The current issue and full text archive of this journal is available on Emerald Insight at:
https://www.emerald.com/insight/0306-8293.htm

ESG performance and corporate volatility: an empirical exploration in an emerging economy

International Journal of Social Economics

467

Received 24 February 2024
Revised 21 May 2024
Accepted 17 June 2024

Sudhi Sharma
Fortune Institute of International Business, New Delhi, India
Vaibhav Aggarwal
Jindal Global Business School, OP Jindal Global University, Sonipat, India
Reepu
Chandigarh University, Chandigarh, India, and
Gitanjali Kaur Mehta
Fortune Institute of International Business, New Delhi, India

Abstract

Purpose – This study aims to investigate into the dynamic connection between ESG scores and the volatility term structure for Indian companies listed BSE. The study divides the BSE-100 listed companies into two panels based on their median ESG scores in 2022, creating high and low ESG scoring groups to capture volatility structure.

Design/methodology/approach – The study employs time-varying symmetric and asymmetric GARCH models and followed by continuous Wavelet to capture volatility structure and explore comparative resilience behavior.

Findings – The study found similar volatility patterns regardless of ESG scores, nudging doubt on the direct impact of ESG on volatility. Additionally, both high- and low-ESG-scored companies displayed high vulnerabilities during the pandemic, raising questions about the effectiveness of ESG frameworks in capturing risks. Finally, by examining the resilience behavior of ESG-scored companies during the pandemic, our study contributes to the evolving understanding of the intersection between ESG performance and crisis response.

Practical implications – The study carries vital implications for investors and policymakers. It highlights the urgent need to strengthen the ESG framework and scores to shield investors from short- and long-term volatilities and economic vulnerabilities.

Originality/value – To the best of the authors' knowledge, this is the first study investigating the Indian market by examining the volatility structure and resilience behavior of high- and low-ESG-scored companies during the pandemic.

Peer review – The peer review history for this article is available at: https://publons.com/publon/10.1108/IJSE-02-2024-0113

Keywords ESG score, Time-varying volatility models, Continuous wavelet, BSE 100

Paper type Research paper

JEL Classification — G10, G11, G38

Funding information: There is no funding support.

Conflict of interest: There is no conflict of interest financial or non-financial to report by the authors.

Competing interests: The authors declare that they have no competing interests in relation to the research presented in this manuscript.

Author contributions: Authors 1: Conceptualization, Methodology, Writing, Formal analysis. Author 2: Data curation, Visualization. Authors 3 and 4: Supervision, Project administration. All authors have read and approved the final manuscript.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

International Journal of Social Economics
Vol. 52 No. 3, 2025
pp. 467-483

0306-8293
DOI 10.1108/IJSE-02-2024-0113

1. Introduction

The integration of sustainable investment practices has become mainstream among global investors and portfolio managers, with 86% of asset owners now considering sustainability factors in portfolio construction (FTSE Russell Global Survey [1]). Incorporating environmental, social and governance (ESG) criteria in investment portfolios has shown to positively impact overall performance (RBC Wealth Management [2]). However, the exploration of such opportunities in emerging markets remains limited. While ESG factors are integral to investment decisions globally, emerging markets have been slower to adopt these practices due to weaker regulatory frameworks and limited access to quality ESG data (Ametefe *et al.*, 2023; Wasan *et al.*, 2021). The availability of accurate ESG data is crucial for informed decision-making, yet emerging markets face challenges in obtaining comprehensive and standardized ESG information. Financial constraints and cultural factors further hinder the prioritization of ESG initiatives in these markets (Ameli *et al.*, 2021). The slower adoption of ESG practices in emerging markets highlights the need for research to understand the relevance and impact of ESG scores in these regions.

India is leading the way in ESG (environmental, social and governance) investing. As the world's fifth-largest and fastest-growing economy, recently Securities and Exchange Board of India (SEBI) has taken proactive measures to guide the business responsibility and sustainability reporting (BRSR) framework. This framework aims to promote a culture of ESG-consciousness that fosters a conscious ecosystem. SEBI's recent circular on ESG ratings addresses the need for standardization, comparability and effectiveness, ensuring a reliable foundation for ESG evaluation. By rewarding progress through initiatives like the Parivartan score, SEBI incentivizes companies to prioritize ESG goals, fostering a culture of transition finance and commitment to achieving net-zero targets by 2070. Furthermore, SEBI's guidelines allow mutual funds to launch multiple ESG-oriented funds with specific strategies. This diversifies the ESG-conscious investing landscape, paving the way for a more nuanced approach to sustainable investing in India. However, on the other hand, a CRISIL report [3] in 2020 indicates that 80% of Indian firms have ESG ratings that are merely adequate or below average. This prompts the need to investigate the relevance of ESG scores in terms of volatility structures, leverage effects and the safe haven properties of ESG stocks during periods of vulnerability. The study gauged the underpinning theory suggests that companies with high ESG scores should exhibit long-term outperformance, lower idiosyncratic risk, lower leverage effect and greater resilience during times of vulnerability (Cardoso *et al.*, 2019). The present study contributes comprehensively to address the relevance of ESG scores for Indian investors. The motivation stems from the remarkable growth of India's ESG assets (Beloskar and Rao, 2023), which have increased by 4.7 times in the last 2 decades (Bodhanwala and Bodhanwala, 2023) [4]. Additionally, this study even becomes more crucial where the world economies are facing back-to-back crises in terms of COVID-19, the invasion of the Russia–Ukraine war, Silicon Valley Bank (SVB) collapse and western countries' headwinds. Henceforth, the study aims to address three research questions:

RQ1. What is the relation between ESG scores and idiosyncratic volatilities?

RQ2. What is the relation between ESG scores and asymmetric volatilities?

RQ3. What is the resilience behavior of high ESG scores during the pre-post-outbreak of COVID-19?

By delving into these research questions, the study divides the BSE-100 listed companies into two panels based on their median ESG scores in 2022, creating high and low ESG scoring groups to capture volatility structure. It employs time-varying symmetric and asymmetric GARCH models and is followed by continuous Wavelet to capture volatility structure and explore comparative resilience behavior.

The innovation of this paper is twofold. Firstly, it introduces a novel research perspective in the Indian market by examining the volatility structure and resilience behavior of high and low-ESG-scored companies during the pandemic. The Indian context has witnessed numerous studies examining the relationship between ESG scores and financial performance, stock returns and even the alpha generated during the pandemic. A very few studies identified ESG scores and investment returns and volatility. However, one intriguing aspect that has received limited attention is the link between ESG scores and volatility, as well as the resilience of ESG stocks during periods of market volatility. This research gap presents a unique opportunity to examine the interesting dynamics of ESG investments in India, providing fresh insights into the relevance and potential benefits of integrating ESG factors into investment strategies. Henceforth, to the best of the author's knowledge, this is the first study investigating the Indian market by examining the volatility structure and resilience behavior of high and low-ESG-scored companies during the pandemic. The study highlights the urgent need to strengthen the ESG framework and scores to shield investors from short and long-term volatilities and economic vulnerabilities. Secondly, the paper employs GARCH models supplementing with continuous Wavelet in a peculiar context, otherwise mostly has applied on an individual asset rather in a panel that enhances the methodological strength of the study.

The remainder of the paper is structured as follows: Section 2 deals with literature. Section 3 discusses the sample, data and methods employed in the study. Section 4 highlights methods and models used in the study. Section 5 presents the results and discussions. Section 6 concludes the paper, and Sections 7 and 8 highlight managerial and policy implications, respectively.

2. Literature review

In recent years, the surge in interest in non-conventional asset classes, particularly those rooted in environmental, social and governance (ESG) factors, reflects a significant shift in investor priorities and market dynamics (Boffo and Patalano, 2020). The escalating awareness of pressing global issues such as climate change, social inequalities and governance failures has propelled ESG investing to the forefront, not just as a trend but as a fundamental consideration for both investors and policymakers (OECD Report [5]). The evolving landscape of investment strategies underscores the critical importance of managing risks, with investors increasingly recognizing the need for sustainable and responsible investment practices (Alighanbari *et al.*, 2017; Patel *et al.*, 2021).

The flourishing literature on ESG investments over the past 2 decades has provided valuable insights to investors, highlighting the long-term benefits and strategic advantages of integrating ESG factors into investment portfolios. Numerous studies have delved into the intricate relationship between ESG stocks and volatility (Meher *et al.*, 2020; Mulchandani *et al.*, 2022), emphasizing the pivotal role of green asset classes in driving sustainable investment practices (Rajesh, 2020; Assous, 2022; Yang *et al.*, 2022; Rath and Deo, 2023).

Moreover, the effectiveness of ESG scores in generating returns and mitigating risks has been a focal point of research, with studies such as those by Baldi and Pandimiglio (2022) and Bahra and Thukral (2020) shedding light on the potential financial benefits of ESG integration. The works of Gao *et al.* (2022), Umar *et al.* (2022) have emphasized the importance of ESG scores in enhancing investment performance and resilience in the face of market uncertainties.

In the context of corporate social responsibility (CSR) practices, studies like that of Godfrey *et al.* (2009) have highlighted the role of CSR in mitigating risks associated with adverse events, emphasizing the long-term benefits of CSR engagement. Similarly, research by Shiu and Yang (2017) has explored the protective effects of CSR during negative events, emphasizing the strategic value of CSR in crisis communication and management.

Furthermore, the study by Gibson Brandon *et al.* (2021) revealing ESG rating divergence across S&P 500 firms and its positive correlation with stock returns, particularly driven by environmental concerns, raises pertinent questions about the relevance and impact of ESG scores. The recent investigation by Gyönyörová *et al.* (2023) into the reliability of ESG data from different providers underscores the importance of meticulous assessment and interpretation of ESG data to avoid potential misinterpretation and ensure informed decision-making.

The increasing prominence of ESG factors globally has led to a growing demand for transparency and disclosure of ESG information by investors and regulators. Studying ESG volatility not only enhances the credibility of ESG reporting and data but also provides valuable insights into the stability and reliability of ESG scores. This research endeavor aims to contribute to the development of robust investment strategies and policies that promote sustainable practices and responsible investing. The focus on analyzing the volatility and resilience of high and low-ESG-scored companies in India during market turbulence offers a unique perspective on the dynamics of ESG investing. However, the study's reliance on Bloomberg scores highlights the need for further exploration and validation by other rating agencies to ensure the robustness and reliability of the analysis.

In the Indian context, while existing studies have explored the relationship between ESG scores and financial performance (Jha and Rangarajan, 2020; Maji and Lohia, 2023; Sinha Ray and Goel 2023), stock returns (Sudha, 2015; Singh and Maurya, 2021; Sood *et al.*, 2023; Yadav and Bhama, 2023) and ESG alpha during the pandemic, there remains a notable research gap in understanding the volatility and resilience behavior of ESG scores in India, particularly in times of market volatility. This research presents a compelling opportunity to investigate deeper into the dynamics of ESG investments in India and unravel the implications of ESG factors on company volatility.

3. Data description

The objective of the study is to identify the answers to two research questions: first, to gauge the relationship between ESG scores and their time-varying volatility, and second, identifying the resilience of the high and low- ESG-scored companies during the outbreak of the pandemic. For this the study has considered daily closing price data fetched from Bloomberg from 01.01.2010 to 31.01.2022. And, the latest ESG Scores-2022, of all these 100 BSE listed companies were taken from Bloomberg. The study considered BSE 100, as it encompasses majority of overall Market cap. This index is designed to represent the overall performance of the Indian stock Market by including companies from various sectors, additionally ESG scores more readily available for top market companies. Out of 100 companies, 72 companies had filtered out for further analysis. The selection of 72 stocks, is based on the availability of closing price data for the considered time period and the availability of 2022-ESG Scores. Henceforth, we considered 72 stocks for further analysis. We segregate these 72 stocks into two groups that are High Score (Panel 1, comprises 36 stocks), and Low Score companies (Panel 2, comprises 36 stocks). The criterion for dividing these two groups is the median value of the ESG Score of all 72 companies (See. Table 1). Both panels are representing 36 companies.

4. Methods and models

The financial time series is prone to stochastic behavior. In this study, we are capturing the volatility structure of high-ranked ESG stocks and low-ranked ESG stocks. To capture the volatility structure, the study has applied time-varying volatility models that are

Panel-1: High ESG Score – 2022			Panel-2: Low ESG Score – 2022		
Ticker	ESG Score Jan 2022	Rank	Ticker	ESG Score Jan 2022	Rank
ACEM IB equity	66.9421	1	EIM IB equity	40.4959	1
GAIL IB equity	65.5602	2	PIEL IB equity	40.0826	2
ADSEZ IB equity	58.6777	3	TTAN IB equity	39.2562	3
BPCL IB equity	58.5062	4	TATA IB equity	37.6033	4
UTCEM IB equity	58.2645	5	APNT IB equity	37.1901	5
VEDL IB equity	57.8512	6	UPLL IB equity	34.2975	6
MSIL IB equity	57.438	7	LPC IB equity	33.0579	7
HAVL IB equity	57.0248	8	HNDL IB equity	32.6446	8
DRRD IB equity	56.6116	9	BAF IB equity	32.5118	9
ACC IB equity	56.1983	10	HUVR IB equity	32.2314	10
ITC IB equity	55.3719	11	BRGR IB equity	30.5785	11
TPWR IB equity	55.3719	12	TATACONS IB equity	30.5785	12
MM IB equity	54.9587	13	CLGT IB equity	30.1653	13
HMCL IB equity	54.5455	14	NEST IB equity	29.3388	14
AL IB equity	54.5455	15	SIEM IB equity	29.3388	15
IOCL IB equity	53.719	16	Z IB equity	28.9256	16
LT IB equity	53.3058	17	DIVI IB equity	28.5124	17
SRCM IB equity	52.0661	18	DABUR IB equity	28.0992	18
MRCO IB equity	50.4132	19	CIFC IB equity	28.0702	19
DLFU IB equity	50	20	SHTF IB equity	28.0702	20
NTPC IB equity	49.5868	21	MRF IB equity	27.686	21
GRASIM IB equity	48.7603	22	SRF IB equity	27.2727	22
PAG IB equity	48.7603	23	ADE IB equity	27.2727	23
PIDI IB equity	47.9339	24	HDFC IB equity	26.3158	24
HPCL IB equity	47.9339	25	CCRI IB equity	26.0331	25
PI IB equity	47.5207	26	INFOE IB equity	26.0331	26
BRIT IB equity	47.5207	27	APHS IB equity	25.6198	27
BHFC IB equity	47.1074	28	KMB IB equity	25	28
VOLT IB equity	46.6942	29	BJFIN IB equity	25	29
ONGC IB equity	46.473	30	GCPL IB equity	24.7934	30
SUNP IB equity	45.8678	31	FB IB equity	24.5614	31
CIPLA IB equity	45.8678	32	PLNG IB equity	23.9669	32
JSTL IB equity	42.562	33	ARBP IB equity	23.1405	33
RIL IB equity	41.3223	34	MAXF IB equity	22.314	34
TTMT/A IB equity	40.9091	35	IGL IB equity	18.1818	35
TTMT IB equity	40.9091	36	BJHI IB equity	16.2281	36

Note(s): The table captured the Scores of ESG-2022 of 72 Stocks, listed in BSE 100. The two groups were segregated on the basis of Median value i.e. 40.49. The two Group of companies created in Panel-1 (High ESG Score) and Panel-2 (Low ESG Score)
Source(s): Authors' own creation

Table 1. High and low ESG scores groups of companies

Generalized Autoregressive Conditional Heteroscedasticity (GARCH – 1, 1) and a non-linear model that is exponential GARCH. Finally, the study has applied Continuous Wavelet to capture the time-varying average volatility of high-scored ESG and low-scored ESG stocks.

4.1 Generalized autoregressive conditional heteroscedasticity (GARCH – 1, 1)

ARCH modeling has been considered a base model to analyze the volatility further GARCH model developed by Bollerslev (1986).

σ_t^2 is the conditional volatility depends on lagged squared error term of the mean model and lagged its own conditional volatility. The conditional of the series Y_t explained as:

$$Y_t|\varphi_{t-1} \sim N(0, \sigma_t^2) \tag{1}$$

σ_t^2 is the conditional volatility and φ_{t-1} is the tangible news available at time t.

GARCH (1, 1) model is explained as:

$$\sigma_t^2 = \alpha + \beta_1 \in_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \mu_t \tag{2}$$

Further, GARCH (p, q) model can be written as:

$$\sigma_t^2 = \alpha + \sum_{i=1}^{p} \beta_1 \in_{t-1}^2 + \sum_{j=1}^{q} \beta_2 \sigma_{t-1}^2 + \mu_t \tag{3}$$

Where,

$$\alpha > 0; \beta_1 \geq 0; \beta_2 \geq 0$$

GARCH (1, 1) model captures both short and long-term volatility. The conditional volatility depends on lagged squared residuals $\in_{t-1}^2$ i.e. also called as ARCH effect and its own lagged value σ_{t-1}^2 i.e. GARCH effect. Where the ARCH effect is a measure of short-term volatility and the GARCH effect captures the long-term volatility. The ARCH term implies the recent news created volatility in the given financial time series in the short term. The GARCH effect captures the long-term persistence of volatility, which implies the impact of old news on the behavior of prices.

4.2 Exponential generalized autoregressive conditional heteroscedasticity (E GARCH – 1, 1)

The non-negative constraint restricts the model to study the symmetrical behaviour. Thus, EGARCH considers that $\alpha > 0; \beta_1 \geq 0; \beta_2 \geq 0$ restricts the scope of volatility and won't be able to capture the overall dynamic behaviour of volatility in the time series. Thus, in the EGARCH model, the conditional variance, i.e. σ_t^2 captures the asymmetry in the given equation:

$$log\,log\,(\sigma_t^2) = \alpha + \sum_{i=1}^{p} \beta_i \left[\frac{|\in_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \gamma \frac{\in_{t-1}}{\sqrt{\sigma_{t-i}^2}} + \sum_{i=1}^{p} \beta_j log\,log\,\sigma_{t-j}^2 \tag{4}$$

The above equation α, β_i, γ and β_j are the coefficients having no restriction of non-negativity constraints of the conditional variances. Thus, the EGARCH model captures the asymmetry among positive and negative return shocks. This asymmetry measures by γ. If, $\gamma = 0$, then positive news having the same effect of a negative shock. If $\gamma < 0$, a positive shock is having low volatility and if, $\gamma > 0$, negative news has a greater effect of volatility.

4.3 Continuous wavelet transforms (CWT)

Continuous wavelet transforms is the most preferred technique in wavelet analysis it captures information of frequency in a particular time frame. The technique is rigor to identify a particular hidden pattern or behavior of a time series during a period of time. The number of wavelets depends on the length of the data. It breaks the time series into some elementary functions, which are in turn derived from a mother wavelet. To be a mother wavelet, the series should have a zero mean, its square should integrate into unity and fulfill the admissibility condition. The commonly used mother wavelet is known as the Morlet wavelet. It is made up of a complex exponential multiplied by the Gaussian envelope. The Gaussian envelope gives less weightage to the pixels away from the center and makes the wavelet localized in time. It is expressed mathematically as follows:

$$w_t^{\varepsilon}(\Omega) = \sqrt{\frac{\Phi_t}{\Omega}} \sum_{t=1}^{n} X\mathrm{n}\varepsilon\psi\theta\left[(\eta\varepsilon - n)\frac{\Phi t}{\Omega}\right] \tag{5}$$

where $n = 1, \ldots, N$, s = scales, Φ_t indicates the time and wavelet power $|\mathrm{Wt}^{\varepsilon}\,(\Omega)|^2$ presents the local phase.

5. Empirical results

5.1 Discussion on the results of GARCH (1, 1)

Tables 2 and 3 are showing the elaborated results of GARCH (1, 1) of Panel-1 and Panel −2 respectively. Both the tables highlight the overall mean (m), autoregression, moving average, omega, ARCH term (α1) i.e. coefficient of (ε2 t−1)) and GARCH term (β1), i.e. coefficient of (σ2 t−1)). In Table 2, we captured that all companies are showing significant short and long-term volatilities. The coefficients of both the ARCH and GARCH terms are significant and non-negative. Moreover, the sum of both terms is less than 1. The ARCH coefficient is varying from 0.0096 to 0.14, whereas the GARCH term varies from 0.60 to 0.99. The total volatility is varying within Panel 1 from 0.70 to 0.998. Similarly, Table 3 is representing the time-varying volatilities of the set of companies with low ESG Scores. The table shows the existence of short and long-term volatilities. The results are similar to Panel-1, the coefficients of both ARCH and GARCH terms are non-negative, significant and the sum of both is less than 1. The ARCH coefficient is varying from 0.011 to 0.24 and the GARCH term is varying from 0.35 to 0.99. The overall volatilities varied from 0.57 to 0.99.

Table 4 is encapsulating the results of GARCH (1, 1) on an average basis. The results show the average volatility behavior of two sets of companies. Interestingly, the results have shown that Panel-2 is more volatile in the short term, the alpha coefficient of Panel 2 is higher than Panel-1 i.e. 0.094 > 0.069, and is statistically different at 0.05 significance level (t-value > 1.96). The results support the hypothesis that high ESG score companies are less vulnerable in the short term whereas low ESG companies are showing idiosyncratic risk in the short run. We can infer that the companies listed in BSE 100 with strong ESG scores are resilient to short-term shocks. Thus, in the context of India, we can conclude that the companies good in corporate governance, socially and environmentally friendly are resilient in the short term and in consonance with the hypothesis. However, Panel 1 is showing a greater long-term volatility persistence in comparison to Panel 2 i.e. 0858 > 0.804, the average long-term volatility is statistically different at the 0.05 significance level (t-value > 1.96). It infers that the High ESG score companies are showing relatively greater long-term volatility persistence than Low ESG score companies. The results are failed to accept our hypothesis that the long-term volatility of companies with good ESG scores is lower than those with low ESG scores companies. Rest the total volatility (α+β) of Panel 1 is again greater than Panel 2 i.e. 0.927 > 0.898 but the difference is not statistically significant. Henceforth we can infer that the overall behavior of volatilities of two sets of companies remains constant. But the significant differences capture in the short and long term. We can conclude that Indian companies with good ESG scores are resilient from short-term shocks but in long run, they showed high volatility and the overall volatility of both sets of companies is converging to be almost the same. Here we can infer that there is a need to further strengthen the ESG norms to protect investors from volatilities.

Companies	Model	μ	Ω	α	β	α+β	Companies	Model	μ	Ω	α	β	α+β	Companies	Model	μ	Ω	α	β	α+β
R_PIDI	Coef.	0.001	0.000	0.073	0.807	0.880	R_MM	Coef.	0.001	0.000	0.044	0.941	0.985	R_HMCL	Coef.	0.000	0.000	0.053	0.923	0.976
	t-value	4.330	4.402	5.372	21.812			*t*-value	1.905	1.598	11.996	282.370			*t*-value	0.469	12.124	12.893	174.698	
R_HAVL	Coef.	0.001	0.000	0.101	0.601	0.702	R_	Coef.	0.001	0.000	0.091	0.749	0.839	R_MSIL	Coef.	0.001	0.000	0.051	0.907	0.958
	t-value	4.038	3.375	4.479	5.716		UTCEM	*t*-value	2.763	4.259	5.641	15.224			*t*-value	3.054	58.195	18.882	193.334	
R_TTMT	Coef.	0.000	0.000	0.031	0.956	0.988	R_SUN	Coef.	0.001	0.000	0.090	0.792	0.881	R_VEDL	Coef.	0.000	0.000	0.070	0.870	0.941
	t-value	0.072	9.711	45.894	417.344			*t*-value	2.279	4.326	5.562	20.173			*t*-value	−0.378	4.771	7.040	44.252	
R_VOLT	Coef.	0.001	0.000	0.044	0.936	0.980	R_ACEM	Coef.	0.001	0.000	0.043	0.917	0.960	R_ACC	Coef.	0.000	0.000	0.043	0.915	0.958
	t-value	2.173	18.541	14.832	200.463			*t*-value	1.786	65.148	20.105	205.489			*t*-value	1.531	77.153	21.574	219.669	
R_	Coef.	0.001	0.000	0.069	0.895	0.964	R_HPCL	Coef.	0.000	0.000	0.094	0.793	0.887	R_SRCM	Coef.	0.001	0.000	0.044	0.899	0.942
GRASIM	*t*-value	2.508	26.848	17.309	146.108			*t*-value	0.713	4.632	6.851	23.521			*t*-value	3.074	3.347	5.131	38.185	
R_PI	Coef.	0.001	0.000	0.010	0.989	0.998	R_PAG	Coef.	0.001	0.000	0.143	0.679	0.822	R_AL	Coef.	0.001	0.000	0.086	0.864	0.950
	t-value	3.281	2.187	21.254	3304.319			*t*-value	3.811	6.518	7.647	18.149			*t*-value	2.141	4.072	5.799	35.830	
R_MRCO	Coef.	0.001	0.000	0.050	0.900	0.950	R_BRIT	Coef.	0.001	0.000	0.111	0.757	0.868	R_BHFC	Coef.	0.001	0.000	0.048	0.910	0.958
	t-value	2.744	96.890	19.779	182.929			*t*-value	3.607	3.979	4.807	14.547			*t*-value	1.816	3.218	4.954	43.710	
R_DLFU	Coef.	0.000	0.000	0.089	0.756	0.845	R_BPCL	Coef.	0.000	0.000	0.118	0.784	0.902	R_	Coef.	0.000	0.000	0.050	0.921	0.972
	t-value	0.477	4.604	5.335	16.627			*t*-value	1.305	4.469	6.432	21.761		TTMT_2	*t*-value	0.731	1.936	2.968	30.218	
R_NTPC	Coef.	0.000	0.000	0.027	0.964	0.991	R_CIPLA	Coef.	0.000	0.000	0.081	0.815	0.896	R_ONGC	Coef.	0.000	0.000	0.090	0.873	0.962
	t-value	−0.473	3.177	13.242	516.913			*t*-value	1.666	4.518	5.889	25.042			*t*-value	0.128	9.342	20.554	107.400	
R_GAIL	Coef.	0.000	0.000	0.038	0.936	0.974	R_TPWR	Coef.	0.000	0.000	0.061	0.925	0.986	R_IOCL	Coef.	0.000	0.000	0.109	0.820	0.929
	t-value	0.300	35.955	18.065	239.458			*t*-value	0.121	2.750	10.911	162.295			*t*-value	0.189	4.478	7.014	31.155	
R_RIL	Coef.	0.000	0.000	0.071	0.869	0.940	R_ADSEZ	Coef.	0.001	0.000	0.097	0.781	0.878	R_JSTL	Coef.	0.001	0.000	0.054	0.917	0.971
	t-value	1.595	7.610	32.715	121.955			*t*-value	2.264	5.664	7.082	26.515			*t*-value	2.774	10.694	17.456	160.614	
R_ITC	Coef.	0.000	0.000	0.105	0.738	0.843	R_DRRD	Coef.	0.001	0.000	0.063	0.870	0.932	R_LT	Coef.	0.000	0.000	0.056	0.908	0.963
	t-value	1.229	5.357	5.970	17.929			*t*-value	2.258	4.646	5.519	38.582			*t*-value	1.658	39.314	17.671	176.468	

Note(s): The above table encapsulated the short-term volatility, long-term volatility and total volatility, represented α, β, α+β of Panel 1 (High ESG Scored companies)
Source(s): Authors' own creation

Table 2.
Panel-1: results of symmetrical volatility of companies with high CSR scores GARCH (1, 1)

Table 3. Panel 2: results of symmetrical volatility of companies with low CSR scores GARCH (1, 1)

Companies	μ	Ω	α	β	α+β	Companies	μ	Ω	α	β	α+β	Companies	μ	Ω	α	β	α+β
R_TATA	0.000	0.000	0.046	0.930	0.976	R_CIFC	0.001	0.000	0.079	0.889	0.969	R_ADE	0.001	0.000	0.107	0.733	0.840
	0.388	26.327	18.245	203.564			4.000	5.114	7.743	63.559			2.086	6.356	6.582	21.345	
R_PIEL	0.001	0.000	0.119	0.808	0.927	R_HUVR	0.001	0.000	0.119	0.722	0.841	R_EIM	0.001	0.000	0.017	0.977	0.993
	1.730	3.729	5.251	20.572			3.051	5.988	6.863	18.765			3.379	3.530	17.274	1426.306	
R_UPLL	0.001	0.000	0.119	0.808	0.927	R_INFOE	0.001	0.000	0.101	0.814	0.915	R_ARBP	0.001	0.000	0.107	0.733	0.840
	1.730	3.729	5.251	20.572			3.138	4.105	5.606	23.223			2.086	6.356	6.582	21.345	
R_CLGT	0.001	0.000	0.102	0.763	0.864	R_HDFC	0.001	0.000	0.060	0.904	0.964	R_TTAN	0.001	0.000	0.077	0.851	0.927
	2.496	3.915	5.270	15.228			2.772	26.155	16.510	156.682			3.818	4.768	6.680	35.958	
R_IGL	0.001	0.000	0.249	0.415	0.664	R_BAF	0.002	0.000	0.080	0.847	0.927	R_BJFIN	0.001	0.000	0.077	0.851	0.927
	4.534	6.744	10.082	6.417			5.959	4.975	6.601	35.136			3.818	4.768	6.680	35.958	
R_Z	0.001	0.000	0.012	0.987	0.999	R_SHTF	0.001	0.000	0.076	0.862	0.938	R_MAXF	0.000	0.000	0.073	0.875	0.948
	1.813	2.499	122.664	2524.498			1.817	4.826	6.756	41.031			1.346	5.072	7.690	52.507	
R_SRF	0.002	0.000	0.218	0.351	0.569	R_NEST	0.001	0.000	0.079	0.838	0.916	R_BRGR	0.001	0.000	0.134	0.730	0.864
	4.211	5.964	6.403	3.760			3.090	3.088	4.688	28.113			4.357	4.224	6.426	14.951	
R_Dabur	0.001	0.000	0.056	0.890	0.946	R_SIEM	0.001	0.000	0.131	0.753	0.884	R_LPC	0.001	0.000	0.112	0.691	0.803
	6.823	65.008	19.494	166.589			1.696	5.116	6.801	20.661			2.149	4.469	5.120	11.628	
R_BJHI	0.001	0.000	0.231	0.632	0.863	R_PLNG	0.001	0.000	0.075	0.855	0.930	R_KMB	0.001	0.000	0.065	0.904	0.968
	2.369	7.119	8.614	16.943			2.673	2.684	4.176	20.513			18.799	17.960	15.564	154.887	
R_APNT	0.001	0.000	0.059	0.884	0.943	R_DIVI	0.001	0.000	0.023	0.961	0.985	R_CCRI	0.000	0.000	0.032	0.957	0.989
	4.204	51.649	17.404	147.541			2.772	17.499	67.220	619.353			1.007	2.118	9.135	361.375	
R_FB	0.001	0.000	0.062	0.880	0.942	R_GCPL	0.001	0.000	0.082	0.792	0.874	R_APHS	0.001	0.000	0.159	0.670	0.829
	1.711	2.577	3.897	23.766			2.750	4.688	5.921	21.488			1.792	5.954	7.570	15.578	
R_Tata_	0.001	0.000	0.088	0.754	0.842	R_HNDL	0.001	0.000	0.082	0.792	0.874	R_MRF	0.001	0.000	0.079	0.838	0.916
Cons	2.400	3.971	5.046	14.271			2.750	4.688	5.921	21.488			3.090	3.088	4.688	28.113	

Note(s): The above table encapsulated the short-term volatility, long-term volatility and total volatility, represented α, β, α+β of Panel 2 (Low ESG Scored companies)
Source(s): Authors' own creation

5.2 Discussion on the results of EGARCH (1, 1)

Tables 5 and 6 are encapsulating the results of asymmetric volatilities of each stock in Panel-1 and Panel-2 respectively.

Table 5 is representing the asymmetric volatilities of the stocks having high ESG score. From the results we capture the shreds of evidence of short-term asymmetric volatilities but there is no evidence of long-term asymmetry. The same results are captured in Table 6.

Table 7 is providing the overall picture of the asymmetric volatilities. In both panels, there is evidence of short-term asymmetric volatility which means the negative news created steeper shocks than positive news. The negative α-Coefficient captured the short-term volatility, i.e. ARCH term that is ($\varepsilon 2\ t-1$). Further, it has been captured that Panel 1 asymmetric volatility is more than Panel 2, although the average value is not statistically different. However, there is no asymmetric volatility captured in the long term in both panels. Henceforth we can infer that although in the short term, there is an impact on the volatilities, and the impact is relatively larger in low ESG Score companies but the difference in the average values of short-term leverage of both Panels is not significant. The inferences drawn from various GARCH models are further strengthened by the time-varying continuous wavelet transform.

5.3 Discussion on continuous wavelet transform

We can analyze meticulously the time-varying behavior of average stock returns of high and low-scored ESG companies, it strengthened our previous inferences and also provides insights into the resilience behavior of these two sets of companies. Figures 1 and 2 are representing the time-varying average returns of the companies that are top-ESG-scored and Low ESG-scored companies respectively. The frequencies or scales and time are shown on *Y*-axis and *X*-axis respectively. To make it simpler, we categorize the scale into five different cycles 6–16, 16–64, 64–256 and 256–1,024 days. Further, these cycles are categorized as short scale (6–16 and 16–64 days), medium scale (64–256 days) and long scale (256–1,024 days). The power of the wavelet is captured through its color, where blue shows the low power, yellow is the medium and red is the high power. The data ranges from 01.01.2010 to 31.01.2022. In these data frames, we captured some of the volatile events like the repercussions of the subprime crisis and outbreak of the COVID-19. We noticed that the behavior of both sets of average returns are showing similar patterns thus, no prominent difference has been captured. The short-term volatility is perceived throughout both sets of companies. The results are in the consensus of GARCH models. Henceforth, the companies having high ESG score is not able to create any different results in terms of volatilities. The results are in the Jain *et al.* (2019), Bruno *et al.* (2022) and not in consensus with Verheyden *et al.* (2016), Gibson Brandon *et al.* (2021) and Khan (2019). Under vulnerable situations, it has been perceived that during the post-sub-prime crisis, there are impressions of short-term volatilities but during the period of the outbreak of COVID-19, the signs of volatility are very prominent in both sets of companies. However, the volatility is relatively consistent or powerful in low ESG-scored companies compared to high ESG-scored companies. The results

	Model	α	β	α+β
Panel-1	GARCH (1, 1)	0.069	0.858	0.927
Panel-2	GARCH (1, 1)	0.094	0.804	0.898
	t-statistics	−2.42***	2.01***	1.62

Note(s): The above table encapsulated the short-term volatility, long-term volatility and total volatility, represented α, β, α+β of Panel 1 and Panel 2. *t*-statistics ***, **, * denote significance at 1, 5 and 10% significance level

Source(s): Authors' own creation

Table 4.
Average results of GARCH (1, 1) of Panel-1 and Panel-2

Table 5. Panel 1: results of asymmetrical volatility of companies with high CSR scores EGARCH (1, 1)

Companies	μ	Ω	α	β	y	α+β+y	Companies	μ	Ω	A	β	y	α+β+y	Companies	μ	Ω	α	β	y	α+β+y
R_TATA	0.00	−0.11	−0.05	0.99	0.08	1.019	R_ADE	0.001	−0.939	−0.007	0.864	0.221	1.078	R_BRGR	0.001	−1.193	−0.001	0.847	0.291	1.137
	−328.28	−81.84	−7.67	7851.40	11.33			2.228	−4.542	−0.388	29.289	8.356			5.033	−5.174	−0.094	29.048	9.316	
R_PIEL	0.00	−0.30	−0.02	0.96	0.17	1.111	R_EIM	0.001	−1.415	−0.060	0.816	0.193	0.950	R_LPC	0.001	−0.925	−0.047	0.884	0.189	1.027
	0.96	−10.68	−2.16	259.89	11.24			5.011	−3.703	−3.738	16.579	5.506			1.864	−4.152	−3.429	32.050	26.684	
R_UPLL	0.00	−0.66	−0.04	0.91	0.21	1.082	R_ARBP	0.000	−0.391	−0.091	0.946	0.196	1.051	R_KMB	0.001	−0.201	−0.048	0.975	0.116	1.043
	2.85	−1.45	−3.74	15.22	4.38			0.753	−4.350	−6.456	79.026	11.769			22,424	−124.4	−10.211	2247.4	20.033	
R_CLGT	0.00	−1.34	−0.02	0.84	0.23	1.055	R_TTAN	0.001	−0.445	−0.021	0.940	0.177	1.096	R_CCRI	0.000	−0.111	−0.003	0.985	0.094	1.076
	2.50	−4.13	−1.18	22.51	7.00			4.578	−22.293	−2.019	360.012	11.119			0.869	−50.905	−0.532	4787.6	26.562	
R_IGL	0.00	−2.70	−0.15	0.66	0.38	0.886	R_BJFIN	0.001	−0.445	−0.021	0.940	0.177	1.096	R_APHS	0.001	−0.936	0.016	0.878	0.279	1.173
	5.00	−6.49	−16.68	12.54	16.74			4.578	−22.293	−2.019	360.012	11.119			5.036	−8.157	1.284	59.424	10.703	
R_Z	0.00	−0.05	−0.03	0.99	0.11	1.068	R_MAXF	0.000	−0.289	0.002	0.961	0.167	1.130	R_MRF	0.001	−0.503	−0.017	0.940	0.161	1.084
	3.52	−26.11	−6.01	78,802	10.05			1.095	−7.533	0.176	194.059	11.694			3.736	−12.333	−1.526	193.9	9.178	
R_SRF	0.00	−1.62	−0.03	0.78	0.29	1.046	R_CIFC	0.001	−0.159	−0.042	0.977	0.156	1.092	R_NEST	0.001	−0.503	−0.017	0.940	0.161	1.084
	4.87	−5.08	−1.64	18.74	9.12			2.908	−6.889	−4.852	342.992	6.803			3.736	−12.333	−1.526	193.9	9.178	
R_Dabur	0.00	−0.33	−0.01	0.96	0.12	1.063	R_HUVR	0.001	−0.876	0.014	0.896	0.211	1.122	R_SIEM	0.000	−0.750	−0.039	0.904	0.223	1.088
	2.83	−14.98	−1.31	338.76	7.17			3.849	−3.559	0.970	31.105	7.461			0.623	−4.078	−2.948	39.047	6.821	
R_BJHI	0.00	−1.23	0.01	0.85	0.40	1.258	R_INFOE	0.001	−0.626	0.011	0.916	0.216	1.143	R_PLNG	0.001	−0.468	−0.012	0.941	0.161	1.090
	3.20	−8.07	3.10	46.25	13.56			1.065	−1.436	1.183	16.101	18.174			3.102	−2.718	−1.056	43.687	5.949	
R_APNT	0.00	−0.32	−0.04	0.96	0.13	1.050	R_HDFC	0.000	−0.210	−0.073	0.974	0.102	1.003	R_DIVI	0.001	−2.004	0.005	0.747	0.379	1.131
	2.86	−5.80	−3.28	145.35	8.93			1.253	−21.838	−7.360	897.398	23.793			2.751	−5.990	0.254	17.944	11.193	
R_FB	0.00	−0.10	−0.04	0.99	0.06	1.008	R_BAF	0.002	−0.380	−0.056	0.949	0.156	1.049	R_GCPL	0.001	−0.620	−0.022	0.921	0.149	1.047
	0.60	−61.27	−6.83	5225.30	27.02			4.502	−8.286	−5.619	156.699	7.935			2.251	−4.017	−1.794	46.714	5.681	
R_Tata_	0.00	−0.68	−0.06	0.91	0.17	1.017	R_SHTF	0.000	−0.195	−0.065	0.973	0.115	1.023	R_HNDL	0.000	−0.107	−0.034	0.985	0.089	1.040
Cons	1.79	−5.97	−5.26	63.27	11.75			1.202	−28.030	−7.450	804.448	9.913			0.459	−39.293	−4.722	2936.5	17.830	

Note(s): The above table encapsulated the short-term volatility, long-term volatility, leverage effect volatility and total volatility, represented α, β, y, α+β of Panel 1 (High ESG Scored companies)

Source(s): Authors' own creation

Table 6.
Panel 2: results of asymmetrical volatility of companies with low CSR scores EGARCH (1, 1)

Companies	μ	Ω	α	β	y	α+β+y	Companies	μ	Ω	α	β	y	α+β+y	Companies	μ	Ω	α	β	y	α+β+y
R_PIDI	0.0	−0.9	0.0	0.9	0.2	1.047	R_MM	0.0	−0.1	0.0	1.0	0.1	1.040	R_HMCL	0.0	−0.2	0.0	1.0	0.1	1.1
	4.4	−3.0	−1.0	25.5	10.3			1.5	−48.9	−5.1	3813.2	23.4			−0.3	−4.3	−3.1	242.4	2.4	
R_HAVL	0.0	−1.0	0.0	0.9	0.2	0.980	R_	0.0	−0.5	−0.1	0.9	0.1	0.993	R_MSIL	0.0	−0.2	−0.1	1.0	0.1	1.0
	4.0	−2.4	−6.3	16.4	13.6		UTCEM	1.8	−13.8	−6.5	206.9	8.5			1.8	−82.8	−11.1	6277.3	13.5	
R_TTMT	0.0	0.0	0.0	1.0	0.1	1.052	R_SUN	0.0	−0.2	0.0	1.0	0.1	0.998	R_VEDL	0.0	−0.2	0.0	1.0	0.1	1.1
	0.0	−49.7	−2.0	66,059.0	92.9			2.2	−123.7	−8.5	32,936.1	10.3			−1.9	−2.4	−4.3	73.6	6.6	
R_VOLT	0.0	−0.1	0.0	1.0	0.1	1.055	R_ACEM	0.0	−0.3	0.0	1.0	0.1	1.004	R_ACC	0.0	−0.2	0.0	1.0	0.1	1.0
	2.6	−17.9	−4.1	1041.1	11.2			10.9	−462.2	−5.1	2689.6	18.3			1.0	−137.3	−4.6	4725.3	60.6	
R_	0.0	−0.2	0.0	1.0	0.1	1.069	R_HPCL	0.0	−0.8	0.0	0.9	0.2	1.094	R_SRCM	0.0	−0.4	0.0	1.0	0.1	1.0
GRASIM	1.9	−8.6	−4.5	297.5	7.1			0.7	−8.7	−1.2	74.6	12.2			2.5	−88.3	−3.8	1404.3	22.4	
R_PI	0.0	−0.4	0.0	0.9	0.2	1.110	R_PAG	0.0	−1.3	0.0	0.8	0.3	1.100	R_AL	0.0	−0.5	−0.1	0.9	0.2	1.1
	5.7	−3.3	−1.0	55.1	17.1			3.4	−5.6	−0.2	28.6	9.7			1.4	−1.4	−2.7	21.3	3.8	
R_MRCO	0.0	−0.2	0.0	1.0	0.1	1.040	R_BRIT	0.0	−0.4	0.0	0.9	0.2	1.107	R_BHFC	0.0	−0.1	0.0	1.0	0.1	1.0
	4.4	−21.9	−4.8	809.8	22.0			4.0	−7.6	−0.5	143.9	20.3			1.3	−53.2	−6.7	5457.8	19.5	
R_DLFU	0.0	−0.5	−0.1	0.9	0.1	0.963	R_BPCL	0.0	−0.5	0.0	0.9	0.2	1.118	R_TTMT_	0.0	−0.1	0.0	1.0	0.1	1.1
	−0.2	−16.9	−9.8	241.9	7.3			0.9	−2.7	−2.5	43.3	7.4		2	−0.2	−22.3	−2.1	2354.0	10.2	
R_NTPC	0.0	−0.3	0.0	1.0	0.1	1.098	R_CIPLA	0.0	−0.5	0.0	0.9	0.2	1.064	R_ONGC	0.0	−0.3	0.0	1.0	0.2	1.1
	−0.5	−79.3	0.3	1342.7	11.7			1.7	−7.7	−3.2	113.9	10.2			−0.1	−6.5	−1.7	151.1	11.8	
R_GAIL	0.0	−0.1	0.0	1.0	0.1	1.031	R_TPWR	0.0	−0.1	0.0	1.0	0.1	1.103	R_IOCL	0.0	−0.7	0.0	0.9	0.3	1.2
	−0.4	−567.3	−4.0	16,830.2	34.8			−0.5	−10.2	−2.7	768.4	8.7			0.2	−4.1	−0.8	42.3	9.8	
R_RIL	0.0	−0.3	0.0	1.0	0.1	1.051	R_ADSEZ						0.000	R_JSTL	0.0	−0.2	−0.1	1.0	0.1	1.0
	1.1	−32.0	−8.2	891.7	9.5										2.3	−2.8	−5.3	106.5	1.8	
R_ITC	0.0	−0.5	0.0	0.9	0.2	1.074	R_DRRD	0.0	−0.5	0.0	0.9	0.1	1.031	R_LT	0.0	−0.2	0.0	1.0	0.1	1.0
	12.7	−97.9	−1.3	886.2	17.9			1.3	−17.4	−4.0	275.1	14.3			1.0	−22.9	−4.9	1001.3	8.2	

Note(s): The above table encapsulated the short-term volatility, long-term volatility, leverage effect volatility and total volatility, represented α, β, y, α+β of Panel 1 (Low ESG Scored companies)
Source(s): Authors' own creation

are in the consensus of the non-linear GARCH model. Overall the impact is not significantly differentiated among both sets of companies. The results are in the consensus of the GARCH (1, 1) models. The results are in the consensus of the studies done by Rubbaniy *et al.* (2021) and Pavlova and de Boyrie (2022).

6. Conclusion

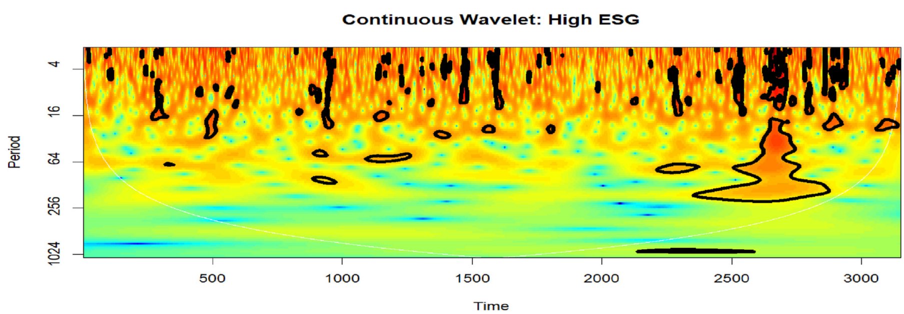
The study delves into analyzing the volatility structure and resilience behavior of high and low-ESG-scored companies during the COVID-19 pandemic, guided by the theory that high ESG scores should lead to long-term outperformance and greater resilience. With the significant growth of India's ESG assets and the majority of Indian firms having below-average ESG ratings, the research aims to investigate the impact of ESG scores on volatility structures, leverage effects and safe haven properties of ESG stocks during vulnerable periods.

	Model	α	β	y	α+β+y
Panel-1		−0.0319	0.9516	0.1360	1.0557
Panel-2		−0.0309	0.9139	0.1869	1.0699
	t-Statistics	−0.1527	2.7347	−3.1107	−1.0899

Note(s): The above table encapsulated the short-term volatility, long-term volatility, leverage effect volatility and total volatility, represented α, β, y, α+β of Panel 1 (High ESG Scored companies) and Panel 2 (Low ESG Scored companies). *t*-statistics ***, **, * denote significance at 1, 5 and 10% significance level
Source(s): Authors' own creation

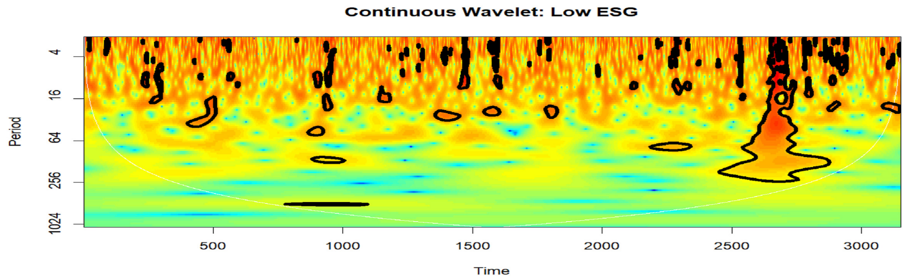
Table 7. Average results of EGARCH (1, 1) of Panel-1 and Panel-2

Observations	Time
1	04-01-2010
500	01-12-2011
1000	31-10-2013
1500	01-10-2015
2000	31-08-2017
2500	01-08-2019
3000	01-07-2021



Source(s): Authors' own creation

Figure 1. Continuous wavelet of average returns of high ESG scored companies



Note(s): In the above figures, we apply continuous wavelet of average returns of High and Low ESG Scored companies. The frequencies or scales and time are shown in Y-axis and X-axis respectively, where we categorized the scale across five different cycles, identified across 4-16, 16-64, 64-256, and 256-1024. Further, these cycles are categorized as short-scale (4-16 and 16- 64 days), medium-scale (64-256 days) and long-scale (256-1024 days)
Source(s): Authors own creation

Figure 2.
Continuous wavelet of average returns of low ESG scored companies

The study created two panels based on high and low ESG scores, and employs multiple time-varying volatility econometric methods to analyze the data. The GARCH (1, 1) model revealed that high ESG-scored companies are more resilient in the short term but show higher volatility in the long run. The overall volatility of both sets of companies is converging. Asymmetric volatility is observed in the short term, with low ESG stocks exhibiting slightly higher volatility. Wavelet analysis confirmed similar patterns in the average returns of both sets. Thus, there are no significant differences in the volatility structure of both sets of companies during times of vulnerability. Thus, in the overall analysis, it has been captured no significant differences in the volatility structure of both sets of companies during times of vulnerability. The results are in the consensus of the studies done by Rubbaniy *et al.* (2021) and Pavlova and de Boyrie (2022). These findings have important implications for investors and policymakers. The research provides valuable insights into the relevance and volatility of ESG scores in the Indian market, shedding light on the potential benefits and risks associated with investing in ESG stocks. The limitation of this study is that it only considers Bloomberg scores to test the volatility structure of high and low scored companies. However, this limitation presents an opportunity for future research to include scores from other rating agencies, test the hypothesis further and provide consistent insights to investors and policymakers. Additionally, future studies could expand beyond the Indian context to include emerging countries, thereby broadening the applicability and relevance.

7. Managerial implications

The study provide implications for investors and portfolio managers particularly investing in ESG based thematic indexes. Investors and portfolio managers should exercise caution and diligence when allocating funds based solely on ESG scores. They should consider incorporating additional factors and indicators beyond ESG scores when evaluating the sustainability and responsible practices of companies. This assessment can include examining the company's specific ESG initiatives, performance metrics, disclosures and transparency in order to gain a more comprehensive understanding of their ESG practices.

8. Policy implications

The study provides implications for policymakers that they should focus on ensuring the implementation of effective ESG scores and indexes in the market. This involves establishing robust methodologies and frameworks for assessing and rating companies' ESG performance. Standardized and reliable ESG scores and indexes can provide investors with a clear understanding of a company's sustainability practices and facilitate informed investment decision-making. Henceforth, policymakers and regulators play a crucial role in promoting standardized ESG reporting requirements for companies.

Notes

1. https://www.lseg.com/en/media-centre/press-releases/ftse-russell/2022/sustainable-investment-now-mainstream-according-ftse-russell-global-asset-owner-survey
2. https://www.rbcwealthmanagement.com/en-eu/insights/the-rise-of-esg-investing-opportunities-in-emerging-markets
3. https://rmaindia.org/esg-rating-of-80-indian-firms-just-adequate-or-below-average-analysis/
4. https://indiacorplaw.in/2022/10/indias-changing-landscape-of-esg-disclosures.html#:~:text=Globally%2C%20ESG%20assets%20are%20expected,crore%20rupees%20in%20November%202019.
5. Chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.oecd.org/finance/ESG-Investing-Practices-Progress-Challenges.pdf

References

Alighanbari, M., Doole, S. and Melas, D. (2017), "Managing risks beyond volatility", *The Journal of Beta Investment Strategies*, Vol. 8 No. 2, pp. 68-76, doi: 10.3905/jii.2017.8.2.068.

Ameli, N., Dessens, O., Winning, M., Cronin, J., Chenet, H., Drummond, P., Grubb, M. and Anandarajah, G. (2021), "Higher cost of finance exacerbates a climate investment trap in developing economies", *Nature Communications*, Vol. 12 No. 1, 4046, doi: 10.1038/s41467-021-24305-3.

Ametefe, F.K., Brenni, P.A. and Viruly, F. (2023), "Sustainable real estate investment and finance in developing economies: challenges and opportunities", *Sustainable and Responsible Investment in Developing Markets: A Companion*, p. 262.

Assous, H.F. (2022), "Saudi green banks and stock return volatility: GLE algorithm and neural network models", *Economies*, Vol. 10 No. 10, p. 242, doi: 10.3390/economies10100242.

Bahra, B. and Thukral, L. (2020), "ESG in global corporate bonds: the analysis behind the hype", *The Journal of Portfolio Management*, Vol. 46 No. 8, pp. 133-147, doi: 10.3905/jpm.2020.1.171.

Baldi, F. and Pandimiglio, A. (2022), "The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: a conceptual framework and an econometric analysis", *Global Finance Journal*, Vol. 52, 100711, doi: 10.1016/j.gfj.2022.100711.

Beloskar, V.D. and Rao, S.N. (2023), "Did ESG save the day? Evidence from India during the COVID-19 crisis", *Asia-Pacific Financial Markets*, Vol. 30 No. 1, pp. 73-107.

Bodhanwala, S. and Bodhanwala, R. (2023), "Environmental, social and governance performance: influence on market value in the COVID-19 crisis", *Management*, Vol. 61 No. 8, pp. 2442-2466, doi: 10.1108/md-08-2022-1084.

Boffo, R. and Patalano, R. (2020), *ESG Investing: Practices, Progress and Challenges*, OECD, Paris, available at: www.oecd.org/finance/ESG-Investing-Practices-Progress-and-Challenges.pdf

Bollerslev, T. (1986), "Generalized autoregressive conditional heteroskedasticity", *Journal of Econometrics*, Vol. 31 No. 3, pp. 307-327, doi: 10.1016/0304-4076(86)90063-1.

Bruno, G., Esakia, M. and Goltz, F. (2022), "'Honey, I Shrunk the ESG alpha': risk-adjusting ESG portfolio returns", *The Journal of Investing*, Vol. 31 No. 3, pp. 45-61, doi: 10.3905/joi.2021.1.215.

Cardoso, G., Carr, D.D. and Rogers, P. (2019), "Does corporate governance matter for stock returns volatility in the Brazilian context?", *Corporate Governance: The International Journal of Business in Society*, Vol. 19 No. 6, pp. 1236-1252, doi: 10.1108/cg-03-2019-0083.

Gao, J., Chu, D., Zheng, J. and Ye, T. (2022), "Environmental, social and governance performance: can it be a stock price stabilizer?", *Journal of Cleaner Production*, Vol. 379, 134705, doi: 10.1016/j.jclepro.2022.134705.

Gibson Brandon, R., Krueger, P. and Schmidt, P.S. (2021), "ESG rating disagreement and stock returns", *Financial Analysts Journal*, Vol. 77 No. 4, pp. 104-127, doi: 10.1080/0015198x.2021.1963186.

Godfrey, P.C., Merrill, C.B. and Hansen, J.M. (2009), "The relationship between corporate social responsibility and shareholder value: an empirical test of the risk management hypothesis", *Strategic Management Journal*, Vol. 30 No. 4, pp. 425-445, doi: 10.1002/smj.750.

Gyönyörová, L., Stachoň, M. and Stašek, D. (2023), "ESG ratings: relevant information or misleading clue? Evidence from the S&P Global 1200", *Journal of Sustainable Finance and Investment*, Vol. 13 No. 2, pp. 1075-1109, doi: 10.1080/20430795.2021.1922062.

Jain, M., Sharma, G.D. and Srivastava, M. (2019), "Can sustainable investment yield better financial returns: a comparative study of ESG indices and MSCI indices", *Risks*, Vol. 7 No. 1, p. 15, doi: 10.3390/risks7010015.

Jha, M.K. and Rangarajan, K. (2020), "Analysis of corporate sustainability performance and corporate financial performance causal linkage in the Indian context", *Asian Journal of Sustainability and Social Responsibility*, Vol. 5 No. 1, pp. 1-30, doi: 10.1186/s41180-020-00038-z.

Khan, M. (2019), "Corporate governance, ESG, and stock returns around the world", *Financial Analysts Journal*, Vol. 75 No. 4, pp. 103-123, doi: 10.1080/0015198x.2019.1654299.

Maji, S.G. and Lohia, P. (2023), "Environmental, social and governance (ESG) performance and firm performance in India", *Society and Business Review*, Vol. 18 No. 1, pp. 175-194, doi: 10.1108/sbr-06-2022-0162.

Meher, B.K., Hawaldar, I.T., Mohapatra, L., Spulbar, C.M. and Birau, F.R. (2020), "The effects of environment, society and governance scores on investment returns and stock market volatility", *International Journal of Energy Economics and Policy*, Vol. 10 No. 4, pp. 234-239, doi: 10.32479/ijeep.9311.

Mulchandani, K., Mulchandani, K., Iyer, G. and Lonare, A. (2022), "Do equity investors care about environment, social and governance (ESG) disclosure performance? Evidence from India", *Global Business Review*, Vol. 23 No. 6, pp. 1336-1352, doi: 10.1177/09721509221129910.

Patel, P.C., Pearce, J.A. II and Oghazi, P. (2021), "Not so myopic: investors lowering short-term growth expectations under high industry ESG-sales-related dynamism and predictability", *Journal of Business Research*, Vol. 128, pp. 551-563, doi: 10.1016/j.jbusres.2020.11.013.

Pavlova, I. and de Boyrie, M.E. (2022), "ESG ETFs and the COVID-19 stock market crash of 2020: Did clean funds fare better?", *Finance Research Letters*, Vol. 44, 10205, doi: 10.1016/j.frl.2021.102051.

Rajesh, R. (2020), "Exploring the sustainability performances of firms using environmental, social, and governance scores", *Journal of Cleaner Production*, Vol. 247, 119600, doi: 10.1016/j.jclepro.2019.119600.

Rath, C. and Deo, M. (2023), "The moderating role of ESG disclosure scores in determining the impact of firm performance on CEO pay: a dynamic panel approach", *International Journal of Corporate Governance*, Vol. 13 No. 3, pp. 243-259, doi: 10.1504/ijcg.2023.10054182.

Rubbaniy, G., Khalid, A.A., Rizwan, M.F. and Ali, S. (2021), "Are ESG stocks safe-haven during COVID-19?", *Studies in Economics and Finance*, Vol. 39 No. 2, pp. 239-255, doi: 10.1108/sef-08-2021-0320.

Shiu, Y.M. and Yang, S.L. (2017), "Does engagement in corporate social responsibility provide strategic insurance-like effects?", *Strategic Management Journal*, Vol. 38 No. 2, pp. 455-470, doi: 10.1002/smj.2494.

Singh, A.K. and Maurya, S. (2021), "Analysis of historical trend and determinants of ESG index performance in India", *Corporate Governance*, Vol. 3 No. 2, pp. 12-27, doi: 10.58426/cgi.v3.i2.2021.12-27.

Sinha Ray, R. and Goel, S. (2023), "Impact of ESG score on financial performance of Indian firms: static and dynamic panel regression analyses", *Applied Economics*, Vol. 55 No. 15, pp. 1742-1755, doi: 10.1080/00036846.2022.2101611.

Sood, K., Pathak, P., Jain, J. and Gupta, S. (2023), "How does an investor prioritize ESG factors in India? An assessment based on fuzzy AHP", *Managerial Finance*, Vol. 49 No. 1, pp. 66-87, doi: 10.1108/mf-04-2022-0162.

Sudha, S. (2015), "Risk-return and volatility analysis of sustainability index in India", *Environment, Development and Sustainability*, Vol. 17 No. 6, pp. 1329-1342, doi: 10.1007/s10668-014-9608-8.

Umar, M., Mirza, N., Rizvi, S.K.A. and Naqvi, B. (2022), "ESG scores and target price accuracy: evidence from sell-side recommendations in BRICS", *International Review of Financial Analysis*, Vol. 84, 102389, doi: 10.1016/j.irfa.2022.102389.

Verheyden, T., Eccles, R.G. and Feiner, A. (2016), "ESG for all? The impact of ESG screening on return, risk, and diversification", *Journal of Applied Corporate Finance*, Vol. 28 No. 2, pp. 47-55, doi: 10.1111/jacf.12174.

Wasan, P., Kumar, A. and Luthra, S. (2021), "Green finance barriers and solution strategies for emerging economies: the case of India", *IEEE Transactions on Engineering Management*, Vol. 71, pp. 414-425, doi: 10.1109/tem.2021.3123185.

Yadav, N. and Bhama, V. (2023), "Sustainability, resilience, and returns during COVID-19: empirical evidence from US and Indian stock markets", *Journal of Emerging Market Finance*, 09726527231158555.

Yang, Q., Du, Q., Razzaq, A. and Shang, Y. (2022), "How volatility in green financing, clean energy, and green economic practices derive sustainable performance through ESG indicators? A sectoral study of G7 countries", *Resources Policy*, Vol. 75, 102526, doi: 10.1016/j.resourpol.2021.102526.

Further reading

Anita, M., Shveta, S., Surendra, S.Y. and Arvind, M. (2023), "When do ESG controversies reduce firm value in India?", *Global Finance Journal*, Vol. 55, 100809, doi: 10.1016/j.gfj.2023.100809.

Corresponding author

Vaibhav Aggarwal can be contacted at: vaibhavapj@gmail.com