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Exploring the financial performance of ESG investing in India: evidence using asset-pricing models

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Abstract

Purpose – Contrary to the developed markets, where ESG (environmental, social and governance) investing has received considerable attention, the extant literature in the context of emerging markets remains fragmented and scarce. To fill this gap, the study examines the financial performance of ESG investing in an emerging market, India.

Design/methodology/approach – The study evaluates the financial performance of ESG indices listed on major Indian exchanges against market benchmarks using the Capital Asset Pricing Model (CAPM) and multi-factor models (Fama–French three-factor, Carhart four-factor and Fama–French five-factor) from 2011 to 2023. It investigates performance differences through investors' underreaction to positive earnings surprises, assesses the impact of market crises and examines the effects of mandatory CSR provisions and the Paris Agreement using difference-in-differences (DiD). Risk-return metrics are computed for robustness.

Findings – The findings indicate that ESG portfolios exhibit lower market risk than conventional portfolios and generate positive, albeit statistically insignificant, alphas. Earnings surprises explain higher abnormal returns for ESG constituents, suggesting investors' underreaction to positive information. Additionally, ESG investments demonstrate greater resilience during market downturns, as evidenced by crisis period analyses.

Originality/value – The outcomes provide important perspectives from an emerging market in the context of a growing interest in sustainable investment practices. This study offers important implications for academia and practitioners promoting sustainable finance and investment.

Keywords ESG, Socially responsible investing, CAPM, Fama–French, COVID-19, India

Paper type Research paper

1. Introduction

ESG (environmental, social and governance) investing is primarily derived from socially responsible investing (SRI), the basic premise of which is to invest in businesses that implement responsible social and environmental practices (Townsend, 2020; Wu, Xiong, & Gao, 2022). While the origin of SRI is embedded in ancient Jewish, Christian and Islamic traditional practices, modern SRI emphasizes the contribution that businesses make in particular areas of interest as defined by ESG criteria (Losse & Geissdoerfer, 2021). Under the ambit of ESG principles, environmental criteria assess how well an organization acts as a custodian of the environment. Social criteria observe stakeholder relationships that an organization has with its employees, investors, suppliers, customers and communities. Governance standards evaluate factors such as organization management and leadership, remuneration and compensation, audits and board structure (Gillan, Koch, & Starks, 2021; Atz, Van Holt, Liu, & Bruno, 2023).

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Globally, ESG investments have been gaining momentum in recent years. The number of signatories to the United Nations Principles for Responsible Investing (UNPRI) [1], for example, demonstrates the global acknowledgment and advocacy for responsible investing. As of January 2023, the total number of signatories exceeds 5,000 across 135 countries (UNPRI, 2023). These signatories are committed to incorporating ESG considerations into their investment decision-making. Additionally, it is projected that by 2025, global ESG assets will amount to more than $53 tri, accounting for more than one-third of the total assets under management (Bloomberg, 2022). Furthermore, the financial crisis resulting from the outbreak of COVID-19 (coronavirus disease) in early 2020 boosted ESG fund inflows to new records as investors sought more resilient investments. According to Morningstar Research, investments in sustainable funds increased by 88% globally in the fourth quarter of the fiscal year 2020 (Reuters, 2021).

Following the worldwide trend, ESG investing is gaining traction in India as well. The assets under management of funds linked to ESG themes have seen a five-fold jump since 2019. The fund size of ESG funds stood at $1.57 bn as of March 2022, a massive increase from $300 m in March 2019 (CRISIL, 2022). Quite a few indices have also emerged in recent years to track and monitor the ESG performance of major Indian enterprises, such as the NIFTY 100 ESG Index, NIFTY 100 Enhanced ESG Index, S&P BSE 100 ESG Index, S&P BSE Greenex and S&P BSE Carbonex (Sharma, Shrivastava, Rohatgi, & Mishra, 2023). The increased awareness of the implications of climate change as well as the social and economic effects of the COVID-19 outbreak, has further accelerated the demand for ESG investing in India. For instance, India is the third-largest carbon emitter in the world and has committed to zero-carbon emissions by 2070, demonstrating a greater interest in ESG commitments (World Economic Forum, 2021; Hasan, Singh, & Kashiramka, 2023). Similarly, only a few mutual fund ESG schemes existed up until 2019; however, after 2020, various asset management companies launched similar ESG funds and schemes to capitalize on the growing investors' interests in sustainable investments in the Indian stock market (OXFAM India, 2020).

Several factors currently support the growth of ESG investments in India. Indian investors and analysts increasingly use "extra-financial information" for evidence-based investment decisions (Chauhan & Kumar, 2018; Ahmad, Yaqub, & Lee, 2023). Growing awareness of Corporate Social Responsibility (CSR), which emphasizes social, economic and environmental responsibilities, also contributes to the popularity of ESG investing (Hasan, Singh, & Kashiramka, 2022; Mendiratta, Singh, Yadav, & Mahajan, 2023a). India was among the first nations to legally mandate CSR under Section 135 of the Companies Act 2013, effective from FY 2014–2015, requiring eligible firms to spend at least two percent of their profits on socially desirable sectors (Tripathi & Kaur, 2020). Furthermore, SEBI recently proposed standardizing ESG reporting through the BRSR (business responsibility and sustainability reporting) framework, which is mandatory for the top 1,000 listed companies starting FY 2023. This initiative enhances the robustness and transparency of ESG assessment for Indian firms and stakeholders (Jyoti & Khanna, 2023; Mendiratta, Singh, Yadav, & Mahajan, 2023b). These developments have significantly supported ESG investing in India.

On the academic front, the empirical research exploring the relationship between ESG investing and financial performance has yielded mixed results. Some studies highlight that ESG investments outperform traditional investments, while others claim that ESG investors benefit less from the prospect of diversification, resulting in lower risk-adjusted returns when compared to conventional investments [2] (Talan & Sharma, 2019; Gillan *et al.*, 2021; Revelli, 2017). Researchers attribute mixed findings to inconsistencies in methodology adoption, study period and variable(s) selection (Pedersen, Fitzgibbons, & Pomorski, 2021; Atz *et al.*, 2023). As a result, the literature on the financial impact of ESG investing is inconclusive.

Despite rising debates on ESG and growing stakeholder interest, limited studies have evaluated ESG investment performance in India based on equity portfolio returns. Research comparing ESG and conventional investments during market downturns also remains scarce (Chiappini, Vento, & De Palma, 2021; Omura, Roca, & Nakai, 2021; Anita, Shveta, Surendra,

& Arvind, 2023). To bridge these gaps, this study assesses ESG index performance relative to market benchmarks using the Capital Asset Pricing Model (CAPM) and multi-factor models, including the Fama–French three-factor, Carhart four-factor and Fama–French five-factor models, within the Indian market. It also explores the effects of market crises and two key regulatory events, namely the introduction of mandatory CSR in 2014 and the Paris Agreement in 2015, on ESG indices. Furthermore, the study examines whether performance gaps between ESG and market indices arise from investor underreaction to positive earnings surprises. Unlike previous studies, this research focuses on ESG indices rather than funds, enabling direct evaluation of ESG screening effects while avoiding issues like transaction costs, fund manager skill or timing (Statman, 2006; Schröder, 2007; Friede, Busch, & Bassen, 2015; Hoang, 2023).

The outline of the paper is as follows: In Section 2, we review the extant literature on ESG investing and develop research hypotheses in Section 3. Section 4 highlights the research design. Section 5 discusses empirical findings, and Section 6 concludes the study with implications and limitations.

2. Literature review

From the perspective of responsible investing, ESG investing is concerned not only with the risk-return profile of an investment but also with the impact of the investment on society (Grim & Berkowitz, 2020; Martini, 2021). The idea of whether ESG investment strategies produce higher returns has been addressed in several academic studies. Theoretically, the arguments yield mixed results. Following the framework of modern portfolio theory, ESG-based investments are said to have a limited universe, which reduces diversification benefits and overall returns compared to an unconstrained portfolio (Townsend, 2020). Furthermore, the additional costs incurred in social screening and monitoring ESG performance are attributed to the underperformance of such portfolios (Pedersen *et al.*, 2021; Revelli, 2017). Halbritter and Dorfleitner (2015) examine the available empirical evidence on the relationship between social and financial performance for the US market from 1991 to 2012. Using multi-factor models, they report that ESG portfolios do not yield a substantial return, and the results depend on the sample of companies and the period of the analysis. They also emphasize that investors should not anticipate top-rated ESG stocks to achieve a higher return. Similarly, El Ghoul, Karoui, Patel, and Ramani (2023) examined 2,255 US portfolios from 2010–2021 and reported that ESG portfolios do not exhibit superior performance when measured in terms of risk-adjusted returns and Sharpe ratios. Their overall results are consistent with the notion that ESG considerations have a negative effect on financial performance.

Another strand of the literature suggests that employing ESG investments can result in superior returns viewed in the context of stakeholder theory and good management theory. In the context of responsible investing, stakeholder theory dictates that serving the requirements of all stakeholders can result in improved financial performance owing to continuing loyalty to the organization (Daugaard, 2020). Businesses that prioritize the interests of their stakeholders generally have high-quality management and can retain value-driven employees who care about their customers and society in general. Such businesses thrive with higher productivity and firm performance (Agrawal & Hockerts, 2021). Similarly, the good management hypothesis prioritizes social performance; as a result, a company with a positive reputation earns greater financial performance. This positive association is alternatively interpreted as the "doing well by doing good" theory (Chernev & Blair, 2015; Talan & Sharma, 2019). Friede *et al.* (2015) reviewed more than two thousand studies on the effects of ESG on financial performance and indicated that the business case for ESG investing has a solid empirical foundation. Approximately 90% of their sample studies report that ESG considerations have no detrimental influence on financial performance. Similarly, Maiti (2021) highlights the significance of ESG criteria on stock returns in contrast to other well-established characteristics such as size and value. According to their findings, ESG factors are statistically significant and have a considerable impact on portfolio returns; thus, investors should consider them when making investment decisions.

The final argument presented in the extant literature is that ESG investments have nothing to gain or lose owing to market sensitivity (Lean & Pizzutilo, 2021). Researchers assert that any discrepancy in performance can be attributed to the differences in the portfolio selection and allocation process or the skills of fund managers rather than the ESG nature of the portfolio (Belghitar, Clark, & Deshmukh, 2014; Jacobsen, Lee, & Ma, 2019). Another explanation is that due to the "mainstreaming" of responsible investing, the performance differences between ESG and conventional portfolios may be insignificant (Erragragui & Lagoarde-Segot, 2016). Atz *et al.* (2023) reviewed over a thousand studies published between 2015 and 2022 and indicated that there is either no statistical difference between ESG and traditional benchmarks or the results are mixed (i.e. positive and negative) within a study. The authors ascribe these findings to the subjectivity associated with sustainability and the shortcomings of ESG measures in finance scholarship.

Also, concerning the market crises, Broadstock, Chan, Cheng, and Wang (2021) report that organizations with stronger ESG performance experience reduced downside risk and are more resilient to financial market turmoil. Omura *et al.* (2021) investigate the performance of ESG funds and SRI indices of the US, Europe and Japan in relation to conventional funds during the COVID-19 pandemic employing asset-pricing models. Their results highlight that SRI indices outperformed conventional investments during the pandemic. Yu (2022) emphasizes that while businesses with the sustainable competitive advantage do not outperform others in normal years, they greatly outperformed their competitors during the COVID-19 pandemic. These findings offer empirical evidence that is consistent with the investors' "flight-to-safety" behavior as well as the insurance role that ESG performance offers to investors regarding possible resilience against downside risk. On the contrary, Chiappini *et al.* (2021) highlight that sustainable indices are adversely impacted by COVID-19 pandemic, and they do not depict any abnormal returns compared to conventional indices. Similarly, Folger-Laronde, Pashang, Feor, and ElAlfy (2022) investigated the relationship between fund performance and sustainability ratings during the COVID-19-related financial market crash and reported no evidence of any insurance role offered by high ESG ratings. To summarize, there is currently no unequivocal agreement on the outcome of ESG investments. Especially, evidence from emerging markets, such as India, is scant.

Considering the gradual recognition of ESG investment in emerging economies, there is a growing but still limited body of literature on the subject. Although a few studies examine the performance of ESG portfolios in the context of India, the results are inconsistent. Tripathi and Bhandari (2015) employ numerous risk-adjusted metrics to compare portfolios of conventional companies and socially responsible stocks in the Indian stock market. Their findings report that, despite having higher systematic risk, socially responsible stock portfolios experience lower relative risk. Furthermore, during the crisis and post-crisis periods, responsible stock portfolios achieve higher returns compared with other portfolios. Using CAPM and risk-adjusted metrics, Sudha (2015) examines and compares ESG index performance with market benchmark indices. The study highlights that while the daily cumulative returns of the ESG index do not differ statistically from broad market proxies, the annualized returns of the ESG index are superior to those of market indices. On the contrary, Meher, Hawaldar, Mohapatra, Spulbar, and Birau (2020) investigated the performance of the ESG index using panel regression and reported a negative association between ESG ratings and stock performance, suggesting the likelihood that Indian investors are not considering ESG ratings while investing. Their findings do not support the notion that firms with superior ESG scores are better alternatives for investors. Similarly, Gill, Kohli, and Satija (2022) claim that there is no evidence that material sustainability concerns and financial performance are positively correlated in a portfolio-level analysis of Indian companies across several industries.

Some recent studies have examined the performance of ESG indices in India, yielding interesting insights. Sharma (2023) examines the performance NIFTY 100 Enhanced ESG and NIFTY 100 Sector Leaders Index using the ARMA-EGARCH model from 2021 to 2022. The results demonstrate that the ESG index remains stable even during turbulent market conditions. The study argues that integrating sustainable practices into businesses not only attracts more profits but also enhances the financial market and economic stability. Mukhopadhyay and Sarkar (2021) explored the performance of the S&P BSE SENSEX, BSE Greenex, BSE Carbonex, BSE Energy and BSE Oil & Gas indices using Sharpe, Treynor and Jensen's Alpha, along with the GARCH-in-mean model from January 2010 to December 2019. The study concludes that green indices such as BSE Carbonex outperform traditional indices, indicating the potential of green investments in India. Similarly, Bhattacharjee and De (2022) studied the MSCI EM ESG Leaders Index and MSCI ACWI Islamic Index using a nonlinear Markov regime-switching model from January 2020 to February 2022. The research highlights that the risk dynamics of ESG equity portfolios differ across developed, emerging, Brazil, Russia, India, and China (BRIC) and global markets during crises and calm periods. ESG equity investments depict higher systematic risk in emerging and BRIC markets during both periods, while developed markets experience higher risk only during crises. Their findings provide insights into the time-varying risk dynamics of ESG investing.

Deshmukh, Sharma, and Sharma (2022) examined the BSE SENSEX, BSE Greenex and S&P BSE Carbonex from 2011 to 2022. Using the Student's *T*-test and GARCH model along with Sharpe and Treynor ratios, they assess the impact of various crises on these indices. In periods of crisis, the study finds a high correlation between the market index and ESG indices, with CARBONEX exhibiting stronger alignment. Their results indicate that ESG indices perform better in the short term during crises, while traditional investments outperform in the long run. Nain, Bhat, and Bhat (2023) compare the adaptive resilience of NIFTY100ESG and NIFTY100 using the MGARCH model from April 2011 to January 2022. They highlight that NIFTY100ESG yields slightly higher average excess returns than NIFTY100. The study indicates that the short-run contribution of return shocks is higher for conditional volatility, whereas long-run volatility persists. The study concludes that ESG investments demonstrate greater adaptive resilience, as bad news contributes more to volatility reduction in NIFTY100ESG compared to traditional benchmarks.

Our study differs from previous research in several ways. It covers a broader sample period from FY 2011–2012 to FY 2022–2023, incorporating recent data. Additionally, it includes both major Indian exchanges, NSE and BSE and their ESG indices, enhancing sample representation and coverage. By leveraging this extended period, the study accounts for various sub-periods and crisis periods. Specifically, black swan events such as the US Debt Ceiling Crisis, Black Monday China, BREXIT, Demonetization and COVID-19 are examined. The study also analyzes the impact of mandatory CSR provisions, introduced in April 2014 through India's Companies Act 2013, using the difference-in-differences (DiD) technique along with robustness checks, including structural break analysis via the Chow Test. Asset pricing models such as CAPM, Carhart four-factor and Fama–French three- and five-factor models are employed to improve the reliability and robustness of findings. Multiple-factor models are especially valuable as they provide a comprehensive assessment of asset returns by incorporating risk factors like size, value and profitability, allowing for a more nuanced understanding of ESG index performance. The study also compares ESG and market index performance using risk-adjusted return metrics, including the Sharpe ratio, Treynor ratio, modified Sharpe ratio, Sortino ratio and Omega ratio, enabling broader risk-return profile evaluation. To the authors' knowledge, this is among the first comprehensive studies integrating multiple factor models and diverse risk-return metrics to examine ESG indices in India, offering deeper and more reliable insights than traditional benchmarks.

3. Hypotheses development

As indicated by the theoretical arguments and empirical studies described in the literature review section, the evidence on ESG investing performance seeking "does it pay to be good?" remains inconclusive. Considering previous studies as well as recent trends in major capital markets and increased focus on ESG investments in India, we argue that the ESG portfolio returns could potentially outperform conventional portfolio returns as social performance builds a good reputation and generates a sustainable competitive advantage. Furthermore, sustainable performance builds moral capital and goodwill among stakeholders and untimely translates to superior financial performance. These arguments stem from stakeholder theory, good management theory and "doing well by doing good" theory, which we contend have a dominant position in the literature on sustainable investments (Gillan *et al.*, 2021; Daugaard & Ding, 2022). Lately, recent studies have also begun to examine the impact of COVID-19 and related market shocks on sustainable investments and finance; however, the results are ambiguous. Taking into account the "flight-to-safety" hypothesis, which suggests that ESG performance can potentially provide investors with resilience against downside risks, we anticipate that the ESG index may outperform the market benchmark during such a crisis period (Beloskar & Rao, 2023; Broadstock *et al.*, 2021; Zorina & Corlett-Roy, 2022). As such, our testable hypotheses are as follows:

H1. The ESG indices outperform the market benchmarks based on risk and return estimates of asset-pricing models.

H2. The ESG indices outperformed the market benchmarks during the COVID-19 downturn based on risk and return estimates of asset-pricing models.

4. Empirical methodology

4.1 Data and sources

In this study, we employ market and ESG indices listed on two major exchanges in India, the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE). NIFTY 100 (NIFTY100) and BSE 100 (BSE100) are used as market benchmarks. For ESG indices, NIFTY 100 ESG (NIFTY100ESG) and NIFTY 100 Enhanced ESG (NIFTY100ENHANCEDESG) represent the NSE ESG indices, while S&P BSE GREENEX (BSEGREENEX) and S&P BSE CARBONEX (BSECARBONEX) are included as BSE ESG indices. By covering both exchanges, the study ensures broader market representation and coverage. The ESG indices are compared to their respective market benchmarks. Among the market indices, NIFTY 100 represents about 68.40% of the free float market capitalization of the stocks listed on the NSE as of March 28, 2024 (NSE, 2024b). Launched in 2005, the index comprises the top 100 companies listed on the NSE based on market capitalization and covers all significant economic sectors. Similarly, the BSE 100 is designed to measure the performance of the 100 largest and most liquid Indian companies on the BSE based on market capitalization. It serves as a benchmark for large-cap companies in India and provides a comprehensive view of the Indian equity market by including companies from various sectors (BSE, 2024). Both market indices are widely used by investors to gauge market trends and evaluate the overall performance of the broader market.

The NIFTY100 ESG Index aims to reflect the performance of NIFTY 100 companies that meet specific ESG criteria. Companies engaged in activities such as tobacco, alcohol and controversial weapons are excluded from this index (NSE, 2023). The NIFTY100 Enhanced ESG Index builds on this by incorporating an ESG risk score to assess companies within the NIFTY 100. Companies with severe ESG risks are excluded, and the weights of the remaining constituents are adjusted based on their ESG risk scores (NSE, 2024a). The S&P BSE CARBONEX is derived from the BSE 100 Index, with weights modified according to companies' relative carbon performance, which is assessed through their greenhouse gas (GHG) emissions and carbon policies. The S&P BSE GREENEX includes top constituents from the BSE 100 Index that excel in environmental sustainability. It uses sector-specific proprietary algorithms to evaluate companies' energy efficiency based on publicly available energy and financial data. Key metrics considered include reductions in energy consumption, adoption of renewable energy sources and associated energy costs (Deshmukh *et al.*, 2022; Sharma *et al.*, 2023).

Table 1 provides a summary of the sample indices. Due to space constraints, the sector-wise exposure of each index, based on the Global Industry Classification Standard® (GICS) developed by Morgan Stanley Capital International (MSCI) and Standard & Poor's (S&P), is presented in Appendix I of the Supplementary file. While some companies may be present in both market and ESG indices, the main objective of this study is to evaluate the performance of a portfolio based on ESG criteria compared to a broader market portfolio. Additionally, the indices differ in the weights assigned to various sectors and their constituents. The study also carries out both descriptive and inferential statistical tests to evaluate whether the difference in performance between the two indices is statistically meaningful. The findings presented in Section 5 strongly suggest that the overlap in companies between the indices does not significantly affect the results of the study. Additionally, various empirical studies have employed similar sample selection methodologies (Jasuja, Prosad, & Nautiyal, 2021; Singh, Makhija, & Chacko, 2021; Shobhwani & Lodha, 2023).

When comparing market indices with ESG indices on both the NSE and BSE based on the fundamentals reported in Table 1, several key differences emerge. On the NSE, the NIFTY100ESG and NIFTY100ENHANCEDESG indices exhibit slightly lower dividend yields than the broader NIFTY100 index, indicating a marginally lower income return for ESG-focused investments. However, these ESG indices exhibit higher P/E and PB ratios, suggesting that they are priced at a premium due to expected growth associated with ESG criteria. Furthermore, the EPS of ESG indices is significantly lower than that of the NIFTY100, highlighting a disparity in current earnings despite higher valuations. Similarly, on the BSE, the BSEGREENEX has the lowest dividend yield among the indices, reflecting its focus on growth rather than income. The P/E ratio for BSEGREENEX is the highest, indicating a premium valuation likely driven by growth expectations. In contrast, BSECARBONEX offers the highest dividend yield but has the lowest P/E and PB ratios, suggesting that it may be perceived as undervalued relative to its earnings. Overall, ESG indices on both exchanges tend to have higher P/E and PB ratios than their market

Table 1. Profile of sample indices included in the study

Indicators	NIFTY100	NIFTY100ESG	NIFTY100 ENHANCEDESG	BSE100	BSEGREENEX	BSECARBONEX
Launch year	2005	2018	2018	1989	2012	2012
Base year	2003	2011	2011	1984	2008	2010
Number of constituents	100	93	92	101	25	100
Market cap coverage (trillion INR)	285.28	265.20	261.17	268.63	112.65	267.53
Weight top 10 constituents (%)	44.78	36.62	36.66	42.64	35.19	36.59
Dividend yield (%)	1.16	1.12	1.12	1.09	0.74	1.52
P/E	24.44	25.3	25.29	23.76	31.13	21.37
PB	4.42	4.87	4.70	4.14	5.46	3.02
EPS	820.81	127.75	124.74	792.15	152.90	132.25

Note(s): An overview of the sample indices included in the study is provided in this table. INR – Indian Rupee
Source(s): Bloomberg® (as of March 31, 2023)

counterparts, reflecting higher growth expectations and valuation premiums. Therefore, the focus of ESG indices appears to be on long-term growth and sustainability rather than immediate financial gains.

The period of analysis for the study extends from the financial year (FY) 2011–2012 to FY 2022–2023 [3]. The implicit yield on 91-day T-bills is used as a measure of the risk-free rate of return. The data on daily closing values of the indices and risk-free rate of return are obtained from the Bloomberg® database. The daily closing values are used as they are more stable and widely used than other intraday prices. In addition, daily prices offer an accurate representation of market movements and trends, capturing brief fluctuations and accurately estimating risk. The use of daily data also results in a larger sample size, which increases the statistical power of tests and the reliability of findings. Numerous empirical studies that examine index performance advocate the use of daily closing prices (Cho, Chung, & Young, 2019; Erdem, 2020; Reboredo & Ugolini, 2020).

The data related to explanatory variables in the multi-factor models, such as size (SMB), value (HML) and momentum (WML), are obtained from "Fama French and Momentum Factors: Data Library for Indian Market," managed by the Indian Institute of Management (IIM), Ahmedabad, India [4]. The profitability and investment factors, RMW (robust minus weak) and CMA (conservative minus aggressive), in the Fama–French five-factor model are constructed following the methodologies outlined by Fama and French (2015), Chiah, Chai, Zhong, and Li (2016) and Foye (2018). Owing to space constraints, the methodology of the Fama–French five-factor model is presented in Appendix II of the Supplementary file provided with this paper.

4.2 Disaggregation process and crisis periods

The study undertakes disaggregate analyses to ensure that the results are accurate and can be applied to a variety of sub-periods and sample sizes (Sherwood & Pollard, 2018). To that end, we first perform the analysis for the entire sample period, i.e. from FY 2011–2012 to FY 2022–2023. The sample is then divided into two equal sub-periods, sub-period I (April 2011–March 2017) and sub-period II (April 2017–March 2023). In addition, we conduct a disaggregate analysis considering the crisis periods defined by Phadnis, Joshi, and Sharma (2021) and Deshmukh *et al.* (2022). This includes analyzing three significant black swan events within the sample period: the US Debt Ceiling Crisis (2011–2012), Black Monday in China, BREXIT and Demonetization (2015–2016, and the COVID-19 pandemic (2020). Specifically, these events are categorized into three crisis periods: Crisis I, spanning from April 1, 2011, to December 31, 2012; Crisis II, from June 1, 2015, to December 30, 2016 and Crisis III, from February 1, 2020, to November 27, 2020. The daily return series of the sample indices across the overall period, sub-periods I and II and crisis periods I, II and III are depicted in Figures 1–6. These figures visually represent the daily returns and facilitate a comparative analysis across different timeframes. This approach aids in understanding bull and bear phases and allows for a comparison between ESG indices and market indices. The trends indicate that both ESG and market indices experience similar market regimes throughout, consistent with the observations of Managi, Okimoto, and Matsuda (2012) and Broadstock *et al.* (2021).

4.3 Performance evaluation using asset-pricing models

Using daily closing index values, we first calculate the arithmetic mean returns for both indices by subtracting the previous day's closing value from the present-day closing value and dividing it by the previous day's closing value (He, Liu, Wang, & Yu, 2020), as specified in Equation (1).

$$R_{i,t} = (P_{i,t} - P_{i,t-1})/P_{i,t-1} \quad (1)$$

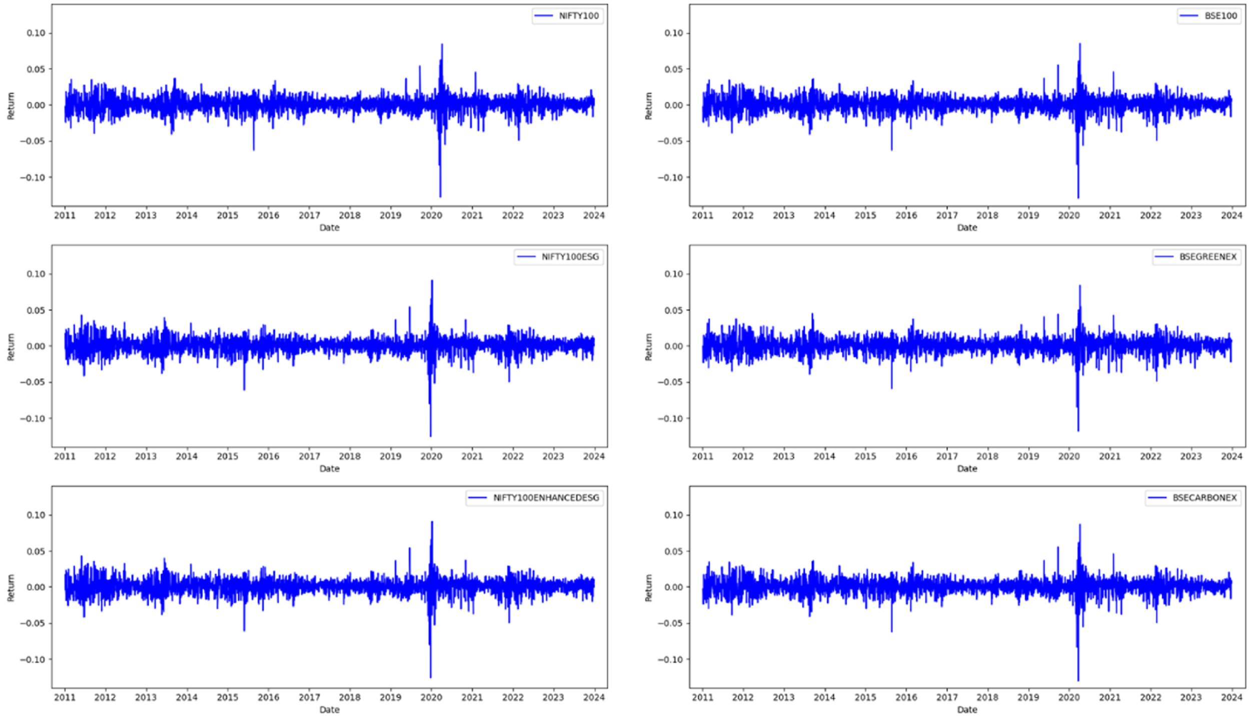

Figure 1. Daily return series of sample indices covering the overall period of the study (FY 2011–2012–FY 2022–2023). Source: Authors' illustration

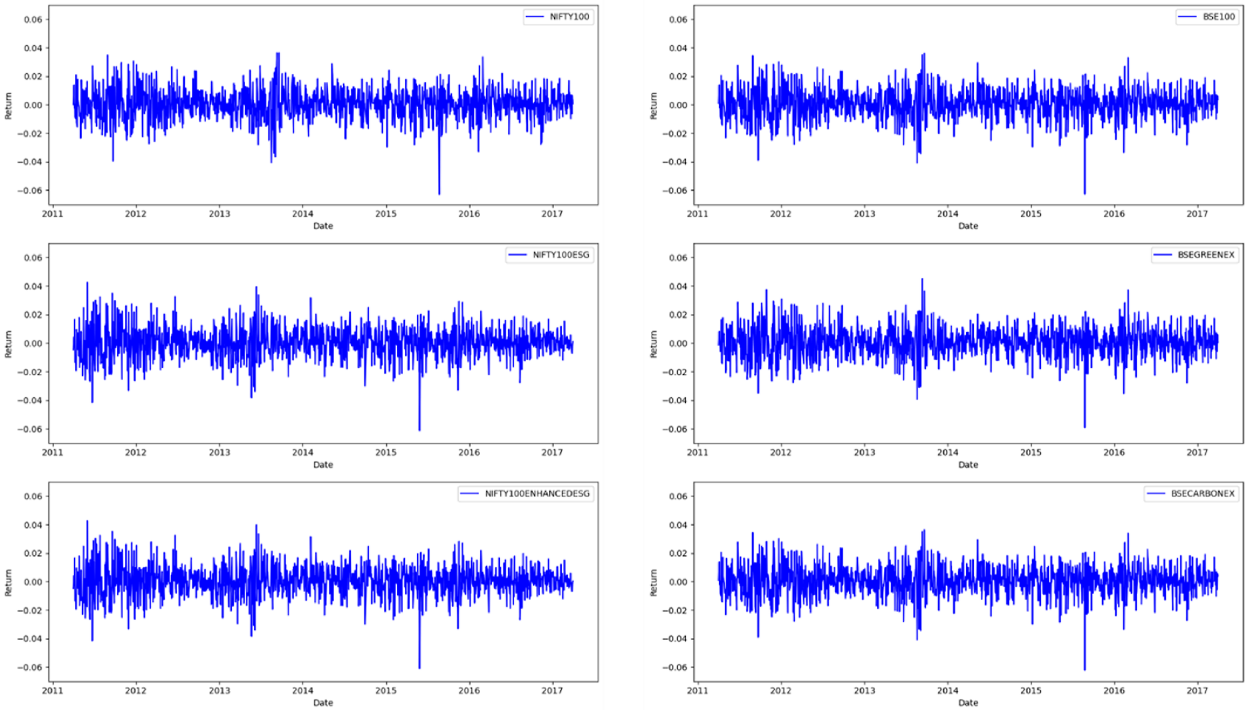

Figure 2. Daily return series of sample indices for sub-period I (April 2011–March 2017). Source: Authors’ illustration

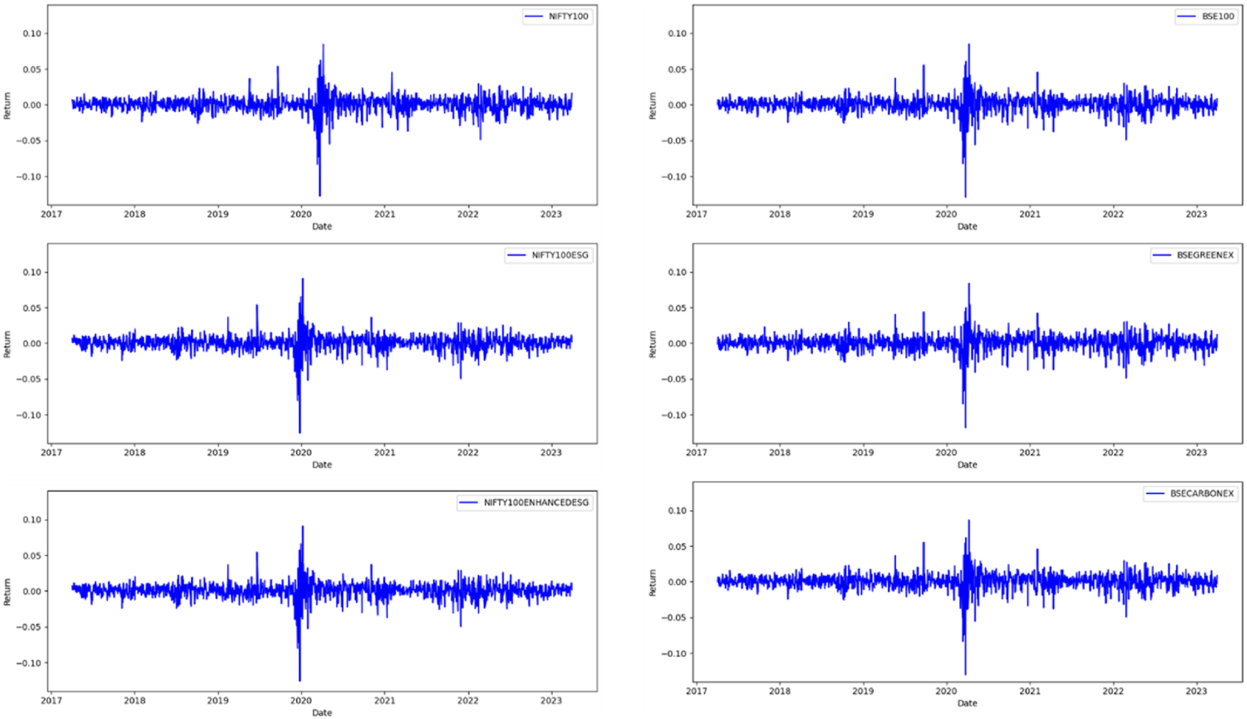

Figure 3. Daily return series of sample indices for sub-period II (April 2017–March 2023). Source: Authors' illustration

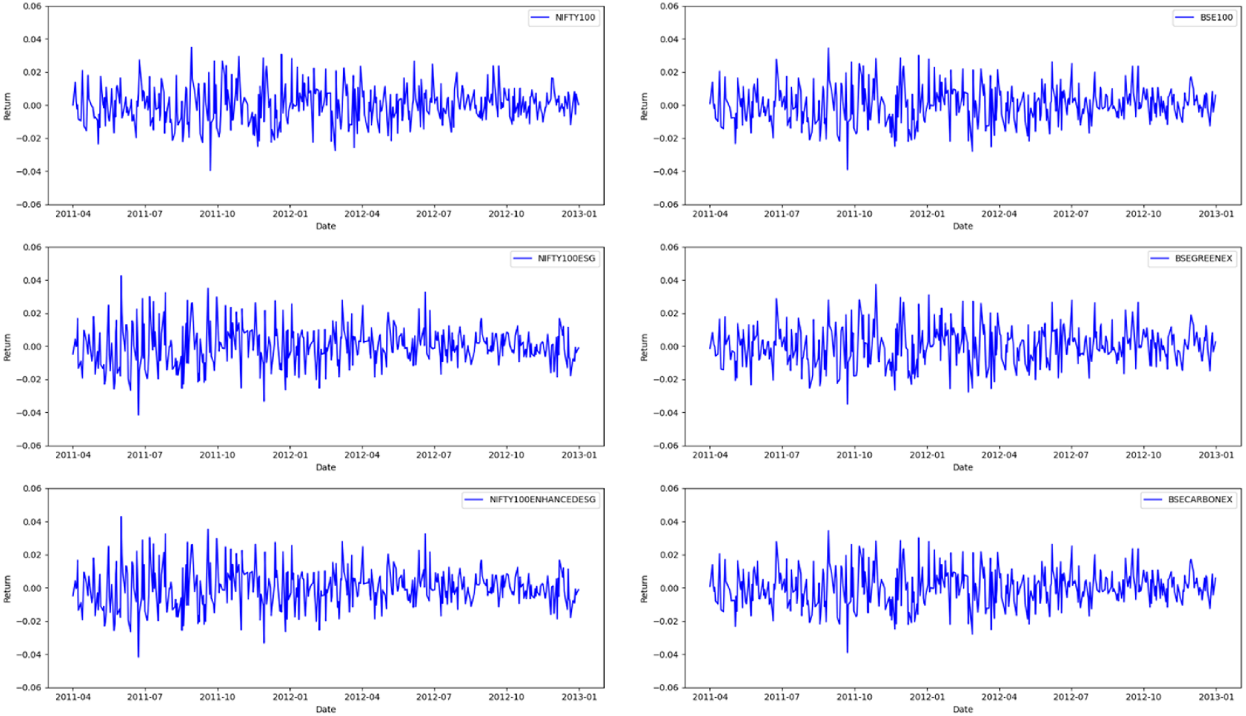

Figure 4. Daily return series of sample indices for crisis period I (April 2011–December 2012). Source: Authors' illustration

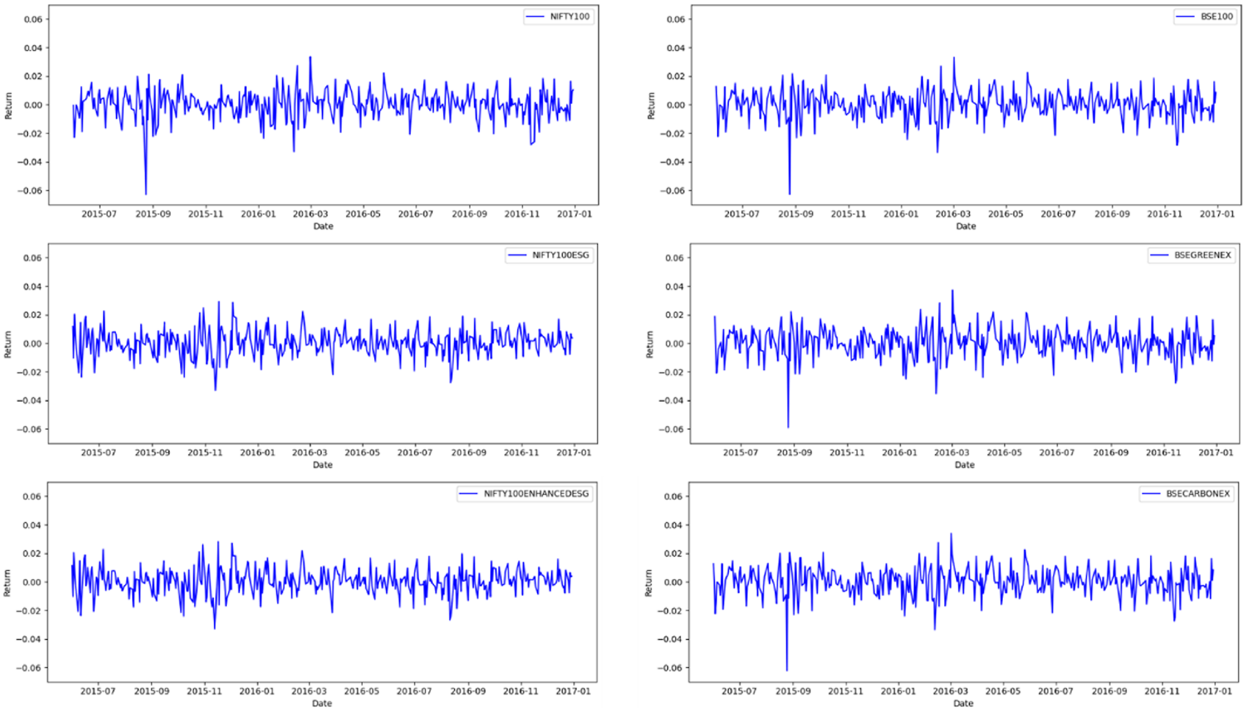

Figure 5. Daily return series of sample indices for crisis period II (June 2015–December 2016). Source: Authors' illustration

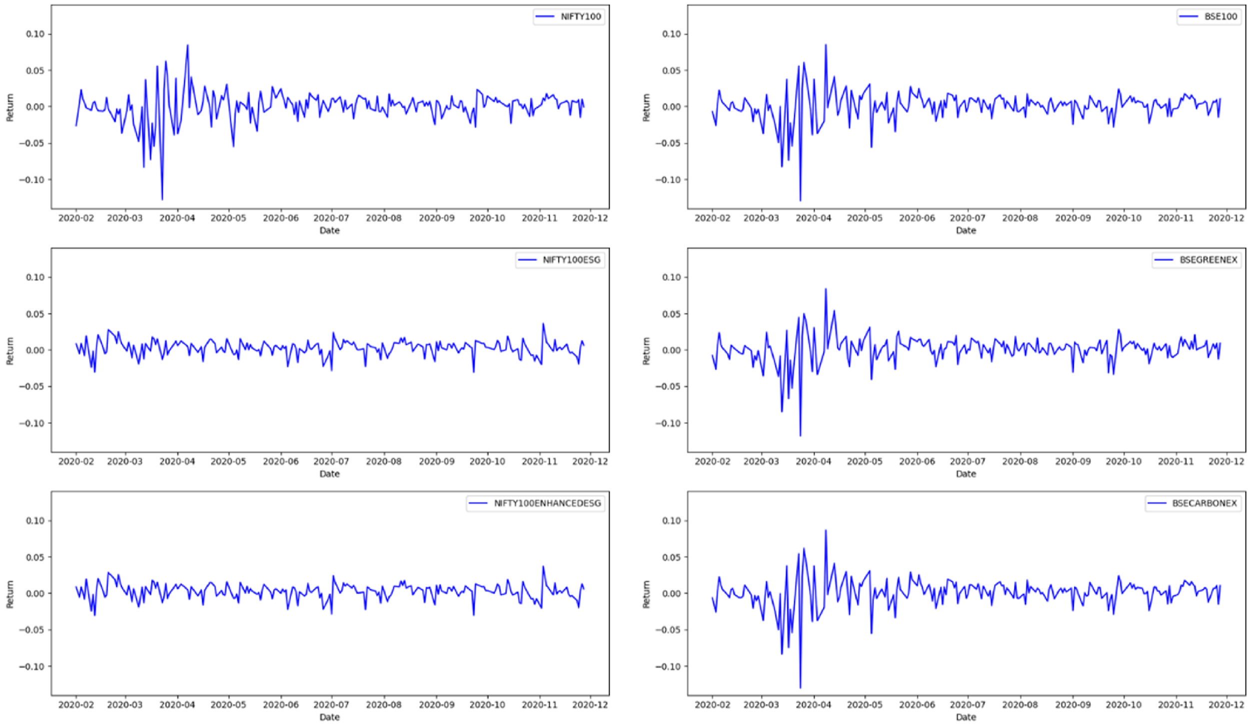

Figure 6. Daily return series of sample indices for crisis period III (February 2020–November 2020). Source: Authors' illustration

Where $R_{i,t}$ is the return on the index i at time t, $P_{i,t}$ is the present-day closing value of index i, $P_{i,t-1}$ is the previous day's closing value of index i. We also calculate beta (β) as a measure of the sensitivity of the ESG index with respect to the market index. The formula for determining beta is the covariance of the return of the portfolio with the return of the benchmark (Covar (R_i, R_m)), divided by the variance of the return of the benchmark (Var (R_m)) over the period (Elton & Gruber, 2020), as depicted in Equation (2). A beta value of more than one implies that the portfolio is more volatile than the market, whereas a beta value of less than one suggests that the portfolio is less volatile.

$$\beta = \frac{\mathrm{Covar}\left(\mathrm{R_i}, \mathrm{R_m}\right)}{\mathrm{Var}\left(\mathrm{R_m}\right)} \tag{2}$$

Then, we expand on the methodology given by Statman (2006) and Schröder (2007). We begin with the Sharpe (1964) and Lintner (1965) CAPM, followed by the Fama and French (1993) three-factor model, the Carhart (1997) four-factor model and the Fama and French (2015) five-factor model. The CAPM primarily assesses the sensitivity of portfolio returns with respect to changes in market return only. Therefore, we begin our factor analysis by employing CAPM first.

CAPM specifies that the excess return (R_p–R_f) depends on the active return on the investment (alpha, α_i) and the systematic risk (beta, β_{MKT}) as specified in Equation (3). The systematic risk is evaluated as the market risk premium, which is the difference between the market index return and the risk-free rate (R_m–R_f). A portfolio that performs better than the market benchmark exhibits a positive alpha ($\alpha_i > 0$), whereas a portfolio that performs worse than the market benchmark exhibits a negative alpha ($\alpha_i < 0$). The CAPM considers only systematic market risk as the main determining factor, which limits its application. As a result, numerous scholars have expanded the fundamental CAPM into multi-factor models to better reflect the reality of the market trends.

$$R_p - R_f = \alpha_i + \beta_{MKT}\left(R_m - R_f\right) + \varepsilon_i \tag{3}$$

The incorporation of additional factors is based on various empirical relationships (Fama & French, 1995; Fama, 1996). To commence, small firms typically command a higher premium than big firms do. Hence, the alpha could be influenced by the premium generated from the differences in returns of portfolios consisting of small and large firms, known as the size factor (β_{SMB}). Additionally, companies with higher market value tend to have higher stock returns and the discrepancy in returns between high- and low-value firms, also known as the value factor (β_{HML}), could potentially contribute to the alpha. The Fama–French three-factor model, as defined in Equation (4), accounts for these two additional factors.

$$R_p - R_f = \alpha_i + \beta_{MKT}\left(R_m - R_f\right) + \beta_{SMB}SMB + \beta_{HML}HML + \varepsilon_i \tag{4}$$

The size effect is present when β_{SMB} is positive and significant, indicating that small-cap stocks drive the return on the portfolio. Similarly, the value effect is prominent when β_{HML} is positive and significant. A high-value stock or value stock has a high book-to-market ratio, whereas a low-value stock or growth stock has a low book-to-market ratio. The value effect implies that high book-to-market ratio stocks drive portfolio returns. The growth effect, on the other hand, exists when β_{HML} is negative and significant. The growth effect indicates that the return on the portfolio is skewed more in favor of firms with a low book-to-market ratio. While the Fama–French three-factor asset pricing model includes three factors – market risk premium, size and value (MKT, SMB and HML), Carhart (1997) added a fourth factor, incorporating Jegadeesh and Titman's (1993) momentum trend, indicated in Equation (5).

$$R_p - R_f = \alpha_i + \beta_{MKT}\left(R_m - R_f\right) + \beta_{SMB}SMB + \beta_{HML}HML + \beta_{WML}WML + \varepsilon_i \tag{5}$$

The momentum factor (β_{WML}) is calculated by taking the difference between the equal-weighted averages of the best- and worst-performing stocks (winners minus losers, WML) in a lagged one-month period (Lim, Wang, & Yao, 2018). This factor explains the propensity of the portfolio to continue moving in the same direction, whether rising or falling. In other words, the alpha, if it exists, might be a result of market momentum. The momentum effect exists when β_{WML} is positive and significant. Overall, the incorporation of additional factors is useful since it explains market-wide effects. We use time-series regression with ordinary least squares (OLS) and Newey–West standard errors to estimate the fundamental CAPM and multi-factor models.

To extend the multi-factor models further, we also incorporate the Fama–French five-factor model, which includes additional factors other than those in the Fama–French three-factor model. This model employs two additional profitability (RMW) and investment (CMA) to provide a more comprehensive analysis of asset returns. The profitability factor (RMW) reflects the difference in returns between firms with robust and weak operating profitability, while the investment factor (CMA) captures the difference in returns between firms that invest conservatively and those that invest aggressively (Chiah *et al.*, 2016; Foye, 2018). The Fama–French five-factor model is specified by Equation (6).

$$R_p - R_f = \alpha_i + \beta_{MKT}\left(R_m - R_f\right) + \beta_{SMB}SMB + \beta_{HML}HML + \beta_{RMW}RMW + \beta_{CMA}CMA + \varepsilon_i \tag{6}$$

In this model, β_{RMW} captures the effect of profitability, where a positive and significant β_{RMW} suggests that firms with higher profitability drive the returns. β_{CMA} represents the impact of investment, where a positive and significant β_{CMA} indicates that firms with conservative investment policies contribute to returns (Cox & Britten, 2019). By including these additional factors, the Fama–French five-factor model aims to better account for variations in returns that are not fully explained by the three-factor model, providing a more nuanced understanding of asset performance.

4.4 Investigating performance differences through earnings surprises and abnormal returns

The study further investigates whether performance differences between ESG and market indices stem from investors' underreaction to positive earnings surprises. To explore this, the analysis examines abnormal returns around earnings announcements and the impact of earnings surprises on stock performance using secondary data sourced from Investing.com and Bloomberg®. Quarterly earnings per share (EPS) data, including actual and consensus forecast EPS, are collected for constituent stocks of ESG and market indices for the overall study period (FY 2011–2012 to 2022–2023). Daily stock returns and corresponding market index returns are also gathered to compute abnormal returns. The earnings surprise for each stock is calculated as the difference between actual and expected EPS, as specified in Equation (7):

$$Earnings\,Surprise = Actual\,EPS - Expected\,EPS \tag{7}$$

On the earnings announcement date, abnormal returns (AR) are computed using Equation (8):

$$AR = R_i - R_m \tag{8}$$

where R_i represents the stock return and R_m denotes the market return on the same day. Abnormal returns of ESG and market stocks are compared to identify performance differences. To assess the relationship between abnormal returns and earnings surprises, we estimate a two-way fixed effect panel regression, as specified in Equation (9):

$$AR = \beta_0 + \beta_1(Earnings\ Surprise) + \beta_2(ESG\ Dummy) + \beta_3(Earnings\ Surprise \times ESG\ Dummy) + \beta_4(lnMCAP) + \beta_5(Risk) + \alpha_i + \delta_t + \varepsilon_i \tag{9}$$

where AR is the dependent variable, and the independent variables include Earnings Surprise, ESG Dummy (1 for ESG stocks and 0 for market stocks), and their interaction term. Control variables include the natural logarithm of market capitalization (lnMCAP) to account for firm size and the debt-to-total-assets ratio (Risk) to capture risk, consistent with the approach used by Wang, Wang, and Yan (2024) and Schiemann and Tietmeyer (2022). Firm fixed effects (α_i) control for unobserved, time-invariant firm characteristics and time-fixed effects (δ_t) account for temporal factors common across firms. The interaction term identifies any differential market reaction to earnings surprises for ESG index constituents. This methodology provides empirical insights into whether ESG index constituents benefit from investors' delayed responses to positive information, offering a novel perspective distinct from Nain *et al.* (2023), Sharma (2023), Deshmukh *et al.* (2022), Serafeim and Yoon (2022) and Sudha (2015).

4.5 Impact of mandatory provision of CSR and the Paris Agreement on ESG indices

In addition to examining the performance of ESG indices using multiple asset pricing models, this study investigates the impact of two significant policy interventions on ESG index returns: (1) Section 135 of India's Companies Act 2013, which mandates eligible firms to allocate 2% of their average net profit over the past three years to CSR activities and (2) the Paris Agreement, a legally binding international treaty on climate change adopted in December 2015 and entered into force in November 2016. To evaluate the impact of these policies, we employ the difference-in-differences (DiD) technique, a quasi-experimental method used to assess the causal effect of a policy or intervention by comparing changes in outcomes over time between a treatment group and a control group.

The mandatory CSR provision under Section 135 of India's Companies Act, 2013, became effective on April 1, 2014, to promote inclusive growth and sustainable development in India (Hasan, Singh, & Kashiramka, 2024). Regarding the CSR mandate in India, our study follows the established precedent in the empirical literature that employs the effective date (April 1, 2014) as the key threshold for analysis. To assess its impact, we create a binary variable, Post2014, which equals 1 for dates after April 1, 2014 and 0 otherwise, to differentiate between the pre- and post-mandatory periods. For each ESG index, we compare its returns with those of a market benchmark index. The ESG index subject to the CSR intervention represents the treatment group, while the corresponding market benchmark serves as the control group. We introduce an interaction term between Post2014 and a Treatment variable to capture the differential impact of the CSR provision on the treated group relative to the control group, as outlined in Equation (10):

$$Returns_i = \alpha + \beta_1 Post2014 + \beta_2 Treatment_i + \beta_3 Post2014\ X\ Treatment_i + \varepsilon_i \tag{10}$$

where $Returns_i$ represents the return of the ESG index, Post2014 is a binary variable equal to 1 for dates after April 1, 2014, and 0 otherwise. $Treatment_i$ is a binary variable equal to 1 for the ESG index (treatment group) and 0 for the market index (control group). Post2014 $\times$ $Treatment_i$ is the interaction term capturing the differential impact of the CSR provision on ESG indices.

The Paris Agreement, adopted on December 12, 2015, and effective from November 4, 2016, represents a global commitment under the United Nations Framework Convention on Climate Change (UNFCCC) to combat climate change. It aims to limit the global average temperature increase to well below 2°C above pre-industrial levels while pursuing efforts to restrict it to 1.5°C (UNFCCC, 2015). This agreement is expected to influence ESG index performance by promoting global sustainability initiatives, particularly those focused on climate change mitigation (Hasan *et al.*, 2024). To evaluate its impact, we apply the DiD framework by defining a binary variable, Post2015, which equals 1 for dates after December 12, 2015, and 0 otherwise. The framework is outlined in Equation (11).

$$Returns_i = \alpha + \beta_1 Post2015 + \beta_2 Treatment_i + \beta_3 Post2015 \times Treatment_i + \varepsilon_i \quad (11)$$

where the interaction term $\text{Post2015}\times\text{Treatment}_i$ captures the differential impact of the Paris Agreement on ESG indices relative to market benchmarks. The DiD regression is performed using OLS with Newey–West standard errors for each pair of ESG and market benchmark indices. A significant interaction term (β_3) in both DiD regression frameworks indicates that the policies had a measurable impact on ESG index performance, reflecting the regional and global shift toward ESG-related initiatives. The DiD approach estimates the difference in average outcomes between treatment and control groups before and after the treatment, comparing these differences to measure the policy's impact. Similar methodologies have been applied in studies by Dharmapala and Khanna (2018), Roy, Rao, and Zhu (2022) and Panwar, Pandey, Suddaby, and Vidal (2023).

As part of the robustness checks for these policy interventions, we examine structural breaks in the sample indices around the implementation dates of the CSR provision and the Paris Agreement using the Chow Test. The Chow Test evaluates whether there is a significant structural break in the regression model at the point of the policy change (Chow, 1960; Chen, Su, & Chen, 2022; Jawadi, Jawadi, & Idi Cheffou, 2022). Specifically, the null hypothesis posits that there is no structural break, meaning that the relationship between the variables remains consistent before and after the intervention. The alternative hypothesis suggests a structural break, indicating that the parameters of the regression model change due to the policy intervention. This test helps determine whether the introduction of the mandatory CSR provision and the Paris Agreement led to significant shifts in the performance of ESG indices post-2014 and post-2015, respectively.

4.6 Robustness tests

As part of the robustness check, this study assesses the performance of ESG indices compared to their market benchmarks using various risk-adjusted performance metrics, including the Sharpe ratio, Treynor ratio, modified Sharpe ratio, Sortino ratio and Omega ratio. These metrics are chosen for several reasons. Firstly, they provide essential insights into portfolio performance and address different assumptions about return distributions. Secondly, they incorporate a range of portfolio theories, offering an objective evaluation of investment returns. Thirdly, these measures use multiple risk indicators to assess portfolio performance, catering to investors with different risk preferences. Additionally, the chosen metrics include both well-known financial ratios, such as Sharpe and Treynor, and more sophisticated measures like Sortino and Omega. Lastly, these metrics are selected for their methodological precision, allowing for robust calculations and comparative analyses. These measures will also assist in corroborating the findings from the asset pricing models, providing a comprehensive view of the performance and risk profiles of the indices. The formula for each metric used in the calculations is presented in Appendix III of the Supplementary file.

The Sharpe ratio, developed by Nobel laureate William F. Sharpe, is widely used to evaluate an investment's return relative to its risk (Sharpe, 1966). It is calculated by dividing the excess return of an index by the standard deviation of its overall risk. This ratio does not assume broad diversification, using standard deviation as the sole risk measure. A higher Sharpe ratio indicates better risk-adjusted performance. The Treynor ratio, introduced by Jack Treynor (Treynor, 1965), assesses the excess return per unit of systematic risk, measured by beta (β). A higher Treynor ratio reflects the greater value added by the portfolio. The modified Sharpe ratio, which considers value at risk (VaR) as a risk indicator, is used for evaluating non-normally distributed investments (Chuang, Chiu, & Edward Wang, 2008). Unlike the traditional Sharpe ratio, it evaluates downside risk, making it useful for risk-averse investors and applicable to assets with non-normal return distributions. The Sortino ratio, named after Frank A. Sortino (Sortino & Price, 1994), differs from the Sharpe ratio by only penalizing returns that fall below a user-defined target return, rather than both upside and downside volatility. This ratio measures the return of a portfolio relative to its downside risk, focusing on negative returns that fall short of the investor's acceptable return rate. The Omega ratio, introduced by Con Keating and William F. Shadwick in 2002, evaluates the portfolio by comparing the weighted gains above a specified threshold to the weighted losses below it (Sherwood & Pollard, 2018). This ratio accounts for all moments of the return distribution, providing a comprehensive view of performance.

5. Results and discussion

5.1 Descriptive statistics

Table 2 depicts the descriptive statistics of the daily return series of the sample indices and other variables. Panel A reports summary statistics for the overall period, while Panels B and Panel C represent sub-periods I and II, respectively. Panels D, E and F present data for crisis periods I, II and III, respectively. As depicted in Table 2, the daily mean returns and standard deviation of sample indices differ considerably over the study period. The daily raw mean returns for the ESG indices are slightly greater than the market benchmark index for the overall period, sub-period I and sub-period II. Specifically, during the overall period, market indices depict daily mean returns of 0.0005, whereas ESG indices range from 0.0005 to 0.0006. In sub-period I, market indices have daily mean returns between 0.0003 and 0.0004, compared to 0.0003 to 0.0005 for ESG indices. In sub-period II, the mean returns for market indices are around 0.0005, while ESG indices yield approximately 0.0006. Although the variation in returns is relatively modest, which may be attributable to the daily frequency of the data, the ESG indices still exhibit higher raw mean returns than the market benchmarks across the different periods examined. The standard deviation of the ESG indices is slightly higher than or nearly equal to that of the market benchmarks for the overall period, sub-period I and sub-period II.

During the crisis period I, all sample indices exhibited similar raw mean returns. This could be attributed to the relatively low adoption and interest in ESG indices among investors in the Indian market during that time. In crisis period II, NSE ESG indices demonstrate superior raw mean returns (0.0005 vs 0.0001), whereas BSE ESG indices do not reveal significant variation. In crisis period III, both NSE and BSE ESG indices present superior raw mean returns than their market benchmarks, with NSE ESG indices displaying a more pronounced effect (0.0025 vs 0.0006) than BSE indices (0.0006 vs 0.0005). This shift can be attributed to the increased market popularity of ESG investments following the COVID-19 pandemic. Regarding standard deviation, ESG indices exhibit higher volatility in crisis period I. However, in crisis period II, only NSE ESG indices recorded a lower standard deviation than the market index. Interestingly, in crisis period III, all sample ESG indices reported a lower standard deviation compared to their market benchmarks (approximately 0.0105–0.0208 for ESG indices vs 0.0207–0.0210 for market indices), reflecting strong market sentiment for ESG investments post-COVID-19.

Table 2 also provides the third and fourth moments of distribution, as investors favor higher skewness and lower kurtosis (Belghitar *et al.*, 2014). This is because higher skewness indicates a greater likelihood of positive returns, while lower kurtosis implies a lower probability of experiencing extreme losses. Similar to the first and second moments of the distribution, we observe similar trends for the third and fourth moments of the distribution. Furthermore, the summary statistics reveal variability in the mean values and standard deviations of the factors across different periods. Particularly, the SMB, HML and WML factors exhibit significant changes in their mean returns and standard deviations. In contrast, the RMW and CMA factors

Table 2. Summary statistics of daily return series of sample indices and related variables

	NIFTY100	NIFTY100ESG	NIFTY100 ENHANCEDESG	BSE100	BSE GREENEX	BSE CARBONEX	SMB	HML	WML	RMW	CMA	R_f
Panel A: overall period												
Mean	0.0005	0.0006	0.0006	0.0004	0.0005	0.0005	0.0001	0.0003	0.0006	0.0002	0.0001	0.0003
Standard deviation	0.0109	0.0109	0.0110	0.0109	0.0110	0.0109	0.0075	0.0090	0.0086	0.0068	0.0081	0.0002
Kurtosis	12.2308	11.5298	11.6139	12.5340	8.8806	12.8007	3.3331	2.4840	2.6912	5.5126	2.1219	2.7390
Skewness	−0.8103	−0.6776	−0.6805	−0.8296	−0.6404	−0.8228	−0.6555	0.1389	−0.4051	−0.1008	0.1589	1.7425
Minimum	−0.1280	−0.1258	−0.1261	−0.1296	−0.1183	−0.1303	−0.0533	−0.0472	−0.0490	−0.0369	−0.0162	0.0001
Maximum	0.0843	0.0909	0.0907	0.0848	0.0839	0.0867	0.0326	0.0542	0.0391	0.0333	0.0185	0.0013
N	3,218	3,218	3,218	3,218	3,218	3,218	3,218	3,218	3,218	3,218	3,218	3,218
Panel B: sub-period I												
Mean	0.0004	0.0005	0.0005	0.0003	0.0004	0.0003	0.0002	0.0002	0.0006	0.0001	0.0002	0.0003
Standard deviation	0.0101	0.0103	0.0103	0.0101	0.0102	0.0101	0.0071	0.0095	0.0085	0.0091	0.0063	0.0002
Kurtosis	1.7788	1.6239	1.6368	1.7042	1.4749	1.6817	3.0134	2.7036	2.4461	3.0081	2.4471	1.9346
Skewness	−0.2005	−0.1190	−0.1173	−0.2171	−0.0988	−0.2052	−0.6531	0.2352	−0.5062	−0.5955	0.2227	1.6582
Minimum	−0.0630	−0.0613	−0.0610	−0.0628	−0.0592	−0.0622	−0.0433	−0.0472	−0.0490	−0.0710	−0.0146	0.0002
Maximum	0.0365	0.0425	0.0427	0.0361	0.0450	0.0362	0.0309	0.0543	0.0391	0.0316	0.0181	0.0013
N	1,608	1,608	1,608	1,608	1,608	1,608	1,608	1,608	1,608	1,608	1,608	1,608
Panel C: sub-period II												
Mean	0.0005	0.0006	0.0006	0.0005	0.0006	0.0006	−0.0001	0.0004	0.0006	0.0003	0.0005	0.0002
Standard deviation	0.0116	0.0115	0.0116	0.0117	0.0118	0.0117	0.0077	0.0085	0.0088	0.0046	0.0099	0.0001
Kurtosis	18.4065	18.3083	18.2546	18.6244	13.3322	18.8412	3.4625	1.9464	2.8494	4.4232	15.6455	1.7750
Skewness	−1.2829	−1.1479	−1.1469	−1.2907	−1.0791	−1.2790	−0.6608	0.0054	−0.3338	−0.0011	−1.2411	1.6360
Minimum	−0.1280	−0.1258	−0.1261	−0.1296	−0.1183	−0.1303	−0.0533	−0.0360	−0.0452	−0.0265	−0.1079	0.0001
Maximum	0.0843	0.0909	0.0907	0.0848	0.0839	0.0867	0.0326	0.0521	0.0385	0.0333	0.0729	0.0008
N	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610
Panel D: crisis period I												
Mean	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	−0.0001	0.0006	−0.0003	0.0002	0.0003

(*continued*)

Table 2. Continued

	NIFTY100	NIFTY100ESG	NIFTY100 ENHANCEDESG	BSE100	BSE GREENEX	BSE CARBONEX	SMB	HML	WML	RMW	CMA	R_f
Standard deviation	0.0110	0.0119	0.0119	0.0109	0.0115	0.0109	0.0060	0.0076	0.0099	0.0093	0.0039	0.0002
Kurtosis	0.4256	0.6172	0.6283	0.4011	0.2065	0.3981	0.6865	0.7460	1.5872	0.4017	0.1923	0.9753
Skewness	0.1500	0.2063	0.2117	0.1328	0.1157	0.1341	−0.2920	0.1485	−0.1611	−0.0578	0.0261	1.5014
Minimum	−0.0396	−0.0416	−0.0417	−0.0390	−0.0350	−0.0390	−0.0232	−0.0269	−0.0363	−0.0346	−0.0146	0.0002
Maximum	0.0349	0.0425	0.0427	0.0344	0.0373	0.0343	0.0169	0.0265	0.0391	0.0269	0.0181	0.0012
N	435	435	435	435	435	435	435	435	435	435	435	435
Panel E: crisis period II												
Mean	0.0001	0.0005	0.0005	0.0001	0.0001	0.0001	0.0002	0.0006	0.0004	0.0001	0.0002	0.0003
Standard deviation	0.0098	0.0091	0.0090	0.0099	0.0102	0.0099	0.0068	0.0100	0.0061	0.0097	0.0031	0.0002
Kurtosis	4.3161	0.8930	0.8826	4.1147	3.0602	4.0123	2.4233	1.1417	3.1255	7.0944	3.0190	1.3068
Skewness	−0.7683	−0.1370	−0.1486	−0.7722	−0.5466	−0.7353	−0.7141	−0.0902	−0.7880	−1.2621	0.1696	1.5985
Minimum	−0.0630	−0.0329	−0.0330	−0.0628	−0.0592	−0.0622	−0.0377	−0.0306	−0.0332	−0.0710	−0.0128	0.0002
Maximum	0.0334	0.0292	0.0282	0.0331	0.0372	0.0339	0.0197	0.0354	0.0177	0.0316	0.0177	0.0010
N	394	394	394	394	394	394	394	394	394	394	394	394
Panel F: crisis period III												
Mean	0.0006	0.0025	0.0025	0.0005	0.0006	0.0006	−0.0002	0.0002	0.0000	0.0008	−0.0004	0.0001
Standard deviation	0.0207	0.0105	0.0106	0.0210	0.0194	0.0208	0.0107	0.0100	0.0122	0.0173	0.0387	0.0001
Kurtosis	9.5878	1.0547	1.0631	9.5848	9.7657	9.6797	4.6616	3.3491	1.5000	9.4764	3.8533	2.6596
Skewness	−1.4164	−0.5139	−0.4872	−1.4127	−1.3507	−1.3993	−1.2066	0.5442	−0.3571	−1.4998	0.2371	1.8236
Minimum	−0.1280	−0.0306	−0.0306	−0.1296	−0.1183	−0.1303	−0.0533	−0.0267	−0.0437	−0.1079	−0.0491	0.0001
Maximum	0.0843	0.0363	0.0370	0.0848	0.0839	0.0867	0.0326	0.0521	0.0385	0.0729	0.0017	0.0005
N	207	207	207	207	207	207	207	207	207	207	207	207

Note(s): SMB (Small Minus Big), HML (High Minus Low), WML (Winners Minus Losers), RMW (Robust Minus Weak) and CMA (Conservative Minus Aggressive) represent the size, value, momentum, profitability and investment factors in the multi-factor models, respectively. R_f is the risk-free rate. The overall period spans FY 2011–2012 to FY 2022–2023, divided into two sub-periods: Sub-period I (April 2011–March 2017) and Sub-period II (April 2017–March 2023). The crisis periods are defined as follows: Crisis I (April 2011–December 2012), Crisis II (June 2015–December 2016) and Crisis III (February 2020–November 2020)
Source(s): Authors' calculations

exhibit relatively stable mean returns with only slight variations in standard deviations, indicating consistent performance in profitability and investment dynamics. These observations suggest shifts in market dynamics and factor influences over time.

5.2 Statistical and performance analyses

To assess the similarity of returns and variances among the sample indices, the study employs Welch's two-sample *t*-test and Levene's *F*-test, both of which are commonly used in financial empirical research. Welch's *t*-test is robust to unequal variances and sample sizes, making it more appropriate for comparing index return series where the assumption of homogeneity of variance may not hold. Levene's *F*-test is used to test the equality of variances across groups (Baraibar-Diez & Odriozola, 2019). The results, presented in Appendix IV of the Supplementary file, indicate no statistically significant differences in mean returns across indices in any examined period, consistent with the values in Table 2. Several Welch's *t*-statistics are negative, which indicates that the mean return of the market index is lower than that of the corresponding ESG index, though not at a statistically significant level. However, significant differences in variances are observed only during Crisis Period III, particularly between the NIFTY100 and both ESG variants, suggesting heightened disparity in return volatility during this time of market stress.

Before analyzing the relationship between variables in time series data, it's important to test for nonstationary behavior using pre-estimation tests such as unit root tests. The study uses augmented Dickey and Fuller (ADF) and Philips and Perron (PP) test statistics to test the stationary nature of time series (Jasuja *et al.*, 2021). The results, summarized in Appendix V of the Supplementary file, indicate that both return series are stationary, with ADF and PP values having p-values below 0.01, which is less than the 5% significance level. Thus, there is no need to take the first difference in the return series, and further econometric analysis can be carried out with confidence.

Further, the study examines correlations and variance inflation factors (VIF) to avoid multicollinearity. Panel A in Table 3 reports the correlation between factors. The results indicate generally low correlations among the factors, with SMB and HML indicating a slight negative correlation (−0.15), while SMB and WML exhibit a small positive correlation (0.08). The correlations among RMW, CMA and RF are minimal, suggesting a lack of strong relationships between these factors. Panel B reports the VIF values, where all variables have VIFs well below the threshold of 10, indicating no significant multicollinearity among the factors. These findings align with the expectations of avoiding multicollinearity in factor models.

Table 3. Correlation matrix and multicollinearity diagnostics

	SMB	HML	WML	RMW	CMA	R_f	R_m-R_f
Panel A: Pearson's correlation values							
SMB	1.00						
HML	−0.15***	1.00					
WML	0.08***	−0.26***	1.00				
RMW	−0.09***	0.024***	−0.26**	1.00			
CMA	0.01***	0.01**	0.08***	−0.02**	1.00		
R_f	0.00	0.04**	0.00	0.03**	−0.01	1.00	
R_m-R_f	−0.09***	0.04***	−0.01**	0.02***	0.01***	−0.04**	1.00
Panel B: multicollinearity diagnostics							
VIF values	1.027	1.301	1.074	1.223	1.785	1.005	1.220

Note(s): In this table, Panel A reports Pearson correlation values between factors. Significant at ***1, **5 and *10% level of significance. Panel B presents VIF values

Source(s): Authors' calculations

The study also calculates the annual and total returns and standard deviations of the sample indices, with results presented in Appendix VI and Appendix VII of the Supplementary file. The findings suggest positive growth in the sample indices over time, with ESG indices generally outperforming market indices. The NIFTY100ESG index reports a higher total return (26.740%) than the NIFTY100 index (20.045%), indicating better performance by ESG-focused investments. Similarly, the BSEGREENEX index outperformed the BSE100 index, with a total return of 22.029% versus 21.127%. In crisis periods, ESG indices demonstrated greater resilience compared to market benchmarks and rebounded strongly in FY 2020–2021 with superior returns. Overall, these results suggest that ESG indices performed better over the long term than conventional indices, indicating both resilience and potential for higher returns, particularly during post-crisis recoveries. The standard deviation data indicates slightly higher volatility in ESG indices, especially during FY 2019–2020 and FY 2020–2021 due to the COVID-19 pandemic. Graphically, Figure 7 illustrates the performance of the daily return series of the sample indices for the overall study period.

5.3 Performance evaluation using time-series factor models

Table 4 through Table 7 present the empirical results of time series regressions across various models for different ESG indices. Table 4 includes results for the NIFTY100 ESG index, using the CAPM (Panel A), Fama–French three-factor model (Panel B), Carhart four-factor model (Panel C) and Fama–French five-factor model (Panel D). Table 5 covers similar regressions for the NIFTY100 Enhanced ESG index. Table 6 reports results for the BSE GREENEX index, and Table 7 provides findings for the BSE CARBONEX index, using the same set of models.

The intercept term, α_i, obtained from the CAPM and multi-factor models for ESG indices remains close to zero and positive, though statistically insignificant, across all periods of analysis. This indicates that even after controlling for multiple factors, the portfolio created using the ESG index does not yield significant returns. Even during crisis periods, the intercept term remains positive and statistically insignificant, with minimal variation. This consistency indicates that the ESG indices, while not yielding significant excess returns, maintain a stable performance relative to the market, regardless of market conditions. The lack of significant return may reflect the nascent stage of ESG investing within the Indian market. For all time-series models, the market factor (β_{MKT}) is mostly significant at a one percent significance level in all periods of analysis. The beta value of the ESG indices is less than one in all regression models for all sample indices, indicating less volatility of the ESG indices compared to the market index. This low volatility can be attributed to the ESG screening that excludes securities dealing with controversial industries. Interestingly, even during the crisis periods, the market factor remains less than one, demonstrating that the ESG indices remain less volatile than the market benchmarks amid market disruptions.

In contrast to previous research, our findings demonstrate that across most models, the SMB and HML factors exhibit negative coefficients, with HML occasionally reaching significance, suggesting a tilt toward larger and growth-oriented stocks over smaller and value-based counterparts. The WML factor is also negative but generally lacks significance, indicating a limited impact of momentum on ESG index performance. Additionally, the RMW and CMA factors are negative, though largely insignificant, suggesting that profitability and investment strategies do not significantly influence the performance of these indices. This trend may reflect investor preference for growth and larger-cap stocks in ESG investing, alongside limited reliance on momentum, profitability and conservative investment strategies. The negative HML factor is particularly relevant, indicating a shift away from value stocks, which are traditionally less represented in ESG portfolios due to their higher exposure to riskier sectors.

For the NIFTY100ESG, the adjusted R^2 ranges from 0.238 to 0.658, while the Durbin–Watson statistic varies between 1.876 and 2.292. The NIFTY100 ENHANCED ESG index reports adjusted R^2 ranging from 0.230 to 0.396 and a Durbin–Watson statistic

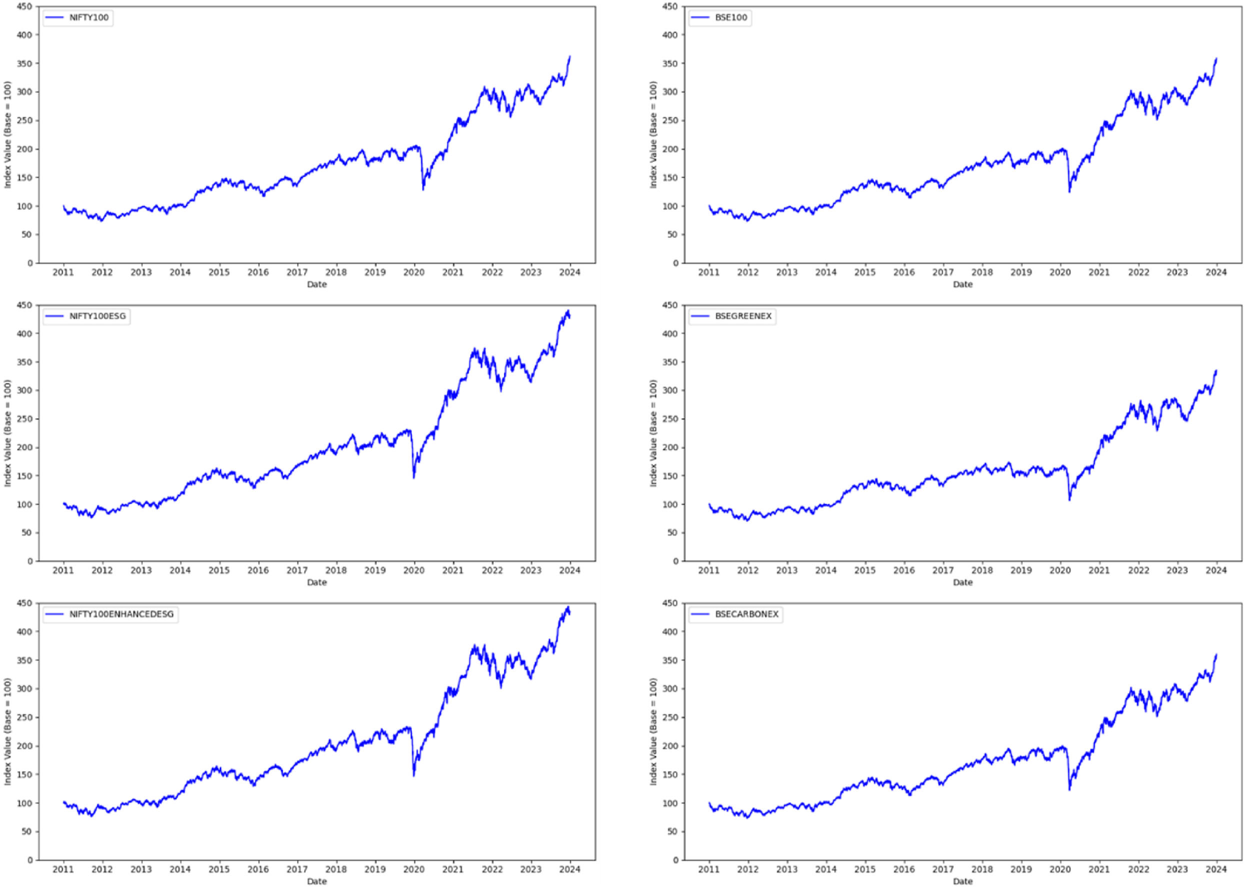

Figure 7. Daily performance of sample indices for the overall period from FY 2011–2012 to 2022–2023. Bases adjusted for 100 points on April 1st, 2011. Source: Authors' illustration

Table 4. Performance evaluation of the NIFTY100 ESG index using asset-pricing models

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel A: Capital Asset Pricing Model (CAPM)										
Overall period	0.0002	0.9607***	–	–	–	–	–	3,218	0.301	2.035
	(0.064)	(61.289)								
Sub-period I	0.0003	0.9714***	–	–	–	–	–	1,608	0.238	2.240
	(0.053)	(60.446)								
Sub-period II	0.0001	0.9769***	–	–	–	–	–	1,610	0.477	1.996
	(0.069)	(61.953)								
Crisis period I	0.0003	0.9819***	–	–	–	–	–	435	0.342	2.260
	(0.047)	(61.807)								
Crisis period II	0.0002	0.9887***	–	–	–	–	–	394	0.313	2.292
	(0.028)	(60.889)								
Crisis period III	0.0001	0.9816***	–	–	–	–	–	207	0.642	1.876
	(0.023)	(60.634)								
Panel B: Fama–French three-factor model										
Overall period	0.0002	0.9611***	0.0003	−0.009**	–	–	–	3,218	0.356	2.031
	(0.061)	(62.980)	(0.523)	(−1.997)						
Sub-period I	0.0003	0.9715***	−0.0013	−0.0024	–	–	–	1,608	0.279	2.232
	(0.051)	(62.254)	(−1.695)	(−3.531)						
Sub-period II	0.0001	0.9709***	0.0019	0.0006	–	–	–	1,610	0.453	1.998
	(0.070)	(61.661)	(2.855)	(0.974)						
Crisis period I	0.0003	0.9826***	0.0003	−0.0018	–	–	–	435	0.346	2.260
	(0.042)	(62.223)	(0.179)	(−1.199)						
Crisis period II	0.0002	0.9817***	−0.0027*	−0.0012	–	–	–	394	0.342	2.289
	(0.033)	(61.658)	(−1.936)	(−1.046)						
Crisis period III	0.0001	0.9805***	0.0010	0.0012	–	–	–	207	0.646	1.887
	(0.021)	(60.189)	(1.180)	(1.155)						

(*continued*)

Table 4. Continued

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel C: Carhart four-factor model										
Overall period	0.0002	0.9611***	0.0003	−0.0010**	−0.0004	–	–	3,218	0.357	2.030
	(0.034)	(62.025)	(0.558)	(−2.164)	(0.803)					
Sub-period I	0.0002	0.9714***	−0.0012	−0.0025	−0.0004	–	–	1,608	0.282	2.230
	(0.037)	(61.258)	(−1.600)	(−3.547)	(−0.556)					
Sub-period II	0.0001	0.9709***	0.0019	0.0005	−0.0002	–	–	1,610	0.457	1.998
	(0.061)	(61.693)	(2.859)	(0.908)	(−0.297)					
Crisis period I	0.0002	0.9822***	0.0001	−0.0021	−0.0006	–	–	435	0.347	2.258
	(0.029)	(61.314)	(0.068)	(−1.149)	(0.320)					
Crisis period II	0.0002	0.9817***	−0.0028**	−0.0012	0.0004	–	–	394	0.343	2.299
	(0.018)	(61.484)	(−2.022)	(−1.004)	(0.231)					
Crisis period III	0.0001	0.9805***	0.0007	0.0003	−0.0012	–	–	207	0.658	1.885
	(0.031)	(60.291)	(0.725)	(0.233)	(−1.033)					
Panel D: Fama–French five-factor model										
Overall period	0.0002	0.9611***	0.0003	−0.0009**	–	−0.0014	0.0002	3,218	0.355	2.029
	(0.056)	(62.664)	(0.527)	(−1.971)		(−1.798)	(0.210)			
Sub-period I	0.0003	0.9715***	−0.0012	−0.0024	–	−0.0031	0.0026	1,608	0.343	2.228
	(0.047)	(62.255)	(−1.614)	(−3.535)		(−2.365)	(1.460)			
Sub-period II	0.0001	0.9709***	0.0019	0.0006	–	−0.0010	−0.0001	1,610	0.448	1.998
	(0.062)	(61.392)	(2.862)	(1.002)		(−1.093)	(−0.135)			
Crisis period I	0.0002	0.9826***	0.0003	−0.0018	–	0.0002	0.0021	435	0.361	2.258
	(0.041)	(61.546)	(0.183)	(−1.197)		(0.157)	(1.684)			
Crisis period II	0.0002	0.9817***	−0.0027*	−0.0012	–	−0.0001	−0.0069**	394	0.358	2.298
	(0.037)	(61.157)	(−1.930)	(−1.049)		(−0.063)	(−2.327)			
Crisis period III	0.0001	0.9806***	0.0010	0.0012	–	−0.0010	0.0018	207	0.467	1.887
	(0.032)	(60.644)	(1.222)	(1.197)		(−0.971)	(0.770)			

Note(s): This table presents regression results for asset-pricing models estimated using OLS with Newey-West standard errors
The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance
Source(s): Authors' calculations

Table 5. Performance evaluation of the NIFTY100 enhanced ESG index using asset-pricing models

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel A: Capital Asset Pricing Model (CAPM)										
Overall period	0.0002	0.9607***	–	–	–	–	–	3,218	0.325	2.035
	(0.066)	(61.806)								
Sub-period I	0.0003	0.9704***	–	–	–	–	–	1,608	0.255	2.241
	(0.041)	(60.598)								
Sub-period II	0.0001	0.9709***	–	–	–	–	–	1,610	0.395	1.996
	(0.036)	(61.933)								
Crisis period I	0.0003	0.9819**	–	–	–	–	–	435	0.360	2.260
	(0.016)	(61.709)								
Crisis period II	0.0002	0.9817***	–	–	–	–	–	394	0.230	2.296
	(0.034)	(60.638)								
Crisis period III	0.0001	0.9835***	–	–	–	–	–	207	0.375	1.875
	(0.017)	(61.767)								
Panel B: Fama–French three-factor model										
Overall period	0.0002	0.9611***	0.0003	−0.0009**	–	–	–	3,218	0.298	2.032
	(0.069)	(62.546)	(0.052)	(0.045)						
Sub-period I	0.0003	0.9715***	−0.0013	−0.0024	–	–	–	1,608	0.270	2.233
	(0.025)	(62.075)	(−1.689)	(−3.555)						
Sub-period II	0.0001	0.9709***	0.0019	0.0006	–	–	–	1,610	0.392	1.998
	(0.041)	(61.837)	(2.850)	(0.968)						
Crisis period I	0.0003	0.9726***	0.0003	−0.0018	–	–	–	435	0.357	2.260
	(0.074)	(62.219)	(0.173)	(−1.212)						
Crisis period II	0.0002	0.9817***	−0.0026*	−0.0012	–	–	–	394	0.232	2.302
	(0.051)	(61.426)	(−1.887)	(−1.064)						
Crisis period III	0.0001	0.9812***	0.0010	0.0012	–	–	–	207	0.378	1.885
	(0.014)	(61.804)	(1.180)	(1.145)						

(*continued*)

Table 5. Continued

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel C: Carhart four-factor model										
Overall period	0.0002	0.9611**	0.0003	−0.0010**	−0.0004	–	–	3,218	0.299	2.031
	(0.051)	(62.533)	(0.571)	(−2.179)	(0.808)					
Sub-period I	0.0003	0.9714***	−0.0012	−0.0025***	−0.0004	–	–	1,608	0.271	2.231
	(0.046)	(61.986)	(−1.593)	(−3.574)	(−0.564)					
Sub-period II	0.0001	0.9709***	0.0019	0.0005	−0.0002	–	–	1,610	0.390	1.998
	(0.070)	(61.844)	(2.854)	(0.903)	(−0.295)					
Crisis period I	0.0003	0.9823***	0.0001	−0.0021	−0.0006	–	–	435	0.355	2.258
	(0.026)	(61.546)	(0.063)	(−1.159)	(−1.320)					
Crisis period II	0.0002	0.9817***	−0.0027*	−0.0012	0.0004	–	–	394	0.241	2.302
	(0.032)	(61.406)	(−1.966)	(−1.025)	(0.208)					
Crisis period III	0.0001	0.985***	0.0007	0.0003	−0.0011	–	–	207	0.393	1.884
	(0.030)	(61.765)	(0.733)	(0.244)	(−1.013)					
Panel D: Fama–French five-factor model										
Overall period	0.0002	0.9611***	0.0003	−0.0009	–	−0.0014	0.0002	3,218	0.302	2.030
	(0.041)	(62.578)	(0.540)	(−1.984)		(−1.793)	(0.216)			
Sub-period I	0.0002	0.9715***	−0.0012	−0.0024***	–	−0.0031**	0.0026	1,608	0.273	2.231
	(0.035)	(61.096)	(−1.608)	(−3.559)		(−2.365)	(1.449)			
Sub-period II	0.0001	0.9709***	0.0019	0.0005	–	−0.0010	−0.0001	1,610	0.391	1.991
	(0.041)	(61.855)	(2.866)	(0.995)		(−1.081)	(−0.109)			
Crisis period I	0.0001	0.9726***	0.0003	−0.0018	–	0.0002	0.0021	435	0.356	2.258
	(0.038)	(62.224)	(0.177)	(−1.210)		(0.058)	(0.683)			
Crisis period II	0.0002	0.9817***	−0.0027*	−0.0012	–	−0.0001	−0.0069***	394	0.243	2.301
	(0.036)	(61.442)	(−1.883)	(−1.067)		(−0.060)	(−2.330)			
Crisis period III	0.0001	0.9806***	0.0010	0.0012	–	−0.0010	0.0019	207	0.396	1.886
	(0.045)	(60.866)	(1.221)	(1.187)		(−0.962)	(0.776)			

Note(s): This table presents regression results for asset-pricing models estimated using OLS with Newey–West standard errors
The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance
Source(s): Authors' calculations

Table 6. Performance evaluation of the BSE GREENEX index using asset-pricing models

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel A: Capital Asset Pricing Model (CAPM)										
Overall period	0.0002	0.9610***	–	–	–	–	–	3,218	0.326	2.078
	(0.014)	(71.014)								
Sub-period I	0.0001	0.9706***	–	–	–	–	–	1,608	0.205	2.333
	(0.015)	(71.898)								
Sub-period II	0.0000	0.9715***	–	–	–	–	–	1,610	0.428	2.043
	(0.012)	(71.931)								
Crisis period I	0.0001	0.9834***	–	–	–	–	–	435	0.310	2.390
	(0.011)	(71.359)								
Crisis period II	0.0000	0.9808***	–	–	–	–	–	394	0.276	2.403
	(0.011)	(72.037)								
Crisis period III	0.0001	0.9818***	–	–	–	–	–	207	0.758	2.223
	(0.0123)	(73.011)								
Panel B: Fama–French three-factor model										
Overall period	0.0002	0.9615**	−0.0015***	−0.0016***	–	–	–	3,218	0.329	2.074
	(0.011)	(71.322)	(−1.415)	(−1.066)						
Sub-period I	0.0001	0.9718***	−0.0026***	−0.0029***	–	–	–	1,608	0.221	2.329
	(0.011)	(71.869)	(−4.012)	(−4.788)						
Sub-period II	0.0002	0.9715	−0.0001	−0.0001	–	–	–	1,610	0.428	2.042
	(0.013)	(71.652)	(−0.188)	(−0.252)						
Crisis period I	0.0001	0.9835***	−0.0023	−0.0022*	–	–	–	435	0.315	2.384
	(0.011)	(71.308)	(−1.453)	(−1.709)						
Crisis period II	0.0002	0.9820***	−0.0037***	−0.0015	–	–	–	394	0.295	2.428
	(0.011)	(71.610)	(−3.407)	(−1.285)						
Crisis period III	0.0001	0.9814***	−0.0002	0.0016**	–	–	–	207	0.763	2.222
	(0.013)	(72.791)	(−0.203)	(2.056)						

(*continued*)

Table 6. Continued

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel C: Carhart four-factor model										
Overall period	0.0002	0.9615**	−0.0015***	−0.0019***	−0.009**	–	–	3,218	0.331	2.073
	(0.011)	(71.470)	(−1.331)	(−1.532)	(−2.107)					
Sub-period I	0.0001	0.9717***	−0.0025***	−0.0031***	−0.0010	–	–	1,608	0.223	2.325
	(0.011)	(71.833)	(−3.719)	(−5.022)	(−1.526)					
Sub-period II	0.0002	0.9715***	−0.0001	−0.0001	−0.0005	–	–	1,610	0.429	2.044
	(0.012)	(71.734)	(−0.237)	(−0.560)	(−1.104)					
Crisis period I	0.0000	0.9830***	−0.0027*	−0.0029*	−0.0010	–	–	435	0.316	2.384
	(0.012)	(71.346)	(−1.604)	(−1.888)	(−0.758)					
Crisis period II	0.0002	0.9821***	−0.0034**	−0.0015	−0.0011	–	–	394	0.299	2.192
	(0.011)	(71.907)	(−2.694)	(−1.330)	(−0.614)					
Crisis period III	0.0001	0.9814***	−0.0004	0.0011	−0.0007	–	–	207	0.764	2.230
	(0.013)	(72.414)	(−0.324)	(0.953)	(−0.584)					
Panel D: Fama–French five-factor model										
Overall period	0.0002	0.9615**	−0.0015***	−0.0016***	–	−0.0003	−0.0002	3,218	0.332	2.074
	(0.011)	(71.305)	(−1.413)	(−1.054)		(−0.400)	(−0.292)			
Sub-period I	0.0002	0.9719***	−0.0026***	−0.0029***	–	−0.0024**	0.0021	1,608	0.223	2.324
	(0.011)	(71.860)	(−3.920)	(−4.780)		(−2.054)	(1.390)			
Sub-period II	0.0001	0.9715***	−0.0001	−0.0001	–	0.0005	−0.0005	1,610	0.429	2.044
	(0.012)	(71.563)	(−0.168)	(−0.461)		(0.690)	(−0.522)			
Crisis period I	0.0001	0.9835***	−0.0023*	−0.0022*	–	−0.0002	0.0018	435	0.316	2.379
	(0.011)	(71.315)	(−1.432)	(−1.709)		(−0.055)	(0.690)			
Crisis period II	0.0002	0.9821***	−0.0034**	−0.0015	–	−0.0007	−0.0038	394	0.300	2.422
	(0.011)	(71.686)	(−3.088)	(−1.264)		(−0.428)	(−1.531)			
Crisis period III	0.0001	0.9814***	−0.0002	0.0016**	–	−0.0012	−0.0013	207	0.758	2.217
	(0.013)	(72.508)	(−0.197)	(2.065)		(−1.086)	(−0.690)			

Note(s): This table presents regression results for asset-pricing models estimated using OLS with Newey–West standard errors
The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance
Source(s): Authors' calculations

Table 7. Performance evaluation of the BSE CARBONEX index using asset-pricing models

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel A: Capital Asset Pricing Model (CAPM)										
Overall period	0.0002	0.9610***	–	–	–	–	–	3,218	0.270	2.079
	(0.057)	(83.169)								
Sub-period I	0.0003	0.9708***	–	–	–	–	–	1,608	0.212	2.344
	(0.053)	(83.534)								
Sub-period II	0.0002	0.9715***	–	–	–	–	–	1,610	0.425	2.029
	(0.031)	(84.582)								
Crisis period I	0.0003	0.9832***	–	–	–	–	–	435	0.305	2.419
	(0.049)	(83.193)								
Crisis period II	0.0002	0.9807***	–	–	–	–	–	394	0.280	2.419
	(0.078)	(83.727)								
Crisis period III	0.0001	0.9828***	–	–	–	–	–	207	0.780	2.044
	(0.079)	(83.776)								
Panel B: Fama–French three-factor model										
Overall period	0.0002	0.9617***	−0.0017***	−0.0019***	–	–	–	3,218	0.279	2.075
	(0.062)	(83.199)	(−1.751)	(−1.743)						
Sub-period I	0.0003	0.9720***	−0.0026***	−0.0029***	–	–	–	1,608	0.229	2.341
	(0.0772)	(83.919)	(−4.003)	(−4.838)						
Sub-period II	0.0002	0.9715***	−0.0004	−0.0007	–	–	–	1,610	0.427	2.029
	(0.012)	(84.774)	(−0.697)	(−1.530)						
Crisis period I	0.0003	0.9834***	−0.0026	−0.0026**	–	–	–	435	0.313	2.413
	(0.094)	(83.184)	(−1.608)	(−2.052)						
Crisis period II	0.0002	0.9821***	−0.0035	−0.0016***	–	–	–	394	0.298	2.444
	(0.011)	(83.227)	(−2.891)	(−1.451)						
Crisis period III	0.0001	0.9825***	−0.0003	0.0013	–	–	–	207	0.783	2.033
	(0.092)	(83.616)	(−0.295)	(1.696)						

(*continued*)

Table 7. Continued

	α_i	β_{MKT}	β_{SMB}	β_{HML}	β_{WML}	β_{RMW}	β_{CMA}	Observations	Adj. R^2	Durbin-Watson
Panel C: Carhart four-factor model										
Overall period	0.0002	0.9617***	−0.0016***	−0.0021***	−0.0008	–	–	3,218	0.280	2.074
	(0.050)	(83.216)	(−1.677)	(−1.146))	(−1.846)					
Sub-period I	0.0003	0.9719***	−0.0025***	−0.0030***	−0.0006	–	–	1,608	0.229	2.339
	(0.054)	(83.890)	(−3.792)	(−4.950)	(−0.966)					
Sub-period II	0.0002	0.9717***	−0.0004	−0.0009**	−0.0007	–	–	1,610	0.428	2.031
	(0.039)	(84.999)	(−0.767)	(−1.956)	(−1.472)					
Crisis period I	0.0003	0.9834***	−0.0026	−0.0026*	0.0002	–	–	435	0.313	2.413
	(0.095)	(83.133)	(−1.533)	(−1.764)	(0.021)					
Crisis period II	0.0002	0.9821***	−0.0032	−0.0017***	−0.0009	–	–	394	0.299	2.447
	(0.038)	(1.477)	(−2.578)	(−1.481)	(−0.549)					
Crisis period III	0.0001	0.9825***	−0.0004	0.0010	−0.0004	–	–	207	0.783	2.033
	(0.073)	(83.371)	(−0.358)	(0.901)	(−0.379)					
Panel D: Fama–French five-factor model										
Overall period	0.0002	0.9617***	−0.0017***	−0.0019***	–	−0.0005	−0.0001	3,218	0.279	2.075
	(0.0582)	(83.218)	(−1.753)	(−1.172)		(−0.691)	(−0.024)			
Sub-period I	0.0003	0.9720***	−0.0026***	−0.0029***	–	−0.0024**	0.0023	1,608	0.231	2.336
	(0.061)	(83.910)	(−3.907)	(−4.830)		(−2.102)	(1.514)			
Sub-period II	0.0002	0.9716***	−0.0004	−0.0007**	–	0.0002	−0.0003	1,610	0.427	2.030
	(0.068)	(84.700)	(−0.687)	(−1.531)		(0.224)	(−0.294)			
Crisis period I	0.0003	0.9834***	−0.0026	−0.0026*	–	−0.0002	0.0018	435	0.314	2.408
	(0.045)	(83.391)	(−1.589)	(−2.053)		(−0.78)	(0.712)			
Crisis period II	0.0002	0.9821***	−0.0032	−0.0017***	–	−0.0008	−0.0037	394	0.304	2.437
	(0.085)	(83.260)	(−2.873)	(−1.426)		(−0.526)	(−1.536)			
Crisis period III	0.0001	0.9825***	−0.0004	0.0010	–	−0.0012	−0.0006	207	0.784	2.030
	(0.084)	(83.449)	(−0.283)	(0.901)		(−1.314)	(−0.286)			

Note(s): This table presents regression results for asset-pricing models estimated using OLS with Newey–West standard errors
The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance
Source(s): Authors’ calculations

between 1.875 and 2.302. The BSEGREENEX index has a broader adjusted R^2 range from 0.205 to 0.764 and a Durbin–Watson statistic from 2.073 to 2.428. Lastly, the BSECARBONEX index displays an adjusted R^2 between 0.212 and 0.783, with the Durbin–Watson statistic ranging from 2.029 to 2.447. Overall, the Fama–French and Carhart models report slightly higher adjusted R^2 than the CAPM model, especially in crisis periods, demonstrating that additional factors better explain the variations in returns. This is noteworthy because numerous studies highlight that multi-factor regression models explain portfolio returns better than the single-factor CAPM, resulting in higher adjusted R^2 (Maiti, 2021; Lioui & Tarelli, 2022). In our analysis, the Carhart four-factor model and the Fama–French five-factor model provide the best explanatory power for the ESG indices returns during the study period. The Durbin–Watson statistic across all periods remains close to 2, indicating that there is no significant autocorrelation in the residuals.

Concerning the performance of ESG investments, two results stand out: first, the ESG indices display lesser volatility in terms of beta values than the market benchmark in all periods of analysis. The trend is consistent even during crisis periods, suggesting that the "flight-to-safety" hypothesis may stand true at times of crisis for ESG investors in the context of the Indian market. These findings are similar to Broadstock *et al.* (2021), Beloskar and Rao (2023) and Zorina and Corlett-Roy (2022). The positive, yet insignificant alphas suggest that there's no clear evidence to support the idea that the ESG index provides higher returns than the market or risk factors, after adjusting for systematic risk. Therefore, the results do not provide compelling evidence for the research hypotheses regarding the superior performance of ESG investments. However, this should not necessarily dissuade investors from ESG investments, as these outcomes may be attributed to the nascent stage of ESG investing in India. The early-stage insignificant ESG performance could also be a result of market mispricing or information asymmetry. Similar to Ashwin Kumar *et al.* (2016) and Jin (2020), we reiterate that ESG characteristics can over time result in superior risk-adjusted returns. While conventional research suggests that lower volatility correlates with lower returns, the study contends that incorporating ESG concerns into investment decisions can produce greater risk-adjusted returns in the long run. The comparable findings were also reported by Sherwood and Pollard (2018), Maiti (2021) and Chan, Hogan, Schwaiger, and Ang (2020).

5.4 Investigating performance differences through earnings surprises and abnormal returns

Table 8 presents the results of the regression analysis, estimated with two-way fixed effects, examining the relationship between abnormal returns and earnings surprises across different index comparisons and periods [5]. The results are presented in four panels: Panel A compares NIFTY100 and NIFTY100 ESG, Panel B examines NIFTY100 and NIFTY100 ENHANCED ESG, Panel C evaluates BSE100 and GREENEX and Panel D analyzes BSE100 and CARBONEX. The coefficient of the interaction term (β_3, Earnings Surprise × ESG Dummy) is positive and significant in all models, indicating that ESG stocks exhibit higher abnormal returns in response to positive earnings surprises than market stocks. This effect is consistent across the overall period and sub-periods, suggesting that ESG constituents benefit from investors' delayed reactions to positive information, which helps explain the positive (though insignificant) alpha observed in the case of ESG indices. Also, while the standalone coefficients for the ESG dummy (β_2) and earnings surprise (β_1) are mostly statistically insignificant, the significance of the interaction term implies that the outperformance of ESG stocks is primarily driven by their differential reaction to earnings surprises rather than their ESG status or earnings surprises alone.

For the NIFTY100–NIFTY100 ESG comparison, the interaction term β_3 (Earnings Surprise × ESG Dummy) is positive and statistically significant across all periods, with coefficients ranging from 0.0052 to 0.0065 and significance at varying levels. In the NIFTY100–NIFTY100 ENHANCED ESG comparison, β_3 is consistently positive and highly

Table 8. Regression results on abnormal returns and earnings surprises across indices and periods

	Overall period	Sub-period I	Sub-period II	Crisis period I	Crisis period II	Crisis period III
Panel A: NIFTY100 and NIFTY100 ESG						
β_1(Earnings Surprise)	0.0315	0.0228	0.0341	0.0271	0.0304	0.0289
	(0.682)	(0.648)	(0.777)	(0.703)	(0.726)	(0.675)
β_2(ESG Dummy)	0.0412	0.0351	0.0450	0.0388	0.0420	0.0406
	(0.359)	(0.325)	(0.374)	(0.337)	(0.355)	(0.342)
β_3(Earnings Surprise ×	0.0061***	0.0052*	0.0065**	0.0053*	0.0059**	0.0057**
ESG Dummy)	(5.411)	(5.287)	(5.432)	(5.190)	(5.318)	(5.294)
β_4(lnMCAP)	0.0103**	0.0091**	0.0110**	0.0096**	0.0101**	0.0098*
	(6.725)	(6.181)	(6.681)	(6.612)	(6.715)	(6.685)
β_5(Risk)	0.0005*	0.0004*	0.0006**	0.0005**	Sup	0.0006
	(1.198)	(1.115)	(1.187)	(1.144)		(1.179)
Fixed effects	Included	Included	Included	Included	Included	Included
Number of quarters	48	24	24	07	07	04
Index pair constituents	190	190	190	190	190	190
Observations	9,120	4,560	4,560	1,330	1,330	760
Adj. R^2	0.251	0.224	0.242	0.235	0.249	0.243
Panel B: NIFTY100 and NIFTY100 ENHANCED ESG						
β_1(Earnings Surprise)	0.0580	0.0495	0.0630*	0.0545	0.0579*	0.0562
	(3.601)	(3.159)	(4.003)	(3.457)	(3.619)	(3.528)
β_2(ESG Dummy)	0.3452***	0.3284***	0.3596***	0.3421***	0.3515***	0.3474***
	(6.774)	(6.523)	(6.973)	(6.629)	(6.781)	(6.688)
β_3(Earnings Surprise ×	0.0583***	0.0531***	0.0628***	0.0560**	0.0591**	0.0580***
ESG Dummy)	(8.589)	(8.276)	(8.825)	(8.532)	(8.603)	(8.555)
β_4(lnMCAP)	0.0530**	0.0487**	0.0562**	0.0514**	0.0533**	0.0522**
	(7.702)	(7.472)	(7.926)	(7.621)	(7.714)	(7.668)
β_5(Risk)	0.0003**	0.0002*	0.0004*	0.0003	0.0003**	0.0003**
	(1.258)	(1.198)	(1.288)	(1.238)	(1.252)	(1.246)
Fixed effects	Included	Included	Included	Included	Included	Included
Number of quarters	48	24	24	07	07	04
Index pair constituents	189	189	189	189	189	189
Observations	9,072	4,536	4,536	1,323	1,323	756
Adj. R^2	0.381	0.354	0.395	0.369	0.383	0.378
Panel C: BSE100 and BSE GREENEX						
β_1(Earnings Surprise)	0.0229*	0.0234	0.0301*	0.0306	0.0240	0.0217
	(1.921)	(1.828)	(2.038)	(1.885)	(1.935)	(1.914)
β_2(ESG Dummy)	0.0532	0.0469	0.0593	0.0515	0.0546	0.0530
	(1.101)	(1.020)	(1.185)	(1.078)	(1.118)	(1.099)
β_3(Earnings Surprise ×	0.0838***	0.0773***	0.0891***	0.0822***	0.0846***	0.0829***
ESG Dummy)	(7.945)	(7.887)	(8.012)	(7.900)	(7.927)	(7.911)
β_4(lnMCAP)	0.0214**	0.0190**	0.0231**	0.0205**	0.0217**	0.0210**
	(3.081)	(2.958)	(3.195)	(3.038)	(3.108)	(3.078)
β_5(Risk)	0.0009***	0.0008**	0.0010***	0.0009***	0.0009**	0.0009***
	(5.060)	(4.925)	(5.199)	(5.027)	(5.071)	(5.052)
Fixed effects	Included	Included	Included	Included	Included	Included
Number of quarters	48	24	24	07	07	04
Index pair constituents	123	123	123	123	123	123
Observations	5,904	2,952	2,952	861	861	492
Adj. R^2	0.402	0.376	0.414	0.391	0.406	0.413
Panel D: BSE100 and BSE CARBONEX						
β_1(Earnings Surprise)	0.0301	0.0305	0.0222	0.0278	0.0310	0.0313
	(0.429)	(0.324)	(0.571)	(0.387)	(0.455)	(0.426)
β_2(ESG Dummy)	0.0133	0.0110	0.0149	0.0124	0.0137	0.0132
	(0.161)	(0.136)	(0.187)	(0.153)	(0.167)	(0.162)

(*continued*)

Table 8. Continued

	Overall period	Sub-period I	Sub-period II	Crisis period I	Crisis period II	Crisis period III
β_3(Earnings Surprise × ESG Dummy)	0.1007***	0.0934**	0.1072***	0.0981**	0.1022***	0.1005**
	(2.452)	(2.346)	(2.594)	(2.392)	(2.461)	(2.444)
β_4(lnMCAP)	0.0027***	0.0023**	0.0030*	0.0026**	0.0028*	0.0029**
	(3.478)	(3.432)	(3.530)	(3.467)	(3.485)	(3.477)
β_5(Risk)	0.0004**	0.0009**	0.0011***	0.010***	0.0012**	0.0121***
	(3.429)	(3.313)	(3.561)	(3.396)	(3.452)	(3.428)
Fixed effects	Included	Included	Included	Included	Included	Included
Number of quarters	48	24	24	07	07	04
Index pair constituents	121	121	121	121	121	121
Observations	5,808	2,904	2,904	847	847	484
Adj. R^2	0.483	0.463	0.472	0.478	0.481	0.479

Note(s): This table presents regression results examining performance differences between ESG indices and market benchmarks using earnings surprises and abnormal returns, estimated through OLS with Newey-West standard errors

The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance

Source(s): Authors' calculations

significant at the 1% level, with values between 0.0531 and 0.0628. For the BSE100–BSE GREENEX comparison, β_3 remains positive and statistically significant at the 1% level, ranging from 0.0773 to 0.0891. In the BSE100–BSE CARBONEX comparison, β_3 is also positive and significant at the 5% level, with coefficients ranging from 0.0934 to 0.1072. Control variables indicate that market capitalization (β_4) positively affects abnormal returns, while risk (β_5) also has a positive and significant impact, aligning with the risk-return trade-off. The total number of observations for each period of analysis is determined as the product of the number of constituents in the index pair and the number of quarters during which earnings announcements were available for the respective period. The adjusted R^2 values (0.224 to 0.483) indicate moderate explanatory power across models and index pairs. Overall, the findings highlight that ESG stocks benefit from delayed investor responses to positive earnings information, explaining the positive yet insignificant alphas observed for ESG indices in factor models. To the best of the authors' understanding, these insights have not been previously explored and mark a clear distinction while building on prior research by Nain *et al.* (2023), Sharma (2023), Deshmukh *et al.* (2022), Mukhopadhyay and Sarkar (2021) and Sudha (2015).

5.5 Impact of mandatory provision of CSR and the Paris Agreement on ESG indices

Table 9 presents the DiD regression results evaluating the impact of the mandatory CSR provision (Post2014) in Panel A and the Paris Agreement (Post2015) in Panel B on ESG indices relative to market benchmarks in the Indian market. The findings indicate that neither event has a statistically significant effect on ESG index returns compared with their benchmarks. While the coefficients for Post2014 and Post2015 are positive, suggesting a slight increase in returns after both events, these effects are not statistically significant. Additionally, the interaction terms (Post2014**Treatment and Post2015**Treatment) reveal negligible and statistically insignificant changes, indicating that neither policy substantially altered ESG indices' performance relative to benchmarks. The low adjusted R^2 values and Durbin–Watson statistics suggest that other factors may have a stronger influence on index performance. Further, the Chow test results in Table 10 indicate no significant structural break in ESG index returns during the periods following both the CSR provision and the Paris Agreement. The high p-values imply that the coefficients remain stable across the tested

Table 9. Difference-in-differences (DiD) regression results for sample indices

	Intercept	Post2014	Treatment	Post2014*Treatment	Adj. R^2	N	Durbin-Watson
Panel A: mandatory CSR provision (Post2014)							
NIFTY100ESG vs NIFTY100	0.0008	0.0015	0.0004	0.0003	0.149	6,436	1.945
	(0.210)	(1.106)	(0.402)	(0.342)			
NIFTY100ENHANCEDESG vs NIFTY100	0.0002	0.0018	0.0002	−0.0005	0.149	6,436	1.946
	(0.246)	(1.105)	(0.415)	(−0.352)			
BSEGREENEX vs BSE100	0.0007	0.013	−0.0003	0.0006	0.136	6,436	1.931
	(0.174)	(1.136)	(−0.059)	(0.027)			
BSECARBONEX vs BSE100	0.0009	0.0017	0.0008	0.0009	0.157	6,436	1.945
	(0.175)	(1.145)	(0.001)	(0.002)			

	Intercept	Post2015	Treatment	Post2015*Treatment	Adj. R^2	N	Durbin-Watson
Panel B: Paris Agreement (Post2015)							
NIFTY100ESG vs NIFTY100	0.0004	0.0030	0.0003	0.0001	0.167	6,436	1.968
	(0.971)	(0.705)	(0.067)	(0.263)			
NIFTY100ENHANCEDESG vs NIFTY100	0.0003	0.0003	−0.0001	0.0002	0.164	6,436	1.944
	(0.942)	(0.674)	(−0.028)	(0.232)			
BSEGREENEX vs BSE100	0.0002	0.0004	−0.0001	−0.0001	0.155	6,436	1.952
	(0.852)	(0.788)	(−0.011)	(−0.038)			
BSECARBONEX vs BSE100	0.0004	0.0005	−0.0001	0.0002	0.160	6,436	1.949
	(0.801)	(0.741)	(−0.021)	(0.034)			

Note(s): This table presents regression results for DiD methodology estimated using OLS with Newey–West standard errors
The numbers in parentheses are *t*-values. Significant at ***1, **5 and *10% level of significance
Source(s): Authors' calculations

Table 10. Chow test results for structural break in ESG indices

	Panel A: mandatory CSR provision (Post2014) Chow statistic (*p*-value)	Panel B: Paris Agreement (Post2015) Chow statistic (*p*-value)
NIFTY100ESG	0.241 (0.914)	0.153 (0.982)
NIFTY100ENHANCEDESG	0.242 (0.914)	1.129 (1.000)
BSEGREENEX	0.030 (0.998)	0.023 (1.027)
BSECARBONEX	0.015 (0.999)	0.002 (1.000)

Note(s): The table displays the Chow test statistics and *p*-values for sample ESG indices
Source(s): Authors' calculations

periods, reinforcing the conclusion that neither event caused a significant shift in the ESG index performance in the Indian market.

5.6 Robustness tests

Table 11 presents the results of risk-adjusted performance measures as part of the robustness checks. The Sharpe ratio consistently displays higher values for ESG indices than market benchmarks for both the overall period and sub-periods, indicating better risk-adjusted returns. Although Sharpe ratios decline during crisis periods, ESG indices still display relatively higher values (i.e. less negative or more stable) than their benchmarks. The Treynor ratio also reflects that ESG indices perform better per unit of market risk throughout the analysis periods. The modified Sharpe ratio, which accounts for skewness in returns, demonstrates strong downside risk management by ESG indices in non-crisis periods, though it declines during crises with negative values indicating challenges in managing downside risk. Nonetheless, ESG indices reflect less severe negative values than market benchmarks. The Sortino ratio, which measures returns relative to downside risk, reveals that ESG indices effectively manage negative returns across all periods, though variability increases during crises. Similarly, the Omega ratio displays superior performance for ESG indices in general. During crisis periods, Omega ratios are positive but lower than in stable periods, indicating a decrease in performance relative to risk.

Overall, ESG indices tend to manage risk and downside risk better than traditional benchmarks, particularly during stable periods. However, during crises, such as crisis period III, ESG indices demonstrate notable outperformance, likely due to increased awareness of ESG investments and their perceived resilience post-COVID-19. This heightened focus on ESG investing may have enhanced stability and reduced downside risk, supporting the notion that ESG investments are better equipped to navigate economic uncertainties and improve portfolio resilience. The robustness results further reinforce the observation that ESG indices maintain lower volatility and stable performance during market crises, consistent with the main regression results.

6. Conclusion

The extant literature on ESG investing in the context of emerging economies is scarce and fragmented. To fill this gap, the study evaluated the performance of ESG indices, listed on two major stock exchanges in India, with respect to the market benchmarks using multiple asset-pricing models. Interestingly, our findings indicate that ESG investments in India are less sensitive to market risk and thereby exhibit less volatility. This demonstrates that ESG investments do not penalize investors with sustainability concerns seeking financial rewards.

Table 11. Risk-adjusted performance metrics as part of robustness tests

	Sharpe ratio	Treynor ratio	Modified Sharpe ratio	Sortino ratio	Omega ratio
Panel A: overall period					
NIFTY100	0.0179	0.0003	0.0103	0.0184	1.0157
NIFTY100ESG	0.0267	0.0004	0.0148	0.0277	1.1207
NIFTY100ENHANCEDESG	0.0270	0.0004	0.0146	0.0302	1.1155
BSE100	0.0178	0.0002	0.0074	0.0131	0.9890
BSEGREENEX	0.0219	0.0003	0.0150	0.0224	1.1407
BSECARBONEX	0.0221	0.0004	0.0151	0.0174	0.9872
Panel B: sub-period I					
NIFTY100	0.0099	0.0002	0.0169	0.0102	1.0207
NIFTY100ESG	0.0193	0.0003	0.0182	0.0200	1.1423
NIFTY100ENHANCEDESG	0.0195	0.0003	0.0184	0.0253	1.1332
BSE100	0.0098	0.0001	0.0142	0.0000	0.9796
BSEGREENEX	0.0099	0.0002	0.0178	0.0101	1.1619
BSECARBONEX	0.0099	0.0003	0.0164	0.0000	0.9735
Panel C: sub-period II					
NIFTY100	0.0258	0.0003	0.0036	0.0263	1.0104
NIFTY100ESG	0.0338	0.0004	0.0112	0.0354	1.0991
NIFTY100ENHANCEDESG	0.0345	0.0004	0.0108	0.0351	1.0978
BSE100	0.0256	0.0003	0.0003	0.0261	0.9983
BSEGREENEX	0.0338	0.0004	0.0122	0.0345	1.1195
BSECARBONEX	0.0342	0.0004	0.0138	0.0348	1.0010
Panel D: crisis period I					
NIFTY100	−0.0186	−0.0001	−0.0032	−0.0174	1.0083
NIFTY100ESG	−0.0169	−0.0001	−0.0012	−0.0172	1.0075
NIFTY100ENHANCEDESG	−0.0168	−0.0001	−0.0108	−0.0172	1.0075
BSE100	−0.0183	−0.0002	−0.0048	−0.0189	1.0084
BSEGREENEX	−0.0174	−0.0001	−0.0047	−0.0175	1.0079
BSECARBONEX	−0.0183	−0.0001	−0.0042	−0.0172	1.0084
Panel E: crisis period II					
NIFTY100	−0.0104	−0.0001	−0.0021	−0.0211	1.0102
NIFTY100ESG	0.0011	0.0002	0.0192	0.0117	1.0540
NIFTY100ENHANCEDESG	0.0012	0.0002	0.0017	0.0130	1.0545
BSE100	−0.0202	−0.0001	−0.0110	−0.0137	1.0100
BSEGREENEX	−0.0191	−0.0001	−0.0100	−0.0134	1.0103
BSECARBONEX	−0.0188	−0.0001	−0.0101	−0.0132	1.0102
Panel F: crisis period III					
NIFTY100	0.0242	0.0005	0.0278	0.0389	1.0282
NIFTY100ESG	0.1286	0.0014	0.1134	0.1200	1.1950
NIFTY100ENHANCEDESG	0.1264	0.0014	0.1168	0.1183	1.1937
BSE100	0.0190	0.0004	0.0204	0.0322	1.0233
BSEGREENEX	0.0258	0.0005	0.0232	0.0417	1.0302
BSECARBONEX	0.0238	0.0005	0.0249	0.0420	1.0304

Note(s): The table presents risk-adjusted performance metrics for the overall period and various sub-periods: sub-period I, sub-period II, crisis period I, crisis period II and crisis period III, as part of the robustness checks
Source(s): Authors' calculations

Although the Carhart four-factor and Fama–French five-factor models enhance the explanation of variance by incorporating additional factors, they do not account for significant variations in intercept performance. This suggests that while these models provide a more comprehensive view of ESG index performance, they still fail to explain the observed insignificance of the alpha coefficients.

To further explain these findings, the study explores the role of earnings surprises and demonstrates that constituents of ESG indices generate higher abnormal returns in response to positive earnings surprises. This helps explain the positive yet statistically insignificant alpha observed across factor models, which is attributed to investors' underreaction to positive information. These insights have not been previously explored and mark a clear distinction while building on prior research by Nain *et al.* (2023), Sharma (2023), Deshmukh *et al.* (2022), Mukhopadhyay and Sarkar (2021) and Sudha (2015). The insignificant alphas can also be attributed to the nascent stage of ESG investments in India compared to developed markets. Furthermore, the analysis of fundamentals for the sample ESG indices, which exhibit higher P/E and P/B ratios, suggests that these indices are priced at a premium due to the anticipated growth associated with ESG criteria. These findings indicate that the focus of ESG indices in India is oriented toward long-term growth and sustainability rather than immediate financial returns.

Our findings indicate that ESG investments mitigate greater risk during market downturns, as evidenced by their lower volatility and stable performance during crisis periods. However, despite this resilience, the CSR provisions mandated by Section 135 of India's Companies Act 2013 and the Paris Agreement did not significantly impact ESG index performance relative to benchmarks. The absence of substantial changes in return post-mandate suggests that the required CSR expenditures have yet to yield observable financial benefits. These findings, coupled with the limited impact of global ESG initiatives like the Paris Agreement, indicate that their immediate influence on ESG index performance in emerging markets like India may be constrained. While both the CSR mandate and the Paris Agreement aim to promote sustainable finance, their effects appear gradual, potentially requiring more time to materialize or being overshadowed by other factors such as investor sentiment or broader market dynamics.

Similar to Yu (2022), Omura *et al.* (2021) and Lean and Pizzutilo (2021), we reinforce the notion that ESG investments can serve as a hedge in times of market crisis. In addition, similar to Sharma (2019), Tripathi and Kaur (2020) and Hasan *et al.* (2022), we conclude that over time, there can be positive prospects to invest in socially responsible corporations in emerging markets like India. This takes into account the increasing appetite for ESG-linked assets and consistent regulatory developments to standardize ESG reporting and transparency. Overall, investors in India are warming up to ESG investing and future studies can highlight related market trends and investor preferences.

This study contributes to the body of knowledge on sustainable finance and investment by providing the most recent information on ESG investing in India. While the majority of existing studies explore sustainable investments in the context of developed economies, this study provides valuable insights from an emerging market perspective in the context of a growing interest in ESG investment practices, addressing an important research gap. Furthermore, by examining the performance of ESG investments during crisis periods, the study provides novel evidence that ESG criteria can provide a hedge against possible downside risks as compared to the traditional style of investing.

The study offers important implications for finance practitioners as it identifies low betas and positive alphas that can serve the potential for generating higher returns while allocating capital toward responsible investing. The demonstrated resilience of ESG indices during market downturns highlights their potential as lower-risk, stable investments. However, investors should adjust their expectations for immediate returns, as ESG investments appear to focus on long-term growth and sustainability rather than short-term financial gains. Furthermore, the lack of significant impact of mandated CSR provisions highlights the need for greater ESG awareness in the Indian market. Our findings dictate that ESG investments can provide alternative investment options to faith-based or ethical investors to diversify their portfolios while also being exposed to lower market risk. This may promote the financial inclusion of investors with varied risk preferences. The findings may also prompt portfolio managers to embrace the magic square of sustainability, return, risk, and liquidity, rather than the simplified triangular pattern of liquidity, risk and return.

Also, given the global trend toward SDGs, financial markets could become an effective vehicle for encouraging social responsibility and rewarding sustainable finance. In this regard, government regulators and policymakers can take away the findings of our study and work by way of regulations to promote and standardize ESG investments. This can also assist rating agencies in employing a variety of nonfinancial metrics to better assess financial performance. Lastly, the findings of the study reveal ESG trends for corporate managers and provide insights for companies interested in participating in sustainability indices.

There are certain limitations to our research. The findings of our study may be limited to the selected data, country and period of analysis. These constraints may hinder generalizing the results to stock markets of other countries and regions. Because the study focuses on index performance, it cannot be generalized to other asset classes like fixed income or hedge funds. Notwithstanding the limitations, the findings of the study merit attention and indicate directions for future research. Methodological advances, including disaggregate analysis at the firm or industry level or the inclusion of additional financial factors, can be examined. Following the standard practice, the present study employs the market index as the benchmark; however, the scope can be broadened to include additional indices. Individual effects of the E, S and G criteria on portfolio returns can also be assessed. Another promising avenue for future research could involve exploring the unique contribution of ESG constituents that do not overlap with the market benchmark to better understand their distinct impact on portfolio return performance.

Notes

1. Launched in April 2006, UNPRI is an international organization that works to promote the incorporation of ESG criteria into investment decision-making (https://www.unpri.org/).
2. We define conventional or traditional investments in the context of this study as those that are primarily made to generate financial returns, without taking into account factors like environmental, social and governance (ESG) impact.
3. The financial year (FY) in India begins on April 1 and ends on March 31 of the following year.
4. Available at: https://faculty.iima.ac.in/~iffm/Indian-Fama-French-Momentum/index.php
5. Due to space constraints, the summary statistics of sample indices for performance analysis using earnings surprises and abnormal returns are presented in Appendix VIII of the Supplementary file.

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Supplementary material

Supplementary material for this article can be found online.

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