Risk-Adjusted Performance and Market Timing of ESG Mutual Funds in India: A Multifactor Analysis

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Abstract
This study examines the risk adjusted performances and market timing abilities of 7 ESG Mutual Funds in India using daily data from 2021-2025. This study uses Capital Asset Pricing Model (CAPM), Carhart four factor model and Treynor-Mazuy Market Timing Model to find out the performances of the ESG Mutual Funds. The NIFTY 100 ESG and NIFTY 500 have been taken as benchmark to examine the performance of the Mutual Funds. Newey-West HAC standard errors are used to make inference robust to heteroskedasticity and autocorrelation. It has been found that the risk adjusted performances differ between different Mutual Funds. Quant ESG Mutual Fund has shown positive and significant alphas under CAPM model. However, it depends on the benchmark under Carhart model. Evidence of market timing is limited and inconsistent: Kotak and Quant show significantly negative Gamma under the ESG benchmark, while SBI shows significantly positive Gamma under the NIFTY 500 only.

Keywords: ESG Mutual Funds, Risk adjusted performances, Carhart four factor model, Benchmark sensitivity, Treynor-Mazuy Model.

1. Introduction

In recent years, sustainable investing has emerged as a major trend in global financial markets. Investors are increasingly incorporating environmental, social, and governance (ESG) considerations into their investment decisions alongside traditional financial metrics. (Liu et al., 2023; Ma, 2023; Pástor et al., 2020). The ability of the sustainability practises to influence the long-term value of firms led to this boom. The Indian market is also trying to catch with the global ESG trend. This led to the growth of Socially Responsible Investment in mutual funds. These mutual funds integrate ESG features into the portfolio of such funds. The selection categories include exclusionary screening, positive screening, or best-in-class. The firms with ESG practises have shown more resilience with better management in many studies (Eccles, Ioannou, & Serafeim, 2014). Evidence has shown that it has led to better financial performance. The ESG funds are proven to provide investors with both social impact and financial returns. Even though there have been studies which highlights the positive performance of ESG funds, it is still an ongoing debate. Early studies have provided mixed results on whether ESG investments underperform or outperform the conventional funds. One such argument is that the screening of ESG strategies limit the diversification. In turn this might affect the returns of ESG funds (Renneboog, Ter Horst, & Zhang, 2008). Some studies suggest that the stock picking based on ESG strategy might enhance the portfolio performance as such stocks might have higher management quality and long-term structured orientation (Friede, Busch, & Bassen, 2015). As a result, empirical evidence regarding the performance of ESG funds has remained inconclusive. Multiple studies indicate that, on a risk-adjusted basis, ESG funds perform in a way similar to conventional funds.

Bollen (2007) states that traditional fund attracts investors that look for non-financial preferences even though they might not outperform. Meta-analyses, including Friede et al. (2015), indicate that the link between ESG performance and financial returns tends to be non-negative. This suggests that applying ESG criteria does not inevitably undermine financial performance. Despite the growing literature on ESG investing, emerging market studies remain very limited. The Indian market has marked substantial growth in ESG oriented investments (Malhotra, 2025; Priya & Sharma, 2024). Many asset management companies have started introducing funds with sustainability screening and responsible investing into portfolio construction. Nifty 100 ESG Index was introduced to assess the companies with strong ESG characteristics. These trends raise significant questions about how well ESG mutual funds perform in producing better risk-adjusted returns than standard market benchmarks (Brooks & Oikonomou, 2017; Gupta & Chaudhary, 2023; Jonwall et al., 2024; Kräussl et al., 2023).

A further key question is what part active management plays in ESG funds. According to traditional asset pricing theory, once risk factors are correctly accounted for, abnormal returns ought to vanish in efficient markets. As a result, the assessment of ESG fund managers stock-picking ability or market-timing skills needed to beat benchmark indices

needed to be studied. Capital Asset Pricing Model (CAPM) and Carhart four-factor model are used widely for assessing the mutual fund performance. The evaluation of ESG mutual funds against conventional fund as well as ESG specific indexes are also required. If the ESG funds only replicate the index returns, this leads to low-cost passive investing. Investors might be able to know which will be more cost effective. Therefore, the comparison of ESG funds with broad market benchmark and ESG benchmark is important. Taking these factors into account, this study assesses how selected ESG mutual funds in India have performed, drawing on a range of performance measurement techniques. The analysis relies on conventional risk-adjusted performance metrics. They are; the Sharpe ratio, the Treynor ratio, and Jensen's alpha. Beyond that, regression-based asset pricing models such as the CAPM and the Carhart four-factor model are applied to test whether ESG mutual funds earn abnormal returns once systematic risk factors are accounted (Beloskar & Rao, 2023; Gubareva et al., 2023; Kiymaz, 2019). The market timing ability is studied using The Treynor-Mazuy model. Index comparisons provides insights into the fact that whether the ESG funds provide any additional returns to the investors (Zouaoui, 2019). The focus on the Indian mutual fund industry contributes to the literature of sustainable finance in emerging market literature (Beloskar & Rao, 2023; Vishali & M.K, 2024).

2. Literature Review

As sustainable investing has grown in importance, a steadily expanding body of literature has emerged to investigate how ESG practices relate to financial performance. Scholars have approached this relationship from a number of viewpoints. Such as how ESG characteristics affect firm performance, how socially responsible investment (SRI) funds perform, and how well ESG investment strategies work across different markets. The existing literature can broadly be categorized into several thematic areas.

2.1 ESG Performance and Financial Outcomes

ESG performance and its influence on the firm's financial outcomes is a major theme in the literature. Many early researches have assessed the influence of sustainability practices on the financial performance of companies. Eccles, Ioannou, and Serafeim (2014) finds that firms with higher sustainability characters outperformed the firms with low sustainability markers in the long term. The meta-analysis of 2000 studies by Friede, Busch, and Bassen (2015) found out that the relationship between the ESG and performance of firms are non-negative. The integration of ESG factors into firm is also said to increase the value creation. Some researchers assert that adding the ESG criteria could restrict the available investment universe. This may in turn have consequences for portfolio diversification. Renneboog, Ter Horst, and Zhang (2008) note that socially responsible investment approaches frequently depend on exclusionary screening. This practice may restrict investment opportunities and shape portfolio performance. Consequently, how ESG considerations affect financial performance continues to be a matter of active discussion.

2.2 Performance of Socially Responsible Mutual Funds

A further key line of study looks at how socially responsible investment funds perform when compared with conventional mutual funds. A number of studies indicate that, on a risk-adjusted basis, socially responsible funds tend to deliver better results comparable to those of traditional funds. Chatterjee, 2022; Momparler et al., 2024). According to Bollen (2007), socially responsible mutual funds do not deliver significantly better results than conventional funds. These funds attract investors who hold ethical or social concerns. In a similar way, Renneboog et al. (2007) examined socially responsible funds in a range of international markets and concluded that in several countries these funds generally fall below conventional benchmarks, even though the gaps are not always statistically significant. Many findings indicate that ESG funds frequently mirror the returns of broad market indices. This suggests that active management offers only limited added value relative to passive ESG investment strategies (Chen & Scholtens, 2018; Raghunandan & Rajgopal, 2021, 2022; Saliev, 2024). In the Indian literature the evidence remains mixed. Tripathi and Bhandari finds that the portfolio of ESG funds performed better comparing with broad market indices. Another study by Beloskar & Rao, (2023) found that the SRI funds generate shareholder returns similar to the market. With financial ratios and performance indicators Jonwall et al., (2024) tested the ESG benchmarks in emerging markets and found that it doesn't not deviate from conventional benchmarks when risks are accounted for. Indian stock market at the time of COVID-19 the high ESG and low SG portfolio did not differ in performances. However, during crisis period both delivered higher returns (Sood et al., 2022). These results imply that ESG tilts within Indian equity portfolios have not consistently produced better risk-adjusted returns. This calls for a more detailed analysis of fund-level performance through CAPM and multifactor models that also account for market-timing behaviour.

ESG investing is widely researched in developed markets. Studies conducted in emerging economies are still scarce. Emerging markets have very different institutional settings. These economies are marked by varying regulatory systems, disclosure standards, and

degrees of ESG awareness. As ESG investing gathers momentum in countries like India, empirical research on how ESG mutual funds perform in these settings is increasingly needed. (Beloskar & Rao, 2022; Joshi & Joshi, 2024).

Several ESG featured funds with sustainability-oriented portfolio was recently introduced in the Indian mutual fund industry. Even with this quick growth, empirical studies assessing how ESG mutual funds perform in India are still fairly limited. ESG funds' performance against conventional market indices as well as ESG benchmarks could offer useful insights into how effective sustainable investment strategies are in emerging financial markets. (Beloskar & Rao, 2023; Jonwall et al., 2024).

2.3 Quantitative Methods for ESG Mutual Fund Performance Analysis

Multi-factor models are used to evaluate ESG performance. Single factor models such as the Capital Asset Pricing Model (CAPM) have been widely used to evaluate whether fund managers are generating abnormal returns whilst accounting for market risk (Bauer et al., 2006; Fama & French, 2004). However, multi-factor models such as the Fama-French and Carhart model have also been used by researchers to account for additional risk factors such as company size, value and momentum (Carhart, 1997).

Multi-factor models can be useful to determine whether abnormal returns are caused by ESG funds due to exposure to systematic risk factors. Studies using these models suggests that ESG fund performance are explained by factor exposure. This is because ESG portfolios often have an investment style bias of growth and industry biases such as technology and healthcare.

When evaluating mutual fund performance, the ability of the fund manager to time the market is an important aspect. The Treynor and Mazuy (1966) model is widely used to evaluate whether fund managers are effectively managing exposure within their portfolios in relation to anticipated changes in the market. Empirical evidence suggests there has been little evidence of this. Many studies have found that most mutual fund managers do not have any significant market timing ability. This suggests that fund performance is largely due to exposure to systematic risk factors, rather than actively selecting a strategical approach.

2.4 Research Gap

While earlier research has looked at how ESG-related mutual funds perform and the application of alternative asset-pricing models in India. More evidence is still required regarding how sensitive ESG mutual fund performance estimates are to the choice of benchmark and whether results hold consistently across different risk-adjusted performance measures. Particularly, it remains an important empirical question how the Sharpe ratio, Treynor ratio, Jensen's alpha, CAPM, the Carhart four-factor model and the Treynor–Mazuy market-timing model perform when applied together to the dominating Indian ESG mutual funds universe. A complete picture of active ESG mutual funds in India is scarce. This study addresses the problem using seven ESG mutual funds, with daily data from January 2021 to December 2025, and benchmarks NIFTY 100 ESG and NIFTY 500. The study provides an insight on the consistency of performance evaluation using different benchmarks and models. It also evaluates whether the funds have statistically significant market timing ability.

3. Methodology

3.1 Data

This study examines the performance of selected Environmental, Social, and Governance (ESG) mutual funds operating in the Indian mutual fund industry. 7 ESG-oriented equity mutual funds were selected for the analysis: SBI ESG Fund, ICICI Prudential ESG Fund, Axis ESG Equity Fund, Kotak ESG Opportunities Fund, Aditya Birla Sun Life ESG Fund, Quant ESG Integration Strategy Fund and the Quantum ESG Best in Class Strategy Fund.

The funds were selected based on the availability of at least five years of performance data. The analysis covers January 2021 to December 2025. The selection of funds with at least five years of available data was intended to provide a consistent basis for comparison across schemes. Daily fund excess returns were analysed against two alternative market benchmarks: the NIFTY 100 ESG Index and the NIFTY 500 Index. These benchmarks allow to examine whether estimated risk-adjusted performance and market-timing relationships vary according to the market reference employed.

The final sample consists of seven ESG mutual funds over the five-year study period. The analysis applies the Capital Asset Pricing Model (CAPM), the Carhart four-factor model, and the Treynor–Mazuy market-timing model to assess risk-adjusted performance and market-timing behaviour. The findings are therefore specific to the selected funds and the January 2021–December 2025 period; they should not be interpreted as representative of every ESG mutual fund available in India.

The study uses daily Net Asset Value (NAV) data for the selected funds over the period from December 2020 to December 2025, resulting in a total of 1226 observations for each fund. The NAV data for mutual funds were obtained from the Association of Mutual Funds in India (AMFI) database, while index data for NIFTY 500, and NIFTY100 ESG were sourced from the National Stock Exchange (NSE) database and The Fama–French size and value factors and the momentum factor were obtained from the Indian

Fama–French and Momentum Factors Data Library maintained by the Indian Institute of Management Ahmedabad (IIMA).

3.2 Econometric Model Specifications

3.2.1 Risk-Adjusted Performance Measures

Three commonly used performance indicators were computed in order to assess the risk-adjusted performance of the ESG mutual funds that were selected.

i) The Sharpe Ratio, calculates the excess return produced for each unit of total risk; which is computed as follows:

$$\text{Sharpe Ratio} = (Rp - Rf) / \sigma p$$

where Rp represents the average portfolio return, Rf is the risk-free rate, and σp is the standard deviation of portfolio returns (Sharpe, 1966)

ii) The Treynor Ratio evaluates performance relative to systematic risk and is computed as:

$$\text{Treynor Ratio} = (Rp - Rf) / \beta p$$

where βp represents the portfolio beta calculated from the CAPM regression (Treynor, 1965).

iii) Jensen's Alpha assesses a portfolio's abnormal return beyond what the CAPM predicts, and it is estimated using the regression intercept.

iv) Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model assess whether ESG mutual funds generate abnormal returns relative to market risk. The CAPM regression is specified as:

$$Rp - Rf = \alpha + \beta (Rm - Rf) + \varepsilon$$

where Rp − Rf represents the excess return of the mutual fund, Rm − Rf represents the excess return of the market index, α represents Jensen's alpha indicating abnormal performance, β measures the sensitivity of the fund to market movements, and ε represents the error term (Sharpe, 1964).

v) Carhart Four-Factor Model

To analyze in greater depth the factors that determine fund returns, the Carhart four-factor model was used. By adding further risk factors such as size, value, and momentum effects, this model builds upon the CAPM. The model is expressed as:

$$Rp - Rf = \alpha + \beta_1 (Rm - Rf) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \varepsilon$$

where SMB represents the size factor (small minus big), HML represents the value factor (high minus low), and WML represents the momentum factor (winner minus loser). These factors assist in determining whether fund returns are affected by exposure to systematic risk factors other than the market (Carhart, 1997).

vi) Market Timing Ability: Treynor–Mazuy Model

The Treynor–Mazuy model was used to assess the market timing ability of fund managers. The model introduces a quadratic term of the market excess return to capture timing ability and is calculated as:

$$Rp - Rf = \alpha + \beta (Rm - Rf) + \gamma (Rm - Rf)^2 + \varepsilon$$

where γ represents the market timing coefficient. A positive and statistically significant value of γ indicates that the fund manager successfully adjusts portfolio exposure in anticipation of market movements (Treynor & Mazuy, 1966).

vii) Benchmark Comparison

To evaluate whether ESG mutual funds outperform sustainability-focused market indices or broad market indices the CAPM regression and Carhart Four-Factor Model were estimated using the NIFTY100 ESG index and NIFT 500.

3.3 Tools Used for Analysis

The empirical analysis was run on Stata software package. The descriptive statistics, correlation and regression estimates were also calculated using Stata software. The regression models used Newey-West HAC standard errors in order to account for potential heteroskedasticity and autocorrelation issues in the time series data. For the Newey–West estimator, a lag length of three months was chosen so as to capture possible short-term autocorrelation in the daily return series, thereby ensuring that the standard error estimates stay robust despite the volatility that sustainable investment vehicles frequently exhibit. The results were subsequently compiled and displayed in tabular form for interpretation.

3.4 Definitions of Variables Used in the Study

Variable	Type	Definition
Rp − Rf	Dependent	Excess return of the mutual fund portfolio
Rp	Independent	daily return of the mutual fund portfolio
Rf	Independent	91-day Treasury bill rate (RBI)
Rm	Independent	Market return represented by benchmark indices (NIFTY 500, or NIFTY100 ESG)
Rm − Rf	Independent	Market excess return
SMB	Independent	Size factor representing the return difference between small-cap and large-cap stocks (Small Minus Big)
HML	Independent	Value factor representing the return difference between high book-to-market and low book-to-market stocks (High Minus Low)
WML	Independent	Momentum factor representing the return difference between

		past winner and past loser stocks (Winner Minus Loser)
$(Rm - Rf)^2$	Independent	Squared market excess return used in the Treynor–Mazuy model to capture market timing ability
α (Alpha)	Parameter	Abnormal return or intercept term representing fund performance beyond systematic risk factors
β (Beta)	Parameter	Sensitivity of fund returns to market movements
γ (Gamma)	Parameter	Market timing coefficient in the Treynor–Mazuy model
ε	Error Term	Error term capturing unexplained variation in returns

4. Results and Discussion

This section presents the empirical findings from the performance evaluation of selected ESG mutual funds in India. The analysis includes descriptive statistics, risk-adjusted performance measures, and regression-based asset pricing models including the Capital Asset Pricing Model (CAPM), the Carhart four-factor model, and the Treynor–Mazuy market timing test.

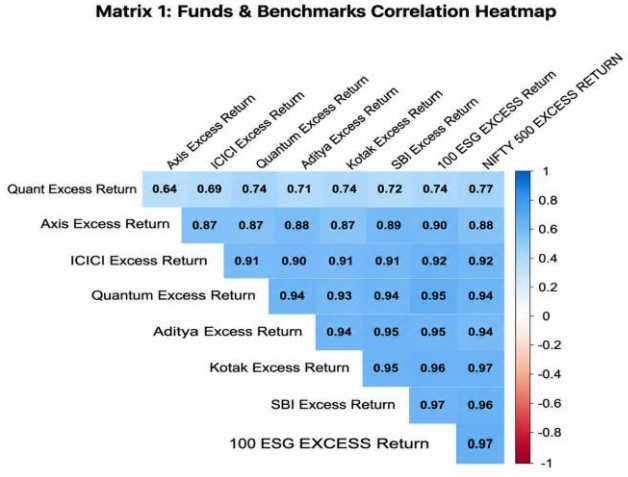
Table 1: Descriptive Statistics

Series	Mean	Std_Dev	Min	Max	Skewness	Kurtosis
Axis Excess Return	0.000256	0.007997	-0.03553	0.036903	-0.33147	2.125295
Aditya Excess Return	0.000374	0.008942	-0.04744	0.038115	-0.47059	2.608309
SBI Excess Return	0.000371	0.00855	-0.05479	0.042128	-0.4306	3.761865
ICICI Excess Return	0.000422	0.007624	-0.04602	0.031319	-0.49287	2.568428
Kotak Excess Return	0.000339	0.00865	-0.05937	0.035784	-0.57987	3.544725
Quantum Excess Return	0.000352	0.008154	-0.04684	0.038503	-0.4078	2.543229
Quant Excess Return	0.000753	0.010777	-0.07225	0.046732	-0.7207	3.829316
NIFTY 500 Excess Return	0.000399	0.009043	-0.06788	0.04125	-0.70867	4.926005
NIFTY 100 ESG Excess Return	0.000342	0.008855	-0.0517	0.039001	-0.44433	3.16412

Source:Authors' own calculation

From the descriptive statistics it can be seen that all seven ESG mutual funds had positive average abnormal daily returns. The highest average abnormal return was from Quant ESG Fund with a value of 0.000753 followed by ICICI Prudential ESG with an average abnormal return of 0.000422. Axis ESG had the lowest average abnormal return (0.000256). Quant ESG also had the highest level of standard-deviation (0.010777) which indicates more volatility in returns. Between the benchmarks NIFTY 500 had a higher average abnormal return (0.000399) compared to NIFTY 100 ESG (0.000342). Every fund and both benchmarks display negative skewness, pointing to longer left tails, and their positive kurtosis values point to departures from normality in the direction of heavier tails.

Table 2: Correlation Matrix



In this correlation analysis, the high correlation (0.97) between NIFTY 100 ESG and NIFTY 500 shows the large overlap between the two indices. This explains why estimates of fund performance using these benchmarks could be similar. Kotak ESG Fund and SBI ESG Fund also have high correlations with the benchmarks. This shows high correlation within the market. Therefore, it appears that fund returns from ESG mutual funds are largely influenced by the overall market behaviour. The high correlations between ESG funds and market indices show that ESG mutual funds act very similarly to well diversified market portfolios. This agrees with the regression results found later in the study where market factors are shown to explain a large amount of the fund return variation.

4.3 Performance Measures of ESG Mutual Funds

Table 3: Performance Measures of ESG Mutual Funds (Benchmark: NIFTY 100 ESG index)

Fund	Mean daily excess return	CAPM Alpha	Carhart Alpha	Treynor Ratio	Sharpe Ratio	Adj_ R^2 CAPM	Adj_ R^2 Carhart
Axis	0.0256	-0.54 (0.830)	0.58 (0.816)	0.0796	0.508	0.8036	0.8089
Aditya	0.0374	1.18 (0.606)	1.41 (0.499)	0.0986	0.6639	0.895	0.9039
SBI	0.0371	1.3 (0.449)	1.16 (0.501)	0.1002	0.6885	0.9328	0.9345
ICICI	0.0422	3.81 (0.103)	2.64 (0.218)	0.1343	0.8792	0.8463	0.8621
Kotak	0.0339	0.43 (0.808)	-1.39 (0.399)	0.0908	0.6212	0.9247	0.9334
Quantum	0.0352	1.30 (0.442)	1.34 (0.410)	0.1011	0.6856	0.9088	0.9186
Quant	0.0755	11.28** (0.017)	7.28* (0.080)	0.209	1.1083	0.5561	0.5963

**p < 0.10, **p < 0.05, ***p < 0.01*
Source: Authors' own calculation

Table 4: Performance Measures of ESG Mutual Funds (Benchmark: NIFTY 500 index)

Fund	Mean daily excess return	CAPM Alpha	Carhart Alpha	Treynor Ratio	Sharpe Ratio	Adj_ R^2 CAPM	Adj_ R^2 Carhart
Axis	0.0256	-1.34 (0.624)	1.78 (0.484)	0.0833	0.508	0.7654	0.7916
Aditya	0.0374	0.10 (0.965)	2.81 (0.198)	0.1017	0.6639	0.8774	0.8949
SBI	0.0371	0.20 (0.914)	2.50 (0.128)	0.1028	0.6885	0.9251	0.9385
ICICI	0.0422	2.80 (0.211)	3.78* (0.079)	0.1365	0.8792	0.8542	0.8617
Kotak	0.0339	-0.77 (0.640)	-0.06 (0.971)	0.0923	0.6212	0.9341	0.9355
Quantum	0.0352	0.33 (0.861)	2.64 (0.154)	0.1045	0.6856	0.8873	0.9046
Quant	0.0755	9.91** (0.025)	8.55** (0.040)	0.2072	1.1083	0.5907	0.6039

**p < 0.10, **p < 0.05, ***p < 0.01*
Source: Authors' own calculation

The seven ESG funds demonstrate differing levels of risk adjusted performance over the years 2021-2025. The Quant ESG funds had the best performance based on the descriptive statistics showing it had the highest daily average excess return (0.755), highest Sharpe ratio (1.1083) and Treynor ratio 0.2090 (NIFTY 100 ESG benchmark) and 0.2072 (NIFTY 500 benchmark). The next best performance was from the ICICI Prudential ESG Fund, with the second highest daily average excess return and Sharpe ratio. The Axis ESG Fund displayed the lowest Sharpe ratio. There seems to be inconsistency in the performance of the chosen ESG funds with regard to risk adjusted returns.

However, a more detailed look can be gained using regression analysis. When using the NIFTY 100 ESG index as the benchmark the only fund that had a statistically significant positive alpha was the Quant ESG Fund (alpha = 11.28, p = .017) under the CAPM model. However, when using the Carhart 4 factor model the alpha still remained positive but was not as strong (alpha=7.28, p= .080). This suggests that the addition of the size, value and momentum factors have helped explain some of the abnormal return seen in the CAPM model. However, there is still a positive alpha showing that these factors cannot fully explain the abnormal performance of the fund. A similar pattern can be seen when using the NIFTY 500 as the benchmark. The Quant ESG Fund had a positive alpha (9.91, p= .025) under the CAPM model and a positive alpha under the Carhart model (8.55, p= .040). This makes the Quant ESG the only fund in the sample with statistically significant positive alpha under more than one specification, although the alpha has dropped when adding in more factors, it is still statistically significant under the NIFTY 500 benchmark. The abnormal return cannot be fully explained by the factors included.

The results for the rest of the funds were much less clear. Both benchmarks showed that the ICICI Prudential ESG Fund had a positive alpha under the CAPM model. However, neither alpha value was statistically significant. The Carhart model showed an insignificant alpha under the NIFTY 100 ESG benchmark. However, under the NIFTY 500 benchmark the alpha was positive and significant at the 10% level (alpha=3.78, p=.079). This suggests that depending on the benchmark and model used, the evidence of abnormal performance also varies. For all four of the benchmarks and models, the other five funds did not have any statistically significant alpha values at the 10% level. There is variation between the different schemes. The most clear and consistent evidence was seen with the Quant ESG Fund.

4.4 Market-Timing behaviour under Alternative Benchmarks.

Table 5: Treynor–Mazuy Market-Timing Regression Results (NIFTY 100 ESG Index)

Fund	Gamma	OLS SE	OLS p_val	HAC SE	HAC t_stat	HAC p_val	HAC CI_95	Adj_R^2 CAPM	Adj_R^2 TM
Axis	0.377408	0.579292	0.5148	0.693309	0.5444	0.5863	[-0.9815, 1.7363]	0.8036	0.8035
Aditya	-0.409998	0.473661	0.3869	0.738742	-0.555	0.579	[-1.8579, 1.0379]	0.895	0.8949
SBI	-0.31534	0.362309	0.3843	0.835199	-0.3776	0.7058	[-1.9523, 1.3216]	0.9328	0.9328
ICICI	-1.119984	0.487675	0.0218	0.651028	-1.7203	0.0856	[-2.3960, 0.1560]	0.8463	0.8468
Kotak	-1.346852	0.386032	0.00050	0.583382	-2.3087	0.0211	[-2.4903, -0.2034]	0.9247	0.9254
Quantum	0.112617	0.402568	0.7797	1.078075	0.1045	0.9168	[-2.0004, 2.2256]	0.9088	0.9087
Quant	-5.638229	1.165843	0	1.318052	-4.2777	0	[-8.2216, -3.0548]	0.5561	0.564

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Source: Authors' own calculation

Table 6: Treynor–Mazuy Market-Timing Regression Results (NIFTY 500 Index)

Fund	Gamma	OLS SE	OLS p_val	HAC SE	HAC t_stat	HAC p_val	HAC CI_95	Adj_R^2 CAPM	Adj_R^2 TM
Axis	1.683831	0.531729	0.0016	0.862417	1.9525	0.0511	[-0.0065, 3.3742]	0.7654	0.7671
Aditya	1.528731	0.429419	0.00040	1.155025	1.3235	0.1859	[-0.7351, 3.7926]	0.8774	0.8785
SBI	1.332515	0.320409	0	0.344049	3.873	0.00010	[0.6582, 2.0069]	0.9251	0.926
ICICI	0.431061	0.401108	0.2827	0.490912	0.8781	0.3801	[-0.5311, 1.3932]	0.8542	0.8542
Kotak	0.272711	0.305923	0.3729	0.566604	0.4813	0.6304	[-0.8378, 1.3833]	0.9341	0.9341
Quantum	2.0205	0.372856	0	1.503329	1.344	0.1792	[-0.9260, 4.9670]	0.8873	0.8899
Quant	-3.03649	0.948936	0.0014	1.875997	-1.6186	0.1058	[-6.7134, 0.6405]	0.5907	0.5938

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

Source: Authors' own calculation

The Treynor-Mazuy analysis provides an alternative perspective. The presence of a statistically significant positive quadratic coefficient (Gamma) would indicate evidence of successful market timing. Alternatively, a negative and statistically significant coefficient would indicate negative market timing. (Treynor & Mazuy, 1966).

Results differ between the two benchmarks. Both the Kotak ESG Fund and Quant ESG Fund show a significantly negative Gamma coefficient when using HAC inference with the NIFTY 100 ESG Index benchmark. Kotak shows a negative Gamma coefficient of -1.346852 (p=.0211) whilst Quant ESG Fund shows a much more negative coefficient of -5.638229 (p<.001). This shows that a fund can have a positive alpha without evidence of positive market timing. Axis ESG Fund, Aditya ESG Fund, SBI ESG Fund and Quantum ESG Fund do not show significant coefficients. This indicates that there is evidence of negative market timing with the ESG- index comparison of Kotak and Quant.

The NIFTY 500 results show a different trend. The SBI ESG Fund displays significant results with a positive Gamma coefficient of 1.332515. Axis ESG Fund shows a positive Gamma significant only at the 10% level (p=0.0586). The other funds show no significant coefficients. Notably Quant shows a negative coefficient which is no longer significant (p=0.1080).

Overall, there was a difference between the two benchmarks. One of the most interesting things to note is that Quant showed a very significant negative Gamma Coefficient with the NIFTY 100 ESG Index. However, with the NIFTY 500 index, it is not showing a significant negative relationship. Meanwhile SBI ESG Fund showed no significance with the ESG index but a very significant positive relationship with the NIFTY 500 market benchmark. This indicates that the estimated market timing results are sensitive to the benchmark used.

This may be due to the different market exposures of the two benchmarks. An ESG based index may not act like an index representing the whole market so the non-linear relationship between fund returns and benchmark returns may change.

Whilst Quant has the highest descriptive risk adjusted performance and has positive alphas for all benchmark models, it has a negative Gamma coefficient using the NIFTY 100 ESG benchmark and an insignificant gamma coefficient using the NIFTY 500. The alpha coefficient indicates how much abnormal returns the fund has for the given risk factors whilst the gamma coefficient indicates its convexity due to market timing ability in the Treynor-Mazuy model. This shows that a fund can have a positive alpha without evidence of positive market timing.

4.5 Explanatory Power of the Asset Pricing Models.

The adjusted r-squared measures suggest that CAPM and Carhart models explain a large amount of daily excess returns for many funds. Adjusted r-squared values ranged between 0.5561 (Quant ESG Fund) and 0.9328 (SBI ESG Fund) for CAPM models based on the NIFTY 100 ESG benchmark and between 0.5963 (Quant ESG Fund) and 0.9345 (SBI ESG Fund) for the Carhart models. Adjusted r-squared values ranged between 0.5907 (Quant ESG Fund) and 0.9341 (SBI ESG Fund) for CAPM models based on the NIFTY 500 benchmark and between 0.6039 (Quant ESG Fund) and 0.9385 (SBI ESG Fund) for the Carhart models.

Overall, the Carhart model provides a better fit (higher adjusted r-squared) than the CAPM model for all funds. This indicates that adding the size, value and momentum factors helps to explain the in-sample data better. This is consistent with the wider literature around asset pricing which acknowledges that mutual fund returns can be driven by more than one systematic risk factor (Carhart, 1997).

5. Conclusion and Implications

5.1 Conclusion

This study looks at market co-movement and risk adjusted returns of seven ESG Mutual Funds in India from January 2021 until December 2025 based on daily analysis. Two different benchmarks were used, the NIFTY 100 ESG index and the NIFTY 500 index. The study uses CAPM, Carhart 4 Factor Model and Treynor-Mazuy to provide extra evidence surrounding abnormal returns.

The results show there was some variation between the performance of the different ESG Mutual Funds. Quant ESG Fund had the highest average excess return, Sharpe Ratio and Treynor Ratio. It was also the only ESG Mutual Fund with significant positive alphas for all four combinations of benchmark and model, significant at the 5% level in three and at the 10% level under the Carhart model with the NIFTY 100 ESG benchmark. Quant ESG Fund had the strongest performance on the measures used here. ICICI Prudential ESG Fund did appear to have some abnormal performance, with the Carhart alpha being significantly positive at the 10% level only under the NIFTY 500 benchmark.

Kotak ESG Fund and Quant ESG Fund had significant negative Gamma coefficients under the NIFTY 100 ESG. However, SBI ESG Fund had a positive and highly significant Gamma coefficient under the NIFTY 500. Axis ESG Fund also had some evidence of positive market timing under the NIFTY 500. This demonstrates that market timing results differ between the funds and benchmarks.

In terms of models, the Carhart model had a higher Adjusted R-Squared compared to the CAPM for all

seven Mutual Funds under both benchmarks. This shows that adding more factors helps to explain more of the variation.

5.2. Practical Implications

These findings have implications for investors interested in investing in ESG mutual funds. Investors may wish to look at the abnormal returns, risk adjusted ratios and factor adjusted alpha values when assessing ESG funds. The results of Quant ESG Fund demonstrate how using descriptive statistics and regression can give a clearer picture of fund performance, whereas the weaker point estimates of the other funds highlight the importance of assessing each scheme individually.

The sensitivity of the results to the choice of benchmark means that investors will gain a more complete picture by looking at the results against both ESG and market benchmarks. The results do not provide consistent evidence that market timing is a common feature of the ESG funds in this sample. The results highlight that there are differences between different schemes and benchmarks. Therefore, it may help fund managers and analysts to assess market timing as well as risk adjusted long term performance. The analysis was conducted on seven ESG mutual funds with a minimum of 5 years of data. The results therefore are specific to the time period of 2021-2025. They cannot automatically be assumed to apply to all ESG mutual funds in India or to other market conditions. Also, the results only look at the financial performance observed. This study cannot assume ESG funds outperform conventional funds, as no conventional funds were included.

Overall, the main implication for policy makers and market participants is that having clear information on what benchmark and risk model were used when analysing fund performance can help investors. As seen in the results of market timing, differing estimates can appear depending on the specification chosen. By being clear about what benchmark was used, what factors were controlled for and how statistical inference was performed, investors can be more careful when interpreting any claims regarding fund performance. The results of this study therefore indicate that a scheme specific and benchmark aware approach should be taken when analysing ESG mutual funds.

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