JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Comparative Analysis of BSE Sustainability Indices - Implications for Climate Finance and Sustainability Outcomes

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ABSTRACT

This study conducts a comparative evaluation of the performance of Bombay Stock Exchange (BSE) sustainability indices (Greenex, Carbonex, BSE 100 ESG) and traditional indices (Sensex, Nifty50, BSE 100) to explore the potential implications for climate finance. Amid increasing global environmental challenges, financial markets have emerged as critical platforms for driving sustainable development. In this context, sustainability indices, which monitor the performance of environmentally and socially responsible companies, have gained significant attention. However, the understanding of how these indices perform compared to traditional indices and their implications for climate finance, remains limited. Using a comprehensive dataset of these indices over a certain period (October 2017 to June 2023), this study applies various financial metrics and statistical analyses to assess their performance. The study provides a theoretical discussion on the potential impacts of these indices on climate finance, despite the absence of direct data on climate finance. The findings of this study have significant implications for climate finance, as they indicate that sustainability indices are not detached from the broader market dynamics represented by traditional indices which is evident from very strong correlations found between them.

The significance test for the VAR model shows that the lagged returns of the indices do not have a significant influence on the current returns of the other index. Granger causality test indicates there's no significant evidence to suggest that the past returns of any of the indices have a predictive relationship with the current returns of another index.

Keywords: BSE sustainability indices, climate finance, sustainability outcomes, VAR model, Granger causality test

1. Introduction

In today's evolving economic landscape, pressure is mounting from stakeholders across the spectrum, including individual companies, exchanges, and institutions, to prioritize green energy initiatives, reduce carbon emissions, and adhere to Environmental, Social, and Governance (ESG) practices. The concept of sustainability has expanded beyond mere philanthropic endeavours, becoming a strategic imperative for businesses seeking to navigate an increasingly complex and interconnected world. This prevailing emphasis has made it imperative for listed companies and stock exchanges to devise robust frameworks and policies. The goal is to seamlessly integrate climate finance and sustainability-related practices into their core operations, thereby fostering a culture that embraces sustainability and climate finance within the broader financial stream and economy.

In response to this urgent need, a notable shift is evident as companies and stock exchanges alike are actively aligning their strategies and operations in this direction. The BSE Sustainability Indices, launched in collaboration with S&P Dow Jones Indices, aim to provide a benchmark for companies listed on BSE that are following the principles of sustainability and are disclosing their Environmental, Social and Governance (ESG) performance transparently.

The three BSE Sustainability Indices are as follows:

1. Greenex, which tracks companies based on their greenhouse gas emissions,
2. Carbonex, which includes companies prepared for a transition to a low carbon economy and
3. BSE 100 ESG, which monitors the performance of companies in the BSE 100 index following ESG norms.

They can be crucial tools for climate finance as they offer insights into the sustainability practices of companies. They serve as benchmarks for investors to assess the sustainability performance of listed companies and identify investment opportunities aligned with their sustainability goals. Therefore, these indices represent a significant development in the integration of sustainability into India's financial markets. Simultaneously, traditional indices like the Sensex, Nifty and BSE 100 continue to serve as barometers of the overall market performance, reflecting the dynamics of a broad range of companies irrespective of their sustainability profiles.

In this paper, we seek to examine these BSE Sustainability Indices and their implications for climate finance and sustainable outcomes. A comparative analysis with broad market indices, such as BSE 100, Sensex and Nifty (BSE 100 index is also the benchmark for the three BSE sustainability indices as the constituent companies of these indices are selected from BSE 100), will provide an understanding of the performance of sustainability focused indices against conventional market indices.

By undertaking this research, we seek to contribute to the existing literature on sustainability indices and their role in driving climate finance. The findings will provide insights into the effectiveness of BSE sustainability indices in attracting sustainable capital, influencing investment decisions, and fostering sustainability practices among listed companies. Moreover, by conducting a comparative analysis of different BSE sustainability indices, the research will highlight the differences and similarities among these frameworks and their respective implications for climate finance and sustainability outcomes. Ultimately, this research intends to provide valuable insights for investors, policymakers, and organizations interested in aligning their financial strategies with sustainability objectives. The outcomes of this study can inform decision-making processes, encourage the integration of sustainability considerations into investment practices and contribute to the overall transition towards a more sustainable and climate-resilient economy.

2. Literature Review

The relationship between sustainable and conventional indices has emerged as a significant theme in recent finance literature, reflecting growing interest in sustainable investment practices. Gupta, Sharma, & Srivastava (2019) conducted a comprehensive examination of the interconnections between these two types of indices, employing daily closing prices from January 2013 to December 2017. Utilizing statistical methodologies such as Granger's causality model and ARCH-GARCH modeling, they discovered a close integration between sustainable and conventional indices. Importantly, they found no substantial performance differences between the two, indicating that sustainable indices could effectively replace conventional ones. This finding has implications for portfolio diversification, highlighting opportunities for both risk management and return optimization.

The role of sustainability indices in advancing green investing has also been explored in various studies. For instance, Friede, Busch, & Bassen (2015) demonstrated that sustainable investing could achieve financial returns that are comparable to or even exceed those of traditional investments, thereby strengthening the argument for environmentally responsible investment strategies.

In contrast, Raja (2018) conducted a focused study on the BSE Greenex index, concluding that the performances of BSE Greenex and its constituent companies did not surpass those of other indices and control companies. However, the study also posited that aligning trading interests with companies' carbon efficiency could bolster sustainable business practices.

A distinct perspective has been offered by scholars such as Eccles, Ioannou, & Serafeim (2014), who contended that firms listed in sustainability indices often exhibit superior environmental performance relative to their peers. Their research provided robust evidence that high-sustainability companies consistently outperform their counterparts in the long run, both in stock market and accounting terms.

Furthermore, Boitan (2020) shed light on the correlation among sustainability indices across different regions, including Europe, Japan, the US, and other developed nations. The study revealed that these indices exhibit synchronized price returns, whereas the Dow Jones Sustainability Indices (DJSI) for emerging countries remain distinct. This insight suggests that both emerging market sustainability indices and any of the five major DJSI (DJSI World, DJSI North America, DJSI Europe, DJSI Asia Pacific, DJSI Emerging Markets) may be strategically incorporated into investors' portfolios for risk diversification and hedging purposes.

3. Research Gap

Limited Comparative Analysis: While there have been studies examining the effectiveness of individual BSE sustainability indices and their relationship with climate finance, there is a scarcity of research conducting a comprehensive comparative analysis of multiple BSE sustainability indices in the context of climate finance and sustainability outcomes. Therefore, there is a need for a comparative analysis that considers the differences and similarities between various BSE sustainability indices and their implications for climate finance and sustainability outcomes. Moreover, a comparative analysis of these indices with their benchmark of BSE 100 and broad market indices like Sensex and Nifty is scarce. Addressing these research gaps would contribute to a deeper understanding of the effectiveness of BSE sustainability indices and their role in driving climate finance and promoting sustainability practices.

4. Problem Statement

The lack of a comprehensive comparative analysis of BSE sustainability indices and their implications for climate finance and sustainability outcomes using secondary data sources limits the understanding of their effectiveness and potential for driving sustainable investments. Additionally, the scarcity of research on comparison of these indices with their benchmark of BSE 100 and traditional broad market indices like Sensex and Nifty hinders their ability to accurately reflect sustainability performance.

5. Research Objectives

1. To conduct a comparative analysis of different BSE sustainability indices.
2. To analyse the performance of BSE sustainability indices in comparison to broad market indices.
3. To examine the correlation between the performance of BSE sustainability indices and broad market indices.
4. To assess the relationship between various indices' returns by applying the statistical tests.

6. Data and Research Methodology

This study utilizes data from the monthly closing prices of BSE sustainability indices, namely Greenex, Carbonex, and BSE 100 ESG, as well as broad market indices including Sensex, Nifty, and BSE 100. The data spans from October 2017 to June 2023 and was retrieved from the official BSE India website. To ensure the accuracy of the data, the values were cross verified with Yahoo Finance, both of which are recognized as popular and reliable sources in the financial industry.

For many analyses, especially those looking at long-term trends or seasonality over years, monthly data can be more relevant than daily data. Monthly data can smooth out some of the short-term volatility seen in daily data, making certain patterns or trends more evident.

The monthly closing prices were recorded as of the 1st of each month. In cases where the 1st was a non-trading day, the closing price of the subsequent trading day was considered. These closing prices were then transformed into percentage returns using the following formula:

*Return for the period t = [(closing price of t – closing price of t-1)/closing price of t-1] *100*

Since the return for period t is based on the closing price of previous period t-1, we have returns from November 2017 as the closing prices are available from October 2017. Therefore, the returns data is from November 2017 to June 2023.

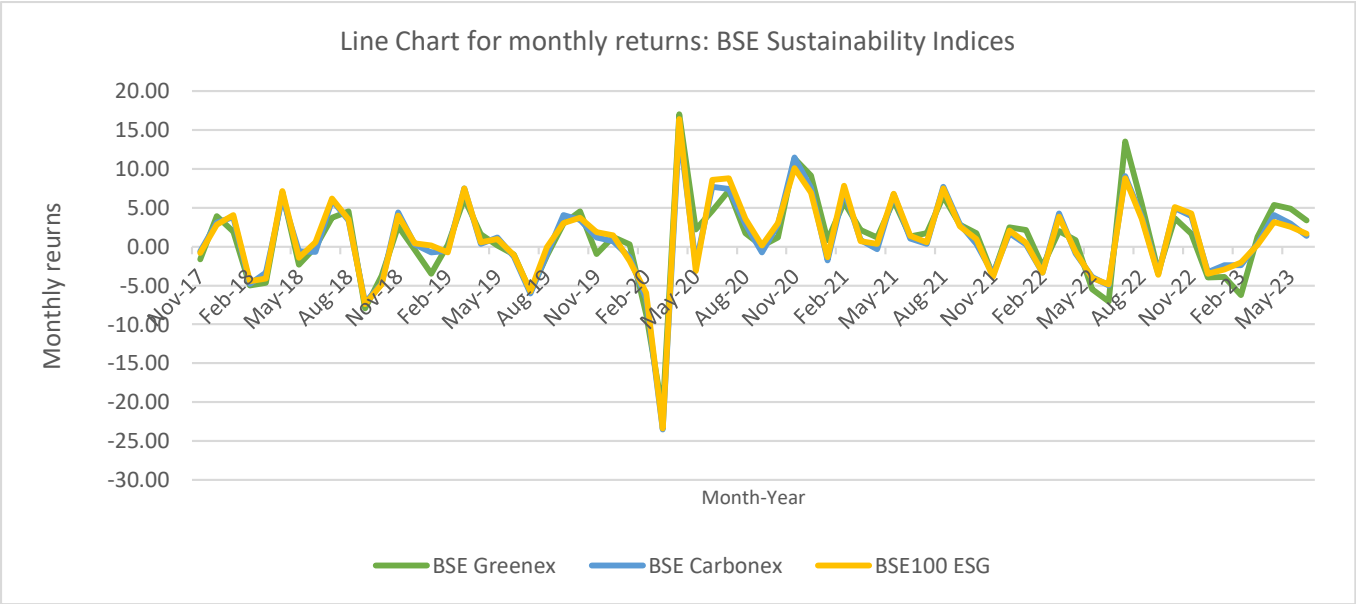
The analysis focused on these returns, as they provide an appropriate measure for financial analysis. Descriptive statistics were computed for each index to characterize their general performance. In addition, correlation analysis was conducted to examine the relationships between the indices.

Visual representations, such as line graphs and box-and-whisker plots, were employed to illustrate the findings. To further validate the research, appropriate statistical tests were applied. These include the VAR model and Granger causality tests to assess relationships between the indices. Tests were also performed to assess the normality and stationarity of the returns data.

7. Data Analysis and Discussion of Findings

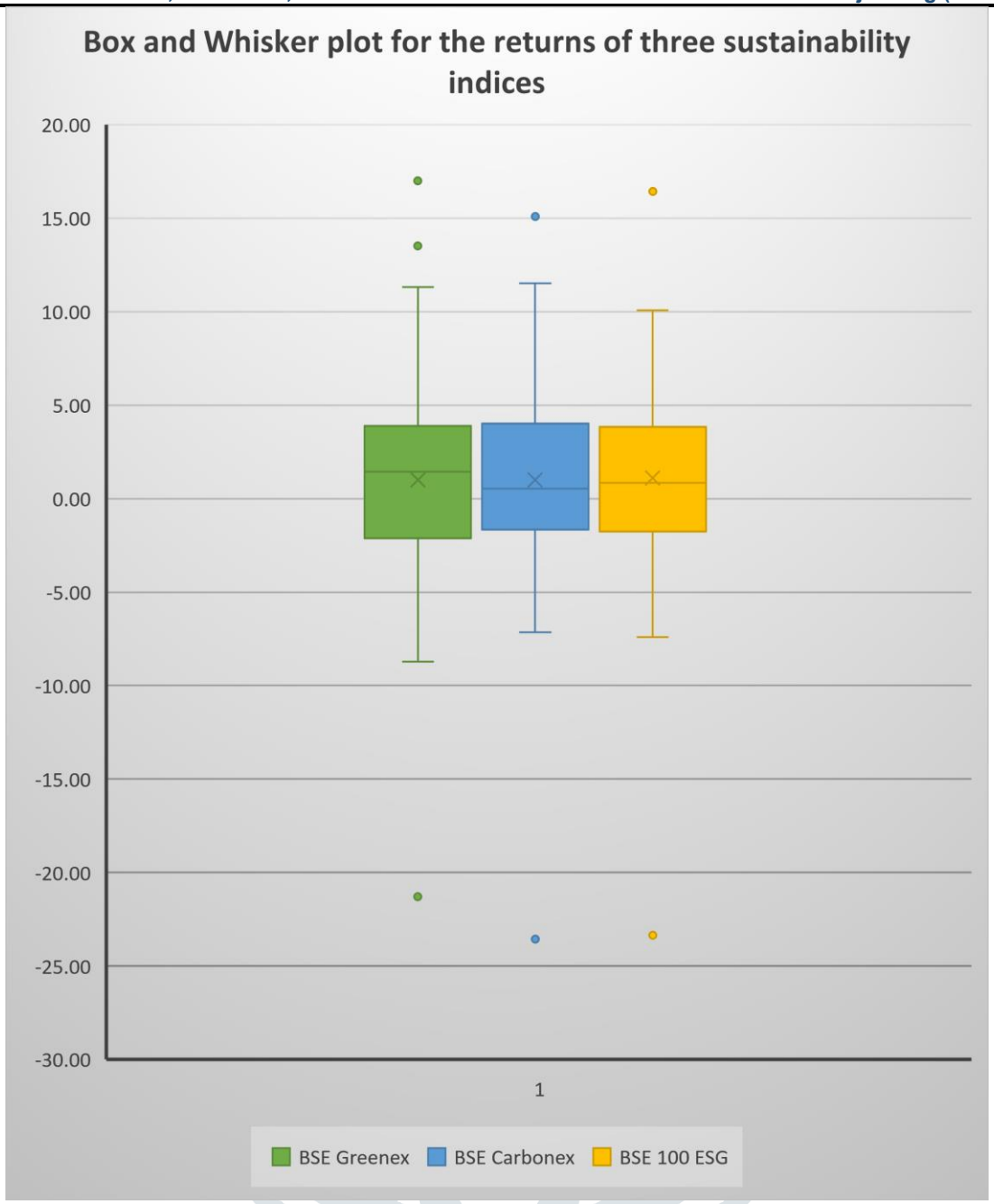
7.1. Comparison of BSE Sustainability Indices

Figure 1. *Line chart for the monthly percentage returns of three BSE sustainability indices from November 2017 to June 2023.*



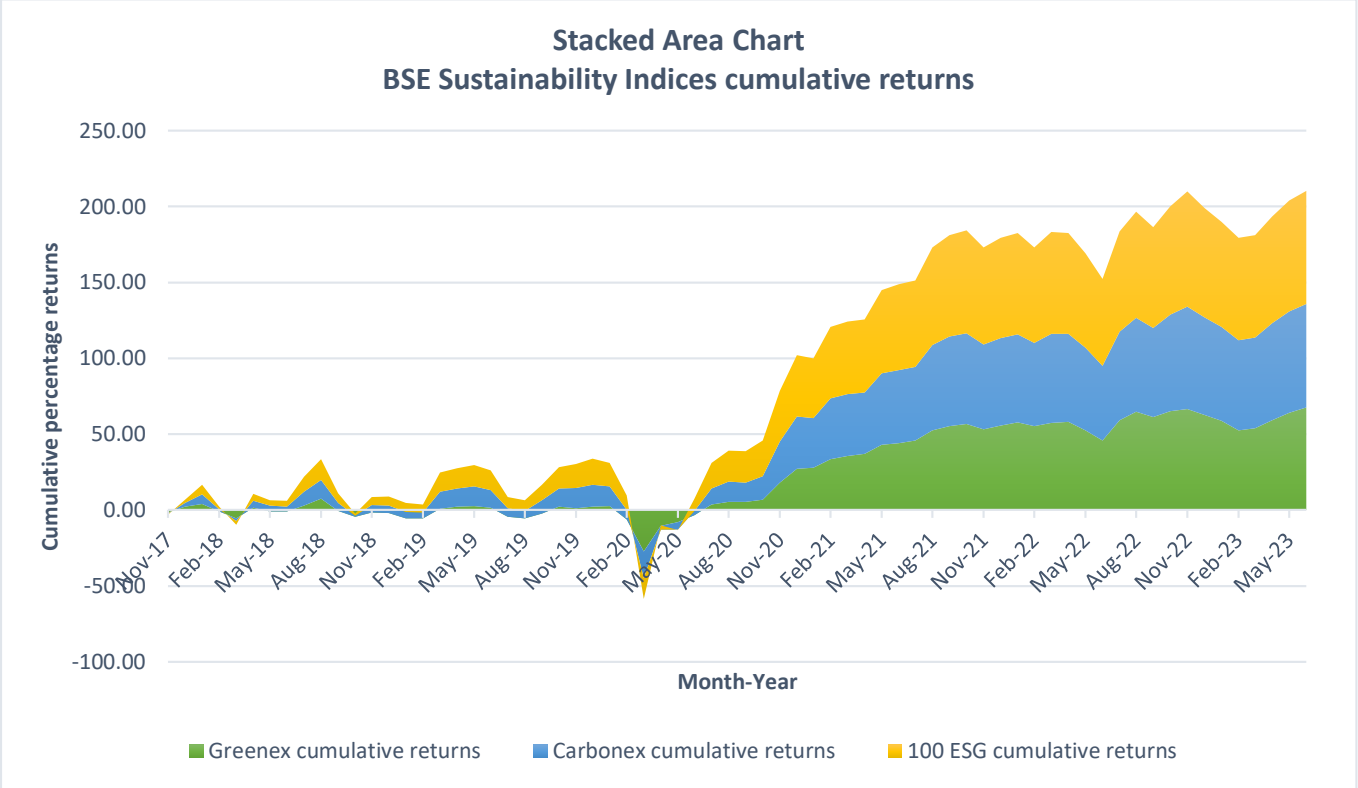
In the illustrated line chart, all three indices exhibit a remarkable synchronicity in their movements, both in ascents and descents. Notably, the BSE Greenex, represented by the green trajectory, manifests marginally heightened volatility compared to its counterparts during these oscillations. A pronounced decline across the indices is evident in early 2020, attributable to the ramifications of the COVID-19 outbreak and the subsequent nationwide lockdown measures. However, a robust rebound in these indices is observed in subsequent months, likely driven by the easing of lockdown restrictions and the promising advent of vaccination campaigns.

Figure 2. *Box and Whisker plot for the returns of BSE sustainability indices.*



The dots indicate the outliers. There are few outliers for each of the three indices on both upper and lower ends. The outliers on the lower end which are the extreme negative returns are due to the fall witnessed across the Indian stock market in line with the global markets because of the uncertainty arisen out of Covid-19 pandemic and the lockdowns that followed during early 2020. Later the markets rebounded sharply and made new highs which is evident from the outliers on the upper side indicating the extreme positive returns.

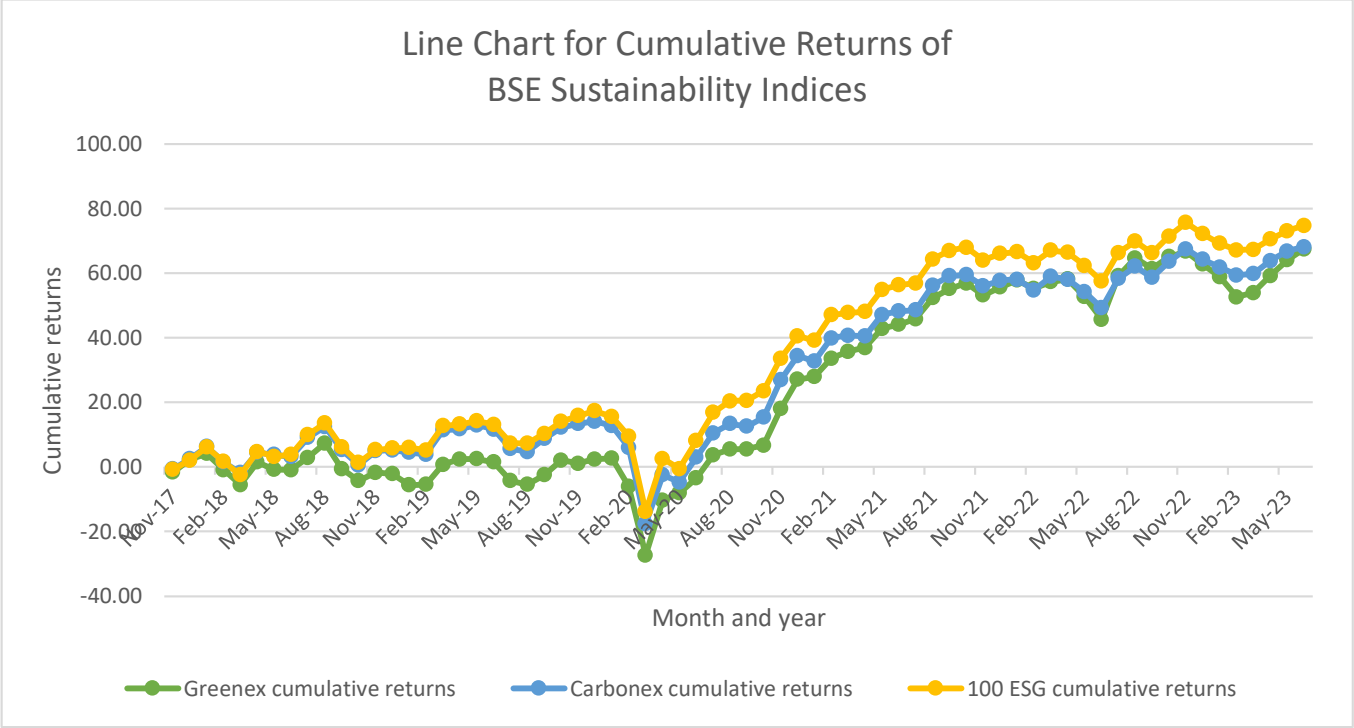
Figure 3. *Stacked area chart for the cumulative percentage returns of BSE sustainability indices from November 2017 to June 2023.*



1. Cumulative Greenex Returns (Green Area): Greenex starts strong and shows an initial upward trajectory. A significant dip is observed around the start of 2020. After this decline, Greenex recovers and continues its upward trend, but in terms of area, it remains smaller than 100 ESG towards the latter part of the chart.
2. Cumulative Carbonex Returns (Blue Area): Carbonex displays a stable and consistent growth throughout the period. It doesn't exhibit as much volatility as Greenex and contributes steadily to the cumulative returns.
3. Cumulative 100 ESG Returns (Yellow Area): 100 ESG is the most dominant in terms of cumulative returns, especially in the latter years. It shows consistent and strong growth, becoming the most significant contributor to the overall returns by 2023.

Each of the three indices demonstrates growth in cumulative returns. However, by 2023, 100 ESG emerges as the most dominant in terms of cumulative returns, followed by Carbonex and then Greenex.

Figure 4. *Line Chart for Cumulative Returns of BSE Sustainability Indices from Nov 2017 to June 2023.*



Let's analyse the line chart from an investor's perspective, focusing on risk, return, and the downturn observed at the start of 2020 (obviously due to the uncertainty arisen out of Covid-19 and continuous lockdowns across the nation).

1. Cumulative Greenex returns (green line):

a. Risk and Return: Greenex shows a strong initial growth but also exhibits higher volatility, especially with the significant dip at the start of 2020. This suggests that while Greenex can offer high returns, it also comes with higher risk. Investors with a higher risk appetite might have been attracted to it initially.

b. Dip in 2020: The sharp decline in early 2020 indicates a period of significant underperformance. The maximum dip seems considerable, pointing to potential external factors like Covid 19 impacting this index more severely than the others.

2. Cumulative Carbonex returns (blue line):

a. Risk and Return: Carbonex presents a more consistent upward trend, suggesting it might be a safer bet for investors seeking steady returns. It offers moderate growth with less dramatic fluctuations than Greenex, making it suitable for risk-averse investors.

b. Dip in 2020: While Carbonex also experiences a downturn in 2020, the dip is less pronounced than Greenex. This resilience suggests a potentially more stable underlying asset composition or sector focus.

3. Cumulative 100 ESG returns (yellow line):

a. Risk and Return: 100 ESG starts moderately but accelerates its growth around mid-2019, surpassing the other two indices. Its consistent rise, especially post-2020, suggests that it might offer the best balance of risk and return among the three.

b. Dip in 202: 100 ESG also dips in 2020, but its subsequent growth trajectory is the most impressive. This recovery indicates strong fundamentals or a shift in investor sentiment favouring ESG-focused assets.

From an investor's perspective, diversifying across these three indices prior to 2020 would have been a wise strategy to balance risk and return. The dip at the start of 2020, due to market reactions to the Covid-19 and lockdowns, affected all three indices, highlighting the importance of diversification and risk management.

In terms of risk and return:

Greenex offers potential for high returns but comes with higher volatility, making it more suitable for risk-tolerant investors.

Carbonex provides a safer haven with steady growth, ideal for conservative investors.

100 ESG emerges as the top performer post-2020, suggesting that investments with an ESG focus not only offer competitive returns but also resilience against market downturns.

The maximum dip (on a cumulative basis) in May 2020 for Greenex was the most pronounced (-27.30% on a cumulative basis from Nov 2017), followed by Carbonex (-17.54% on a cumulative basis from Nov 2017) and then 100 ESG (-13.82% on a cumulative basis from Nov 2017). Investors considering future investments might weigh these past performances, especially the 2020 dip and subsequent recovery, in their decision-making processes.

The findings suggest that the BSE Greenex, Carbonex, and 100 ESG indices, though they focus on different aspects of sustainability, show similar return patterns. This could be due to the fact that they all represent segments of the same market and are influenced by similar economic and market conditions. The strong correlations among the returns of these indices indicate that they tend to move together, reflecting similar market reactions to sustainability-related issues.

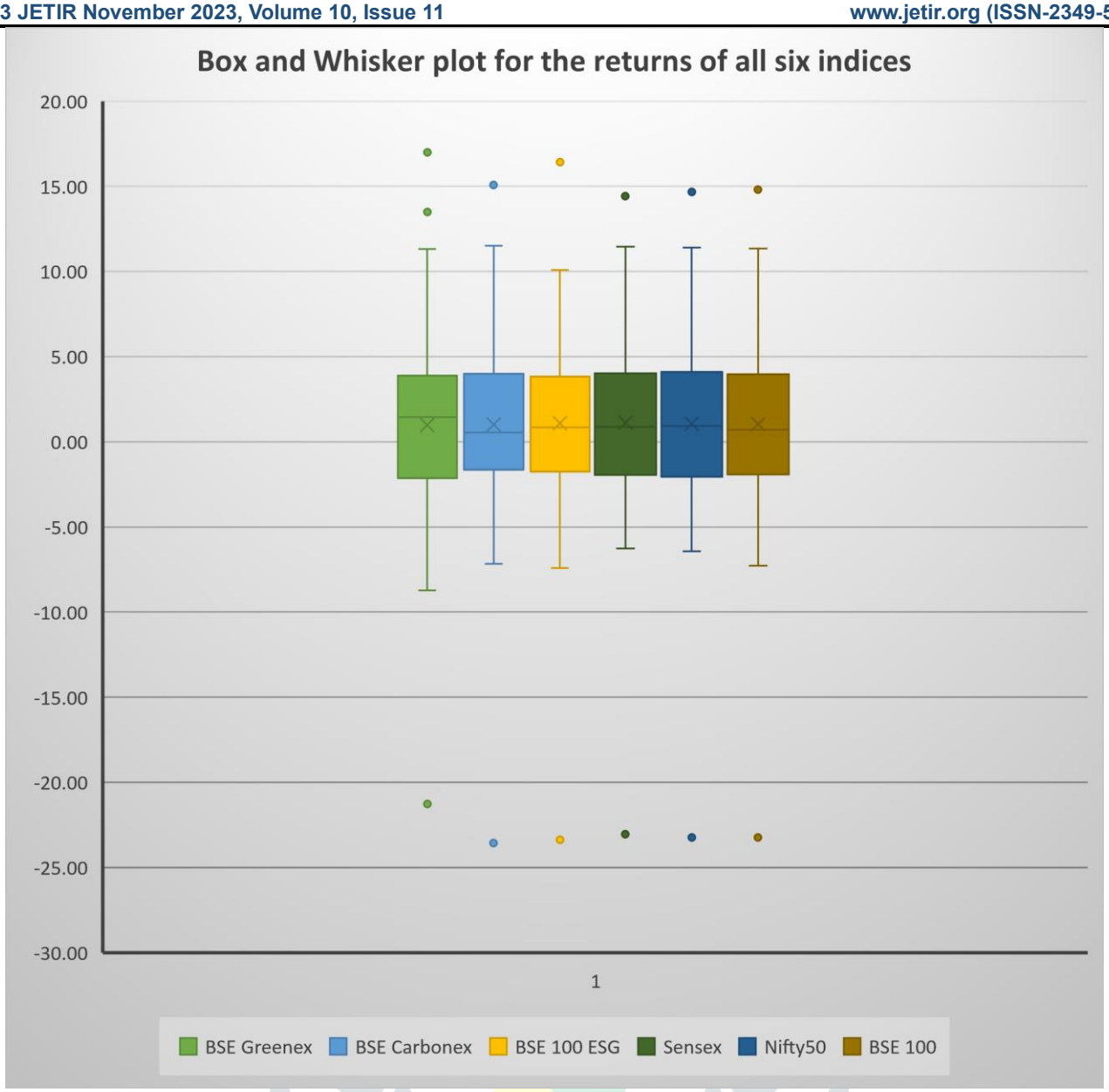
7.2. Comparison of BSE Sustainability Indices and Traditional Broad Market Indices

Table 1. *Summary statistics for BSE sustainability indices' returns and broad market indices' returns*

	BSE Greenex	BSE Carbonex	BSE 100 ESG	Sensex	Nifty50	BSE 100
Mean	0.99	1.00	1.10	1.13	1.06	1.03
Standard Error	0.67	0.65	0.65	0.64	0.64	0.64
Median	1.44	0.54	0.84	0.88	0.91	0.70
Mode	4.52	0.36	0.54	#N/A	4.72	2.89
Std Deviation	5.50	5.34	5.38	5.31	5.31	5.30
Variance	30.26	28.49	29.00	28.17	28.24	28.06
Kurtosis	3.83	5.93	5.76	5.49	5.64	5.76
Skewness	-0.57	-1.07	-0.99	-1.03	-1.06	-1.07
Range	38.28	38.64	39.78	37.47	37.93	38.02
Minimum	-21.28	-23.56	-23.37	-23.05	-23.25	-23.23
Maximum	17.00	15.08	16.41	14.42	14.68	14.79
Sum	67.51	68.16	74.79	76.81	71.92	69.70
Count	68.00	68.00	68.00	68.00	68.00	68.00
Largest (1)	17.00	15.08	16.41	14.42	14.68	14.79
Smallest (1)	-21.28	-23.56	-23.37	-23.05	-23.25	-23.23

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

Figure 5. *Box and Whisker plot for the returns of BSE sustainability indices and broad market indices.*



BSE Greenex and BSE Carbonex show notable differences in the variability of their returns above and below the median. Specifically, Greenex has more variability in returns below the median, while Carbonex has more variability above the median. BSE 100 ESG, Sensex, Nifty50, and BSE 100 display a more balanced distribution of returns around the median. This suggests that the variability in returns, whether above median or below median, is relatively consistent for these indices. Further, looking at the outliers on the upper and lower ends of all indices, it is clear that the BSE sustainability indices are showing similar reactions as that of broad market indices to the significant market events which in this case is the first wave of Covid-19 pandemic during the year 2020.

Table 2. *Correlations among BSE sustainability indices' returns, and broad market indices' returns*

	BSE Greenex	BSE Carbonex	BSE100 ESG	Sensex	Nifty50	BSE100
BSE Greenex	1.0000					
BSE Carbonex	0.9524	1.0000				
BSE100 ESG	0.9441	0.9945	1.0000			
Sensex	0.9216	0.9897	0.9859	1.0000		
Nifty50	0.9405	0.9958	0.9909	0.9969	1.0000	
BSE100	0.9562	0.9981	0.9926	0.9907	0.9967	1.0000

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

Figure 6. *Correlation Matrix Heat Map.*

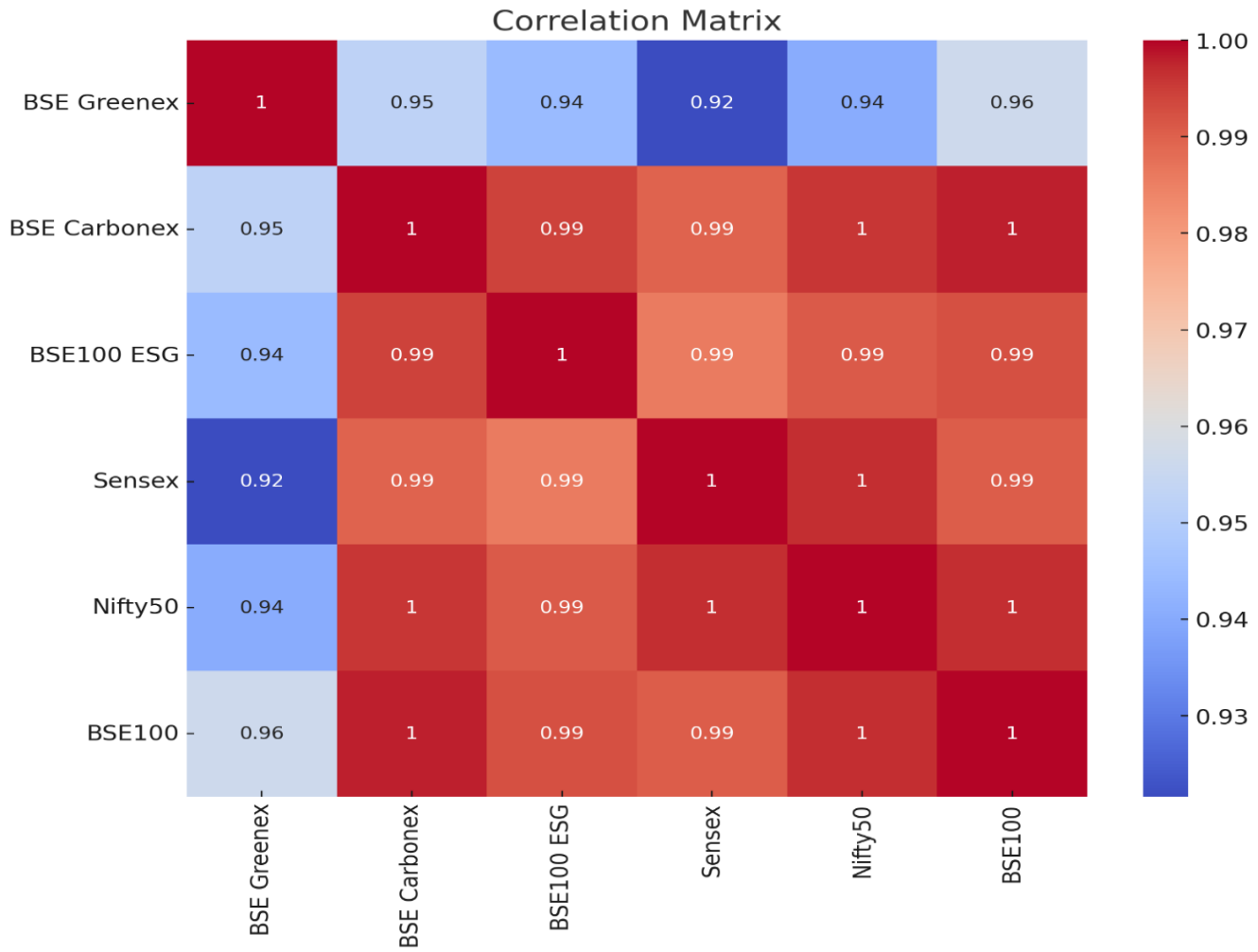


Figure 7. *Line chart for monthly percentage returns of all the six indices.*

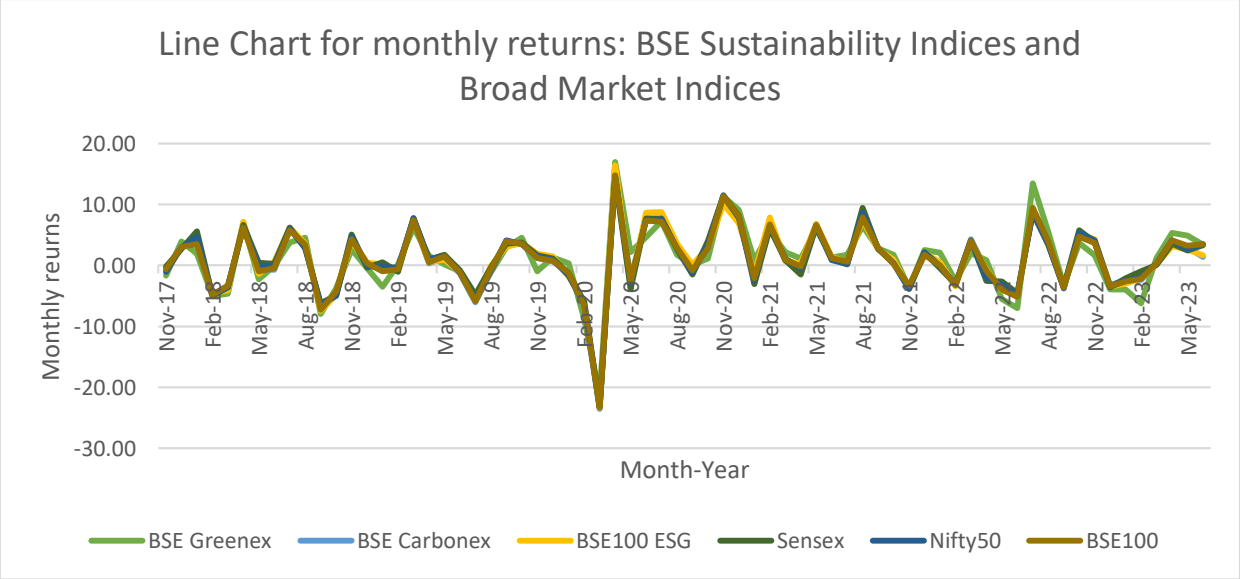


Table 3. *Table showing CAGR, Sharpe Ratio and Maximum Drawdown of Sustainability Indices and Traditional indices*

Index	CAGR	Sharpe Ratio	Max Drawdown
BSE Greenex	0.1074	2.8647	0
BSE Carbonex	0.1096	2.9820	0
BSE100 ESG	0.1224	3.2416	0
Sensex	0.1270	3.3783	0
Nifty50	0.1173	3.1617	0
BSE 100	0.1129	3.0713	0

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

The analysis of the monthly returns of the sustainability indices and traditional indices provided several insights.

1. The indices exhibited similar average monthly returns, suggesting comparable financial performance over the period considered.
2. The standard deviations of the returns, which reflect the riskiness of the indices, were also similar across all indices, indicating comparable levels of risk.
3. The skewness of all indices is negative, indicating that the returns distribution is skewed to the left. This means that there are more instances of returns being lower than the average than there are of returns being higher than the average.
4. The kurtosis of all indices is greater than 3, indicating a leptokurtic distribution. This means the distribution has fatter tails and a sharper peak than the normal distribution. In the context of investment returns, this suggests a higher probability of extreme returns (either very high or very low).
5. The CAGR ranges from 0.1074 (BSE Greenex) to 0.1270 (Sensex), indicating the annual return rate if the investment was held for the entire time period.
6. The Sharpe Ratio ranges from 2.8647 (BSE Greenex) to 3.3783 (Sensex), providing a measure of the average return in excess of the risk-free rate per unit of risk (as measured by standard deviation). A higher Sharpe Ratio suggests better risk-adjusted performance.
7. The Maximum Drawdown is 0 for all indices, indicating that there were no periods in which the indices fell to a new low without first reaching a new high.
8. The correlation between the indices is very high, ranging from 0.9216 (between BSE Greenex and Sensex) to 1.0000 (between any index and itself). This suggests that the indices tend to move in the same direction.

7.3 Statistical Tests

Normality test (Shapiro-Wilk test)

Null hypothesis (H0): The data is normally distributed.

Alternative hypothesis (H1): The data is not normally distributed.

Table 4. *Shapiro-Wilk test result*

Index	Statistic	p-value
BSE Greenex	.9400	.0027
BSE Carbonex	.9138	.0002
BSE100 ESG	.9154	.0002
Sensex	.9194	.0003
Nifty50	.9188	.0003
BSE 100	.9176	.0003

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

For all the indices, the p-values are less than 0.05, so we reject the null hypothesis and conclude that the returns are not normally distributed.

Stationarity test (ADF: Augmented Dickey-Fuller test)

Null hypothesis (H0): The data is non-stationary (i.e., it has a unit root)

Alternative hypothesis (H1): The data is stationary (i.e., it does not have a unit root).

Table 5. *ADF test result*

Index	ADF Statistic	p-value	Used lag	No. of observations
BSE Greenex	-7.74	.0000	0	67
BSE Carbonex	-8.48	.0000	0	67
BSE100 ESG	-8.78	.0000	0	67
Sensex	-8.81	.0000	0	67
Nifty50	-8.55	.0000	0	67
BSE100	-8.45	.0000	0	67

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

For all the indices, the p-values are less than .05, so we reject the null hypothesis and conclude that the returns are stationary. This means that the mean and variance of the return series are not a function of time, which is a desirable property for many time series modelling techniques.

These tests show that while the return series of the indices are not normally distributed, they are stationary.

VAR model:

Selecting the optimal lag length for the VAR model

A common approach in time series analysis is to fit the Vector Autoregressive (VAR) model with different lag lengths and select the one that minimizes a chosen criterion like the Akaike Information Criterion (AIC) or the Bayesian Information Criterion (BIC). These criteria help in selecting a model that best explains the underlying data with the fewest parameters. Here are the AIC values for different lag lengths:

Lag 1: -2.6281

Lag 2: -2.1940

Lag 3: -1.7073

Lag 4: -1.6144

Lag 5: -1.6366

A lower AIC value indicates a better model fit, and from the above values, a lag of 1 provides the lowest AIC. Thus, the optimal lag order for the VAR model, based on the AIC with reduced maximum lags, is found to be 1. This means that a VAR model with one lag is the most suitable.

Significance test for coefficient in the VAR model:

Null Hypothesis (H0): The coefficient is equal to zero (no relationship between the variables).

Alternative Hypothesis (H1): The coefficient is not equal to zero (there is a relationship between the variables).

We'll typically use a significance level of 0.05, meaning that if the p-value is less than 0.05, we'll reject the null hypothesis and conclude that the coefficient is statistically significant.

Table 6. *The p-values for the hypothesis testing for each coefficient of six indices return series in the VAR model*

	BSE Greenex	BSE Carbonex	BSE 100 ESG	Sensex	Nifty50	BSE 100
Constant	0.0865	0.0689	0.0454	0.0394	0.0538	0.0598
L1 BSE Greenex	0.7121	0.5058	0.5298	0.5475	0.5195	0.5288
L1 BSE Carbonex	0.9474	0.8339	0.7355	0.8036	0.8455	0.8573
L1 BSE100 ESG	0.4246	0.4577	0.4049	0.3719	0.4377	0.3921
L1 Sensex	0.3859	0.4296	0.4301	0.4634	0.4531	0.4246
L1 Nifty50	0.4066	0.4698	0.4844	0.5845	0.5409	0.4704
L1 BSE 100	0.9828	0.7625	0.6948	0.8698	0.8463	0.8246

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

All coefficients related to lag 1 returns of the various indices are not statistically significant in predicting the current returns, as their p-values are all above 0.05. It meant that the lagged returns of the indices do not have a significant influence on the current return of the index in question.

The constants for BSE 100 ESG and Sensex are statistically significant at the 0.05 level as the p-values are less than 0.05. It indicates that there's a significant inherent effect in the returns of these indices that is not captured by the lagged returns of the other indices.

There are two different aspects being evaluated: the coefficients for the lagged returns of the indices and the constant term.

1. Coefficients for lagged returns:

A significant coefficient (p-value < 0.05) for a lagged return means that past value has a statistically significant influence on the current return of the index being analysed.

If the p-value is greater than 0.05, it means that the lagged return does not have a statistically significant influence.

2. Constant term:

A significant constant (p-value < 0.05) means there's an inherent average or base effect in the dependent variable that isn't explained by the predictors (lagged returns) in the model.

If the p-value for the constant is greater than 0.05, it means that this inherent average effect is not statistically distinguishable from zero.

A significant constant term does not mean the model is good at predictions. It just means there's an average effect in the series not explained by the predictors.

The coefficients of the lagged returns directly relate to the predictive power of the VAR model. If they are significant, it means the past values of one series provide useful information in predicting the current value of another series.

Granger causality test:

The Granger Causality tests indicate whether the lagged values of one series can help predict another series. A low p-value (typically below 0.05) suggests Granger causality.

Table 7. *Granger Causality test result for the returns data of six indices from Nov 2017 to June 2023. Here's the table of p-values for Granger Causality tests for all pairs of indices.*

Effect (Target)	BSE 100	BSE Carbonex	BSE Greenex	BSE100 ESG	Nifty50	Sensex
BSE 100	NaN	0.888	0.318	0.429	0.543	0.203
BSE Carbonex	0.963	NaN	0.327	0.338	0.506	0.205
BSE Greenex	0.171	0.188	NaN	0.148	0.178	0.147
BSE100 ESG	0.339	0.350	0.227	NaN	0.687	0.721
Nifty50	0.615	0.572	0.362	0.679	NaN	0.118
Sensex	0.227	0.220	0.286	0.661	0.106	NaN

Note. Table created by the author using data adapted from historical values of BSE sustainability indices on the BSE India website.

Interpretation using a threshold of $p < 0.05$: The past returns of none of the indices Granger-cause the current returns of any other index, as all p-values are above 0.05.

Thus, there's no significant evidence to suggest that the past returns of any of the indices have a predictive relationship with the current returns of another index.

7.4. Implications for Climate Finance and Sustainability

The financial performance of sustainability indices has significant implications for climate finance. Climate finance involves directing financial flows towards climate change mitigation and adaptation initiatives. A key component of climate finance is sustainable investing, which involves investing in entities with strong environmental, social, and governance (ESG) practices.

1. Performance of sustainability indices: The analysis showed that the sustainability indices (BSE Greenex, BSE Carbonex, BSE 100 ESG) have similar average monthly returns and risk levels compared to traditional indices (Sensex, Nifty50, BSE 100). This suggests that investors do not necessarily have to sacrifice financial returns when investing in sustainable firms. This is a positive signal for climate finance, as it may encourage more investors to allocate funds towards sustainable investments.

2. Correlation among indices: The high positive correlation among the sustainability and traditional indices suggest that they move together over time. This indicates that sustainability indices are not detached from the broader market dynamics. It implies that broader market conditions, economic policies, and global trends affecting traditional indices also influence sustainability indices. It suggests that efforts to mitigate climate change and promote sustainability must be integrated with broader economic policies and market practices.

3. Resilience of sustainability indices: The analysis of residuals from the AR models suggested that the sustainability indices have similar dynamics as the traditional indices. This can be interpreted as the resilience of sustainability indices to market shocks like that of traditional indices. This resilience is a critical aspect of climate finance, as climate risks are expected to increase market volatility in the future.

4. Investor perception and market sentiment: The similar performance and dynamics of sustainability and traditional indices could reflect changing investor perceptions and market sentiment. Investors might be increasingly recognizing the financial materiality of ESG factors, and the risks associated with climate change, and this could be driving the market performance of sustainability indices.

8. Conclusion

The research aimed to compare the performance of BSE's sustainability indices with traditional indices and discuss potential implications for climate finance. The findings suggest that sustainability indices show similar financial performance and risk levels compared to traditional indices and are highly correlated with them showing that they match up well in both performance and risk when compared to traditional indices. This could have important implications for climate finance, as it suggests that sustainable investing, as reflected by sustainability indices, is not necessarily at odds with financial performance, as reflected by traditional indices. This is good news for those who are keen on sustainable investing as it seems you don't have to sacrifice financial returns to invest responsibly. However, while sustainability indices align with investor values, they don't appear to offer additional financial benefits over traditional indices.

In conclusion, this analysis provides some positive signals for climate finance and sustainability. However, it also highlights the need for further research and policy action to promote sustainable investing and integrate climate considerations into broader market practices. Climate finance is not just about creating separate sustainability indices or investment products, but about transforming financial markets to support a sustainable and resilient economy.

9. Scope for Further Research

While this research provides a comparative analysis of the BSE sustainability indices and traditional indices, there is scope for further research. Future studies could

1. investigate the factors influencing the returns of these sustainability indices and their implications for investor behaviour
2. explore the impact of specific ESG criteria on index performance
3. explore the perspectives of investors, companies, and policymakers in relation to sustainability indices
4. analyse the impact of major policy changes or global events on these indices
5. study specific financial and sustainability metrics associated with different indices and analyze their long-term performance.

Additionally, qualitative research approaches could be employed to gain a deeper understanding of the drivers and barriers in utilizing BSE sustainability indices for climate finance. Furthermore, future research could consider a broader set of indices, different time periods, or different financial markets. Lastly, as more data becomes available, future research could directly measure the impacts on climate finance and investigate how these are related to the performance of sustainability and traditional indices.

10. References

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