International Journal of Financial Management and Economics

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Empirical investigation of relationship between equity ETF and stock index: Study of Indian market

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Abstract
The synergy between the index volatility and equity ETFs have attracted the analysts due to their increase in utility as investment vehicle. The current study aims to investigate the association between the equity ETF and index volatility. The daily data from 1st January 2021 to 31st December 2022 has been taken for the current study. The percentage change in volume traded of ETF has been calculated. The volatility of Sensex has been calculated by generating GARCH variance series in E-views. Before applying GARCH, the condition of ARCH has been estimated. Pearson correlation coefficient has been performed on SPSS. The result of the study indicates a positive correlation between he understudy variables. The results have been supported by previous studies. It signifies that with increase in volatility in Stock index, the fluctuation in ETF trade volume is also increased.

Keywords: Equity ETF, Sensex, GARCH, volatility, correlation coefficient

1. Introduction

Over the last several years, researchers, practitioners, and regulators have focused a significant amount of attention on the volatility of financial market prices and returns. Exchange Traded Fund (ETF), has become household name in the financial markets among investors. Even though ETFs have become a prominent vehicle for investment, numerous concerns about the ETF's fluctuation has been raised as these seem to be directly correlated with that of the equities market. Over time, the transmission of volatility between ETFs and the stock market has been seen. There has been a significant increase in the amount of research conducted on the concerns pertaining to exchange traded funds (ETFs), Exchange traded funds (ETFs) have also seen an increase in research since the introduction of the first ETF in January 1993. ETFs, which are also known as index funds, attempt to mimic the results of their corresponding indexes as precisely as possible. The aim of the current study is to garden light on the nexus between the degree of volatility in the market index and the amount of trading if ETFs that track that index. For researchers and practitioners, the findings of this study have a significant impact on regulatory policymakers. For this reason, regulators are concerned about the effect ETFs have on markets they are linked to.

The trading of exchange-traded funds (ETFs) is seeing tremendous expansion and ETFs become apparent as a crucial part by which their underlying equities generate volatility (Krause *et al*., 2014) [9]. In the current informatics age, the process of knowledge transfer between an ETF and the given stock indices has become significantly simpler. The concept of market efficiency is directly related to the significance of doing research on volatility spillover. The existence of present volatility in the market, which is influenced by the instability of the market in the past and is referred to as volatility clustering, is what determines the level of efficiency in the market.

Finding the impact that results from the volatility of an exchange-traded fund's (ETF) specified index in India is the primary purpose of the current study. The chaos on the financial market could be caused by a lot of different things. Take, for example, how the stock price moves around all over the place. A strong impact is exerted on both investors and policymakers as a result of the impact of volatility on the financial instruments such as stock market, oil prices, and ETF. The volatility spillover could potentially have an effect on when making an investing decision, keep in mind that the risk is proportional to the asset's volatility.

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It is possible that investors and regulators will profit from the importance of spillover effect studies in the process of determining the kind of the correlation between the various financial vehicles. In the current research, the authors investigate the index base volatility and ETFs. In addition to that, the focus of this study is on the existence of an asymmetric relationship as well as its continued existence. Less is known, though, about how trading exchange-traded funds (ETFs) as financial derivatives affects the volatility of the market index that the ETFs are watching.

What follows is an outline of the remainder of the paper. ETFs and their underlying securities are discussed in detail in Section 2. In addition, it provides an overview of the relevant academic literature. Sensex volatility and ETF trading are briefly summarised in Section 3. Section 4 examines the connection between Sensex and equity exchange-traded funds (ETFs). The study's final conclusions and implications are presented in Sections 5 and 6.

2. A literature review

In this section, we will discuss the essential research that has been conducted in relation to ETFs. A study on the relationship between exchange-traded funds (ETFs) and the underlying spot index in Taiwan was carried out. For the purpose of this research, the intra-day data of five different ETFs were examined, beginning on January 15, 2007, and continuing through July 15, 2008, at 5-minute intervals. The results of the vector autoregressive (VAR) model reveal that the data has been transformed from the spot indices to the appropriate ETFs. This conclusion can be drawn from the findings. It was the subject of a study by Krause and Tse (2013) [13] to see how the ETF markets in the United States and Canada interact. The outcomes of the econometrics models show that the lagged US ETF returns have a considerable impact on the Canadian ETF market. There is a bidirectional movement between the Canadian and U.S. markets; however, the US equity market has a significant influence than the Canadian stock market. In addition, both markets have asymmetric volatility. Chen and Diaz (2015) [4] employed the integrated autoregressive moving average ARCH model to study the seven emerging markets' equity ETFs. The majority of ETFs had good returns based on the average value. According to the asymmetry coefficient, the market was more volatile in the face of negative news than in the face of positive. A clustering of volatility in the emerging market was shown to exist, according to the researchers. According to the research conducted by Agarwal *et al*. (2017), ETF ownership exacerbates co-movement in selected equity liquidity. This is because of the underlying arbitrage mechanism. According to the findings of Da and Shive (2015), ownership of an ETF is associated with a greater degree of co-movement of the selected stocks. The statistical results are on the similar lines with the following hypothesis: Exchange-traded funds (ETFs) impart the same shocks to each of the companies in their basket, which causes the stocks to move in the same direction. Evans, *et al*. (2017) [14] reinforce the earlier findings that ETF ownership increases the uncertainty of chosen stocks and their intraday bid-ask gap, and they observe that this proven impact is more prominent when the ETF investors are more involved in the creation and recovery of ETF shares. Additionally, they find that ETF ownership increases the intraday bid-ask spreads. Yavas and Rezayat (2016) [15]

investigated the movement between the stock markets of seven developing nations and the US equity ETFs in context of the volatility. In the study, the MARMA model was devised to examine the stock return and instability between the understudy nations. The data for this study were compiled from year 2012 to year 2014. The most important findings revealed that the spillover effect only goes in one direction, from developed markets to emerging countries. In the short run, volatility was higher in Indonesia and Turkey than other nations. Countries like Russia, Turkey, Indonesia, and China take a longer time than the other countries in the sample to recover from volatility shocks. More recent research into the origins of clustering volatilities by Gillemot, Doyne Farmer, and Lillo (2006) [8] has consistently confirmed that high volatilities are associated with low liquidity. Liquidity and volatility are clearly linked, as evidenced by a wealth of research. Krause *et al*. (2014) [9] provide evidence that volatility travels from exchange-traded funds to the stocks that are most directly underlying those ETFs. Similar evidence is presented by Petajisto (2011) [10], who draws the conclusion that ETF mispricing is caused by the illiquidity of component assets. As a result of improved liquidity, the author proposes that exchange-traded funds (ETFs) that are made up of domestic assets can be priced rather effectively. According to Bogan *et al*. (2012) [1], there is strong evidence that excessive short selling of ETFs causes systemic risk. With more short sellers committing to repay credit amount, the ETF operator's holdings in index stocks are eroded to a minimum percentage of the ETF's depicted market ownership. Cespa and Foucault (2012) [2] offer a theoretical model in which illiquidity in one asset, such as an ETF, might trigger a liquidity crisis in other assets, such as stocks. This model was published in 2012. Using a model called "rational expectations," the authors explain how the lack of liquidity in one asset can spread to other assets, like stocks.

3. Research Design

The daily data from 1st January 2021 to 31st December 2022 has been extracted from the official website of Bombay stock exchange. Total 499 observations have been taken for the current study. Daily data of understudy variables i.e. exchange traded funds and Sensex has been taken. Descriptive statistics have been used to understand the nature of the data. The volatility of SENSEX has been calculated by GARCH model. Volatility series of SENSEX has been created in EViews statistical software. GARCH Variance series has been generated in E-views. To find the relationship between Sensex volatility and ETF, Bivariate correlation has been calculated. SPSS software has been employed to execute the bivariate correlation between the variables. GARCH model was devised by Wilhelmsson (2006) [12] to for investigating the volatility forecast In this paper conditional variance (Volatility) can be estimated using the GARCH (1, 1) Model which is given

$$y_t = \varphi + \sigma_t \, \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 Y_{t-1}^2 + \alpha_1 Y_{t-1}^2$$

Where
Y_{t-1}^2 = Squared Residuals.
σ_{t-1}^2 = Conditional Variance.

The return on the Sensex has been calculated as

$$R_t = \log(P_t) - \log(P_{t-1})$$

Before calculating the GARCH Variance series, the existence of ARCH effects in the residual return series are tested. For determining the presence of ARCH effects in the data, Ljung-box and Lagrange multiplier (LM) test are used (Engle, 2001) [6].
Null and Alternative hypothesis for The Ljung-box and Lagrange multiplier (LM) is defined as:

H_0: ARCH effect does not exist

H_1: ARCH effects is present

4. Data Analysis
The following section exhibits the results of the statistical outcome of various test applied on the given data.

Table 1: Descriptive Statistics

Descriptive Statistics			
	Mean	Std. Deviation	N
ETF	23107.1560	22448.29321	499
Sensex	349044.3058	3.96339E5	499

Source: SPSS Output

The above table depicts the descriptive statistics of the data taken for the research. Total 499 observations have been taken. The mean value of Exchange traded funds is 22.63 and for Sensex fluctuation, it is 349044.3058.

Table 2: ARCH Effect

	Ljung Box test	LM Test	ADF Test
p-value	5.835e-05	< 3.4 e-13	0.023

Source: E-Views output.

Table 2 exhibit the statistics of ARCH Model effect. From the statistics depicted in the above table, it can be determined that the ARCH effect volatility is present in the Sensex return series. Hence, the GARCH models are appropriate to employ the generate the variance series of Sensex.
GARCH variance series is generated through E-views. To investigate the relationship between the volatility of Sensex return series and ETF trade volume, Pearson correlation has been evaluated.

Table 3: Correlation Statistics

Correlations			
		TVETF	Sensex
TVETF	Pearson Correlation	1	0.301
	Sig. value		0.000
	N	2	499
Sensex	Pearson Correlation	0.301	1
	Sig. value	0.000	
	N	499	499

Source: SPSS Output

Table 3 depicts the correlation relationship between Equity ETF return and Sensex volatility. The statistics shows a significant relationship between the equity ETF and Sensex volatility as the p-value is lower than 0.05 that leads to accept the null hypothesis. The positive sign of correlation coefficient indicates that both the understudy variables are positively correlated. It signifies the direct relationship between these equity ETF and Sensex volatility. It shows that with increase in volatility of stock index i.e. Sensex, the ETF trade volume also increase.

5. Conclusion
The primary purpose of current research is to investigate the linkage between the volatility of Sensex and exchange-traded funds. The index returns and ETFs are utilised in the analysis. According to the findings of the empirical research, both ETF and index returns exhibit a phenomenon known as lagging conditional variance, which has a large and beneficial effect on the current conditional variance. Additionally, persistent volatility was present in each of the ETFs and the indexes that corresponded to them. The index volatility has considerable impact on most ETFs. This evidence substantiates the existence of conditional fluctuation in the data. Usually, index returns spill over into ETF volume, but not vice versa. This shows that index volatility can be applied to predict ETF trade volume. It further shows that Volatility spillover demonstrate that ETF lagging boost index returns.

6. Implications
The results of this study have important repercussions, not only for those who invest in exchange-traded funds (ETFs), but also for those who oversee the industry. India is experiencing a surge in interest in ETFs. The fact that average returns on ETFs have been positive over a reasonably extended time suggests that passive Indian stock ETFs represent a feasible investment strategy for the long run for general investors. It can be demonstrated that fundamental factors have a significant impact on exchange-traded fund (ETF) returns when there is a unidirectional return spillover from index returns to ETF returns. In addition, investors with a short-term horizon stand to benefit from the potential of forecasting the return of an ETF by using the performance of a prior index.

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