A study on volatility and return spillover of exchange-traded funds and their benchmark indices in India

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Abstract

Purpose – The purpose of this paper is to empirically examine the volatility and return spillover between exchange-traded funds (ETFs) and their respective benchmark indices in India. The paper uses time series data which consist of equity ETF and respective index returns.

Design/methodology/approach – The study uses autoregressive moving average–generalized autoregressive conditional heteroscedasticity and autoregressive moving average–exponential generalized autoregressive conditional heteroscedasticity models. The study uses data from the inception date of each ETF to December 2016.

Findings – The findings of the paper confirm that there is unidirectional return spillover from the benchmark index to ETF returns in most of the ETFs. Furthermore, ETF and benchmark index return have volatility persistence and show the presence of asymmetric volatility wherein a negative news has more influence on volatility compared to a positive news. Finally, unlike unidirectional return spillover, there is a bidirectional volatility spillover between ETF and benchmark index return.

Practical implications – The study has several practical implications for investors and regulators. A positive daily mean return over a fairly long period of time indicates that the passive equity ETFs can be a viable long-term investment option for ordinary investors. A bidirectional volatility spillover between the ETFs and benchmark index returns calls for the attention of the market regulators to examine the reasons for the same.

Originality/value – ETFs have seen fast growth in the Indian market in recent years. The present study considers the longest period data possible.

Keywords Volatility spillover, GARCH, EGARCH, ETF, Asymmetric volatility

Paper type Research paper

1. Introduction

Exchange-traded funds (ETFs) are the most popular and innovative investment products around the world. Since the inception of ETFs, they have been the prime choice of investment for institutional investors (Guedj and Huang, 2009; Ivanov, 2013; Chen and Malinda, 2014). With low-cost exposure to an equity index, ETFs have gained popularity over the time, where, currently, one-third of American stock exchanges trade belongs to ETFs. As per the global ETF research report of 2017, the cumulative average growth of ETFs was around 21 percent from the period 2005 to 2017. The investment increased from $417bn in 2005 to $4.4tn by the end of September 2017. In India, ETFs saw a considerably slower growth in comparison to global market. NIFTYBEES was the first ETF launched by the Benchmark Mutual Fund in the year 2002. Initially, the size of the ETF market was around Rs9.56bn, which increased to Rs904.39bn in September 2018 as per the Association of Mutual Funds in India. With the 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).

Although ETFs have emerged as a good investment option, there are concerns that volatility of ETFs highly correlates with the equity market. Volatility transmission between ETFs and the stock market has been observed over the time. Past studies have shown the spillover and leverage effect between ETFs and their respective indices (Chen and Huang,

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2010; Chen, 2011; Chen and Malinda, 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 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 ETF to its underlying index or vice versa.

Since there is a significant growth of ETF trading, ETFs have emerged as an essential factor in the volatility generating process of their underlying stocks (Krause *et al.*, 2014). The advent of information technology has made the information transmission between the ETF and underlying index easier. Importance of examining volatility spillover pertains to the notion of market efficiency. The level of efficiency in the market is determined by the presence of current volatility in the market, which is affected by the past volatility, referred to as volatility clustering.

Furthermore, volatility spillover indicates the market integration that shows the level of spillover effect among the markets that are integrated. The existence of higher interdependence among market would lead to chances of contagions occurring in the event of a financial crisis. Volatility spillover in our study is interpreted as the volatility in the ETF return spread or impact on the underlying index, as the ETF market in India has grown exponentially. Moreover, it is important to know how the spillover transmission works between ETFs and underlying index and which one is more dominant between the ETF and underlying index. Hence, investigation on volatility spillover is of prime importance.

The studies on volatility spillover of ETFs are primarily focused on the developed markets (Chen and Huang, 2010; Chen, 2011; Chen and Malinda, 2014; Krause *et al.*, 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 index. Chen (2011) found that any changes in current-day index return would be reflected in the ETF returns the next day. Krause *et al.* (2013) examined volatility spillover between the USA and Canada with ETFs; results show that the USA has more share in spillover than Canada. Most of the works support that information about volatility could spill over in a bidirectional way between the countries. Investors and regulators can easily understand the volatility of the financial instrument that is mutual with underlying constituents. Besides, investors and regulators could predict the ETF returns on the basis of lagged or past index returns information.

The primary objective of the present study is to find the spillover and leverage effect from the returns and volatility of the ETF to its underlying 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 effect among the financial instruments (stock market, oil prices and ETF) has a significant consequence on investors and policymakers. The volatility spillover may affect investment decision: the higher the volatility, the greater is the risk. The importance of spillover effect studies may benefit investors and regulators in finding the nature of the interaction between the financial instruments. In the present study, we assess the volatility and return spillover between ETFs and their underlying indices. Furthermore, this paper focuses on the presence and the 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 autoregressive conditional heteroscedasticity (GARCH) model (Bollerslev, 1986). To explain the leverage effect of ETFs and index return volatility, we use the exponential generalized autoregressive conditional heteroscedasticity (EGARCH) 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. Also, the result confirms the presence of asymmetric volatility in the data, where negative information has more impact than the positive news. Hence, this study assists the investors with the broad details of the ETFs and underlying index. The main contribution of the present study is that it provides the empirical evidence on the return and volatility spillover between ETFs and their benchmark indices. As India is an important emerging market, the findings of the present study have implications for domestic as well as the foreign institutional investors. Regulators can also benefit from the findings of the present study.

The structure of the paper is as follows: Section 2 reviews the relevant literature of past studies in the volatility spillover; Section 3 describes data and methodology; Section 4 discusses the results and Section 5 concludes the study.

2. Literature review

In this section, we review the relevant literature related to the ETFs. Wang *et al.* (2009) conducted a study on the correlation between ETF and the underlying spot index in Taiwan. For this study, five ETFs' intra-day data from 15 January 2007 to 15 July 2008, with 5-min interval, were considered. Based on vector autoregressive (VAR) model, the results show that the information has been transferred from spot index to the respective ETFs. Also, index got affected by its own lags than other variables. Many studies have been conducted on the return spillover between the emerging and developed market ETFs. Chen and Huang (2010) worked on the volatility spillover between ETF and index returns in six developed and three emerging markets. ARMA–EGARCH model has been employed on ETF and stock index returns to examine asymmetric volatility or leverage effects. Results show that volatility is persistent, and ETF returns of most of the developed countries are negatively influenced by the unexpected return. Also, the return spillover existed in most of the developed countries. Furthermore, the previous day stock returns positively influence the current-day ETF returns. The study concluded that volatility spillover has a bidirectional relationship.

Chen and Malinda (2014) continued the analysis on financial and non-financial ETFs based on the countries such as Brazil, China, Canada, Europe and the USA. For data analysis, the study has employed the ARMA-M-GARCH, and ARMA-M-EGARCH model. The result shows the inverse relationship between returns of non-financial ETFs and index. Spillover of volatility shows that stock index has negatively influenced the non-financial ETFs, and the spillover of returns on financial and non-financial ETFs has a bidirectional relationship. Krause and Tse (2013) worked on how the US and Canadian ETF market influence each other. The lagged US ETF returns significantly impacted the Canadian ETF market from the results of the VAR and EGARCH model. Canadian market and the US market have a bidirectional flow; however, the US market has a double impact as compared to the Canadian market. Also, there is a presence of asymmetric volatility in both the markets. Chen and Diaz (2015) worked on the seven emerging markets' equity ETFs, employing the fractionally integrated autoregressive moving average model and fractional integrated asymmetric power ARCH model. Most of the ETFs were giving positive returns as per the mean value. The asymmetric coefficient was negative and significant, indicating that the market was more volatile during negative news than the positive news. They concluded that there is a presence of volatility clustering in the emerging market.

Dedi and Yavas (2016) studied the transmission of ETF returns between the developed markets such as Germany, the UK, and Russia and emerging markets such as China and Turkey. As per GARCH, GARCH in mean and EGARCH models, results have confirmed that volatility has been transmitted from developed to emerging markets. Also, ETF returns from the developed markets influence the other markets such as China and Turkey. All other countries, except the UK, have an adverse effect on their future returns. Yavas and Dedi (2016) continued the previous work with the inclusion of other European countries such as Austria and Poland. All other countries, except Turkey, have high significance in information transmission. The study concluded that Turkey and Russia have more share in the transmission of volatility. Also, volatility is not continued for a long time. Chen *et al.* (2018) concluded that the study of spillover effects of volatility would give input to fund managers regarding investing strategies.

Yavas and Rezayat (2016) discussed the volatility and returns spillover among the seven emerging markets and the US market ETFs. Based on data from 2012 to 2014, the study has used MARMA–GARCH model for the analysis of return and volatility spillover between countries. Major results confirmed that there is a unidirectional spillover from developed markets to emerging markets. Indonesia and Turkey were more volatile in the short run; volatility shocks take a long time to dissolve for the countries such as Russia, Turkey, Indonesia and China as compared to other countries in the sample. Datar *et al.* (2008) examined return, volatility and liquidity transmission between the US (SPY) and Japan (EWJ) ETFs on an intra-day basis. Data have been collected from Trades and Automated Quotations from the New York Stock Exchange. The authors found that the liquidity of both countries is highly correlated. The results of return spillover show a unidirectional flow from the USA to Japan, but not from Japan to the USA. The study concluded that both the country's returns are highly correlated with each other.

Gutierrez *et al.* (2009) found that volatility transmission is bidirectional between US and Asian markets. However, it is once again proved that the USA has dominated in the information transmission to Asian countries. Overnight trades are creating more impact than the day-time trades on volatility. Asian and the US market returns are correlated; however, asymmetric relationship does not exist. The local market played an important role in the Asian ETFs' volatility and returns. Wang and Xu (2019) analyzed the relationship between ETF flow and volatility of its underlying index. Volatility is examined on the basis of the total and fundamental volatility. Based on the data from January 2015 to December 2017, the results confirmed that flow of the ETFs can predict the volatility of underlying index the next day.

Curcio *et al.* (2012) found that the inception of traditional and, particularly, leverage ETFs has a greater impact on volatility of the underlying bank and other financial stock prices. Markov switching model also confirms that accessing the bank and financial stock is feasible through the leveraged ETF. Rompotis (2016a) evaluated the performance, volatility and return spillover of leverage ETFs with the underlying index. ARMA–GARCH model is employed to identify the spillover of return and volatility between leverage ETF and underlying index. Leverage ETF's expected return is achieved in the week time, whereas inverse ETF is produced in two days. Volatility of financial asset and equity prices have an inverse relationship, and a bidirectional return spillover exists between ETF and index.

Dheeriya *et al.* (2014) examined the spillover of returns between the country ETFs. The study examined the ETFs from Brazil, India, Indonesia, Mexico, Russia, South Korea, Turkey and the USA. The study covered the period from February 2011 to December 2012 and used multivariate ARMA–GARCH model. The base results confirmed that spillover between the country ETFs. Most of countries counter the volatility transmission, except Russian and Turkish market from other countries. Finally, the study concluded that investors should not only depend on the domestic news, but they should also consider the international information.

Rompotis (2016b) analyzed how Chinese stock market crisis impacted the US ETF market. Sample data set contained 26 US-listed ETFs that have underlying index of Chinese stock market and 9 US-listed ETFs trading in the US stock market wherein the researcher used a VAR model to assess the relationship. Results confirm that US ETF market got affected by crisis in Chinese market, and both the Chinese and the US market relationship became stronger after the crisis. Concerning spillover, it was highly persistent in both the markets. Kadapakkam *et al.* (2015) observed the information flow between large- and small-size portfolio of ETF using Granger causality test and volatility spillover between large- and small-size firm ETFs and CRSP portfolio. The study used daily and weekly returns for the analysis. The results show that volatility spillover from large to small firms and information flow are same. In addition, index funds gradually add momentum as a tool for asset allocation.

3. Methodology

This paper evaluates the spillover and leverage effects of ETF and stock index returns, and their volatilities. Returns of ETFs and respective indices are calculated as the first difference of the natural logarithm. This study employs the ARMA–GARCH model in order to determine the GARCH effect presence in the ETF return and index returns. In order to determine asymmetric volatility or leverage effects, this study employs the EGARCH model introduced by Nelson (1991) associated with ARMA specification for ETF and index returns. Precisely, each part of the combination of both the GARCH (v, u)–ARMA (c, d) and EGARCH (v, u)–ARMA (c, d) models are presented below.

3.1 Domestic ETF returns model

We employ the following GARCH (v, u)–ARMA (c, d) and EGARCH (v, u)–ARMA (c, d) to find if GARCH effect is present between ETF and index return. To check the asymmetric effect, we use the EGARCH–ARMA model.

We use the ARMA in mean Equation (1), and conditional variance is explained by the past conditional variance and lagged innovation in GARCH Equation (2), and asymmetric function is explained in EGARCH from Equation (3):

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{c} \alpha_i R^e_{i,t-i} + \epsilon^e_{i,t} + \sum_{i=1}^{d} \theta_i \epsilon^e_{i,t-i}, \tag{1}$$

$$h^e_{i,t} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \epsilon^{e^2}_{i,t-1} + \sum_{i=1}^{u} \beta_i h^e_{i,t-i}, \tag{2}$$

$$\log\left(h^{e^2}_{i,t}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} \right| \right\rangle + \delta_i \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} + \sum_{i=1}^{u} \beta_i \log\left(h^{e^2}_{i,t-i}\right), \tag{3}$$

where $R^e_{i,t}$ and $R^s_{i,t}$ are ETF and index return, respectively, at time t. $R^e_{i,t-i}$ and $R^s_{i,t-i}$ denote the maximum order of the autoregressive AR(c) for ETF and stock index return, respectively. Meanwhile, $\epsilon^e_{i,t-i}$ and $\epsilon^s_{i,t-i}$ represent the moving average MA(d) for ETF and stock index return, respectively. $\epsilon^{e^2}_{i,t-1}$ and $\epsilon^{s^2}_{i,t-1}$ are defined as the lagged residual square of ETF and index returns, respectively. $\epsilon^e_{i,t}$ and $\epsilon^s_{i,t}$ are ETF and index returns residual at the period t.

In order to check whether the residuals have heteroscedasticity, we estimate the below equation from the residuals of Equation (1):

$$\epsilon^2_t = \alpha_0 + g_1\epsilon^2_{t-1} + g_2\epsilon^2_{t-2} + g_3\epsilon^2_{t-3} + g_q\epsilon^2_{t-q}. \tag{4}$$

Presume that $q = n$ shows the residual series for conditional heteroscedasticity. The null hypothesis shows whether correlation exists 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.

3.2 Domestic stock index return models

We exhibit the ARMA in mean Equation (5), and current conditional variance is explained by the lagged conditional variance and innovation in GARCH Equation (6), and asymmetric function is explained in EGARCH from Equation (7):

$$R^s_{i,t} = \rho + \sum_{i=1}^{c} \rho_i R^s_{i,t-i} + \epsilon^s_{i,t} + \sum_{i=1}^{d} \partial_i \epsilon^s_{i,t-i}, \tag{5}$$

$$h^s_{i,t} = O_0 + \sum_{i=1}^{v} O_i \epsilon^{S^2}_{i,t-1} + \sum_{i=1}^{u} \lambda_i h^S_{i,t-i}, \tag{6}$$

$$\log\left(h^{S^2}_{i,t}\right) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right| + \delta_i \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right\rangle + \sum_{i=1}^{u} \lambda_i \log\left(h^{s^2}_{i,t-i}\right). \tag{7}$$

Note that $h^{e^2}_{i,t}$ and $h^{s^2}_{i,t}$ are the conditional variances of the ETF and stock index returns, respectively. Also, 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 ETF and index returns.

3.3 Spillover effect of returns

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

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{c} \alpha_i R^e_{i,t-i} + \omega R^s_{i,t-1} + \epsilon^e_{i,t} + \sum_{i=1}^{d} \theta_i \epsilon^e_{i,t-i}, \tag{8}$$

$$h^e_{i,t} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \epsilon^{e^2}_{i,t-1} + \sum_{i=1}^{u} \beta_i h^e_{i,t-i}, \tag{9}$$

$$\log\left(h^{e^2}_{i,t}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} \right| \right\rangle + \delta_i \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} + \sum_{i=1}^{u} \beta_i \log\left(h^{e^2}_{i,t-i}\right), \tag{10}$$

$$R^s_{i,t} = \rho + \sum_{i=1}^{c} \rho_i R^s_{i,t-i} + \upsilon R^s_{i,t-1} + \epsilon^e_{i,t} + \sum_{i=1}^{d} \partial_i \epsilon^e_{i,t-i}, \tag{11}$$

$$h^s_{i,t} = O_0 + \sum_{i=1}^{v} O_i \epsilon^{S^2}_{i,t-1} + \sum_{i=1}^{u} \lambda_i h^S_{i,t-i}, \tag{12}$$

$$\log\left(h^{S^2}_{i,t}\right) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right| + \delta_i \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right\rangle + \sum_{i=1}^{u} \lambda_i \ \mathrm{logo}\left(h^{s^2}_{i,t-i}\right), \tag{13}$$

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

3.4 Spillover effect of volatility
The multiple ARMA–GARCH and ARMA–EGARCH for volatility spillover effect between ETF and stock returns are shown below:

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{c} \alpha_i R^e_{i,t-i} + \epsilon^e_{i,t} + \sum_{i=1}^{d} \theta_i \epsilon^e_{i,t-i}, \tag{14}$$

$$h^e_{i,t} = \alpha_0 + \sum_{i=1}^{v} \alpha_i \epsilon^{e^2}_{i,t-1} + \sum_{i=1}^{u} \beta_i h^e_{i,t-i} + j\epsilon^{s^2}_{i,t-1}, \tag{15}$$

$$\log\left(h^{e^2}_{i,t}\right) = \alpha_0 + \sum_{i=1}^{v} \left\langle \alpha_i \left| \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} \right| \right\rangle + \delta_i \frac{\epsilon^e_{i,t-i}}{h^e_{i,t-i}} + \sum_{i=1}^{u} \beta_i \log\left(h^{e^2}_{i,t-i}\right) + j\epsilon^{s^2}_{i,t-1}, \tag{16}$$

$$R^s_{i,t} = \rho + \sum_{i=1}^{c} \rho_i R^s_{i,t-i} + \epsilon^e_{i,t} + \sum_{i=1}^{d} \partial_i \epsilon^e_{i,t-i}, \tag{17}$$

$$h^s_{i,t} = O_0 + \sum_{i=1}^{v} O_i \epsilon^{S^2}_{i,t-1} + \sum_{i=1}^{u} \lambda_i h^S_{i,t-i} + k\epsilon^{e^2}_{i,t-1}, \tag{18}$$

$$\log\left(h^{S^2}_{i,t}\right) = O_0 + \sum_{i=1}^{v} \left\langle O_i \left| \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right| + \delta_i \frac{\epsilon^s_{i,t-i}}{h^s_{i,t-i}} \right\rangle + \sum_{i=1}^{u} \lambda_i \log\left(h^{s^2}_{i,t-i}\right) + k\epsilon^{e^2}_{i,t-1}. \tag{19}$$

The null hypothesis of spillover effects of volatility claims that the spillover of volatility does not exist ($j=0$ and $k=0$), whereas an alternative hypothesis conveyed that there exists spillover of volatility ($j \neq 0$ and $k \neq 0$). j and k are the coefficients of the lagged stock index residuals and lagged ETF residuals, respectively. If j is not equal to 0, it denotes that the lagged stock index residuals influence volatility of ETF returns. If k is different from 0, it denotes that lagged ETF residuals impact the volatility of index returns.

4. Data

The study collects the data from two sources, namely National Stock Exchange of India (NSE) website and Centre for Monitoring Indian Economy Prowess database. ETF price and and index price are collected from the NSE and prowess database, respectively. After the collection of prices, the study calculates the returns of the respective data series. Data have been included from the inception date of each ETF to December 2016. For this study, 14 ETFs and their corresponding indices have been selected. ETFs are selected on the basis of the criteria that ETF should have a minimum number of 500 traded days and it should currently trade in the exchange.

5. Results

We present the summary statistics in Table I. The mean values on return indicate that both the ETF and index returns are giving a more or less same return, which confirms less tracking error. Most of ETFs are yielding positive returns, except for INFRABEES, which is yielding a negative return. This is similar to the studies of Chen and Diaz (2015), which found that emerging market ETFs were producing positive returns than the negative returns.

Index	Type	Observations	Mean	SD	Skewness	Kurtosis	Jarque–Bera
BANKBEES	ETF	2,719	0.0008	0.0208	0.2189	8.1516	3,028.312*
Nifty Bank	INDEX	2,719	0.0008	0.0211	0.1632	7.463	2,268.603*
BSLNIFTY	ETF	1,135	0.0005	0.0285	−0.1198	5.5747	316.2101*
Nifty 50 Index	INDEX	1,135	0.0004	0.0113	−0.055	4.8879	169.1201*
CPSEETF	ETF	647	0.0005	0.0135	0.1734	8.2909	757.8936*
Nifty CPSE Index	INDEX	647	0.0003	0.0138	−0.0042	8.516	820.2306*
INFRABEES	ETF	1,509	−0.0003	0.0192	0.1353	6.2212	656.9697*
Nifty Infrastructure	INDEX	1,509	−0.0003	0.014	−0.0986	4.4538	135.3279*
JUNIORBEES	ETF	3,211	0.0008	0.0212	−0.8354	21.8182	47,752.15*
Nifty Next 50	INDEX	3,211	0.0008	0.0178	−1.1591	19.6299	37,719.17*
KOTAKNIFTY	ETF	1,641	0.0004	0.0104	−0.0726	6.1212	667.5098*
Nifty 50 Index	INDEX	1,641	0.0004	0.0107	−0.1119	4.4798	153.1336*
KOTAKPKSUB	ETF	2,188	0.0001	0.0249	−0.0866	12.6514	8,494.82*
Nifty PSU BANK	INDEX	2,188	0.0001	0.0228	0.6497	12.2739	7,994.591*
M100	ETF	1,435	0.0005	0.0135	−0.1974	5.2161	302.9469*
Nifty Midcap 100	INDEX	1,435	0.0005	0.0113	−0.7557	6.7384	972.1875*
NIFTYBEES	ETF	3,664	0.0006	0.0146	−0.3225	11.9265	12,228.34*
Nifty 50 Index	INDEX	3,664	0.0006	0.0148	−0.2561	12.8548	14,866.5*
PSUBNKBEES	ETF	2,227	0.0001	0.0236	0.2235	7.5241	1,917.661*
Nifty PSU BANK	INDEX	2,227	0.0001	0.0227	0.6359	12.1825	7,973.938*
QNIFTY	ETF	1,770	0.0005	0.0157	0.0491	18.5305	17,788.77*
Nifty 50 Index	INDEX	1,770	0.0004	0.0153	0.2881	14.8534	10,386.52*
RELCNX100	ETF	779	0.0006	0.0252	0.0503	9.2608	1,272.605*
Nifty 100	INDEX	779	0.0006	0.0112	−0.8299	8.537	1,084.515*
RELCONS	ETF	533	0.0003	0.0423	0.1512	7.6917	490.877*
Nifty India Consumption	INDEX	533	0.0006	0.0105	−0.3212	6.8477	337.9458*
SHARIABEES	ETF	1,449	0.0003	0.0262	0.017	6.6279	794.6726*
Nifty50 Shariah Index	INDEX	1,449	0.0003	0.011	0.081	6.2118	624.3813*

Note: *Significance at 1 percent level

Table I.
Summary statistics of returns of Index and ETF

The standard deviation of results shows that deviation from the mean value is not crossing 3 percent, except for RELCONS, where the deviation is nearly 4 percent. ETFs such as BSLNIFTY, JUNIORBEES, KOTAKNIFTY, KOTAKPKSUB, M100 and NIFTYBEES are skewed somewhat negatively in the standard distribution curve. All other ETFs are positively skewed. Furthermore, ETFs such as JUNIORBEES, KOTAKPKSUB, NIFTYBEES and QNIFTY are quite high compared to the other ETFs. Jarque–Bera values confirm that ETFs are not normally distributed.

For checking the stationarity of the data set, we conduct the augmented Dickey–Fuller test (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test on ETF and index returns. We present the unit root results in Table II. As per the ADF test, all the ETFs and index return series are stationary at 1 percent level. KPSS test values are lesser than critical values, thereby confirming the data series to be stationary. Table III shows the results of the test for the presence of the ARCH effect in the residuals. Both in the ETF and underlying index, there is presence of ARCH effect and provides justification for proceeding with GARCH and EGARCH test.

The data set has been segregated as broad-based indices and sectoral indices. Each group consists of seven ETFs. Table IV shows the results of mean and variance equation for broad-based indices. ARMA lag lengths are selected on the basis of the lowest Akaike information criteria value. ARCH effect indicates the impact of recent news on the volatility, and GARCH effect indicates the impact of old news on the volatility. The combination of ARCH and GARCH terms indicates the persistence of volatility. Mean equations show that the past returns and residuals are impacting current-day ETF returns, where JUNIORBEES and RELCNX100 have more impact than other ETFs. KOTAKNIFTY past returns and residuals

	ADF		KPSS			
	Level 0	Level 0	Returns on ETF		Return on index	
	ETF	Index	Level 0	Level 1	Level 0	Level 1
BANKBEES	−47.789*	−46.438*	0.060	0.066	0.054	0.105
BSLNIFTY	−20.684*	−31.618*	0.133	0.053	0.071	0.109
CPSEETF	−19.216*	−23.748*	0.197	0.356	0.200	0.102
INFRABEES	−47.603*	−34.751*	0.089	0.032	0.082	0.044
JUNIORBEES	−64.739*	−39.576*	0.100	0.092	0.094	0.048
KOTAKNIFTY	−40.065*	−38.045*	0.055	0.041	0.054	0.076
KOTAKPKSUB	−48.641*	−42.099*	0.052	0.039	0.050	0.098
M100	−41.607*	−33.004*	0.082	0.039	0.073	0.063
NIFTYBEES	−44.34*	−43.55*	0.044	0.079	0.044	0.251
PSUBNKBEES	−45.837*	−42.729*	0.048	0.141	0.049	0.094
QNIFTY	−45.003*	−39.201*	0.053	0.019	0.045	0.018
RELCNX100	−19.22*	−21.276*	0.069	0.052	0.048	0.030
RELCONS	−14.987*	−21.062*	0.063	0.096	0.064	0.153
SHARIABEES	−24.373*	−37.099*	0.096	0.042	0.056	0.065

Notes: KPSS TEST level of significance at 1 percent – 0.216; 5 percent – 0.146; 10 percent – 0.119. *Significance at 1 percent level p-value

Table II.
Unit root test of ETF and index returns

	ETF return	Index return	Individual returns		Spillover returns	
	ARMA	ARMA	ETF-ARCH	INDEX-ARCH	ETF-ARCH	INDEX-ARCH
BANKBEES	1, 1	1, 1	112.468*	47.235*	53.425*	47.643*
BSLNIFTY	0, 3	3, 3	12.558*	1.067	11.798*	3.245**
CPSEETF	2, 4	0, 2	21.673*	17.762*	21.376*	20.911*
INFRABEES	3, 2	2, 3	58.432*	3.672***	16.318*	4.495**
JUNIORBEES	2, 3	2, 4	129.764*	80.445*	4.951**	79.145*
KOTAKNIFTY	2, 2	3, 2	114.62*	1.201	3.376***	1.182
KOTAKBKETF	4, 4	2, 4	266.911*	7.14*	47.614*	6.835*
M100	0, 1	2, 3	50.599*	12.107*	3.409***	12.967*
NIFTYBEES	2, 4	2,4	256.84*	213.765*	191.894*	213.861*
PSUBNKBEES	4, 4	0, 1	153.129*	6.261**	62.404*	6.133**
QNIFTY	2, 4	4, 2	428.775*	15.453*	30.276*	15.046*
RELCNX100	1, 1	1, 1	3.323***	1.936	3.223***	1.788
RELCONS	1, 2	1, 1	31.859*	0.8	37.876*	0.761
SHARIABEES	2, 3	1, 2	54.754*	0.077	37.689*	0.071

Notes: ARCH value denotes F-statistical value in heteroscedasticity test. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table III.
Specification of ARMA structure and Heteroscedasticity

are not impacting current-day ETF returns since they are not significant. Variance equation indicates that the ARCH and GARCH values are highly significant at 1 percent level. Summation of ARCH and GARCH coefficients are near to unity but less than 1 for most of the ETFs, except M100 ETF. It indicates that the data have a persistence of volatility, which means that if there is any new shock to the market, it will take a long time to die. The volatility on JUNIORBEES mostly depends on the news about the previous volatility period, around 14 percent; all other ETFs, except JUNIORBEES, are below 10 percent.

We present the sectoral indices-based ETF results in Table V. Past returns and past noise are giving mixed results of negative and positive impacts on current-day ETF returns. In the case of RELCONS, both past returns and residuals negatively impact the current-day ETF return. In case of KOTAKPKSUB and SHARIABEES, shock persists for quite a long time. CPSEETF has a least GARCH value among this group. However, past volatility information impact is more than

Table IV. ARMA–GARCH results of ETF returns of broad-based indices ETFs

	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	NIFTYBEES	QNIFTY	RELCNX100
Mean equation							
α_0	0.00066 (2.572)	0.001 (4.325)*	0.0005 (1.941)***	0.00069 (2.325)**	0.0008 (4.227)*	0.00064 (2.3)**	0.00072 (2.477)**
α_1		0.584 (3.166)*	−0.352 (−0.237)		0.254 (8.329)*	0.02 (0.002)	0.214 (2.81)*
α_2		−0.722 (−5.714)*	−0.246 (−0.631)		−0.944 (−33.742)*	0.025 (0.006)	
α_3							
α_4							
θ_1	−0.492 (−15)*	−0.629 (−3.39)*	0.423 (0.285)	−0.088 (−3.015)*	−0.213 (−6.326)*	−17167.85 (−42.105)*	−0.614 (−9.424)*
θ_2	−0.072 (−1.944)***	0.778 (6.119)*	0.253 (0.545)		0.917 (26.792)*	−30.883 (−0.001)	
θ_3	−0.034 (−1.026)	−0.02 (−0.686)			0.049 (2.561)	43.18 (0.001)	
θ_4					0.0049 (0.273)	−123.1934 (−0.039)	
Variance equation							
α_0	0.00003 (3.833)*	0.0001 (8.758)*	0.00000333 (4.192)*	0.0001 (3.902)*	0.0001 (7.414)*	0.0001 (4.004)*	0.0001 (2.226)**
α_1	0.1062 (7.35)*	0.142 (20.227)*	0.086 (7.795)*	0.1067 (5.04)*	0.097 (15.223)*	0.056 (9.427)*	0.0927 (6.384)*
β_1	0.8592 (43.902)*	0.857 (129.471)*	0.884 (57.477)*	0.7103 (11.547)*	0.8874 (121.82)*	0.9349 (153.047)*	0.9109 (80.598)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table V. ARMA–GARCH results of ETF returns of sectoral indices ETFs

	BANKBEES	CPSEETF	INFRABEES	KOTAKPKSUB	PSUBNKBEES	RELCONS	SHARIABEES
Mean equation							
α_0	0.001 (2.375)**	0.00059 (1.617)	−0.000178 (−0.515)	−0.0000355 (−0.088054)	0.00027 (0.601)	0.0005 (0.87)	0.00026 (1.025)
α_1	0.102 (0.374)	0.707 (0.988)	1.468 (35.554)*	0.043 (0.038)	0.384 (5.744)*	−0.086 (−0.186)	−1.845 (−138.71)*
α_2		−0.072 (−0.104)	−0.675 (−13.446)*	0.336 (0.317)	−0.594 (−8.826)*		−0.971 (−73.653)*
α_3			−0.137 (−4.149)*	−0.317 (−0.26)	0.349 (5.159)*		
α_4				−0.008 (−0.163)	−0.881 (−16.067)*		
θ_1	−0.0301 (−0.11)	−0.642 (−0.906)	−1.657 (−55.918)*	47255.97 (1.461)	−0.345 (−5.01)*	−0.354 (−0.802)	1.372 (53.564)*
θ_2		−0.1297 (−0.204)	0.936 (34.855)*	16942.71 (0.22)	0.5781 (8.702)*	−0.177 (−0.782)	0.102 (2.328)**
θ_3		0.1245 (0.76)		−30496.33 (−0.547)	−0.3245 (−4.695)*		−0.472 (−20.287)*
θ_4		−0.0769 (−0.753)		21077.8 (0.275)	0.8631 (14.57)*		
Variance equation							
α_0	0.000003(4.346)*	0.0001 (2.988)*	0.000023 (5.002)*	−0.0001 (−1.391)	0.0001 (4.949)*	0.0001 (4.083)*	0.0001 (2.753)*
α_1	0.0621 (10.165)*	0.1412 (5.911)*	0.1076 (7.307)*	0.067 (13.864)*	0.0759 (9.69)*	0.1606 (7.224)*	0.0548 (8.217)*
β_1	0.9309 (143.605)*	0.7469 (13.598)*	0.8283 (34.152)*	0.9461 (289.21)*	0.9069 (110.599)*	0.8622 (63.07)*	0.9427 (162.977)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

other ETFs. Volatility persistence is confirmed on the basis of the aggregate of ARCH and GARCH coefficients, and the value is near to unity for most of the ETFs, except CPSEETF.

We present the ARMA–GARCH results for index returns for broad-based and sectoral indices-based ETF in Tables VI and VII, respectively. The lagged index returns negatively impact current index returns for most of the cases. The lagged unexpected returns show a positive influence for the next-day index returns in case of BSLNIFTY and RELCNX100, and all other ETFs give a variation of output each day, for example, *t*–1 gives positive, and *t*–2 gives negative results. The ARCH and GARCH coefficients in the variance equations are significant at 1 percent level, which confirms that the volatility has longevity in the market. Also, if there is any shock or information, it will take a long time to die in the market. The previous lagged returns negatively impact the current-day stock returns. The significantly positive lagged innovation of sectoral indices, except CPSE ETF in the mean equation, implies that past unexpected returns have a negative influence on index returns. The ARCH and GARCH terms are positive and significant, indicating that the lagged conditional variance have a higher positive influence on current conditional variance than the lagged innovations (ARCH). Also, being close to unity value of ARCH and GARCH indicates that the volatility sustains for a more extended period.

We present the EGARCH results in Table VIII for the ETFs of broad-based indices. The asymmetric terms are negative and significant for the all the ETFs, except for BSLNIFTY, which indicates that adverse asymmetric volatility effect is present in most of the broad-based index ETFs, except for BSLNIFTY. We present the asymmetric term in the sector-wise ETFs in Table IX. The significant negative asymmetric term confirms the asymmetric volatility on the current conditional variance, and GARCH and ARCH also confirm the persistence of volatility. The negative impact of volatility on the ETF returns such as BANKBEES, INFRABEES, KOTAKPKSUB, PSUBNKBEES, RELCONS and SHARIABEES is 2.9, 2.3, 1, 1.2 and 1.2 percent, respectively.

We present the EGARCH results for broad-based and sectoral index returns in Tables X and XI, respectively. The asymmetric effect of index returns is negative, and it implies that negative news impacts volatility more than positive news. The size of negative impacts for ETFs such as BSLNIFTY, JUNIORBEES, KOTAKNIFTY, M100, NIFTYBEES, QNIFTY and RELCNX100 is 9, 6, 5, 7, 9, 9 and 11.4 percent, respectively. Broad-based indices, as well as the sectoral indices-based index returns, are negatively influenced. However, the study of Madhavan (2014) shows that no asymmetric effect and ARCH effect are present in the BANKBEES and JUNIORBEES ETF. However, in contrast, our study finds both ARCH and asymmetric effect in BANKBEES and JUNIORBEES. Besides, negative news increases the volatility persistence than the positive news; as confirmed by the lagged conditional variance, results are in line with the studies of Krause and Tse (2013) in which they worked on between the US and Canada ETFs.

We present the results of the spillover of returns and volatility in Table XII. The spillover of returns is mostly unidirectional. The spillover from index returns to ETFs is significant than ETFs to index returns. Lagged index returns positively influence the current-day ETF returns, whereas lagged ETF returns are giving mixed results. Lagged ETF returns have a positive influence on the index returns for the ETFs such as CPSEETF and RELCONS, and a negative influence on INFRABEES and KOTAKPKSUB. Rest all other ETFs show a unidirectional relationship, from index returns influencing the ETF returns but not from the ETF returns to the index returns.

In EGARCH estimation, index returns for most of the ETFs are not influenced by the lagged ETFs return due to the insignificance of the coefficients, except for the ETFs such as CPSEETF and KOTAKNIFTY, which positively influence the index reurn, and INFRABEES and KOTAKPKSUB, which negatively influence index returns. However, lagged ETF returns are positively influenced by the index return, except for CPSEETF. Hence, we can predict that the ETF returns based on the previous day index return or current-day index return can influence the next-day ETF trades.

Table VI. ARMA–GARCH results of index returns of broad-based indices ETFs

	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	NIFTYBEES	QNIFTY	RELCNX100
ρ_0	0.0007 (0.056)***	0.0012 (4.71)*	0.0006 (2.393)**	0.0013 (4.78)*	0.0009 (4.38)*	0.0007 (2.233)**	0.0006 (1.175)
ρ_1	−0.041 (−1.463)	1.243 (10.451)*	1.657 (1.116)	0.174 (0.029)	0.507 (2.233)**	−0.332 (−0.802)	−0.525 (−2.594)*
ρ_2	−0.189 (−7.418)*	−0.734 (−6.265)*	−0.735 (−0.494)	0.038 (0.026)	−0.764 (−4.239)*	0.438 (1.1)	
ρ_3	−0.893 (−32.71)*		0.06 (0.553)			−0.06 (−1.643)	
ρ_4						−0.043 (−1.46)	
∂_1	0.111 (5.603)*	−1.101 (−9.165)*	−1.586 (−1.068)	−7374.754 (−0.102)	−0.429 (−1.889)***	0.41 (0.993)	0.644 (3.563)*
∂_2	0.162 (8.911)*	0.564 (5.238)*	0.602 (0.432)	40653.33 (1.86)***	0.706 (4.038)*	−0.411 (−0.978)	
∂_3	0.946 (52.568)*	0.126 (4.043)*		6629.01 (0.037)	0.091 (3.923)*		
∂_4		−0.046 (−2.301)**			−0.007 (−0.323)		
Variance equation							
O_0	0.0001 (1.966)**	0.0001 (7.74)*	0.00000288 (3.329)*	0.0001 (0.72)	0.0001 (7.37)*	0.0001 (4.287)*	0.0001 (2.041)**
O_1	0.044 (4.228)*	0.13 (16.741)*	0.055 (4.801)*	0.076 (9.946)*	0.102 (14.544)*	0.071 (7.637)*	0.052 (2.823)*
λ_1	0.945 (70.351)*	0.865 (135.673)*	0.921 (56.465)*	0.905 (103.624)*	0.882 (113.042)*	0.917 (86.944)*	0.906 (26.438)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table VII.
ARMA–GARCH results of index returns of sectoral indices ETFs

	BANKBEES	CPSEETF	INFRABEES	KOTAKPKSUB	PSUBNKBEES	RELCONS	SHARIABEES
ρ_0	0.00091 (2.618)*	0.0006 (1.216)	−0.0003 (−0.719)	0.0003 (0.486)	0.0003 (0.457)	0.0011 (2.131)**	0.0005 (1.666)***
ρ_1	−0.173 (−0.973)		−1.494 (−4.87)*	−0.81 (−5.602)*		−0.4 (−1.672)***	−0.962 (−4.646)*
ρ_2			−0.716 (−2.708)*	−0.831 (−6.298)*			
ρ_3							
ρ_4							
∂_1	0.277 (1.595)	0.039 (0.848)	1.605 (5.233)*	0.92 (6.21)*	0.109 (4.965)*	0.54 (2.579)*	1.016 (4.799)*
∂_2		−0.138 (−3.107)*	0.883 (2.998)*	0.947 (6.8)*			0.054 (1.75)***
∂_3			0.097 (2.675)*	0.139 (4.933)*			
∂_4				0.046 (1.9)***			
Variance equation							
O_0	0.00000254 (4.635)*	0.00001 (3.067)*	0.00000758 (3.295)*	0.0001 (4.687)*	0.0001 (5.45)*	0.0001 (2.052)**	0.0001 (4.259)*
O_1	0.056 (10.663)*	0.114 (5.797)*	0.052 (4.915)*	0.066 (8.253)*	0.069 (8.48)*	0.09 (3.221)*	0.063 (5.298)*
λ_1	0.939 (185.761)*	0.814 (21.456)*	0.91 (49.354)*	0.925 (112.843)*	0.921 (119.782)*	0.832 (15.493)*	0.898 (47.419)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table VIII. ARMA–EGARCH results of ETF returns of broad-based indices ETFs

EGARCH	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	NIFTYBEES	QNIFTY	RELCNX100
α_0	0.0005 (2.334)**	0.0007 (3.142)*	0.0002 (284.793)*	0.0004 (1.603)	0.0005 (3.023)*	0.0004 (1.931)***	0.0006 (1.992)**
α_1		0.593 (2.664)*	−0.131 (−91.193)*		0.306 (4.225)*	−0.58 (−0.072)	0.245 (3.306)*
α_2		−0.697 (−4.483)*	−0.089 (−541.236)*		−0.85 (−11.91)*	0.212 (0.033)	
α_3							
α_4							
θ_1	−0.498 (−15.695)*	−0.636 (−2.838)*	−7.04E+26 (−36.782)*	−0.093 (−3.193)*	−0.278 (−3.769)*	0.593 (0.074)	−0.633 (−10.232)*
θ_2	−0.072 (−1.988)**	0.752 (4.83)*	−9.28E+25 (−34.101)*		0.833 (11.391)*	−0.178 (−0.027)	
θ_3	−0.036 (−1.196)	−0.019 (−0.686)			0.047 (2.579)*	0.028 (0.095)	
θ_4					0.012 (0.693)	−0.005 (−0.02)	
Variance equation							
α_0	−0.474 (−5.583)*	−0.307 (−13.684)*	−2.912 (−165.327)*	−1.678 (−4.588)*	−0.364 (−12.677)*	−0.12 (−8.223)*	−0.237 (−6.391)*
α_1	0.215 (8.385)*	0.234 (20.578)*	0.226 (2047.079)*	0.223 (7.116)*	0.213 (21.844)*	0.114 (11.118)*	0.178 (7.876)*
δ_1	0.005 (0.345)	−0.036 (−5.68)*	−0.083 (−1012.294)*	−0.046 (−2.59)*	−0.055 (−8.934)*	−0.045 (−5.615)*	−0.033 (−1.842)***
β_1	0.958 (94.309)*	0.983 (469.37)*	0.986 (7723.253)*	0.826 (20.305)*	0.976 (340)*	0.996 (719.711)*	0.986 (227.227)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table IX.
ARMA–EGARCH results of ETF returns of Sectoral indices ETFs

EGARCH	BANKBEES	CPSEETF	INFRABEES	KOTAKPKSUB	PSUBNKBEES	RELCONS	SHARIABEES
α_0	0.000654 (1.98)**	0.0005 (1.63)	−0.0004 (−1.064)	−0.0000168 (−0.0359)	0.0001 (0.278)	0 (−0.016)	0 (15.523)*
α_1	0.025 (0.1)	0.888 (1.114)	−0.292 (−10.716)*	−0.207 (−3.358)*	−0.174 (−4.461)*	0.129 (0.25)	0.094 (29.287)*
α_2		−0.209 (−0.29)	−1.004 (−130.967)*	0.221 (4.081)*	0.118 (2.783)*		0.637 (238.686)*
α_3			−0.169 (−6.206)*	−0.266 (−4.751)*	−0.109 (−2.644)*		
α_4				−0.921 (−14.864)*	−0.929 (−25.946)*		
θ_1	0.0521 (0.207)	−0.826 (−1.044)	0.124 (37.937)*	0.214 (3.617)*	0.202 (4.6)*	−0.586 (−1.14)	5.33E+32 (33.916)*
θ_2		0.005 (0.008)	0.995 (285.316)*	−0.213 (−4.061)*	−0.098 (−2.031)**	−0.04 (−0.147)	3.93E+32 (32.551)*
θ_3		0.152 (0.91)		0.249 (4.479)*	0.098 (2.045)**		−6.83E+32 (−33.759)*
θ_4		−0.083 (−0.83)		0.922 (15.845)*	0.919 (21.869)*		
Variance equation							
α_0	−0.159 (−7.809)*	−0.994 (−3.636)*	−0.675 (−5.349)*	−0.306 (−12.043)*	−0.262 (−7.828)*	−0.407 (−6.175)*	−1.434 (−103.622)*
α_1	0.1202 (10.388)*	0.261 (8.327)*	0.218 (8.585)*	0.162 (16.784)*	0.165 (12.679)*	0.247 (7.122)*	0.076 (1083.477)*
δ_1	−0.0291 (−4.604)*	−0.023 (−1.474)	−0.023 (−1.717)***	−0.001 (−0.3)	−0.012 (−1.709)***	−0.012 (−0.515)	−0.007 (−162.432)*
β_1	0.9917 (537.612)*	0.908 (30.351)*	0.936 (67.184)*	0.974 (331.505)*	0.982 (237.87)*	0.965 (127.4)*	0.993 (11765.19)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table X. ARMA–EGARCH results of index returns of broad-based indices ETFs

	BSLNIFTY	JUNIORBEES	KOTAKNIFTY	M100	NIFTYBEES	QNIFTY	RELCNX100
Mean equation							
ρ_0	0.0002 (0.69)	0.0008 (3.099583)*	0.000543 (995.917)*	0 (0.025)	0 (2.702)*	0 (1.272)	0 (0.435)
ρ_1	−0.039 (−1.132)	−0.792 (−217.503)*	−0.783 (−2272.3)*	0.138 (0.041)	0.499 (1.847)***	−0.927 (−1.531)	−0.503 (−2.822)*
ρ_2	−0.199 (−6.516)*	−0.988 (−293.213)*	−0.779 (−2507.713)*	0.119 (0.097)	−0.628 (−3.391)*	−0.042 (−0.082)	
ρ_3	−0.89 (−26.191)*		0.193 (554.464)*			−0.001 (−0.03)	
ρ_4						−0.035 (−1.231)	
∂_1	0.103 (4.112)*	0.947 (53.279)*	4.25E+25 (36.542)	−5412086 (−0.576)	−0.404 (−1.496)	1.016 (1.685)***	0.638 (4.027)*
∂_2	0.173 (8.007)*	1.12 (45.36)	1.2E+26 (36.542)	16650058 (1.213)	0.578 (3.35)*	0.138 (0.245)	
∂_3	0.942 (39.412)*	0.158 (6.498)		5554071 (0.104)	0.094 (4.184)*		
∂_4		0.0001 (0.004823)			0.01 (0.429)		
Variance equation							
O_0	−0.237 (−4.165)*	−0.371 (−13.966)*	−3.319 (−173.24)*	−3.468 (−5.306)*	−0.43 (−12.43)*	−0.254 (−6.67)*	−0.413 (−3.44)*
O_1	0.0744 (3.562)*	0.238 (19.583)*	0.257 (1867.85)*	0.166 (7.609)*	0.213 (16.465)*	0.152 (10.906)*	0.067 (2.226)**
δ_1	−0.0947 (−6.442)*	−0.064 (−7.062)*	−0.05 (−725.446)*	−0.071 (−6.704)*	−0.092 (−11.427)*	−0.09 (−7.378)*	−0.114 (−4.702)*
λ_1	0.9801 (173.173)*	0.978 (387.103)*	0.985 (6890.042)*	0.922 (60.798)*	0.97 (293.668)*	0.985 (268.343)*	0.96 (79.299)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table XI.
ARMA–EGARCH results of index returns of sectoral indices ETFs

	BANKBEES	CPSEETF	INFRABEES	KOTAKPKSUB	PSUBNKBEES	RELCONS	SHARIABEES
Mean equation							
ρ_0	0.0005 (1.584)	0.0004 (0.821)	−0.004 (−1196.948)*	0.000204 (0.432)	0.0001 (0.536)	0 (0.828)	0 (1.357)
ρ_1	−0.134 (−0.755)		−0.074 (−57.082)*	−0.579 (−62.691)*		−0.275 (−0.801)	0.963 (35.668)*
ρ_2			0.138 (127.287)*	−0.986 (−99.942)*			
ρ_3							
ρ_4							
∂_1	0.239 (1.365)	0.033 (0.741)	−6.3E+22 (−0.003)	0.689 (30.512)*	0.11 (5.316)*	0.378 (1.169)	−0.918 (−24.448)*
∂_2		−0.13 (−3.008)*	3.98E+25 (37.706)	1.075 (40.089)			−0.057 (−1.94)***
∂_3			6.08E+21 (0.001)	0.128 (5.249)			
∂_4				0.021 (0.999)			
Variance equation							
O_0	−0.135 (−7.714)*	−0.923 (−3.845)*	−60.182 (−1226.291)*	−0.225 (−6.863)*	−0.231 (−7.859)*	−1.259 (−3.391)*	−0.599 (−5.379)*
O_1	0.1027 (9.777)*	0.248 (7.685)*	0.83 (458.699)*	0.144 (9.153)*	0.147 (9.4)*	0.127 (2.797)*	0.106 (4.661)*
δ_1	−0.0435 (−6.999)*	−0.0329 (−2.446)**	0.873 (475.555)*	−0.024 (−2.915)*	−0.021 (−2.745)*	−0.244 (−6.567)*	−0.13 (−8.886)*
λ_1	0.9929 (634.863)*	0.915 (34.885)*	0.544 (1722.868)*	0.985 (298.414)*	0.985 (339.731)*	0.875 (22.191)*	0.944 (85.892)*

Notes: *z*-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

Table XII. Spillover effects of returns and volatilities for index and ETF returns

	Spillover effect of returns				Spillover effect on volatility			
	ARMA–GARCH		ARMA–EGARCH		ARMA–GARCH		ARMA–EGARCH	
ETFs	ETF (ω)	INDEX (υ)	ETF (ω)	INDEX (υ)	ETF (j)	INDEX (k)	ETF (j)	INDEX (k)
BANKBEES	0.7275 (25.857)*	0.0455 (1.292)	0.706 (26.375)*	0.0292 (0.793)	0.032 (4.615)	0.012 (1.649)***	15.264 (2.095)**	8.753 (1.263)
BSLNIFTY	0.392 (9.179)*	0.009 (0.945)	0.402 (9.457)*	0.007 (0.659)	−0.3731 (−2.403)	0.003 (2.574)*	−433.2988 (−5.108)*	0.968 (0.184)
CPSEETF	0.114 (0.854)	0.438 (3.009)*	0.148 (1.031)	0.459 (3.185)*	−0.0784 (−2.9087)*	0.156 (2.81)*	−93.4339 (−0.704)	67.863 (0.413)
INFRABEES	0.607 (0)*	−0.051 (−3.16)*	0.604 (0)*	−0.067 (−3.672)*	0.023 (1.1413)	0.001 (3.991)*	−38.4179 (−1.043)	32.231 (3.939)*
JUNIORBEES	0.864 (67.555)*	−0.0261 (−1.232)	0.87 (72.614)*	−0.026 (−1.291)	0.11 (14.079)*	−0.029 (−25.5)*	44.3278 (10.114)*	−10.785 (−2.832)*
KOTAKNIFTY	0.7 (22.779)*	0.0193 (0.44)	0.698 (25.799)*	0.112 (766.357)*	0.0362 (3.5184)*	0.005 (0.527)	76.2322 (19.06)*	93.108 (1.957)**
KOTAKPKSUB	0.617 (34.989)*	−0.0665 (−2.939)*	0.81 (5616.522)*	−0.051 (−2.225)**	0.0001 (12.127)*	0.009 (2.514)**	16.0995 (10.292)*	12.345 (3.198)*
M100	0.81 (44.886)*	0.051 (1.894)***	0.806 (44.788)*	0.04 (1.626)	0.1451 (6.696)*	0.025 (3.12)*	59.935 (0.628)	149.887 (2.491)**
NIFTYBEES	0.756 (33.129)*	−0.0292 (−0.909)	0.749 (32.76)*	−0.04 (−1.393)	0.0466 (5.34)*	0.04 (4.118)*	16.1759 (1.178)	48.147 (2.989)*
PSUBNKBEES	0.678 (0)*	0.023 (0.395)	0.667 (0)*	0.007 (0.772)	0.0641 (6.432)*	0.012 (2.188)**	27.7474 (3.529)*	0.205 (0.037)
QNIFTY	0.827 (41.464)*	0.0122 (0.361)	0.826 (47.515)*	0 (−0.003)	0.0001 (2.2001)**	0.035 (3.509)*	434.1132 (8.525)*	29.109 (2.492)**
RELCNX100	0.677 (17.357)*	0.0053 (0.328)	0.093 (6.078)*	0.008 (0.555)	0.093 (2.8125)*	−0.002 (−1.908)***	23.8894 (0.529)	−2.268 (−0.291)
RELCONS	0.565 (6.508)*	0.0181 (1.808)***	0.683 (8.247)*	−0.961 (−56.881)*	−0.7996 (−6.3807)*	−0.001 (−3.667)*	45.8034 (0.404)	−9.87 (−1.286)
SHARIABEES	0.702 (27.308)*	−0.0088 (−0.825)	0.702 (28.513)*	−0.004 (−0.395)	−0.0087 (−0.782)	−0.011 (−5.424)*	12.498 (13.519)*	13.163 (1.924)***

Notes: z-statistics value are in parentheses. *,**,***Significant at 1, 5 and 10 percent levels, respectively

This study has examined the spillover effects of volatilities between the ETF returns and stock index returns using both ARMA–GARCH and ARMA–EGARCH models. The lagged innovation of index returns and ETFs returns for both broad-based and sectoral indices are considered. The lagged innovations of the index positively and significantly impact conditional variance equation of ETF return, except for CPSEETF and RELCONS. Hence, index return volatility spillover to ETF returns is confirmed. Lagged innovation of ETF returns positively influences the conditional variance equation of index return, except for JUNIORBEES, RELCNX100, RELCONS and SHARIABEES. Hence, this confirms volatility of ETFs return spillover to the index returns. Overall, it indicates a bidirectional volatility spillover between ETF and index returns. In EGARCH, the results are slightly different. Most of the results are insignificant in both index and ETF returns.

6. Conclusion

The major objective of the study is to examine the volatility spillover between ETF and index returns. The study uses the ETF and index returns, and it employs the ARMA–GARCH and ARMA–EGARCH models. Based on the empirical results, ETF and index returns show lagged conditional variance, which significantly and positively impacts the current conditional variance. Also, volatility persistence existed in all the ETFs and their respective indices. 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 index return to ETF returns and not vice versa. Hence, it confirms that current-day index returns can be used to predict the ETFs returns. However, as per EGARCH results, there is a bidirectional influence for majority of the ETFs. Volatility spillover results confirm that lagged squared residuals of ETF have a positive impact on the index returns, which conveys that volatility transmits from ETF to index for more number of ETFs than the index to ETF.

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

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