traded Fund-Nifty 50	691	0.318	1.72	-4.49	21.94	5.01	58.14
LIC MF Exchange Traded Fund-Nifty 100	601	-1.994	4.21	-14.31	13.22	0.01	3.89
LIC MF Exchange Traded Fund-Sensex	641	-1.707	15.49	-43.11	66.91	0.76	4.81
Motilal Oswal M50 ETF	692	-0.598	1.17	-4.47	5.03	1.26	7.17
Motilal Oswal Midcap 100 ETF	692	0.367	0.56	-0.58	2.22	1.04	3.44
Motilal Oswal Nasdaq 100 ETF	691	47.955	40.13	-26.38	134.97	0.005	1.58
Quantum Nifty ETF	699	-2.198	7.22	-84.13	17.28	-4.88	57.44
Nippon ETF Bank BeES	692	0.564	5.11	-12.93	22.51	0.32	3.21
Nippon ETF Hang Seng BeES	651	114.093	222.76	-298.15	705.94	0.45	2.25
Nippon ETF Infra BeES	692	-0.036	2.04	-25.80	14.41	-3.00	58.41
Nippon ETF Junior BeES	692	0.283	0.61	-1.29	2.55	-0.30	2.66
Nippon ETF Nifty 100	681	0.080	0.64	-1.606	7.655	3.50	40.82
Nippon ETF Nifty BeES	692	-0.156	1.79	-3.84	4.20	0.22	1.93
Nippon ETF NV20 ETF	527	1.757	3.25	-9.14	25.15	2.11	16.56
Nippon ETF PSU Bank BeES	692	0.101	2.94	-48.20	11.32	-11.11	171.86
Nippon ETF Sensex	411	0.394	5.14	-14.34	64.86	9.21	118.81
SBI-ETF BSE 100	636	0.483	1.52	-3.11	9.68	3.09	14.98
SBI-ETF Nifty 50	692	0.105	0.25	-0.61	1.96	1.75	12.68
SBI-ETF Nifty Next 50	692	0.472	1.13	-3.79	10.97	1.13	2.58

SBI-ETF Nifty Bank	692	0.177	0.68	-1.65	8.12	3.13	39.66
UTI NIFTY Exhcange Traded Fund	670	1.308	7.24	-19.38	66.21	2.48	22.55
UTI SENSEX Exchange Traded Fund	490	3.001	12.22	-52.36	50.201	-0.48	8.57

Source: Author's compilation

Note: β1 and β2 represent skewness and kurtosis, respectively.

Table 26 presents the summary statistics of the price deviation series of the selected ETFs. The measure of performance herein is used to indicate the average price deviation of the respective ETF. The mean value signifies, on an average, 26 ETFs trade at a premium and the remaining 13 at a discount. The standard deviation reflects the variation in data over a period of time. During the study period, the lowest deviation of ₹ -1531.60 and the highest deviation of ₹ 2286.80 is witnessed for Edelweiss ETF - Nifty 50. The summary statistic results are provided to know the data's nature before proceeding with the advanced analysis.

Test of Stationarity

Table 27. Result of stationarity test of price deviation series

ETF	t-statistics	ETF	t-statistics
Aditya Birla Sun Life Nifty ETF	-4.12903 ***	Motilal Oswal M50 ETF	-7.921***
Edelweiss ETF - Nifty 100 Quality 30	-3.533***	Motilal Oswal Midcap 100 ETF	-3.662***
Edelweiss ETF - Nifty Bank	-3.068**	Motilal Oswal Nasdaq 100 ETF	-19.759***
Edelweiss ETF - Nifty 50	-2.941**	Quantum Nifty ETF	-12.225***

HDFC Nifty 50 ETF	-7.760***	Nippon ETF Bank BeES	-9.475***
HDFC Sensex ETF	-15.790***	Nippon ETF Hang Seng BeES	-2.935**
ICICI Prudential Nifty 100 ETF	-22.439***	Nippon ETF Infra BeES	-20.629***
ICICI Prudential Nifty ETF	-9.552***	Nippon ETF Junior BeES	-4.893***
ICICI Prudential NV20 ETF	-12.421***	Nippon ETF Nifty 100	-10.016***
ICICI Prudential Sensex ETF	-15.023***	Nippon ETF Nifty BeES	-12.891***
IDFC Nifty ETF	-14.317***	Nippon ETF NV20 ETF	-13.284***
IDFC Sensex ETF	-12.412***	Nippon ETF PSU Bank BeES	-14.178***
Invesco India Nifty ETF	-18.842***	Nippon ETF Sensex	-13.428***
Kotak Banking ETF	-15.029***	SBI-ETF BSE 100	-6.267***
Kotak Nifty ETF	-22.121***	SBI-ETF Nifty 50	-10.258***
Kotak PSU Bank ETF	-14.944***	SBI-ETF Nifty Next 50	-12.660***
Kotak Sensex ETF	-12.895***	SBI-ETF Nifty Bank	-19.475***
LIC MF Exchange Traded Fund-Nifty 50	-19.865***	UTI NIFTY Exhcange Traded Fund	-11.695***
LIC MF Exchange Traded Fund-Nifty 100	-7.260***	UTI SENSEX Exchange Traded Fund	-5.561***
LIC MF Exchange Traded Fund-Sensex	-4.613***		

Source: Author's compilation

Note: ***, ** indicate significance at 1% and 5% confidence levels, respectively.

Table 27 presents the ADF test results to check for a unit root in the price deviation series. The results indicate data to be stationary, as the null hypothesis (H_5) gets rejected at various levels of significance. The ADF tests result is considered favorable in the study's present context for applying the autoregression model.

Autoregression (AR) analysis

Table 28. Persistence in the price deviations

Sr. No.	ETF	Φ_0	Φ_1	Φ_2	Φ_3	Φ_4
1	Aditya Birla Sun Life Nifty ETF	−0.281***	0.518***	0.288***	0.064	
2	Edelweiss ETF - Nifty 100 Quality 30	0.185***	0.533***	0.141***	0.79	
3	Edelweiss ETF - Nifty Bank	2.144	0.594***	-0.230		
4	Edelweiss ETF - Nifty 50	96.790**	0.438***	0.198***	0.085	
5	HDFC Nifty 50 ETF	0.111	0.289***	0.137**	0.090**	0.085
6	HDFC Sensex ETF	7.647***	0.194***	0.031		
7	ICICI Prudential Nifty 100 ETF	0.010	-0.014			
8	ICICI Prudential Nifty ETF	-0.008	0.445***	0.148***	-0.033	
9	ICICI Prudential NV20 ETF	0.048***	-0.005			
10	ICICI Prudential Sensex ETF	0.555***	0.006			
11	IDFC Nifty ETF	-0.280***	0.496***	-0.009		
12	IDFC Sensex ETF	0.389	0.213***	0.042		

13	Invesco India Nifty ETF	-3.110***	0.366***	0.148***	0.153***	0.004
14	Kotak Banking ETF	0.038	0.233***	0.153***	0.103	
15	Kotak Nifty ETF	-2.026	-0.000			
16	Kotak PSU Bank ETF	-0.028	0.345***	-0.124***	-0.043	
17	Kotak Sensex ETF	-0.259***	0.040			
18	LIC MF Exchange Traded Fund-Nifty 50	0.263***	0.096**	0.08		
19	LIC MF Exchange Traded Fund-Nifty 100	-0.510***	0.636***	0.089		
20	LIC MF Exchange Traded Fund-Sensex	-0.700***	0.476***	0.106		
21	Motilal Oswal M50 ETF	-0.171***	0.445***	0.190***	0.072	
22	Motilal Oswal Midcap 100 ETF	0.02**	0.71***	0.155***	0.062	
23	Motilal Oswal Nasdaq 100 ETF	0.813	0.887***	0.093		
24	Quantum Nifty ETF	-2.164***	0.011			
25	Nippon ETF Bank BeES	0.307	0.285***	0.203***	0.043	
26	Nippon ETF Hang Seng BeES	4.218**	0.743***	0.130**	0.08	
27	Nippon ETF Infra BeES	-0.029	0.049			
28	Nippon ETF Junior BeES	0.125***	0.264***	0.085		
29	Nippon ETF Nifty 100	0.067**	0.155***	-0.009		
30	Nippon ETF Nifty BeES	-0.062	0.434***	0.095**	0.040	
31	Nippon ETF NV20 ETF	1.030***	0.244***	0.088		

32	Nippon ETF PSU Bank BeES	0.071	0.450***	-0.156***	0.014	
33	Nippon ETF Sensex	0.375	0.071			
34	SBI-ETF BSE 100	0.092**	0.594***	0.105		
35	SBI-ETF Nifty 50	0.049***	0.345***	0.093**	0.114***	-0.015
36	SBI-ETF Nifty Next 50	0.332***	0.142***	0.108***	0.056	
37	SBI-ETF Nifty Bank	0.139***	0.111***	0.089**	0.035	
38	UTI NIFTY Exhcange Traded Fund	0.844***	0.209***	0.112***	0.050	
39	UTI SENSEX Exchange Traded Fund	2.512***	0.463***	-0.102		

Source: Author's compilation

Note: ***, **, * indicate significance at 1%, 5% and 10% confidence levels, respectively.

The result of the autoregression (AR) analysis is displayed in Table 28. The intercept estimate of this regression model should closely approximate the average difference between the market price and the NAV of the ETF. The average percentage deviation captured by the intercept for 12 ETFs is negative, which shows that these funds trade at a discount to their NAV. Whereas the remaining 27 ETFs trade at a premium to their NAV. However, intercept values are significant only for 25 out of 39 ETFs. For eight funds (ICICI Prudential Nifty 100 ETF, ICICI Prudential NV20 ETF, ICICI Prudential Sensex ETF, Kotak Nifty ETF, Kotak Sensex ETF, Quantum Nifty ETF, Nippon ETF Infra BeES, Nippon ETF Sensex), the coefficient on the first day was insignificant, thereby indicating that the premium/discount disappears within one day.

Thirteen funds took two days for the deviation to disappear whch include Edelweiss ETF - Nifty Bank, HDFC Sensex ETF, IDFC Nifty ETF, IDFC Sensex ETF, LIC MF Exchange Traded Fund-Nifty 50, LIC MF Exchange Traded Fund-Nifty 100, LIC MF Exchange Traded Fund-Sensex, Motilal Oswal Nasdaq 100 ETF, Nippon ETF Junior BeES, Nippon ETF Nifty 100, Nippon ETF NV20 ETF, SBI-ETF BSE 100, and UTI SENSEX Exchange Traded Fund. Three funds, which include (HDFC Nifty 50 ETF, Invesco India Nifty ETF, and SBI-ETF Nifty 50), the coefficient on fourth lag was insignificant, thereby indicating that the premium or discount disappears within four days. The study found that from the sample, eight funds take one day, thirteen funds take two days, fifteen funds take three days, and three funds take four days for its market price to align back to its NAV. Our study document that equity ETFs listed in India takes a minimum of one day and a maximum of four days for the price deviation to disappear. This finding is in contrast with previous studies made on Indian equity ETFs but during different time horizons. Aditya and Desai (2015), with a sample of seventeen ETFs, found that Indian ETFs take a minimum of four days and a maximum of ten days for the deviation between market price and NAV to disappear. Our findings are partly consistent with Purohit and Malhotra (2015) which found that arbitrage opportunity in Indian equity ETF persist for an average of three days.

The sample also includes two funds tracking foreign market indices, Nasdaq 100 TRI representing the U.S. market, and Hang Seng TRI for the Hong Kong market. It is also interesting to see arbitragers' role to set off the price deviation considering incongruity in timings of Indian stock markets vis-a-vis the foreign market. The study found the Motilal Oswal Nasdaq 100 ETF requires two days for its deviation to disappear. While Nippon ETF Hang Seng BeES needs three days for aligning price with NAV. Thus, with the

available information, we fail to reject the null hypothesis (H_6) and found the Indian ETF market only partially efficient. Our finding is partly in line with Charteris (2013), which found the deviation of domestic and foreign ETFs listed in South Africa does not persist for more than two days. The varying levels of ETFs' pricing efficiency tracking the same indices highlight the critical role to be played by each AP tied up with the fund house.

Table 29. Unit root tests for the Price and NAV of ETF

Scheme name	Price		NAV	
	Level	First Diff	Level	First Diff
Aditya Birla Sun Life Nifty ETF	0.5325	0.0000	0.5862	0.0000
Edelweiss ETF - Nifty 100 Quality 30	0.7294	0.0000	0.6116	0.0000
Edelweiss ETF - Nifty Bank	0.0707	0.0000	0.5744	0.0000
Edelweiss ETF - Nifty 50	0.1818	0.0000	0.3785	0.0000
HDFC Nifty 50 ETF	0.6542	0.0000	0.5946	0.0000
HDFC Sensex ETF	0.5015	0.0000	0.4323	0.0000
ICICI Prudential Nifty 100 ETF	0.3523	0.0000	0.4207	0.0000
ICICI Prudential Nifty ETF	0.5715	0.0000	0.5881	0.0000
ICICI Prudential NV20 ETF	0.7527	0.0000	0.7172	0.0000
ICICI Prudential Sensex ETF	0.4224	0.0000	0.5261	0.0000
IDFC Nifty ETF	0.6311	0.0000	0.5143	0.0000
IDFC Sensex ETF	0.5451	0.0000	0.6759	0.0000
Invesco India Nifty ETF	0.1770	0.0000	0.5923	0.0000
Kotak Banking ETF	0.9453	0.0000	0.7446	0.0000
Kotak Nifty ETF	0.1873	0.0000	0.1920	0.0000

Kotak PSU Bank ETF	0.3267	0.0000	0.2057	0.0000
Kotak Sensex ETF	0.6338	0.0000	0.7490	0.0000
LIC MF Exchange Traded Fund-Nifty 50	0.3074	0.0000	0.6230	0.0000
LIC MF Exchange Traded Fund-Nifty 100	0.2276	0.0000	0.3881	0.0000
LIC MF Exchange Traded Fund-Sensex	0.0772	0.0000	0.1881	0.0000
Motilal Oswal M50 ETF	0.3671	0.0000	0.5768	0.0000
Motilal Oswal Midcap 100 ETF	0.2390	0.0000	0.2377	0.0000
Motilal Oswal Nasdaq 100 ETF	0.3898	0.0000	0.5897	0.0000
Quantum Nifty ETF	0.2712	0.0000	0.2644	0.0000
Nippon ETF Bank BeES	0.7875	0.0000	0.7503	0.0000
Nippon ETF Hang Seng BeES	0.3689	0.0000	0.1847	0.0000
Nippon ETF Infra BeES	0.3249	0.0000	0.2653	0.0000
Nippon ETF Junior BeES	0.0707	0.0000	0.0774	0.0000
Nippon ETF Nifty 100	0.2650	0.0000	0.3474	0.0000
Nippon ETF Nifty BeES	0.5878	0.0000	0.5929	0.0000
Nippon ETF NV20 ETF	0.4992	0.0000	0.3576	0.0000
Nippon ETF PSU Bank BeES	0.3122	0.0000	0.2075	0.0000
Nippon ETF Sensex	0.2877	0.0000	0.4130	0.0000
SBI-ETF BSE 100	0.1692	0.0000	0.3016	0.0000
SBI-ETF Nifty 50	0.5870	0.0000	0.3713	0.0000
SBI-ETF Nifty Next 50	0.0682	0.0000	0.0704	0.0000
SBI-ETF Nifty Bank	0.7166	0.0000	0.7403	0.0000
UTI NIFTY Exchange Traded Fund	0.5802	0.0000	0.5776	0.0000

UTI SENSEX Exchange Traded Fund	0.6656	0.0000	0.8370	0.0000

Source: Author's compilation Note: Values in the table are P-values of ADF test.

The study also attempts to understand the price discovery process between the market price and NAV of ETFs. The existence of a long-run relationship between the market price and NAV of ETFs needs to be examined before capturing the ETFs' price discovery process. The long-run relationship can be examined by using the Johansen co-integration test. To check for the existence of any long-run relationship using the co-integration technique requires checking for the stationarity of data at the level. For the co-integration technique, the data have to be non-stationary at the level and should be stationary at the same difference. The ADF test is used to test for stationarity of data. Table 29 presents the ADF test results applied on the levels and the first difference of ETFs daily market price and NAV series, respectively.

Evidence from ADF unit root tests suggests that market price and NAV get stationary at the first difference and at levels, they are non-stationary, as can be inferred from table 28. This means that both the variables follow an I (1) process. Since both the series are integrated at the same order, we reject our null hypothesis (H_{7a} and H_{7b}), thus, the co-integration test can be applied to the price and NAV of the ETF.

Table 30. Johansen Co-Integration Test: One Vector

Scheme name	Co-Integrating Vector*	Trace Test	Max-Eigen Test	Lags
Aditya Birla Sun Life Nifty ETF	None At most one	(0.0002) (0.1003)	(0.003) (0.1003)	2

Edelweiss ETF - Nifty 100 Quality 30	None At most one	(0.0377) (0.1016)	(0.0630) (0.1016)	4
Edelweiss ETF - Nifty Bank	None At most one	(0.0893) (0.0426)	(0.2351) (0.0426)	3
Edelweiss ETF - Nifty 50	None At most one	(0.0121) (0.0264)	(0.0542) (0.0264)	14
HDFC Nifty 50 ETF	None At most one	(0.0000 (0.0930)	(0.0000) (0.0930)	3
HDFC Sensex ETF	None At most one	(0.0000 (0.0938)	(0.0000 (0.0938)	1
ICICI Prudential Nifty 100 ETF	None At most one	(0.0000 (0.0711)	(0.0000 (0.0711)	1
ICICI Prudential Nifty ETF	None At most one	(0.0000 (0.1261)	(0.0000 (0.1261)	2
ICICI Prudential NV20 ETF	None At most one	(0.0000 (0.2886)	(0.0000 (0.2886)	1
ICICI Prudential Sensex ETF	None At most one	(0.0000) (0.0872)	(0.0000 (0.0872)	1
IDFC Nifty ETF	None At most one	(0.0011) (0.0664)	(0.0023) (0.0664)	7
IDFC Sensex ETF	None At most one	(0.0000) (0.2135)	(0.0000) (0.2135)	2
Invesco India Nifty ETF	None At most one	(0.0000) (0.0952)	(0.0000) (0.0952)	2

Kotak Banking ETF	None At most one	(0.0000) (0.2451)	(0.0000) (0.2451)	2
Kotak Nifty ETF	None At most one	(0.0000) (0.0200)	(0.0000) (0.0200)	2
Kotak PSU Bank ETF	None At most one	(0.0000) (0.0330)	(0.0000) (0.0330)	2
Kotak Sensex ETF	None At most one	(0.0000) (0.2010)	(0.0000) (0.2010)	2
LIC MF Exchange Traded Fund-Nifty 50	None At most one	(0.0000) (0.1055)	(0.0000) (0.1055)	2
LIC MF Exchange Traded Fund-Nifty 100	None At most one	(0.0000) (0.0554)	(0.0000) (0.0554)	1
LIC MF Exchange Traded Fund-Sensex	None At most one	(0.0015) (0.0156)	(0.0085) (0.0156)	3
Motilal Oswal M50 ETF	None At most one	(0.0000) (0.1334)	(0.0000) (0.1334)	3
Motilal Oswal Midcap 100 ETF	None At most one	(0.0081) (0.0338)	(0.0266) (0.0338)	2
Motilal Oswal Nasdaq 100 ETF	None At most one	(0.0386) (0.1304)	(0.0388) (0.1304)	3
Quantum Nifty ETF	None At most one	(0.0000) (0.0259)	(0.0000) (0.0259)	2
Nippon ETF Bank BeES	None At most one	(0.0000) (0.2167)	(0.0000) (0.2167)	2

Nippon ETF Hang Seng BeES	None At most one	(0.0000) (0.0376)	(0.0021) (0.0376)	2
Nippon ETF Infra BeES	None At most one	(0.0000) (0.0604)	(0.0000) (0.0604)	1
Nippon ETF Junior BeES	None At most one	(0.0003) (0.0126)	(0.0017) (0.0126)	6
Nippon ETF Nifty 100	None At most one	(0.0000) (0.0420)	(0.0000) (0.0420)	4
Nippon ETF Nifty BeES	None At most one	(0.0000) (0.1325)	(0.0000) (0.1325)	2
Nippon ETF NV20 ETF	None At most one	(0.0000) (0.0309)	(0.0000) (0.0309)	1
Nippon ETF PSU Bank BeES	None At most one	(0.0000) (0.0324)	(0.0000) (0.0324)	2
Nippon ETF Sensex	None At most one	(0.0000) (0.0228)	(0.0000) (0.0228)	1
SBI-ETF BSE 100	None At most one	(0.0000) (0.0435)	(0.0000) (0.0435)	2
SBI-ETF Nifty 50	None At most one	(0.0000) (0.0576)	(0.0000) (0.0576)	2
SBI-ETF Nifty Next 50	None At most one	(0.0000) (0.0043)	(0.0000) (0.0043)	2

SBI-ETF Nifty Bank	None At most one	(0.0000) (0.1398)	(0.0000) (0.1398)	2
UTI NIFTY Exchange Traded Fund	None At most one	(0.0000) (0.1010)	(0.0000) (0.1010)	3
UTI SENSEX Exchange Traded Fund	None At most one	(0.0002) (0.2643)	(0.0002) (0.2643)	12

Source: Author's compilation. Notes: **Test proves significant at 5% confidence level.

Results in Table 30 demonstrate the existence of only one co-integrating relationship between the market price and NAV during the period using the Johansen co-integration test. The lag selection is based upon the Akaike information criteria. Typically, one of the variables is used to normalize the co-integrating vector by fixing its coefficient at unity. We use market price as the normalizing (dependent) variable and NAV as an independent variable. The results of the Johansen co-integration test based on the trace test and the max-eigenvalue test are reported in Table 29. The results indicate that all ETFs show a long-run relationship between price and NAV. Based on the results of the Johansen co-integration test, the null hypothesis (H_8): The market price and NAV of ETFs do not have any log run relationship gets rejected.

Table 31. Vector Error Correction Model Estimates for One Co-Integration Vector

Scheme Name	Variable	Error Coefficient	Std Error	P-Value	Lag	Inference
Aditya Birla Sun Life Nifty ETF	NAV Price	-0.0058 -0.1742	0.012 0.033	0.811 0.000	2	Error coefficient of price is higher than NAV and NAV's error

						coefficient is not significant. Hence, the NAV leads the price.
Edelweiss ETF - Nifty 100 Quality 30	NAV Price	0.000578 0.118513	0.007 0.031	0.938 0.002	4	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Edelweiss ETF - Nifty Bank	NAV Price	-0.01123 -0.16198	0.014 0.048	0.424 0.001	3	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Edelweiss ETF - Nifty 50	NAV Price	0.01840 0.03166	0.007 0.032	0.0101 0.3343	14	Error coefficient of price is higher than NAV and both are significant. Hence, the NAV leads the price.
HDFC Nifty 50 ETF	NAV Price	0.07984 0.44438	0.147 0.141	0.5892 0.0017	3	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
HDFC Sensex ETF	NAV Price	-0.03732 0.77236	0.040 0.070	0.3537 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
ICICI Prudential Nifty 100 ETF	NAV Price	0.00901 1.02137	0.055 0.081	0.8717 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not

						significant. Hence, the NAV leads the price.
ICICI Prudential Nifty ETF	NAV Price	-0.2368 0.23907	0.221 0.210	0.2851 0.2570	2	Error coefficient of price is higher than NAV and both are not significant. Hence, the NAV leads the price.
ICICI Prudential NV20 ETF	NAV Price	-0.0259 0.97596	0.067 0.090	0.7013 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
ICICI Prudential Sensex ETF	NAV Price	0.04070 1.09185	0.041 0.075	0.3328 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
IDFC Nifty ETF	NAV Price	0.04370 0.32131	0.038 0.068	0.2509 0.0000	7	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
IDFC Sensex ETF	NAV Price	-0.0444 0.62708	0.034 0.090	0.2018 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Invesco India Nifty ETF	NAV Price	-0.02583 0.39232	0.028 0.072	0.3615 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not

						significant. Hence, the NAV leads the price.
Kotak Banking ETF	NAV Price	-0.2018 0.33325	0.155 0.157	0.1937 0.0349	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Kotak Nifty ETF	NAV Price	-0.70206 0.03992	0.056 0.795	0.0000 0.9600	2	Error coefficient of price is higher than NAV and NAV's error coefficient is significant. Hence, the NAV leads the price.
Kotak PSU Bank ETF	NAV Price	-0.42018 0.51724	0.195 0.164	0.0317 0.0018	2	Error coefficient of price is higher than NAV and both are significant. Hence, the NAV leads the price.
Kotak Sensex ETF	NAV Price	-0.01094 0.81884	0.078 0.092	0.8886 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
LIC MF Exchange Traded Fund-Nifty 50	NAV Price	-0.04357 0.73787	0.034 0.075	0.2013 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
LIC MF Exchange Traded Fund-Nifty 100	NAV Price	-0.0151 0.2595	0.015 0.044	0.3415 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not

						significant. Hence, the NAV leads the price.
LIC MF Exchange Traded Fund-Sensex	NAV Price	0.0227 0.2860	0.018 0.066	0.2162 0.0000	3	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Motilal Oswal M50 ETF	NAV Price	-0.0912 0.2300	0.035 0.044	0.0110 0.0000	3	Error coefficient of price is higher than NAV and both are significant. Hence, the NAV leads the price.
Motilal Oswal Midcap 100 ETF	NAV Price	-0.0164 0.0598	0.017 0.020	0.3477 0.0030	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Motilal Oswal Nasdaq 100 ETF	NAV Price	-0.0012 0.0219	0.008 0.011	0.8786 0.0555	3	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Quantum Nifty ETF	NAV Price	-0.4119 0.4452	0.150 0.139	0.0066 0.0016	2	Error coefficient of price is higher than NAV and both are significant. Hence, the NAV leads the price.
Nippon ETF Bank BeES	NAV Price	-0.4932 0.0223	0.285 0.281	0.0852 0.9368	2	Error coefficient of price is higher than NAV and both are not significant. Hence, the NAV leads the price

Nippon ETF Hang Seng BeES	NAV Price	-0.0393 0.1192	0.015 0.031	0.0131 0.0001	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Nippon ETF Infra BeES	NAV Price	-0.1849 0.7536	0.114 0.127	0.1076 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Nippon ETF Junior BeES	NAV Price	0.1468 0.4501	0.336 0.325	0.6624 0.1666	6	Error coefficient of price is higher than NAV and both are not significant. Hence, the NAV leads the price
Nippon ETF Nifty 100	NAV Price	0.0916 0.8893	0.122 0.128	0.4540 0.0000	4	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Nippon ETF Nifty BeES	NAV Price	-0.3911 0.0670	0.253 0.241	0.1238 0.7811	2	Error coefficient of price is higher than NAV and both are not significant. Hence, the NAV leads the price
Nippon ETF NV20 ETF	NAV Price	0.1098 0.8764	0.124 0.123	0.3794 0.000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Nippon ETF PSU Bank BeES	NAV	0.2513	0.211	0.2342	2	Error coefficient of price is higher than

	Price	0.5118	0.184	0.0058		NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
Nippon ETF Sensex	NAV Price	-0.0319 0.9553	0.080 0.116	0.6924 0.0000	1	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
SBI-ETF BSE 100	NAV Price	0.0081 0.2109	0.028 0.034	0.7745 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
SBI-ETF Nifty 50	NAV Price	-0.2517 0.3338	0.230 0.219	0.2764 0.1288	2	Error coefficient of price is higher than NAV and both are not significant. Hence, the NAV leads the price
SBI-ETF Nifty Next 50	NAV Price	0.1474 0.8400	0.174 0.158	0.3976 0.0000	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
SBI-ETF Nifty Bank	NAV Price	-0.3451 0.4163	0.229 0.219	0.1332 0.0585	2	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.

UTI NIFTY Exchange Traded Fund	NAV Price	-0.0804 0.5404	0.087 0.096	0.3558 0.0000	3	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.
UTI SENSEX Exchange Traded Fund	NAV Price	-0.0261 0.5070	0.072 0.113	0.7171 0.0000	12	Error coefficient of price is higher than NAV and NAV's error coefficient is not significant. Hence, the NAV leads the price.

Source: Author's compilation

A VECM model is commonly used for data where the underlying variables have a long-run stochastic trend, also known as co-integration. The VECM has co-integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their co-integration while allowing for short-run adjustment dynamics. The co-integration term knows as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. Table 30 reports the VECM estimation results. Coefficients of the equilibrium error correction term represent the speed at which the short-run deviation from the long-run equilibrium is corrected in the subsequent period. The result suggests that for all the ETFs, the NAV leads the market price in information transmission and price discovery processes. The market price often deviates substantially from the long-run equilibrium. The results help to understand the lead-lag relationship between the market price and NAV of the ETFs. The market price corrects itself based on the movements of the NAV. Hence, we can reject our null hypothesis (H_9) and conclude that historical NAV data can be used for

predicting future market price discovery of ETFs. Investors can devise profitable strategies based on the NAV-market price movement, which would be reflected in future ETF price levels.

5.5 Conclusion

Our findings contribute to the understanding of equity ETFs listed in India tracking domestic as well as foreign market indices, by studying the relation between the market price and the NAV of ETFs. The recent substantial increase in the flow of funds to ETFs signifies the rise in ETF's popularity as an investment tool in India. The present study will contribute to the existing literature on ETFs in India and investigate the pricing efficiency achieved through the creation-redemption mechanism by the ETF market makers.

The autoregression analysis results showed that during the study period, ETFs listed in India take a minimum of one day and a maximum of four days for the deviation between the NAV and market price to disappear. The autoregression results are in contrast with Elton et al. (2002) and Rompotis (2010), where persistence in deviation was observed for a day. The presence of deviation between market price and NAV of ETF for more than one day represents an additional cost to the investors, but also provides arbitragers with an opportunity to book low-risk profit. The VECM results demonstrate the short-term dynamics and help understand the lead-lag relationship; it indicated the NAV as the lead variable, followed by market price (lag variable). The persistence of deviation between price and NAV and the understanding of lead-lag movement, can be used by investors to frame profitable investment strategies in the Indian ETF market. Though ETFs' pricing efficiency in India has substantially improved over the period, there is still a need for ETF providers to partner with the AP for efficiently aligning price and NAV using the creation-

redemption mechanism effectively. Thus, we can conclude that India's ETF market is partially efficient, and there still exist arbitrage opportunities to market makers and investors. Yadav and Pope (1994) reported that mispricing is more likely to represent profit opportunities than risk premia. The market regulators in India must increase their efforts to educate investors about the benefits of investing in ETFs, which will help improve pricing efficiency in the future.

Chapter VI

Measuring ETF liquidity

6.1 Introduction

Liquidity is a critical parameter while investing in ETF as it impacts the overall cost of ownership for investors. The ease with which an ETF unit can be traded without affecting its price is liquidity. It is a known market risk when trading significant positions of any stock. Though ETFs trade like stocks, we have seen how they are different from the later in the Introduction chapter. ETF liquidity can be classified into primary liquidity (creation-redemption) and secondary liquidity (stock exchange). Unlike stocks, ETFs' liquidity can easily be created by market makers called APs, who are appointed by AMCs to provide ETF liquidity on stock exchanges. When an ETF trades above NAV, the APs create and inject new units until the difference diminishes. When the ETF trades below NAV, the APs remove units until the market price increases sufficiently. An AP may be a market maker or any other large financial institution with a lot of buying power. Thus, the active participation of an AP ensures that the ETF is liquid, making it easier to trade.

As ETF is listed on the stock exchange, secondary liquidity comes from the buyers and sellers in the market. They are constantly on the lookout for buying and selling opportunities. Secondary liquidity is the ‘on-screen’ liquidity one can see from its brokerage and is determined primarily by the volume of stocks generally traded. In a liquid market, trades are effected at low cost with little impact on price. Liquidity measures an asset's ability to be sold without causing a significant price movement, representing the

discount that a seller concedes or the premium that a buyer pays when undertaking a market order (Amihud, 2002). Higher liquidity offers lower transaction costs and easy entry and exit to the investors from the market.

ETFs, unlike index mutual funds, have two prices, market price, and NAV price. ETFs NAV price gets determined by the net value of the constituent assets. At the same time, ETFs' market price depends upon the number of units bought or sold on the stock exchange during trading hours. As per the law of one price, the ETF's NAV and market price should be the same. However, due to demand and supply forces, the market price may divert from its NAV. An illiquid ETF may not track its index successfully and can thus move away from the NAV of the underlying constituents, which undermines the ETF credentials as an index tracking investment. ETF trades at a premium if it's price is higher than the NAV, and at a discount, if the price is lower than the NAV. The creation/redemption mechanism of ETF units helps keep the NAV and market price in line. Better liquidity tends to reduce the risk of trading or market making in ETF shares, and generally have the effect of lowering the bid/offer spread of the ETF.

6.2 Data and Methodology

Measuring liquidity across its various dimensions (immediacy and price impact) is difficult and requires various proxies. Since we use daily data, we restrict our choice to the Average Daily Traded Volume (ADTV) and the Amihud Illiquidity ratio (2002). Daily volume is how many ETF shares are traded each day. The ADTV gives the average number of individual shares traded during a specific period. When the ADTV of an ETF is high, it is traded more actively, associated with a narrower spread.

The study also used Amihud's (2002) price impact measure ILLIQ to capture the level of illiquidity and determine the relationship between returns and illiquidity over time. This proxy provides a measure of price impact. The Amihud ratio is one of the best price impact measure constructed from low-frequency data (Calamia & Riva, 2013; Goyenko et al., 2009; Marshall et al., 2018). For individual stock, the illiquidity ratio ($ILLIQid$) is given by:

$$\boldsymbol{ILLIQ} = \frac{\mathbf{1}}{\boldsymbol{N}} \sum_{\boldsymbol{t-1}}^{\boldsymbol{T}} \frac{|\boldsymbol{r_t}|}{\$\boldsymbol{V_t}}$$

Where :

r_t is the return on stock on day t and $\$V_t$ is the dollar volume on the same day. The dollar volume is derived by the number of shares multiplied by the respective day's closing price.

The data for the study was collected from the inception of the funds or depending on the availability of data until March 2020.

The sample includes only classical equity ETFs listed in India and existence for more than two years. The above conditions left us with a sample of 41 equity ETF schemes

The daily closing price of ETFs traded volume and ₹ volume was sourced from the NSE and BSE websites.

6.3 Empirical Results and Discussion

Table 32. Profile of selected ETFs (Obj 4)

Sr. No.	ETF	Issuer	Underlying Index	Inception
1	Aditya Birla Sun Life Nifty ETF	Aditya Birla Sun Life Mutual Fund	NIFTY 50 TRI	21-Jul-11
2	Axis Nifty ETF	Axis Mutual Fund	NIFTY 50 TRI	14-Jul-16
3	Edelweiss ETF - Nifty Bank	Edelweiss Mutual Fund	NIFTY Bank TRI	15-Dec-15
4	Edelweiss ETF - Nifty 50	Edelweiss Mutual Fund	NIFTY 50 TRI	08-May-15
5	HDFC Nifty 50 ETF	HDFC Mutual Fund	NIFTY 50 TRI	09-Dec-15
6	HDFC Sensex ETF	HDFC Mutual Fund	S&P BSE Sensex TRI	09-Dec-15
7	BHARAT 22 ETF	ICICI Prudential Mutual Fund	S&P BSE Bharat 22 TRI	28-Nov-17
8	ICICI Prudential Midcap Select ETF	ICICI Prudential Mutual Fund	S&P BSE Midcap Select TRI	04-Jul-17
9	ICICI Prudential Nifty 100 ETF	ICICI Prudential Mutual Fund	NIFTY 100 TRI	20-Aug-13
10	ICICI Prudential Nifty ETF	ICICI Prudential Mutual Fund	NIFTY 50 TRI	20-Mar-13
11	ICICI Prudential Nifty Low Vol 30 ETF	ICICI Prudential Mutual Fund	NIFTY 100 Low Volatility 30	03-Jul-17
12	ICICI Prudential NV20 ETF	ICICI Prudential Mutual Fund	NIFTY 50 Value 20 TRI	17-Jun-16
13	ICICI Prudential Sensex ETF	ICICI Prudential Mutual Fund	S&P BSE Sensex TRI	10-Jan-03
14	IDFC Nifty ETF	IDFC Mutual Fund	NIFTY 50 TRI	07-Oct-16

15	IDFC Sensex ETF	IDFC Mutual Fund	S&P BSE Sensex TRI	07-Oct-16
16	Invesco India Nifty ETF	Invesco Mutual Fund	NIFTY 50 TRI	13-Jun-11
17	Kotak Nifty ETF	Kotak Mahindra Mutual Fund	NIFTY 50 TRI	02-Feb-10
18	Kotak PSU Bank ETF	Kotak Mahindra Mutual Fund	NIFTY PSU Bank TRI	08-Nov-07
19	Kotak Sensex ETF	Kotak Mahindra Mutual Fund	S&P BSE Sensex TRI	06-Jun-08
20	LIC MF ETF-Nifty 50	LIC Mutual Fund	NIFTY 50 TRI	20-Nov-15
21	LIC MF ETF -Nifty 100	LIC Mutual Fund	NIFTY 100 TRI	17-Mar-16
22	LIC MF ETF –Sensex	LIC Mutual Fund	S&P BSE Sensex TRI	30-Nov-15
23	Motilal Oswal M50 ETF	Motilal Oswal Mutual Fund	NIFTY 50 TRI	28-Jul-10
24	Motilal Oswal Midcap 100 ETF	Motilal Oswal Mutual Fund	NIFTY Midcap 100 TRI	31-Jan-11
25	Motilal Oswal Nasdaq 100 ETF	Motilal Oswal Mutual Fund	Nasdaq 100	29-Mar-11
26	Quantum Nifty ETF	Quantum Mutual Fund	NIFTY 50 TRI	10-Jul-08
27	Nippon India ETF Bank BeES	Nippon Mutual Fund	NIFTY Bank TRI	27-May-04
28	Nippon India ETF Infra BeES	Nippon Mutual Fund	NIFTY Infrastructure TRI	29-Sep-10
29	Nippon India ETF Junior BeES	Nippon Mutual Fund	NIFTY Next 50 TRI	21-Feb-03
30	Nippon India ETF Nifty 100	Nippon Mutual Fund	NIFTY 100 TRI	22-Mar-13

31	Nippon India ETF Nifty BeES	Nippon Mutual Fund	NIFTY 50 TRI	28-Dec-01
32	Nippon India ETF NV20 ETF	Nippon Mutual Fund	NIFTY 50 Value 20 TRI	08-Jun-15
33	Nippon India ETF PSU Bank BeES	Nippon Mutual Fund	NIFTY PSU Bank TRI	25-Oct-07
34	Nippon India ETF Sensex	Nippon Mutual Fund	S&P BSE Sensex TRI	24-Sep-14
35	SBI-ETF BSE 100	SBI Mutual Fund	S&P BSE 100 TRI	16-Mar-15
36	SBI-ETF Nifty 50	SBI Mutual Fund	NIFTY 50 TRI	23-Jul-15
37	SBI-ETF Nifty Next 50	SBI Mutual Fund	NIFTY Next 50 TRI	16-Mar-15
38	SBI-ETF Nifty Bank	SBI Mutual Fund	NIFTY Bank TRI	20-Mar-15
39	SBI –ETF Sensex	SBI Mutual Fund	S&P BSE Sensex TRI	08-Mar-13
40	UTI NIFTY ETF	UTI Mutual Fund	NIFTY 50 TRI	03-Sep-15
41	UTI SENSEX ETF	UTI Mutual Fund	S&P BSE Sensex TRI	03-Sep-15

Source: Author's compilation

Table 32 presents the profile of selected ETFs. It shows the fund name, Fund Issuer, Tracking index, and its inception date. The sample comprises of ETF schemes tracking different indices.

Table 33. Results showing measured liquidity of ETFs using ADTV

Rank	Fund Name	Tracking Index	ADTV
1	Motilal Oswal Midcap 100 ETF	NIFTY Midcap 100 TRI	115472.4
2	SBI-ETF Nifty 50	NIFTY 50 TRI	96311.09
3	Nippon India ETF NV20 ETF	NIFTY 50 Value 20 TRI	84553.37
4	ICICI Prudential Nifty ETF	NIFTY 50 TRI	75386.18

5	SBI-ETF Nifty Next 50	NIFTY Next 50 TRI	64084.22
6	SBI –ETF Sensex	S&P BSE Sensex TRI	64084.22
7	Kotak Nifty ETF	NIFTY 50 TRI	36901.35
8	Nippon India ETF Nifty 100	NIFTY 100 TRI	29443.8
9	ICICI Prudential Nifty Low Vol 30 ETF	NIFTY 100 Low Volatility 30	23915.55
10	Motilal Oswal M50 ETF	NIFTY 50 TRI	22346.67
11	Nippon India ETF Bank BeES	NIFTY Bank TRI	21645.2
12	ICICI Prudential NV20 ETF	NIFTY 50 Value 20 TRI	6261.114
13	Motilal Oswal Nasdaq 100 ETF	Nasdaq 100	5835.366
14	Kotak PSU Bank ETF	NIFTY PSU Bank TRI	5503.303
15	SBI-ETF Nifty Bank	NIFTY Bank TRI	5233.477
16	Nippon India ETF Sensex	S&P BSE Sensex TRI	4705.78
17	ICICI Prudential Sensex ETF	S&P BSE Sensex TRI	4572.789
18	Kotak Sensex ETF	S&P BSE Sensex TRI	3274.158
19	Nippon India ETF PSU Bank BeES	NIFTY PSU Bank TRI	3000.108
20	UTI NIFTY ETF	NIFTY 50 TRI	1996.337
21	HDFC Sensex ETF	S&P BSE Sensex TRI	1969.433
22	ICICI Prudential Nifty 100 ETF	NIFTY 100 TRI	1493.15
23	IDFC Nifty ETF	NIFTY 50 TRI	1485.648
24	SBI-ETF BSE 100	S&P BSE 100 TRI	1451.769
25	Nippon India ETF Nifty BeES	NIFTY 50 TRI	1187.972
26	Nippon India ETF Junior BeES	NIFTY Next 50 TRI	1046.245
27	Aditya Birla Sun Life Nifty ETF	NIFTY 50 TRI	946.36

28	HDFC Nifty 50 ETF	NIFTY 50 TRI	766.733
29	UTI SENSEX ETF	S&P BSE Sensex TRI	611.5916
30	LIC MF ETF-Nifty 50	NIFTY 50 TRI	510.8181
31	Nippon India ETF Infra BeES	NIFTY Infrastructure TRI	444.0604
32	BHARAT 22 ETF	S&P BSE Bharat 22 TRI	391.6765
33	LIC MF ETF -Sensex	S&P BSE Sensex TRI	318.4136
34	LIC MF ETF -Nifty 100	NIFTY 100 TRI	293.5584
35	Axis Nifty ETF	NIFTY 50 TRI	227.2
36	Invesco India Nifty ETF	NIFTY 50 TRI	175.752
37	Quantum Nifty ETF	NIFTY 50 TRI	96.94694
38	IDFC Sensex ETF	S&P BSE Sensex TRI	94.46929
39	Edelweiss ETF - Nifty 50	NIFTY 50 TRI	55.174
40	Edelweiss ETF - Nifty Bank	NIFTY Bank TRI	22.90828
41	ICICI Prudential Midcap Select ETF	S&P BSE Midcap Select TRI	6.91425

Source: Author's compilation

Table 33 presents the rank of ETFs based on measured liquidity using ADTV as a proxy. These values offer valuable information to analysts and traders. A high ADTV of a particular ETF indicates that the stock is traded more actively and has a narrow spread making the liquidity level high. On the contrary, if the ADTV is low, it means fewer buyers and sellers, thereby making it hard to enter or exit the market at the desired price. The result shows Motilal Oswal Midcap 100 ETF has the highest ADTV (115472.4), followed by SBI-ETF Nifty 50 (96311.09), Nippon India ETF NV20 ETF (84553.37), ICICI Prudential Nifty ETF (75386.18), and SBI-ETF Nifty Next 50 (64084.22). The ADTV attempts to

measure the average amount of trading taking place in the stock. The higher the ADTV, the more attractive the stock would be for traders and investors. The study documents the lowest ADTV for ICICI Prudential Midcap Select ETF (6.91), followed by Edelweiss ETF - Nifty Bank (22.90), and Edelweiss ETF - Nifty 50 (55.17).

Table 34. Results showing measured liquidity of ETFs using ILLIQ

Rank	Fund Name	Tracking Index	ILLIQ
1	Aditya Birla Sun Life Nifty ETF	NIFTY 50 TRI	0.000005
2	Axis Nifty ETF	NIFTY 50 TRI	0.00001
3	Edelweiss ETF - Nifty Bank	NIFTY Bank TRI	0.00004
4	Edelweiss ETF - Nifty 50	NIFTY 50 TRI	0.00004
5	HDFC Nifty 50 ETF	NIFTY 50 TRI	0.00005
6	HDFC Sensex ETF	S&P BSE Sensex TRI	0.00006
7	ICICI Prudential Nifty ETF	NIFTY 50 TRI	0.00006
8	BHARAT 22 ETF	S&P BSE Bharat 22 TRI	0.00008
9	ICICI Prudential Midcap Select ETF	NIFTY Midcap 100 TRI	0.00022
10	ICICI Prudential Nifty 100 ETF	NIFTY 100 TRI	0.00022
11	ICICI Prudential Nifty Low Vol 30 ETF	NIFTY 100 Low Volatility 30	0.00031
12	ICICI Prudential NV20 ETF	NIFTY 50 Value 20 TRI	0.00035
13	ICICI Prudential Sensex ETF	S&P BSE Sensex TRI	0.00044
14	IDFC Nifty ETF	NIFTY 50 TRI	0.00046
15	IDFC Sensex ETF	S&P BSE Sensex TRI	0.0005

16	Invesco India Nifty ETF	NIFTY 50 TRI	0.00056
17	Kotak Nifty ETF	NIFTY 50 TRI	0.00057
18	Kotak PSU Bank ETF	NIFTY PSU Bank TRI	0.00077
19	Kotak Sensex ETF	S&P BSE Sensex TRI	0.00081
20	LIC MF ETF -Nifty 100	NIFTY 100 TRI	0.00089
21	LIC MF ETF-Nifty 50	NIFTY 50 TRI	0.00109
22	LIC MF ETF -Sensex	S&P BSE Sensex TRI	0.00114
23	Motilal Oswal M50 ETF	NIFTY 50 TRI	0.0013
24	Motilal Oswal Midcap 100 ETF	NIFTY Midcap 100 TRI	0.00139
25	Motilal Oswal Nasdaq 100 ETF	Nasdaq 100	0.00171
26	Nippon India ETF Bank BeES	NIFTY Bank TRI	0.00186
27	Nippon India ETF Infra BeES	NIFTY Infrastructure TRI	0.01038
28	Nippon India ETF Junior BeES	NIFTY Next 50 TRI	0.01521
29	Nippon India ETF Nifty 100	NIFTY 100 TRI	0.01603
30	Nippon India ETF Nifty BeES	NIFTY 50 TRI	0.02451
31	Nippon India ETF NV20 ETF	NIFTY 50 Value 20 TRI	0.03963
32	Nippon India ETF PSU Bank BeES	NIFTY PSU Bank TRI	0.04194
33	Nippon India ETF Sensex	S&P BSE Sensex TRI	0.04491
34	Quantum Nifty ETF	NIFTY 50 TRI	0.06072
35	SBI –ETF Sensex	S&P BSE Sensex TRI	0.07286
36	SBI-ETF BSE 100	S&P BSE 100 TRI	0.0737

37	SBI-ETF Nifty 50	NIFTY 50 TRI	0.08423
38	SBI-ETF Nifty Bank	NIFTY Bank TRI	0.11097
39	SBI-ETF Nifty Next 50	NIFTY Next 50 TRI	0.25708
40	UTI NIFTY ETF	NIFTY 50 TRI	0.27409
41	UTI SENSEX ETF	S&P BSE Sensex TRI	0.50424

Source: Author's compilation

Table 34 illustrates the rank wise results that we obtain using the Amihud ratio. An ETF stock with a high Amihud measure tends to be more illiquid, and thus investors who buy such ETF stocks can be expected to incur higher transaction costs and market impact when they want to sell the ETF stock. Therefore, they are more exposed to illiquidity risk. It is pertinent to note that the Amihud measure captures the illiquidity of a stock. Thus, if we want to measure the liquidity, we should take the Amihud measure's reciprocal. The result finds Aditya Birla Sun Life Nifty ETFas the most liquid ETF amongst the sample with a Illiq ratio of 0.000005, followed by Axis Nifty ETF (0.00001), Edelweiss ETF - Nifty Bank (0.00004), Edelweiss ETF - Nifty 50 (0.00004), and HDFC Nifty 50 ETF (0.00005). The findings also highlight different levels of the Illiq ratio for the ETFs tracking the same indices. The Amihud measure itself has very little interpretation because it is most commonly used to compare stock liquidity. A higher Amihud ratio is observed for UTI SENSEX ETF (0.50424), followed by UTI NIFTY ETF (0.27409), SBI-ETF Nifty Next 50 (0.2570), SBI-ETF Nifty Bank (0.11097), and SBI-ETF Nifty 50 (0.08423).

6.4 Conclusion

ETF units are continuously created and redeemed by the authorized participant based on investor demand. The ETF liquidity depends upon index liquidity (Calamia & Riva, 2013),

But our result documents varied liquidity levels for ETFs tracking the same index. Hence we infer that ETF liquidity, besides other factors, is also determined by how active the authorized participant is. The liquidity measured for the ETFs varies considerably between ETF providers and between ETFs tracking the same index. An illiquid ETF will move away from its NAV and may not track its target index successfully. It is the AP who ensures that the price-NAV difference is low, making the ETF easier to trade. Thus, investment decisions can also be taken considering daily trading value, as it also signifies the active role of an authorized participant to maintain ETF liquidity.

Chapter VII

Findings and Conclusion

7.1 Major findings of the study

Tracking performance and Tracking error

The regression analysis was used to understand index funds' tracking performance, where index fund returns are dependent variables, and index returns are independent variables. The study found significant replication of the chosen market index by index fund and ascertain that index funds in India can significantly replicate the underlying index's performance. The study found regression coefficients of ETFs more significant compared to index mutual funds. The TE of funds in relation to the underlying index was also examined for ETFs and index mutual funds. The average TE of ETFs was 0.109, and that of index mutual funds is 0.266. Hence, it can be inferred that the ETF fund managers have shown a better ability to mimic index returns than their counterparts.

Determinants of fund flow to Index Mutual fund

The panel regression found the fund age, total expense ratio, and fund size of the index mutual fund statistically significant at a 1 percent significance level. The study confirms that the index mutual funds with lower expense ratios attract more fund flows and vice-versa. As indexing is a passive investment strategy and does not require the fund manager to outperform the market, the investors prefer the funds with lower expenses while investing their money. The significant positive relationship between fund age and fund flows depicts that older funds attract more flows to index mutual funds. It also shows that

a greater fund size could attract more investor attention and, at the same time, influence investors to put more money into the funds. Experienced funds with a higher AUM base can better take care of their operating expenses, thereby attracting higher flows to the fund.

The panel regression result of determinants of ETFs indicates statistically insignificant p-values for index return and tracking error. With a 0.07 p-value, the panel regression finds the total expense ratio as the only statistically significant determinant at a 10 % level of significance. The coefficient of -18.029 indicates a negative relationship between the total expense ratio with fund flows. It confirms the fact that the ETF schemes with lower expense ratios attract higher fund flows and vice-versa.

Pricing efficiency

The result of the autoregression (AR) analysis found the average percentage deviation captured by the intercept for 12 ETFs is negative, which shows that these funds trade at a discount to their NAV. Whereas the remaining 27 ETFs trade at a premium to their NAV. Our study documents that India's equity ETFs take a minimum of one day and a maximum of four days for the price deviation to disappear.

The Johansen co-integration test results based on the trace test and the max-eigenvalue test indicate that all ETFs show a long-run relationship between price and NAV. The VECM estimation results suggest that the NAV leads the market price in information transmission and price discovery processes for all the ETFs. The market price often deviates substantially from the long-run equilibrium. The market price corrects itself based on the movements of the NAV. Hence, we can conclude that historical NAV data can predict future market price discovery of ETFs.

ETF Liquidity

The study also measured the liquidity of ETFs using ADTV and Amihud ILLIQ (2002) proxy. Using the ADTV study found the Motilal Oswal Midcap 100 ETF as the most liquid, followed by SBI-ETF Nifty 50, Nippon India ETF NV20 ETF, ICICI Prudential Nifty ETF, and SBI-ETF Nifty Next 50.

The study also reports the liquidity of ETFs using Amihud Illiq proxy. The result finds Aditya Birla Sun Life Nifty ETF as the most liquid ETF amongst the sample, followed by Axis Nifty ETF, Edelweiss ETF - Nifty Bank, Edelweiss ETF - Nifty 50, and HDFC Nifty 50 ETF. The findings also highlight different levels of the Illiq ratio for the ETFs tracking the same indices. The main result is that liquidity varies considerably between ETF providers, which is also in line with Roncalli and Zheng (2014) findings.

7.2 Conclusion

- The study examines how well the index mutual funds and ETFs in India can mimic the chosen market index based on tracking performance and tracking error. Indexing is a passive investment strategy, and unlike active funds, does not aim to outperform the market index. The regression analysis found the tracking performance of ETFs is more significant compared to its counterpart. The possible reason could be the index fund manager's obligation to maintain minimum cash to meet redemptions because of which index mutual fund can not invest its full corpus. Another reason could be the round-off effect. The index mutual funds are required to align every additional fund flow with replicating the portfolio, which sometimes requires round-off, as the minimum number of security that can be purchased on the stock market is one. Whereas, due to its in-kind creation redemption mechanism, ETFs only need to take care of its operating expenses.
- The study also examined the determinants of fund flows to index mutual funds and ETFs in India. As index funds are a relatively new product in India known for its lower operating cost, the total expense ratio was the only significant determinant of fund flows to both index funds classes. Our findings indicate index investors' thinking behavior, which displays indifference to performance, as a broad passive approach implies. The significant increase in the AUM of both index funds classes signifies the kind of momentum indexing has gained in India. Given the rise in investor education, fund expenses, and the funds' tracking ability will get due consideration in the near future.

- Though due to its in-kind creation redemption mechanism ETFs look like a win-win product, investors also need to consider the market price before buying an ETF. ETFs have two prices, the NAV and the market price. ETF is overpriced if the market price is above NAV and underpriced if it is below NAV. Buying an overpriced or underpriced ETF will negate the advantage produced by its low expense. The law of one price necessitates the NAV and market price of the ETF to be the same. ETFs being traded on the secondary market are subject to market forces, which may deviate the ETF price substantially from its NAV. An authorized participant ensures there is no significant deviation between the two by creating and redeeming ETF units as and when required. Whenever ETF price increases, the authorized participant creates more ETF units in the primary market and sells them on the secondary market to investors, thereby making ETFs price-efficient and, at the same time, making a low-risk profit. ETFs' pricing efficiency highlights an authorized participant's role in keeping ETF price aligned with the market price. It requires the active participation of an authorized participant to keep ETF price efficient. The persistence of price deviation denotes inefficient pricing and represents an additional cost to the ETF investor. But it is more of a problem for long-term investors as for frequent investors with an understanding of the price-NAV movement can book a low-risk profit.
- ETF units are continuously created and redeemed by the authorized participant based on investor demand. Hence ETF liquidity, besides other factors, is also determined by how active the authorized participant is. The liquidity measured for the ETFs varies considerably between ETF providers and between ETFs tracking

the same index. An illiquid ETF will move away from its NAV and may not track its target index successfully. The authorized participant ensures that the price-NAV difference is low, making the ETF easier to trade. Thus, investment decisions can also be taken considering daily trading value, as it also signifies the active role maintained by an authorized participant to maintain ETF liquidity.

- The advent of indexing has profound consequences for the finance industry. With its significant tracking performance, index funds in India offer a superior route for global investors to geographically diversify their investment portfolio in a range of companies in one of the largest emerging markets of the world.

7.3 Theoretical and Managerial Implication

The study supplements the existing academic literature on Index funds in India and pushes the quality of research by employing econometric tools to evaluate the Indian index fund market critically. The study contributes significantly to the finance literature and helps market regulators, fund houses, market makers, and research analysts evaluate the Indian index fund market.

As individual and institutional investors tend to diversify their investments across different markets, the study's result would be crucial for investors interested in portfolio diversification. The determinants of fund flows can guide fund distributors and investors to fine-tune their decisions.

The persistence of deviation between price and NAV and the understanding of lead-lag movement can be used by investors to frame profitable investment strategies in the Indian ETF market.

7.4 Limitations of the study

- The study identifies various factors that tend to determine investment inflows-outflows to index mutual funds. Though the variables were identified based on extensive literature review, there is always a scope for identifying additional factors that may contribute significantly to the ongoing literature on fund flow determinants to index funds.
- The study has been conducted only on index equity ETFs listed on the Indian stock market. As ETFs tracking the same indices have shown varying pricing efficiency levels, further research can be made to examine the factors affecting the persistence of price deviation.
- Measuring liquidity is a difficult task and involves the use of various proxies aimed at capturing liquidity across its multiple dimensions (immediacy and price impact). Since we use daily data, we restrict our choice to the average daily trading value (ADTV), and widely used Amihud illiquidity ratio (2002)

7.5 Scope for further research

- The tracking performance and tracking error of those index funds that track indices other than equity indices can be undertaken to understand further index funds working in India. A comparative study on the tracking performance of index funds in various countries or groups like SAARC, BRICS, etc. and then compare the role of tracking error and index performance in determining fund flows.
- The pricing efficiency and price discovery study can be extended to ETFs tracking Gold indices to understand the ETFs' co-movement tracking their underlying index.
- Most liquidity proxies were developed for stocks, whereas ETFs have an active primary market where units are frequently created and redeemed. A comprehensive study analyzing liquidity proxies' performance, both daily and intraday basis, can understand the best proxy to measure liquidity in Indian ETFs.

Research Paper Publications:

1. Pinkesh Dhabolkar, Dipti Anand Naik, and Y. V. Reddy (2017), "Performance Evaluation of Select Index Funds in India." ***Management Today***, Vol. 7 No. 1, pp. 22-27. ISSN: 2230-9764 EISSN: 23483989 (UGC Refereed Journal)
2. Pinkesh Dhabolkar and Y. V. Reddy (2019)."Evaluating the tracking performance of index mutual funds and exchange traded funds in India", **The IUP Journal of Financial Risk Management,** Vol. XVI, No. 1, pp. 37-49. ISSN: 0972916X, (UGC Refereed Journal).
3. Y. V. Reddy and Pinkesh Dhabolkar (2020) "Pricing efficiency of exchange traded funds in India", **Organizations and Markets in Emerging Economies**, vol. 11, no. 1(21), pp. 244-268. ISSN: 2029-4581 eISSN: 2345-0037, (Scopus indexed)

Research Paper Presentations:

1. Presented a research paper "Pricing efficiency and arbitrage mechanism of exchange traded funds in India" at 2nd India-Greater Mekong Sub-Region International Conference from 27th to 29th November 2019.
2. Won the ***'Best Paper Award'*** for the research paper "Determinants of fund flow to index mutual funds in India" at One Day National Conference on "Innovations and Integration in Financial Markets" organized by Swami Vivekanand Vidyaprasarak Mandal's College of Commerce, Borim, Ponda, Goa on 20th February 2020.

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