AN ANALYSIS OF PRICING EFFICIENCY OF EXCHANGE TRADED FUNDS (ETFS) IN INDIA

THESIS

Submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

By

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DECLARATION

(By the PhD Research Scholar)

I hereby declare that the Research Thesis entitled "**AN ANALYSIS OF PRICING EFFICIENCY OF EXCHANGE TRADED FUNDS (ETFS) IN INDIA"** which is being submitted to the National Institute of Technology Karnataka, Surathkal, in partial fulfillment of the requirements for the award of the Degree of Doctor of Philosophy in Management, is a *bonafide report of the research work carried out by me.* The material contained in this Research Thesis has not been submitted to any University or Institution for the award of any degree.

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Date: 17th November 2020

CERTIFICATE

This is to certify that the Research Thesis entitled “**AN ANALYSIS OF PRICING EFFICIENCY OF EXCHANGE TRADED FUNDS (ETFS) IN INDIA”** submitted by BUVANESH C (Register Number: 155038HM15F02), as the record of research work carried out by his, is *accepted as the Research Thesis submission* in the partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy.

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DEDICATED TO MY PARENTS, FAMILY MEMBERS, FRIENDS AND TEACHERS

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ABSTRACT

An ETF is a marketable security, which is traded similar to a common stock in the stock exchange that tracks an index, a commodity, or a basket of assets. ETFs are index funds representing a basket of securities, that include stocks, bonds, and other assets traded in the stock exchange. An ETF is designed to track a particular stock or bond index. Nifty Bees' based on S&P CNX Nifty, was the first ETF launched in India in the year 2001 (December) by the Benchmark Mutual Fund. The current study focuses on the pricing efficiency of equity ETFs in India. Data period was covered from the inception date of ETFs to 31st December 2018. Seventeen equity ETFs were examined in the study.

The four major objectives of the study includes the pricing efficiency of ETFs and its underlying benchmark indices, the speed of adjustment of ETFs and underlying benchmark indices to its intrinsic values. Further, the study continues to examine the persistence of premiums and discounts. The study also investigates on the volatility and returns spillover between ETFs and underlying benchmark indices.

The current study employs the ARDL model to examine the long-run relationship of ETFs market price and underlying index price, ETF's market price, and NAV. Also, the present study uses the ARMA estimator for assessing the speed of adjustment. Finally, the study employs the ARMA-GARCH and ARMA -EGARCH for volatility spillover of ETFs and underlying benchmark indices. Empirical results suggested that ETFs have a long-run relationship with underlying benchmark index prices, and single and multiple structural breaks had an impact on the results compared to those without structural break.

The results of the second objective showed that ETFs and underlying benchmark index prices did not reflect full information in 20 days. The results of the third objective showed that most ETFs are trading in discount than premium, except a few ETFs. The bounds test result also confirmed that all the ETFs had a long-run relationship between ETF price and NAV.

The finding of the fourth objective shows that volatility persistence existed in all the ETFs and their respective indices. Leverage term was negative and significant in most of the ETFs and their respective indices, which further confirmed the asymmetric volatility present in the data. In most of the cases, the spillover of returns was unidirectional from index return to ETF returns and not vice versa.

Keywords: ETF, ARDL, ARMA Estimator, Volatility spillover, ARMA, GARCH, EGARCH

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ABBREVIATION

ADF	-	Augmented Dickey-Fuller
AIC	-	Akaike Information Criterion
AMC	-	Asset Management Company
AMEX	-	American Stock Exchange
AMFI	-	Association of Mutual Funds in India
ARCH	-	Autoregressive Conditional Heteroscedasticity
ARDL	-	Autoregressive Distributed Lag
ARMA	-	Autoregressive Moving Average
BSE	-	Bombay Stock Exchange
CAPM	-	Capital Asset Pricing Model
CBOE	-	Chicago Board of Options Exchange
CEFs	-	Closed- end funds
CMIE	-	Centre for Monitoring Indian Economy
CRSP	-	Centre for Research in Security Prices
DJIA	-	Dow Jones Industrial Average
ECM	-	Error Correction Model
EGARCH	-	Exponential Generalized Autoregressive Conditional Heteroscedasticity
EMH	-	Efficient Market Hypothesis
ETFs	-	Exchange Traded Funds
GARCH	-	Generalized Autoregressive Conditional Heteroscedasticity
KPSS	-	Kwiatkowski–Phillips–Schmidt–Shin
NAV	-	Net Asset Value
NSE	-	National Stock Exchange

SPDR	-	Standard & Poor's Depository Receipts
SUNDAR	-	S&P CNX Nifty UTI Depository Receipts Schemes
TIPs35	-	Toronto 35 Index Participation Units
VAR	-	Vector Auto Regressive
PSUs	-	Public Sector Undertakings
EPFO	-	Employee Provident Fund Organization
iNAV	-	Indicative Net Asset Value

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Investors have been seeking effective ways to diversify their portfolio since the development of the Markowitz Modern Portfolio Theory (1952) to avoid peculiar risk and to obtain efficient portfolios that maximizes return and minimizes risk. This can be done by replicating indices through the purchase of all stocks or, at least, a representative sample of them. This technique could however, only be used by major investors as retail investors would face shortage of funds. Due to these issues, retail investors started to demand equity funds that could buy stocks in large quantities, which would result in lower transaction costs. Such funds are meant to replicate indices that charge their customers less than the active funds to surpass the market index. To this end, passive funds employ fund managers who build stock portfolios, usually mirrored by a benchmark index, and offer retail investors the stock of funds at lower costs compared with purchasing all the stocks themselves.

On the other hand, there are active mutual funds based on the knowledge of skilled managers, which follow active strategies and pay more in return. In these funds, investors are offered various fund assets by following different strategies to generate an abnormal return on an index benchmark. The behaviour of retail investors was revolutionized by passive management of mutual funds since they made it easy and relatively cheap to have wide exposure on the market. Nevertheless, liquidity and pricing efficiencies were still in limitation. There are two different ways in which mutual funds are structured. There are open-ended funds with significant liquidity problems, as their shares are not priced throughout day. The shares of the fund may only be sold to a fund house at the end of trading session through Net Asset Value (NAV). Nevertheless, the ability to purchase and sell shares at the end of business sessions is not ideal as it raises the costs of the company and limits investors' ability to liquidate their assets.

For short-term investors, this liquidity issue is important, as they are required to carry out multiple transactions and recover money quickly and at the lowest transaction costs. Liquidity is less of a challenge for long-term investors, since they plan for a long time to keep the money invested in the fund. Nonetheless, these limitations, before taking a final investment decision, are taken into account by increasing the costs with the greater likelihood of defaulting fewer liquid funds.

Closed-end funds (CEFs) are, on the other hand, funds which are exchanged in a structured market between individuals, and traded like stocks and exchanged through brokers. With these investments, the dilemma is that once the fund has issued shares, it cannot be withdrawn, ensuring that the stocks can only be bought or sold in the market and not returned to the fund. Since the price does not reflect the real value of the underlying assets, these securities run the risk of significant price discrepancies between their market price and the value of the fund's assets. Such variations are usually a discounted price in comparison to the NAV of the company, meaning that shareholders value the shares of the fund less than its capital. The problem is that there is no mechanism whereby investors can use arbitrage and eliminate differences. The rationale of this paradox has become an important question for academicians and finance professionals, as rates are not to vary significantly and are subject of major research [e.g., Boudreaux (1973) or Pontiff (1996)].

With the rise of new empirical research showing that active funds typically fail to achieve their index benchmarks such as Malkiel (1995), and understanding that low-cost passive strategies can deliver superior results compared with historically active mutual funds, investors began to look for low-cost approaches to replicate indices. They started to demand funds that could quickly be exchanged and would not be subject to significant NAV discounts and premiums.

As a consequence of these requirements, Spiders (Standard & Poor's Depository Receipts) was introduced in the American Stock Exchange (AMEX) in the 1990s as the first generation of Exchange Traded Fund (ETF). Spiders has a combination of open-end fund and closed-end fund. Through structure, it is very similar to the passive mutual funds, in the sense that it is an actively trading stock portfolio, and Spiders could therefore be exchanged continuously through the market session, as opposed to open-ended index mutual funds. In fact, it can be returned to the fund provider at NAV. Such securities were later named as ETF, and have been designed to minimize price differences, while allowing continuous trading.

1.2 INTRODUCTION TO ETFS

ETF is a marketable security, which is traded similar to a common stock in the stock exchange that tracks an index, a commodity or a basket of assets. Unlike mutual funds, ETFs are traded throughout the day and thereby, have higher daily liquidity and lower fees making them an attractive alternative for individual investors. ETFs are index funds representing a basket of securities, which include stocks, bonds, and other assets traded in the stock exchange. An ETF is designed to track a particular stock or bond index. It has combined the features of mutual fund and common stock. For example, an investor with inadequate funds to invest in broad-based Nifty 50 index could invest in Nifty benchmark ETF.

1.3 STRUCTURE OF ETFS

ETFs are a composition of stocks, which represent the underlying index. ETFs differ from mutual funds at the time of creation and redemption. They follow a unique mechanism of creation and redemption. At the time of creation, the authorized participants and large investors buy the constituent shares of an index from the secondary market in the proportion of an individual company stock in the underlying index. These shares will be handed over to the Asset Management Company (AMC), which in turn, converts them into units of ETF, and subsequently, ETF trade in the secondary market.

The market prices of ETF units are in line with underlying NAV, which is induced by the continuous process of creation and redemption of shares. If the market price of the ETF diverges from the NAV substantially, the arbitrage process sets in to correct the difference. It is facilitated by the unique creation and redemption process of the ETFs. ETF units can be sold in the secondary market as well as by surrendering the ETF units to the AMC, and in turn, can get the underlying stocks of the index, and these stocks can be sold in the secondary market. Therefore, it is said that ETFs have double liquidity, first, the liquidity of the ETFs in the secondary market and second, the liquidity of the individual stocks in the secondary market, which are part of the ETF. However, the creation and redemption of the ETFs with the AMC is restricted to large investors and authorized participants.

There are two related but different variables in the ETFs, which signify the value of the units. They are the NAV of the units and the ETF price in the secondary market. ETF prices are expected to follow the NAV very closely even on an intraday basis considering the unique creation and redemption process. The behaviour of the NAV and ETF prices has attracted considerable research interest since the last decade.

1.4 HISTORY AND GROWTH OF ETFS

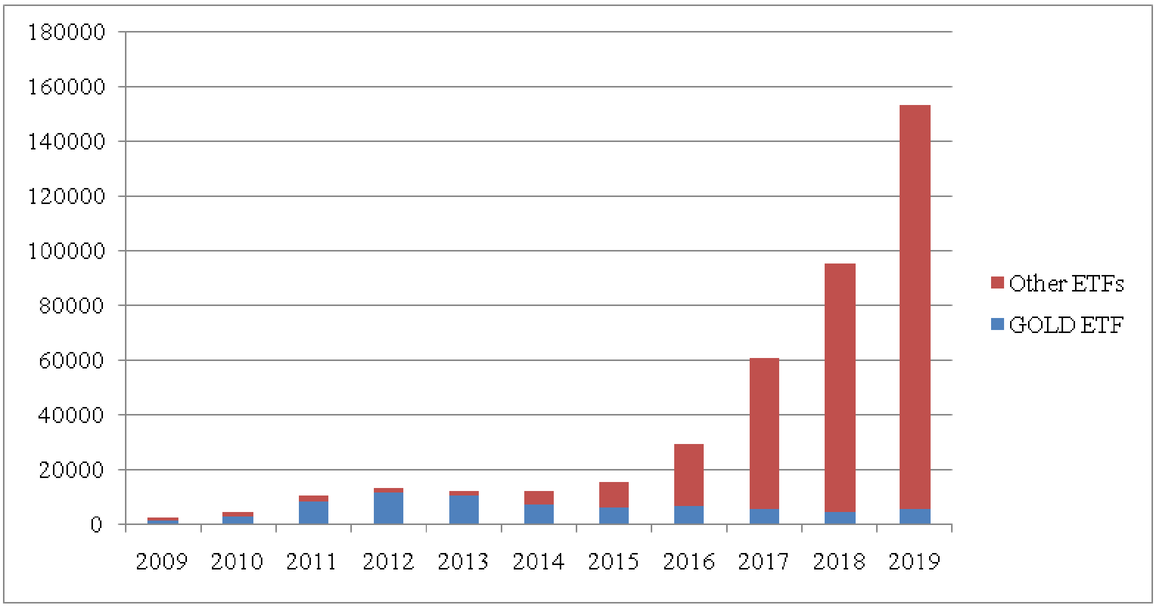
The idea of trading a basket of securities like an index in a single transaction has been in vogue for quite some time. It dates back to the 1970s in the USA, when portfolio trading was allowed in the name of portfolio trading or programme trading. Trading was allowed in the stock indices, viz., S&P 500 and other indices in the USA. Subsequently, it was extended to other financial markets in Canada, Europe, and Asia.

A formal attempt at launching a financial instrument, which closely resembles ETF, was the launch of index participation shares for the stocks in the S&P 500 in 1989. However, its growth was stalled; a federal court in Chicago while delivering its verdict on a lawsuit filed by the Chicago Mercantile Exchange ruled that index participation shares worked like a futures contract and hence, has to be traded on a futures exchange. Subsequently, in 1990, a similar product was launched in the Toronto Stock Exchange known as Toronto 35 Index Participation Units (TIPs 35). The instrument was based on a warehouse receipt, which tracked the TSE-35 Index. Finally, in 1993, the American Stock Exchange (AMEX) launched S&P 500 Depository Receipt (called the SPDR or "spider"), which became very popular and one of the most actively traded ETFs until date.

1.5 ETFS IN INDIA

Nifty Bees' based on S&P CNX Nifty was the first ETF to be launched in India in December 2001 by the Benchmark Mutual Fund. Subsequently, in 2002-03 financial year, two more ETFs were launched, namely, 'Junior Bees' based on CNX Nifty Junior and S&P CNX Nifty UTI Depository Receipts Schemes (SUNDER) based on S&P

CNX Nifty. Over the years, more and more AMCs launched ETFs on various stock indices and other asset classes like gold, debt, and world indices. The first debt-based ETF was launched in July 2003,and is known as ‘Liquid Bees’ by the Benchmark Mutual Fund. The first gold-based ETF was launched in March 2007, and is known as ‘Gold Bees’ by the Benchmark Mutual Fund and as ‘Gold Share’ by the UTI Mutual Fund. Finally, in March 2010,the first foreign index-based ETF was launched, and is known as ‘GS Hang Seng Bees’ by Goldman Sachs. As in October 2018, there are 27 stock index-based ETFs covering indices, which represent the broad-based market indices based on size, sector, and Islamic finance. There are 13 gold-based ETFs and two ETFs on world indices. In 2009, ETF's Asset Under Management (AUM) value was ₹952.06 crores, which rose to ₹1,47,187 crores in September2019, as per the Association of Mutual Funds in India (AMFI).



Source: As per AMFI data

Figure 1.1: Growth in ETF AUM -2009 to 2019

Table 1.1 – Asset Under Management of ETFs

ETF	AUM (Crores) (November 2020)
BANKBEES	2,489.74
BSLNIFTY	109.11
CPSEETF	9,854.40
INFRABEES	10.53
JUNIORBEES	1,195.36
KOTAKBKETF	5,086.75
KOTAKNIFTY	879.45
KOTAKPSUBK	24.78
M100	42.28
M50	19.74
NIFYBEES	2,489.74
PSUBNKBEES	30.63
QNIFTY	7.6
RELCNX100	27.59
RELDIVOPP	23.9
RELCONS	34.05
SHARIABEES	3.14

Table 1.1 shows the asset under management (AUM) of the ETFs which are part of the study. Different aspects of the present study, like pricing efficiency, speed of adjustment, volatility spillover, may also depend on the size of the ETFs. As seen in the table, there are five ETFs with AUM of more than Rs. 1000 crores whereas, 10 ETFs have AUM of less than Rs. 50 crores.

1.6 DIFFERENCE BETWEEN ETFS AND MUTUAL FUNDS

Both ETFs and mutual funds are collective investment vehicles because both track different types of securities so as to offer diversified portfolios to the investors. The main difference between the two is that ETFs trade throughout the day, while mutual fund trading happens at the end of the day based on NAV related price. The ETFs' NAV is calculated based on the most recent value of the underlying stocks or index, rather than the previous day's closing price; for every 15 seconds, a new ETF NAV is calculated. In India, most of the ETFs are passive in nature, which means that they track the underlying index due to which the operating expenses of ETFs are lower compared with actively managed mutual funds. So, ETFs can increase the realized rate of return.

ETFs creation or redemption is done in IN-KIND basis, and these are not considered as sale event since it does not result in a taxable event. But in case of a mutual fund, it is cash basis, and hence, redemption activity will create taxable event. ETF has greater tax efficiency because of the fund structure and decreases the capital gain, and although ETF and mutual fund track the same type of index, they have a different rate of return.

ETFs have better cost advantage than mutual funds due to passive strategy. Moreover, ETFs have greater transparency than mutual funds regarding the holdings and in the expected composition of the portfolio. Mutual funds are used to trade only at NAV at the end of the day, however in ETFs, trading can be done at both NAV as well at market price. It allows large investors, who hold the two rates closer together, to take full advantage of any difference between the market price and NAV of the ETFs.

1.7 THEORETICAL BACKGROUND

Fama (1991) has described the Efficient Market Hypothesis (EMH) as a state in which security prices represent the information available on the market entirely. EMH literature is generally categorized under three headings as weak form, semi-strong form, and strong form. EMH's weak form concentrates on the predictability of the return measures based on previous returns or historical data. Studies in this group primarily rely on the return predictability test, independence statistics testing such as autocorrelation test, run test, etc. Some of the early empirical tests of weak EMH are by Fama (1965), Fisher (1966), and Lo and MacKinlay (1988), who have reported autocorrelation in past returns, whereas, Fama and French (1988) showed that share prices are more volatile at market openings than at overnight non-trading hours.

Several studies have analyzed the predictability of returns based on certain forecast variables such as Basu (1977) based on the Price to Earnings (P / E) ratio, Banz (1981) on the basis of the firm's size, and Rosenberg et al. (1985) on the basis of Book Value to Market Value of Equity (BE / ME) ratios. Besides, Cross (1973), French (1980), Ariel (1987 and 1990), and Harris (1986) investigated seasonality in stock return. The findings from these studies raised questions about stock market performance on the basis of a weak form definition.

Semi-strong type of efficiency studies primarily relies on event study methodology to investigate the effect of particular corporate events on stock prices. Fama et al. (1969), Desai and Jain (1997), and Ikenberry et al. (1996) investigated the effect of stock split on firm valuation, while Miller and Reilly (1987), Ibbotson et al. (1994), Ritter (1991), and Carter and Manaster (1990) looked into the problem of Initial Public Offer (IPO). Mergers and acquisitions by Asquith et al. (1983), Mitchell and Mulherin (1996), and Agrawal et al. (1992) are yet another essential corporate action discussed in the recent literature. Even predictable trends in stock price was observed in regard to specific events under this category.

Strong form of EMH evaluations are based on the analysis of the market performance behaviour of corporate insiders and stock market experts. When prices are efficient in strong form, all private information is reflected in the prices. Adopting this variant of the EMH would make it difficult to beat the market using any information that is private. Jaffe (1974) claimed that changes in insider trading has not affected the profitability of their transactions, and Seyhun (1986) confirms that insider trading profitability was influenced by firm specific and economy wide factors. Chowdhury et al. (1993) and Pettit and Venkatesh (1995) reported in the same vein that insiders enjoyed above-average earnings consistently. Ultimately, the results of the studies on the behavior of corporate insiders, stock market experts, and those with the company's expertise that is not in the public domain could result in abnormal returns.

Several empirical studies reported results that contradicted each of the three EMH types. However, the EMH's proponents argue that anomalies in return are very responsive to the methodology used in the study. A rational change in methodology caused the return anomalies to disappear, and even if it was present, it was economically insignificant. Therefore, a successful investment or trading plan cannot be made to gain a return above and beyond the market.

The present study focuses on the pricing efficiency of ETFs, which falls into the weak form of the EMH and attempts to test it from various angles in the Indian context.

1.8 RESEARCH GAP

As the ETF market is well established in the global context, as most of the researchers have focused on the developed markets. Most of the research related to ETFs are centered around the idea of pricing deviation (Defusco et al. 2011; Ivanov 2013a) and the study of premium and discount (Engle and Sarkar 2006; Kayali 2007; Lin et al. 2006; Milani and Ceretta 2013). However, there are very few studies in the Indian context. Therefore, the present study focuses on the ETFs' pricing efficiency and premium and discount in the Indian context.

The extant studies have also examined the volatility spillover between ETFs and the underlying indices domestically or across countries (Krause and Tse 2013; Chen and Diaz 2015; Hughen and Mathew 2009), and the correlation between the ETF and the underlying index (Chen and Huang, 2010). Further, speed of adjustment in the context of equity indices and individual securities have been extensively examined (Theobald and Yallup 2004). However, its application in the context of ETFs is very limited globally as well. Therefore, the present study addresses the volatility spillover between the ETFs and the underlying indices in the Indian context. Further, the speed of adjustment of the ETFs will be a unique experiment in the global as well as in the Indian context.

1.9 RESEARCH PROBLEM AND RESEARCH QUESTIONS DEFINED

The research problem focuses on gaining a better understanding about the functioning of ETFs in the context of India. The study seeks to examine the pricing efficiency of ETFs in terms of long- and short-run relationship between the closing price of ETF and its underlying index price. Suppose, if any new information arrives, how long does it take for the ETFs to incorporate the news into the prices. Whether the NAV and closing price of ETF follow the same pattern or does the difference in the market price of ETF and NAV persist for a longer duration. Finally, the study seeks to identify the volatility spillover from the ETF and the index.

Against this backdrop, the following research questions are framed:

1. Whether ETF prices deviate from their fundamental values?
2. How quickly does the ETF prices adjust to their intrinsic values?
3. Whether premium and discount persist in ETFs?
4. Whether the ETF and underlying index return and volatility spillover?

1.10 OBJECTIVES OF THE STUDY

The following are the objectives of the study:

1. To estimate the pricing efficiency of ETFs and its underlying indices;
2. To assess the speed of adjustment of ETFs;
3. To examine the persistence of premium and discount in ETFs; and
4. To analyze on volatility and return spillover of ETFs and their benchmark indices.

1.11 METHODOLOGY

The study largely relies on the econometric methodology, while the objective-wise methodology is presented in this section.

Estimating the pricing efficiency of ETFs and its underlying indices: Examining pricing deviation has been the central point of ETF studies. It stems from the fact that the law of one price or no arbitrage condition should hold in the case of ETFs because the price of an ETF should equal the sum of the components' prices. If the ETF price deviates from its fundamental or intrinsic value, arbitrage can clear the mispricing as traders can take opposite position in the ETF and underlying securities, and thus make an arbitrage profit. However, the deviation should be sufficiently large enough to account for the transaction costs associated with multiple transactions. The most commonly used methodology under these circumstances is the co-integration and error correction framework. This study proposes to use the Autoregressive and Distributed Lag (ARDL) model by Pesaran and Shin (1998) to check the long-run relationship between the ETF and the index price.

Assessing the speed of adjustment of ETFs: The existence of pricing deviation in the financial markets provide ground for estimating the speed of adjustment of the asset prices to their intrinsic values. This can be applied in the case of ETFs as well. The analysis of the speed of adjustment of security prices is largely based on serial correlation. Theobald and Yallup (2004) developed an estimator for measuring the speed of adjustment based on the ARMA model. The present study proposes to examine the speed of adjustment of the ETF and index prices using the Theobald and Yallup (2004) methodology.

Persistence of premium and discount in ETFs: The premium and discounts in ETFs means the difference between the ETF price and the NAV. If the difference is positive, it is called as premium, and discount, if it is negative. The study employs the ARDL model proposed by Pesaran and Shin (1998). The study analyses the premium or discount, and checks its persistence and how long it takes to restore equilibrium.

Analysis of volatility and return spillover of ETFs and their benchmark indices: The return and volatility spillover are examined when similar assets are traded in the same or different markets, for example, spot and futures/options markets in the currency, commodity, and stock markets. In the present study, the return and volatility spillover will be examined between the ETF and the underlying index. The study proposes to use the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Exponential GARCH (EGARCH) model.

1.12 RESEARCH HYPOTHESIS

The following are the hypotheses of the study:

Hypothesis 1

H0-There is no long-term relationship between the ETF and the underlying index price.

H1-There is long-term relationship between the ETF and the underlying index price.

Hypothesis 2

H0- New information is not quickly incorporated into the prices of the ETFs and the underlying indices.

H1- New information is quickly incorporated into the prices of the ETFs and the underlying indices.

Hypothesis 3

H0- There is persistent premiums and discounts in the ETFs.

H1- There is no persistent premiums and discounts in the ETFs.

Hypothesis 4

H0- Volatility and return spillover are not present between the ETF and the underlying benchmark indices.

H1- Volatility and return spillover are present between the ETF and the underlying benchmark indices.

1.13 DATA

In India, ETFs are trading in the two premier stock exchanges in the country, namely, the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) of India. The study used the data from the National Stock Exchange (NSE) considering the fact that it is the largest stock exchange in India in terms of total turnover since its inception. Data at daily frequency was collected from the official website of the NSE. The study also used the Centre for Monitoring Indian Economy (CMIE) Prowess database for the underlying index information. Analysis of pricing efficiency and premium or discount uses ETF and index price series whereas, return and volatility spillover uses ETF and index return which is calculated as the first difference of natural logarithm. Speed of adjustment analysis uses returns calculated using differencing intervals from day one to day 20 using natural logarithm.

The period of analysis extended from the beginning of each ETF to 31 December 2018. The study only included equity ETFs as both the ETF and the underlying index are traded in the same market. The study chose ETFs based on two criteria: first, the ETF should be trading in the market during the study period, and second, there should be at least 500 observations or two years transaction history. Thus, based on the criteria, total 17 ETFs were chosen. The data analysis was conducted using the statistical analysis software, viz., STATA and Eviews.

1.14 SIGNIFICANCE OF THE STUDY

The concept of ETF is at a very nascent stage in India. Therefore, the study will contribute to the body of knowledge in the area of ETF. It will educate the investors by giving information on price variation in ETFs, thus, enabling them in the arbitrage of their investments effectively. Additionally, it will also help the stock market regulators by giving them insights into the price volatility of ETFs. The study will also contribute by analyzing the spillover between the ETF and the index. It will also give knowledge on the correction time of the ETF and the index price towards the intrinsic value.

1.15 LIMITATIONS OF THE STUDY

The present study is an empirical study as it relies on market data and statistical models to establish relationships. Therefore, it will have all the limitations of an empirical research. As outlined by Philips (2003), the correct model for any data is unknown, and even it is known, it still depends on parameter estimates based on the data. Further, the ETFs are still in the nascent stage in India. Therefore, with the growth of ETFs over the course of time, these relationships may change substantially.

CHAPTER 2

REVIEW OF LITERATURE

A significant part of any research study deals with the review of literature. It presents a critical overview of the multiple aspects of each topic explored over several frameworks and enables to comprehend the methodology, results, and the gaps in literature, which also tends to motivate further research in the area. ETF is a topic which of late has started gaining interest in India. The following discussion is to provide an overview of the various aspects and the dimensions of ETFs, particularly on an empirical level. There are very few studies, which discusses the price, return, and volatility spillover, speed of adjustment comparisons, and assessment of ETFs in the Indian context.

This chapter provides elaborate literature study in relation to the objectives of the research. Section 2.1 provides a detailed account on pricing deviation or pricing efficiency in India as well as in the global context. Further, Section 2.2 presents the past studies associated with the speed of adjustment. Section 2.3 discusses the premium and discount studies in ETFs in the domestic and international markets. Finally, Section 2.4 deals with the volatility spillover between the ETF and the underlying benchmark indices studies.

2.1 PRICING EFFICIENCY OF ETFS

The first objective of the study is to analyze the pricing efficiency of ETFs and its underlying benchmark indices. Terms like pricing deviation and pricing efficiency are used interchangeably in the extant literature. Pricing deviation is understood as the difference between the closing price of an underlying benchmark index and the closing price of the ETF (Defusco et al. 2011).

Ackert and Tian (2000) examined the pricing relationship between SPDRs and the underlying spot portfolio. The study period was from the trust's inception in January 1993 to the end of December 1997. The results indicated that SPDRs or spiders are priced in the market comparatively effectively, especially in comparison with CEFs. However, the study reported larger and economically significant discount for midcap

SPDRs. The midcap depositary receipts were probable to have higher arbitrage expenses. The study observed that SPDRs and midcap SPDRs were not highly volatile.

Chu and Hsieh (2002) extended Ackert and Tian's (2000) work and examined the price effectiveness of SPDRs and the S&P500 index future arbitrage possibilities. The study also examined the impact of SPDRs on the efficiency of the spot and futures market. The study collected intraday data for the S&P 500 index, SPDR quote prices, and trading prices of the S&P 500 index futures from the ISSM / Telekurs database developed by the Institute for the Study of Securities Markets. The results showed that there was a close relationship between S&P 500 futures index and SPDR. In addition, the analysis based on intraday data, suggested that both futures and SPDR prices quickly reversed after mispricing signals were detected.

Hughen (2003) examined the effect of the suspension of in-kind creation and redemption arbitrage by the Malaysian government on the iShares Malaysia Fund. The study used a time series regression model with the total value of the premium from the iShares Malaysia Fund as the dependent variable. The study corrected serial correlation using an autoregressive error model with two lags. During the time when the arbitrage was suspended, ETF had greater premiums and discounts in comparison when the arbitrage was not suspended. The result showed that arbitrage was important for the pricing of the ETFs.

Hseu et al. (2007) examined S&P 500, Nasdaq-100, and Dow Jones Industrial Average (DJIA) intraday price dynamics before and after the Nasdaq crash between March 2000 to March 2001. The study used 5 minutes intraday data acquired from Tick Data Inc. to look at the intraday price dynamics of S&P 500, DJIA, and Nasdaq-100 index from 1st April 1998 to 31st March 2002. The study disclosed significant relationship between the three indices, namely, spot index, index futures, E-mini futures, and ETF markets after the crash. The findings showed that the three markets had a co-integrating relationship following the crash. The results of the Vector Auto Regressive (VAR) model showed that S&P 500 index led the price discovery function for the Nasdaq-100 and DJIA indices.

Rompotis (2008) compared the performance and risk characteristics of the ETFs and the index funds. The average return showed that both the funds had almost similar returns, but the ETFs had more risk than the index funds. The average beta of the ETFs was significantly different from one, whereas for the index funds, it was not different from one. Both the index funds and the ETFs were not giving excess return over the market return as per the regression result. In terms of tracking error, the index funds were having less tracking error compared with the ETFs. The tracking error of both the ETFs and the index funds was positively related to the expense ratios and the risk.

Johnson (2009) worked on the tracking error in country ETFs and its respective home index. To achieve this objective, the study used the correlation between the ETFs daily and monthly return with the respective index returns and regression. The data was collected from the Centre for Research in Security Prices (CRSP) database for twenty different countries' ETFs. More the time that a foreign stock exchange's operating time overlapped with that of the American exchange, there was more significant correlation between the ETFs. Furthermore, it was found that the annual return differences between the foreign index and the U. S. index were significant and positive on account of daily data correlation coefficients, but not significant for the monthly data. The author stated that in a developed market, tracking error was less, but in the emerging market, it was more.

Schlusche (2009) examined the price discovery role of the futures and ETFs in the spot market based on the German DAX ETFs, futures, and the spot market. Based on the VAR model, the study demonstrated a clear price leadership role of the futures over both on-site and ETFs. The author argued that volatility was the primary force behind the price leadership of the futures market and not the liquidity. The study also discovered that price formation in the futures market was decreasing in periods of low to high volatility.

Natarajan and Dharani (2010) examined the returns of NIFTYBEES and its benchmark index return. Using a simple regression model, this article analyzed the connection between portfolio and market returns. During the six-year study period, the portfolio returns of the NIFTYBEES outweighed the market returns and consequently was considered as a promising investment product in the Indian capital market. In essence, the researchers found that NIFTYBEES outperformed its benchmark, while supporting investors with lower risk than the standard deviation of the Nifty index.

Defusco et al. (2011) analyzed the factors influencing the pricing deviation of the world's most liquid ETFs such as Spider (SPY), Diamond (DIA), and Cubes (QQQQ). The study argued that the creation and redemption process of the ETFs and the inability to directly trade the index was responsible for the non-zero price deviation. The price deviation which was predictable, could be considered as an additional administering cost of the ETFs. Stationarity of the price deviation was considered as responsible for its predictability. Based on the Error Correction Model (ECM), the result showed that during dividend payout, there was lesser impact on price deviation. Whereas, during the time of accumulated dividend, it showed variation in the pricing deviation.

Shanmugam and Zabiulla (2012) examined the return performance, tracking error, and persistence of premium and discount of NIFTYBEES using high frequency data for a period of seven years. The Capital Asset Pricing Model (CAPM) and regression model were employed in the study. Tracking error under bearish conditions was found to be relatively high. In bearish markets with highest volatility, the average premium was higher. In bullish markets with lower volatility, discount was prominent.

Ivanov (2013a) extended the work of DeFusco et al. (2011) using high-frequency data and employed the Vector Error Correction Model (VECM). The base results suggested negative correlation between high volume trading and pricing deviation. Dividend accumulation was documented as the prime reason for the pricing deviation between the ETF and the underlying index price. The VECM results showed that QQQQ and DIA were underperforming compared with their respective indices, but SPY showed positive relationship towards its underlying index due to the popularity of the S&P 500 index. Additionally, the change in the ETF price was negatively related to the lagged ETF price and positively related to the lagged index price.

Ivanov (2013b) studied the relationship between the gold, silver, and oil ETFs and their futures instruments and commodities from 1st March 2009 to 31st August 2009. The study monitored the performance of ETFs using the tracking error and price difference metrics. The gold and silver prices were mostly discovered in the ETF market, whereas the oil market price discovery happened in the futures market. The findings in this research, therefore, indicated that the price discovery as observed earlier, which originated traditionally in the futures market, had moved to the ETF market for gold and silver.

Bas and Sarıoğlu (2015) assessed the performance and price effectiveness of the ETFs operating in Turkish capital markets. They examined the tracking errors and pricing efficiency of 16 ETFs during the period 2005-2013. The study discovered that Turkish ETFs were underperforming their underlying indices based on the daily data. However, the empirical findings of this research indicated that the ETFs were priced very close to their NAV, and therefore, there was no arbitrage opportunity in the market.

Chen et al. (2016) examined the role of active management on the incorporation of information by using data from the U. S. stock market traded ETFs. For this purpose, the study used the random walk, transaction cost, and trading strategy tests. Upon taking into account numerous price performance measures, the authors concluded that active management mattered for improving efficiency. One practical implication of this study was that fund managers should take a proper approach to manage their ETFs to represent all the information available in the prices of the funds.

Narend and Thenmozhi (2016) examined the performance and the determinants of fund flows to index MFs and index ETFs in India. The study found that the index MFs performed better than index ETFs in terms of tracking the benchmark index. The insignificant tracking error of a few index MFs indicated that relative to index ETFs, these index MFs better tracked their underlying benchmarks. Based on panel data regression analysis, the study found that the expense ratio and asset base were the main variables influencing the fund flow into the ETFs, whereas the age of the fund was not a major determinant. However, for MFs, relatively newer funds attracted more funds than the old ones. The study concluded that expense ratio played a vital role in the investment decision and therefore, it was necessary for funds managers to adopt strategies to reduce the same.

Malhotra et al. (2016) attempted to assess the price discovery role of equity ETFs using the data of ETFs based on the flagship indices of two major stock exchanges in India, namely, the NSE and the Bombay Stock Exchange (BSE). Nine equity ETFs, which tracked the CNX Nifty and S&P BSE Sensex were considered from the inception date of each ETF to December 2014. The study employed the VECM and Johansen cointegration tests and confirmed the presence of long-run relationship between the ETFs and the underlying indices. The study found that the benchmark indices were leading the price discovery process. The results of the impulse response function indicated that the shock due to variation in index takes two to three periods for the ETF prices to incorporate the same.

Steyn (2019) conducted a study on the pricing efficiency of the domestic and international ETFs listed in the Johannesburg Stock Exchange. In terms of tracking the benchmark indices, the result showed that ETFs follow the domestic index more efficiently than ETFs tracking the international benchmark indices.

2.2 SPEED OF ADJUSTMENT

The present study examines the adjustment of ETF closing price and the underlying benchmark indices values to the intrinsic value in the second objective. The subsequent paragraphs present a review of the speed of adjustment related research in various stock markets around the world.

Patell and Wolfson (1984) examined the impact of earnings and dividend announcements on intraday stock price behaviour in terms of mean return, variance, and serial correlation using the data collected from the Chicago Board of Options Exchange (CBOE). The study observed that the returns earned by simple trading rules disappeared within five to 10 minutes of information arrival. However, significant returns were observed in the overnight and next day opening. The return variance and serial correlation changes were more persistent than the return as it took several hours and extended into the subsequent trading day. The study observed that earnings announcement induced more trading activity than dividend announcement.

Aggarwal and Chen (1985) examined the adjustment of the securities market due to block trades announcement. The time to adjust the release of new information was calculated by using the daily data. The study period covered all block trades transactions in the year 1977 and used the statistical method introduced by Hillmer and Yu (1979). The results showed that the block trades did not generate excess return. However, increased variability was observed in the prices of some of the stocks.

Amihud and Mendelson (1987) examined the impact of trading mechanism on the behaviour of the stock price. The data was collected from the active opening and closing transaction from the New York Stock Exchange (NYSE). The results showed that open-to- open returns had more deviation than the close- to- close returns. The ARMA model results confirmed that the opening returns showed higher residual noise and higher dependency on the past returns. Overall, trading at the opening exposed traders to a higher variance than in the close. The study argued that it was due to the differences in the two trading mechanisms.

Woodruff and Senchack (1988) examined the speed of adjustment in the security price and its path due to the earnings surprise in the announcement of quarterly earnings report. The study mainly relied on the price and volume of transaction data for this purpose. The time frame of the study was from 15th January to 15th April 1980 and the data was retrieved from the value line. The study found that stocks with positive earnings surprise experienced faster adjustment in comparison to stocks with negative earnings surprise. A larger absolute size of the earnings surprise was associated with the higher volume of transaction, larger size, and a greater frequency of transaction and vice versa. Further, favorable earnings surprise was associated with large number of small size transactions, whereas unfavorable earnings surprise was associated with smaller number of large transactions.

Damodaran (1993) examined the speed of adjustment in the Nasdaq and Amex sample stocks from 1st January 1977 to December 1986 using the price adjustment model based on returns. The base results showed lagged adjustment to information on intraday basis and different speed of adjustment across small and large capitalization firms. The results also showed that large capitalization firms were leading small capitalization firms in the speed of adjustment. Hence, it was confirmed that market capitalization was an important factor for speed of adjustment. Finally, the study concluded that over-the-counter stocks had significantly reduced speed of adjustment coefficients for the return periods of up to five days.

Martin (1993) examined the theoretical relation between speed of adjustment and the structure of the market. The study discussed the speed of adjustment in types of market structure such as oligopoly and monopolistic markets. In monopolistic market, the results showed that speed of adjustment and elasticity of demand had a positive correlation. This meant that prices adjusted quickly when the firms had less market power to exploit. In oligopoly, the results showed that the prices were changing faster as the number of companies rose, which reduced the market share. Further, the study added that speed of adjustment was high in the competitive market.

Kraft (1995) examined the speed of price adjustment to cost and demand changes. Specifically, the paper focused on the impact of firm concentration as measured by the market size of six firms on the speed of adjustment. For this purpose, data was collected from 17 German sectors from 1970 to 1987. The primary results showed that the concentration variable had a positive and significant coefficient across different specifications indicating higher speed of adjustment for concentrated industries. On the other hand, capital intensity had a negative impact on speed of adjustment indicating lower speed of adjustment for capital intensive industries. The study also pointed that prices were more flexible during a bull market in comparison with the bear market.

Lin and Rozeff (1995) estimated the speed of adjustment of individual stocks to the release of private information. The daily data was collected from stock exchange and over-the-counter market from 1988 to 1991. The findings showed that 85 to 88 per cent of private information possessed by informed traders was incorporated in the prices on the same trading day. The speed of incorporation of private information was relatively slow in over-the-counter markets in comparison with the stocks listed in the exchanges. Further, stocks with higher trading volume had higher speed of adjustment to private information. Finally, the study concluded that the stock market was efficient as per its definition of a strong form of efficiency.

Koutmos (1999) tested the hypothesis of stock index returns adjusting asymmetrically to past information in emerging markets. The data used was the daily prices of six emerging stock markets, namely, Korea, Malaysia, Philippine, Singapore, Taiwan, and Thailand. The reporting time frame covered a total of 2,584 observations from January 1986 to December 1995. The empirical evidence promoted the hypothesis that the dependent mean and the conditional variance asymmetrically reacted to previous information. This behaviour corresponded to a partial adjustment price model in which bad news (negative returns) was integrated more quickly into current market prices than good news (positive returns).

Chan and Ariff (2002) calculated the speed of market pricing in an attempt to determine how efficient was information processing in the Hong Kong stock market. DataStream International provided daily index values for Hong Kong, the U. S., and Japan from January 1988 to December 1996. The study proposed an alternative methodology, which avoided the joint hypothesis testing of the efficient market hypothesis. The evidence showed that the speed of adjustment time was around six days for the Hong Kong stock market and it was comparable with the U. S. and Japan stock markets.

Marisetty (2003) measured the speed of price adjustment to its intrinsic value in two major Indian stock exchanges such as the NSE and BSE using the revised Damodaran model (1993) and a new method based on the auto-covariance ratio between the stock prices. The findings showed that the auto-covariance ratio of the BSE Sensex was near to one, indicating a rapid and effective price adjustment. The NSE Nifty had, however, overreacted to the arrival of information. There was no evidence that price adjustments varied with the size of the firm. The overreaction in prices gradually decreased with time and a complete adjustment was made on the 19th day of information arrival.

Theobald and Yallup (2004) addressed the issue of evaluating the security speed of price adjustment to its intrinsic values. The study developed a speed of adjustment estimator based on the ARMA model on the logic that stock price reaction led to a particular type of autocorrelation in the stock price series. Specifically, underreactions led to positive autocorrelation, and overreactions led to negative autocorrelation. The stocks were found to have underreaction at shorter differencing intervals, and overreaction at longer differencing intervals. Further, large capitalization stocks had higher speed of adjustment in comparison with the small market capitalization stocks.

Chiang et al. (2008) examined the speed of price adjustment in A and B class of shares listed in the Chinese stock markets, which were primarily traded by domestic and foreign institutional investors, respectively. The study collected stock return data from the official websites of the Shanghai and Shenzhen Stock Exchanges from the first date of listing until 31 December 2003. Based on a VAR model, the study found that A class of shares had better speed of price adjustment than B class of shares. For A class of shares, the speed of adjustment was related to earnings per share, whereas for B class of shares, it was the firm size. Further, the A class of shares reacted more to bad news, whereas B class of shares reacted to good news. Finally, with the liberalization of the financial markets in 2001, which allowed the domestic investors to invest in the B class of shares, led to a decline in the speed of adjustment difference between the A and B class of shares.

Louhichi (2008) used the intraday data to examine the speed at which new information was incorporated in the stock prices using a sample of 117 announcements published every night by Reuters for the period 2001-2003. The event was divided into three categories, namely, good news, bad news, and no news. The empirical results of the study showed that investors positively reacted to good news and negatively to bad news. The abnormal returns disappeared in 15 minutes after the arrival of information. The study also found that the stock prices adjusted faster to good news in comparison with bad news, and the earnings information release led to an increase in the trading volume even after the adjustment of the news in the price.

Acharya (2010) examined the speed of adjustment of a sample of 40 companies listed in the NSE. The analysis period extended from January 1995 to December 2008. The main aim of the study was to find the speed of adjustment in stock price towards the intrinsic value for different periods to assess the impact of changes in the market microstructure. The companies were classified into low and high market capitalization groups. The results of the study did not show any systematic pattern in terms of persistent underreaction or overreaction. Further, the study did not find any difference in the adjustment speed between small and large capitalization stocks.

Joshi (2011) analyzed the co-movement of the U.S., Brazil, Mexico, China, and Indian stock markets and the speed of adjustment for the Indian stock market. The study covered the period from 1996 to 2007 using daily, weekly, and monthly data. The results of the cointegration and ECM showed that there was a co-movement among the selected markets during the study period. The speed of adjustment results showed that the Indian markets' speed of adjustment was higher than the other stock markets examined in the study. The study also observed significant under and overreactions along with full adjustment during shorter and longer differencing intervals for the 1996-

2001 period. For the remaining study period, significant overreactions and higher speed of adjustment was found.

Dasilas and Leventis (2011) analyzed the stock price and trading volume reactions to dividend change announcements for a sample of companies listed on the Athens Stock Exchange (ASE).The authors observed that the dividend distribution in Greece was different from that of the U.S., the U.K., and other developed stock markets. The regulations in Greece mandated a minimum amount of dividend distribution from the taxed corporate profits and an annual dividend payment practice as against quarterly or semi-annual in developed markets. There was no dividend or capital gains tax during the study period. Further, there was a higher degree of ownership concentration and resultant participation in the management, which rendered the dividend announcement less important for such investors. In spite of these characteristics of Greece, a significant market reaction to dividend announcement was recorded. The finding suggested that in the case of dividend increases, the share price reaction was positive, while dividend declines were related to average share price decline. The prices remained unchanged with constant dividends. Even the trades reacted positively when the dividend distribution took place. Finally, it was found that Greek stock prices incorporated the dividend information into the price within two days.

Jacoby and Liao (2012) explored the effect of sentimental traders on adjustment of the security price. The study generated a new general model based on Easley and O'Hara's (1992) work. The study showed that noise-trading activity decreased the risk of asymmetric information the market maker faced, while dealing with informed traders resulted in a narrower bid-ask spread being set by the market maker. When the market makers ability of forecasting the sentiment of the noise trader diminished, they were likely to set lower bid-ask spread due to perceived low level of asymmetric information risk. On the other hand, when the market maker believed that the noise traders were likely to make correct purchase and sale, they were likely to widen the bid-ask spread. Finally, the study predicted that the greater presence of noise traders and increased ability of market makers to predict them resulted in lower speed of adjustment of the security prices.

Chung and Hrazdil (2013) examined the informational efficiency of 273 ETF prices, which traded in the NYSE. The study used the daily data of the first six months of 2008 and employed the approach used by Chordia et al. (2005) to measure the speed of convergence to market efficiency. The results confirmed that the volume of trading had the strongest impact on actively traded ETFs improving the speed of convergence to market efficiency. Not only the volume, but also the probability of informed trade was significant in terms of the time needed to achieve market efficiency of the ETFs.

Prasanna and Menon (2012) reviewed the company level characteristics that determined the speed of information adaptations in the Indian stocks. The study sample consisted of 64 stocks with 10 years of annual data and a total of 640 firm-year observations and the study used the Dimson Beta Regression (1979). It was discovered that the data assimilation process was largely influenced by three main factors, namely, corporate size, trading volume, and turnover. Large companies and companies with higher turnover and trading volumes assimilated the market-wide news faster when compared with smaller counterparts. The speed of price adjustment was slower during the 2008-2010 financial crisis period. Though firm size continued to influence the speed of price adjustment, trading volume and turnover ceased to influence the speed of price adjustment.

Prasanna and Menon (2013) studied the speed of adjustment in the indices listed in the NSE and BSE using the ARMA model. Nifty from the NSE and Sensex from the BSE were leading in the speed of correction compared with the other indices. Until 2009, large capitalization indices were leading small capitalization indices in speed of adjustment. However, the pattern was not observed in 2009 and 2010, notably in the banking sector indices.

Arioglu and Tuan (2014) investigated the speed of adjustment for the leverage ratios of companies listed on Borsa Istanbul in order to ascertain the capital structure rebalancing tradeoff theory. The tradeoff theory argued that firms follow target capital structures, and if they deviate from the target, they undertake financial decisions with the aim of closing the gap between the actual and target leverage ratio in the subsequent period. The study used the GMM estimation technique for the speed of adjustment for the data considered from 1999 to 2010. The study recorded 29 per cent speed of adjustment and argued that it was consistent with the prediction of the tradeoff theory.

Kayal and Maheswaran (2018) examined the speed of adjustment of stock prices to the arrival of information by comparing 23 indices of emerging markets and 10 indices of developed markets. The empirical results confirmed that the indices of the developed markets adjusted faster than those of the emerging markets. The study also found the presence of random walk in almost all the indices.

2.3 PREMIUM AND DISCOUNT OF ETFS

Premium/discount is derived from the difference between the closing price of the ETF and the ETF's NAV. If the difference of the ETF price and NAV is positive, then it denotes ‘premium’, and if the difference is negative, then it denotes as a ‘discount’. Previously, several studies have been conducted on the premium and discount in the global stock market. In this section, some of the literatures relevant to premium and discount are discussed.

Many studies argue that trading in ETFs can impact the underlying securities in the ETF portfolio. In particular, the papers argue that ETF can affect the correlation structure of the stock returns. Jares and Lavin (2004) studied the pricing nature, discount, and returns relationship characteristics of Japan and Hong Kong ETFs. The time frame of the study was from March 1996 to December 2001. The mean value of pricing deviation confirmed that both the countries’ market price of ETFs was above their NAV. Hong Kong was having frequent instances of discount than Japan. Current day discount and return had a negative relationship, but lagged discount had a positive impact on current day return.

Simon and Sternberg (2005) analyzed whether current day premium or discount could predict the following day NAV return and whether the prices of iShares overreact to late day U.S. market news. The empirical results show that iShares close at substantial premiums or discounts to their NAV frequently. Though the iShares premium or discount had predictive power on subsequent day NAV, their forecasts were biased. It showed that the European iShares overact to the late day U.S. market developments. Trading rules to exploit this phenomenon resulted in statistically significant profit potential. However, the incorporation of transaction cost, bid-ask spread, etc. substantially eroded the profits.

Lin et al. (2006) analyzed the pricing efficiency of Taiwanese ETFs based on the closing price of the ETF and NAV. The study measured the pricing efficiency of the Taiwan Top 50 tracker fund (TTT) with the underlying Taiwan 50 Index. The authors employed a linear regression model between the NAV and the closing price of the TTT. The study concluded that there was a significant positive relationship between TWSE and Taiwan 50 index. The TTT offered an easy financial instrument for reproducing the Taiwan stock market performance since the correlation between the TAIEX yields and the Taiwan Top 50 Index was as high as 0.984, and between the Taiwan Top 50 Index and TTT was 0.9997.

Engle and Sarkar (2006) investigated the nature of premium and discount in 21 domestic funds and eight international funds. They claimed that the traditional methods of calculations were not giving accurate results. Therefore, they developed a statistical approach that measured the actual premiums by correcting the measurement errors in the NAV. The analysis was conducted on intraday as well as end of the day data. The results showed that correction of the ETF’s mispricing took less time in case of domestic ETFs and longer time in case of international ETFs. The reason behind the slowness was because the underlying securities of the international ETFs needed to price in their local market. Overall, the domestic ETF priced very close to their NAV.

Kayali (2007) worked on the pricing efficiency of the Dow Jones Istanbul 20 (DJIST 20), which tracked the DJIST 20 index trading on the Istanbul Stock Exchange. The results showed a high correlation between the closing price of the ETF and the NAV. The author explained that either premium or discount was not persistent for more than a day. Moreover, most of the time, ETFs traded in discount than in premium. The daily New Turkish Lira (TRY) premium/discount can be an opportunity to arbitrage in which traders can react by purchasing a relatively cheaper asset and selling the more expensive asset. This arbitrage activity could put pressure on prices to eliminate the price deviations from NAV. As a result, DJIST 20 could also be seen as a viable instrument for achieving exposure to Turkish stock market.

Delcoure and Zhong (2007) furthered the study by Engle et al. (2006) by analyzing the economic properties of premium and discount for the domestic and international ETFs. A total of 20 iShares ETFs were considered for the study. The study found economically significant premiums even after controlling for transaction cost and other possible errors. Further, the iShares price series exhibited higher volatility compared with the NAV series. However, the cointegration results indicated that the deviation from the NAV was only temporary and the mispricing converged to zero in a short span of time. The results of the panel regression identified several determinants of the iShares premium. For example, lower institutional ownership, higher bid-ask spread, higher trading volume, higher exchange rate volatility, etc. seemed to result in higher premium.

Ackert and Tian (2008) estimated premium and discount for a sample of 28 U.S. and country ETFs. In the U.S., negative relationship between liquidity and fund premium was observed, but in the case of country ETFs, positive relationship between premium and market liquidity was observed. The finding showed an inverted U-shaped relationship between liquidity and fund premium, and when illiquidity was more, there was a chance of mispricing. The domestic premium was under two basis points (BPS), but the country ETFs recorded more than 10 BPS. Finally, the authors concluded that mispricing and illiquidity have a direct relationship. Country funds showed higher chances of illiquidity due to the creation and redemption process being more complex.

Rompotis (2009) examined whether ETF premium predicts the future return and price volatility on the trading day. The study covered the time period from October 2005 to September 2006. The empirical results of the study found that the returns of iShares move in line with the returns of the tracking indices when the returns are calculated from the closing price as well as NAV. Moreover, the volume of transactions and premium had a negative relationship, and premium and return had a positive relationship on the current day. Further, negative relationship between lagged premium and current day return was observed. The findings of the study were in agreement with that of Jares (2004), which inferred that the high discount ratio of ETF would give high return in the future.

Dolvin (2010) examined the arbitrage opportunities for the securities SPY and IVV since both were tracking the same index and had the same features. The data period covered was from May 2000 to December 2008. The study found that SPY and IVV traded at premium in comparison with S&P 500, and the difference between the premiums was significant enough to create arbitrage profit. However, both premium and significance of the difference in the premium reduced substantially after the establishment of the National Market System (NMS) in 2005. Even though the arbitrage opportunities reduced in the post- NMS period, during periods of higher volatility, it showed arbitrage opportunities.

Jiang et al. (2010) conducted a study on pricing efficiency in the Chinese stock market for the period February 2005 to September 2008. Daily data collected from WIND Finance included the official NAV and SSE 50 ETF market price. The results from the cointegration analysis showed that ETF price and NAV were cointegrated, and a unidirectional causality from ETF price to NAV was observed. In addition, the Granger causality test confirmed that unidirectional cause and effect relationship flowed from the ETF market price to the NAV. The mean values confirmed that SSE 50 ETF was trading with low premium (0.023), and that the premium disappeared in three days.

Charteris (2013) studied the price differences between four domestic and three foreign ETFs listed in South Africa. The period from June 2008 and December 2012 was considered for the study. On average, SATRIX 40, FINI, and INDI in comparison with all the other funds traded at premium to the NAV. However, it was clear that ETF prices fluctuated below and above the NAV. In particular with domestic funds indicating a similar divide among positive and negative observations. The price, on the other hand, lay above the NAV for foreign funds for at least 60 percent of the examined trading days. Therefore, the average national ETF discount or premium percent was much lower than the foreign funds.

Marshall et al. (2013) examined the market characteristics when arbitrage opportunities were created on an intraday basis using data on two liquid S&P 500 ETFs. The authors argued that arbitrage opportunities were created and removed due to price deviation caused by trading during normal trading hours. The creation of arbitrage opportunity was associated with a reduction in liquidity and increase in liquidity risk. Higher return volatility was observed when the arbitrage opportunities arose. Intraday mispricing was found to be correcting with a median duration of about one to two minutes. Mispricing was largely driven by the volatile market than the difference between the NAV and the ETF price.

Charupat and Miu (2013) carried out an extensive review of literature on ETFs. Their literature survey showed that the importance of arbitrage and the size of arbitrage parameters depended on many factors including transaction costs, bid-ask spreads, and creation or redeeming framework specifications. In terms of pricing efficiency, the study showed that the reason behind high premium in international ETFs was NAV's being calculated based on stale prices. The NAVs would have incorporated the exchange rate fluctuations, but any other information received during the opening session could not be fully processed.

Milani and Ceretta (2013) examined the Brazilian ETFs pricing efficiency based on the long-term relationship between stock prices and market index as well as stock prices and NAV of the ETFs. The mean results suggested that stock returns were positive; however, NAV returns were negative indicating negative relationship between stock price and portfolio value. Finally, the authors argued that ETF price was closely related to the underlying index, but not with the NAV.

Hilliard (2014) did an extensive study on premium/discount connected with different types of ETFs with emphasis on premium connected with international equity ETFs. International ETFs face large obstacles to arbitrage in contrast to domestic ETFs that could prompt higher and more persistent premium/discount. A total of 801 ETFs were taken for the study and the data was acquired from the Morningstar database from inception date to April 2010. The study employed the mean-reverting Ornstein–Uhlenbeck process augmented with jumps. The results showed that the premium associated with the ETFs was less than the close-ended fund. The domestic ETFs' traded market price was closely in-line with the NAV due to the efficient arbitrage mechanism, but the arbitrage did not work effectively in international ETFs. The reason was due to different time zones, foreign exchange rates, etc. resulting in higher premium, higher volatility, and low speed of adjustment in case of international ETFs.

Aditya and Desai (2015) carried out the performance evaluation of 17 ETFs in India. The study period was from the inception date of the ETFs to September 2014. VECM was used in the study to find the long-run relationship between the NAV and the closing price of the ETF, and the results found that the Indian ETFs cleared the pricing divergence between the NAV and the closing price from four days to a maximum of 10 days. The study documented the long-run relationship between the ETF and NAV in case of a few ETFs and therefore, the null hypothesis of 'no long-run relationship between NAV and ETF price' was not rejected. Specifically, the authors found that the NAV was leading the ETF price and highlighted the role of the NAV as a predictor of the ETF price. The authors argued that contrary to the claims of other studies in the Indian context which claimed that the market was efficient, the Indian ETF market was not efficient.

Kearney et al. (2014) examined the ETF performance on three levels with NAV premium, ETF price versus underlying index, and ETF price versus market return over a period of 4 years from 2008 to 2012 based on 288 U.S. ETFs in the study. A generalized stepwise procedure was used for restraining the data snooping bias. The study found that ETFs did not show outperformance when analyzed on a non-risk adjusted basis. However, once risk adjusted measures like Sharpe, Treynor, and Sortino ratios were employed, the results showed statistically significant outperformance.

Tripathi and Garg (2016) measured the price performance of ETFs across countries in terms of NAV variations in market prices and the persistence of such deviations. This study analyzed 17 ETFs that tracked standard equity indices of five countries, namely, the U.S., the U.K., Japan, Australia, and India, from 2000 to 2012. The pricing deviation was minimum in the U.S. with 0.15 per cent and maximum in India with deviations ranging from 0.52 per cent to 1.42 per cent. The results show that ETFs in the U.S. have high pricing efficiency with pricing deviation corrected in a day, whereas India showed highest inefficiency with deviation taking three days to correct.

Kreis et al. (2016) assessed the price efficiency in terms of ETF price deviating from NAV of several Latin American ETFs. The study documented significant pricing deviations in case of almost all the ETFs. The deviations were larger than that of the deviations recorded in developed markets like the U.S., and therefore, offered many opportunities to exploit it using long-short trading strategies. The results showed that authorized ETF partners responded to inefficiencies by trading in the ETF's primary market. The findings were not consistent with the efficient market hypothesis, but endorsed the behavioural anomalies.

Petajisto (2017) analyzed the pricing efficiency of ETFs by covering all the ETFs recorded in the CRSP database. Funds holding liquid domestic assets were priced relatively efficiently in comparison with illiquid and international assets. Further, sectoral funds in the U.S. holding liquid assets also showed premium. Instead of comparing the ETF prices with NAVs, the study used a method to eliminate the stale prices using a market price of a peer group of similar firms. This led to a reduction in the size of the premiums. However, ETFs with international or illiquid assets still showed premium of 100 to 200 BPS, which the author argued as being economically significant.

Almudhaf (2019) analyzed the price effectiveness of ETFs by assessing the degree and persistence of the difference between the market price and the NAV. The author found that Saudi Arabia had a premium of $0.41, whereas the UAE markets had an annual $0.06 discount. Additionally, deviations persisted in Kuwait for four days, but were reduced in Saudi Arabia and Qatar after one day. These empirical results showed that ETFs did not fully replicate the performances of their underlying benchmarks. In the ETFs, significant tracking errors and price inefficiencies existed.

2.4 VOLATILITY SPILLOVER OF ETFS AND UNDERLYING BENCHMARK INDICES

Volatility spillover denotes volatility generated from one market transfer to another market. For example, if any news or information generated from one market impacts in another domestic or international market. The subsequent literature discusses the volatility and return spillover between the ETF and the underlying indices.

Datar et al. (2008) examined the return, volatility, and liquidity transmission between the U.S. (SPY) and Japan (EWJ) ETFs on an intraday basis. The data was collected from TAQ (Trades and Automated Quotations) from the NYSE. The empirical results showed specific intraday, daily, and monthly patterns in liquidity for the funds examined. The study found that the liquidity of both the countries was highly correlated. In the results of return spillover, it showed a unidirectional spillover from the U.S. to Japan, but not from Japan to the U.S. The study concluded that both the countries' returns highly correlated with each other.

Gutierrez et al. (2009) investigated the volatility and returns of Asian iShares traded in the U. S. The study used the daily and intraday data for the period from January 2000 to September 2007. The base results showed that volatility transmission was bidirectional between the U.S. and Asian markets. It also proved that the U.S. dominated in the information transmission to Asian countries. Overnight trades were creating more impact than the day time trades on volatility. The Asian and the U.S. market returns were correlated; however, an asymmetric relationship did not exist. The local market played an important role in the Asian ETFs volatility and returns.

Wang et al. (2009) conducted a study on the correlation between ETF and spot index in Taiwan. A total five ETFs intraday data was considered from January 2007 to July 2008 with five-minute intervals. Based on the VAR model, the results showed that the information was transferred from the spot index to the respective ETF. Also, the index got affected by its own lags than by other variables.

Chen and Huang (2010) worked on the volatility spillover between ETF and index returns in six developed and three emerging markets. The ARMA-EGARCH model was employed on the ETF and stock index returns to examine the asymmetric volatility or leverage effects. The results showed that volatility was persistent in most of the developed countries, and the ETFs return was negatively influenced by the unexpected returns. The return spillover also existed in most of the developed countries. Further, the previous day stock returns positively influenced the current day ETF returns. The study concluded that volatility spillover had a bidirectional relationship.

Curcio et al. (2012) examined whether the recently launched leveraged (long and inverse) real estate and real estate related ETFs and the previously launched conventional real estate and real estate related ETFs had significantly affected the volatility of their underlying real estate stocks. The result showed that the inception of traditional, and particularly, leverage ETFs impacted more on the volatility of the underlying bank and other financial stock prices. The Markov regime switching model also confirmed that access to banking and financial assets can be easily achieved through the leveraged ETFs.

Krause and Tse (2013) analyzed the U.S. and Canadian ETF market return and volatility spillover covering the period from March 2001 to September 2010. The study documented that price discovery consistently flowed from the U.S. to Canada. The lagged U.S. ETF returns significantly impacted the Canadian ETF market based on the results of the VAR and EGARCH models. The Canadian and the U.S. market had a bidirectional volatility spillover. The authors argued that the combination of negative return spillover from the U.S. to Canada and asymmetric volatility had significant policy implications to the Canadian equity markets.

Chen and Malinda (2014) examined the volatility spillover between financial and non-financial ETFs. The study covered the period from the starting date of the ETFs to May 2012 and employed the ARMA-M-GARCH and ARMA-M-EGARCH models. The study documented bidirectional return and volatility spillover between the financial and non-financial ETFs and constituent stocks. Then on-financial ETFs volatility had a strong positive influence on stock indices, whereas the stock indices had a negative influence on the ETFs. Further, the non-financial ETFs and indices had more volatility spillover than of the financial ETFs. The spillover effect of the ETF return had a positive effect on the index return. Finally, both the financial and non-financial ETFs showed significant leverage effect.

Dheeriya et al. (2014) examined the spillover of returns between the country ETFs. The study examined ETFs from Brazil, India, Indonesia, Mexico, Russia, South Korea, Turkey, and the U.S. covering the period from February 2011 to December 2012. Using the multivariate ARMA GARCH model, the results confirmed volatility spillover between the country ETFs. Most of the countries countered the volatility transmission, except for the Russian and Turkish market. Finally, the study concluded that investors should not only depend on domestic news, but also take into consideration international information.

Kadapakkam et al. (2015) examined the information efficiency of size-based U.S. ETFs and comparable portfolios. The authors argued that ETFs were better suited for the market efficiency tests as they have very low bid-ask spread and other trading related problems. The study confirmed a decline in the autocorrelations over a decade study period based on variance ratio tests. The size based portfolios did not demonstrate lead-lag relationship, however, there was volatility spillover from ETFs based on large firms to small firms and implied volatilities of the ETF options.

Chen and Diaz (2015) worked on seven emerging markets' equity ETFs using the fractionally integrated autoregressive moving average model and the fractional integrated asymmetric power autoregressive conditional heteroscedasticity model (ARFIMA-FIAPARCH). Most of the ETFs were giving positive returns as per mean value of the ETF returns. The asymmetric coefficient was negative and significant indicating that the market was more volatile during negative news than positive news. They concluded that there was a presence of volatility clustering in the emerging markets.

Dedi and Yavas (2016) studied the transmission of ETF returns and volatilities among developed markets such as Germany, the U.K., and Russia and emerging markets such as China and Turkey. GARCH, GARCH in mean, and EGARCH methodologies were applied in the study. The empirical results confirmed co-movement in the ETF returns in the markets examined in the study. ETF returns from developed markets such as Germany, the U.K., and Russia influenced emerging markets such as China and Turkey. The study found that Russia and Turkey had the highest volatility and China and the U.K. the lowest volatility. All countries in the study, except for the U.K. and Turkey experienced significant volatility spillover. Finally, only the U.K. stock market volatility showed a positive effect on future return.

Yavas and Dedi (2016) examined the ETF return linkage and volatility transmission in Germany, Austria, Poland, Russia, and Turkey. The study used the multivariate ARMA and GARCH models. The study documented significant co-movement in the returns among the sample countries. Though Russia and Turkey were more volatile, it did not persist for a long time. Finally, all the countries examined, with the exception of Turkey, experienced volatility spillover during the study period.

Yavas and Rezayat (2016) discussed the volatility and return spillover in seven emerging markets and the U.S. and European equity ETFs. Based on the data from 2012 to 2014, the study used the Multivariate Auto-Regressive Moving-Averages

(MARMA) and GARCH model for analysis of the return and volatility spillover between the countries. The study documented significant co-movement among the countries examined. However, it still offered diversification benefits for international investment. Further, the results confirmed that there was a unidirectional spillover from the developed markets to the emerging markets. Indonesia and Turkey were more volatile in the short-run; volatility shocks took a long time to dissolve for countries such as Russia, Turkey, Indonesia, and China compared with the other countries in the study.

Rompotis (2016a) evaluated the performance, volatility, and return spillover of leveraged ETFs with the underlying index. The ARMA-GARCH model was employed to identify the spillover of return and volatility between the leverage ETF and the underlying index. The average leveraged ETFs were capable of delivering their return target for a maximum weekly period, while the corresponding inverse ETFs could only deliver its reported return multiple over a period of 2 days. The volatility of the financial asset and equity prices had an inverse relationship, and bidirectional return spillover existed between the ETF and the index.

Rompotis (2016b) analyzed how the Chinese stock market crisis impacted the U.S. ETF market. The study used 26 ETFs covering Chinese stock indices listed in the U.S. stock market and 9 domestic ETFs. The researcher used a VAR model to assess the relationship. The results confirmed that the U.S. ETF market was affected by the crisis in the Chinese stock market and both the Chinese and the U.S. market relationship became stronger after the crisis. In the aspect of spillover, in both the markets, the return spillover and volatility was highly persistent.

Chen and Trang (2018) examined the volatility spillover in precious metal ETFs and precious metal indices and vice versa. The GARCH-M-ARMA and EGARCH-M-ARMA models were employed for the study for the data from January 2005 to June 2013. The results of the both the return and volatility showed bi-directional spillover between precious metal and indices. Finally, the study argued that the spillover effects of volatility would give input to funding managers regarding investing strategies.

Wang and Xu (2019) analyzed the relationship between ETF flow and the volatility of its underlying index. The volatility was examined based on total and fundamental volatility. Based on the data from January 2015 to December 2017, the results confirmed that the flow of the ETFs could predict the volatility of the underlying index the next day. This predictability led to increased creation and redemption activity of the authorized participants more than the market demand. The study argued that passively controlled ETFs were not really passive, possibly because of the dominance of the authorized participants behaviour, which was influencing the fluctuation in the entire index.

Glosten et al. (2020) examined the impact of ETF trading on the short-term information efficiency of the underlying securities. The study found that the short-run information efficiency improved for stocks with weak information environment. The improvement was largely due to the increase in speed of incorporating earnings related information. However, stocks with strong information environment did not experience any improvement. Further, the ETF activity led to an increase in the co-movement of stock prices and partly was due to the incorporation of earnings information in the prices.

2.5 CONCLUDING REMARKS

It is apparent from the review of the selected literature that in overseas nations, the notion of ETFs is common, but in India, it is still in the beginning stages of its development. Most of the ETF features discussed are based on the international stream since, only a few studies have assessed and discussed the impact of Indian ETF markets and indices. Therefore, this forms the basis for the present study to explore the ETFs market in India. Hence, the study selected four objectives based on the literature review, i.e. pricing efficiency, speed of adjustment to intrinsic value, premium and discount, and volatility spillover. The following chapters will elucidate in detail the work carried out on the four mentioned objectives.

CHAPTER 3

PRICING EFFICIENCY OF ETFS AND UNDERLYING BENCHMARK INDICES

3.1 INTRODUCTION

ETFs are index funds representing a basket of securities, which include stocks, bonds, and other assets traded on the stock exchange on par with common equity. One of the important aspects of ETF is its pricing. ETFs have a different pricing mechanism in comparison with other Collective Investment Vehicles (CIVs), for example, Mutual Funds (MFs). Since MFs follow the "forward pricing", which means if an investor gives an order to purchase or sell units through the day, it is executed at the same price called the NAV, which is released at the end of the day. Whereas, ETFs trade for the entire day on the exchange, and its pricing will be calculated on a continuous basis throughout the trading day. Further, the possibility of converting ETF units to underlying asset or vice-versa promotes arbitrage opportunity, if there is large divergence between the price of ETFs in the secondary market and the NAV. The stock exchanges release an indicative NAV (iNAV) throughout the trading day that assists in tracking the accurate value of the ETF units. Therefore, the ETF price should closely associate with the underlying index price.

Pricing efficiency is also called external efficiency denoting that the price of an asset should capture all the available information of the underlying securities. The law of one price suggests that both the market price of the ETFs and the NAV should be equal. If there is any divergence in the price, it may not indicate price inefficiency, but may be due to a problem in the accounts (Charteris 2013).

Due to the unique nature of ETFs compared with other CIVs, not only do financial professionals give importance to ETFs, even academicians have started to investigate the issues relating to the influence of ETFs on the financial markets. The growing significance of ETFs has provided a price discovery role in the market. The present study tries to analyze the pricing deviations of the ETFs in the Indian stock market, and the time duration taken for converging to equilibrium level between the ETFs and the underlying asset price. There are several studies examining the pricing efficiency in the context of developed markets. For example, the studies by Lin et al. (2006), Kayali (2007), and DeFusco et al. (2011) confirm that ETF prices replicate the underlying index prices indicating a high degree of pricing efficiency. The divergence between the two are largely attributed to dividend accumulation, management fees, etc. The difference between the NAV and the ETF price adjust quickly in case of domestic ETFs (Engle and Sarkar 2006), whereas it takes longer time in the international ETFs (Chu and Hseih 2002; Lin et al. 2006; DeFusco et al. 2011; Thirumalai 2003; Kayali 2007).

The present study focuses on the closing price of the ETF and closing index price to analyze the long-run relationship using the Autoregressive Distributed Lag (ARDL) approach. This is in contrast with the extant studies, which have largely used NAV rather than the underlying index price. There is an advantage in using the closing index price over the NAV; the market value of the ETF is represented directly, which in turn helps to understand the pricing deviation. It also presents an opportunity to use the closing price of the index as an indicator for prediction. As the ARDL model accounts for lagged variables, it helps in finding the long-run relationship among the endogenous and exogenous variables (Baharumshah et al. 2009; Duasa 2007; Odhiambo 2009; Ozturk and Acaravci 2010; Ozturk and Acaravci 2011).

The studies done in the context of ETFs are very few in the Indian stock market. Therefore, the present study fills this gap by examining the pricing efficiency of the equity ETFs in India. The study by Madhavan and Maheswaran (2016) concludes that the long-run relationship between the ETF price and the underlying index price was unsuccessful in showing the pricing direction of the Indian ETFs. Further, in most of the studies in the global context have not taken the possibility of structural breaks into account. When structural breaks are not taken into account in the model, the results may be unreliable relative to the presence of the structural breaks (Bai and Perron 2003). On the empirical front, structural breaks have shown that they affect the behaviour and accuracy of the estimates of the time-series models. The present study considers the possibility of structural breaks in the time series by considering single and multiple structural breaks, which were not considered in the previous studies.

The structure of the chapter is as follows: Section 3.2 discusses data, followed by Section 3.3 on methodology, and finally, Section 3.4 concludes the chapter.

3.2 DATA

The present study collected data from the National Stock Exchange (NSE) website and the Prowess database. The data used in the study is the closing price of the ETF and the closing index price. All the ETFs currently traded in the stock exchange with at least 500 trading days or a minimum of two years observation were included in the analysis. The closing price data on each ETF was collected from the inception date of the ETF to the end of December 2018. The closing market price of the ETF and the closing index price was taken from the NSE website and the CMIE Prowess database, respectively. Based on the above criteria, seventeen equity ETFs were considered for the present study. The ETFs were designed based on the proportion of the underlying index price, for example, the price of NIFTYBEES is 1/10th of the Nifty 50 index price. Therefore, the index price was converted to match the price of the ETF.

3.3 METHODOLOGY

This section focuses on the methodology of the pricing efficiency. To estimate the efficiency level of the ETF price, the present study identifies how the ETF market price closely tracks the underlying index price. DeFusco et al. (2011) defined price deviation as the variation in the ETF price to its underlying index. Therefore, the price deviation is formulated as follows:

$$PD = CI - CETF \qquad \ldots(3.1)$$

where, *PD* is the pricing deviation, *CI* is the closing price of index, and *CETF* is the closing price of the ETF.

To find the relationship between the ETF price and the index, the study framed the empirical model as follows:

$$S_t = \beta_0 + \beta_1 Ft + PD_t \qquad \ldots(3.2)$$

where, S_t is the closing price of the index, F_t is closing price of the ETF, and PD_t is the price deviation

The analysis of the long-run time series was pre-tested using the unit root tests. As in most instances, the variables may not be stationary at the level, which may lead to spurious regression. The Augmented Dickey-Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests were employed to check the existence of the unit root in the variables. As both the tests differ in the hypothesis, it helps to ensure that the variables order of integration is identified correctly. Further, the study proposes to use the Autoregressive Distributed Lag (ARDL) approach (Pesaran et al. 2001) to test the long-run relationship between the closing price of the ETF and the closing index price. Based on Equation 3.2, the study rewrote the following Equation 3.3 to test the long-run relationship:

$$\ln CI_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k} \beta_p ln(CI)_{t-p} + \sum_{p=0}^{l} \gamma_p ln(CETF)_{t-p} + e_t \qquad \ldots(3.3)$$

where, $CI_{t\text{-}p}$ is the closing index price and $CETF_{t\text{-}p}$ is the closing price of the ETF at time t. Suitable lag lengths were selected based on the Akaike Information Criterion (AIC). Both variables were expressed in natural logarithm. To analyze both the short and long-run, the ARDL model was written as follows:

The long-run coefficient for the model (3.3) was estimated as:

$$\delta_p = \frac{\sum_{p=0}^{l} \gamma_p}{1 - \sum_{p=1}^{k} \beta_p} \qquad \ldots(3.4)$$

An ARDL model's co-integrating regression method was obtained by translating (3.3) into differences and substituting the long-run coefficients from (3.4).

$$\Delta lnCI_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k} \beta_{p1} \Delta \ln\,(CI)_{t-p} + \sum_{p=0}^{l} \gamma_{p1} \Delta \ln\,(CETF)_{t-p} + \partial EC_{t-1} + e_t$$

...(3.5)

where, Δ denotes the first-order difference.

$$EC_t = \ln CI_{\mathrm{t}} - \alpha - \sum_{p=1} ln(CETF)_{p,t}\,\widehat{\delta_p}. \qquad \text{...(3.6)}$$

$$\partial = 1 - \sum_{p=1}^{k} \hat{\beta}_p.. \qquad \text{...(3.7)}$$

The study tests the cointegration and long-run relationship using the ARDL Bounds test. The computed test uses both the t and F statistics to test the significance level of the variables. In the first case, the bounds test facilitates to identify the long-run relationship and test cointegration among the variables. With the verification of cointegration, the study further estimates the long-run relationship and ARDL error correction model for the index and the ETF price.

3.3.1 Single and Multiple Structural Breaks

To account for the influence of economic incidents, the present study initially tests for the presence of structural breaks with single breakpoint and further with multiple structural breakpoint tests. First, the breakpoint unit root test is conducted on the endogenous variable under I(0) and I(1) level with the criteria of minimizing the Dickey-Fuller t-statistic method and the lag length is chosen based on the Schwarz criterion. Based on the structural break date, a dummy variable is assigned to estimate the ARDL model to account for the effect of the shocks in the model.

$$\ln(\mathrm{CI}) = \alpha_0 + \sum_{p=1}^{k} \beta_p \ln(CI)_{t-p} + \sum_{p=0}^{l} \gamma_p \ln\,(CETF)_{t-p} + \theta_1 d_1 + e_t. \quad ...(3.8)$$

Where, CI is the closing index price, CETF is the closing price of the ETF, and d_1 is the dummy variable used based on the results of the structural break test.

The long-run coefficient for the model is estimated by:

$$\delta_p = \frac{\sum_{p=0}^{l} \gamma_p + \theta_1}{1 - \sum_{p=1}^{k} \beta_p} \quad ...(3.9)$$

An ARDL model's cointegration form can be written as:

$$\Delta lnCI_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k} \beta_{p1}\, \Delta\ln\,(CI)_{t-p} + \sum_{p=0}^{l} \gamma_{p1}\, \Delta\ln\,(CETF)_{t-p} + \partial EC_{t-1} + \theta_1 d_1 + e_t \quad ...(3.10)$$

where, Δ denotes the first-order difference.

$$EC_t = \ln CI_{\mathrm{t}} - \alpha - \sum_{p=1} ln(CETF)_{p,t}\, \widehat{\delta_p} \quad ...(3.11)$$

$$\partial = 1 - \sum_{p=1}^{k} \hat{\beta}_p \quad ...(3.12)$$

With a single breakpoint, there can be loss of information as the dataset may contain multiple breaks. Hence, the present study also uses the multiple structural breakpoints test as it helps identify the structural break dates (Bai and Perron 2003). Multiple dummies are inserted based on the break specification dates in the data to execute the ARDL model. This model specification with multiple structural breakpoints can be written as:

$$\ln{(CI)}_{\mathrm{t}} = \alpha_0 + \sum_{p=0}^{k} \beta_p \ln{(CI)}_{t-p} + \sum_{p=1}^{l} \gamma_p \,(CETF)_{t-p} + \sum_{p=1}^{m} \theta_p \, d_t + e_t \qquad \text{...(3.13)}$$

Where, CI is the converted closing index price, CETF is the closing price of the ETF, and d_t represents the multiple breakpoints.

The long-run coefficient for the model is estimated by:

$$\delta_p = \frac{\sum_{p=0}^{l} \gamma_p + \theta_p}{1 - \sum_{p=1}^{k} \beta_p} \qquad \text{...(3.14)}$$

An ARDL model's cointegration form can be written as:

$$\Delta lnCI_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k} \beta_{p1} \,\Delta\ln{(CI)}_{t-p} + \sum_{p=0}^{l} \gamma_{p1} \,\Delta\ln{(CETF)}_{t-p} + \partial EC_{t-1} + \sum_{p=1}^{k3} \theta_p \, d_t + e_t \qquad \text{...(3.15)}$$

where, Δ denotes the first-order difference.

$$EC_t = \ln CI_{\mathrm{t}} - \alpha - \sum_{p=1} ln(CETF)_{p,t} \,\widehat{\delta_p}.. \qquad \text{...(3.16)}$$

$$\partial = 1 - \sum_{p=1}^{k} \hat{\beta}_p. \qquad \text{...(3.17)}$$

The study attempts to test the following null and alternative hypothesis:

H0-There is no long-run relationship between the ETF and the underlying index price

H1-There is a long-run relationship between the ETF and the underlying index price.

3.4 RESULTS

The summary statistics of ETF prices is presented in Table 3.1. The standard deviation value shows that the deviation is not much from the mean value. KOTAKNIFTY and NIFTYBEES have higher mean value among the selected ETFs. KOTAKNIFTY has the highest standard deviation as well as mean. The M50 has the lowest standard deviation, which shows that the price does not deviate much from the mean value. The skewness value shows that most of the ETFs have a negative sign, which indicates that the left tail is longer and most of the distribution to the right. KOTAKNIFTY has the highest skewness (-1.534), followed by PSUBNKBEES (-0.903). Kurtosis value is to measure the tails of the distribution with reference to normal distribution. If the kurtosis value is above three, it indicates that the series has heavy tails, and if the value is less than three, it indicates low spike or low tails. In the present study, the kurtosis value shows that most of the ETFs have low spikes and only three ETFs have heavy tails. The Jarque-Bera value confirms that the error value is not normally distributed.

The summary statistics of the closing index price is presented in Table 3.2. The mean and standard deviation mostly follows the pattern observed in the case of ETFs as these are the underlying indices. KOTAKNIFTY (Nifty 50) has the highest deviation from the mean value and the CPSSETF (Nifty CPSE) has a low value, which shows that the price movement is less for CPSEETF (Nifty CPSE). The skewness value shows that most of the ETFs have a negative sign, which indicates asymmetrical distribution with a long tail to the left. The KOTAKNIFTY is highly skewed (-1.53), followed by PSUBNKBEES (-0.903). Even here, the kurtosis value replicates the ETF price result, i.e., most of the indices have low spikes, and only three indices such as the Nifty 50 (KOTAKNIFTY) and the Nifty PSU Bank (KOTAKPSUBK, PSUBNKBEES) have heavy tails. The Jarque-Bera value confirms that the error value is not normally distributed. These results are almost the same as for the ETF price.

The results of the summary statistics on pricing deviation is presented in Table 3.3. The mean value presents the difference between the index price and the ETF price. A negative mean value of the pricing deviation shows that the ETFs' prices are higher than the underlying index prices. However, a very small value of the pricing deviation indicates that the difference is not very large between the index price and the ETF price. The PSUBNKBEES has the highest deviation and the SHARIABEES has the lowest deviation. The standard deviation of the pricing deviation confirms that the PSUBNKBEES has high standard deviation of the pricing deviation value. All the other ETFs do not show much deviation from the mean value. The skewness value shows that most of the ETFs have a negative value. Even the kurtosis value shows that the JUNIORBEES have a higher spike than the other ETFs, and the M50 is placed in the last position with a low spike in comparison with the other ETFs.

The unit root test result of the pricing deviation based on the ADF and KPSS tests are presented in Table 3.4. The null hypothesis of the ADF test is that the series is non-stationary, whereas in the KPSS test null hypothesis is that the series is stationary. As per the ADF test, most of the ETFs' pricing deviations are stationary at level, except for M50. However, the KPSS test rejects the null hypothesis of stationarity in most cases, except for INFRABEES and RELCNX100. Both the tests confirm that all the series are stationary at first difference form.

In the same manner, Table 3.5 presents the unit root test result for the closing price of the ETFs based on the ADF and KPSS tests. The results of the ADF test show that only few ETFs are stationary at level, such as the BANKBEES, INFRABEES, JUNIORBEES, and the RELCONS. The remaining ETFs are not stationarity at level. The KPSS test shows that all the ETFs are not stationarity at level. However, all the ETFs are stationary after the first difference in both the tests. The unit root results of the ADF and KPSS for the closing index prices are presented in Table 3.6. In the case of the ADF test, only a few indices are stationarity at level, and all the index prices are stationarity at first difference. In the case of the KPSS test, the null hypothesis is rejected for all the index prices at level and accepted at first difference.

The ARDL model results for the ETFs based on broad-based indices are presented in Table 3.7. The lagged ETF prices negatively impact the current day index price, and the lagged index prices positively impact the current day index price. However, on the current day, the ETF prices positively impact the index price. As the lag length increases, the size of the coefficients decreases indicating lesser impact. The bounds test is conducted to find the presence of long-run relationship between the ETF and the index prices. The study uses the F statistic value to predict the long-run relationship, and if the F-statistic value is above the upper bound critical value, then there is presence of long-run relationship and vice versa. In the case of ETFs based on broad-based indices, only a few ETFs have F-statistic value greater than the critical value such as M100, RELCNX100, and NIFTYBEES. The remaining ETFs do not have long-run relationship.

The ARDL form short-run and long-run coefficients are presented for ETFs based on broad-based indices in Table 3.8. The short-run coefficients denote the shocks in the independent variable and the time that the dependent variable takes to reach the equilibrium level. In short-run, the differenced index price negatively impacts the current day index price, and the differenced ETF prices positively impact the current day index price. The coefficient of the co-integrating term is negative and significant for all the ETFs. The coefficients of BSLNIFTY, JUNIORBEES, KOTAKNIFTY, M100, M50, NIFTYBEES, QNIFTY, and RELCNX100 are 0.004, -0.215, -0.107, -0.067, -0.001, -0.065, -0.061, and -0.060, respectively. It shows that if there is change in the closing price of the ETFs, the shock will be corrected by 1%, 21.5%, 10.7%, 6%, 1%, 6%, 6 %, and 6% of the closing index price for the BSLNIFTY, JUNIORBEES, KOTAKNIFTY, M100, NIFTYBEES, QNIFTY, and RELCNX100, respectively in each time period. The long-run coefficients are presented in the bottom panel of Table 3.8 and indicate a statistically significant positive relationship between the index closing price and the closing prices of the ETFs.

The ARDL and the bounds test results of the ETFs based on sectoral indices are presented in Table 3.9. The lagged index price coefficients positively impact the current day index price, except for a few ETFs, which negatively impact at the second lag. The lagged ETF prices negatively impact the current day index price. However, the current day ETF price has a positive impact on the current day index price. Only few ETFs such as KOTAKBKETF, PSUBNKBEES, and SHARIABEES have a long-run relationship with the underlying index price, and the long-run relationship is validated through the bounds test.

The ARDL and the long-run form coefficients for the ETFs based on sectoral indices results are presented in Table 3.10. In short-run, the differenced index price negatively impacts the index price, whereas the differenced ETF price positively impacts the index price. Almost all the lagged ETF and index price coefficients are significant, except for RELCNX100. The cointegration coefficient shows that KOTAKBKETF has a high speed of correction towards the equilibrium (23.3%) and CPSEETF has the least correction speed. The long-run coefficients are presented in the bottom panel of Table 3.10. The results indicate a statistically significant positive relationship between the index closing price and the closing prices of the ETFs. Hence, the overall results without structural break shows that only 1/3rd of the ETFs show a long-run relationship between the ETF and the index price.

3.4.1 Single Structural Break Results

Table 3.11 presents the ARDL and bounds test results for the ETFs based on broad-based market indices with single structural break. Even with a single structural break, the ARDL results show that the current index price impacts positively by its own lags and the current-day ETF price. The lagged ETF prices negatively impact the index price, which is in line with the results without structural break. The bounds test results show that only four out of eight ETFs have a presence of long-run relationship as against three out eight ETFs without structural break.

The results of short and long-run cointegration are presented in Table 3.12. In the short-run, the differenced index price impacts the current day index price negatively and the differenced ETF price impacts the current day index price positively. In the cointegration, the coefficients show that the JUNIORBEES has a high speed of correction (21.6%), followed by KOTAKNIFTY, and the remaining ETFs' correction speed lies between 1% to 6%. In the long-run, the ETFs prices show a positive and significant impact on the index price. BSLNIFTY has less effect on the index price compared with the other ETFs.

The results of the ETFs based on sectoral indices with single structural break is presented in Table 3.13. Even in the sectoral indices, the ETFs show results similar to the results of the ETFs based on broad-based indices in terms of relationship. The current day index positively impacts by its lags, except for RELDIVOPP. However, the lagged ETF prices negatively impact the index price. The CPSEETF lagged index price has a high negative impact on the current day index price, followed by BANKBEES. More sectoral indices ETFs show cointegration between the ETF and the index price in comparison with ETFs of broad-based indices. As per the bounds test results, all the ETFs show long-run relationship, except for KOTAKPKSUB. The sectoral indices results show that more ETFs have a long-run relationship than broad-based indices' ETFs. The dummy variable is significant in most of the ETFs. The structural break has a substantial impact on the sectoral indices' ETFs. Nearly, eight out of nine ETFs have long-run relationship as against three out of nine ETFs without structural break. The short and long-run coefficients with single break is presented in Table 3.14. In the short-run, the differenced index price largely has negative impact on the index price. However, there are few exceptions in the form of positive impact or insignificant relationship. The differenced ETF prices have a positive impact on the index price, except for RELDIVOPP. In the long-run, almost all the ETFs' price positively impacts the index price. The cointegrating terms are negative and significant confirming the existence of cointegration between the variables, except for CPSEETF. KOTAKBKETF and BANKBEES carry a high speed of correction towards the midpoint or equilibrium around 42% and 23.7%, respectively.

3.4.2 Multiple Structural Breakpoint Results

The study tests for the presence of multiple structural breaks by using the Bai-Perron test. Based on the structural break dates, dummy variables are created to identify the same. The results of the ARDL and bounds test are presented in Table 3.15 for ETFs based on broad-based market indices. The ARDL results are more or less the same with the other two scenarios, i.e., without structural break and with single structural break. The multiple structural break result shows that the lags of the index price and the current ETF prices positively impact the current-day index price. However, the lagged ETF prices negatively impact the current day index price. Under the broad-based market indices, the structural break dummy variables are statistically significant in most cases, except for a few ETFs. The bounds test result shows that most of the ETFs have a long-run relationship, except for the BSLNIFTY and QNIFTY. The remaining ETFs have F-statistic value greater than the critical value and confirm the presence of long-run relationship or cointegration between the ETF and the index price.

The short and long-run coefficients with multiple structural breaks are presented in Table 3.16. JUNIORBEES dominates in the correction time (40%) towards equilibrium. If there is a shock in closing ETF price, it will be corrected by 2%, 40%, 11%, 7%, 1%, 7%, 8 %, and 8% of the closing index price for BSLNIFTY, JUNIORBEES, KOTAKNIFTY, M100, NIFTYBEES, QNIFTY, and RELCNX100, respectively, in each time period. The speed of correction to equilibrium increases for all the ETFs after the introduction of multiple structural breaks in the equation. Even long-run coefficients are significant; it shows positive relationship between the ETFs and the index price.

The results of the ETFs based on sectoral indices after incorporating multiple structural breaks are presented in Table 3.17. The first lag of the index price has more impact on current day index price than the deeper lags. The underlying index price of RELCONS and RELDIVOPP are more positively influenced by previous day prices of the index. The positive impact gradually reduces from lag two. The current ETF price has positive and significant impact towards the current index price. RELDIVOPP and RELCONS carry a less positive impact compared with the other ETFs in the sectoral indices. Lagged ETFs have a negative impact on the current day index price. The negative impact starts to reduce after the first lag. In terms of dummy variables, all the ETFs carry a negative influence on the index price. However, in terms of significance, only a few ETFs are significant. The results of the bounds test replicate the single structural breakpoint result. Almost all the ETFs in the sectoral indices have a long-run relationship, except for KOTAKBKETF and KOTAKPSUBK.

The short and long-run coefficients of the ETFs based on sectoral indices with multiple structural breaks are presented in Table 3.18. In the short-run, the differenced index price has a negative impact on the current day index price. Specifically, BANKBEES and CPSEETF have more impact on the index price. The lagged ETF price positively impacts the index price. Even in the long-run, the ETF price has a positive influence on the dependent variable. However, in the long-run, the dummy variable has a negative influence and most of the dummies give mixed results. The speed of correction gradually increases for all the ETFs after the introduction of multiple structural breaks in the data. Most of the ETFs show long-run relationship after the incorporation of multiple structural breaks.

The empirical results of the study confirm that most of the ETFs examined show long-run relationship between the ETF and the underlying index price. Therefore, the study rejects the null hypothesis of no long-run relationship between the ETF and the underlying index price.

3.5 SUMMARY

The study analyzes the pricing efficiency of the ETFs by considering the closing price of the ETFs and its underlying index prices in India. The time frame covered in the study is from inception date of the ETFs to December 2018. The study employs the ARDL model between the closing price of the ETF and the closing price of the underlying index. The analysis was done in three scenarios, i.e., without structural break, single structural break, and multiple structural breaks.

The results show that ETFs and index prices give positive return over longer period of time. However, there is a presence of negative pricing deviation, indicating that the ETFs are priced higher compared with the index prices. Further, the study compares the results with and without structural breaks. The empirical results suggest that the consideration of single and multiple structural breaks impact on the results compared to without structural break. More number of ETFs exhibit long-run relationship with the underlying indices. The speed of correction towards equilibrium increased after the incorporation of single and multiple structural breaks. Hence, the present study proves against the study of Madhavan and Maheswaran (2016) as their work shows that the long-run relationship between the ETF price and the underlying index price was unsuccessful in showing the pricing direction of the Indian ETF. However, in the present study, most of the ETFs have a stable long-run relationship between the ETFs' price and the underlying index price.

Table 3.1 - Summary Statistics of ETF Price

ETF	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	4.356	0.299	-0.294	1.480	181.453	1640
BSLNFITY	4.356	0.299	-0.294	1.480	181.453	1640
CPSEETF	3.213	0.127	-0.491	2.465	60.516	1163
INFRABEES	5.658	0.154	-0.322	2.002	118.628	2019
JUNIORBEES	4.751	0.608	-0.176	2.279	99.863	3721
KOTAKBKETF	5.352	0.188	0.012	1.711	69.063	998
KOTAKNIFTY	6.210	0.704	-1.534	3.824	904.269	2151
KOTAKPSUBK	5.754	0.237	-0.666	3.639	245.120	2696
M100	2.449	0.395	0.052	1.524	177.142	1943
M50	4.414	0.141	0.454	2.490	93.794	2073
NIFTYBEES	6.074	0.690	-0.715	2.519	396.010	4173
PSUBNKBEES	5.778	0.240	-0.903	3.837	451.546	2736
QNIFTY	6.472	0.345	-0.338	2.775	44.062	2081
RELCNX100	4.452	0.222	-0.438	2.299	66.139	1262
RELDIVOPP	3.170	0.176	-0.155	1.668	70.255	901
RELCONS	3.703	0.196	-0.042	1.882	53.700	1025
SHARIABEES	5.091	0.282	0.209	1.598	170.903	1916

Note: ETF price denoted as natural logarithm of ETF price

Table 3.2 - Summary Statistics of Index Price

ETF	Underlying indices	Mean	Std. Dev.	Skew -ness	Kurt-osis	Jarque-Bera	Obser-vations
BANKBEES	Nifty Bank	4.325	0.257	-0.196	1.789	110.758	1640
BSLNFITY	Nifty 50 Index	4.325	0.257	-0.196	1.789	110.758	1640
CPSEETF	Nifty CPSE Index	3.143	0.111	-0.693	2.509	104.866	1163
INFRABEES	Nifty Infrastructure	5.650	0.147	-0.305	2.110	97.976	2019
JUNIORBEES	Nifty Next 50	4.741	0.61	-0.199	2.263	108.631	3721
KOTAKBKETF	Nifty Bank	5.338	0.183	-0.002	1.742	65.770	998
KOTAKNIFTY	Nifty 50 Index	6.199	0.707	-1.529	3.814	897.436	2151
KOTAKPSUBK	Nifty PSU Bank	5.725	0.231	-0.704	3.636	267.797	2696
M100	Nifty Midcap 100	2.425	0.373	0.063	1.528	176.614	1943
M50	Nifty 50 Index	4.284	0.254	0.081	1.693	149.88	2073
NIFTYBEES	Nifty 50 Index	6.063	0.686	-0.733	2.525	413.048	4173
PSUBNKBEES	Nifty PSU BANK	5.720	0.236	-0.718	3.623	279.177	2736
QNIFTY	Nifty 50 Index	6.445	0.327	-0.339	2.933	40.332	2081
RELCNX100	Nifty 100	4.44	0.211	-0.437	2.320	64.522	1262
RELDIVOPP	Nifty Dividend Opportunities 50	3.117	0.129	-0.168	1.869	52.199	901
RELCONS	Nifty India Consumption	3.674	0.175	0.074	1.854	56.992	1025
SHARIABEES	Nifty50 Shariah Index	5.084	0.272	0.199	1.627	163.197	1916

Note: Summary statistics calculated on natural logarithm of converted index price

Table 3.3 - Summary Statistics of Pricing Deviation

ETFs	**Mean**	**Std. Dev.**	**Skew-ness**	**Kurto-sis**	**Jarque-Bera**	**Obser-vations**
BANKBEES	-0.032	0.079	-0.448	2.522	70.497	1640
BSLNIFTY	-0.032	0.079	-0.448	2.522	70.497	1640
CPSEETF	-0.070	0.053	-0.147	1.684	88.154	1163
INFRABEES	-0.008	0.022	0.436	7.322	1635.040	2019
JUNIORBEES	-0.010	0.014	-1.663	31.750	129863.200	3721
KOTAKBKETF	-0.014	0.008	0.507	4.336	116.917	998
KOTAKNIFTY	-0.011	0.009	-0.525	5.532	673.304	2151
KOTAKPSUBK	-0.029	0.027	-0.416	4.335	277.964	2696
M100	-0.025	0.030	-0.524	4.402	248.041	1943
M50	-0.130	0.178	-0.042	1.081	318.757	2073
NIFTYBEES	-0.012	0.011	-0.964	4.583	1081.963	4173
PSUBNKBEES	-0.350	4.774	-0.592	15.149	16985.700	2736
QNIFTY	-0.027	0.027	0.049	4.096	104.921	2081
RELCNX100	-0.012	0.024	0.128	7.227	942.983	1262
RELCONS	-0.029	0.043	0.613	5.713	378.429	1025
RELDIVOPP	-0.053	0.059	0.812	2.934	99.283	901
SHARIABEES	-0.007	0.027	0.234	7.828	1878.517	1916

Note: Pd denotes pricing deviation, Pricing deviation (IP-ETF price)

Table 3.4 - Unit Root Results of Pricing Deviation

ETF	ADF test Statistic				KPSS	
	Level		First Difference		Level	First Difference
	t-Statistic	Prob.	t-Statistic	Prob.		
BANKBEES	-8.66	0	-27.28	0	0.52	0.02
BSLNIFTY	-3.73	0.02	-24.97	0	0.51	0.05
CPSEETF	-3.5	0.04	-27.27	0	0.34	0.03
INFRABEES	-9.89	0	-22.71	0	0.08	0.03
JUNIORBEES	-6	0	-30.33	0	0.96	0.06
KOTAKBKETF	-11.57	0	-18.38	0	0.21	0.24
KOTAKNIFTY	-3.97	0.01	-22.65	0	0.45	0.09
KOTAKPSUBK	-3.62	0.03	-21.85	0	1.09	0.11
M100	-5.89	0	-24.48	0	0.35	0.08
M50	-2.34	0.41	-39.62	0	0.43	0.05
NIFTYBEES	-5.27	0	-36.79	0	0.76	0.06
PSUBNKBEES	-12.66	0	-23.01	0	0.14	0.06
QNIFTY	-3.41	0.05	-25.2	0	0.34	0.11
RELCNX100	-10.6	0	-19.22	0	0.05	0.15
RELCONS	-8.4	0	-17.91	0	0.07	0.05
RELDIVOPP	-8.46	0	-15.68	0	0.23	0.07
SHARIABEES	-8.56	0	-30.56	0	0.29	0.07

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 3.5 - Unit Root Results of ETF Price

ETF	ADF test Statistic				KPSS	
	Level		First Difference		Level	First Difference
	t-Statistic	Prob.*	t-Statistic	Prob.*		
BANKBEES	-3.95	0.01	-52.46	0	0.15	0.06
BSLNIFTY	-2.70	0.24	-24.40	0	0.53	0.10
CPSEETF	-1.94	0.63	-24.85	0	0.46	0.11
INFRABEES	-3.35	0.06	-54.63	0	0.42	0.08
JUNIORBEES	-3.85	0.01	-63.00	0	0.35	0.03
KOTAKBKETF	-2.20	0.49	-31.09	0	0.53	0.08
KOTAKNIFTY	-1.62	0.78	-46.35	0	0.93	0.04
KOTAKPSUBK	-2.63	0.27	-53.31	0	0.40	0.04
M100	-2.33	0.42	-48.60	0	0.38	0.11
M50	-2.80	0.20	-49.23	0	0.32	0.03
NIFTYBEES	-1.99	0.60	-47.14	0	1.11	0.04
PSUBNKBEES	-2.64	0.26	-50.81	0	0.35	0.04
QNIFTY	-2.93	0.15	-48.38	0	0.18	0.04
RELCNX100	-2.46	0.35	-23.60	0	0.32	0.06
RELDIVOPP	-3.13	0.10	-30.19	0	0.43	0.08
RELCONS	-4.05	0.01	-19.81	0	0.19	0.03
SHARIABEES	-2.47	0.34	-27.74	0	0.60	0.10

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 3.6 - Unit Root Results of Index Price

ETF	Underlying Indices	ADF test Statistic				KPSS	
		Level		First Difference		Level	First Difference
		t-Statistic	Prob.*	t-Statistic	Prob.*		
BANKBEES	Nifty Bank	-4.04	0.01	-51.01	0	0.15	0.05
BSLNIFTY	Nifty 50	-3.19	0.09	-38.08	0	0.31	0.05
CPSEETF	Nifty CPSE	-2.07	0.56	-31.73	0	0.44	0.11
INFRABEES	Nifty Infrastructure	-3.39	0.05	-40.43	0	0.42	0.07
JUNIORBEES	Nifty Next 50	-3.72	0.02	-59.75	0	0.34	0.03
KOTAKBKETF	Nifty Bank	-2.23	0.47	-30.33	0	0.53	0.08
KOTAKNIFTY	Nifty 50	-1.61	0.79	-46.35	0	0.93	0.04
KOTAKPSUBK	Nifty PSU BANK	-2.81	0.19	-47.49	0	0.34	0.04
M100	Nifty Midcap 100	-2.48	0.34	-38.43	0	0.4	0.09
M50	Nifty 50	-2.91	0.16	-42.09	0	0.36	0.04
NIFTYBEES	Nifty 50	-2.04	0.58	-46.33	0	1.12	0.04
PSUBNKBEES	Nifty PSU BANK	-2.76	0.21	-48.03	0	0.36	0.03
QNIFTY	Nifty 50	-2.98	0.14	-42.68	0	0.2	0.04
RELCNX100	Nifty 100	-2.39	0.38	-26.12	0	0.31	0.04
RELDIVOPP	Nifty Dividend Opportunities 50	-2.17	0.51	-22.66	0	0.46	0.08
RELCONS	Nifty India Consumption	-2.87	0.17	-29.77	0	0.24	0.05
SHARIABEES	Nifty50 Shariah	-2.83	0.19	-41.88	0	0.58	0.06

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119

Table 3.7 - ARDL and Bounds Test Results without Structural Break for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
IP(-1)	1.055 (42.705)*	0.346 (20.952)*	0.424 (19.736)*	0.828 (34.519)*	0.944 (42.144)*	0.359 (22.707)*	0.471 (19.332)*	0.974 (33.251)*
IP(-2)	-0.059 (-2.351)**	0.146 (8.375)*	0.167 (7.206)*	0.033 (1.078)	0.03 (0.997)	0.23 (13.803)*	0.117 (4.394)*	-0.097 (-2.421)**
IP(-3)		0.122 (7.000)*	0.167 (7.219)*	0.074 (3.122)*	-0.007 (-0.232)	0.161 (9.695)*	0.182 (6.873)*	0.063 (2.302)**
IP(-4)		0.172 (10.528)*	0.137 (6.350)*		0.033 (1.728)***	0.186 (11.776)*	0.173 (7.147)*	
ETF	0.047 (4.653)*	0.943 (227.886)*	1 (465.217)*	0.564 (35.230)*	0.342 (26.843)*	0.996 (182.409)*	0.804 (49.217)*	0.175 (11.795)*
ETF(-1)	-0.024 (-2.119)**	-0.281 (-17.687)*	-0.425 (-19.704)*	-0.287 (-12.874)*	-0.262 (-14.868)*	-0.348 (-21.524)*	-0.247 (-10.169)*	-0.081 (-4.977)*
ETF(-2)	-0.02 (-1.957)	-0.158 (-9.590)*	-0.165 (-7.107)*	-0.148 (-6.427)*	-0.079 (-5.336)*	-0.233 (-13.867)*	-0.186 (-7.529)*	-0.039 (-2.468)**
ETF(-3)		-0.125 (-7.584)*	-0.169 (-7.291)*	-0.067 (-3.348)*		-0.173 (-10.276)*	-0.206 (-8.386)*	
ETF(-4)		-0.167 (-10.503)*	-0.136 (-6.289)*			-0.178 (-11.297)*	-0.11 (-4.985)*	
C	0.006 (1.159)	-0.004 (-2.517)**	-0.004 (-3.412)*	0.009 (4.747)*	-0.004 (-0.554)	0.003 (3.218)*	0.02 (3.473)*	0.019 (2.961)*
Bounds Test Results								
F-statistic	0	0.119646	0	943.3834	0	2049.561	0	619.3363

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.8 - ARDL and Long Run Form Results without Structural Break for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
D(IP(-1))	0.059 (2.351)**	-0.439 (-22.275)*	-0.469 (-20.053)*	-0.106 (-4.363)*	-0.056 (-2.489)**	-0.576 (-34.353)*	-0.450 (-17.567)*	0.033 (1.126)
D(IP(-2))		-0.293 (-15.280)*	-0.303 (-12.655)*	-0.073 (-3.122)*	-0.026 (-1.372)	-0.347 (-19.270)*	-0.339 (-12.857)*	-0.063 (-2.302)**
D(IP(-3))		-0.172 (-10.528)*	-0.136 (-6.350)*		-0.033 (-	-0.186 (-11.776)*	-0.164 (-6.800)*	
D(ETF price)	0.047 (4.653)*	0.943 (227.886)*	1.000 (465.217)*	0.564 (35.230)*	0.342 (26.843)*	0.995 (182.409)*	0.780 (47.779)*	0.175 (11.795)*
D(ETF price(-1))	0.020 (1.957)	0.157 (9.590)*	0.164 (7.107)*	0.148 (6.427)*	0.078 (5.336)*	0.233 (13.867)*	0.181 (7.355)*	0.038 (2.468)**
D(ETF price(-2))		0.124 (7.584)*	0.169 (7.291)*	0.067 (3.348)*		0.172 (10.276)*	0.196 (7.984)*	
D(ETF price(-3))		0.166 (10.503)*	0.135 (6.289)*			0.178 (11.297)*	0.105 (4.803)*	
CointEq(-1)	-0.004 (-1.046)	-0.215 (-13.341)*	-0.107 (-7.564)*	-0.067 (-6.346)*	-0.001 (-0.982)	-0.065 (-7.787)*	-0.061 (-4.990)*	-0.060 (-4.027)*
Long Run Coefficients								
ETF price	0.730 (3.366)*	1.001 (753.694)*	1.004 (694.332)*	0.941 (128.764)*	1.759 (1.332)	0.992 (616.315)*	0.933 (87.426)*	0.931 (45.246)*
C	1.227 (1.243)	-0.016 (-2.579)*	-0.034 (-3.789)*	0.122 (6.748)*	-3.183 (-0.555)	0.034 (3.450)*	1.227 (6.296)*	0.302 (3.277)*

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

Table 3.9 - ARDL and Bounds Test Results without Structural Break for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
IP(-1)	0.337 (18.369)*	0.487 (16.577)*	0.872 (37.019)*	0.321 (9.651)*	0.507 (23.499)*	0.601 (29.732)*	0.993 (29.627)*	1.028 (32.822)*	0.951 (86.518)*
IP(-2)	0.146 (7.698)*	0.277 (8.503)*	-0.06 (-1.946)***	0.217 (6.262)*	0.098 (4.121)*	0.099 (4.259)*	-0.165 (-3.515)*	-0.055 (-1.736)***	
IP(-3)	0.184 (9.698)*	0.113 (3.457)*	0.058 (2.425)**	0.126 (3.646)*	0.151 (6.337)*	0.15 (6.429)*	0.117 (3.500)*		
IP(-4)	0.113 (6.179)*	0.125 (4.235)*		0.105 (3.181)*	0.164 (7.564)*	0.13 (6.432)*			
ETF price	0.976 (131.441)*	1.009 (156.149)*	0.449 (30.537)*	0.948 (67.141)*	0.818 (61.658)*	0.865 (76.383)*	0.094 (7.454)*	0.074 (7.430)*	0.109 (9.582)*
ETF price(-1)	-0.295 (-15.780)*	-0.506 (-16.563)*	-0.25 (-13.053)*	-0.264 (-7.880)*	-0.326 (-15.773)*	-0.466 (-22.654)*	-0.029 (-1.981)**	-0.016 (-1.476)	-0.025 (-2.014)**
ETF price(-2)	-0.168 (-8.808)*	-0.264 (-7.784)*	-0.039 (-1.895)***	-0.249 (-7.230)*	-0.133 (-6.172)*	-0.127 (-5.678)*	0.011 (0.749)	-0.037 (-3.670)*	-0.006 (-0.446)
ETF price(-3)	-0.197 (-10.339)*	-0.122 (-3.626)*	-0.01 (-0.494)	-0.119 (-3.446)*	-0.146 (-6.822)*	-0.133 (-5.985)*	-0.037 (-2.855)*		-0.032 (-2.937)*
ETF price(-4)	-0.095 (-5.356)*	-0.118 (-3.949)*	-0.027 (-1.891)***	-0.091 (-2.857)*	-0.136 (-7.075)*	-0.12 (-6.220)*			
C	-0.001 (-0.655)	-0.001 (-0.113)	0.041 (4.378)*	0.034 (5.419)*	0.02 (2.790)*	0.01 (1.686)***	0.047 (3.868)*	0.019 (2.807)*	0.011 (2.179)**
Bounds Test Results									
F-statistic	0	2.027094	0	191.9551	0	17.54607	0	0	138.9102

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.10 - ARDL and Long Run Form Results without Structural Break for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
D(IP(-1))	-0.443 (-20.369)*	-0.514 (-17.458)*	0.002 (0.098)	-0.447 (-11.358)*	-0.411 (-17.908)*	-0.378 (-18.436)*	0.048 (1.431)	0.054 (1.736)***	
D(IP(-2))	-0.297 (-13.948)*	-0.237 (-7.326)*	-0.057 (-2.425)**	-0.230 (-5.892)*	-0.313 (-13.391)*	-0.279 (-13.136)*	-0.117 (-3.500)*		
D(IP(-3))	-0.113 (-6.179)*	-0.125 (-4.235)*		-0.105 (-3.181)*	-0.163 (-7.564)*	-0.130 (-6.432)*			
D(ETF)	0.976 (131.44)*	1.009 (156.149)*	0.448 (30.537)*	0.948 (67.141)*	0.818 (61.658)*	0.864 (76.383)*	0.093 (7.454)*	0.074 (7.430)*	0.108 (9.582)*
D(ETF (-1))	0.168 (8.808)*	0.263 (7.784)*	0.038 (1.895)***	0.249 (7.230)*	0.133 (6.172)*	0.126 (5.678)*	-0.011 (-0.749)	0.036 (3.670)*	0.005 (0.446)
D(ETF (-2))	0.197 (10.339)*	0.122 (3.626)*	0.010 (0.494)	0.119 (3.446)*	0.146 (6.822)*	0.133 (5.985)*	0.036 (2.855)*		0.031 (2.937)*
D(ETF (-3))	0.095 (5.356)*	0.118 (3.949)*	0.027 (1.891)***	0.090 (2.857)*	0.135 (7.075)*	0.119 (6.220)*			
Coint Eq(-1)	-0.220 (-12.732)*	0.000 (0.247)	-0.131 (-9.831)*	-0.233 (-7.237)*	-0.082 (-6.772)*	-0.022 (-3.862)*	-0.055 (-4.359)*	-0.027 (-2.896)*	-0.050 (-4.508)*
Long Run Coefficients									
ETF price	0.999 (914.02) *	0.993 (0.593)	0.943 (79.757)*	0.970 (276.341)*	0.954 (65.364)*	0.911 (18.999)*	0.717 (20.799)*	0.810 (13.552) *	0.960 (57.286)*
C	-0.005 (-0.657)	0.596 (0.126)	0.312 (4.666)*	0.144 (7.674)*	0.236 (2.811)*	0.451 (1.626)	0.848 (7.745)*	0.693 (3.086)*	0.204 (2.388)**

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

Table 3.11 - ARDL and Bounds Test Results with Single Structural Break for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
IP(-1)	1.055 (42.692)*	0.346 (20.927)*	0.424 (19.716)*	0.828 (34.502)*	0.944 (42.127)*	0.358 (22.64)*	0.47 (19.294)*	0.973 (33.187)*
IP(-2)	-0.059 (-2.348)**	0.146 (8.358)*	0.167 (7.196)*	0.033 (1.081)	0.03 (0.989)*	0.229 (13.756)*	0.116 (4.369)*	-0.097 (-2.436)**
IP(-3)		0.122 (6.984)*	0.167 (7.209)*	0.074 (3.109)*	-0.007 (-0.234)*	0.161 (9.652)*	0.181 (6.847)*	0.063 (2.3)**
IP(-4)		0.172 (10.495)*	0.137 (6.337)*		0.033 (1.719)*	0.185 (11.718)*	0.171 (7.081)*	
ETF price	0.047 (4.645)*	0.944 (227.652)*	1 (459.616)*	0.564 (35.228)*	0.342 (26.837)*	0.996 (182.451)*	0.803 (49.169)*	0.176 (11.813)*
ETF price(-1)	-0.025 (-2.129)**	-0.28 (-17.664)*	-0.425 (-19.685)*	-0.287 (-12.867)*	-0.262 (-14.859)*	-0.347 (-21.458)*	-0.246 (-10.139)*	-0.081 (-4.924)*
ETF price(-2)	-0.02 (-1.981)**	-0.157 (-9.57)*	-0.165 (-7.096)*	-0.148 (-6.425)*	-0.078 (-5.306)*	-0.233 (-13.819)*	-0.185 (-7.496)*	-0.038 (-2.403)**
ETF price(-3)		-0.124 (-7.567)*	-0.169 (-7.281)*	-0.068 (-3.36)*		-0.172 (-10.229)*	-0.205 (-8.346)*	
ETF price(-4)		-0.166 (-10.481)*	-0.135 (-6.276)*			-0.177 (-11.259)*	-0.108 (-4.93)*	
Dummy	0.001 (0.422)	-0.001 (-0.579)	0.001 (0.423)	0.001 (0.584)	0.001 (0.403)*	0.001 (2.061)**	0.003 (2.088)**	-0.001 (-0.689)

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
C	0.008 (1.144)	-0.004 (-1.872)***	-0.005 (-	0.01 (3.87)*	-0.003 (-0.456)*	0.004 (3.692)*	0.026 (4.047)*	0.015 (1.951)***
Bounds Test Results								
F-statistic	0	1497.533	1.587504	0	0	2050.139	1027.483	625.6445

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.12 - ARDL and Long Run Form Results with Single Structural Break for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
D(IP(-1))	0.059 (2.347)**	-0.438 (-22.166)*	-0.469 (-19.986)*	-0.106 (-4.353)*	-0.055 (-2.466)**	-0.573 (-34.129)*	-0.467 (- [illegible]	0.034 (1.148)
D(IP(-2))		-0.293 (-15.223)*	-0.302 (-12.625)*	-0.073 (-3.108)*	-0.026 (-1.361)	-0.345 (-19.165)*	-0.351 (-13.338)*	-0.063 (-2.299)**
D(IP(-3))		-0.171 (-10.494)*	-0.136 (-6.337)*		-0.033 (-1.719)***	-0.185 (-11.718)*	-0.171 (-7.081)*	
D(ETF price)	0.047 (4.645)*	0.943 (227.652)*	1.000 (459.616)*	0.564 (35.227)*	0.342 (26.837)*	0.995 (182.451)*	0.802 (49.169)*	0.175 (11.812)*
D(ETF price(-1))	0.02 (1.980)**	0.157 (9.570)*	0.164 (7.096)*	0.148 (6.425)*	0.078 (5.305)*	0.232 (13.818)*	0.185 (7.495)*	0.037 (2.402)**
D(ETF price(-2))		0.124 (7.567)*	0.168 (7.280)*	0.067 (3.360)*		0.171 (10.229)*	0.205 (8.346)*	
D(ETF price(-3))		0.166 (10.480)*	0.135 (6.275)*			0.177 (11.259)*	0.108 (4.930)*	
D (Dummy)	0.001 (0.422)	0.000 (-0.578)	0.000 (0.422)	0.001 (0.583)	0.000 (0.402)	0.001 (2.060)**	0.002 (2.087)**	-0.001 (-0.689)
CointEq (-1)	-0.005 (-1.039)	-0.216 (-13.313)*	-0.108 (-7.550)*	-0.067 (-6.369)*	-0.002 (-0.919)	-0.069 (-8.045)*	-0.064 (-5.117)*	-0.061 (-4.083)*
Long Run Coefficients								
ETF price	0.627 (1.687)***	1.001 (753.725)*	1.005 (298.425)*	0.934 (70.427)*	1.397 (1.387)	0.988 (394.769)*	0.930 (73.972)*	0.945 (33.508)*
Dummy	0.078 (0.389)	-0.002 (-0.581)	0.003 (0.425)	0.006 (0.584)	0.165 (0.569)	0.007 (2.099)**	0.032 (2.059)**	-0.009 (-0.696)
C	1.639 (1.030)	-0.014 (-1.887)***	-0.043 (-1.949)***	0.136 (4.679)*	-1.754 (-0.409)	0.055 (3.993)*	0.400 (5.445)*	0.243 (2.012)**

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

Table 3.13 - ARDL and Bounds Test Results with Single Structural Break for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEEES
IP(-1)	0.333 (18.126)*	0.487 (16.565)*	0.855 (66.852)*	0.282 (8.45)*	0.502 (23.199)*	0.6 (29.682)*	0.982 (29.133)*	1.027 (32.757)*	0.973 (41.017)*
IP(-2)	0.143 (7.496)*	0.277 (8.501)*		0.192 (5.657)*	0.094 (3.955)*	0.099 (4.236)*	-0.167 (-3.576)*	-0.055 (-1.74)***	-0.04 (-1.613)
IP(-3)	0.181 (9.504)*	0.113 (3.462)*		0.103 (3.081)*	0.147 (6.178)*	0.149 (6.405)*	0.107 (3.195)*		
IP(-4)	0.108 (5.921)*	0.126 (4.248)*			0.158 (7.302)*	0.13 (6.382)*			
ETF price	0.976 (131.613)*	1.009 (155.989)*	0.448 (31.436)*	0.958 (68.745)*	0.82 (61.849)*	0.865 (76.403)*	0.099 (7.797)*	0.075 (7.444)*	0.109 (9.573)*
ETF price (-1)	-0.291 (-15.541)*	-0.506 (-16.552)*	-0.25 (-13.523)*	-0.23 (-6.824)*	-0.321 (-15.516)*	-0.465 (-22.611)*	-0.024 (-1.638)	-0.016 (-1.425)	-0.022 (-1.778)***
ETF price (-2)	-0.164 (-8.596)*	-0.264 (-7.781)*	-0.059 (-4.159)*	-0.224 (-6.627)*	-0.129 (-5.976)*	-0.126 (-5.652)*	0.015 (1.032)	-0.036 (-3.596)*	0.001 (0.039)
ETF price (-3)	-0.194 (-10.13)*	-0.123 (-3.632)*		-0.092 (-2.891)*	-0.142 (-6.619)*	-0.133 (-5.958)*	-0.031 (-2.38)**		-0.028 (-2.521)**
ETF price (-4)	-0.092 (-5.159)*	-0.119 (-3.963)*			-0.132 (-6.885)*	-0.119 (-6.177)*			
Dummy	0.002 (3.755)*	0.001 (0.431)	-0.002 (-	-0.004 (-6.369)*	0.004 (3.338)*	-0.002 (-1.277)	-0.003 (-2.469)**	-0.001 (-0.517)	0.003 (3.344)*
C	0.006 (2.168)**	-0.001 (-0.206)	0.032 (2.862)*	0.052 (8.07)*	0.022 (3.064)*	0.01 (1.621)	0.058 (4.473)*	0.017 (2.219)**	0.03 (4.068)*
Bounds Test Results									
F-statistic	1612.696	3.315137	129.3971	493.3175	0	70.21137	411.3445	95.12854	947.9216

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.14 - ARDL and Long Run Form Results with Single Structural Break for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEEES
D(IP(-1))	-0.431 (-19.614)*	-0.514 (-17.446)*		-0.294 (-7.362)*	-0.398 (-17.098)*	-0.376 (-18.280)*	0.060 (1.780)***	0.055 (1.742)*	0.039 (1.613)
D(IP(-2))	-0.288 (-13.501)*	-0.238 (-7.336)*		-0.102 (-3.081)*	-0.304 (-12.922)*	-0.278 (-13.045)*	-0.107 (-3.195)*		
D(IP(-3))	-0.108 (-5.921)*	-0.125 (-4.248)*			-0.158 (-7.302)*	-0.129 (-6.381)*			
D(ETF price)	0.975 (131.612)*	1.009 (155.988)*	0.447 (31.435)*	0.958 (68.745)*	0.819 (61.849)*	0.864 (76.402)*	0.099 (7.796)*	0.074 (7.444)*	0.109 (9.572)*
D(ETF price(-1))	0.164 (8.596)*	0.263 (7.781)*	0.058 (4.158)*	0.223 (6.627)*	0.129 (5.976)*	0.126 (5.651)*	-0.015 (-1.032)	0.036 (3.595)*	0.000 (-0.039)
D(ETF price(-2))	0.193 (10.129)*	0.122 (3.631)*		0.091 (2.890)*	0.141 (6.619)*	0.132 (5.958)*	0.031 (2.380)**		0.027 (2.521)**
D(ETF price(-3))	0.092 (5.158)*	0.118 (3.962)*			0.131 (6.884)*	0.119 (6.177)*			
D(Dummy)	0.002 (3.754)*	0.000 (0.431)	-0.001 (-1.756)***	-0.003 (-6.369)*	0.003 (3.337)*	-0.001 (-1.276)	-0.003 (-2.468)**	0.000 (-0.517)	0.003 (3.343)*
CointEq(-1)	-0.237 (-13.292)*	0.001 (0.462)	-0.145 (-11.346)*	-0.424 (-10.69)*	-0.101 (-7.560)*	-0.025 (-4.062)*	-0.078 (-4.983)*	-0.028 (-2.940)*	-0.067 (-5.538)*
Long Run Coefficients									
ETF price	0.995 (630.258)*	0.922 (1.410)	0.961 (69.524)*	0.976 (491.894)	0.958 (81.423)*	0.924 (21.704)*	0.762 (27.022)*	0.838 (11.188)	0.907 (44.622)*
Dummy	0.008 (3.877)*	-0.125 (-0.513)	-0.008 (-1.81)***	-0.008 (-8.285)*	0.032 (3.695)*	-0.043 (-1.370)	-0.035 (-3.046)*	-0.016 (-0.526)	0.041 (3.368)*
C	0.022 (2.178)**	0.466 (0.235)	0.219 (2.861)*	0.121 (11.651)*	0.211 (3.107)*	0.384 (1.563)	0.730 (8.538)*	0.603 (2.272)*	0.444 (4.546)*

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

Table 3.15 - ARDL and Bound Test Results with Multiple Structural Breaks for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
IP(-1)	1.04 (42.005)*	0.292 (17.498)*	0.421 (19.542)*	0.823 (34.223)*	0.934 (41.688)*	0.355 (22.436)*	0.466 (19.045)*	0.967 (32.999)*
IP(-2)	-0.063 (-2.524)**	0.103 (5.896)*	0.165 (7.105)*	0.032 (1.052)	0.05 (2.207)**	0.227 (13.614)*	0.113 (4.253)*	-0.096 (-2.396)**
IP(-3)		0.078 (4.488)*	0.164 (7.091)*	0.07 (2.923)*		0.159 (9.528)*	0.179 (6.752)*	0.063 (2.274)**
IP(-4)		0.12 (7.254)*	0.134 (6.187)*			0.183 (11.563)*	0.17 (6.979)*	
ETF price	0.046 (4.517)*	0.947 (232.772)*	0.998 (345.542)*	0.566 (35.054)*	0.341 (26.809)*	0.996 (182.573)*	0.805 (49.129)*	0.171 (11.464)*
ETF price(-1)	-0.025 (-2.161)**	-0.229 (-14.323)*	-0.422 (-19.511)*	-0.284 (-12.721)*	-0.261 (-14.906)*	-0.344 (-21.257)*	-0.243 (-9.951)*	-0.083 (-5.064)*
ETF price(-2)	-0.021 (-2.084)**	-0.114 (-6.899)*	-0.163 (-7.006)*	-0.146 (-6.337)*	-0.074 (-5.078)*	-0.23 (-13.674)*	-0.182 (-7.36)*	-0.041 (-2.614)*
ETF price(-3)		-0.081 (-4.89)*	-0.166 (-7.163)*	-0.067 (-3.3)*		-0.17 (-10.098)*	-0.203 (-8.239)*	
ETF price(-4)		-0.115 (-7.172)*	-0.133 (-6.13)*			-0.176 (-11.153)*	-0.109 (-4.924)*	
Dummy 1	0.005 (3.741)*	-0.004 (-5.82)*	-0.001 (-1.226)	-0.002 (-1.965)**	0.002 (2.48)**	0.001 (1.342)	0.001 (0.666)	0.006 (2.725)*
Dummy 2	0.011 (4.437)*	0.004 (6.604)*	0.001 (0.844)	0.001 (0.289)	0.007 (4.519)*	0.002 (1.941)***	-0.001 (-0.188)	0.004 (1.935)***
Dummy 3	0.013 (4.654)*	0.002 (2.098)**	0.001 (0.962)	0.002 (0.545)	0.008 (4.609)*	0.001 (0.73)	-0.001 (-0.228)	0.006 (2.568)

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Dummy 4	0.018 (4.747)*	-0.004 (-3.845)*	-0.003 (-0.898)	0.002 (0.683)	0.01 (4.461)*		0.002 (0.64)	0.009 (2.777)*
Dummy 5								0.01 (2.604)*
C	0.093 (4.823)*	-0.01 (-4.173)*	0.008 (0.563)	0.016 (2.893)*	0.044 (3.467)*	0.005 (2.193)**	0.027 (2.142)	0.077 (3.431)*
Bounds Test Results								
F-statistic	0	1114.568	428.0828	956.6828	886.6526	2058.448	0	173.1853

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.16 - ARDL and Long Run Form Results with Multiple Structural Breaks for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
D(IP(-1))	0.063 (2.524)**	-0.3 (-13.557)*	-0.462 (-19.255)*	-0.101 (-4.11)*	-0.05 (-2.207)**	-0.567 (-33.466)*	-0.461 (-17.525)*	0.034 (1.115)
D(IP(-2))		-0.198 (-9.765)*	-0.298 (-12.281)*	-0.07 (-2.923)*		-0.341 (-18.873)*	-0.348 (-13.045)*	-0.063 (-2.274)**
D(IP(-3))		-0.12 (-7.254)*	-0.134 (-6.187)*			-0.183 (-11.563)*	-0.17 (-6.979)*	
D(ETF price)	0.046 (4.517)*	0.947 (232.772)*	0.998 (345.542)*	0.566 (35.054)*	0.341 (26.809)*	0.996 (182.573)*	0.805 (49.129)*	0.171 (11.464)*
D(ETF price(-1))	0.021 (2.084)**	0.114 (6.899)*	0.163 (7.006)*	0.146 (6.337)*	0.074 (5.078)*	0.23 (13.674)*	0.182 (7.36)*	0.041 (2.614)*
D(ETF price(-2))		0.081 (4.89)*	0.166 (7.163)*	0.067 (3.3)*		0.17 (10.098)*	0.203 (8.239)*	
D(ETF price(-3))		0.115 (7.172)*	0.133 (6.13)*			0.176 (11.153)*	0.109 (4.924)*	
D(Dummy 1)	0.005 (3.741)*	-0.004 (-5.82)*	-0.001 (-1.226)	-0.002 (-1.965)**	0.002 (2.48)**	0.001 (1.342)	0.001 (0.666)	0.006 (2.725)*
D(Dummy 2)	0.011 (4.437)*	0.004 (6.604)*	0.001 (0.844)	0.001 (0.289)	0.007 (4.519)*	0.002 (1.941)***	-0.001 (-0.188)	0.004 (1.935)***
D(Dummy 3)	0.013 (4.654)*	0.002 (2.098)**	0.001 (0.962)	0.002 (0.545)	0.008 (4.609)*	0.001 (0.73)	-0.001 (-0.228)	0.006 (2.568)
D(Dummy 4)	0.018 (4.747)*	-0.004 (-3.845)*	-0.003 (-0.898)	0.002 (0.683)	0.01 (4.461)*		0.002 (0.64)	0.009 (2.777)*
D(Dummy 5)								0.01 (2.604)*

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
CointEq(-1)	-0.024 (-3.793)*	-0.409 (-18.799)*	-0.118 (-7.458)*	-0.077 (-6.439)*	-0.018 (-4.72)*	-0.079 (-8.622)*	-0.075 (-5.067)*	-0.067 (-4.394)*
Long Run Coefficients								
ETF price	0.015 (0.077)	1.003 (821.057)*	0.989 (55.983)*	0.909 (24.916)*	0.341 (2.961)*	0.989 (210.177)*	0.941 (30.93)*	0.723 (7.97)*
In_Dummy 1	0.179 (4.119)*	-0.009 (-6.158)*	-0.005 (-1.3)	-0.019 (-2.175)**	0.095 (2.759)*	0.008 (1.344)	0.01 (0.648)	0.079 (2.472)**
In_Dummy 2	0.452 (4.149)*	0.01 (6.972)*	0.007 (0.816)	0.007 (0.285)	0.377 (10.474)*	0.014 (1.963)**	-0.004 (-0.19)	0.056 (1.831)***
In_Dummy 3	0.53 (4.176)*	0.005 (2.102)**	0.009 (0.924)	0.014 (0.531)	0.425 (12.016)*	0.007 (0.729)	-0.007 (-0.232)	0.09 (2.304)**
In_Dummy 4	0.719 (4.748)*	-0.009 (-3.956)*	-0.025 (-0.864)	0.025 (0.662)	0.563 (12.14)*		0.021 (0.612)	0.132 (2.473)**
In_Dummy 5								0.14 (2.362)**
C	3.876 (5.17)*	-0.023 (-4.318)*	0.061 (0.548)	0.197 (2.714)*	2.531 (5.113)*	0.053 (2.227)**	0.355 (1.962)**	1.149 (3.093)*

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

Table 3.17 - ARDL and Bound Test Results with Multiple Structural Breaks for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
IP(-1)	0.324 (17.566)*	0.484 (16.441)*	0.853 (66.112)*	0.275 (8.169)*	0.487 (22.391)*	0.573 (28.119)*	0.989 (29.383)*	1.016 (32.438)*	0.966 (40.742)*
IP(-2)	0.135 (7.082)*	0.275 (8.442)*		0.185 (5.425)*	0.083 (3.49)*	0.081 (3.493)*	-0.165 (-3.51)*	-0.057 (-1.82)***	-0.043 (-
IP(-3)	0.173 (9.098)*	0.112 (3.411)*		0.095 (2.822)*	0.136 (5.71)*	0.131 (5.663)*	0.112 (3.303)*		
IP(-4)	0.1 (5.472)*	0.124 (4.173)*			0.143 (6.577)*	0.101 (4.927)*			
ETF price	0.979 (131.862)*	1.01 (154.71)*	0.447 (31.309)*	0.961 (68.003)*	0.824 (62.195)*	0.872 (77.289)*	0.092 (7.011)*	0.072 (7.212)*	0.108 (9.485)*
ETF price(-1)	-0.282 (-15.01)*	-0.504 (-16.436)*	-0.25 (-13.476)*	-0.222 (-6.56)*	-0.307 (-14.786)*	-0.441 (-21.32)*	-0.029 (-2.007)**	-0.017 (-1.572)	-0.022 (-
ETF price(-2)	-0.156 (-8.157)*	-0.262 (-7.724)*	-0.059 (-4.171)*	-0.216 (-6.369)*	-0.117 (-5.427)*	-0.107 (-4.824)*	0.011 (0.703)	-0.039 (-3.913)*	-0.001 (-0.038)
ETF price(-3)	-0.186 (-9.706)*	-0.121 (-3.582)*		-0.086 (-2.689)*	-0.13 (-6.035)*	-0.113 (-5.1)*	-0.037 (-2.797)*		-0.03 (-2.734)*
ETF price(-4)	-0.086 (-4.773)*	-0.117 (-3.893)*			-0.121 (-6.284)*	-0.096 (-4.928)*			
Dummy 1	0.002 (2.098)**	-0.001 (-0.482)	-0.001 (-0.359)	-0.004 (-4.675)*	-0.003 (-1.958)	0.001 (0.134)	-0.003 (-1.74)***	0.001 (0.871)	-0.002 (-1.94)***
Dummy 2	0.001 (0.004)	-0.001 (-1.427)	-0.001 (-0.058)	-0.005 (-6.274)*	-0.005 (-3.886)*	-0.005 (-3.814)*	-0.002 (-0.918)	0.004 (2.136)**	0.004 (3.974)*
Dummy 3	-0.001 (-0.272)	-0.002 (-1.525)	-0.002 (-2.057)**	-0.004 (-3.479)*	-0.001 (-0.487)	-0.01 (-5.312)*	0.002 (0.722)	0.008 (3.207)*	0.008 (4.099)*
Dummy 4	-0.003 (-2.088)**	-0.002 (-1.15)	-0.001 (-0.905)	-0.005 (-2.976)*	0.002 (1.418)	-0.011 (-6.072)*	0.003 (0.96)	0.01 (3.121)*	0.013 (4.225)*

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Dummy 5									
C	-0.009 (-1.825)	-0.003 (-0.583)	0.046 (2.52)**	0.047 (2.732)*	0.018 (1.829)	-0.006 (-0.576)	0.087 (3.312)*	0.089 (4.21)*	0.099 (4.68)*
Bounds Test Results									
F-statistic	1610.816	27.70492	131.3239	0	0	377.3725	421.4415	421.4415	945.2006

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 3.18 - ARDL and Long Run Form Results with Multiple Breaks for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
D(IP(-1))	-0.408 (-18.127)*	-0.51 (-17.073)*		-0.28 (-6.85)*	-0.361 (-14.849)*	-0.313 (-14.047)*	0.053 (1.567)	0.057 (1.82)***	0.043 (1.751)***
D(IP(-2))	-0.273 (-12.65)*	-0.235 (-7.19)*		-0.095 (-2.822)*	-0.278 (-11.592)*	-0.232 (-10.5)*	-0.112 (-3.303)*		
D(IP(-3))	-0.1 (-5.472)*	-0.124 (-4.173)*			-0.143 (-6.577)*	-0.101 (-4.927)*			
D(ETF price)	0.979 (131.862)*	1.01 (154.71)*	0.447 (31.309)*	0.961 (68.003)*	0.824 (62.195)*	0.872 (77.289)*	0.092 (7.011)*	0.072 (7.212)*	0.108 (9.485)*
D(ETF price(-1))	0.156 (8.157)*	0.262 (7.724)*	0.059 (4.171)*	0.216 (6.369)*	0.117 (5.427)*	0.107 (4.824)*	-0.011 (-0.703)	0.039 (3.913)*	0.001 (0.038)
D(ETF price(-2))	0.186 (9.706)*	0.121 (3.582)*		0.086 (2.689)*	0.13 (6.035)*	0.113 (5.100)*	0.037 (2.797)*		0.03 (2.734)*
D(ETF price(-3))	0.086 (4.773)*	0.117 (3.893)*			0.121 (6.284)*	0.096 (4.928)*			
D(Dummy 1)	0.002 (2.098)**	-0.001 (-0.482)	-0.001 (-0.359)	-0.004 (-4.675)*	-0.003 (-1.958)	0.001 (0.134)	-0.003 (-1.74)***	0.001 (0.871)	-0.002 (-1.94)***
D(Dummy 2)	0.001 (0.004)	-0.001 (-1.427)	-0.001 (-0.058)	-0.005 (-6.274)*	-0.005 (-3.886)*	-0.005 (-3.814)*	-0.002 (-0.918)	0.004 (2.136)**	0.004 (3.974)*
D(Dummy 3)	-0.001 (-0.272)	-0.002 (-1.525)	-0.002 (-2.057)**	-0.004 (-3.479)*	-0.001 (-0.487)	-0.01 (-5.312)*	0.002 (0.722)	0.008 (3.207)*	0.008 (4.099)*

D(Dummy 4)	-0.003 (-2.088)**	-0.002 (-1.15)	-0.001 (-0.905)	-0.005 (-2.976)*	0.002 (1.418)	-0.011 (-6.072)*	0.003 (0.96)	0.01 (3.121)*	0.013 (4.225)*
D(Dummy 5)									
CointEq(-1)	-0.27 (-14.082)*	-0.007 (-1.086)	-0.148(-11.417)*	-0.447 (-10.757)*	-0.154 (-9.116)*	-0.116 (-8.263)*	-0.065 (-4.239)*	-0.042 (-4.073)*	-0.077 (-6.155)*
Long Run Coefficients									
ETF price	1.004 (373.552)*	1.109 (4.521)*	0.945 (43.759)*	0.98 (131.692)*	0.977 (84.246)*	1.006 (73.427)*	0.559 (4.235)*	0.392 (2.766)*	0.735 (12.102)*
In_Dummy 1	0.005 (2.105)**	-0.031 (-0.618)	-0.003 (-0.36)	-0.007 (-4.976)*	-0.019 (-2.074)**	0.002 (0.134)	-0.04 (-1.68)***	0.024 (0.888)	-0.022 (-1.933)***
In_Dummy 2	0.001 (0.004)	-0.114 (-2.23)**	-0.001 (-0.058)	-0.01 (-8.275)*	-0.032 (-4.545)*	-0.036 (-4.558)*	-0.021 (-1.02)	0.083 (2.121)**	0.048 (3.983)*
In_Dummy 3	-0.001 (-0.272)	-0.165 (-2.209)**	-0.013 (-2.119)**	-0.009 (-3.903)*	-0.005 (-0.491)	-0.084 (-8.013)*	0.024 (0.684)	0.192 (3.093)*	0.099 (3.726)*
In_Dummy 4	-0.01 (-2.132)**	-0.154 (-3.746)*	-0.006 (-0.919)	-0.01 (-3.261)*	0.01 (1.407)	-0.093 (-10.79)*	0.043 (0.903)	0.227 (3.12)*	0.162 (3.851)*
In_Dummy 5									
C	-0.032 (-1.859)***	-0.381 (-0.476)	0.311 (2.53)**	0.105 (2.695)*	0.113 (1.788)***	-0.044 (-0.587)	1.341 (3.351)*	2.129 (4.326)*	1.278 (4.36)*

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level*

CHAPTER 4

ASSESSING THE SPEED OF ADJUSTMENT OF ETF AND UNDERLYING BENCHMARK INDEX PRICES

4.1 INTRODUCTION

The second objective of the research deals with the speed of adjustment of the ETFs and their underlying benchmark indices towards intrinsic value in India. Knowledge of stock market efficiency and the speed with which stock markets integrate information flow into asset prices is essential to investors and regulators, and policymakers. EMH relates to the quick and unbiased way of price adjustment as the information is immediately incorporated in the prices (Patell and Wolfson 1983). However, in reality, prices may not adequately reflect the information; thus, the concept of speed of adjustment is an essential element in market efficiency (Aggarwal and Chen 1985). In an imperfect market, the new information changes the price permanently and traders incur additional cost. Active efficiency requires prices to rapidly reflect the arrival of private information (Lin and Rozeff 1995).

In recent times, the analysis of adjustment of security price towards the new information receives more attention in the finance domain. The interest is whether the prices adjust to the arrival of new information quickly and unbiasedly. One of the essential factors to consider for an efficient market is how quickly information adjusts in the security price. From the point of view of investors, market efficiency has an influence on investment strategy, e.g., if a market is inefficient, investors have a chance to tap the information for profit and thus, drive the market towards efficiency. The pace of market price adjustment is therefore, a key area of study because of its practical implications. Numerous studies have concentrated on speed of adjustment in different asset classes and exchanges in the national and international markets. The current study focuses on equity ETFs and indices in the Indian stock market.

The primary work of the current objective is to measure the speed of adjustment of ETFs and the underlying index prices. If there is any information or shock, how much time does it take to adjust in the ETFs and the underlying index prices. Daily returns are used to measure the time taken for incorporating the information in the security prices. The study has reviewed past studies in terms of factors influencing the time taken for adjustment such as corporate action (e.g., dividend announcement), information or news (e.g., good or bad news), and the size of the firm. One of the reasons for the delay in the speed of adjustment is due to earnings and dividend announcement. Moreover, an earnings announcement has an impact on the percentage of return (Patell and Wolfson 1983). Woodruff and Senchack (1988) pointed out that the speed of adjustment takes 3 to 4 hours from the time of the earnings report received.

Some studies argue that the type of trades also impacts the speed of adjustment. If the market is perfect, any trade can quickly adjust to recent information. For example, block trade does not impact the return on regular trade. However, it can affect if the markets are not perfect. If new information is supposed to come, stock prices will continuously change (Aggarwal and Chen 1985). Moreover, the speed of adjustment also depends on the size of the firm. Large capitalization companies show high speed of adjustment than small capitalization companies (Vives 1994; Prasanna and Menon 2012) and companies which have a good source of information will be quicker in correction (Damodaran 1993).

Koutmos (1999) admits that bad information (negative returns) is integrated more quickly into current market prices than good information (positive returns). The performance of the price discovery process of an ETF market can be estimated through the speed of the price adjustment process. Speed of adjustment to the intrinsic value is also determined by market structure and the intensity of the technology used. Further, external information plays an important role in the price discovery process and to understand the asset value (Schenck et al. 2018).

The present study evaluated 17 equity ETFs by combining all the established and recently launched ETFs. The speed of adjustment gives an idea regarding which ETF quickly adjust to new information and to compare the speed with which the underlying index adjusts as well. The study looks at price modifications without reference to any specific event, e.g., dividend news, quarterly earnings reports, macroeconomic releases, etc. The ARMA estimator is used in the present study to measure the speed of the adjustment coefficient. As the return interval is expanded, the pricing adjustment coefficient approaches one. This hypothesis is both intuitively and empirically justifiable. The importance of the present study is that it will give knowledge on how ETFs react towards the arrival of new information. It will also give an idea on how much time is required for price adjustment, thereby giving knowledge on which prices are getting adjusted soon; whether the ETF price or index price adjustments are different. When the investors understand the adjustment between the index and the ETF, appropriate trading strategies can be devised. It also adds to the body of knowledge on market overreaction or under-reaction to new information. Hence, it assists investors and regulators to decide on the regulation and investment in ETFs. The rest of the chapter will discuss about the data and methodology, followed by empirical results and conclusion.

4.2 DATA

The present study collected data from two sources, namely, the NSE and the CMIE Prowess database. The closing price of the ETF was collected from the NSE website and the closing index price was collected from the CMIE Prowess database. The study calculated the returns on the ETF and the index from the difference of one day to twenty days. The ETFs were separated on the basis of broad-based market and sectoral indices.

4.3 METHODOLOGY

The present study followed Amihud and Mendelson's (1987) partial adjustment with noise model for the stochastic process for the observed price and intrinsic values. Further, the study of Theobald and Yallup (2004) provided the final model used in the estimation. It was assumed that the actual or observed prices adapted incompletely to their intrinsic values. The speed of adjustment factor gave an adjustment range. The intrinsic value series is assumed to follow a random walk. The specifications for the observed or actual series and the intrinsic or fundamental series are given by the following two equations:

$$\Delta P_{(t)} = \pi\{V_{(t)} - P_{(t-1)}\} + u_{(t)} \qquad \text{... (4.1)}$$

$$\Delta V_{(t)} = \mu + e_{(t)} \qquad \text{...(4.2)}$$

Where, $\Delta P_{(t)}$ is the change in logarithmic prices and π is the coefficient for the speed of the adjustment, which for non-explosive series will be within (0,2). The white noise term expressed as $u_{(t)}$, and $\Delta V_{(t)}$ is the change of the logarithmic intrinsic values. The mean of the intrinsic value series is μ, which follows the random walk process, and $e_{(t)}$ is the logarithmic intrinsic value's innovation that in efficient markets would be serially uncorrelated. If $\pi = 1$ when the prices are fully adjusted, then, $\pi > 1$ when overreaction occurs and $\pi < 1$ when underreaction occurs.

4.3.1 The ARMA Estimator

Equation (4.1) can be rewritten after first differencing and rearranging as:

$$R_{(t)} = (1-\pi)R_{(t-1)} + \pi\Delta V_{(t)} + \Delta u_{(t)} \qquad \text{..(4.3)}$$

By substituting for $\Delta V_{(t)}$ in Equation (4.2), Equation (4.3) becomes:

$$R_{(t)} = \pi\mu + (1-\pi)R_{(t-1)} + \pi e_{(t)} + u_{(t)} - u_{(t-1)} \qquad \text{...(4.4)}$$

An ARMA (1, 1) represents the autocorrelations caused by underreactions or overreactions. The AR (1) coefficient reflects the speed of adjustment. The AR component satisfies stationarity, if $|1-\pi| < 1$ or $0 < \pi < 2$. When $\pi = 1$ denotes full adjustment, then the process will be an MA (1) process. Noises such as bid- ask bounce will push the return process in such a situation. When non-synchronicity such as thin trading is present, its effect can be captured by the higher-order moving average. As indicated earlier, autoregressive component provides speed of adjustment ($1-\pi$) and the moving average component represents the thin trading effects. The study uses the Wald test to confirm whether the AR(1) coefficient is equal to one.

In this objective, the study tests the following null and alternative hypothesis:

H0 - New information is not quickly incorporated into the prices of the ETFs and the underlying indices.

H1 - New information is quickly incorporated into the prices of the ETFs and the underlying indices.

4.4 RESULTS

The results of summary statistics of the ETFs' return for each of the 20 return differencing intervals are presented in Figures 4.1 to 4.4. Figure 4.1 and Figure 4.2 present the mean returns of the ETFs based on broad-based market and sectoral indices, respectively. The average returns of the ETFs from day one to twenty differencing interval shows that most of the ETF returns are positive, except for two ETFs. The percentage of ETFs' return gradually increase as the differencing interval increases, as expected. Hence, most of the ETFs show higher returns at the end of twenty-day differencing interval. Overall, BANKBEES yields the highest return compared with the all other ETFs, and KOTAKNIFTY shows the least return than the other ETFs. Figures 3 and 4 present the standard deviation of the returns of the underlying broad-based market and sectoral indices, respectively. The results of the standard deviation show that as the differencing interval increases, the standard deviation also increases. KOTAKNIFTY has a high deviation from the mean value on day 20 and SHARIABEES has less deviation compared with the other ETFs.

The results of the mean and standard deviation of the indices return is presented in Figures 4.5 to 4.8. Figure 4.5 and Figure 4.6 present the mean returns of the broad-based indices and sectoral indices, respectively. Even in the index return, the results' pattern is similar to the ETF returns. The returns gradually increase as the differencing interval increases. Indices such as KOTAKNIFTY/ Nifty50, KOTAKPKSUB/ Nifty PSU Bank, and INFRABEES/ Nifty

Infrastructure yield negative returns; the other underlying indices of the ETFs yield positive return. Overall, BANKBEES/ Nifty Bank yields the highest return compared with the other indices, and KOTAKNIFTY/ Nifty 50 yields the lowest return compared with the other indices. Figure 4.7 and Figure 4.8 present the standard deviation of the returns of the underlying broad-based market indices and sectoral indices, respectively. Even the standard deviation of the indices follows the same pattern as that of the ETFs' standard deviation. The deviation increases when the differencing interval increases.

ADF and KPSS unit root tests are conducted on the ETF and index return series and the results are presented in Tables 4.1 to 4.8. The ADF test results are presented in Tables 4.1 to 4.4. The KPSS test results are presented in Tables 4.5 to 4.8. The null hypothesis of the ADF test is that the series is non-stationary. The ADF results shows that all the coefficients are statistically significant. Hence, the ADF test rejects the null hypothesis and confirms the stationarity. The null hypothesis of the KPSS test is that the series is stationary and has no unit root. The KPSS test also confirms the stationarity based on the LM statistic value which is lesser than the asymptotic critical values. Almost all the LM statistics values are lesser than 0.216 (1%), 0.146 (5%), and 0.119 (10%) critical value, thus they do not reject the null hypothesis.

The ARMA (1, 1) is the model chosen for all the ETFs in the present study. The ETF return was calculated from one to twenty days difference interval. The adjustment speed percentage is denoted by the ETF and the index return coefficients. If the coefficients are equal to one, it confirms full incorporation of the information to the respective prices. Furthermore, to check whether a coefficient is equal to 1 or not, the present study conducted the WALD test. The results of the ARMA model on the ETFs based on broad-based indices are presented in Table 4.9. Most of the ETFs under the broad-based indices have negative coefficients on day 2 compared with day 1. From the 2nd day onwards, the coefficients are positive and less than one, indicating underreaction to the news. Almost all the ETFs follow the same pattern. From day 1 to 11, the percentage of adjustment starts to increase gradually. On the 12th day, most of the ETFs' speed of adjustment percentage come close to 90%. On day 20, all the ETFs attain 95% of speed correction, but do not reach 100%. The QNIFTY speed of adjustment coefficient is the highest and the BSLNIFTY ETF is the least in the group.

The results of the ETFs based on sectoral indices are presented in Table 4.10. Even here, most of the ETFs' coefficients are significant and less than one. It indicates underreaction in most of the ETFs. Moreover, with each passing day, the speed gradually increases. On day 1, five out of nine ETFs have negative coefficients, which are not significant in some cases. A few ETFs give mixed results, i.e., on day 1, they have positive coefficients, and on day 2, negative coefficients. From day 3 onwards, all the ETFs under sectoral indices have significant and positive coefficients, which shows underreaction or slow reaction to the news. On day 19 and 20, most of the ETFs' coefficients are 0.9 or near to one. The pattern shows that the coefficients do not attain unit one until day 20. Moreover, all the ETFs' coefficients are positive and significant, thus confirming that the ETFs react less to the news.

Results of the broad-based indices are presented in Table 4.11. On day 1, the coefficients are negative and significant for most of the indices. From day 2, all the underlying indices' coefficients are positive and significant. Hence, the study can confirm that current day indices over-react to immediate news, but gradually decline as the news get older. Further, the BSLNIFTY[1]/ Nifty50 index coefficient is low compared with the other ETF's underlying indices. It can also be observed that the coefficients are below one, which implies that the adjustment does not meet the intrinsic value within 20 days. The results of the sectoral indices are presented in Table 4.12. Even in the sectoral indices, the results show that the BANKBEES/Nifty Bank and the CPSEETF/ Nifty CPSE overreact on day 1,and all the other ETFs' underlying indices are not significant, even if they have a negative sign. From day 2 onwards, the coefficients have a positive sign and are significant, reflecting underreaction to information. The correction speed of the PSUBNKBEES/ Nifty PSU Bank and the RELDIVOPP/ Nifty Dividend Opportunities 50 is high and low, respectively, compared with the other underlying indices.

The Wald test results are presented in Tables 4.13 to 4.16. The results of the broad-based ETF returns are presented in Table 4.13 and the sectoral indices ETF returns are presented in Table 4.14. Table 4.15 and Table 4.16 present the broad-based and sectoral indices' returns, respectively. The null hypothesis of the Wald test is that the AR coefficients are equal to one and the alternate hypothesis is coefficient not equal to one. A probability value of less than five percent rejects the null hypothesis. The results show that all the ETFs coefficients are not equal to one, except for JUNIORBEES and KOTAKNIFTY. Both, the JUNIORBEES and KOTAKNIFTY do not reject the null hypothesis on day 1.

A comparison between the ETF and the index result shows that most of the ETFs and the underlying indices follow the same pattern; however, some ETFs' results are different from the indices results. ETFs such as the BSLNIFTY, INFRABEES, JUNIORBEES, and RELDIVOPP

[1] Some ETFs follow the same index, hence in the index returns, the study represents the ETF's Name /Respective underlying indices in the result section.

underreact on day one. Conversely, the respective indices overreact during the same time. The adjustment speed pattern is the same for both with minor differences.

Past studies have mostly focused on different stock markets around the world. The present study is done on ETFs in India. It looked at the possibility of differential adjustment speeds in the individual ETFs and underlying indices. The findings show that Indian ETF markets largely underreact to news. This finding has implications to investors about the correction time in ETFs and the future movement in the ETF prices.

The null hypothesis of the objective is that new information is quickly incorporated in the prices of the ETF and the index return. The empirical results show that in the case of both the ETFs and indices, information is not fully incorporated into the returns. However, more than 90% of the information is incorporated into both the ETF and index returns at the end of the 20th day return difference. Therefore, the null hypothesis is not rejected.

4.5 SUMMARY

The main purpose of this objective is to check the speed of adjustment of prices towards the intrinsic value of equity ETFs and the underlying benchmark indices. Based on the analysis, most of the ETFs were underreacting to information. The ETF prices and the underlying index prices were having a more or less similar reaction to information. The Wald test confirmed that the AR coefficients were not equal to one in the time period from day 1 to day 20. Most of the ETFs' speed of adjustment coefficient on day 20 was very close to one indicating that it was very near to full adjustment. Additionally, the mean returns of both the ETFs and index prices were following the same pattern indirectly confirming higher degree of efficiency in the ETFs while tracking the underlying indices.

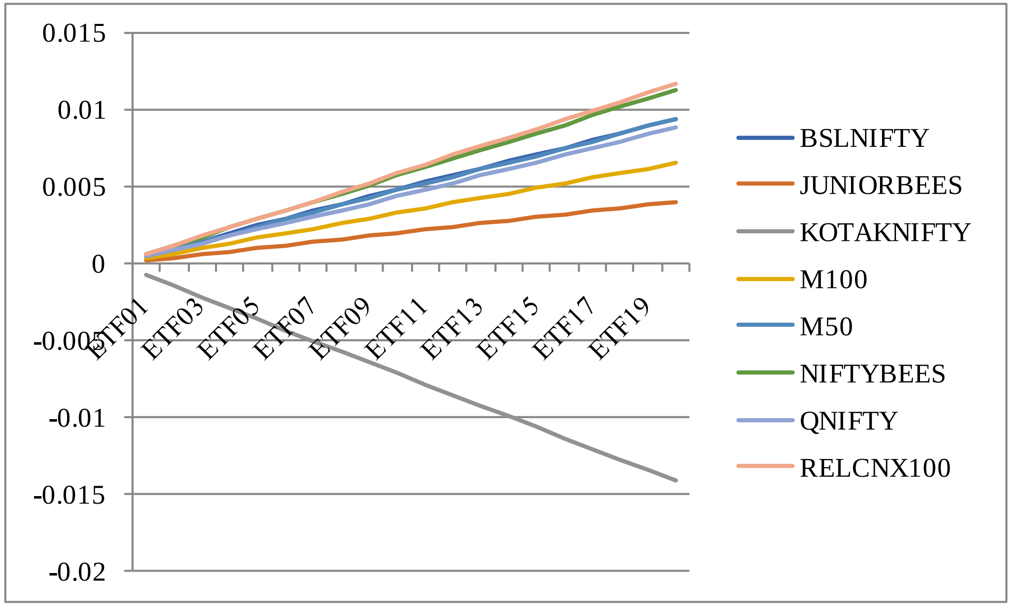


Figure 4.1 - Mean Return of the ETFs Based on Broad Based Indices

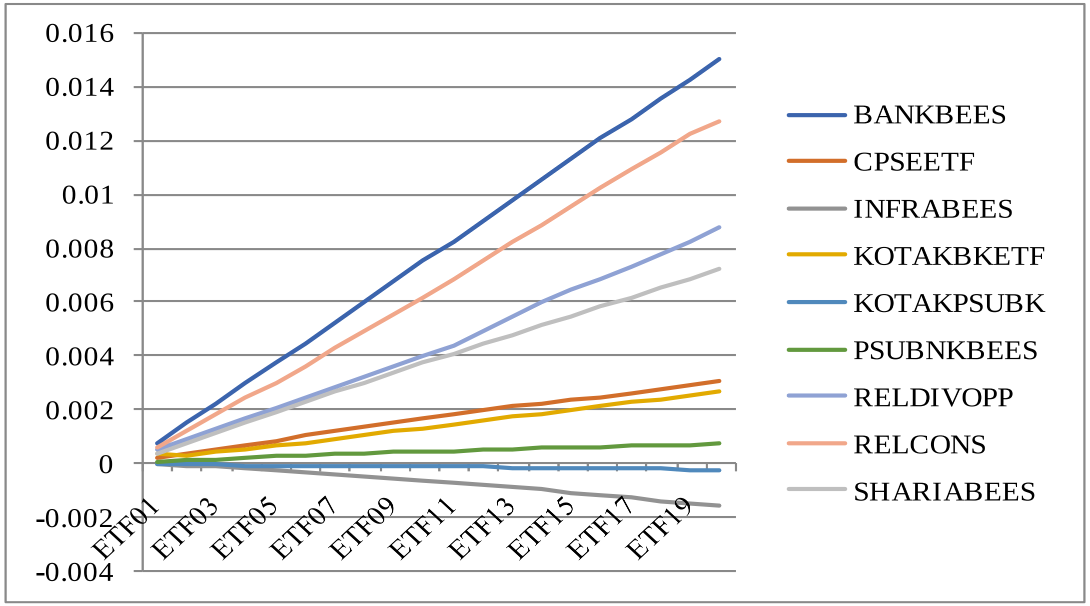


Figure 4.2 - Mean Return of the ETFs Based on Sectoral Indices

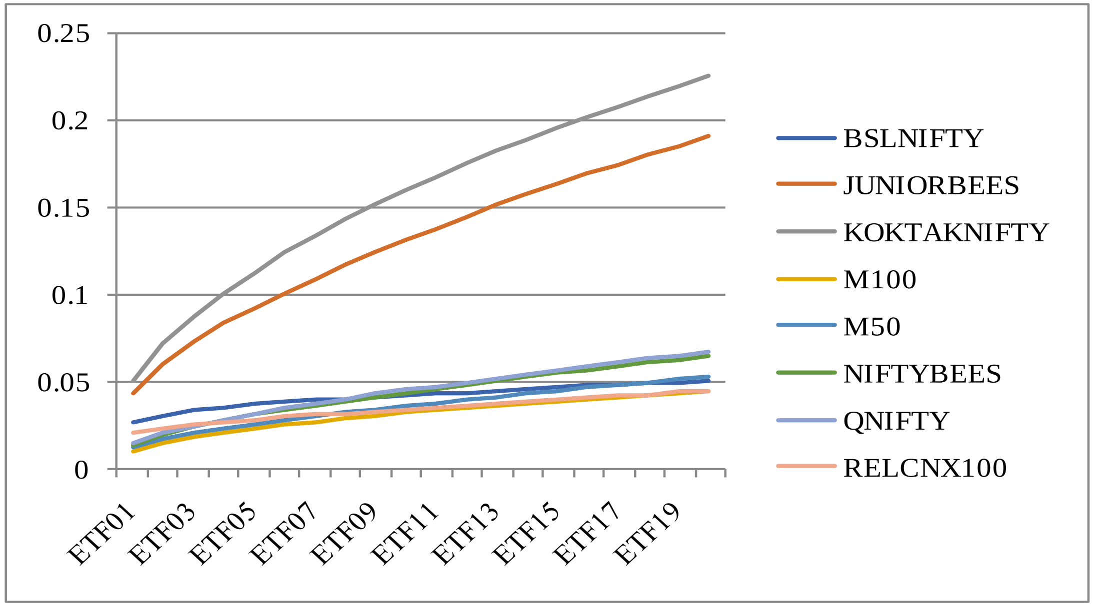


Figure 4.3 - Standard Deviation of the ETFs Based on Broad Based Indices

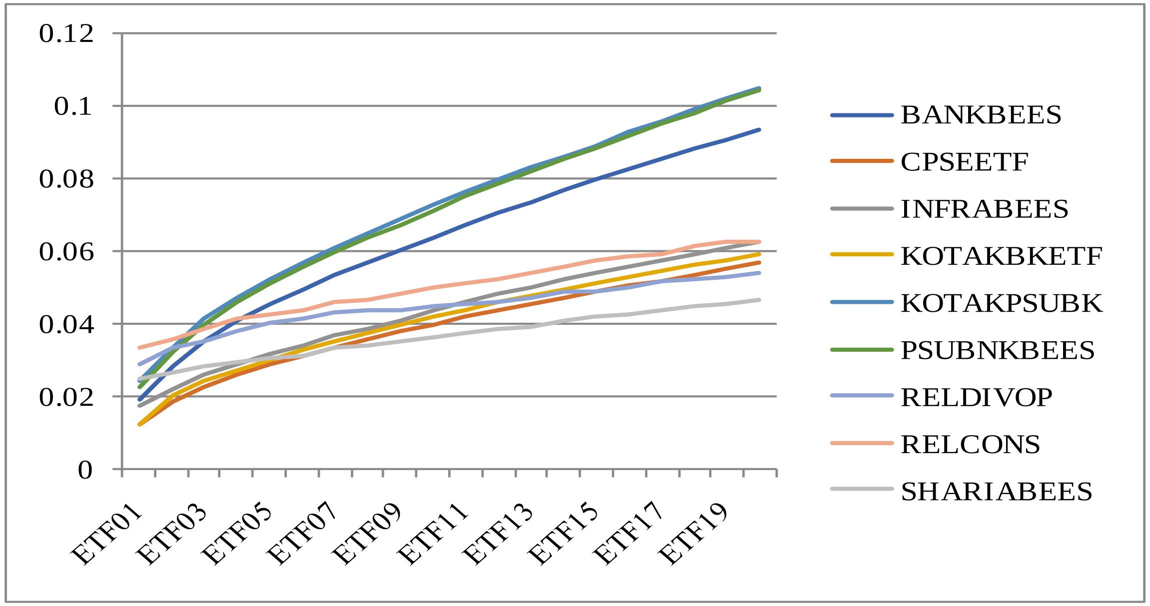


Figure 4.4 - Standard Deviation of the ETFs Based on Sectoral Indices

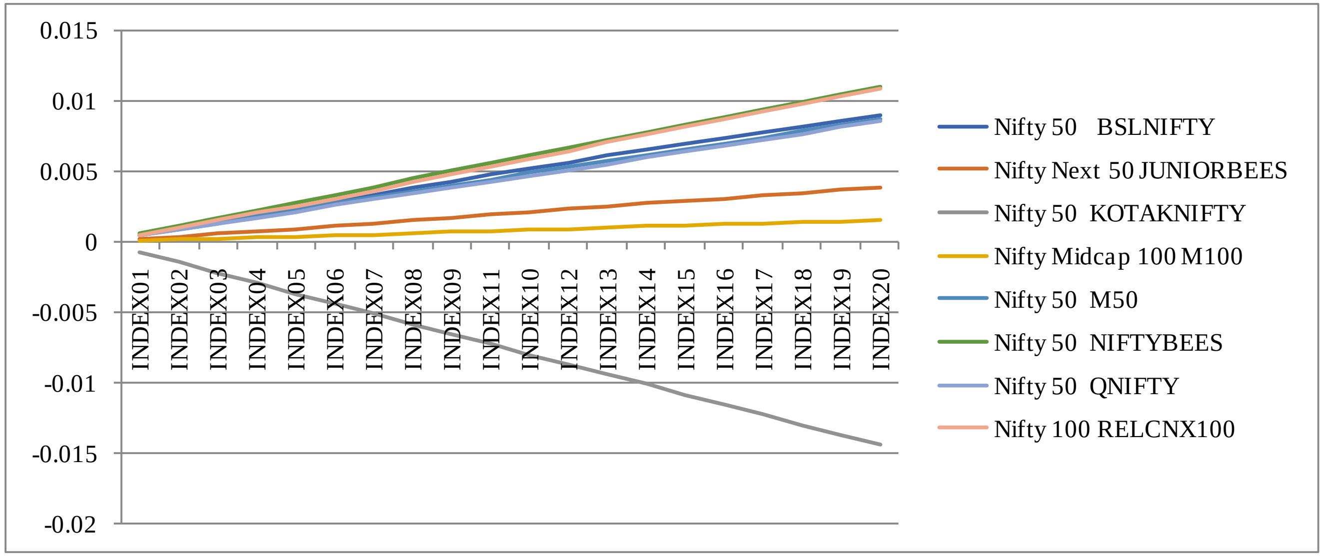


Figure 4.5 - Mean Return Based on Broad Based Indices

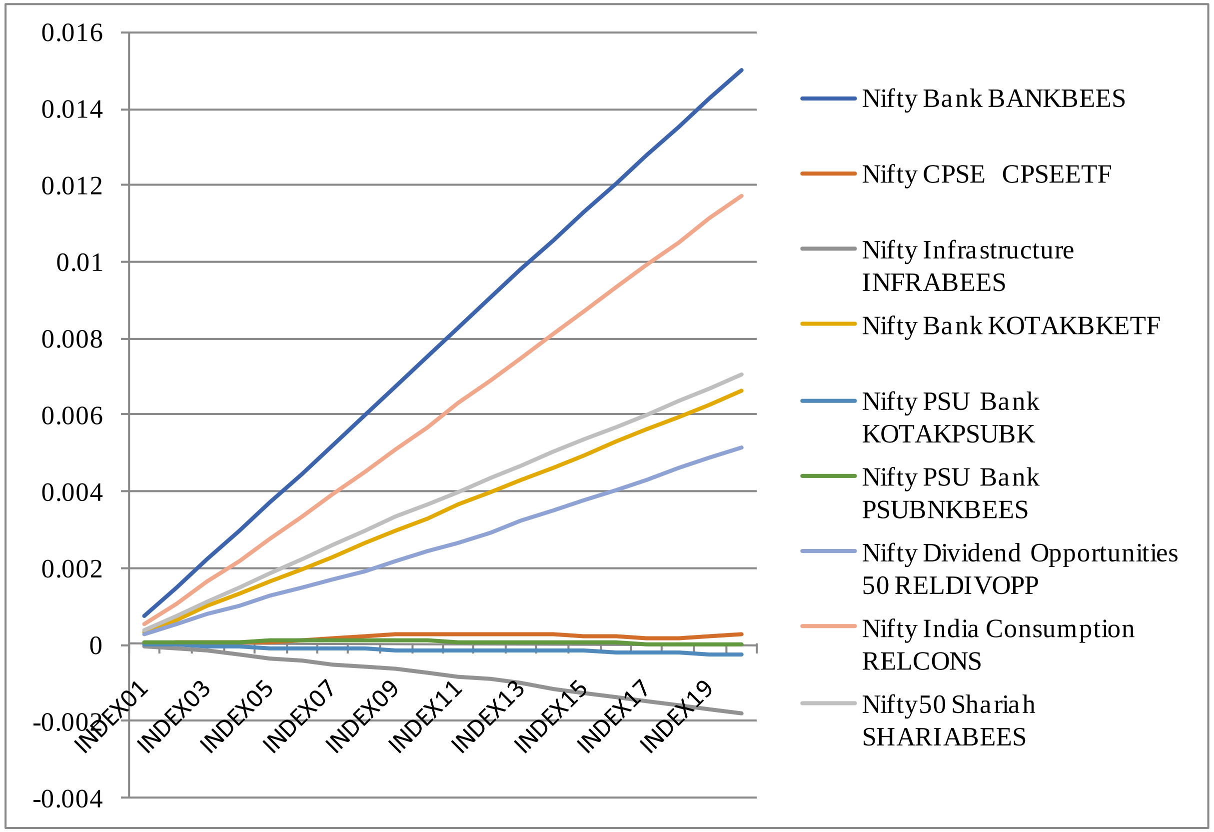


Figure 4.6 - Mean Return Based on Sectoral Indices

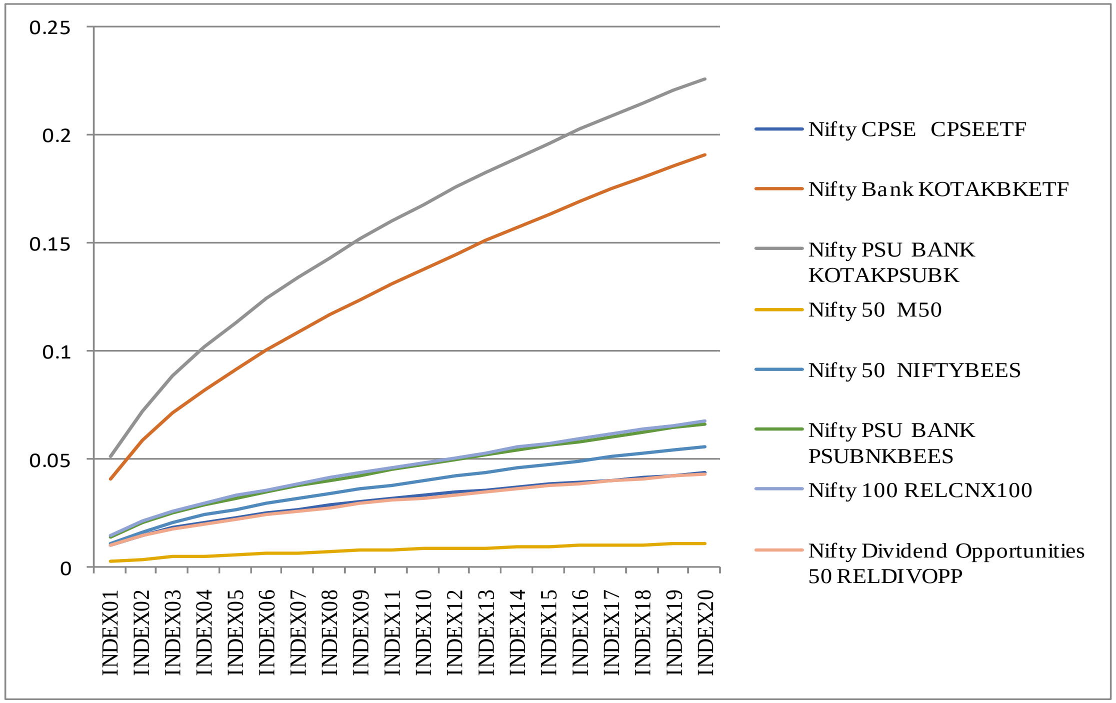


Figure 4.7 - Standard Deviation Based on Broad Based Indices

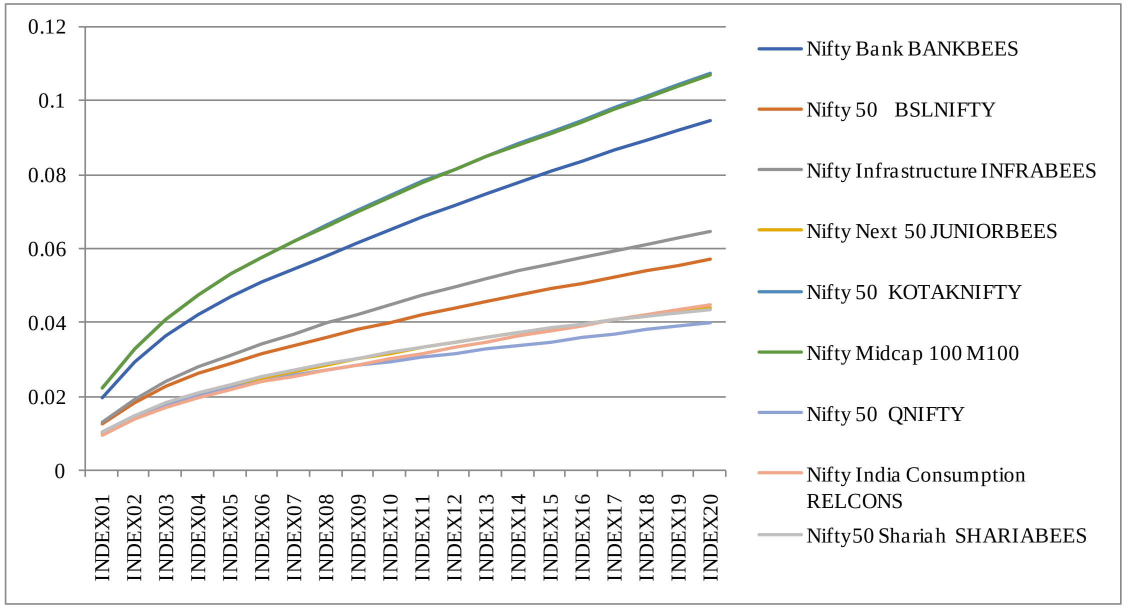


Figure 4.8 - Standard deviation Based on Sectoral Indices

Table 4.1 - ADF Unit Root Results of ETF Returns for ETFs Based on Broad Based Indices

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF01	-24.40*	-63.00*	-46.35*	-48.60*	-52.38*	-47.13*	-48.38*	-23.60*
ETF02	-13.77*	-11.91*	-11.63*	-10.72*	-11.90*	-13.97*	-8.46*	-8.87*
ETF03	-12.78*	-12.98*	-9.73*	-8.27*	-9.95*	-11.36*	-7.72*	-8.44*
ETF04	-8.32*	-10.72*	-8.40*	-7.97*	-9.32*	-11.18*	-8.37*	-8.09*
ETF05	-9.31*	-11.04*	-8.02*	-7.61*	-8.53*	-10.37*	-7.66*	-8.34*
ETF06	-8.31*	-11.21*	-7.92*	-7.45*	-8.44*	-10.16*	-7.93*	-6.61*
ETF07	-8.59*	-10.23*	-8.00*	-7.63*	-8.72*	-9.99*	-7.38*	-6.75*
ETF08	-7.68*	-11.02*	-7.51*	-6.90*	-7.78*	-10.40*	-7.08*	-6.55*
ETF09	-8.15*	-9.72*	-7.91*	-7.42*	-8.15*	-10.15*	-7.13*	-6.57*
ETF10	-7.38*	-10.58*	-7.50*	-7.32*	-8.28*	-8.68*	-7.10*	-6.42*
ETF11	-7.55*	-10.27*	-7.20*	-6.57*	-7.58*	-10.42*	-6.97*	-6.67*
ETF12	-7.55*	-9.66*	-6.89*	-6.54*	-7.23*	-9.75*	-6.64*	-6.97*
ETF13	-9.12*	-9.24*	-7.60*	-7.29*	-7.883*	-8.71*	-7.25*	-6.95*
ETF14	-8.10*	-8.42*	-7.30*	-7.17*	-7.899*	-8.45*	-6.85*	-6.67*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF15	-8.05*	-9.77*	-7.05*	-7.13*	-7.84*	-8.09*	-6.84*	-5.91*
ETF16	-7.53*	-10.20*	-6.85*	-6.79*	-7.34*	-9.91*	-6.81*	-6.18*
ETF17	-7.33*	-9.28*	-6.64*	-6.71*	-6.97*	-9.82*	-6.41*	-6.49*
ETF18	-6.85*	-9.02*	-6.45*	-6.52*	-7.08*	-9.33*	-6.52*	-6.35*
ETF19	-6.82*	-9.04*	-6.29*	-6.70*	-7.09*	-8.72*	-6.01*	-5.93*
ETF20	-6.69*	-8.80*	-6.08*	-6.69*	-7.06*	-8.02*	-6.07*	-6.09*

*Note: The results of ADF test conducted at level and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.2 - ADF Unit Root Results of ETF Returns for ETFs Based on Sectoral Indices

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
ETF01	-52.46*	-24.85*	-54.63*	-31.09*	-53.31*	-50.81*	-30.19*	-18.90*	-27.74*
ETF02	-10.80*	-10.22*	-8.88*	-8.82*	-10.89*	-9.83*	-8.46*	-10.03*	-15.84*
ETF03	-9.94*	-6.44*	-9.23*	-8.36*	-9.79*	-10.04*	-9.56*	-9.67*	-9.39*
ETF04	-9.36*	-6.60*	-8.57*	-6.55*	-9.37*	-9.09*	-7.55*	-7.58*	-9.14*
ETF05	-9.55*	-6.35*	-8.56*	-5.64*	-8.87*	-8.79*	-7.79*	-7.59*	-9.87*
ETF06	-9.40*	-6.01*	-8.31*	-5.82*	-8.64*	-8.80*	-7.42*	-6.12*	-9.04*
ETF07	-8.91*	-7.02*	-8.43*	-5.00*	-8.99*	-8.89*	-7.48*	-7.52*	-8.76*
ETF08	-9.92*	-5.78*	-7.73*	-5.5*	-8.02*	-7.93*	-6.92*	-7.00*	-9.32*
ETF09	-9.12*	-6.63*	-8.36*	-5.03*	-7.92*	-7.80*	-6.58*	-5.76*	-9.30*
ETF10	-8.97*	-6.42*	-7.89*	-4.91*	-8.36*	-8.30*	-6.24*	-6.54*	-8.71*
ETF11	-8.28*	-5.58*	-8.08*	-5.81*	-7.71*	-7.48*	-6.69*	-6.81*	-8.25*
ETF12	-8.77*	-5.58*	-7.68*	-5.7*	-7.67*	-7.59*	-6.68*	-6.57*	-9.42*
ETF13	-8.43*	-6.26*	-8.27*	-5.31*	-7.31*	-7.20*	-6.15*	-6.48*	-11.19*

ETFs	BANK BEES	CPSEE TF	INFRABEE S	KOTAKB KETF	KOTAKP KSUB	PSUBNKB EES	RELDIVO PP	RELCO NS	SHARIAB EES
ETF14	-7.98*	-6.51*	-7.53*	-4.92*	-7.92*	-8.25*	-6.99*	-6.38*	-8.63*
ETF15	-8.52*	-6.02*	-7.08*	-4.51*	-7.78*	-7.78*	-5.87*	-6.15*	-9.45*
ETF16	-10.25*	-5.53*	-7.33*	-4.38*	-7.39*	-7.50*	-5.61*	-6.05*	-9.36*
ETF17	-8.80*	-5.08*	-6.84*	-4.16*	-7.57*	-7.58*	-5.12*	-5.17*	-9.27*
ETF18	-8.23*	-5.84*	-7.34*	-4.3*	-7.43*	-7.68*	-5.74*	-5.35*	-7.37*
ETF19	-8.28*	-5.90*	-7.31*	-4.23*	-7.49*	-7.22*	-5.23*	-5.50*	-6.97*
ETF20	-7.68*	-5.84*	-6.57*	-4.33*	-7.51*	-7.17*	-5.88*	-6.31*	-8.01*

*Note: The results of ADF test conducted at level and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.3 - ADF Unit Root Results for Broad Based Index Returns

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying Indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap**	**NIFTY 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX01	-38.08*	-59.75*	-46.35*	-38.43*	-42.1 *	-46.32*	-42.68*	-26.12*
INDEX02	-11.99*	-13.20*	-11.26*	-11.60*	-12.50*	-12.01*	-8.63*	-9.75*
INDEX03	-8.39*	-11.23*	-9.73*	-9.53*	-10.22*	-11.25*	-8.42*	-8.91*
INDEX04	-8.35*	-10.80*	-8.41*	-8.27*	-9.47*	-11.32*	-8.13*	-7.99*
INDEX05	-8.47*	-10.94*	-8.03*	-7.52*	-8.55*	-10.41*	-7.43*	-7.29*
INDEX06	-7.27*	-10.81*	-7.92*	-7.31*	-8.22*	-10.24*	-7.93*	-7.71*
INDEX07	-7.80*	-9.93*	-8.01*	-7.65*	-8.71*	-10.09*	-8.34*	-7.01*
INDEX08	-6.66*	-10.06*	-7.50*	-6.63*	-7.72*	-10.85*	-6.95*	-7.51*
INDEX09	-7.69*	-9.46*	-7.92*	-8.11*	-9.09*	-10.23*	-7.27*	-6.68*
INDEX10	-7.04*	-10.36*	-7.51*	-6.97*	-8.19*	-8.67*	-7.01*	-6.72*
INDEX11	-7.20*	-9.96*	-7.19*	-6.76*	-7.4*	-10.55*	-6.69*	-6.21*
INDEX12	-6.93*	-9.37*	-6.88*	-7.15*	-7.81*	-9.94*	-6.49*	-6.97*
INDEX13	-7.42*	-9.01*	-7.60*	-7.59*	-8.29*	-8.83*	-7.22*	-6.26*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying Indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap**	**NIFTY 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX14	-7.03*	-8.31*	-7.32*	-7.42*	-7.74*	-8.51*	-8.08*	-6.11*
INDEX15	-6.31*	-9.51*	-7.07*	-6.39*	-7.29*	-8.18*	-7.43*	-6.21*
INDEX16	-6.58*	-9.58*	-6.85*	-6.49*	-7.09*	-10.00*	-6.92*	-6.23*
INDEX17	-7.17*	-8.97*	-6.66*	-6.59*	-7.85*	-9.90*	-6.69*	-5.81*
INDEX18	-6.54*	-8.79*	-6.46*	-6.78*	-7.65*	-9.34*	-6.33*	-6.25*
INDEX19	-6.60*	-8.67*	-6.27*	-6.47*	-6.93*	-8.74*	-5.90*	-5.66*
INDEX20	-6.16*	-8.52*	-6.07*	-5.90*	-7.04*	-8.34*	-5.63*	-5.49*

*Note: The results of ADF test conducted at level and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.4 - ADF Unit Root Results for Sectoral Index Returns

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX01	-51.01*	-31.73*	-40.43*	-30.33*	-47.49*	-48.03*	-22.66*	-27.38*	-41.88*
INDEX02	-11.77*	-10.39*	-9.99*	-9.07*	-10.45*	-10.66*	-9.31*	-8.31*	-12.23*
INDEX03	-10.13*	-6.91*	-10.15*	-7.19*	-11.33*	-10.11*	-6.34*	-6.95*	-9.79*
INDEX04	-9.45*	-6.64*	-9.21*	-6.58*	-9.33*	-9.27*	-6.25*	-5.95*	-9.18*
INDEX05	-9.74*	-6.23*	-8.21*	-5.90*	-8.78*	-8.75*	-6.19*	-5.91*	-8.60*
INDEX06	-9.61*	-6.11*	-7.97*	-5.84*	-8.56*	-8.47*	-6.43*	-5.84*	-8.73*
INDEX07	-8.99*	-6.55*	-8.35*	-5.00*	-9.14*	-9.14*	-6.65*	-5.99*	-8.84*
INDEX08	-10.05*	-5.83*	-7.68*	-5.50*	-7.96*	-7.98*	-5.85*	-5.77*	-8.36*
INDEX09	-9.27*	-6.66*	-8.71*	-5.12*	-7.85*	-7.75*	-5.49*	-5.07*	-9.03*
INDEX10	-9.22*	-6.43*	-7.84*	-4.87*	-8.27*	-8.18*	-4.84*	-5.07*	-8.15*
INDEX11	-8.79*	-5.60*	-7.69*	-5.91*	-7.92*	-7.52*	-5.23*	-5.23*	-8.19*
INDEX12	-8.88*	-5.70*	-7.52*	-5.70*	-8.06*	-7.89*	-5.35*	-5.45*	-7.65*

ETFs	BANK BEES	CPSEE TF	INFRABE ES	KOTAK BKETF	KOTAK PKSUB	PSUBN KBEES	RELDIVOPP	RELCONS	SHARIAB EES
Underlyi ng indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastruc ture**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX13	-8.44*	-6.32*	-8.04*	-5.17*	-7.29*	-7.05*	-5.22*	-4.88*	-8.77*
INDEX14	-7.95*	-6.46*	-7.30*	-4.85*	-8.28*	-8.38*	-4.94*	-4.86*	-8.15*
INDEX15	-8.78*	-6.08*	-6.77*	-4.40*	-7.79*	-7.53*	-4.73*	-4.77*	-7.75*
INDEX16	-9.05*	-5.53*	-6.99*	-4.37*	-7.21*	-7.37*	-4.56*	-5.24*	-7.42*
INDEX17	-8.56*	-5.11*	-7.28*	-5.02*	-7.80*	-7.62*	-4.67*	-4.71*	-7.62*
INDEX18	-8.51*	-5.44*	-6.66*	-4.56*	-7.68*	-7.68*	-4.38*	-4.62*	-7.54*
INDEX19	-8.15*	-5.86*	-6.90*	-4.13*	-7.67*	-7.00*	-4.33*	-5.02*	-7.11*
INDEX20	-7.81*	-5.86*	-6.47*	-4.39*	-7.52*	-7.55*	-4.10*	-4.52*	-6.91*

*Note: The results of ADF test conducted at level and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.5 - KPSS Unit Root Results of ETF Returns for ETFs Based on Broad Based Indices

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF01	0.100	0.031	0.043	0.110	0.040	0.116	0.042	0.060
ETF02	0.109	0.030	0.046	0.195	0.078	0.114	0.042	0.052
ETF03	0.103	0.030	0.046	0.118	0.045	0.115	0.041	0.047
ETF04	0.101	0.029	0.047	0.111	0.046	0.116	0.040	0.049
ETF05	0.105	0.030	0.047	0.106	0.047	0.115	0.040	0.051
ETF06	0.101	0.030	0.048	0.104	0.048	0.115	0.040	0.056
ETF07	0.108	0.030	0.048	0.103	0.049	0.115	0.039	0.055
ETF08	0.114	0.031	0.049	0.103	0.050	0.114	0.039	0.054
ETF09	0.117	0.031	0.049	0.104	0.051	0.114	0.039	0.055
ETF10	0.119	0.032	0.050	0.105	0.051	0.114	0.040	0.056
ETF11	0.120	0.032	0.050	0.105	0.052	0.115	0.040	0.056
ETF12	0.120	0.032	0.051	0.106	0.053	0.115	0.041	0.057
ETF13	0.122	0.032	0.051	0.108	0.054	0.116	0.041	0.058
ETF14	0.121	0.033	0.052	0.110	0.055	0.118	0.042	0.059

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF15	0.122	0.033	0.052	0.111	0.056	0.119	0.043	0.060
ETF16	0.122	0.033	0.053	0.113	0.057	0.120	0.043	0.061
ETF17	0.121	0.034	0.054	0.114	0.058	0.121	0.044	0.061
ETF18	0.121	0.034	0.054	0.116	0.059	0.122	0.044	0.062
ETF19	0.122	0.034	0.055	0.117	0.060	0.123	0.045	0.063
ETF20	0.121	0.035	0.056	0.118	0.060	0.124	0.045	0.064

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 4.6 - KPSS Unit Root Results of ETF Returns for ETFs Based on Sectoral Indices

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
ETF01	0.059	0.107	0.078	0.077	0.038	0.035	0.081	0.023	0.097
ETF02	0.060	0.130	0.087	0.078	0.041	0.038	0.082	0.025	0.077
ETF03	0.058	0.119	0.089	0.084	0.041	0.038	0.084	0.029	0.077
ETF04	0.057	0.120	0.089	0.089	0.039	0.037	0.084	0.031	0.082
ETF05	0.057	0.121	0.088	0.087	0.038	0.036	0.085	0.032	0.109
ETF06	0.058	0.120	0.087	0.087	0.037	0.036	0.082	0.051	0.092
ETF07	0.058	0.118	0.087	0.088	0.037	0.035	0.086	0.042	0.089
ETF08	0.057	0.119	0.087	0.089	0.037	0.035	0.094	0.044	0.090
ETF09	0.058	0.120	0.088	0.090	0.037	0.035	0.095	0.046	0.092
ETF10	0.058	0.121	0.088	0.092	0.037	0.036	0.099	0.047	0.094
ETF11	0.059	0.123	0.089	0.093	0.037	0.036	0.103	0.047	0.096
ETF12	0.059	0.126	0.090	0.095	0.038	0.036	0.108	0.047	0.097
ETF13	0.060	0.128	0.091	0.097	0.038	0.037	0.113	0.047	0.099

ETFs	BAN KBE ES	CPSEE TF	INFRABE ES	KOTAKBK ETF	KOTAKPKS UB	PSUBNKB EES	RELDIVO PP	RELCO NS	SHARIAB EES
ETF14	0.060	0.131	0.092	0.099	0.039	0.037	0.119	0.047	0.101
ETF15	0.060	0.134	0.094	0.102	0.039	0.037	0.124	0.047	0.103
ETF16	0.061	0.138	0.095	0.103	0.039	0.038	0.129	0.047	0.105
ETF17	0.061	0.140	0.096	0.106	0.040	0.038	0.133	0.048	0.106
ETF18	0.061	0.143	0.097	0.108	0.040	0.038	0.138	0.048	0.107
ETF19	0.062	0.145	0.098	0.109	0.041	0.039	0.143	0.049	0.108
ETF20	0.062	0.145	0.099	0.111	0.041	0.039	0.141	0.049	0.109

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 4.7 - KPSS Unit Root Results for Broad Based Index Returns

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX01	0.047	0.032	0.043	0.093	0.040	0.119	0.036	0.039
INDEX02	0.049	0.032	0.046	0.100	0.046	0.116	0.038	0.044
INDEX03	0.051	0.031	0.047	0.099	0.045	0.116	0.039	0.046
INDEX04	0.053	0.031	0.048	0.094	0.046	0.118	0.039	0.047
INDEX05	0.054	0.031	0.048	0.091	0.047	0.117	0.039	0.048
INDEX06	0.054	0.031	0.049	0.089	0.048	0.118	0.039	0.048
INDEX07	0.054	0.031	0.049	0.090	0.049	0.118	0.039	0.049
INDEX08	0.054	0.032	0.049	0.091	0.051	0.117	0.039	0.050
INDEX09	0.053	0.032	0.050	0.092	0.051	0.117	0.039	0.051
INDEX10	0.052	0.032	0.050	0.093	0.052	0.117	0.039	0.051
INDEX11	0.052	0.033	0.051	0.094	0.053	0.118	0.040	0.052
INDEX12	0.052	0.033	0.051	0.096	0.054	0.118	0.040	0.053

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX13	0.052	0.033	0.052	0.097	0.054	0.119	0.041	0.054
INDEX14	0.052	0.033	0.053	0.099	0.055	0.121	0.041	0.055
INDEX15	0.053	0.034	0.053	0.101	0.057	0.122	0.042	0.056
INDEX16	0.053	0.034	0.054	0.101	0.058	0.124	0.043	0.057
INDEX17	0.052	0.034	0.054	0.103	0.059	0.125	0.044	0.058
INDEX18	0.052	0.035	0.055	0.104	0.060	0.126	0.044	0.059
INDEX19	0.052	0.035	0.056	0.105	0.061	0.127	0.044	0.060
INDEX20	0.052	0.036	0.056	0.107	0.061	0.128	0.045	0.061

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 4.8 - KPSS Unit Root Results for Sectoral Index Returns

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX01	0.052	0.107	0.074	0.077	0.037	0.034	0.081	0.065	0.058
INDEX02	0.056	0.112	0.075	0.077	0.038	0.038	0.079	0.068	0.059
INDEX03	0.056	0.118	0.075	0.086	0.038	0.038	0.193	0.105	0.065
INDEX04	0.055	0.120	0.075	0.087	0.037	0.037	0.091	0.080	0.067
INDEX05	0.055	0.119	0.076	0.085	0.036	0.037	0.098	0.081	0.069
INDEX06	0.056	0.119	0.077	0.087	0.036	0.036	0.102	0.083	0.071
INDEX07	0.055	0.117	0.078	0.088	0.035	0.036	0.101	0.082	0.074
INDEX08	0.056	0.117	0.079	0.089	0.035	0.036	0.102	0.082	0.077
INDEX09	0.056	0.118	0.079	0.091	0.035	0.036	0.104	0.081	0.079
INDEX10	0.057	0.119	0.080	0.092	0.036	0.036	0.106	0.080	0.081
INDEX11	0.058	0.121	0.081	0.093	0.036	0.036	0.109	0.080	0.083
INDEX12	0.059	0.123	0.082	0.095	0.036	0.037	0.112	0.080	0.084

ETFs	BANK BEES	CPSEETF	INFRABEES	KOTAK BKETF	KOTAK PKSUB	PSUBN KBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX13	0.059	0.125	0.083	0.097	0.037	0.037	0.117	0.079	0.086
INDEX14	0.059	0.128	0.085	0.100	0.037	0.038	0.121	0.080	0.088
INDEX15	0.060	0.131	0.086	0.102	0.038	0.038	0.125	0.080	0.089
INDEX16	0.060	0.134	0.088	0.103	0.038	0.038	0.129	0.081	0.091
INDEX17	0.061	0.137	0.089	0.106	0.039	0.039	0.132	0.081	0.093
INDEX18	0.061	0.139	0.090	0.108	0.039	0.039	0.135	0.081	0.093
INDEX19	0.062	0.141	0.091	0.109	0.040	0.039	0.137	0.082	0.094
INDEX20	0.062	0.142	0.092	0.111	0.040	0.040	0.140	0.082	0.095

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 4.9 - Speed of Adjustment Coefficients for ETFs Based on Broad Based Indices

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX100
ETF01	0.239*	0.349	-0.019	0.146	-0.057	-0.512*	-0.011	0.13*
ETF02	-0.356*	-0.033*	0	-0.08*	-0.094*	0.051*	-0.059*	-0.359*
ETF03	0.317*	0.571*	0.585*	0.531*	0.563*	0.575*	0.591*	0.33*
ETF04	0.466*	0.674*	0.686*	0.643*	0.669*	0.667*	0.691*	0.53*
ETF05	0.58*	0.753*	0.759*	0.736*	0.75*	0.735*	0.757*	0.613*
ETF06	0.635*	0.803*	0.804*	0.79*	0.794*	0.784*	0.809*	0.688*
ETF07	0.694*	0.833*	0.835*	0.816*	0.828*	0.822*	0.844*	0.744*
ETF08	0.738*	0.859*	0.858*	0.838*	0.85*	0.85*	0.867*	0.797*
ETF09	0.777*	0.877*	0.875*	0.859*	0.877*	0.874*	0.879*	0.832*
ETF10	0.797*	0.894*	0.889*	0.874*	0.888*	0.882*	0.902*	0.848*
ETF11	0.827*	0.904*	0.9*	0.887*	0.903*	0.893*	0.91*	0.858*
ETF12	0.825*	0.913*	0.908*	0.9*	0.909*	0.903*	0.922*	0.874*
ETF13	0.848*	0.917*	0.914*	0.912*	0.921*	0.918*	0.924*	0.882*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX100
ETF14	0.84*	0.924*	0.921*	0.916*	0.928*	0.921*	0.934*	0.894*
ETF15	0.848*	0.93*	0.928*	0.92*	0.933*	0.926*	0.938*	0.901*
ETF16	0.859*	0.937*	0.932*	0.924*	0.936*	0.933*	0.942*	0.907*
ETF17	0.866*	0.939*	0.936*	0.93*	0.939*	0.939*	0.946*	0.917*
ETF18	0.88*	0.946*	0.94*	0.937*	0.946*	0.94*	0.947*	0.915*
ETF19	0.892*	0.948*	0.943*	0.942*	0.948*	0.941*	0.953*	0.929*
ETF20	0.902*	0.951*	0.946*	0.944*	0.95*	0.943*	0.954*	0.927*

Note: *In the table coefficient of ARMA value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.10 - Speed of Adjustment Coefficients for ETFs Based on Sectoral Indices

ETFs	BANK BEES	CPSEE TF	INFRABE ES	KOTAKPKS UB	PSUBNKB EES	RELCO NS	SHARIAB EES	KOTAKBK ETF	RELDIVO PP
ETF01	-0.324*	-0.451*	0.118	-0.626**	-0.12	0.029	0.042	-0.745**	0.333*
ETF02	0.085*	0.093*	-0.194*	-0.028*	0.029**	-0.428*	-0.428*	0.015	-0.32*
ETF03	0.605*	0.574*	0.497*	0.581*	0.588*	0.327*	0.245*	0.604*	0.333*
ETF04	0.671*	0.647*	0.625*	0.682*	0.673*	0.485*	0.435*	0.659*	0.471*
ETF05	0.746*	0.725*	0.731*	0.759*	0.742*	0.616*	0.63*	0.713*	0.545*
ETF06	0.796*	0.775*	0.782*	0.804*	0.79*	0.692*	0.699*	0.787*	0.602*
ETF07	0.835*	0.815*	0.824*	0.836*	0.83*	0.752*	0.762*	0.826*	0.669*
ETF08	0.859*	0.833*	0.852*	0.86*	0.858*	0.779*	0.79*	0.854*	0.723*
ETF09	0.877*	0.855*	0.875*	0.875*	0.877*	0.812*	0.831*	0.871*	0.743*
ETF10	0.887*	0.874*	0.887*	0.89*	0.888*	0.841*	0.855*	0.883*	0.787*
ETF11	0.9*	0.889*	0.892*	0.898*	0.895*	0.861*	0.879*	0.894*	0.804*
ETF12	0.907*	0.89*	0.904*	0.909*	0.903*	0.875*	0.892*	0.9*	0.83*
ETF13	0.916*	0.897*	0.911*	0.917*	0.914*	0.885*	0.898*	0.905*	0.838*

ETFs	BANK BEES	CPSEE TF	INFRABE ES	KOTAKPKS UB	PSUBNKB EES	RELCO NS	SHARIAB EES	KOTAKBK ETF	RELDIVO PP
ETF14	0.921*	0.909*	0.918*	0.928*	0.923*	0.886*	0.908*	0.906*	0.858*
ETF15	0.928*	0.92*	0.922*	0.931*	0.929*	0.895*	0.912*	0.916*	0.851*
ETF16	0.934*	0.925*	0.933*	0.936*	0.933*	0.904*	0.918*	0.923*	0.85*
ETF17	0.937*	0.929*	0.937*	0.939*	0.937*	0.906*	0.92*	0.929*	0.855*
ETF18	0.942*	0.931*	0.946*	0.946*	0.943*	0.916*	0.926*	0.936*	0.856*
ETF19	0.946*	0.935*	0.944*	0.947*	0.945*	0.923*	0.925*	0.942*	0.871*
ETF20	0.949*	0.942*	0.947*	0.95*	0.946*	0.924*	0.932*	0.939*	0.895*

Note: *In the table coefficient of ARMA value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.11 - Speed of Adjustment Coefficients for Broad Based Indices

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying indices	Nifty 50	Nifty Next 50	Nifty 50	Nifty Midcap 100	Nifty 50	Nifty 50	Nifty 50	Nifty 100
INDEX01	-0.921*	-0.402	-0.037	0.203	0	-0.385*	-0.358**	-0.588*
INDEX02	0.06*	0.021	0	0.14*	0.081*	0.069*	0.068*	0.062*
INDEX03	0.574*	0.578*	0.585*	0.627*	0.59*	0.582*	0.58*	0.564*
INDEX04	0.659*	0.68*	0.686*	0.691*	0.674*	0.661*	0.654*	0.629*
INDEX05	0.741*	0.123*	0.759*	0.764*	0.754*	0.736*	0.735*	0.722*
INDEX06	0.796*	0.115*	0.804*	0.813*	0.799*	0.786*	0.795*	0.788*
INDEX07	0.823*	0.1*	0.835*	0.845*	0.826*	0.825*	0.828*	0.818*
INDEX08	0.85*	0.089*	0.859*	0.865*	0.852*	0.848*	0.843*	0.832*
INDEX09	0.861*	0.069*	0.875*	0.884*	0.873*	0.871*	0.866*	0.846*
INDEX10	0.87*	0.055*	0.889*	0.895*	0.882*	0.882*	0.882*	0.862*
INDEX11	0.884*	0.052*	0.899*	0.909*	0.889*	0.892*	0.895*	0.883*
INDEX12	0.901*	0.063*	0.908*	0.914*	0.897*	0.901*	0.906*	0.899*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX13	0.905*	0.06*	0.915*	0.922*	0.911*	0.913*	0.913*	0.903*
INDEX14	0.907*	0.069*	0.922*	0.926*	0.915*	0.921*	0.917*	0.904*
INDEX15	0.911*	0.058*	0.928*	0.93*	0.92*	0.924*	0.923*	0.908*
INDEX16	0.925*	0.05*	0.933*	0.937*	0.924*	0.932*	0.936*	0.92*
INDEX17	0.929*	0.056*	0.936*	0.942*	0.931*	0.936*	0.935*	0.925*
INDEX18	0.935*	0.034*	0.94*	0.947*	0.936*	0.939*	0.936*	0.931*
INDEX19	0.934*	0.047*	0.943*	0.949*	0.939*	0.939*	0.939*	0.935*
INDEX20	0.935*	0.047**	0.946*	0.95*	0.939*	0.943*	0.946*	0.938*

*Note: In the table coefficient of ARMA value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in *** and ETFs which follow the same underlying indices giving different results due to each ETFs have different inception date.*

Table 4.12 - Speed of Adjustment Coefficients for Sectoral Indices

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX01	-0.203**	-0.455**	-0.007	-0.514	-0.027	-0.023	-0.369	0.114	0.011
INDEX02	0.111*	0.07*	0.105*	0.046***	0.09*	0.085*	0.043	0.079*	0.043**
INDEX03	0.608*	0.574*	0.605*	0.599*	0.603*	0.605*	0.54*	0.608*	0.574*
INDEX04	0.674*	0.654*	0.69*	0.658*	0.67*	0.678*	0.636*	0.68*	0.661*
INDEX05	0.741*	0.726*	0.764*	0.714*	0.75*	0.747*	0.715*	0.753*	0.749*
INDEX06	0.792*	0.775*	0.813*	0.779*	0.802*	0.798*	0.744*	0.79*	0.792*
INDEX07	0.832*	0.817*	0.84*	0.821*	0.836*	0.834*	0.786*	0.834*	0.816*
INDEX08	0.859*	0.836*	0.869*	0.849*	0.859*	0.861*	0.799*	0.859*	0.844*
INDEX09	0.873*	0.855*	0.886*	0.866*	0.876*	0.876*	0.836*	0.881*	0.864*
INDEX10	0.884*	0.876*	0.893*	0.881*	0.883*	0.887*	0.849*	0.887*	0.871*
INDEX11	0.895*	0.891*	0.901*	0.89*	0.893*	0.895*	0.871*	0.885*	0.883*
INDEX12	0.905*	0.892*	0.91*	0.896*	0.905*	0.904*	0.867*	0.91*	0.895*

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX13	0.912*	0.899*	0.922*	0.9*	0.915*	0.913*	0.885*	0.92*	0.907*
INDEX14	0.919*	0.91*	0.925*	0.902*	0.921*	0.921*	0.891*	0.922*	0.91*
INDEX15	0.925*	0.919*	0.928*	0.913*	0.928*	0.929*	0.902*	0.927*	0.913*
INDEX16	0.931*	0.925*	0.935*	0.919*	0.935*	0.934*	0.908*	0.936*	0.915*
INDEX17	0.935*	0.93*	0.943*	0.928*	0.938*	0.937*	0.908*	0.941*	0.921*
INDEX18	0.94*	0.934*	0.946*	0.933*	0.94*	0.94*	0.907*	0.943*	0.93*
INDEX19	0.943*	0.935*	0.948*	0.941*	0.943*	0.943*	0.914*	0.946*	0.934*
INDEX20	0.947*	0.944*	0.948*	0.935*	0.945*	0.946*	0.926*	0.951*	0.934*

*Note: In the table coefficient of ARMA value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in *** and ETFs which follow the same underlying indices giving different results due to each ETFs have different inception date.*

Table 4.13 - Wald Test Results for ETFs Based on for Broad Based Indices

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF01	-19.956*	-0.968	-0.001	-4.117*	-6.38*	-15.781*	-5.056*	-20.975*
ETF02	-66.558*	-97.878*	-5.573*	-45.183*	-104.528*	-121.484*	-126.582*	-79.215*
ETF03	-12.927*	-215.365*	-113.523*	-19.962*	-62.007*	-37.701*	-24.623*	-12.328*
ETF04	-13.364*	-164.42*	-78.641*	-18.184*	-51.757*	-37.028*	-21.776*	-12.491*
ETF05	-12.715*	-122.168*	-57.154*	-16.045*	-44.594*	-33.788*	-20.882*	-11.446*
ETF06	-12.231*	-93.876*	-44.137*	-14.434*	-14.434*	-29.397*	-20.504*	-9.944*
ETF07	-11.721*	-78.12*	-35.719*	-14.123*	-32.471*	-28.759*	-18.759*	-12.333*
ETF08	-11.149*	-69.51*	-29.854*	-13.382*	-31.017*	-25.229*	-16.413*	-10.005*
ETF09	-10.435*	-59.943*	-25.536*	-12.599*	-25.022*	-24.574*	-18.059*	-8.629*
ETF10	-10.839*	-51.7*	-22.09*	-11.994*	-24.457*	-24.941*	-15.673*	-8.736*
ETF11	-9.942*	-48.049*	-19.714*	-12.049*	-21.281*	-22.189*	-14.254*	-8.708*
ETF12	-10.531*	-41.644*	-17.729*	-11.235*	-19.099*	-22.31*	-14.94*	-7.869*
ETF13	-9.803*	-37.46*	-16.21*	-10.06*	-18.055*	-20.161*	-15.176*	-8.227*
ETF14	-9.976*	-37.051*	-14.669*	-10.458*	-10.458*	-20.466*	-14.556*	-7.553*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
ETF15	-8.949*	-35.09*	-13.371*	-9.904*	-15.352*	-20.499*	-14.324*	-7.625*
ETF16	-9.116*	-30.553*	-12.38*	-9.782*	-15.415*	-19.341*	-14.774*	-6.774*
ETF17	-9.293*	-27.326*	-11.399*	-8.972*	-14.813*	-17.701*	-14.245*	-6.977*
ETF18	-8.837*	-27.058*	-10.604*	-8.88*	-12.74*	-18.971*	-14.423*	-6.9*
ETF19	-8.68*	-26.925*	-9.954*	-8.68*	-12.833*	-18.854*	-12.846*	-6.079*
ETF20	-8.335*	-22.695*	-9.464*	-8.676*	-11.768*	-17.874*	-13.021*	-6.579*

*Note: In the table T-statistics value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.14 - Wald Test Results for ETFs Based on for Sectoral Indices

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
ETF01	-12.544*	-9.877*	-10.309*	-4.78*	-6.631*	-2.354**	-29.324*	-17.127*	-31.012*
ETF02	-86.019*	-44.594*	-79.164*	-34.733*	-112.618*	-80.405*	-88.041*	-65.674*	-93.485*
ETF03	-32.837*	-18.497*	-17.212*	-12.797*	-25.192*	-27.685*	-11.468*	-12.544*	-8.439*
ETF04	-31.098*	-20.178*	-16.638*	-13.311*	-23.683*	-26.484*	-12.308*	-13.349*	-9.441*
ETF05	-27.839*	-17.716*	-15.124*	-12.445*	-20.424*	-22.934*	-10.645*	-11.618*	-8.851*
ETF06	-25.8*	-15.494*	-13.729*	-10.175*	-18.691*	-22.533*	-10.334*	-13.372*	-9.744*
ETF07	-23.613*	-13.62*	-12.716*	-9.085*	-16.902*	-18.631*	-10.404*	-11.43*	-8.972*
ETF08	-20.079*	-12.195*	-12.208*	-9.418*	-15.55*	-16.826*	-10.581*	-10.138*	-8.772*
ETF09	-19.541*	-11.482*	-11.156*	-8.352*	-15.113*	-16.385*	-9.411*	-12.349*	-8.139*
ETF10	-19.819*	-10.926*	-10.552*	-7.715*	-14.179*	-14.859*	-8.17*	-8.907*	-8.029*
ETF11	-18.007*	-10.905*	-10.81*	-7.795*	-13.914*	-13.911*	-7.404*	-8.917*	-7.461*
ETF12	-18.571*	-11.332*	-10.114*	-8.165*	-12.801*	-13.59*	-6.408*	-8.464*	-7.221*
ETF13	-16.902*	-9.598*	-9.83*	-7.649*	-12.474*	-13.062*	-7.026*	-7.931*	-7.455*

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
ETF14	-16.126*	-8.654*	-9.06*	-7.072*	-11.515*	-11.809*	-7.547*	-7.658*	-6.996*
ETF15	-15.621*	-8.057*	-9.199*	-7.163*	-11.106*	-11.223*	-7.733*	-8.203*	-6.961*
ETF16	-14.891*	-8.469*	-8.57*	-6.36*	-11.254*	-10.577*	-7.533*	-8.23*	-6.97*
ETF17	-13.144*	-8.361*	-8.297*	-6.129*	-10.685*	-10.489*	-7.444*	-8.826*	-6.967*
ETF18	-13.554*	-7.977*	-7.945*	-6.007*	-10.172*	-9.846*	-6.575*	-7.997*	-6.687*
ETF19	-13.553*	-7.517*	-8.04*	-6.041*	-9.881*	-9.855*	-6.148*	-7.663*	-6.705*
ETF20	-12.919*	-7.06*	-7.743*	-6.124*	-9.759*	-9.429*	-6.388*	-7.981*	-6.458*

*Note: In the table T-statistics value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in ****

Table 4.15 - Wald Test Results for Broad Based Index Returns

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
Underlying indices	Nifty 50	Nifty Next 50	Nifty 50	Nifty Midcap 100	Nifty 50	Nifty 50	Nifty 50	Nifty 100
INDEX01	-61.662*	-1.142	-0.001	-4.132*	-4.117*	-15.44*	-9.629*	-9.885*
INDEX02	-41.679*	-60.19*	-2.156**	-46.553*	-45.183*	-117.611*	-65.914*	-39.381*
INDEX03	-18.663*	-216.992*	-114.521*	-20.713*	-19.962*	-39.472*	-29.929*	-16.43*
INDEX04	-17.327*	-166.069*	-79.631*	-18.742*	-18.184*	-38.386*	-28.059*	-15.521*
INDEX05	-15.668*	-117.482*	-57.664*	-16.552*	-16.045*	-35.176*	-24.663*	-13.16*
INDEX06	-13.397*	-92.943*	-44.529*	-14.844*	-14.434*	-30.106*	-21.628*	-12.683*
INDEX07	-12.858*	-77.141*	-36.246*	-14.703*	-14.123*	-29.647*	-20.323*	-12.188*
INDEX08	-11.846*	-66.149*	-30.102*	-13.745*	-13.382*	-26.483*	-21.797*	-11.109*
INDEX09	-12.102*	-57.018*	-25.566*	-13.087*	-12.599*	-25.49*	-19.886*	-10.895*
INDEX10	-11.15*	-50.003*	-22.409*	-12.553*	-11.994*	-25.303*	-17.446*	-11.375*
INDEX11	-10.787*	-42.717*	-20.088*	-12.446*	-12.049*	-22.9*	-18.064*	-9.962*
INDEX12	-9.623*	-39.307*	-17.908*	-11.582*	-11.235*	-23.045*	-17.236*	-9.075*
INDEX13	-10*	-37.608*	-16.288*	-10.353*	-10.06*	-21.071*	-16.017*	-9.08*
INDEX14	-9.724*	-34.93*	-14.843*	-10.782*	-10.458*	-20.849*	-16.883*	-8.803*

ETFs	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX 100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 50**	**Nifty 100**
INDEX15	-9.953*	-31.137*	-13.589*	-10.236*	-9.904*	-20.766*	-16.469*	-8.564*
INDEX16	-9.259*	-29.226*	-12.478*	-10.141*	-9.782*	-19.661*	-13.706*	-7.856*
INDEX17	-8.727*	-27.264*	-11.572*	-9.255*	-8.972*	-18.53*	-13.926*	-7.793*
INDEX18	-8.304*	-25.202*	-10.789*	-9.228*	-8.88*	-18.978*	-14.221*	-7.378*
INDEX19	-8.358*	-24.339*	-10.151*	-8.998*	-8.68*	-19.151*	-14.278*	-6.911*
INDEX20	-8.559*	-20.583*	-9.591*	-8.978*	-8.978*	-18.02*	-13.567*	-7.023*

*Note: In the table T-statistics value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in *** and ETFs which follow the same underlying indices giving different results due to each ETFs have different inception date.*

Table 4.16 - Wald Test Results for Sectoral Index Returns

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX01	-11.838*	-7.537*	-5.07*	-3.99*	-5.986*	-5.765*	-2.305**	-4.372*	-2.029**
INDEX02	-73.078*	-48.229*	-44.681*	-35.564*	-58.183*	-58.175*	-33.552*	-35.632*	-47.067*
INDEX03	-30.932*	-17.179*	-18.046*	-13.955*	-27.263*	-27.488*	-14.874*	-13.275*	-18.586*
INDEX04	-30.041*	-18.541*	-16.584*	-13.651*	-26.791*	-26.669*	-14.886*	-14.59*	-19.661*
INDEX05	-26.511*	-17.384*	-16.129*	-12.471*	-23.184*	-23.088*	-12.842*	-12.541*	-16.324*
INDEX06	-24.967*	-15.491*	-14.196*	-10.725*	-20.003*	-20.74*	-11.766*	-12.882*	-15.164*
INDEX07	-22.99*	-13.194*	-13.573*	-9.308*	-17.766*	-18.79*	-11.879*	-11.099*	-14.707*
INDEX08	-19.69*	-12.041*	-12.813*	-10.043*	-17.049*	-16.871*	-9.944*	-10.357*	-13.117*
INDEX09	-18.734*	-11.323*	-12.057*	-8.955*	-15.972*	-16.006*	-9.15*	-9.492*	-12.503*
INDEX10	-19.884*	-10.887*	-11.027*	-8.195*	-15.977*	-15.89*	-8.649*	-8.914*	-11.849*
INDEX11	-18.107*	-11.114*	-11.073*	-8.62*	-14.632*	-14.32*	-8.812*	-8.816*	-11.721*
INDEX12	-18.127*	-11.313*	-10.387*	-8.644*	-13.821*	-13.804*	-7.656*	-9.473*	-11.051*
INDEX13	-16.784*	-9.519*	-9.758*	-7.779*	-12.696*	-13.093*	-7.192*	-8.056*	-10.06*

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPKSUB	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying indices	**Nifty Bank**	**Nifty CPSE Index**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah Index**
INDEX14	-15.714*	-8.623*	-9.557*	-7.49*	-12.485*	-12.409*	-6.876*	-7.4*	-9.946*
INDEX15	-15.362*	-8.008*	-8.954*	-7.735*	-11.383*	-11.663*	-7.152*	-7.612*	-9.577*
INDEX16	-14.768*	-8.445*	-8.953*	-6.958*	-10.245*	-10.472*	-6.406*	-6.761*	-9.634*
INDEX17	-13.728*	-8.319*	-8.487*	-6.315*	-10.496*	-10.473*	-6.439*	-6.98*	-8.868*
INDEX18	-13.582*	-7.797*	-8.331*	-6.308*	-10.038*	-10.419*	-6.235*	-6.931*	-8.598*
INDEX19	-13.705*	-7.516*	-8.164*	-6.318*	-9.791*	-9.948*	-6.073*	-6.855*	-8.298*
INDEX20	-13.06*	-6.904*	-8.104*	-6.476*	-9.791*	-9.519*	-5.727*	-6.036*	-8.489*

*Note: In the table T-statistics value presented and probability value of 1% indicate in *, 5% indicate in **, 10% indicate in *** and ETFs which follow the same underlying indices giving different results due to each ETFs have different inception date.*

CHAPTER 5

PERSISTENCE OF PREMIUM AND DISCOUNT IN ETFS

5.1 INTRODUCTION

ETFs carry dual prices in the market, first is the NAV, and the second is the observed market price. The market price is derived based on the demand and supply of the asset. On most financial platforms, arbitrageurs are able to monitor the ETF price as well as the intraday indicative NAV (INAV) of the ETF basket during the day. The ETF INAVs are measured using the intraday prices of the constituent stocks of the index on which the ETF was created, and are released every 15 seconds for the underlying baskets continuously trading in the exchange (Thirumalai 2003).

Theoretically, the NAV and the market price of the ETFs should be same. However, in reality, there will be a modest difference between these two prices. When the ETF price is trading higher compared with the NAV, it is defined as premium, and if ETF market price is trading less than the NAV, it is called as discount. The law of one price suggests that the price of ETF and NAV should be the same. The occurrence of premiums or discounts does not necessarily entail to inefficient pricing (Hughen 2003). The primary reason for deviations in pricing is because of dividend accumulation and fee expenses (Ivanov 2013). It is also presumed that at the end of the day, the ETF's market price and the ETF's NAV should be similar.

Arbitrageurs play an essential role in the price discovery process as they impose the law of one price by controlling price efficiency between similar securities (Brown et al. 2016). Theoretically, the activity of arbitrage commences when the market has a pricing difference. However, in practice, the difference should be large enough to cover the costs of multiple transactions. In ETFs, arbitrage happens in three ways; first, arbitrageurs make a profit when there is a difference in the ETF price and the NAV. For example, if there is premium, the Authorized Participants (AP) purchase the underlying securities in the market, form ETF units, and sell it in the exchange, and vice versa for the discount. Second, through pairs trading, i.e., holding a position in one ETF in short and another ETF in long. The third is called as taking advantage of bid-ask spread difference (Dolvin 2010).

Most of the existing empirical studies have examined the economic nature of premium and discount in the domestic or international ETFs (Delcoure and Zhong 2007). Previously, premium and discount studies were conducted in the context of global markets. For example, Engle and Sarkar (2006) examined the premium and discount of domestic and international ETFs. Premium/discount in domestic ETFs was less persistent than in international ETFs. Delcoure and Zhong (2007) continued Engle and Sarkar's (2006) work and found that dividend distribution was the prime reason for the deviation between prices. Rompotis (2006) found that ETFs premium was positively related to return on the current day. Current day premium negatively affected the next day returns (Rompotis 2009). In addition, discount trading give a positive relationship on the next day's return (Jares and Lavin 2004). The traditional procedures of premiums or discounts for ETFs are inaccurate because the NAV is not precisely presented. As a result, the price of the fund is not correctly recorded (Engle and Sarkar 2006). Previous studies show that domestic ETFs' premium/discount only last for one day due to effective arbitrage. For example, Shanmugham and Zabiulla (2012) provided evidence of the importance and persistence of premium in the NIFTYBEES.

The primary objective of this chapter is to find the premium and discount between the ETF price and the NAV. The present study also aims to check the persistence of the premium or discount. The ARDL bounds test approach proposed by Pesaran et al. (2001) was used to find the relationship between the ETF price and NAV. The current study is motivated by the absence of technical details in previous literature. When compared with the other traditional cointegration methods, the ARDL model is more flexible. It gives better outcomes like how its own lagged variables are affecting current day prices. Short-run coefficients provide a better understanding of the correction of one variable impacted by another variable.

The chapter is organized as follows: Section 5.2 gives the details of the data, and the methodology is presented in Section 5.3. Section 5.4 shows the empirical results, and Section 5.5 concludes the chapter.

5.2 DATA

The present study uses the NAV and ETF price data. The NAV was collected from the Association of Mutual Funds in India (AMFI) and respective ETF company websites. The closing price of the ETFs was collected from the NSE website. For some days in the study period, either the NAV or the closing price of the ETF was not available. Hence, the study removed the missing values and used the remaining complete dataset. The time frame for the study was between the inception date of the ETF and December 2018.

5.3 METHODOLOGY

In order to estimate the relationship between the ETF price and the NAV, the present study used the ARDL approach developed by Pesaran et al. (2001). The study identified how the ETF market price closely tracks the NAV. The ARDL first examined the presence of long-run equilibrium with the F-test. Secondly, the long-run and the short-term model parameters were estimated. The method allowed the evaluation and choice of the long-run relation between the variables based on the following considerations:

First, the ARDL cointegration testing method yields valid results, regardless of whether the variables underlying them are I(0), I(1) or both. The traditional Johansen technique can only be used when all the variables are of I(1) series.

The present section examines the long-run relationship between the closing ETF price and the NAV using the ARDL approach. Engle and Sarkar (2006) defined premium/discount as the difference in the ETF price and the NAV. Therefore, the basic premium/discount can be formulated as follows:

$$PD = ETF\ price - NAV \qquad \text{....(5.1)}$$

where, *PD* denotes premium or discount, *ETF price* is the closing price of ETF, and *NAV* is the net asset value

In order to find the percentage of premium/discount, the difference of the ETF and the NAV is divided by the NAV:

$$Percent\ PD = \frac{ETF\ price - NAV}{NAV} \qquad \text{… (5.2)}$$

where, ETF is closing price of the ETF and NAV is the net asset value of the ETF.

In most cases, the time series variables may not be stationary at level, and using such data may lead to spurious regression. For checking the stationarity of the variables, the present study used the ADF and KPSS test. Further, the study employed the ARDL approach for testing the long-run relationship between the closing price of the ETF and the NAV. Pesaran et al.(2001) introduced the ARDL bounds test approach. Based on this technique, the present study wrote the Equation 5.3 to test the relationship between the ETF price and the NAV:

$$\ln ETF_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k} \beta_p ln(ETF)_{t-p} + \sum_{p=0}^{l} \gamma_p ln(NAV)_{t-p} + e_t \qquad \text{... (5.3)}$$

where, ETF is the closing price of the ETF, NAV is the Net Asset Value of the ETF, and suitable lag lengths were selected based on the AIC. The NAV and the closing price of the

ETFs are expressed in natural logarithm. To examine both the short and long-run, the ARDL model was written as follows:

The long-run coefficient for the model is estimated by:

$$\delta_p = \frac{\sum_{p=0}^{l}\gamma_p}{1-\sum_{p=1}^{k}\beta_p}\ldots \qquad \ldots(5.4)$$

An ARDL model's co-integrating regression method was obtained by translating (5.3) into differences and substituting the long-run coefficients from (5.4).

$$\Delta lnETF_{\mathrm{t}} = \alpha_0 + \sum_{p=1}^{k}\beta_{p1}\,\Delta\ln\,(ETF)_{t-p} + \sum_{p=0}^{l}\gamma_{p1}\,\Delta\ln\,(NAV)_{t-p} + \partial EC_{t-1} + e_t\ldots\ (5.5)$$

where, Δ denotes the first-order difference.

$$EC_t = \ln ETF_{\mathrm{t}} - \alpha - \sum_{p=1} ln(NAV)_{p,t}\,\widehat{\delta_p}. \qquad ..(5.6)$$

$$\partial = 1 - \sum_{p=1}^{k}\hat{\beta}_p \qquad \ldots(5.7)$$

To test the long-run relationship between the ETF price and the NAV, the study employed the bounds test. In the univariate framework, the computed test used both the t and F statistic to test the significance level of the variables. If the F statistics value is above the upper bound critical value, then it confirmed the long-run relationship. If the F-statistic is value below the critical value, then there was no long-run relationship between the variables. In the first case, the bound test facilitated in identifying the long-run relationship and test cointegration among the variables. With the verification of cointegration, the study estimated the long-run relationship and the ARDL error correction model for the NAV and closing price of the ETF.

The hypothesis of the third objective is stated as follows:

H0-There is persistent premium or discount in the ETFs.

H1-There is no persistent premium or discount in the ETFs.

5.4 RESULTS

The summary statistics of the ETF price and the NAV are presented in Tables 5.1 and 5.2. The results of the ETF price and NAV are almost identical, which means that both are effectively priced at the end of the day. ETFs and NAVs with greater number of observations have higher mean and standard deviations in comparison with ETFs and NAVs with lesser number of observations. It indicates that over time, the stock market appreciates and tends to be volatile. The skewness tests revealed that most of the ETFs are skewed towards the left side of the distribution curve. Only four out of the seventeen ETFs were right skewed and all other ETFs were negatively skewed. The range of skewness was between -1.5 and 0.46; the KOTAKNIFTY had a sharp tail on the left and the M50 had a sharp tail on the right. The Kurtosis range was 1.48 to 3.88 showing that it is not normally distributed and the Jarque-Bera test confirms the same.

Premium/discount as a percent of NAV is presented in Table 5.3. Out of the17 ETFs, only two ETFs were trading in premium, namely, the INFRABEES and KOTAKPSUBK, and the remaining were trading in discount. The M50 ETF alone had the highest difference in the series trading in discount and the difference was -0.0107. The standard deviation result showed that the deviation from the NAV value was very less; almost all the ETFs fell between 0.002 to 0.07. It showed the deviation between the ETF and the NAV as minimal. The low mean value of the premium/discount also confirmed that the deviation was very less. Jarque-Bera confirmed that the series did not follow the standard normal distribution curve. The skewness value showed that most of the ETFs' skewness was positive, except for a few confirming that ETFs are right skewed in the normal distribution curve. The KOTAKNIFTY had more negative skewness compared with the other ETFs. All the ETFs were highly peaked than a normal distribution curve, and the results of the kurtosis values confirmed it.

The unit root results for the ETF prices are presented in Table 5.4. The ADF and KPSS tests were conducted on natural log ETF price, NAV, and the difference of the ETF and the NAV was divided by the NAV. The null hypothesis of the ADF test is that the data series is non-stationary or has a unit root. The alternative hypothesis is that the series is stationary or the unit root does not exist. For the KPSS test, the null hypothesis is that the series is stationary and the alternate hypothesis is that the series is non-stationary and has a unit root. As per the ADF test, most of the ETFs are not stationary at level, except for a few ETFs such as the BANKBEES, JUNIORBEES, INFRABEES, and RELCONS. However, at first difference, all the ETFs attained stationarity. Even in the KPSS test, the ETF price was not stationary at level. In the first difference, all the ETFs were stationary.

The unit root results of the NAV are presented in Table 5.5. As per the ADF test, the BANKBEES, BSLNIFTY, INFRABEES, and JUNIORBEES are stationary at level, and all the other ETFs have a unit root in the NAV series. The presence of the unit root is removed after first differencing the variable. The results of the KPSS test shows that all the NAV series reject the null hypothesis at level and confirm the presence of the unit root. However, the NAV series is stationary at first difference.

The unit root test results on premium/discount is presented in Table 5.6. As per the ADF test, all the ETFs are stationary at level. However, the KPSS test shows that some of the ETFs are not stationary at level; ETFs such as the BANKBEES, BSLNIFTY, M100, and M50 are not stationary at level since the mentioned ETFs' LM stat values are higher than the mentioned critical value. However, at first difference, all the ETFs are stationary removes the presence of unit root in the data series.

The primary analysis is to check the long-run relationship between the ETF price and the NAV. The ARDL results of the broad-based indices ETFs are presented in Table 5.7. The lagged ETF prices positively impact the current day ETF price, but the second lag of M50 has a negative impact on the current day ETF price. The first lag of the JUNIORBEES (0.96) and the M50 ETFs' price has more impact on the current day compared with the other ETFs. On current day, the NAV has a positive impact towards the ETF market price. However, the lagged NAV impact is negative and significant, except for BSLNIFTY, on the current day ETF price. The first lag of the ETF and the NAV has more impact on the current day. The impact of the lagged NAV and ETF on the current ETF price decreases as the lag length increases.

To check the long-run relationship between the ETF price and the NAV, the study conducted the bounds test. If the F-statistics value is more than the upper bound critical value, then the study confirms the presence of a long-run relationship. If the value is less than the upper bound critical value, then the study can conclude that no long-run relationship exists between the variables. All the ETFs' F-statistic value was higher than the upper bound critical value. Hence, the study confirmed the presence of a long-run relationship.

ARDL form short-run and long-run coefficients are presented in Table 5.8 for ETFs based on broad-based market indices. The short-run coefficients denote the shocks in the independent variable and the time that the dependent variable takes to reach equilibrium. In the short-run, the differenced ETF price has a negative impact on current day ETF closing price. However, the differenced NAV and its lags have a positive impact on the closing price of the ETF on the current day for most of the cases in broad-based market indices. The coefficient of the cointegrating term is negative and significant for all broad-based market indices. Hence, it confirms the presence of a long-run relationship. The difference of equilibrium between the ETF price and the NAV correction speed in the next trading day for the BSLNIFTY, JUNIORBEES, KOTAKNIFTY, M100, M50, NIFTYBEES, QNIFTY, and RELCNX100 are 4%, 4%, 27%, 10%, 31.9%, 42.4%, 42.8%, and 29%, respectively.

The ARDL results for ETFs based on sectoral indices are presented in Table 5.9. The ETF price lags positively influence the current day ETF price. In addition, lag one of the ETF prices has greater influence on the current day ETF prices. From lag 2 onwards, the ETF price impact gradually decreases as the lag length increases. The current day NAV price has a positive impact on the current ETF price. However, the ETF prices are negatively impacted by the lagged NAV prices. Almost all the lags are significant, which confirms the impact on ETF price. The F-statistic values are more than the upper bound critical value and hence, confirm the long-run relationship between the ETF and the NAV. The KOTAKBKETF and KOTAKPSUBK ETFs have larger F-statistic value than the other ETFs in the group.

The ARDL cointegration and short-run coefficients for the ETFs based on sectoral indices are presented in Table 5.10. In the short-run, the lagged ETFs price impact negatively on the current day ETF price. The lagged NAV positively impacts the current day ETF price. In the short-run, one percent increase in NAV leads to increase in the rate of the ETF price by 30 percent for CPSEETF, INFRABEES, and PSUBNKBEES. The highest impact was recorded in the case of SHARIABEES (47%) and the lowest in the case of KOTAKBKETF (17%) at 1% level of significance. The difference of the ETF and the NAV price was corrected by the next trade day for BANKBEES, CPSEETF, INFRABEES, KOTAKBKETF, KOTAKPSUBK, PSUBNKBEES, RELDIVOPP, RELCONS, and SHARIABEES at 43.2%, 49.3%, 19.0%, 64%, 53.3%, 25.0%, 26.0%, 22.7%, and 23%, respectively. Even the long-run coefficients were positive and significant confirming long-run price stability between the ETF and the NAV.

Table 5.11 and 5.12 shows the variance inflation factor (VIF) of the variables used in the study. As seen in the table, the coefficients are less than one and therefore, there is no problem of multi-collinearity.

The null hypothesis of the objective is that there is persistent premium or discount. However, the empirical results confirm that the difference between the ETF and the NAV is minimal. Further, the results of the ARDL model show that there is long-run relationship between the ETF price and the NAV. The difference between the ETF and the NAV is minimal and the difference is corrected to a greater extent on a daily basis for most of the ETFs. It confirms that the persistence of premium/discount does not last for a long time. Therefore, the study rejects the null hypothesis.

5.5 SUMMARY

The prime objective of the study is to find the persistence of premium or discount in 17 equity ETFs. The ARDL model was employed to find the relationship between the NAV and the ETF price. If the prices are in equilibrium, the chances of premium and discount will be less. In India, most of the ETFs are priced lesser than the NAV. Prior literatures on premium and discount claimed that premiums and lagged discounts have a positive relationship with the current returns (Jares and Lavin 2004; Rompotis 2006). The bounds test confirms that all the ETFs have a long-run relationship with the NAV, unlike Milani and Ceretta (2013), who argued that ETFs and NAV return does not follow the same pattern in the long-run. Further, short-run coefficients provide the correction time to meet the equilibrium level between the NAV and ETF price.

Table 5.1 - Summary Statistics of ETF Price

ETFs	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	7.002	0.567	-0.282	2.392	93.240	3254
BSLNIFTY	4.356	0.299	-0.294	1.480	181.453	1640
CPSEETF	3.213	0.127	-0.491	2.465	60.516	1163
INFRABEES	5.658	0.154	-0.322	2.002	118.628	2019
JUNIORBEES	4.751	0.608	-0.176	2.279	99.863	3721
KOTAKBKETF	5.352	0.188	0.012	1.711	69.063	998
KOTAKNIFTY	6.210	0.704	-1.534	3.824	904.269	2151
KOTAKPSUBK	5.754	0.237	-0.666	3.639	245.120	2696
M100	2.449	0.395	0.052	1.524	177.142	1943
M50	4.414	0.141	0.454	2.490	93.794	2073
NIFTYBEES	6.074	0.690	-0.715	2.519	396.010	4173
PSUBNKBEES	5.778	0.240	-0.903	3.837	451.546	2736
QNIFTY	6.472	0.345	-0.338	2.775	44.062	2081
RELCNX100	4.452	0.222	-0.438	2.299	66.139	1262
RELDIVOPP	3.170	0.176	-0.155	1.668	70.255	901
RELCONS	3.703	0.196	-0.042	1.882	53.700	1025
SHARIABEES	5.091	0.282	0.209	1.598	170.903	1916

Table 5.2 - Summary Statistics of NAV

ETF name	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	7.002	0.567	-0.284	2.390	94.064	3254
BSLNIFTY	4.360	0.279	-0.169	1.791	107.726	1640
CPSEETF	3.215	0.127	-0.489	2.467	60.131	1163
INFRABEES	5.658	0.151	-0.310	2.078	103.852	2019
JUNIORBEES	4.756	0.609	-0.178	2.285	98.992	3721
KOTAKBKETF	5.352	0.188	0.013	1.711	69.153	998
KOTAKNIFTY	6.212	0.704	-1.538	3.836	910.251	2151
KOTAKPSUBK	5.754	0.237	-0.672	3.607	244.527	2696
M100	2.456	0.380	0.033	1.503	181.716	1943
M50	4.425	0.138	0.468	2.493	97.750	2073
NIFTYBEES	6.075	0.690	-0.716	2.519	396.336	4173
PSUBNKBEES	5.779	0.241	-0.923	3.855	471.640	2736
QNIFTY	6.475	0.344	-0.324	2.742	42.127	2081
RELCNX100	4.455	0.219	-0.436	2.307	65.175	1262
RELDIVOPP	3.181	0.160	-0.012	1.553	78.657	901
RELCONS	3.704	0.189	0.065	1.830	59.196	1025
SHARIABEES	5.094	0.275	0.207	1.641	161.252	1916

Table 5.3 - Summary Statistics of Premium/Discount as a Percent of NAV

ETFs	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	0.000	0.008	1.442	13.575	16290.390	3254
BSLNIFTY	-0.001	0.074	0.904	3.222	226.791	1640
CPSEETF	-0.002	0.002	4.586	64.815	189241.000	1163
INFRABEES	0.001	0.019	0.543	10.275	4551.556	2019
JUNIORBEES	-0.002	0.041	-20.244	450.883	31355373.000	3721
KOTAKBKETF	0.000	0.005	1.273	9.216	1876.393	998
KOTAKNIFTY	-0.001	0.020	-40.344	1788.125	286000000.000	2151
KOTAKPSUBK	0.001	0.015	0.994	18.172	26300.610	2696
M100	-0.006	0.024	1.791	8.143	3179.786	1943
M50	-0.011	0.014	-7.432	159.129	2124581.000	2073
NIFTYBEES	-0.001	0.005	1.314	17.972	40175.360	4173
PSUBNKBEES	0.000	0.016	0.498	13.248	12084.920	2736
QNIFTY	-0.003	0.011	-0.697	55.641	240441.100	2081
RELCNX100	-0.002	0.022	1.027	12.012	4492.301	1262
RELDIVOPP	-0.010	0.035	-0.580	6.244	445.479	901
RELCONS	0.000	0.039	0.655	8.309	1277.104	1025
SHARIABEES	-0.002	0.028	-0.255	8.374	2325.880	1916

Table 5.4 - Unit Root Results of ETF Price

ETFs	ADF test Statistic				KPSS	
	Level		First Difference		Level	First Difference
	t-Statistic	Prob.*	t-Statistic	Prob.*	LM-Stat.	LM-Stat.
BANKBEES	-3.948	0.010	-52.457	0	0.146	0.059
BSLNIFTY	-2.696	0.239	-24.399	0	0.527	0.100
CPSEETF	-1.940	0.633	-24.847	0	0.460	0.107
INFRABEES	-3.352	0.058	-54.626	0	0.422	0.078
JUNIORBEES	-3.847	0.014	-63.003	0	0.351	0.031
KOTAKBKETF	-2.196	0.491	-31.092	0	0.527	0.077
KOTAKNIFTY	-1.621	0.785	-46.353	0	0.932	0.043
KOTAKPSUBK	-2.625	0.269	-53.314	0	0.405	0.038
M100	-2.325	0.420	-48.597	0	0.381	0.110
M50	-2.796	0.199	-49.230	0	0.316	0.032
NIFTYBEES	-1.993	0.605	-47.139	0	1.109	0.045
PSUBNKBEES	-2.642	0.262	-50.806	0	0.346	0.035
QNIFTY	-2.932	0.153	-48.385	0	0.185	0.042
RELCNX100	-2.465	0.346	-23.598	0	0.325	0.060
RELDIVOPP	-3.127	0.101	-30.186	0	0.426	0.081
RELCONS	-4.051	0.008	-19.808	0	0.185	0.027
SHARIABEES	-2.474	0.341	-27.737	0	0.604	0.097

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 5.5 - Unit Root Results of NAV

ETFs	ADF test Statistic				KPSS	
	Level		First Difference		Level	First Difference
	t-Statistic	Prob.*	t-Statistic	Prob.*	LM-Stat.	LM-Stat.
BANKBEES	-4.075	0.007	-50.885	0	0.147	0.053
BSLNIFTY	-3.261	0.073	-38.084	0	0.293	0.046
CPSEETF	-1.988	0.607	-31.755	0	0.459	0.106
INFRABEES	-3.407	0.051	-40.428	0	0.433	0.076
JUNIORBEES	-3.654	0.026	-58.669	0	0.364	0.029
KOTAKBKETF	-2.227	0.474	-30.307	0	0.524	0.077
KOTAKNIFTY	-1.624	0.784	-46.378	0	0.930	0.043
KOTAKPSUBK	-2.719	0.229	-47.457	0	0.402	0.040
M100	-2.436	0.361	-38.508	0	0.381	0.092
M50	-2.590	0.285	-43.609	0	0.317	0.031
NIFTYBEES	-2.077	0.558	-46.205	0	1.110	0.043
PSUBNKBEES	-2.808	0.194	-48.066	0	0.352	0.033
QNIFTY	-3.027	0.125	-42.902	0	0.189	0.036
RELCNX100	-2.345	0.409	-26.070	0	0.314	0.040
RELDIVOPP	-2.174	0.503	-22.644	0	0.448	0.083
RELCONS	-2.870	0.173	-29.774	0	0.240	0.052
SHARIABEES	-2.883	0.168	-41.843	0	0.571	0.055

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 5.6 - Unit Root Results of Premium/Discount as a Percent of NAV

ETFs	ADF test Statistic				KPSS	
	Level		First Difference		Level	First Difference
	t-Statistic	Prob.*	t-Statistic	Prob.*	LM-Stat.	LM-Stat.
BANKBEES	-13.056	0.000	-29.170	0	0.261	0.021
BSLNIFTY	-3.734	0.020	-3.734	0.02	0.547	0.046
CPSEETF	-11.777	0.000	-20.288	0	0.134	0.500
INFRABEES	-11.744	0.000	-21.208	0	0.129	0.060
JUNIORBEES	-10.952	0.000	-18.571	0	0.102	0.160
KOTAKBKETF	-16.022	0.000	-18.612	0	0.111	0.221
KOTAKNIFTY	-45.943	0.000	-20.561	0	0.064	0.183
KOTAKPSUBK	-14.893	0.000	-23.084	0	0.057	0.229
M100	-5.887	0.000	-24.464	0	0.305	0.087
M50	-14.136	0.000	-21.983	0	0.241	0.500
NIFTYBEES	-13.481	0.000	-25.254	0	0.104	0.074
PSUBNKBEES	-13.791	0.000	-22.002	0	0.153	0.047
QNIFTY	-8.997	0.000	-23.564	0	0.086	0.090
RELCNX100	-10.871	0.000	-19.275	0	0.025	0.177
RELDIVOPP	-8.677	0.000	-15.675	0	0.197	0.075
RELCONS	-8.456	0.000	-17.932	0	0.064	0.054
SHARIABEES	-7.705	0.000	-30.561	0	0.371	0.073

Note: The critical value for KPSS test at 1% level is 0.216, at 5% level is 0.146 and 10% level is 0.119.

Table 5.7 - ARDL and Bound Test Results for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
LN_ETF PRICE(-1)	0.53 (21.69)*	0.21 (12.55)*	0.36 (16.79)*	0.53 (23.34)*	0.62 (27.82)*	0.21 (13.84)*	0.45 (23.48)*	0.36 (12.81)*
LN_ETF PRICE(-2)	0.21 (7.55)*	0.11 (6.35)*	0.13 (5.59)*	0.19 (7.45)*	-0.13 (-4.68)*	0.14 (8.86)*	0.10 (5.03)*	0.18 (5.94)*
LN_ETF PRICE(-3)	0.08 (2.73)*	0.07 (4.49)*	0.14 (6.04)*	0.11 (4.21)*	0.11 (3.97)*	0.10 (6.66)*	0.11 (5.31)*	0.12 (3.95)*
LN_ETF PRICE(-4)	0.14 (5.72)*	0.10 (6.10)*	0.10 (4.78)*	0.07 (3.06)*	0.07 (3.15)*	0.12 (8.36)*	0.09 (4.79)*	0.06 (2.24)**
LN_NAV	0.27 (4.52)*	0.98 (235.74)*	0.99 (479.93)*	0.69 (35.23)*	0.65 (28.43)*	0.89 (192.46)*	0.80 (79.13)*	0.56 (11.52)*
LN_NAV(-1)	-0.168 (-1.93)***	-0.208 (-12.18)*	-0.356 (-16.51)*	-0.259 (-7.79)*	-0.195 (-5.83)*	-0.120 (-7.80)*	-0.226 (-10.57)*	-0.028 (-0.39)
LN_NAV(-2)	0.112 (1.28)	-0.079 (-4.55)*	-0.125 (-5.50)*	-0.143 (-4.26)*	-0.075 (-2.28)**	-0.149 (-9.67)*	-0.105 (-4.81)*	-0.106 (-1.45)
LN_NAV(-3)	0.004 (0.04)	-0.081 (-4.65)*	-0.137 (-6.03)*	-0.116 (-3.48)*	-0.023 (-0.72)	-0.089 (-5.82)*	-0.130 (-5.98)*	-0.134 (-2.45)**
LN_NAV(-4)	-0.17 (-2.81)*	-0.09 (-5.65)*	-0.10 (-4.76)*	-0.06 (-2.46)**	-0.04 (-1.52)	-0.11 (-7.42)*	-0.09 (-4.42)*	
C	-0.0124 (-1.29)	0.0025 (1.88)***	0.0002 (0.25)	-0.0107 (-5.70)*	-0.0241 (-2.67)*	-0.0019 (-3.27)*	0.0059 (1.10)	-0.01 (-1.31)
Bounds Test Result								
F-statistic	12.62	235.99	73.85	35.27	76.23	244.66	123.39	56.96

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %..*

Table 5.8 - ARDL and Long Run Form Results for ETFs Based on Broad Based Indices

Variable	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFTYBEES	QNIFTY	RELCNX100
D(LN_ETF PRICE(-1))	-0.42 (-17.05)*	-0.28 (-12.18)*	-0.37 (-14.03)*	-0.37 (-15.50)*	-0.06 (-2.05)**	-0.36 (-18.51)*	-0.37 (-13.44)*	-0.35 (-10.98)*
D(LN_ETF PRICE(-2))	-0.21 (-8.18)*	-0.17 (-8.46)*	-0.24 (-9.60)*	-0.18 (-7.27)*	-0.18 (-7.09)*	-0.23 (-12.30)*	-0.25 (-9.75)*	-0.17 (-5.71)*
D(LN_ETF PRICE(-3))	-0.14 (-5.72)*	-0.10 (-6.10)*	-0.10 (-4.78)*	-0.07 (-3.06)*	-0.07 (-3.15)*	-0.12 (-8.36)*	-0.09 (-4.83)*	-0.06 (-2.24)**
D(LN_NAV)	0.270 (4.52)*	0.977 (235.74)*	0.993 (479.93)*	0.691 (35.23)*	0.654 (28.43)*	0.892 (192.46)*	0.672 (52.34)*	0.558 (11.52)*
D(LN_NAV(-1))	-0.112 (-1.28)	0.079 (4.55)*	0.125 (5.50)*	0.143 (4.26)*	0.075 (2.28)**	0.149 (9.67)*	0.118 (5.09)*	0.106 (1.45)
D(LN_NAV(-2))	-0.004 (-0.04)	0.081 (4.65)*	0.137 (6.03)*	0.116 (3.48)*	0.023 (0.72)	0.089 (5.82)*	0.108 (4.67)*	0.134 (2.45)**
D(LN_NAV(-3))	0.17 (2.81)*	0.09 (5.65)*	0.10 (4.76)*	0.06 (2.46)**	0.04 (1.52)	0.11 (7.42)*	0.11 (5.16)*	
CointEq(-1)	-0.044 (-5.00)*	-0.515 (-21.72)*	-0.272 (-12.15)*	-0.104 (-8.40)*	-0.319 (-12.33)*	-0.424 (-22.12)*	-0.428 (-15.70)*	-0.29 (-10.67)*
Long Run Results								
LN_NAV	1.07 (21.64)*	1.00 (1,831.32)*	1.00 (1,817.62)*	1.04 (194.66)*	1.01 (164.73)*	1.00 (4,502.68)*	1.00 (792.60)*	1.01 (134.42)*
C	-0.2812 (-1.31)	0.0049 (1.89)***	0.0009 (0.25)	-0.1027 (-7.74)*	-0.0755 (-2.77)*	-0.0045 (-3.31)*	-0.0264 (-3.22)*	-0.0443 (-1.32)

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level.*

Table 5.9 - ARDL and Bounds Test Results for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
LN_ETF PRICE(-1)	0.24 (13.76)*	0.20 (6.98)*	0.51 (22.90)*	0.19 (6.17)*	0.23 (11.76)*	0.45 (23.48)*	0.46 (13.77)*	0.37 (12.01)*	0.30 (13.11)*
LN_ETF PRICE(-2)	0.11 (6.10)*	0.11 (3.69)*	0.16 (6.49)*	0.17 (5.66)*	0.09 (4.58)*	0.10 (5.03)*	0.10 (2.77)*	0.28 (8.67)*	0.20 (8.39)*
LN_ETF PRICE(-3)	0.15 (8.56)*	0.08 (2.69)*	0.05 (1.83)***		0.06 (3.07)*	0.11 (5.31)*	0.13 (3.60)*	0.12 (4.15)*	0.11 (4.81)*
LN_ETF PRICE(-4)	0.07 (3.99)*	0.11 (3.91)*	0.09 (4.22)*		0.09 (5.22)*	0.09 (4.79)*	0.05 (1.54)		0.17 (7.86)*
LN_NAV	0.87 (135.47)*	0.96 (193.21)*	0.71 (30.77)*	0.86 (70.22)*	0.72 (65.97)*	0.80 (79.13)*	0.63 (7.50)*	0.68 (7.31)*	0.40 (9.20)*
LN_NAV(-1)	-0.115 (-6.40)*	-0.159 (-5.52)*	-0.249 (-6.57)*	-0.07 (-2.13)**	0.054 (2.49)**	-0.226 (-10.57)*	-0.222 (-	-0.26 (-	0.136 (2.13)**
LN_NAV(-2)	-0.112 (-6.28)*	-0.122 (-4.18)*	-0.095 (-2.49)**	-0.15 (-4.73)*	-0.081 (-3.79)*	-0.105 (-4.81)*	0.182 (1.49)	-0.189 (-	-0.175 (-2.72)*
LN_NAV(-3)	-0.135 (-7.56)*	-0.070 (-2.42)**	-0.101 (-2.62)*		-0.082 (-3.80)*	-0.130 (-5.98)*	-0.310 (-3.55)*		-0.130 (-2.74)*
LN_NAV(-4)	-0.07 (-4.33)*	-0.12 (-4.13)*	-0.07 (-2.50)**		-0.07 (-3.68)*	-0.09 (-4.42)*			
C	0.0027 (1.75)***	-0.0003 (-0.17)	-0.0061 (-0.55)	0.006 (1.56)	-0.0017 (-0.29)	0.0059 (1.10)	-0.07 (-3.70)*	-0.017 (-0.96)	-0.03 (-3.26)*
	Bounds Test Results								
F-statistic	184.21	68.58	53.94	152.18	198.92	98.59	32.57	37.71	65.30

*Note: The value presented as beta coefficient in bracket "(" t-statistics value. * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level. I0(lower) bound critical value 4.04 at 1%, 4.94 at 5% and I1(upper) bound critical value 4.78 at 1% and 5.73 at 5 %.*

Table 5.10 - ARDL and Long Run Form Results for ETFs Based on Sectoral Indices

Variable	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
D(LN_ETF PRICE(-1))	-0.33 (-14.25)*	-0.30 (-7.40)*	-0.30 (-12.04)*	-0.17 (-5.66)*	-0.24 (-9.35)*	-0.30 (-13.74)*	-0.28 (-7.30)*	-0.40 (-11.89)*	-0.47 (-18.61)*
D(LN_ETF PRICE(-2))	-0.22 (-10.46)*	-0.19 (-5.23)*	-0.14 (-5.64)*		-0.15 (-6.67)*	-0.20 (-9.44)*	-0.18 (-4.92)*	-0.12 (-4.15)*	-0.28 (-11.10)*
D(LN_ETF PRICE(-3))	-0.07 (-3.99)*	-0.11 (-3.91)*	-0.09 (-4.22)*		-0.09 (-5.22)*	-0.09 (-4.79)*	-0.05 (-1.54)		-0.17 (-7.86)*
D(LN_NAV)	0.867 (135.47)*	0.961 (193.21)*	0.709 (30.77)*	0.86 (70.22)*	0.718 (65.97)*	0.796 (79.13)*	0.631 (7.50)*	0.68 (7.31)*	0.405 (9.20)*
D(LN_NAV(-1))	0.112 (6.28)*	0.122 (4.18)*	0.095 (2.49)**	0.15 (4.73)*	0.081 (3.79)*	0.105 (4.81)*	-0.182 (-1.49)	0.189 (1.93)***	0.175 (2.72)*
D(LN_NAV(-2))	0.135 (7.56)*	0.070 (2.42)**	0.101 (2.62)*		0.082 (3.80)*	0.130 (5.98)*	0.310 (3.55)*		0.130 (2.74)*
D(LN_NAV(-3))	0.07 (4.33)*	0.12 (4.13)*	0.07 (2.50)**		0.07 (3.68)*	0.09 (4.42)*			
CointEq(-1)	-0.432 (-19.19)*	-0.493 (-11.71)*	-0.190 (-10.38)*	-0.641 (-17.44)*	-0.533 (-19.93)*	-0.250 (-14.03)*	-0.26 (-8.07)*	-0.227 (-8.68)*	-0.23 (-11.42)*
Long Run Results									
LN_NAV	1.00 (1,969.45*	1.00 (993.46)*	1.01 (97.94)*	1.00 (867.24)*	1.00 (517.90)*	1.00 (268.41)*	1.08 (52.62)*	1.02 (50.23)*	1.02 (142.18)*
C	0.0062 (1.75)***	-0.0005 (-0.17)	-0.0320 (-0.55)	0.0097 (1.57)	-0.0032 (-0.29)	0.0237 (1.10)	-0.2746 (-4.19)*	-0.0727 (-0.97)	-0.1234 (-3.36)*

*Note: The value presented as beta coefficient in bracket "(" t-statistics value and * denotes 1% significance, ** denotes 5% significance level, *** denotes 10% significance level.*

Table 5.11 – Variance Inflation Factor Results for ETFs Based on Broad Based Indices

	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	M50	NIFYBEES	QNIFTY	RELCNX100
ETF(-1)	0.00060	0.00027	0.00058	0.00052	0.00050	0.00024	0.00048	0.00080
ETF(-2)	0.00077	0.00028	0.00064	0.00065	0.00073	0.00024	0.00048	0.00089
ETF(-3)	0.00077	0.00028	0.00064	0.00065	0.00075	0.00024	0.00048	0.00089
ETF(-4)	0.00059	0.00027	0.00057	0.00049	0.00056	0.00021	0.00037	0.00064
NAV	0.00357	0.00002	0.00000	0.00039	0.00053	0.00002	0.00017	0.00234
NAV(-1)	0.00763	0.00030	0.00057	0.00110	0.00111	0.00024	0.00054	0.00528
NAV(-2)	0.00767	0.00031	0.00064	0.00113	0.00110	0.00024	0.00054	0.00529
NAV(-3)	0.00763	0.00031	0.00064	0.00112	0.00103	0.00024	0.00054	0.00299
NAV(-4)	0.00368	0.00028	0.00057	0.00069	0.00062	0.00022	0.00048	
C	0.00009	0.00000	0.00000	0.00000	0.00008	0.00000	0.00001	0.00009

Table 5.12 – Variance Inflation Factor Results for ETFs Based on Sectoral Indices

	BANKBEES	**CPSEETF**	**INFRABEES**	**KOTAKBKETF**	**KOTAKPSUBK**	**PSUBNKBEES**	**RELDIVOPP**	**RELCONS**	**SHARIABEES**
ETF(-1)	0.00031	0.00086	0.00049	0.00098	0.00037	0.00036	0.00111	0.00096	0.00051
ETF(-2)	0.00032	0.00090	0.00062	0.00086	0.00039	0.00043	0.00133	0.00102	0.00054
ETF(-3)	0.00032	0.00089	0.00062		0.00039	0.00043	0.00134	0.00088	0.00054
ETF(-4)	0.00028	0.00082	0.00049		0.00031	0.00033	0.00102		0.00045
NAV	0.00004	0.00002	0.00053	0.00015	0.00012	0.00010	0.00708	0.00872	0.00194
NAV(-1)	0.00032	0.00083	0.00143	0.00102	0.00048	0.00046	0.01491	0.01897	0.00412
NAV(-2)	0.00032	0.00085	0.00147	0.00098	0.00048	0.00047	0.01492	0.00955	0.00411
NAV(-3)	0.00032	0.00084	0.00147		0.00048	0.00047	0.00761		0.00226
NAV(-4)	0.00030	0.00082	0.00085		0.00042	0.00038			
C	0.00000	0.00000	0.00012	0.00002	0.00004	0.00003	0.00037	0.00030	0.00008

CHAPTER 6

VOLALITY AND RETURN SPILLOVER BETWEEN ETFS AND UNDERLYING BENCHMARK INDICES

6.1 INTRODUCTION

The fourth and final objective of the study is to analyze the volatility and return spillover between the ETFs and its underlying benchmark indices. Spillover refers to the information flow between two financial markets (Maitra and Dawar 2019). It describes the effect of one market or asset return variations or volatility on other markets or assets (Bouri 2015).

ETFs have emerged as a good choice of investment option, but there are concerns that the volatility of the ETFs highly correlate with the equity market. With exponential growth in ETFs' trading, market regulators have raised the concern regarding ETFs as the important factor in the volatility generating process of their underlying index (Krause et al. 2014). The presence of volatility transmission between the ETFs and the stock market exist over time. Past studies have shown the spillover and leverage effect between the ETFs and their respective indices (Chen and Huang 2010; Chen 2011; Chen 2014). With the rapid increase in the different types of ETFs, it is essential to understand the existence of unidirectional or bidirectional spillover effect between the ETFs and their respective indices. This understanding will help the investors to track the investment opportunity either from ETF or from the stock index by evaluating the predictive movement of the ETF to its underlying index or vice versa. The advent of information technology makes the information transmission between the ETF and its underlying index easier.

Further, volatility spillover indicates the market integration that shows the level of spillover among the markets that are integrated. The existence of higher interdependence among markets would lead to chances of contagion occurring in the event of a financial crisis. Volatility spillover in the present study is interpreted as the volatility in the ETF returns' spread or impact the underlying index. As the ETF market in India has grown exponentially, how the spillover transmission works between the

ETFs and the underlying index and which one dominates between the ETF and the underlying index needs to be examined. Hence, investigation on volatility spillover is of prime importance.

The studies on volatility spillover of ETFs are primarily focused on developed markets (Chen and Huang 2010; Chen 2011; Chen 2014; Kruase and Tse 2013). Among the studies conducted, the study by Chen and Huang (2010) found that the Hong Kong Tracker Fund ETFs have strong return spillover from the respective indices. Chen (2011) found that any changes on current day index return would be reflected in the ETF returns on the next day. Krause and Tse (2013) examined volatility spillover between the U.S. and Canada with ETFs. The results showed that the U.S. has more share in the spillover than Canada. Most of the works supported that information about volatility could spillover in bidirectional way between the countries. Investors and regulators can easily understand the volatility of the financial instrument that is mutual from underlying constituents. Adding to that, investors and regulators could predict the ETF returns based on lagged or past index returns information.

The primary objectiveis to find the spillover and leverage effect from the returns and volatility of the ETF to its underlying benchmark index in India. The volatility in the financial market can be due to varied factors. For example, the volatility in the stock market of a country can be linked with the stock market of other countries. Volatility spillover among financial instruments (stock market, oil prices, ETF) has a significant consequence on investors and policymakers. The volatility spillover may affect investment decision as higher the volatility, the greater is the risk. The importance of spillover effect studies can benefit investors and regulators in finding the nature of the interaction between the financial instruments. The present study assesses the volatility and return spillover between the ETFs and its underlying indices. Further, it focuses on the presence and persistence of an asymmetric relationship.

The study uses the Autoregressive Conditional Heteroscedasticity (ARCH) model proposed by Robert Engle in the year 1982 (Engle 1982) to quantify the volatility variation. In order to predict the volatility of returns and asymmetric volatility presence, the study uses the Generalized ARCH model (Bollerslev 1986). To explain the leverage effect of ETFs and underlying benchmark index returns volatility, the study uses the

Exponential GARCH model by Nelson (1991). The results from the present study show that there is unidirectional return spillover from index returns to ETF return and bidirectional volatility spillover. Along with this, the results confirm the presence of asymmetric volatility in the data, where negative information has more impact than positive news. Hence, the present study assists investors in the broad details of the ETFs and the underlying benchmark indices. The main contribution of the present study is that it provides empirical evidence on the return and volatility spillover between the ETFs and their underlying benchmark indices. India being an important emerging market, the findings of the present study has implications for domestic as well as foreign institutional investors. Regulators also can benefit from the findings of the study.

6.2 DATA

The study collected the data from two sources, namely, the NSE website and the CMIE Prowess database. The ETF prices were collected from the NSE website, and the index price from the CMIE Prowess database. After the collection of prices, the study calculated the returns of the respective data series. Data was included from the inception date of each ETF to December 2018. Total 17 ETFs and the corresponding index were selected for the study. The ETFs were selected based on the criteria that ETF has a minimum number of 500 traded days and should currently trade in the exchange.

6.3 METHODOLOGY

The current chapter evaluates the spillover and leverage effects of the ETF and the stock index returns and their volatilities. The returns of the ETFs and respective indices were calculated as the first difference of the natural logarithm. The study employed the ARMA-GARCH model in order to determine the GARCH effect presence in the ETF and index return. In order to determine asymmetric volatility or leverage effects, the study employed the EGARCH model introduced by Nelson (1991) associated with the ARMA specification for ETF and index returns.

6.3.1 Domestic ETF Returns Model

The present study employed the GARCH (v, u) - ARMA (c, d) and EGARCH (v, u) - ARMA (c, d) to find if the GARCH effect is present between the ETF and the index return. To check asymmetric effect, the study employed the EGARCH- ARMA model.

The study uses the ARMA in the mean equation (6.1), and conditional variance explained by past conditional variance and lagged innovation in the GARCH equation (6.2), and the asymmetric function is explained in EGARCH from the Equation (6.3).

$$R_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{c} \alpha_i R_{i,t-i}^{e} + \epsilon_{i,t}^{e} + \sum_{i=1}^{d} \theta_i \epsilon_{i,t-i}^{e} \qquad ...(6.1)$$

$$h_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \epsilon_{i,t-1}^{e^2} + \sum_{i=1}^{u} \beta_i h_{i,t-i}^{e} \qquad ...(6.2)$$

$$\log\left(h_{i,t}^{e^2}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right\rangle + \sum_{i=1}^{u} \beta_i \log\left(h_{i,t-i}^{e^2}\right) \qquad ...(6.3)$$

where, $R_{i,t}^{e}$is the ETF return at time t and $R_{i,t-i}^{e}$ denotes the maximum order of the autoregressive AR(c) term for the ETF return. Meanwhile, $\epsilon_{i,t-i}^{e}$ represents the moving average MA(d) for the ETF return. $\epsilon_{i,t-1}^{e^2}$ is defined as the lagged residuals square of ETF return. $\epsilon_{i,t}^{e}$ is ETF return residual at the period t. $h_{i,t-i}^{e}$ is the GARCH term for ETF return at t.

In the EGARCH Equation (6.3), $h_{i,t}^{e^2}$ is the conditional variance of the ETF returns. The ARCH effect for ETF return is captured by $\frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}}$, and the GARCH effect for ETF return is captured by $h_{i,t-i}^{e^2}$. In addition, if the leverage term (δ_i) has a negative sign and is statistically significant, it indicates that there is an asymmetric effect on the volatility of the ETF returns.

In order to check whether the residuals have heteroscedasticity, and estimate the below equation from the residuals of equation 6.1

$$\epsilon_t^2 = \alpha_0 + g_1\epsilon_{t-1}^2 + g_2\epsilon_{t-2}^2 + g_3\epsilon_{t-3}^2 + g_q\epsilon_{t-q}^2 \qquad ...\ (6.4)$$

Presume that q=n shows the residual series for conditional heteroscedasticity. The null hypothesis is whether correlation with n periods:

$$h_0 = g_1 = g_2 = g_3 = g_n = 0$$

If the series reject the null hypothesis, then the residual series has heteroscedasticity.

6.3.2 Domestic Stock Index Return Model

The present study uses the ARMA in the mean equation (6.5) and current conditional variance explained by the lagged conditional variance and innovation in GARCH equation (6.6), and asymmetric effect is explained in EGARCH from Equation (6.7)

$$R_{i,t}^{s} = \rho + \sum_{i=1}^{c} \rho_i \, R_{i,t-i}^{s} + \epsilon_{i,t}^{s} + \sum_{i=1}^{d} \partial_i \, \epsilon_{i,t-i}^{s} \qquad \text{.. (6.5)}$$

$$h_{i,t}^{s} = O_0 + \sum_{i=1}^{v} O_i \, \epsilon_{i,t-1}^{S^2} + \sum_{i=1}^{u} \lambda_i \, h_{i,t-i}^{S} \qquad \text{...(6.6)}$$

$$\log\left(h_{i,t}^{S^2}\right) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right\rangle + \sum_{i=1}^{u} \lambda_i \log\left(h_{i,t-i}^{s^2}\right) \qquad \text{...(6.7)}$$

Where, $R_{i,t}^{s}$ is the index return at time t. $R_{i,t-i}^{s}$ denotes the maximum order of the autoregressive AR(c) term for the stock index return. Meanwhile, $\epsilon_{i,t-i}^{s}$ represents the moving average MA(d) for the stock index return. $\epsilon_{i,t-1}^{s^2}$ is defined as the lagged residuals square of index returns, and $\epsilon_{i,t}^{s}$ is the index return residual at period t.

Note that in the EGARCH equation (6.7), $h_{i,t}^{s^2}$ is the conditional variance of the index returns. The ARCH effect for the ETF return is captured by $\frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}}$, and the GARCH effect for the ETF return is captured by $h_{i,t-i}^{s^2}$. In addition, if the leverage term (δ_i) has a negative sign and is statistically significant, it indicates that there is an asymmetric effect on the volatility of the index returns

6.3.3 Spillover Effect of Returns

The multiple ARMA-GARCH and ARMA-EGARCH for spillover effect of ETF and stock returns are shown below.

$$R_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{c} \alpha_i \, R_{i,t-i}^{e} + \omega R_{i,t-1}^{s} + \epsilon_{i,t}^{e} + \sum_{i=1}^{d} \theta_i \, \epsilon_{i,t-i}^{e} \qquad \text{... (6.8)}$$

$$h_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \, \epsilon_{i,t-1}^{e^2} + \sum_{i=1}^{u} \beta_i \, h_{i,t-i}^{e} .. \qquad \text{... (6.9)}$$

$$\log\left(h_{i,t}^{e^2}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right\rangle + \sum_{i=1}^{u} \beta_i \log\left(h_{i,t-i}^{e^2}\right) \qquad \text{..(6.10)}$$

$$R_{i,t}^{s} = \rho + \sum_{i=1}^{c} \rho_i \, R_{i,t-i}^{s} + \upsilon R_{i,t-1}^{e} + \epsilon_{i,t}^{s} + \sum_{i=1}^{d} \partial_i \, \epsilon_{i,t-i}^{s} \qquad \text{..(6.11)}$$

$$h_{i,t}^{s} = O_0 + \sum_{i=1}^{v} O_i \, \epsilon_{i,t-1}^{S^2} + \sum_{i=1}^{u} \lambda_i \, h_{i,t-i}^{S} \qquad \text{..(6.12)}$$

$$\log(h_{i,t}^{S^2}) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right\rangle + \sum_{i=1}^{u} \lambda_i \log(h_{i,t-i}^{s^2}) \quad ..(6.13)$$

where, ω and υ are the spillover coefficients of the lagged index and ETF returns. The null hypothesis denotes that the spillover effect does not exist between the returns (ω=0 and υ=0) against the alternative hypothesis and it denotes that there is a spillover effect between the ETF and the index returns (ω≠0 and υ≠0). If ω is not equal to zero, it denotes that the lagged stock index return impacts the ETF returns, and if υ is different from zero, it indicates that the lagged ETF returns influence the stock index return.

6.3.4 Spillover Effect of Volatility

The multiple ARMA-GARCH and ARMA-EGARCH for volatility spillover effect between the ETF and the index returns are shown below.

$$R_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{c} \alpha_i R_{i,t-i}^{e} + \epsilon_{i,t}^{e} + \sum_{i=1}^{d} \theta_i \epsilon_{i,t-i}^{e} \quad ...(6.14)$$

$$h_{i,t}^{e} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \epsilon_{i,t-1}^{e^2} + \sum_{i=1}^{u} \beta_i h_{i,t-i}^{e} + j\epsilon_{i,t-1}^{s^2} \quad ...(6.15)$$

$$\log\left(h_{i,t}^{e^2}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{e}}{h_{i,t-i}^{e}} \right\rangle + \sum_{i=1}^{u} \beta_i \log\left(h_{i,t-i}^{e^2}\right) + j\epsilon_{i,t-1}^{s^2} \quad ...(6.16)$$

$$R_{i,t}^{s} = \rho + \sum_{i=1}^{c} \rho_i R_{i,t-i}^{s} + \epsilon_{i,t}^{s} + \sum_{i=1}^{d} \partial_i \epsilon_{i,t-i}^{s}. \quad ...(6.17)$$

$$h_{i,t}^{s} = O_0 + \sum_{i=1}^{v} O_i \epsilon_{i,t-1}^{S^2} + \sum_{i=1}^{u} \lambda_i h_{i,t-i}^{S} + k\epsilon_{i,t-1}^{e^2} \quad ...(6.18)$$

$$\log\left(h_{i,t}^{S^2}\right) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right| + \delta_i \frac{\epsilon_{i,t-i}^{s}}{h_{i,t-i}^{s}} \right\rangle + \sum_{i=1}^{u} \lambda_i \log\left(h_{i,t-i}^{s^2}\right) + k\epsilon_{i,t-1}^{e^2}. \quad ...(6.19)$$

The null hypothesis of the spillover effects of volatility claims that the spillover of volatility does not exist (*j*=0 and *k*=0), and the alternative hypothesis conveys that spillover of volatility exists (*j* ≠0 and *k*≠0). j and k are the coefficients of the lagged stock index residuals and lagged ETF residuals. If j is not equal to zero, it denotes that the lagged stock index residuals influence the volatility of the ETF returns. If k is different from zero, it conveys that the lagged ETF residuals impact the volatility of the index returns.

This objective states the following null and alternative hypothesis:

H0-Volatility and return spillover are not present between the ETF and the underlying benchmark indices.

H1-Volatility and return spillover are present between the ETF and the underlying benchmark indices.

6.4 RESULTS

The summary statistics of return on ETFs is presented in Table 6.1. The mean value shows that almost all the ETFs have a positive return, except for INFRABEES. The positive return is on expected lines as the equity market indices increase in value over the long run. The standard deviation value depicts that the deviation from the mean value does not cross 3% and the deviation stands between 1% to 3% for all the ETFs. The skewness value shows that some ETFs have negative skewness or long left side tail, and few ETFs have positive skewness or long right tail. All ETFs have skewness between -1.237 to 1.127. The kurtosis value shows that KOTAKPSUBK and PSUBNKBEES have a high peak among all the other ETFs. Other ETFs' kurtosis value shows a leptokurtic distribution and all the values are above 5. The Jarque-Bera values confirm that the ETFs are not normally distributed.

The summary statistics of the index returns are presented in Table 6.2. The results of the index return show similar pattern like the return on the ETFs. The mean value shows that all the underlying indices have a positive return, except for INFRABEES representing the infrastructure sector. The deviation from the mean value of the index return is comparatively lesser than the ETF return. Moreover, the deviation percentage is between 1% to 2%. The skewness values show that most of the index returns have negative skewness. The kurtosis value shows that all the indices have relatively higher values, which implies the distribution is peaked. The Nifty PSU bank index has the highest skewness value among all the indices. Even the Jarque-Bera values confirm that the series is not normally distributed.

For checking the stationarity of the dataset, the current objective conducted the ADF and KPSS tests on the ETF and index returns, and the results are presented in Tables 6.3 and 6.4, respectively. As per the ADF test, all the ETFs and the index return series are stationary at level. The KPSS test values are lesser than critical values and confirm that the data series is stationary.

The dataset has been segregated as ETFs on broad-based indices and sectoral indices. Table 6.5 shows the results of the mean and variance equation for the ETF returns of broad-based indices. The ARMA lag lengths were selected based on the lowest AIC. The ARCH effect indicates the impact of recent news on volatility, and the GARCH effect indicates the impact of past period volatility. The combination of the ARCH and GARCH term indicates the persistence of the volatility. The mean equations show that the past returns and residuals impact current day ETF returns. The lagged ETF returns have a positive influence on the current day ETF returns for most of the ETFs, except for M50. The past residuals impact negatively on most of the ETFs, except for M50. The ARCH and GARCH terms are positive and significant to confirm the presence of volatility. In the ARCH term, it shows the JUNIORBEES as having more effect from recent news; almost 13% impact from recent news is related to volatility. Other than that, all other ETFs' volatility is influenced by past period volatility since the GARCH term indicates past volatility. The summation of the ARCH and GARCH coefficients are near to one. It indicates that the presence of volatility persistence in the ETFs.

The results of EGARCH for ETFs based on broad-based indices is presented in Table 6.6. It shows that most of the ETFs' asymmetric coefficients are negative and significant confirming the presence of asymmetric volatility. Except for BSLNIFTY and RELCNX100, all the other ETFs have asymmetric impact.

The ARMA- GARCH results of broad-based index returns are presented in Table 6.7. The current day index return is not much impacted by the first lag, except for Nifty 50 (M50, NIFTYBEES). However, in the 2nd lag, there is positive influence from Nifty 50 (BSLNIFTY, QNIFTY). The variance equation shows that the ARCH and GARCH terms are positive and significant. It indicates that the lagged conditional variance has a stronger positive influence on the current conditional variance than the lagged innovations (ARCH). Moreover, close to the unit value of the ARCH and GARCH coefficients indicate that the volatility sustains for an extended period. The JUNIORBEES/ Nifty Next 50 and NIFTYBEES/ Nifty 50 have above 10 percent impact from the ARCH term. Other than that, all the other indices have less impact from the lagged innovation or the ARCH term. The BSLNIFTY/ Nifty 50 has 94% impact from the lagged conditional variance or last period volatility on current period volatility.

The ARMA-EGARCH results of the broad-based index returns are presented in Table 6.8. The presence of asymmetric effect on the index returns is confirmed through negative and significant asymmetric coefficients. The size of the negative impact on the underlying indices such as JUNIORBEES/ Nifty Next 50, KOTAKNIFTY/ Nifty 50, M100/ Nifty Midcap 100, M50/ Nifty 50, NIFTYBEES/ Nifty 50, QNIFTY/ Nifty 50, and RELCNX100/ Nifty 100 are 6%, 10%, 9%, 12%, 8%,22 %, and 10 %, respectively. The significant negative asymmetric term confirms the asymmetric volatility on the current conditional variance and the GARCH and ARCH also confirms the persistence of volatility.

The results of the ARMA GARCH ETFs return based on sectoral indices are presented in Table 6.9. The past returns and noise do not impact much on current day ETF return, since most of the coefficients are not significant, except for INFRABEES, RELCONS, and RELDIVOPP. The past return and past residual of INFRABEES give mixed results. ETFs such as RELDIVOPP and RELCONS yield different results, as RELDIVOPP yields a positive impact from past returns and negative impact from past residuals to the current day return. However, RELCONS shows negative impact from past returns and positive impact from past residuals on current day return. Both the ARCH and GARCH terms are positive and significant in the sectoral based ETFs, and the sum of the values of the ARCH and GARCH near to one confirms volatility persistence. SHARIABEES (94.31%) and BANKBEES (93.7%) have high percentage impact from past volatility period. The CPSEETF (19%) shows more impact from recent news. The EGARCH results of the sectoral indices-based ETFs are presented in Table 6.10. The lagged innovation and conditional variance have a positive impact on current conditional variance. The asymmetric term is negative and significant showing the presence of the leverage effect. Bad news has more impact on volatility than good news. Almost all the ETFs have a negative sign and are significant confirming the presence of leverage effect in the series.

The results of ARMA- GARCH of the sectoral indices return are presented in Table 6.11. As per the mean equation, the results show that the lagged returns and innovations of the Nifty Bank, Nifty PSU Bank, Nifty50 Shariah, and NIFTY CPSE indices are statistically significant. Other indices are not significant in the mean equation. However, in the variance equation, the presence of volatility is confirmed through the significance of the ARCH and GARCH coefficients. The Nifty PSU Bank (KOTAKPSUBK and PSUBNKBEES) have high impact from the ARCH term. The summation of past innovation and past conditional variances are close to one, but less than one or unity. Hence, it confirms volatility persistence, especially as the BANKBEES/ Nifty Bank take more time to dissolve the volatility impact or retain it for a longer time. The results of the ARMA-EGARCH of index returns are presented in Table 6.12. The presence of the leverage effect is confirmed through the negative and significant asymmetric term, except for the Nifty PSU bank (PSUBNKBEES). The RELDIVOPP/ Nifty Dividend Opportunities 50 has a high percentage of ARCH. It indicates that it has received high volatility from recent volatility information compared with the rest of the indices.

The results of the spillover effect on returns are presented in Table 6.13. There is unidirectional flow in the returns, i.e., the spillover from the index returns to the ETFs is significant then ETFs to the index returns. The lagged index returns positively influence the current day ETF returns. Whereas, the lagged ETF returns give mixed results. The lagged ETF returns have a positive influence on the index returns of the NIFTY CPSE, Nifty Midcap 100, and Nifty India consumption, and negative influence for Nifty Infrastructure and Nifty PSU Bank. Even in the EGARCH, the results show more or less the same trend. The summary of spillover returns results shows that it is possible to predict the ETF return with the lagged index return. It means that using the current day index return will help to predict the following day ETF returns. Among that, JUNIORBEES has a high impact from the index returns compared with the other ETFs.

The results of the volatility spillover are presented in Table 6.14. Based on the GARCH model, out of 17 ETF and index combinations, 13 ETFs show volatility spillover from the index and 10 indices show volatility spillover from the ETF. There is a total of seven

ETF and index combinations that have bidirectional volatility spillover, i.e., the ETF is influenced by the index and the index is influenced by the ETF volatility. Based on the EGARCH model, out of 17 ETF and index combinations, 12 ETFs show volatility spillover from the index and nine indices show volatility spillover from the ETF. There is a total of five ETF and index combinations have bidirectional volatility spillover. In comparison with the return spillover, a greater number of ETFs and underlying benchmark indices show bidirectional volatility spillover than return spillover.

The hypothesis of this objective states that there is no return and volatility spillover between the ETFs and the underlying benchmark indices. The empirical results give a mixed signal of showing either unidirectional or bidirectional influence between the ETFs and the indices. Therefore, there is no clear evidence to reject the null hypothesis.

6.5 SUMMARY

The major objective of the present study is to examine the return and volatility spillover between the ETFs and their indices. The study uses the ETF and index returns and employs the ARMA-GARCH and ARMA-EGARCH models. Based on the empirical results, the ETF and index returns show lagged conditional variance, which are significant and positively impact the current conditional variance. Moreover, volatility persistence exists in all the ETFs and their respective indices. The leverage term is negative and significant in most of the ETFs and their respective indices. This confirms the asymmetric volatility presence in the data. In most of the cases, spillover of returns is unidirectional from the index return to the ETF returns and not vice versa. Hence, it confirms that current day index returns can be used to predict the ETF returns. The volatility spillover results confirm that the lagged squared residuals of ETF have a positive impact on the index returns, which conveys volatility transmitting from the ETF to the index for a greater number of ETFs than the index to the ETF.

As ETFs are becoming increasingly popular in India, the findings of the present study may have significant implications for the investors as well as the regulators. A positive mean return of the ETFs over a fairly long period of time indicates that the passive Indian equity ETFs is a viable long-run investment strategy for the ordinary investors. A unidirectional return spillover from the index returns to the ETFs confirms that the ETF returns are largely influenced by fundamental factors. Further, short-term investors can benefit from the possibility of predicting the ETF return using past index return. Finally, the bidirectional volatility spillover from the ETFs and the index return calls for the attention of the stock market regulators to examine the reasons for the same.

Table 6.1 - Summary Statistics of ETF Returns

ETFs	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	0.0008	0.019	0.234	9.095	5064.956	3253
BSLNIFTY	0.0004	0.027	-0.188	5.603	472.291	1639
CPSEETF	0.0002	0.012	-0.482	12.259	4195.678	1162
INFRABEES	-0.000	0.018	0.092	7.105	1419.816	2018
JUNIORBEES	0.0008	0.020	-0.461	20.237	46185.760	3720
KOTAKBKETF	0.0004	0.011	-0.175	5.205	206.136	992
KOTAKNIFTY	0.0004	0.010	-0.106	6.522	1115.266	2150
KOTAKPSUBK	0.0000	0.024	0.001	12.881	10963.960	2695
M100	0.0005	0.013	-0.222	5.808	653.807	1942
M50	0.0003	0.0124	0.053	4.243	134.4877	2072
NIFTYBEES	0.0006	0.014	-0.335	12.834	16888.440	4172
PSUBNKBEES	0.0001	0.023	0.315	7.958	2846.786	2735
QNIFTY	0.0005	0.015	-0.014	19.379	23250.960	2080
RELCNX100	0.0006	0.021	0.033	12.717	4961.600	1261
RELDIVOPP	0.0005	0.030	-0.240	12.059	3075.776	897
RELCONS	0.0005	0.034	0.215	12.817	4119.844	1024
SHARIABEES	0.0004	0.025	0.002	6.593	1030.191	1915

Table 6.2 - Summary Statistics of Index Returns

ETFs	Underlying indices	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
BANKBEES	Nifty Bank	0.0007	0.02	0.174	8.344	3886.889	3253
BSLNIFTY	Nifty 50	0.0004	0.01	-0.099	5.284	358.985	1639
CPSEETF	Nifty CPSE	0.0001	0.013	-0.44	10.319	2631.136	1162
INFRABEES	Nifty Infrastructure	-0.0001	0.013	-0.111	4.731	256.094	2018
JUNIORBEES	Nifty Next 50	0.0008	0.016	-0.531	12.699	14756.64	3720
KOTAKNIFTY	Nifty 50	0.0004	0.01	-0.141	4.778	290.362	2150
KOTAKPSUBK	Nifty PSU BANK	0	0.022	1.127	17.372	23765.4	2695
KOTAKBKETF	Nifty Bank	0.0003	0.011	-0.262	5.482	266.031	992
M100	Nifty Midcap 100	0.0004	0.011	-0.686	6.3	1033.751	1942
M50	Nifty 50	0.0003	0.01	-0.181	4.735	271.275	2072
NIFTYBEES	Nifty 50	0.0005	0.014	-0.265	13.794	20302.52	4172
PSUBNKBEES	Nifty PSU BANK	0	0.022	1.114	17.289	23833.4	2735
QNIFTY	Nifty 50	0.0005	0.015	0.262	15.411	13373.12	2080
RELCNX100	Nifty 100	0.0005	0.01	-0.768	9.039	2040.386	1261
RELDIVOPP	Nifty Dividend Opportunities 50	0.0003	0.01	-1.237	12.501	3602.911	897
RELCONS	Nifty India Consumption	0.0006	0.009	-0.135	7.016	691.332	1024
SHARIABEES	Nifty50 Shariah	0.0003	0.01	-0.042	6.516	986.79	1915

Table 6.3 - Unit Root Results of ETF Returns

	ADF				KPSS	
	t-Statistic	Prob.*	t-Statistic	Prob.*	LM-Stat.	LM-Stat.
ETFs	**Level**		**First difference**		**Level**	**First difference**
BANKBEES	-52.457	0	-23.082	0	0.059	0.067
BSLNIFTY	-24.399	0	-21.655	0	0.100	0.052
CPSEETF	-24.847	0	-19.512	0	0.107	0.111
INFRABEES	-54.626	0	-18.280	0	0.078	0.030
JUNIORBEES	-69.183	0	-21.012	0	0.129	0.073
KOTAKNIFTY	-45.570	0	-19.572	0	0.033	0.039
KOTAKBKETF	-31.121	0	-17.271	0	0.077	0.039
KOTAKPSUBK	-53.314	0	-22.352	0	0.038	0.041
M100	-48.597	0	-18.789	0	0.110	0.038
M50	-52.389	0	-18.619	0	0.055	0.032
NIFTYBEEs	-47.139	0	-27.685	0	0.045	0.073
PSUBNKBEES	-50.806	0	-21.987	0	0.035	0.055
QNIFTY	-48.385	0	-16.016	0	0.042	0.020
RELCNX100	-23.598	0	-16.543	0	0.060	0.045
RELDIVOPP	-30.076	0	-13.606	0	0.085	0.104
RELCONS	-19.808	0	-15.567	0	0.027	0.038
SHARIABEES	-27.737	0	-21.268	0	0.097	0.037

Note- KPSS Test level of significance at 1 percent is 0.216; 5 percent is 0.146; 10 percent is 0.119.

Table 6.4 - Unit Root Results of Index Returns

ETF	Underlying Indices	ADF Test				KPSS	
		t-Statistic	Prob.*	t-Statistic	Prob.*	LM-Stat.	LM-Stat.
		Level		First difference		Level	First difference
BANKBEES	Nifty Bank	-51.01	0	-23.645	0	0.052	0.077
BSLNIFTY	Nifty 50	-38.078	0	-17.368	0	0.047	0.078
CPSEETF	Nifty CPSE	-31.727	0	-19.777	0	0.107	0.065
INFRABEES	Nifty Infrastructure	-40.435	0	-18.92	0	0.074	0.056
JUNIORBEES	Nifty Next 50	-53.062	0	-27.483	0	0.12	0.057
KOTAKNIFTY	Nifty 50	-43.678	0	-19.279	0	0.034	0.071
KOTAKBKETF	Nifty Bank	-30.367	0	-17.4	0	0.076	0.048
KOTAKPSUBK	Nifty PSU BANK	-47.489	0	-23.387	0	0.037	0.042
M100	Nifty Midcap 100	-38.433	0	-24.18	0	0.093	0.099
M50	Nifty 50	-42.091	0	-19.38	0	0.04	0.086
NIFTYBEES	Nifty 50	-46.329	0	-28.904	0	0.042	0.033
PSUBNKBEES	Nifty PSU BANK	-48.031	0	-22.375	0	0.034	0.055
QNIFTY	Nifty 50	-42.675	0	-20.726	0	0.036	0.021
RELCNX100	Nifty 100	-26.117	0	-18.444	0	0.039	0.317
RELDIVOPP	Nifty Dividend Opportunities 50	-22.579	0	-16.338	0	0.085	0.183
RELCONS	Nifty India Consumption	-29.767	0	-16.639	0	0.052	0.145
SHARIABEES	Nifty50 Shariah	-41.881	0	-21.576	0	0.058	0.057

Note- KPSS Test level of significance at 1 percent is 0.216; 5 percent is 0.146; 10 percent is 0.119.

Table 6.5 - ARMA GARCH Results for ETFs Return Based on Broad Based Indices

Variables	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX100
C	0.00051 (2.78)*	0.00097 (4.65)*	0.00058 (3.267)*	0.00043 (2.034)**	0.0006 (2.468)**	0.00083 (5.323)*	0.00082 (3.446)*	0.00088 (4.619)*
AR(1)	0.254 (5.018)*	0.524 (3.913)*	0.072 (0.032)	0.132 (0.981)		0.255 (10.192)*	0.033 (0.017)	-0.801 (-10.082)*
AR(2)	0.079 (2.046)**	-0.742 (-5.965)*	-0.01 (-0.064)			-0.954 (-40.591)*	0.021 (0.014)	-0.607 (-6.716)*
AR(3)							0.013 (0.16)	0.321 (4.103)*
AR(4)							-0.015 (-0.257)	
MA(1)	-0.76 (-17.821)*	-0.535 (-4.254)*	-25538.75 (-46.328)*	-0.295 (-2.285)**	-0.086 (-3.359)*	-0.215 (-7.508)*	107.657 (0.001)	0.511 (7.195)*
MA(2)		0.775 (6.699)*	85.132 (0.002)			0.927 (32.718)*	29282.75 (0.661)	0.308 (3.906)*
MA(3)						0.047 (2.786)*	-137.4616 (-0.001)	-0.5857 (-8.564)*
MA(4)								0.00088 (4.619)*
Variance Equation								
C	0.0001 (4.684)*	0.0001 (8.159)*	0.0001 (1.281)	0.0001 (3.222)*	0.0001 (5.149)*	0.0001 (6.131)*	0.0001 (2.103)**	0.0001 (3.203)*
RESID(-1)^2	0.0999 (8.612)*	0.1371 (20.24)*	0.0763 (9.675)*	0.0382 (4.698)*	0.1268 (7.329)*	0.097 (16.679)*	0.0539 (11.616)*	0.1031 (8.816)*
GARCH(-1)	0.8699 (59.165)*	0.8608 (130.892)*	0.9209 (104.821)*	0.9432 (76.661)*	0.676 (13.591)*	0.8972 (150.209)*	0.9403 (196.943)*	0.8951 (91.696)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value,*

Table 6.6 - ARMA EGARCH Results for ETFs Return Based on Broad Based Indices

Variables	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX100
C	0.001 (9.608)*	0.0007 (3.449)*	0.0003 (1.975)**	0.0001 (2297.787)*	0.0004 (1.921)***	0.0005 (3.714)*	0.0006 (2.982)*	0.0008 (4.16)*
AR(1)	-0.505 (-218.656)*	0.498 (2.101)**	-1.002 (-2.798)*	0.098 (14012.35)*		-0.2 (-0.585)	-0.648 (-1.14)	-0.809 (-1089.43)*
AR(2)	-0.154 (-29.84)*	-0.516 (-2.579)*	-0.007 (-0.02)			0.414 (1.33)	-0.729 (-1.519)	0.349 (460.537)*
AR(3)							0.244 (0.455)	0.158 (763.751)*
AR(4)							0.035 (1.237)	
MA(1)	-3621646 (-6.6E+102)*	-0.507 (-2.202)**	1.061 (2.966)*	3.75E+22 (13565.66)*	-0.089 (-3.541)*	0.234 (0.682)	0.67 (1.176)	0.502 (7.177)*
MA(2)		0.558 (2.885)*	0.068 (0.193)			-0.408 (-1.261)	0.767 (1.541)	-0.621 (-12.681)*
MA(3)						0.025 (1.296)	-0.192 (0.723)	-0.129 (-3.887)*
MA(4)								0.0008 (4.16)*
Variance Equation								
C(4)	-26.744 (-5.2E+103)*	-0.303 (-13.457)*	-0.34 (-7.208)*	-49.945 (-196637.3)*	-1.737 (-5.648)*	-0.312 (-13.343)*	-0.193 (-9.999)*	-0.411 (-15.069)*
C(5)	-0.526 (-6.5E+102)*	0.23 (20.039)*	0.165 (9.921)*	2.08 (75101.57)*	0.259 (10.168)*	0.211 (23.171)*	0.135 (12.077)*	0.274 (13.925)*
C(6)	0.097 (36.934)*	-0.039 (-6.2)*	-0.071 (-6.442)*	0.339 (32457.53)*	-0.028 (-1.875)***	-0.056 (-9.933)*	-0.056 (-7.61)*	-0.018 (-1.139)
C(7)	0.267 (4.6E+103)*	0.984 (474.996)*	0.977 (233.257)*	0.595 (226343.6)*	0.824 (24.334)*	0.983 (427.433)*	0.989 (596.417)*	0.975 (313.032)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value, C(4)- Constant, C(5)- Arch(-1), C(6)- Asymmetric value, C(7)- Garch (-1) value*

Table 6.7 - ARMA GARCH Results of Broad Based Indices Return

ETF	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX100
Underlying indices	Nifty 50	Nifty Next 50	Nifty 50	Nifty 50	Nifty Midcap 100	Nifty 50	Nifty 50	Nifty 100
C	0.0007 (0.001)*	0.0011 (4.607)*	0.0007 (3.941)*	0.0007 (2.902)*	0.0007 (2.348)**	0.0009 (5.123)*	0.0008 (3.088)*	0.0007 (2.629)*
AR(1)	0.07 (0.047)	0.054 (0.482)	0.963 (0.185)	0.079 (3.225)*		0.241 (8.021)*	-0.222 (-0.657)	
AR(2)	0.839 (8.587)*		-0.006 (-0.002)			-0.959 (-34.752)*	0.579 (1.788)***	
AR(3)	-0.022 (-0.017)						-0.061 (-2.07)**	
AR(4)							-0.039 (-1.436)	
MA(1)	0.003 (0.002)	0.095 (0.86)	-0.899 (-0.173)	0.079 (3.225)*	0.136 (5.288)*	-0.168 (-4.976)*	0.292 (0.865)	0.083 (2.667)*
MA(2)	-0.874 (-8.969)*		-0.064 (-0.014)			0.927 (28.469)*	-0.559 (-1.643)	-0.044 (-1.437)
MA(3)	-0.023 (-0.017)		-0.004 (-0.011)			0.075 (4.172)*		0.028 (0.4)
MA(4)	-0.0183 (-0.229)					-0.002 (-0.098)		-0.054 (0.09)***
Variance Equation								
C	0.0001 (2.558)	0.0001 (8.524)*	0.0001 (3.702)*	0.0001 (2.933)*	0.0001 (4.331)*	0.0001 (6.37)*	0.0001 (4.712)*	0.0001 (2.634)*
RESID(-1)^2	0.055 (6.305)*	0.113 (15.567)*	0.061 (6.827)*	0.053 (6.448)*	0.099 (6.708)*	0.098 (16.53)*	0.07 (8.356)*	0.063 (5.607)*
GARCH(-1)	0.939 (101.759)*	0.878 (144.387)*	0.928 (85.796)*	0.939 (95.451)*	0.818 (28.552)*	0.895 (143.252)*	0.918 (95.926)*	0.928 (72.223)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value*

Table 6.8 - ARMA EGARCH Results of Broad Based Indices Returns

ETFs	BSLNIFTY	JUNIOR BEES	KOTAK NIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX 100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 100**
C	-0.024 (-62.18)*	0 (3.026)*	0 (1.659)**	0.0003 (1.653)***	0.0003 (1.265)	0.00001 (3.096)*	-0.002 (-25252.78)*	0 (1.297)
AR(1)	-0.371 (-3.955)*	0.079 (0.757)	-0.26 (-12.019)*			0.548 (1.651)***	-0.288 (-32902.1)*	
AR(2)	0.14 (2.687)*		-0.968 (-51.127)*			-0.587 (-2.874)*	-0.173 (-38374.91)*	
AR(3)	0.142 (9.998)*						0.466 (26158.06)*	
AR(4)							-0.089 (-12274.88)*	
MA(1)	-15338.2 (-27.755)*	0.079 (0.765)	0.334 (10.866)*	0.081 (3.441)*	0.138 (5.74)*	-0.459 (-1.381)	1860000000000000000 (30611.56)*	0.105 (3.413)*
MA(2)	12677.5 (12.798)*		0.993 (53.98)*			0.543 (2.88)*	755000000000000000 (66852.89)*	-0.029 (-1.008)
MA(3)	19915.28 (14.387)*		0.061 (2.583)*			0.085 (3.888)*		0.038 (0.226)
MA(4)	3088.767 (1.79)***					0.008 (0.366)		-0.04 (0.1824)
Variance Equation								
C(4)	-27.01 (-157.01)*	-0.371 (-15.07)*	-0.371 (-7.427)*	-0.294 (-6.5)*	-1.34 (-6.577)*	-0.363 (-13.089)*	-79.863 (-1083193)*	-0.318 (-5.063)*

ETFs	BSLNIFTY	JUNIOR BEES	KOTAK NIFTY	M50	M100	NIFTYBEES	QNIFTY	RELCNX 100
Underlying indices	**Nifty 50**	**Nifty Next 50**	**Nifty 50**	**Nifty 50**	**Nifty Midcap 100**	**Nifty 50**	**Nifty 50**	**Nifty 100**
C(5)	222.3785 (91.471)*	0.222 (16.52)*	0.117 (6.196)*	0.099 (5.867)*	0.17 (7.003)*	0.207 (18.141)*	2.335 (22453.45)*	0.107 (4.765)*
C(6)	-222.4578 (-90.716)*	-0.069 (-8.762)*	-0.106 (-9.714)*	-0.09 (-9.005)*	-0.12 (-9.948)*	-0.087 (-12.104)*	-0.22 (-34805.19)*	-0.107 (-6.215)*
C(7)	-0.0112 (-2.522)**	0.977 (437.711)*	0.97 (213.774)*	0.976 (234.897)*	0.868 (40.516)*	0.978 (381.042)*	0.179 (207365.7)*	0.975 (163.623)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value, C(4)- Constant, C(5)- Arch(-1), C(6)- Asymmetric value, C(7)- Garch (-1) value*

Table 6.9 - ARMA GARCH Results for ETFs Return Based on Sectoral Indices

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
C	0.00089 (3.516)*	0.0005 (1.442)	0.00003 (0.102)	0.00085 (2.393)**	0.00001 (0.013)	0.00016 (0.405)	0.00145 (11.155)*	0.00089 (2.656)*	0.00036 (1.711)***
AR(1)	-0.1501 (-0.54)		1.526 (54.408)*	-0.012 (-0.002)	0.133 (0.249)		0.351 (6.011)*	-1.21 (-20.136)*	0.003 (0.055)
AR(2)			-0.726 (-17.101)*	-0.104 (-0.035)				-0.885 (-17.105)*	
AR(3)			-0.126 (-4.73)*	0.182 (0.083)					
AR(4)				-0.008 (-0.023)					
MA(1)	0.2126 (0.772)	0.085 (2.614)*	-1.692 (-128.038)*	-24000 (-31.876)*	-0.091 (-0.169)	0.033 (1.587)	-0.78 (-27.225)*	0.889 (12.681)*	-0.496 (-12.058)*
MA(2)		-0.079 (-2.484)**	0.968 (72.94)*	-76.798 (-0.001)				0.436 (5.857)*	
MA(3)				-2422.2 (-0.035)				-0.329 (-8.631)*	
MA(4)				3536.674 (0.069)					
Variance Equation									
C	0.00001 (4.192)*	0.0001 (5.015)*	0.0001 (5.974)*	0.0001 (2.552)*	0.0001 (11.253)*	0.0001 (7.997)*	0.0001 (5.639)*	0.0001 (6.885)*	0.0001 (4.081)*
RESID(-1)^2	0.0594 (11.331)*	0.1904 (13.317)*	0.0945 (8.613)*	0.0694 (5.783)*	0.0771 (10.802)*	0.0943 (13.691)*	0.186 (11.301)*	0.1359 (11.958)*	0.0499 (9.668)*
GARCH (-1)	0.9376 (180.334)*	0.6856 (19.788)*	0.8664 (55.373)*	0.9086 (51.729)*	0.8818 (99.856)*	0.877 (147.585)*	0.7746 (64.705)*	0.845 (105.947)*	0.9431 (223.897)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value*

Table 6.10 -ARMA EGARCH Results for ETFs Return Based on Sectoral Indices

ETF	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
C	0.0006 (2.594)*	0 (0.237)	-0.0002 (-0.684)	0.0005 (1.548)	0.0001 (0.232)	0 (0.248)	0.0011 (7.852)*	0.0012 (8.212)*	0.0002 (1.252)
AR(1)	-0.1381 (-0.529)		-0.567 (-23.861)*	1.217 (28.484)*	0.243 (0.379)		0.301 (5.458)*	0.122 (0.758)	0.001 (0.034)
AR(2)			-1.047 (-80.822)*	-1.729 (-34.56)*					
AR(3)			-0.151 (-6.59)*	1.186 (24.762)*					
AR(4)				-0.928 (-23.206)*					-0.492 (-12.27)*
MA(1)	0.204 (0.789)	0.079 (2.428)**	0.414 (66.087)*	-1.219 (-25.891)*	-0.211 (-0.327)	0.018 (0.881)	-0.762 (-28.886)*	-0.563 (-3.53)*	
MA(2)		-0.077 (-2.479)**	0.992 (180.229)*	1.746 (30.266)*				-0.138 (-1.31)	
MA(3)				-1.17 (-20.189)*					
MA(4)				0.914 (20.7)*					
Variance Equation									
C(4)	-0.134 (-8.752)*	-1.382 (-6.533)*	-0.403 (-6.405)*	-0.279 (-3.491)*	-0.331 (-15.313)*	-0.445 (-12.897)*	-0.467 (-13.29)*	-0.478 (-13.185)*	-0.137 (-7.994)*
C(5)	0.1123 (10.994)*	0.329 (17.667)*	0.167 (9.582)*	0.082 (3.682)*	0.172 (20.365)*	0.208 (16.966)*	0.337 (13.24)*	0.348 (13.148)*	0.099 (10.262)*

ETF	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
C(6)	-0.0282 (-5.154)*	-0.066 (-5.579)*	-0.033 (-3.754)*	-0.058 (-4.738)*	-0.001 (-0.269)	-0.014 (-1.753)***	-0.077 (-4.787)*	-0.074 (-4.511)*	-0.017 (-1.95)***
C(7)	0.9941 (800.784)*	0.872 (37.351)*	0.966 (153.11)*	0.976 (125.347)*	0.972 (388.196)*	0.962 (213.128)*	0.97 (265.413)*	0.97 (257.145)*	0.992 (475.77)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value, C(4)- Constant, C(5)- Arch(-1), C(6)- Asymmetric value, C(7)- Garch (-1) value*

Table 6.11 – ARMA GARCH Results for Sectoral Indices Return

ETFs	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELDIVOPP	RELCONS	SHARIABEES
Underlying Indices	**Nifty Bank**	**Nifty CPSE**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah**
C	0.001 (3.448)*	0.0003 (0.81)	-0.0001 (-0.021)	0.0008 (2.398)**	0.0001 (0.073)	-0.0001 (-0.042)	0.0006 (1.968)**	0.0013 (4.234)*	0.0006 (2.484)**
AR(1)	-0.998 (-8.638)*			0.598 (2.225)**	0.367 (1.965)**		-0.534 (-0.027)	0.01 (0.015)	
AR(2)	-0.839 (-7.267)*			-0.528 (-1.92)***			0.568 (0.148)	-0.052 (-0.853)	
AR(3)				0.31 (1.22)			0.206 (0.017)		
AR(4)				-0.643 (-3.029)*					
MA(1)	1.0886 (9.289)*	0.053 (1.646)***	0.101 (4.317)*	-0.556 (-1.963)**	-0.271 (-1.384)	0.097 (4.259)*	0.604 (0.031)	-456.312 (-31.948)*	0.082 (3.161)*
MA(2)	0.9171 (7.415)*	-0.063 (-1.93)***		0.49 (1.738)***			-0.585 (-0.112)	-30.466 (-0.106)	
MA(3)	0.0766 (2.651)*			-0.2308 (-0.88)			-0.327 (-0.024)		
MA(4)	0.0133 (0.624)			0.5813 (2.493)**			-0.0369 (-0.018)		
Variance Equation									

ETFs	**BANKBEES**	**CPSEETF**	**INFRABEES**	**KOTAKBKETF**	**KOTAKPSUBK**	**PSUBNKBEES**	**RELDIVOPP**	**RELCONS**	**SHARIABEES**
Underlying Indices	**Nifty Bank**	**Nifty CPSE**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah**
C	0.000002 (4.079)*	0.0001 (4.605)*	0.0001 (3.438)*	0.0001 (2.619)*	0.0001 (10.666)*	0.0001 (10.897)*	0.0001 (2.657)*	0.0001 (4.954)*	0.0001 (4.665)*
RESID(-1)^2	0.054 (11.631)*	0.138 (10.089)*	0.049 (7.15)*	0.055 (5.024)*	0.156 (18.341)*	0.153 (18.86)*	0.075 (7.827)*	0.149 (5.552)*	0.072 (7.564)*
GARCH(-1)	0.944 (221.454)*	0.782 (29.044)*	0.936 (99.644)*	0.931 (66.7)*	0.812 (127.89)*	0.812 (129.857)*	0.917 (83.802)*	0.719 (18.937)*	0.898 (65.31)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value*

Table 6.12 – ARMA EGARCH Results for Sectoral Indices Return

ETF	BANKBEES	CPSEETF	INFRABEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELCONS	RELCONS	SHARIABEES
Underlying Indices	**Nifty Bank**	**Nifty CPSE**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah**
C	0.001 (2.195)**	0.0001 (-0.004)	0 (-0.694)	0.001 (9.662)*	0.007 (814.289)*	0 (0.689)	0.004 (14.269)*	0 (1.82)***	0 (0.458)
AR(1)	-1.003 (-5.567)*			0.32 (10.836)*	0.014 (321.063)*		-0.376 (-0.404)	-0.28 (-0.087)	
AR(2)	-0.775 (-4.421)*			0.244 (8.777)*			0.06 (0.603)	0.085 (0.109)	
AR(3)				-0.21 (-9.152)*			0.07 (1.018)		
AR(4)				-0.22 (-36.384)*					
MA(1)	1.096 (6.05)*	0.05 (1.617)	0.103 (4.58)*	8000.304 (33.074)*	4170000000000000 (51.616)*	0.112 (5.225)*	8121679 (0.221)	0.358 (0.111)	0.079 (3.261)*
MA(2)	0.858 (4.592)*	-0.064 (-2.033)**		5332.926 (12.824)*			27895343 (2.461)**	-0.076 (-0.075)	
MA(3)	0.073 (2.481)**			-7886.86 (-29.161)*			-5752170 (-1.645)		
MA(4)	0.016 (0.766)			4421.284 (12.647)*			5146723 (1.201)		

ETF	BANKBEES	CPSEETF	INFRA BEES	KOTAKBKETF	KOTAKPSUBK	PSUBNKBEES	RELCONS	RELCONS	SHARIA BEES
Underlying Indices	**Nifty Bank**	**Nifty CPSE**	**Nifty Infrastructure**	**Nifty Bank**	**Nifty PSU Bank**	**Nifty PSU Bank**	**Nifty Dividend Opportunities 50**	**Nifty India Consumption**	**Nifty50 Shariah**
Variance Equation									
C(4)	-0.109 (-8.445)*	-1.081 (-6.028)*	-0.193 (-4.971)*	-12.149 (-5057.14)*	-58.896 (-1817.696)*	-0.754 (-26.728)*	-26.045 (-16.545)*	-0.765 (-5.337)*	-0.482 (-6.639)*
C(5)	0.0954 (10.107)*	0.289 (14.478)*	0.096 (7.654)*	-0.268 (-9.2E+102)*	0.705 (1067.915)*	0.281 (17.239)	2.916 (18.535)*	0.126 (4.531)*	0.115 (6.29)*
C(6)	-0.0408 (-7.488)*	-0.0527 (-5.117)*	-0.037 (-5.705)*	0.024 (8.256)*	-0.787 (-1173.57)*	-0.016 (-1.251)	1.444 (11.3)*	-0.188 (-9.909)*	-0.13 (-10.728)*
C(7)	0.9957 (961.302)*	0.9026 (46.073)*	0.987 (246.273)*	0.553 (5799.872)*	0.295 (1468.066)*	0.93 (229.398)*	0.42 (11.435)*	0.93 (63.035)*	0.958 (137.531)*

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value, C(4)- Constant, C(5)- Arch(-1), C(6)- Asymmetric value, C(7)- Garch (-1) value*

Table 6.13 - Spillover Effects of Returns for ETF and Index Returns

		ARMAGARCH		ARMAEGARCH	
ETFs	**Underlying indices**	**ETF (ω)**	**INDEX (υ)**	**ETF (ω)**	**INDEX (υ)**
BANKBEES	Nifty Bank	0.7302 (27.626)*	0.0129 (0.349)	0.404 (2885.073)*	0.0023 (0.066)
BSLNIFTY	Nifty 50 Index	0.32 (8.513)*	-0.001 (-0.18)	0.003 (0.07)	-0.003 (-0.458)
CPSEETF	Nifty CPSE Index	0.476 (4.907)*	0.222 (1.701)***	0.502 (5.225)*	0.196 (1.488)
INFRABEES	Nifty Infrastructure	0.646 (30.446)*	-0.045 (-3.035)*	0.643 (30.138)*	-0.05 (-3.503)*
JUNIORBEES	Nifty Next 50	0.864 (72.579)*	-0.0244 (-1.252)	0.862 (71.672)*	-0.026 (-1.39)
KOTAKNIFTY	Nifty 50 Index	0.705 (25.416)*	0.0089 (0.216)	0.693 (27.766)*	-0.087 (-4.077)*
KOTAKBKETF	Nifty Bank	0.856 (27.258)*	-0.0052 (-0.111)	0.834 (25.964)*	0.063 (1.688)***
KOTAKPSUBK	Nifty PSU Bank	0.807 (65.713)*	-0.0678 (-3.01)*	0.813 (64.718)*	-0.065 (-3.007)*
M50	Nifty 50 Index	0.629 (26.192)*	0.006 (0.366)	0.633 (27.011)*	0.011 (0.736)
M100	Nifty Midcap 100	0.542 (24.655)*	0.0474 (2.214)**	0.549 (25.941)*	0.043 (2.181)**
NIFTYBEES	Nifty 50 Index	0.752 (34.964)*	-0.0332 (-1.095)	0.737 (33.616)*	-0.044 (-1.618)
PSUBNKBEES	Nifty PSU Bank	0.653 (31.676)*	0.037 (1.474)	0.655 (32.488)*	0.038 (1.53)
QNIFTY	Nifty 50 Index	0.694 (32.412)*	0.004 (0.125)	0.704 (1372.38)*	-0.008 (-0.273)
RELCNX100	Nifty 100	0.77 (31.148)*	0.0083 (0.603)	0.531 (786.843)*	0.018 (1.447)
RELDIVOPP	Nifty Dividend Opportunities 50	0.566 (22.109)*	0.0006 (0.043)	0.6 (24.173)*	-0.003 (-0.348)
RELCONS	Nifty India Consumption	0.592 (14.43)*	0.0147 (1.705)***	0.606 (1161.53)*	0.011 (1.329)
SHARIABEES	Nifty50 Shariah Index	0.722 (33.024)*	-0.0017 (-0.192)	0.725 (34.566)*	0.001 (0.225)

*Note- * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value. ω - Index return (-1), υ - ETF return (-1)*

Table 6.14- Spillover Effects of Volatility for ETF and Index Returns

		ARMA GARCH		ARMA EGARCH	
ETF	**Underlying Indices**	**ETF (*j*)**	**INDEX (*k*)**	**ETF (*j*)**	**INDEX (*k*)**
BANKBEES	Nifty Bank	0.0308 (4.845)	0.012 (1.795)***	10.68 (1.944)***	5.125 (0.95)
BSLNIFTY	Nifty 50 Index	-0.2737 (-88.294)	0.001 (1.8)***	180.2082 (4.588)*	-2.406 (-0.878)
CPSEETF	Nifty CPSE Index	0.1725 (8.0941)*	-0.05 (-1.542)	337.7651 (6.116)*	-18.581 (-0.198)
INFRABEES	Nifty Infrastructure	0.0262 (1.766)***	0.005 (2.409)**	-3.5146 (-0.113)	35.104 (6.167)*
JUNIORBEES	Nifty Next 50	0.0796 (11.315)*	0.003 (1.02)	36.8233 (9.806)*	-0.6 (-0.145)
KOTAKNIFTY	Nifty 50 Index	-1.7087 (-1.651)***	0.003 (0.318)	127.4424 (2.351)**	93.337 (2.02)**
KOTAKBKETF	Nifty Bank	0.02 (5.7411)*	0.001 (0.038)	44.0814 (5.207)*	203.138 (15.701)*
KOTAKPSUBK	Nifty PSU Bank	-0.0001 (-6.6515)*	0.044 (5.56)*	30.6246 (8.969)*	11.218 (1.391)
M50	Nifty 50 Index	0.0512 (3.6808)*	0.001 (0.269)	-812.4994 (-870.946)*	61.471 (1.467)
M100	Nifty Midcap 100	0.1125 (4.8682)*	0.021 (3.186)*	205.9108 (3.366)*	160.166 (3.19)*
NIFTYBEES	Nifty 50 Index	0.0381 (4.7455)*	0.04 (4.409)*	3.6726 (0.299)	33.233 (2.335)**
PSUBNKBEES	Nifty PSU Bank	0.0787 (7.2737)*	0.029 (3.21)*	19.5528 (2.715)*	2.023 (0.24)
QNIFTY	Nifty 50 Index	0.0001 (4.3662)*	0.001 (3.311)*	36.7674 (2.641)*	33.067 (2.849)*
RELCNX100	Nifty 100	0.0232 (1.1484)	0.003 (1.946)***	5.797 (0.13)	10.743 (1.929)***
RELDIVOPP	Nifty Dividend Opportunities 50	0.5937 (13.776)*	-0.001 (-0.791)	337.3102 (6.879)*	3.63 (2.744)*
RELCONS	Nifty India Consumption	-0.5999 (-6.963)*	-0.001 (-1.791)***	9.7614 (0.159)	0.385 (0.086)
SHARIABEES	Nifty50 Shariah Index	-0.0055 (-0.596)	0.002 (1.271)	-2.8091 (-0.169)	11.528 (1.802)***

*Note - * denotes 1% of significance, ** denotes 5 % significance, *** denotes 10% of significance. In bracket z-statistics value, j- lag index residual in ETF return, k - lag ETF residual in Index return.*

CHAPTER 7

SUMMARY AND FINDINGS

7.1 INTRODUCTION

Since the introduction of the Markowitz Modern Portfolio Theory (1952), investors have been searching for successful ways to diversify their portfolio to reduce peculiar risk and to obtain efficient portfolios that optimize returns and mitigate risk. Investors began to look for low-cost approaches to replicate the indices. They began to demand funds that could be instantly traded and would not be subject to substantial NAV discount and premium. ETFs have inevitably captured a significant portion of the investor's portfolio due to increased equity market liquidity and other advantages such as lower cost and versatility.

ETFs have gained prominence over time, and now account for one-third of the American stock exchanges' trading. According to the 2017 global ETF research survey, the cumulative average growth in ETFs from 2005 to 2017 was about 21 per cent. The ETF sector in India has witnessed steady growth, but the penetration among the investors is relatively low compared with other investment strategies. Further, the underperformance of various equity linked mutual funds shall make the ETFs better alternative investment among investors. The literature review chapter provides a comprehensive review on the ETFs. As discussed earlier, ETFs in the global context are extensively studied, while in the Indian context, the studies are limited.

The present study provides empirical analysis of the ETFs and their respective underlying benchmark indices in India. The study will help the investors to track the performance of the ETFs with their respective underlying benchmark indices. The objective of the present study can be classified into four folds. Firstly, the study estimates the pricing efficiency of the different ETFs. The objective is to find the presence of long-run relationship between ETFs and underlying indices. In case of a difference between the prices, it reveals the time duration taken for the prices to reach equilibrium level.

The second objective deals with the speed of adjustment of the ETFs and the underlying benchmark index prices towards intrinsic value. It gives an idea regarding the time taken for the prices to reflect or incorporate the information. Thirdly, the study helps to understand the persistence of premium and discount between the ETF and the NAV differences. The study also aims to investigate whether premium or discount continues to exist in the transaction of ETFs. The final objective is to check the presence of volatility and return spillover between the ETFs and the underlying benchmark indices.

7.2. FINDINGS OF THE STUDY

7.2.1 Pricing Efficiency of ETFs and its Underlying Benchmark Indices

The first objective of the study concerns the pricing efficiency of the equity ETFs and their respective underlying indices. Using the ARDL model, the study was conducted in three scenarios, such as, without structural break, single structural break, and multiple structural breaks in the dataset. The mean value of the price deviations showed that the market price of the ETFs was priced higher compared with the underlying index price. In terms of long-run relationships, the bounds test results show that only 1/3 of the ETFs have a long-run relationship when structural breaks were not considered. However, the findings improved significantly after the introduction of single and multiple structural breaks. Except for a few ETFs, most ETFs have a long-run relationship. Further, the short-run coefficient confirms that the percentage of price adjustment towards equilibrium increases after the incorporation of single and multiple structural breaks.

The significance of the long-run relationship shows that if there is any divergence between the prices of the ETFs and the underlying indices, the deviation does not carry for a prolonged period. Hence, the present study proves against the study of Madhavan and Maheswaran (2016) as their work showed that the long-run relationship between the ETF price and the underlying benchmark index price was unsuccessful to show the pricing direction of the Indian ETFs. However, in the present study, most of the ETFs have a long-run relationship between the ETFs' price and the underlying benchmark indices. Hence, the first objective shows the importance of considering structural breaks in the dataset.

7.2.2 Assessing the Speed of Adjustment of ETFs

The second objective is to check the speed of adjustment towards the intrinsic value of the equity ETFs' closing price and the underlying benchmark indices. Based on the ARMA estimator, most of the ETFs were overreacting when information had just arrived. After two days, most of the ETFs were underreacting to the news. Moreover, the underlying benchmark indices prices were showing similar results. The Wald test confirmed that the AR coefficients were not equal to one in the period from day 1 to day 20 differencing interval. Most of the ETFs coefficient on day 20 were almost one indicating that adjustment will be meeting on the following days.

7.2.3 Persistence of Premium and Discount in ETFs

In the third objective, the study continued to examine the persistence of premium and discount based on the ETF price and NAV. The study employed the ARDL model in the third objective. In India, most of ETFs are trading in discount than premium as confirmed from the summary statistics. The findings of the ARDL support the lagged ETF price, and the lagged NAV have a positive and negative effect on the current ETF prices. Moreover, the presence of long-run relationships was confirmed through the bounds test. Furthermore, the short-run coefficients provided the time to adjust to the level of balance between the NAV and the ETF price. Most of the difference between the ETF and the NAV would be corrected on the same day, and the remaining difference will be cleared the next day. Hence, the findings of the current objective are in line with the previous studies conducted globally (Engle and Sarkar, 2006; Kayali, 2007; Hilliard, 2014), which state that domestic ETFs have less difference in premium and discount and high efficiency.

7.2.4 Volatility and Return Spillover of ETFs and their Underlying Benchmark Indices

The final objective of the study is to examine the volatility and return spillover between the ETF and the index returns. The study had employed the ARMA-GARCH and ARMA-EGARCH models. On the basis of empirical evidence, volatility persistence was evident in most ETFs and their respective indices. Moreover, the leverage term was negative and significant in most of the ETFs and their respective benchmark indices.

This confirmed the asymmetric volatility presence in the data. In most cases, the spillover of returns was unidirectional, i.e., the underlying benchmark index returns to the ETF returns, and not vice versa. Hence, it confirms that the current day index returns can be used to predict the ETFs' returns. In terms of volatility spillover, the results show bi-directional flow between the ETF and the index. However, volatility transmitting from the index to the ETF was greater in number than the ETF to the index.

The study is based on the following four hypotheses:

The first objective null hypothesis states that 'there is no long-term relationship between the ETF and the underlying benchmark indices price', while the alternative hypothesis states that 'there is a long-run relationship between the ETF and the underlying benchmark indices price'. The empirical results show that 2/3 of the ETFs have a long relationship with the underlying benchmark indices' price after incorporating multiple structural breakpoints. Therefore, the null hypothesis of the first objective is rejected.

The second objective null hypothesis states that 'new information is not quickly incorporated into the prices of the ETFs and the underlying indices', whereas the alternative hypothesis states that 'information is quickly incorporated into the prices of the ETFs and the underlying indices'. The empirical results show that information is not fully incorporated into the prices of the ETFs and the underlying price indices. However, almost 90% of the information is included in both the prices at the end of the 20th day of the return difference. The second objective, therefore, does not comprehensively reject the null hypothesis.

The null hypothesis of the third objective states that, 'there is persistent premiums and discounts in the ETFs', while the alternative hypothesis states that 'there is no persistent premiums and discounts in the ETFs'. The results show that all the ETFs have a long-run relationship with the NAV. The difference between the ETF and the NAV is minimal, and the difference is corrected above 50% on a daily basis for most of the ETFs. This confirms the persistence of premium/ discount not lasting for a longer time. The third objective, therefore, rejects the null hypothesis.

The null hypothesis of the last objective states, 'volatility and return spillover are not present between the ETF and the underlying benchmark indices', whereas the alternative hypothesis states that 'volatility and return spillover are present between the ETF and the underlying benchmark indices’. The empirical results confirm the presence of volatility spillover between the ETFs and the underlying indices. However, in terms of return spillover, most of the ETFs show unidirectional spillover, i.e., from the underlying benchmark index returns to the ETFs’ returns. Hence, the last objective rejects the null hypothesis.

7.3 CONTRIBUTION TO THE BODY OF KNOWLEDGE

The present study contributes in several ways to the body of knowledge. The concept of ETF is at a very nascent stage in India. Most of the prior studies have been conducted in developed markets, while studies on emerging markets like India are few. Even in India, majority of the studies focus on the performance of ETFs and the comparison of ETFs with mutual funds. However, the present study focuses on the pricing efficiency of the ETFs and their underlying indices. The study was conducted for a longer duration of period, i.e., from the inception date of the ETF to the end of 2018. Therefore, the study will contribute to the body of knowledge in the pricing of the ETFs. The evaluation of the pricing efficiency of the ETFs contributes to investment practice by enabling retail and institutional investors to track the historical performance of the ETFs. Additionally, it will also help the stock market regulators by giving them insights into the return volatility of the ETFs. To that end, the research findings will help financial planners provide appropriate financial advice to investors who wish, as part of their investment portfolios, to include ETFs.

7.4 LIMITATIONS OF THE STUDY

The present study is an empirical study as it relies on market data and statistical models to establish relationships. Therefore, it will have all the limitations of an empirical research. As outlined by Philips (2003), the correct model for any data is unknown, and even if it is known, it still depends on parameter estimates based on data. There are constraints imposed by the availability of data.

7.5 FUTURE SCOPE OF THE STUDY

The current study focuses only on equity ETFs. However, in future, a similar kind of work can be conducted in other types of ETFs such as bonds, gold, etc. In March 2014, an enormous boost was provided to the ETF industry by the Indian government's decision to raise money by divesting its stake in Public Sector Undertakings (PSUs) through ETFs. In August 2015, the Employee Provident Fund Organization (EPFO) announced that it would only accept equity exposure via ETFs. Moreover, the current study focuses on daily data as only few established ETFs have higher frequency transactions. With the increase in frequency of transactions, intraday analysis can be carried out in the future. Intraday data- based analysis may shed more light on the issue. Further work can be done on volatility spillover between the ETFs market in India with the world market.

7.6 CONCLUSION

After the introduction of the Markowitz Modern Portfolio Theory (1952), investors sought effective ways of diversifying their portfolio in order to reduce particular risks and to obtain efficient portfolios that optimize returns and mitigate risk. However, this approach can only be used by large investment firms as small investors face high transaction costs. As a result, institutional investors have started to call for equity funds that can purchase large volumes of stock, which would result in lower transaction costs. Active mutual funds, which follow active strategies and pay more in return are based on the knowledge of skilled portfolio managers. In these funds, portfolio managers, through various strategies try to create an abnormal return on an index benchmark.

CEFs are, on the other hand, funds which are traded as stocks and exchanged through brokers in a structured market. The problem is that there is no mechanism by which investors can make use of arbitrage and remove the difference between the NAV and the price of the units. With the emergence of new empirical studies that show that active funds usually struggle to achieve their index benchmarks such as Malkiel (1995), and realizing that passive low-cost strategies can offer superior outcomes compared with traditionally active mutual funds, investors have started searching for low-cost approaches to replicating the indices. Due to improved stock market liquidity and other advantages, ETFs have inevitably captured a large portion of the investor portfolio.

The present study focuses on the pricing efficiency of equity ETFs in India. The study focused broadly on identifying the relationship between ETFs and their underlying benchmark indices. The data period was from the inception date of the equity ETFs to

31st December 2018. Primarily, the study begins with the analysis of the pricing efficiency of the ETFs' market price, NAV, and underlying benchmark indices. On the basis of the negative price differential, ETFs are priced higher than their underlying benchmarks. On the other hand, ETFs are priced lower than NAVs. The results also show a long-run relationship between the ETF and the underlying benchmarks. A similar result was reported with regard to the price of the ETF and NAV, which suggested long-run relation.

Furthermore, the difference between the ETF and the NAV price is very small, which suggests that most ETFs in the Indian context are at a discount relative to the NAV. The bounds test results show that more numbers of ETFs are attaining long run relationship for ETFs and NAV compared with the ETFs and the underlying benchmark indices' price. The equity ETFs show less variation between the NAV and the ETF market prices confirming active arbitrage environment. The correction of the deviation value between the prices of the ETF and the underlying benchmark indices price, is causing the ETF price and the NAV to take less time to reach equilibrium. Further, the speed of correction towards the intrinsic value shows that ETFs and indices take a longer duration to reflect the arrival of information.

The market will be overreacting for recent news, and after two to three days, this impact starts to reduce, representing underreaction. Referring to volatility and return spillover, the result shows persistence of volatility for both the ETFs and the indices. In terms of volatility spillover, most of the ETFs and their underlying benchmark indices show ~~a~~ bi-directional relationship. However, the underlying benchmark indices return has the upper hand over the ETF returns in respect of return spillover. The ETF returns can be predicted based on previous day's index returns and not vice versa. From the point of asymmetric impact, negative news has more impact than positive news. If there is negative news, there is more volatility compared with that of positive news.

Overall, the study shows various practical implications for investors and regulators. A positive daily mean return over a relatively long period indicates passive equity ETFs as a viable long-term investment option for ordinary investors. Bidirectional volatility spillover between the ETFs and benchmark index returns seeks the attention of the market regulators to examine the reasons for the same. Policymakers need to consider various ways to promote greater integration and contemplate a series of steps aimed at bringing the underserved to the formal financial system.

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Yavas, B.F. and Rezayat, F. (2016). “Country ETF returns and volatility spillovers in emerging stock markets, Europe and USA.” *International Journal of Emerging Markets*, 11(3), 419–437.

BIO-DATA

Brief bio-data of the Scholar

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Education

Examination Passed	Name of the Board / University	Year	% of marks
MBA	Thangavelu Engg College, Chennai	2010	69
BCOM	Patrician College of Arts and Science, Chennai	2008	72
Higher Secondary	Jeevanadam Govt Hr Sec School, Pondicherry	2005	86
SSLC	Wiseman Hr Sec School, Pondicherry	2003	79.6

PUBLICATIONS

Journal

Chandrasekaran, B. and Acharya, R. (2019), "A study on volatility and return spillover of exchange-traded funds and their benchmark indices in India", *Managerial Finance*, *Managerial Finance, Vol. 46 No. 1, pp. 19-39, Emerald publisher*. *https://doi.org/10.1108/MF-01-2019-0025*.

Chandrasekaran, B. and Acharya, R. (2019), “"An Analysis of Pricing Efficiency of Exchange Traded Funds in India using ARDL Bounds Test Approach”, Afro – Asian Journal of Finance and Accounting, *Inderscience Publisher* (In Press)

International Conference

Buvanesh C., and Rajesh H Acharya (2018) “A Study of Pricing Deviation on Indian Exchange Traded Fund with The Underlying Index.” *7th International Engineering Symposium - IES 2018, March 7-9, 2018, Kumamoto University, Japan.*

National Conference

Buvanesh C., and Rajesh H Acharya (2020) “Pricing efficiency of Exchange Traded fund with the Underlying benchmark Index in India.” *56th Annual Conference of the Indian Econometric Society (TIES)- TIES 2020, January 8-10, 2020, Madurai Kamaraja University, Madurai.*

WORKSHOPS ATTENDED

	Name of the Workshop	**Data**
1	Big Data Analysis, Pondicherry University	January 8-10, 2016
2	Time Series and Panel Data Analysis Using Eviews and Stata, NIT Trichy	January 24-28, 2016
3	Applied Financial Modelling	July 8-12, 2016