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An Empirical Investigation of Performance Efficacy of Debt ETFs in India

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Abstract

This study offers the initial empirical evidence on the performance behaviour of 14 Debt ETFs (comprising six G-Sec Index ETFs and eight Corporate Bond ETFs) of India relative to their benchmarks during 2015-2023. This study has employed a single factor-based Capital Asset Pricing Model (CAPM), three conventional (Sharpe, Treynor and Sortino Ratio) and two modified risk-adjusted return measures (Modified Sharpe and M-square Ratio), and three tracking error measures to assess the behaviour of Debt ETFs in India. The overall results of CAPM, different risk-adjusted and tracking error measures show that the sample Debt ETFs more or less move around the performance of their specific benchmark, indicating the presence of a full replication strategy. The findings of this study suggest that the Indian Debt ETF market is efficient itself and leaves minimal or negligible opportunities for managers to time the market. Considering the low risk, better transparency, liquidity and benchmark mirroring ability, Debt ETFs can be a viable alternative for risk-averse investors looking for bond-like investments in the wake of changing market realities.

Major Findings: Evidence related to a full replication strategy in action is found. Very minimal divergence and tracking error from their respective benchmark is recorded. The findings indicate that the Indian Fixed Income ETF (FIETF) functions so efficiently that managers can scarcely time strategies.

Keywords: Debt Exchange Traded Funds, Performance, Risk-adjusted Returns, Tracking Error

1. Introduction

Debt ETFs, also known as Fixed-income ETFs (FIETFs), are financial instruments that trade on exchanges and are designed to track the performance of fixed-income securities like government bonds, corporate bonds with varying maturities, or bond market indices (Rompotis, 2010).

Fixed-income investors are facing a changing market landscape as the global economy shifts away from a period of steady growth, stable inflation, and supportive central banks. The early days of the COVID-19 pandemic saw extreme market volatility, highlighting the usefulness of bond ETFs. Changing market realities call for evolution in the role of fixed income (BlackRock, n.d.). Prior to the introduction of bond ETFs, there were few alternatives for investors seeking liquidity in fixed-income strategies (Fulkerson *et al.*, 2014). Investors now have access to liquidity, transparency, and ETF diversification because of the transformation brought about by fixed-income ETFs in the fixed-income market (Tang & Xu, 2014). Bond ETFs tend to differ from equity ETFs on various pedestals such as the nature of underlying assets, in terms of liquidity, maturity and arbitrage mechanisms.

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Further, Todorov (2021) argued that this particular type of ETF can help reduce the magnitude of shocks to their underlying indices and promote market stability. In addition, Debt ETFs also improve the liquidity of the underlying corporate bonds (Marta, 2019). It has been observed in the past that both retail and institutional investors often lodge on bond ETFs in times of high volatility and uncertainties, and by including fixed-income ETFs in their portfolio, investors can take advantage of the flight-to-safety function of bonds (Laipply *et al.*, 2023). Over time, various studies concerning Indian equity ETFs (Alamelu & Goyal, 2023; Kurian, 2020; Malhotra & Sinha, 2023; Prasanna, 2012; Singh & Kaur, 2016; Tripathi & Sethi, 2022) and Indian gold ETFs (Acharya *et al.* 2015; Kaur & Singh, 2018) have been conducted wherein a deviation from their main objective of performance replication has been documented. However, there is a lack of academic literature concerning Debt ETFs in India (Polisetty & Manda, 2019). Like other ETFs, the key objective of Debt ETFs is to match the underlying benchmark, rather than surpass it. Thus, more research is required to explore the same and various other aspects related to Debt ETFs in India. It would be interesting to see whether the Debt ETFs in India can achieve this objective or if these also deviate from following their respective benchmarks like other types of ETFs available in India.

1.1 Current Status of the Debt ETF Industry

Globally, ETFs hold a significant presence in the equity market, comprising 12.7% of equity assets in the United States, 8.5 per cent in Europe, and 4.4 per cent in the Asia-Pacific region. In contrast, ETFs hold a smaller share in the fixed-income market, representing 2.6% of assets in the U.S., 1.8% in Europe, and 0.4% in Asia-Pacific (Cohen, 2023). Despite this, the global Debt ETF market has reached $2 trillion in Assets Under Management (AUM) and is projected to hit $6 trillion by 2030 (Wilkins, 2023). As per the report of the Association of Mutual Fund Industry (AMFI), India had 49 ETFs, including equity, gold, and debt, totalling 12,856 million INR in July 2015 (Figure 1). Since then, the number has risen to 178 ETFs, with a 46 per cent CAGR in AUM. India's first Debt ETF, Nippon India Nifty 1D Rate Liquid Bees ETF, was launched on 8 July 2003 by Benchmark Asset Management Company Ltd. Back in 2015, only two Debt ETFs existed in the Indian stock market. As of 31 July 2023, there are 24 fixed-income ETFs in India with a CAGR of 37.97 per cent (Figure 2). There are mainly three sub-categories of Debt ETFs prevalent in India (*i.e.*, Government-Security Index ETFs, Corporate Bond ETFs and Liquid ETFs). In India too, Debt ETFs are gaining traction, particularly after the government-promoted BHARAT BOND ETF to support public sector borrowing needs (Economic Times, 2022).

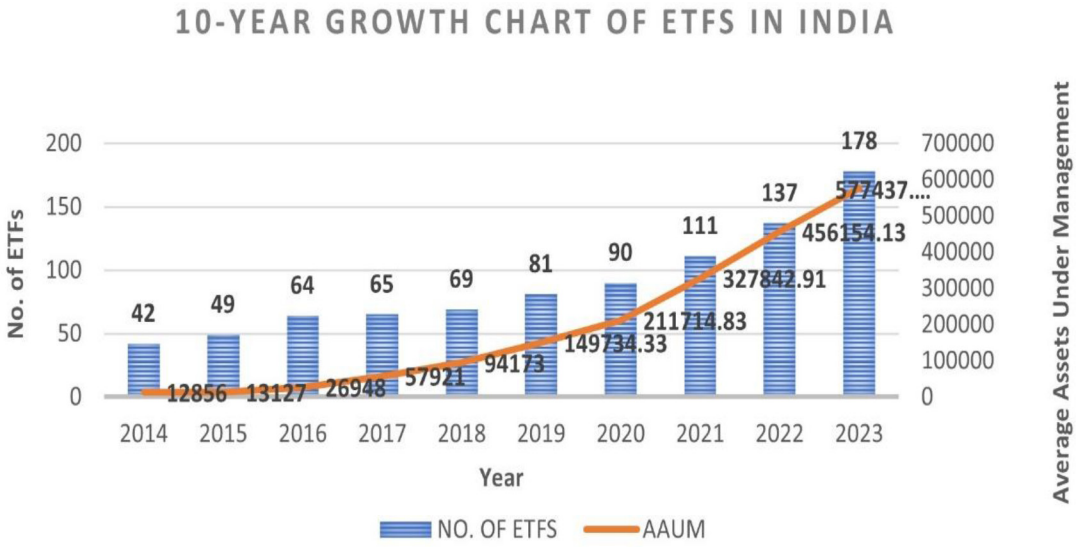


Figure 1. 10-year growth chart of ETFs in India.

Source: The author's Compilation.

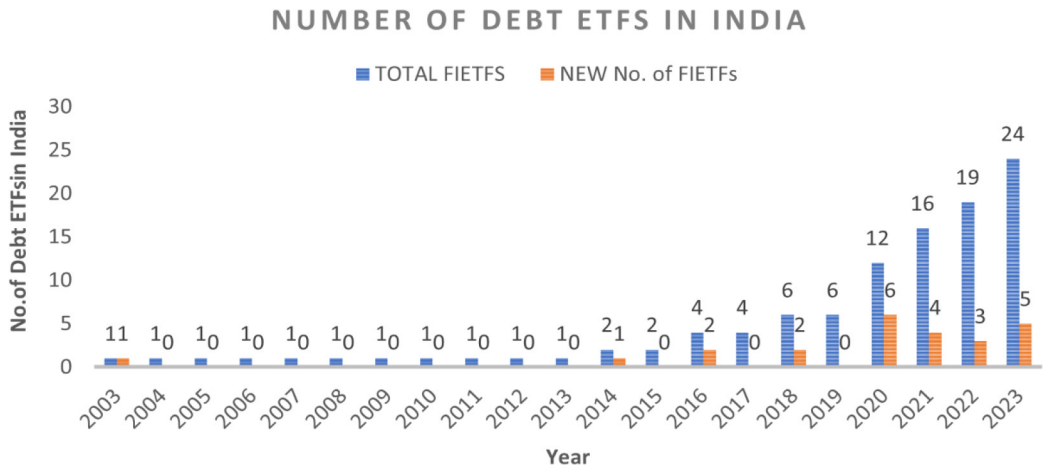


Figure 2. Number of debt ETFs in India.

Source: The author's compilation

1.2 Rationale of the Study

Despite the growing use of debt ETFs by both retail and institutional investors, systematic evidence on whether these funds deliver competitive risk-adjusted returns and efficient index tracking remains limited. The need for such evaluation is further strengthened by the scarcity of literature and the relatively low level of investor awareness regarding bond ETFs in India. As compared to equity ETFs, mutual funds, and traditional fixed-income instruments such as fixed deposits and bonds, Debt ETFs remain relatively less understood, possibly due to late growth. Against this backdrop, the present study pursues the following objectives:

i. To examine the risk-return performance of different categories available within the Indian debt ETFs segment relative to their underlying benchmark asset, using a set of conventional and modified risk-adjusted performance measures.
ii. To evaluate the tracking efficiency of Indian Debt ETFs with respect to their underlying debt indices.

The empirical evidence on their risk-return characteristics and benchmark replication efficiency can assist investors (particularly the risk-averse investors) in making informed investment decisions. Additionally, different measures of tracking efficiency can be used by the fund managers to identify sources of benchmark deviations and improve portfolio construction, rebalancing strategies and replication efficiency. From a policy perspective, understanding their replication efficiency can help policymakers in promoting transparency, investor confidence, and the healthy development of the ETF ecosystem. Thus, by providing comprehensive evidence on available Debt ETFs in India (including Government Bond and Corporate Bond ETFs, the study contributes to the limited literature on Indian Fixed Income ETFs.

The organisation of the current study is as follows. The second part presents a succinct overview of pertinent literature. The third part lays out the objectives of this study and the fourth part elucidates the data and its sources. The fifth part provides the methodology employed. The sixth part showcases the empirical findings and discussion; in the last part, the researcher draws conclusions and suggests directions for future research.

2. Literature Review

Although the past literature on ETFs has expanded considerably over the past decade; however, the focus has remained mainly on equity ETFs and gold ETFs. Most empirical studies have examined performance and tracking ability (Malhotra & Sinha, 2023; Prasanna, 2012; Alamelu & Goyal, 2023; Saji, 2017) and price discovery and pricing efficiency (Goel & Ahluwalia, 2021; Lakshmi, 2022; Purohit & Malhotra, 2015; Singh & Dhariwal, 2024) with regard to equity ETFs in India. Some found results in favour of outperformance (Dhume & Patil, 2019; Garg & Singh, 2013; Narend, 2014; Prasanna, 2012) and

others documented underperformance (Sethi, 2016; Saji, 2017). Performance differences have largely been attributed to management expenses, liquidity conditions and replication strategies (Singh & Kaur, 2016; Malhotra & Sinha, 2023). However, the Indian Debt ETF segment remains largely unexplored.

On the other hand, the Indian debt mutual fund segment has been explored by several researchers. Like Choudhary *et al.* (2020) and Sharma (2020) utilised different risk-adjusted measures to examine the performance of Debt Mutual Funds and reported considerable variation in risk-adjusted performance. Using a similar approach, Wachasundar (2018) found liquid debt mutual funds to be better performing than the benchmark indicators. Acharyya (2017) documented that the U.S recession led by the subprime crisis had a significant adverse impact on Indian debt mutual fund schemes. Another strand of research compared the performance of equity and debt mutual fund schemes in India (Maheshwary & Reddy, 2022; Sharma & Joshi, 2021; Chakraborty & Das, 2021; Prabhakaran *et al.*, 2023). Despite relatively lower returns, debt mutual funds were recorded to have lower return volatility, with better downside protection than the equity funds (Prabhakaran *et al.*, 2023). Thereby suggesting that debt-oriented schemes are more suitable for conservative investors seeking stable risk-adjusted returns. Extending further, Patel *et al.* (2023) examined the relationship between investment style, style consistency and risk-adjusted performance, wherein it was observed that maintaining style consistency generated better risk-adjusted performance. Moreover, in the international fixed-income market too, the performance of bond mutual funds has been explored (Clare *et al.*, 2019; Widyaningrum *et al.*, 2023), but relating to Debt ETFs, very few studies are there. Houwelling (2012) and Rompotis (2010, 2015, 2022) are among the pioneer researchers who have examined performance-related issues concerning the FIETFs in the U.S. According to Houwelling (2012), it was due to the better liquidity and lower transaction costs associated with the treasury bonds that the treasury ETFs were capable of replicating their benchmark more than the corporate bond ETFs. In different studies, Drenovak *et al.* (2012) for 31 eurozone sovereign Debt ETFs from 2007 to 2010 and Milonas and Rompotis (2015) in the context of German bond ETFs exhibited that the bond ETFs underperform their benchmarks. The underperformance can be attributed to the transaction costs of the underlying bonds (Houweling, 2012). Reilly (2022) attributes the underperformance to the hidden cost associated with corporate bond ETFs resulting from the asset's illiquidity. Further, there happens to be a difference between the actual cost and the explicitly reported cost that investors have to pay. Besides, the composition of bond ETFs' portfolios in fixed-income sectors can also affect their performance (Stankevičienė & Petroniene, 2019). Christi and Sihombing (2023) show that risk and tracking error affect performance, while the expense ratio influences the performance of neither stock-based nor bond-based ETFs. Besides, the underlying benchmark performance is reflected in the risk and tracking error, which significantly affect ETFs' performance. Milonas and Rompotis (2015) and Tang and Xu (2014) showed that FIETFs incur significant tracking errors. Besides, the tracking errors have a positive association with the maturity and credit quality of the underlying benchmark (Tang & Xu, 2014). While bond mutual funds generally pursue active portfolio management aimed at outperforming their benchmark (Rodrigues, 2023; Stankevičienė and Petroniene, 2019), the debt ETFs are designed to passively replicate an underlying bond index. Therefore, the latter requires an additional assessment of tracking efficiency, since the success of a passive fund depends not only on generating competitive returns but also on minimising deviations from its benchmark (Milonas & Rompotis, 2015).

Evident from the above review, most existing studies concerning performance evaluation in the Indian context mainly focus on equity ETFs or mutual funds, with relatively limited evidence on debt ETFs as a distinct product class. In the global literature, most studies related to debt ETFs identified in the review are about bond ETFs domiciled in the United States or Europe, and the majority of these report underperformances. However, Debt ETFs domiciled in other regions, including India, are yet to be studied.

3. Data and Sources

The researcher employed a comprehensive sampling method, covering the period from January 1, 2015, to July 31, 2023. The sample includes Debt ETFs with a minimum one-year trading history (excluding liquid ETFs) as of July 31, 2023, resulting in a final sample of 14 Debt ETFs: six G-Sec Index ETFs and eight Corporate Bond ETFs. The data is devoid of survivorship bias. Out of 14 sample Debt ETFs, 13 were still actively trading when the data was collected, while one corporate bond ETF, namely Edelweiss Mutual Fund - Bharat Bond ETF - April 2023 (EBBETF0423), matured in April 2023. The profile data for this study has been availed from factsheets of respective AMCs, and the Net Asset Value (NAV) daily data has been obtained from the AMFI official database, and the 10-year government bond yield has been used as a stand-in for the risk-free rate of return (Damodaran, 2008), data for which has been collected from investing.com. Daily closing prices for the benchmark indices corresponding to each ETF have been gathered from the official website of the National Stock Exchange (NSE) from the inception of each ETF till 31st July 2023.

Table 1 provides basic information related to the sample Debt ETFs, including the name and symbol of FIETF, the name of the underlying benchmark that they track, inception date, age, Asset Under Management and the expense ratio as of 31st July 2023.

4. Methodology

With the proposed study, the researcher aims to investigate the performance behaviour of Debt ETFs in India concerning (i) risk-adjusted returns and (ii)

Table 1. Brief about sample Debt ETFs in India

Name	Symbol	Benchmarks	Inception	Age (in years)	Expense Ratio	AUM (in millions)
Nippon India ETF Long Term Gilt	LTGILTBeES	NIFTY 8-13 YR G-SEC INDEX	05-07-2016	7.07	0.10%	13,548
SBI 10 YEAR GILT	SETF10GILT	NIFTY 10 YR BENCHMARK G-SEC INDEX	10-06-2016	7.14	0.14%	27,121
LIC MF G-SEC Long Term	LICNETFGSC	NIFTY 8-13 YR G-SEC INDEX	24-12-2014	8.60	0.16%	10,401
Nippon India ETF Nifty 5 Yr Benchmark G-Sec	GILT5YBEES	NIFTY 5 YR BENCHMARK G-SEC INDEX	05-04-2021	2.32	0.09%	1,233
Motilal Oswal 5 Year G-Sec	MOGSEC	NIFTY 5 YR BENCHMARK G-SEC INDEX	10-12-2020	2.64	0.15%	579
ICICI Prudential 5 Year G-SEC	ICICI5GSEC	NIFTY 5 YR BENCHMARK G-SEC INDEX	07-03-2022	1.40	0.20%	1,006
Axis AAA Bond Plus SDL 2026 Maturity	AXISBPSETF	NIFTY AAA BOND PLUS SDL APR 2026 50:50 INDEX	11-05-2021	2.22	0.12%	14,905
Nippon India Nifty CPSE Bond Plus SDL - 2024 Maturity	SDL24BEES	NIFTY CPSE BOND PLUS SDL SEP 2024 50:50 INDEX	13-11-2020	2.72	0.20%	18,095
Nippon India Nifty SDL - 2026 Maturity	SDL26BEES	NIFTY SDL APR 2026 TOP 20 EQUAL WEIGHT INDEX	25-03-2021	2.35	0.20%	74,862
Edelweiss Mutual Fund - Bharat Bond ETF - April 2023	EBBETF0423	Nifty BHARAT Bond Index – April 2023	26-12-2019	3.60	0.0005%	67,340
Edelweiss Mutual Fund - Bharat Bond ETF - April 2025	EBBETF0425	Nifty BHARAT Bond Index – April 2025	22-07-2020	3.03	0.0005%	1,26,589
Edelweiss Mutual Fund - Bharat Bond ETF- April 2030	EBBETF0430	Nifty BHARAT Bond Index – April 2030	26-12-2019	3.60	0.0005%	1,77,751
Edelweiss Mutual Fund - Bharat Bond ETF - April 2031	EBBETF0431	Nifty BHARAT Bond Index – April 2031	22-07-2020	3.03	0.0005%	1,29,972
Edelweiss Mutual Fund - Bharat Bond ETF- April 2032 - Growth	EBBETF0432	Nifty BHARAT Bond Index – April 2032	13-12-2021	1.63	0.0005%	1,04,389
Average				3.67	0.10%	54,842
Minimum				1.40	0.00%	579
Maximum				8.60	0.20%	1,77,751

Source: Compiled from monthly factsheets of respective AMCs.
Note: The information provided regarding the expense ratio and AUM is as of 31st July 2023.

tracking performance. The hypothesis developed concerning the above objectives is as follows:

H1: There is a significant difference between the risk-adjusted returns of the Debt ETFs and their respective benchmark.

H2: The Indian Debt ETFs incur significant tracking errors.

Note: The terms FIETF and Debt ETF are used interchangeably in this study.

Before calculating the risk-adjusted measures, daily risk and return characteristics of the sample Debt ETFs and their corresponding benchmarks are analysed from their inception till 31st July 2023 as presented in Table 2.

Formulae used to calculate the return for each FIETF and their respective benchmark are as follows:

4.1 Returns based on NAV

$$Return_{(FIETFi,\,t)} = \frac{[NAV_{(t)} - NAV_{(t-1)}]}{[NAV_{(t-1)}]} \qquad (1)$$

wherein,
$Return_{(FIETFi,\,t)}$ = Return on the *ith* FIETF on day t
$NAV_{(t)}$ = Net Asset Value on the present day (t)
$NAV_{(t-1)}$ = Net Asset Value on the prior day (t-1)

Benchmark Returns are calculated using the same formula used for the FIETFs, by replacing NAV with prices corresponding to the benchmarks.

4.2 Risk-Free Rate

According to Damodaran (2008), an investment is generally considered risk-free only if it is issued by an entity that poses no default risk. It is a fundamental component in risk-adjusted return calculations. Following Damodaran (2008) and Prasanna (2012), this study employs yield on 10-year government bonds as a stand-in for the risk-free rate.

4.3 Single-Factor Regression Analysis

The author runs a single-factor linear regression analysis based on the Capital-Asset-Pricing-Model (CAPM) to explain the behaviour of sample FIETFs. Under which the daily excess return on each FIETF is regressed upon the daily excess return on the specific benchmark using the following equation:

$$R_{(FIETF,\,t)} - R_{ft} = \alpha_j + \beta_j\left(R_{(Benchmark,\,t)} - R_{ft}\right) + \varepsilon_t \qquad (2)$$

Wherein, $R_{(FIETF,\,t)}$ and $R_{(Benchmark,\,t)}$ are the returns on FIETFs and their specific benchmark on day t. R_{ft} represents the daily risk-free rate, *i.e.*, the yield on an Indian 10-year government bond and ε_t is the error term. A negative alpha coefficient is expected as the return calculated is net of administrative expenses or based on NAV (Milonas & Rompotis, 2015). Beta (β_j) in Equation 2 is a measure of systematic risk and representative of replication efficiency, keeping in mind the passive nature of sample FIETFs. The closer the alpha and beta values are to zero and unity respectively, the greater the potential of achieving the primary objective of replicating the benchmark (Tripathi & Sethi, 2022). Further, a t-test is employed on the alpha and beta estimates to check the statistical difference of coefficients from zero and one, respectively.

4.4 Risk-Adjusted Return Measures

The researcher employs three conventional risk-adjusted measures and two modified risk-adjusted measures to evaluate the performance of 14 Debt ETFs in India.

4.4.1 Reward to Variability Ratio (Sharpe, 1966)

The Reward to Variability Ratio is a measure used to evaluate the effectiveness of an exchange-traded fund (ETF) in rewarding its investors proportionally to the unit of risk it undertakes, now popular as the Sharpe Ratio. A portfolio located on the capital market line will have a Sharpe ratio of 1.0, which is equivalent to the market's performance and is considered neutral (Wiberg, 2006). Essentially, the higher the Sharpe ratio, the more favourable the ETF's performance will be.

$$Reward\ to\ Variabilty\ Ratio = \frac{\{R_{pi} - R_f\}}{\{\ \ _{pi}\}} \qquad (3)$$

wherein,
(R_{pi}) = Return on the *ith* portfolio
(R_f) = Risk-free rate
(σ_{pi}) = Standard deviation of the *ith* portfolio returns

4.4.2 Reward to Volatility Ratio (Treynor, 1965)

This ratio is named after Jack Treynor; it evaluates the excess return of the portfolio relative to systematic risk (beta). Contrary to the Sharpe Ratio, it allows the investor to adjust market risk (undiversifiable risk) instead of standard deviation in the portfolio returns.

$$Treynor\ Ratio = \frac{\{R_{pi} - R_f\}}{\{\beta_{pi}\}} \quad (4)$$

where:
(R_{pi}) = Return on the *ith* portfolio
(R_f) = Risk-free rate
(β_{pi}) = Beta of the *ith* portfolio returns

4.4.3 Sortino Ratio (Sortino & Van der Meer, 1991)

The Sortino Ratio assesses the excess return of the portfolio relative to downside risk (standard deviation of negative returns). It is useful from the perspective of risk-averse investors as it emphasizes on downside risk of a portfolio (*i.e.*, potential losses). The potential for loss may provide a more accurate portrayal of investors' appetite for risk and serve as a more reliable indicator of risk (Wiberg, 2006).

$$Sortino\ Ratio = \frac{\{R_{pi} - R_f\}}{downside\ risk} \quad (5)$$

where:
(R_{pi}) = Return on the *ith* portfolio
(R_f) = Risk-free rate
(downside risk) = Standard deviation of negative portfolio returns

The risk-adjusted returns are annualised returns taking an average number of trading days in a year as the base (*i.e.*, 252 days) (Beck *et al.*, 2017).

In addition to the above conventional risk-adjusted measures, the researcher utilises two modified risk-adjusted ratios to make the performance evaluation more reliable and comprehensible for investors to understand.

4.4.4 Modified Sharpe Ratio (Israelson, 2005)

According to Israelson (2005), when excess return is negative, the reliability of the conventional Sharpe Ratio reduces. The most likely reason for the occurrence of a negative Sharpe Ratio is prolonged market downturns (Rodrigues, 2023). The suggested solution for the same is the Modified Sharpe Ratio (MSR) given by Israelson (2005).

$$Modified\ Sharpe\ Ratio = (R_{pi} - R_f)/\sigma_{pi}\ \hat{}\ [(R_{pi} - R_f)\,/\,abs(R_{pi} - R_f)] \quad (6)$$

wherein,
(R_{pi}) = Return on the *ith* portfolio
(R_f) = Risk-free rate
(σ_{pi}) = Standard deviation of the *ith* portfolio returns
(abs) = absolute value

4.4.5 M-square Ratio (Modigliani & Modigliani, 1997)

The M^2 metric is a modification of the Sharpe ratio (Sharpe, 1966), which standardises the excess return of a fund relative to a risk-free asset by considering the volatility of the fund's returns. Unlike the dimensionless Sharpe ratio, which can be challenging to interpret, the M2 is expressed as a percentage return, making it more comprehensible for the average investor (Beck *et al.*, 2017).

$$M^2 = (R_{(FIETFi)} - R_f) \times \frac{\sigma_{(Benchmarkj)}}{\sigma_{(FIETFi)}} - (R_{(Benchmarkj)} - R_f) \quad (7)$$

Where:
$R_{(FIETFi)}$ = Return on the *ith* Fixed-income ETF
$Return_{(Benchmark)}$ = Return on *jth* Benchmark
(R_f) = Risk-free rate
$\sigma_{(Benchmarkj)}$ = Standard deviation of the *jth* Benchmark
$\sigma_{(FIETFi)}$ = Standard deviation of the *ith* Fixed-income ETF

4.5 Tracking Error Measures

The basic aim of ETFs is to track their respective benchmark. The difference between their performances is a sign of Tracking Error (TE) (Malhotra & Sinha, 2023). To measure the tracking performance of the sample FIETFs, the researcher uses three methods to calculate the tracking errors (Singh & Kaur, 2016; Tripathi & Sethi, 2022).

The first one is TE1, which is the average absolute difference between the ETF return and the respective

benchmark return, generally referred to as the active return.

$$TE_1 = \frac{\sum_{t=1}^{n} |R_{(FIETFi,t)} - R_{(Benchmarkj,t)}|}{n} \quad (8)$$

Second is TE_2, which is one of the most commonly accepted measures by researchers (*i.e.*, standard deviation); it is the degree of variation or dispersion between the ETF returns and their benchmark returns (Tang & Xu, 2014).

$$TE_2 = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}[(R_{(FIETFi)} - R_{(Benchmarkj)}) - (\overline{R_{(FIETFi)} - R_{(Benchmarkj)}})]^2} \quad (9)$$

The third measure TE3 used is the standard error of performance regression (Drenovak *et al.*, 2012), in which the FIETF returns are regressed upon the benchmark returns to get the standard error value using TE3 Equation (10). It measures deviation unexplained by benchmark returns (Pope & Yadav, 1994).

$$R_{(FIETF,t)} = \alpha_i + \beta_j R_{(Benchmark,t)} + \varepsilon_t \quad (10)$$

Wherein, $R_{(FIETF, t)}$ and $R_{(Benchmark, t)}$ are the returns on FIETFs and their specific benchmark on day t. Together, these measures can be used by managers to diagnose the underlying cause of tracking deviations, improve replication strategies and enhance overall quality of passive fund management.

5. Results and Discussion

5.1 Descriptive Statistics

Table 2 exhibits the daily return and risk characteristics for the sample FIETFs and their benchmark indices. Considering G-Index ETFs specifically, SETF10GILT and ICICI5GSEC yield identical returns to their benchmarks, while other FIETFs in this category exhibit negligible and insignificant deviations from their respective benchmarks. Similarly, corporate bond ETFs exhibit no significant divergence from their respective benchmarks. Moreover, the average mean returns are positive and equal to 2.2 basis points (bp) for the overall FIETFs as well as their respective benchmarks. The median returns are also positive and equal to 2.2 bp for the FIETFs and 2.1 bp for the corresponding underlying benchmark. Upon employing a t-test on the returns, no significant difference is observed in the mean returns as well as the median returns. Hereby, the researcher infers that the FIETFs closely replicate the performance of the benchmark with very minimal divergence. On the other hand, regarding the risk characteristics and the risk-to-return ratio for the sample FIETFs, the results show that the overall FIETFs are less risky than their respective benchmark indices but still offer almost equivalent returns (Table 2).

Table 3 reports the remaining descriptive statistics figures related to skewness and kurtosis. Consistent with the findings of Milonas and Rompotis (2015), the results show that both the sample FIETF returns and the benchmark returns are negative but the FIETF returns are slightly more skewed. Both the FIETF and the benchmark return distributions are leptokurtic. Financial returns are commonly known to exhibit highly leptokurtic and negatively skewed characteristics (Del Brio *et al.*, 2020), and this pattern has also been observed in the sample FIETFs.

5.2 Single Factor Regression Analysis (CAPM)

Table 4 presents the results of a single-factor regression analysis under which the mean alpha for sample FIETFs is found to be negative 0.001, wherein on the individual level three G-Sec Index ETFs and three corporate bond ETFs out of 14 FIETFs are statistically significant at the 1 per cent level. These significant negative alphas are in line with the expectations of the researcher, as the daily returns of the FIETFs are based on the daily Net Asset Value of these FIETFs, which does not take the administrative expenses into account (Milonas & Rompotis, 2015). Overall, the results also show that the alpha values are close to zero. Thus, it can be inferred that the sample FIETFs closely follow their respective benchmarks (Tripathi & Sethi, 2022).

The average beta recorded is 0.979, and all 14 FIETFs happen to have positive beta, which is also statistically significant at a 1 per cent level (Table 4). Moreover, the individual beta for all the sample FIETFs is greater than 0.885, while SETF10GILT has a beta exactly equal to unity and one among them has a beta greater than 1

Table 2. Descriptive statistics

ETF symbol	Mean return (in per cent)		Median return (in per cent)		Risk (std. deviation) (in per cent)		Risk to return ratio		N
	FIETF	Benchmark	FIETF	Benchmark	FIETF	Benchmark	FIETF	Benchmark	
G-Sec index ETFs									
LTGILTBEES	0.027	0.028	0.023	0.023	0.281	0.304	10.571	11.069	1711
SETF10GILT	0.024	0.024	0.02	0.021	0.3	0.299	12.762	12.62	1720
LICNETF	0.028	0.026	0.025	0.021	0.268	0.286	9.586	11.16	2050
GILT5YBEES	0.018	0.019	0.015	0.016	0.161	0.165	9.056	8.797	555
MOGSEC	0.015	0.016	0.014	0.015	0.166	0.168	11.182	10.276	629
ICICI5GSEC	0.02	0.02	0.012	0.014	0.18	0.183	9.152	9.02	336
Average	0.022	0.022	0.018	0.018	0.226	0.234	10.385	10.49	1167
Minimum	0.015	0.016	0.012	0.014	0.161	0.165	9.056	8.797	336
Maximum	0.028	0.028	0.025	0.023	0.3	0.304	12.762	12.62	2050
T-Test	-0.237		-0.173		-1.991		-0.305		
pvalue	0.824		0.869		0.103		0.773		
Corporate Bond ETFs									
AXISBPETF	0.018	0.019	0.024	0.025	0.104	0.105	5.767	5.667	529
SDL24BEES	0.018	0.018	0.019	0.02	0.081	0.083	4.511	4.533	648
SDL26BEES	0.022	0.021	0.025	0.026	0.114	0.122	5.164	5.742	559
EBBETF0423	0.026	0.027	0.021	0.02	0.153	0.135	5.806	5.071	794
EBBETF0425	0.018	0.019	0.026	0.024	0.122	0.117	6.625	6.078	727
EBBETF0430	0.03	0.031	0.03	0.026	0.27	0.29	9.094	9.399	865
EBBETF0431	0.02	0.021	0.03	0.02	0.192	0.21	9.756	10.043	727
BBETF0432	0.02	0.019	0.031	0.021	0.201	0.227	10.111	12.112	393
Average	0.022	0.022	0.026	0.023	0.155	0.161	7.104	7.331	655.25
Minimum	0.018	0.018	0.019	0.02	0.081	0.083	4.511	4.533	393
Maximum	0.03	0.031	0.031	0.026	0.27	0.29	10.111	12.112	865
T-Test	-1.082		1.779		-1.312		-0.761		
pvalue	0.315		0.118		0.231		0.471		
Overall FIETFs									
Average	0.022	0.022	0.022	0.021	0.185	0.192	8.51	8.685	874.5
Minimum	0.015	0.016	0.012	0.014	0.081	0.083	4.511	4.533	336
Maximum	0.03	0.031	0.031	0.026	0.3	0.304	12.762	12.62	2050
T-Test	-1.084		1.537		-2.225b		-0.803		
pvalue	0.298		0.148		0.044		0.436		

Source: The Author.

Notes: a, b and c denote significance at 1 per cent, 5 per cent and 10 per cent.

(*i.e.*, EBBETF0423); however, this particular ETF matured in April 2023. Ultimately, the strong R-square values imply that the single-factor model is a good fit for explaining the performance of the sample FIETFs. Consistent with the results of (Rompotis, 2015), it can also be inferred that the Indian FIETF Market is efficient in itself.

5.3 Risk-Adjusted Performance

Table 5 presents the annualised risk-adjusted returns calculated for the sample FIETFs and their pertaining benchmarks. As per the Sharpe measure, G-Sec Index ETFs are observed to be slightly underperforming at a 5 per cent significance level. Whereas the corporate bond ETFs are also found to

Table 3. Descriptive statistics

ETF Symbol	Maximum Returns (in per cent)		Minimum Returns (in per cent)		Skewness		Kurtosis	
	FIETF	Benchmark	FIETF	Benchmark	FIETF	Benchmark	FIETF	Benchmark
G-Sec Index ETFs								
LTGILTBEES	2.051	3.555	-2.098	-2.979	-0.179	0.765	10.129	26.542
SETF10GILT	2.008	2.009	-2.095	-2.095	-0.121	-0.181	8.868	8.831
LICNETF	2.052	2.009	-2.099	-2.095	-0.095	-0.149	10.566	9.189
GILT5YBEES	0.572	0.567	-1.205	-1.231	-0.77	-0.793	10.74	10.643
MOGSEC	0.57	0.567	-1.224	-1.231	-0.833	-0.85	10.357	10.235
ICICI5GSEC	0.567	0.567	-1.196	-1.231	-0.852	-0.956	10.234	10.599
Average	1.303	1.545	-1.653	-1.81	-0.475	-0.361	10.149	12.673
Minimum	0.567	0.567	-2.099	-2.979	-0.852	-0.956	8.868	8.831
Maximum	2.052	3.555	-1.196	-1.231	-0.095	0.765	10.74	26.542
T-Test	-0.959		1.086		-0.687		-0.905	
pvalue	0.382		0.327		0.523		0.407	
Corporate Bond ETFs								
AXISBPETF	0.458	0.618	-1.311	-1.16	-4.509	-3.089	55.816	37.198
SDL24BEES	0.406	0.345	-0.777	-0.677	-1.891	-1.668	20.32	15.698
SDL26BEES	0.485	0.534	-1.211	-1.205	-2.634	-2.371	29.833	25.231
EBBETF0423	3.14	2.864	-0.959	-0.702	9.906	11.015	224.759	249.013
EBBETF0425	0.749	0.773	-1.262	-1.117	-1.536	-1.525	25.307	22.506
EBBETF0430	4.279	3.959	-2.06	-2.187	3.366	1.598	81.765	52.753
EBBETF0431	1.111	1.233	-2.31	-2.513	-2.728	-2.461	37.85	36.165
BBETF0432	0.637	0.856	-2.446	-2.715	-5.262	-4.55	62.805	57.627
Average	1.408	1.398	-1.542	-1.534	-0.661	-0.382	67.307	62.024
Minimum	0.406	0.345	-2.446	-2.715	-5.262	-4.55	20.32	15.698
Maximum	4.279	3.959	-0.777	-0.677	9.906	11.015	224.759	249.013
T-test	0.15		-0.114		-0.824		0.978	
pvalue	0.886		0.913		0.437		0.361	
Overall FIETFs								
Average	1.363	1.461	-1.589	-1.653	-0.581	-0.373	42.811	40.873
Minimum	0.406	0.345	-2.446	-2.979	-5.262	-4.55	8.868	8.831
Maximum	4.279	3.959	-0.777	-0.677	9.906	11.015	224.759	249.013
T-Test	-0.851		0.864		-1.038		0.574	
pvalue	0.410		0.404		0.318		0.576	

Source: The Authors

be underperforming their respective benchmark, but with no significant difference from the performance of their specific benchmark. The average Sharpe ratio of the FIETFs turned out to be negative 1.086, while for the specific benchmarks, it is negative 1.059. The results showed that neither a single FIETF nor their corresponding benchmark has a positive Sharpe ratio.

The second risk-adjusted measure is the Treynor ratio, which is also negative for all the sample ETFs. As shown in Table 5, both the G-Sec Index ETFs and the corporate bond ETFs are found to be closely following their specific benchmarks with no significant difference. The results of our third measure (*i.e.*, the Sortino ratio) are also in line with those of the Sharpe ratio. The results of the Sortino ratio reveal that category-wise corporate

Table 4. Single-factor regression analysis

ETF Symbol	Alpha(α)	t-stat	Beta(β)	t-stat	R2
G-Sec Index ETFs					
LTGILTBEES	-0.004[a]	-8.313	0.942[a]	135.395	0.915
SETF10GILT	0.000	-0.271	1.000[a]	987.024	0.998
LICNETF	-0.001[a]	-6.897	0.985[a]	465.161	0.991
GILT5YBEES	0.000[b]	-2.102	0.998[a]	838.700	0.999
MOGSEC	0.000	-0.780	0.999[a]	800.232	0.999
ICICI5GSEC	-0.001[a]	-3.078	0.991[a]	348.589	0.997
Average	-0.001	-3.573	0.986	595.850	0.983
Minimum	-0.004	-8.313	0.942	135.395	0.915
Maximum	0.000	-0.271	1.000	987.024	0.999
T-Test	-1.449		-1.428		
pvalue	0.221		0.226		
Corporate Bond ETFs					
AXISBPETF	-0.001	-1.520	0.993[a]	206.935	0.988
SDL24BEES	0.000	-1.206	0.996[a]	271.360	0.991
SDL26BEES	-0.001[b]	-2.249	0.984[a]	142.645	0.973
EBBETF0423	0.000[c]	1.938	1.006[a]	341.803	0.993
EBBETF0425	0.000	-1.314	0.994[a]	225.519	0.986
EBBETF0430	-0.002[a]	-5.049	0.966[a]	144.971	0.961
EBBETF0431	-0.002[a]	-4.299	0.968[a]	129.131	0.958
BBETF0432	-0.008[a]	-5.999	0.885[a]	46.168	0.845
Average	-0.002	-2.462	0.974	188.567	0.962
Minimum	-0.008	-5.999	0.885	46.168	0.845
Maximum	0.000	1.938	1.006	341.803	0.993
T-TEST	-1.768		-1.803		
pvalue	0.120		0.114		
Overall FIETFs					
Average	-0.001	-2.938	0.979	363.117	0.971
Minimum	-0.008	-8.313	0.885	46.168	0.845
Maximum	0.000	1.938	1.006	987.024	0.999
T-TEST	-2.415[b]		-2.446[b]		
pvalue	0.031		0.029		

Source: The Author.
Notes: a, b and c denote significance at 1 per cent, 5 per cent and 10 per cent.

bond ETFs are better performing than the G-Sec Index ETFs, as no significant difference is observed in their case. The average Sortino ratio for FIETFs is -1.143 and -1.130 for their respective benchmarks. The overall results also indicate that the FIETFs fully replicate their specific benchmarks, which is further supported by the t-test results, as an insignificant difference in the ETFs and benchmarks for all three ratios is recorded.

Considering the negative excess returns generated by sample FIETFs, the fourth measure employed is the Modified Sharpe Ratio given by Israelsen (2005). Table 6 exhibits that four G-Sec Index ETFs perform slightly better, while the remaining two mirror the performance of their respective benchmarks and collectively also these are found to be statistically better performing at the 5 per cent level. Among the Corporate Bond ETFs, the majority of them are found to be performing slightly better or equal to their specific benchmark (except for EBBETF0423, which matured in April 2023) but with no significant difference. When considered broadly, the sample FIETFs and their corresponding benchmarks are found to have a mean Modified Sharpe Ratio of negative 0.068 per cent and 0.071 per cent, respectively. Nevertheless, upon employment of a t-test on these results, statistically weak evidence of significance in support of the difference between their returns is found. Thereby pointing towards the capability of FIETFs in India to attain the primary objective of ETFs.

On the other hand, as per the results obtained from employing the M^2 ratio, G-Sec Index ETFs are capable of matching the performance of their specific benchmarks with very minimal divergence. SETF10GILT exactly replicates the performance, while others in this category slightly underperform. Among the corporate bond ETFs, EBBETF0423 & EBBETF0425 are found to be slightly better performing but statistically insignificant. On average, the results of the M^2 measure show that FIETFs slightly underperform their respective benchmark.

5.4 Tracking Performance

In Table 7, the mean daily tracking errors calculated by using three different measures are presented. Among the three measures, TE_1 generates the lowest values, which range between negative 0.002 per cent and positive 0.002 per cent. Neither the corporate bond ETFs nor the G-Sec Index ETFs are reported to have significant tracking errors. Three FIETFs out of the 14 FIETFs have TE_1 of zero per cent. Thus, to further ensure that sample FIETFs use a full replication strategy, one sample t-test is used to check the estimates; the results showed that the difference between the TE_1 values and zero is statistically insignificant. Contrary to Milonas

Table 5. Risk-adjusted returns

ETF Symbol	Sharpe ratio		Treynor ratio		Sortino ratio	
	FIETF	Benchmark	FIETF	Benchmark	FIETF	Benchmark
G-Sec Index ETFs						
LTGILTBeES	-0.218	-0.202	-0.014	-0.014	-0.284	-0.264
SETF10GILT	-0.204	-0.204	-0.010	-0.010	-0.274	-0.272
LICNETFGSC	-0.195	-0.183	-0.009	-0.009	-0.254	-0.243
GILT5YBEES	-1.195	-1.171	-0.031	-0.031	-1.548	-1.510
MOGSEC	-1.012	-0.999	-0.027	-0.027	-1.285	-1.260
ICICI5GSEC	-1.880	-1.851	-0.055	-0.055	-2.414	-2.320
Average	-0.784	-0.768	-0.024	-0.024	-1.010	-0.979
Minimum	-1.880	-1.851	-0.055	-0.055	-2.414	-2.320
Maximum	-0.195	-0.183	-0.009	-0.009	-0.254	-0.243
t-test	-3.662[b]		-1.643		-2.339[c]	
pvalue	0.015		0.161		0.067	
Corporate Bond ETFs						
AXISBPSETF	-2.238	-2.205	-0.043	-0.043	-1.916	-2.008
SDL24BEES	-1.993	-1.940	-0.033	-0.033	-1.881	-1.873
SDL26BEES	-1.680	-1.560	-0.045	-0.045	-1.656	-1.584
EBBETF0423	-0.836	-0.943	-0.019	-0.019	-0.921	-1.087
EBBETF0425	-1.167	-1.219	-0.026	-0.026	-1.167	-1.219
EBBETF0430	-0.436	-0.407	-0.022	-0.022	-0.502	-0.437
EBBETF0431	-0.740	-0.677	-0.031	-0.031	-0.706	-0.672
BBETF0432	-1.417	-1.259	-0.065	-0.065	-1.195	-1.076
Average	-1.313	-1.276	-0.036	-0.036	-1.243	-1.244
Minimum	-2.238	-2.205	-0.065	-0.065	-1.916	-2.008
Maximum	-0.436	-0.407	-0.019	-0.019	-0.502	-0.437
t-test	-1.225		-0.256		0.042	
pvalue	0.260		0.805		0.968	
Overall FIETFs						
Average	-1.086	-1.059	-0.031	-0.031	-1.143	-1.130
Minimum	-2.238	-2.205	-0.065	-0.065	-2.414	-2.320
Maximum	-0.195	-0.183	-0.009	-0.009	-0.254	-0.243
t-test	-1.628		-1.624		-0.631	
pvalue	0.127		0.331		0.539	

Source: The Author.
Notes: i) a, b and c denote significance at 1 per cent, 5 per cent and 10 per cent.

and Rompotis (2015), FIETFs in India can efficiently replicate the performance of their benchmarks.

Table 7 exhibits that the average TE_2 and TE_3 are 0.076 per cent and 0.070 per cent, respectively. As per the TE_2 and TE_3 measures, significant tracking errors at a 1 per cent level for corporate bond ETFs are reported while no significant tracking errors are recorded for the G-Sec Index ETFs. Collectively, TE2 and TE3 values also differ significantly from zero at a 1 per cent level. TE_2 is the highest among the three variants, but the values will still be the lowest if compared with other categories of ETFs such as equity and gold ETFs. Among the sampled FIETFs, not a single FIETF reported a tracking error greater than 0.5 per cent. Consistent with the findings of Drenovak and Urosevic (2010) about the eurozone

Table 6. Modified risk-adjusted returns

ETF symbol	Modified Sharpe ratio FIETF	Modified Sharpe ratio benchmark	M^2 ratio
G-Sec Index ETFs			
LTGILTBeES	-0.043%	-0.047%	-0.081%
SETF10GILT	-0.044%	-0.044%	0.001%
LICNETFGSC	-0.035%	-0.038%	-0.053%
GILT5YBEES	-0.078%	-0.080%	-0.063%
MOGSEC	-0.070%	-0.070%	-0.271%
ICICI5GSEC	-0.153%	-0.155%	-0.161%
Average	-0.071%	-0.072%	-0.105%
Minimum	-0.153%	-0.155%	-0.271%
Maximum	-0.035%	-0.038%	0.001%
t-test	3.252[b]		-2.645[b]
pvalue	0.023		0.046
Corporate Bond ETFs			
AXISBPSETF	-0.055%	-0.059%	-0.233%
SDL24BEES	-0.033%	-0.034%	-0.069%
SDL26BEES	-0.061%	-0.061%	-0.055%
EBBETF0423	-0.049%	-0.043%	0.229%
EBBETF0425	-0.044%	-0.042%	0.097%
EBBETF0430	-0.080%	-0.086%	-0.134%
EBBETF0431	-0.069%	-0.075%	-0.208%
BBETF0432	-0.144%	-0.162%	-0.568%
Average	-0.067%	-0.070%	-0.118%
Minimum	-0.144%	-0.162%	-0.568%
Maximum	-0.033%	-0.034%	0.229%
t-test	1.432		-1.397
pvalue	0.195		0.205
Overall FIETFs			
Average	-0.068%	-0.071%	-0.112%
Minimum	-0.153%	-0.162%	-0.568%
Maximum	-0.033%	-0.034%	0.229%
t-test	1.959[c]		-2.268[b]
pvalue	0.072		0.041

Source: The Author.
Notes: i) a, b and c denote significance at 1 per cent, 5 per cent and 10 per cent.

Table 7. Tracking errors

ETF symbol	TE_1	TE_2	TE_3	Average TE
G-Sec Index ETFs				
LTGILTBeES	-0.001	0.199	0.179	0.126
SETF10GILT	0.000	0.028	0.028	0.019
LICNETFGSC	0.002	0.068	0.064	0.045
GILT5YBEES	-0.001	0.015	0.015	0.010
MOGSEC	-0.002	0.018	0.018	0.011
ICICI5GSEC	-0.001	0.014	0.014	0.009
Average	0.000	0.057	0.053	0.037
Minimum	-0.002	0.014	0.014	0.009
Maximum	0.002	0.199	0.179	0.126
T-test	-0.494	1.930	2.002	1.958
pvalue	0.642	0.112	0.102	0.108
Corporate Bond ETFs				
AXISBPSETF	-0.001	0.055	0.053	0.036
SDL24BEES	0.000	0.053	0.049	0.034
SDL26BEES	0.001	0.087	0.076	0.054
EBBETF0423	0.000	0.050	0.049	0.033
EBBETF0425	-0.001	0.071	0.069	0.047
EBBETF0430	-0.001	0.130	0.121	0.083
EBBETF0431	-0.001	0.127	0.115	0.080
BBETF0432	0.001	0.142	0.125	0.089
Average	0.000	0.089	0.082	0.057
Minimum	-0.001	0.050	0.049	0.033
Maximum	0.001	0.142	0.125	0.089
T-test	-1.067	6.618[a]	7.049[a]	6.801[a]
pvalue	0.321	0.000	0.000	0.000
Overall FIETFs				
Average	0.000	0.076	0.070	0.048
Minimum	-0.002	0.014	0.014	0.009
Maximum	0.002	0.199	0.179	0.127
T-test	-1.070	5.092[a]	5.294[a]	5.174[a]
pvalue	0.304	0.000	0.000	0.000

Source: The Author.
Notes: i) Tracking error estimates presented in Table 7 are per cent values.
ii) a, b and c denote significance at 1 per cent, 5 per cent and 10 per cent.

FIETFs, the results also point toward the presence of a full replication strategy for FIETFs in India. In line with the findings of Howelling (2012), the researcher reports no significant tracking error for the G-Sec Index ETFs in India, thereby inferring that these track their specific benchmark better than the Corporate Bond ETFs. Thus, *H2* stands rejected in the context of Indian FIETFs.

6. Conclusion

Despite the increasing size of the debt exchange-traded fund market globally, empirical evidence on the performance of FIETFs in developing economies like India is astoundingly sparse. Contrary to the deviation in the performance of Indian equity and gold

ETFs from their respective benchmarks as revealed by past studies, the results of three conventional and two modified risk-adjusted measures altogether show that the FIETFs in India are less risky and capable of following their benchmark with slight or no significant deviation from their respective benchmarks. Thereby suggesting a full replication strategy in action for the Indian FIETF market, which can be attributed to the unique creation-redemption process, low expense ratio and transaction costs associated with these ETFs. Despite the negative risk-adjusted returns (bearing in mind that the evaluation period includes the COVID-19 period), the researcher suggests that FIETFs can be a viable, cost-effective option for inexperienced investors looking for bond-like investments. Moreover, TE_1 confirms the findings of descriptive statistics and risk-adjusted returns. Whereas, as per TE_2 and TE_3, the sample FIETFs perform slightly better, but the difference is not that big to confirm the presence of abnormal returns. This suggests that the Indian FIETF market is efficient and leaves minimal or negligible opportunities for managers to time the market. Additionally, in contrast to conventional fixed-income securities, FIETFs offer extended benefits of better liquidity, low risk and expense ratio, low exit load and the ability to margin trade, which can be explored by risk-averse investors to grapple with changing market realities.

6.1 Scope for Future Research

Debt ETFs in India are relatively new and have proliferated in recent years. This market is expected to grow further; thus, future studies can include Debt ETFs currently excluded due to insufficient trading history, potentially yielding different results. Despite using well-accepted performance measures, our study is limited by the Sharpe ratio's constraints. Future research could explore Debt ETFs' performance in India and other emerging markets with new methodologies. Given the lack of research in this segment, this study only addressed one aspect of Debt ETFs in India. Future studies could examine aspects like managers' selectivity, timing ability, and the impact of credit quality and maturity on Debt ETFs. Additionally, their viability compared to traditional investment methods like fixed deposits, Public Provident Funds (PPF), or gold could be assessed from the perspective of risk-averse investors.

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