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Risk–return spectrum of investment for going green: Evidence from Indian equity market

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Abstract

This study investigates the risk–return spectrum of investment for going green and sustainability practice in India. This article analyses three sustainability focused index from Indian equity market viz. S&P BSE GREENEX, S&P BSE CARBONEX and S&P BSE ESG 100. Statistical and financial rates, ratios and latest five-factor model of asset pricing are used for the said purpose. ESG 100 index turned out to be outperformer whereas the other two gave slightly less return than the market benchmark. Volatility is found to be similar to that of the market for all the indexes. Significant increment of wealth of green investors during and after the COVID-19 pandemic period is another notable finding of the study. Results of this article indicate that investors are getting more return compared to market if they invest in stocks that perform well in sustainability criterion.

KEYWORDS
beta, CAGR, carbon neutrality, five-factor model, Jensen's alpha, S&P BSE CARBONEX, S&P BSE ESG 100, S&P BSE GREENEX, Sharpe ratio, sustainability, Treynor ratio

JEL CLASSIFICATION
C, G, M, Q

1 | INTRODUCTION

Does the economic return raise the hope for environment concerned investors? Are investors paying a premium for going green, carbon neutral and sustainable development? Is there any investment risk trade off? All these questions are global relevant and need concrete evidences on it. This study focuses on the issue of investors' premium for decarbonized and sustainable development in emerging economy like India. This article attempts to evaluate the risk premium of investment for going green, focusing on Indian equity market investors. The article investigates the risk–return spectrum of investment for transformation towards green and sustainable development practice in India.

In order to limit global warming to 1.5°C above pre-industrialisation levels, it is crucial to achieve carbon neutrality by middle of 21st century. This will give solution to the major problems like GHG emission and its result global warming. The biggest source of carbon emission is fossil fuel, among which coal and oil are leading. Use of coal in power sector is biggest contributor in emission and it is increasing day by day in Asia, particularly in India and China. At the same time fossil fuels are also depleting fast, which is a threat to energy security of these nations. Shifting towards green and renewable energy sources will not only solve the problem of scarcity of traditional energy sources but also the environmental problems related to carbon emission. Success towards this shifting requires proper policy framework and large amount of investment as these energy sources are highly capital intensive. To ensure energy secured future, developing nations must use and invest in green energy sources. For a sustainable future, emerging economies must take step towards reducing carbon emission and increased reliance on green energy sources. India is world's third largest GHG emitter

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after China and USA. Since India is an emerging economy and has huge potential in green energy, which in turn can help this planet in decarbonisation, we are considering India here to analyse the risk return scenario of green investors in Indian market. Due to geographical diversity, India is blessed with variety of renewable energy sources like the solar, wind, hydropower, biomass and geothermal energy. The country has potential to become world's one of the largest clean energy producers. In line with SDGs India is committed to produce 40% of electricity from non-fossil fuel based energy sources by 2030.

For achieving the impressive target of net-zero carbon emission by 2070, India needs to invest towards carbon neutral business ecosystem. This can be achieved by encouraging businesses that practice sustainability and are working towards carbon neutrality (Sinha et al., 2021; Umar et al., 2020). Traditional businesses mainly use black energy, and undisclosed their GHG emissions which are creating barriers on the way of India's transition towards carbon-neutral economy. The firms that use black energy in production process do not take into account the cost that they impose on the environment and local society (Bassi, 2009). Planning for a green economy that do the cost–benefit analysis of using natural resources and their side effects on environment and next generation is necessary in this direction since we are witnessing the side effects that arose from past actions. Transition towards the green economy is a saviour as it has the potential to tackle problems like climate change, energy scarcity, intergenerational injustice and pressure on scarce natural resources (Lawson et al., 2008; Porter & Kramer, 2006). Environment friendly Government policies have the potential to reduce the gap between demand for and supply of green funds by inclusion of environment related factors in the time of designing corporate or industrial policies and policies related to investment (Polzin & Sanders, 2020).

Firms that are more transparent in their actions related to non-financial issues like sustainability, diversity, climate change, GHG emission, inclusiveness, social unrest and resource utilisation could be an investment destination for people who are concerned about these factors. Moreover investors have the potential to pressurise corporations to adopt these practices by channelling their investible capital towards corporations that perform well in this criterion. Investors can contribute towards net-zero carbon economy by investing in those sustainability practicing companies. Stock market investors should invest in carbon neutral stock to reduce CO_2 emission (Kim et al., 2020). Finance sector has increasing role in transition towards sustainability and carbon neutral economy (Bielenberg et al., 2016; Grubb, 2014; Hourcade & Shukla, 2013). It channelizes the required fund efficiently towards climate change related sustainable development goals (SDGs).

Investors, who concern for environment, apply various screening method to pick investments. Environmental management of a firm is reflected through choosing input and production process, which when becomes public knowledge effects financial performance of the firm. There are investors who choose stocks based on the technology used by the firm; whether they are energy efficient or not, whether they are using renewable energy or not, having waste management and recycling facility or not and so on. There are some environment cautious investors who choose less polluting and energy efficient firms from the industries that are known as polluting and energy intensive. Environmental management helps firms to avoid penalties that are charged due to externality caused from environmental liability. Such investors avoid investing in firms that take actions that are harmful for the environment. As a result, it becomes costly for such firms to obtain necessary funds. Investment in these firms are risky in terms of long term sustainability.

Investors are considering carbon risk that arises due to energy transition from fossil fuel to renewables while making investment decisions. However, the primary concern of investors is to protect their capital and capital gain, that is, getting high return with minimum possible risk. They will primarily invest in stable companies that give them higher return for their investment. Apart from concern of environment the investors also expect better return opportunities. Financial sector plays an important role as it is an intermediary in the process of economic growth and development. Specifically stock market has an important role in determining the direction of investment. In this scenario it is utmost necessary to empirically check the risk return profile of the stocks that score well in sustainability criterion. This can provide us an insight on whether the investors are paying a premium for supporting carbon-neutral and sustainable economy or not. Also there is a need to study if there is any change of the behaviour of investors before and after the COVID-19 pandemic, which had major impact on the health, environment and the stock market.

This article investigates the financial performance of group of stocks that are working well on reducing carbon footprint, GHG emission, combating climate change and meeting sustainability criterion. In particular, there are three major objectives of this article: (1) to know whether investors are paying a premium for the dream of a green and sustainable economy, (2) to test the relevance of factors introduced in several multi-factor asset pricing model that are used to analyse risk–return performance of portfolio, and (3) to check whether COVID-19 pandemic has significant effect on investment in these indexes ESG 100, GREENEX and CARBONEX or not.

The rest of the article is organised as follows. Section 2 gives brief review of the existing literature. Section 3 describes the data and methodology used in this article. The results are discussed in Sections 4 and 5 concludes with remarks.

2 | LITERATURE REVIEW

It is not possible to increase the investment in sustainable and green economy without involving the private investors and their huge capital. But the private investors have always been incentive driven which is higher return on their capital invested. For the purpose of finding whether green investments get higher or lower return than conventional investment, Reboredo et al. (2017) use five factor model of asset pricing. This article investigated weekly returns of alternative energy mutual funds quoted in EUR and USD and compared with the performance of corporate mutual funds and socially responsible investment (SRI) funds for 2010–2016 and found that these

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renewable energy mutual funds performed poorer than both of their counterparts and Jensen's alpha values were negative for both mutual funds quoted in EUR and USD.

Another article by Martí-Ballester (2019a) use four factor model to compare risk adjusted return of 81 renewable energy mutual funds with 122 black energy Mutual funds and 4293 conventional Mutual funds. Renewable energy based Mutual funds are performing almost similar to the market benchmarks but they are underperforming compared to other conventional Mutual funds. Hence mutual fund investors are penalised for choosing funds that support sustainability and green economy since the fund managers have less option to diversify the funds. Another study by Martí-Ballester (2019b) on 44 alternative energy mutual fund commercialised in Spain, from 2007 to 2017 found that alternative energy Mutual funds do not perform better than the benchmark index. They suggest that investors can contribute to the transition of energy sector while investing in selective renewable energy mutual funds without hurting their process of long term wealth creation. Taking data of 77 Chinese green stocks over 5 years, study by Xianfang (2020) found that the financial performance of these investments are poorer than conventional stocks, they provide less return than benchmark. Investors are paying a premium for investing in green assets.

Chariri et al. (2018) found from the performance of Indonesian stock market that more green investment leads to better financial performance of the companies. They suggest increasing green investment as it can increase the profit of the firm without hurting the environment.

In Indian context Kalpesh and Patel (2012) use data of stock market and mutual fund to compare the return of different funds using Sharpe Ratio, Treynor Ratio, and Jensen's Alpha. Similar study of comparison by Qamruzzaman (2014) in the context of another underdeveloped country Bangladesh is also there in the literature. There are several Indian studies (Bhagyasree & Kishori, 2016; Sheth et al., 2017; Somaiya, 2022) that use statistical and financial ratios for comparing mutual funds but there is no work focused on green energy, green economy and sustainability.

2200 studies on the relation between ESG criterion and financial performance of corporates are reviewed by Friede et al. (2015), found that more than 90% studies have confirmed non-negative return which is consistent over time. This result is true for developed North America and emerging markets. This article suggests that investors should focus on long term responsibility and their interest should coincide with that of broader society.

Large cap firms are more transparent regarding environmental disclosure and as a result they are valued higher compared to small cap firms (Brammer & Pavelin, 2008; Siddique & Sciulli, 2020). Incorporation of environmental management in a firm's operation leads to increased perceived valuation of the firm (Klassen & McLaughlin, 1996).

Study on risk return trade off of green investment in one of the biggest carbon emitter and energy consumer country is a necessary. Number of research articles is limited in green finance whereas there is large number of studies regarding traditional energy sector of India. There is absence of study for Indian market that analyse the performance of the stocks of green companies or the corporates that are committed to combat climate change and follow business model that promote sustainability practice. As of now there is no clear guide for investors regarding risk–return spectrum of such Indian company's stock. This study applied several financial rates, ratios and five-factor model of asset pricing to provide clear picture about the same. Investors who concern about environment and want to support long term sustainability as well as want good return on their investment will find this article helpful for investment purpose. Regulators also will have a deeper understanding on the performance of such investments and can formulate policies on that basis. This article contributes to the existing literature by finding whether the investment towards green economy is fruitful in terms of return or the investors are paying a premium for responsibly choosing a carbon neutral economy. The effect of COVID-19 pandemic, which is a major event in recent times that has impacted our health, environment and the economy, on green investment return is also checked in this article. In this context, the main hypothesis of this study is: H_0: Performance of green and non-green portfolio is similar on the basis of various risk adjusted measures.

3 | DATA AND METHODOLOGY

As indices are used as sectorial benchmark and they are used to make investment decision, these are the primarily investment tool of fund managers. We took daily data of S&P BSE GREENEX, S&P BSE CARBONEX, and S&P BSE ESG 100 index for our analysis of green and sustainable investment return. India's top "green" companies in terms of GHG emission are included in S&P BSE GREENEX; they are separating themselves from rest of the traditional companies by their energy efficient practices. S&P BSE CARBONEX constitutes stocks of the companies that are committed towards mitigating the risks arising from climate change. Best stocks of Indian market based on sustainability practicing criterion are included in S&P BSE ESG 100 index. Data and information regarding the above said indexes are taken from BSE website. S&P BSE GREENEX data is available from October 2008, S&P BSE CARBONEX data is available from October 2010 and S&P BSE ESG 100 data is available from October 2017.

Data on the five factors for Indian stock market are prepared by Agarwalla et al. (2013) which is updated on a regular basis. Data till March 2022 is taken for our analysis. Annual risk free rate is taken that of 364 day Treasury bill which is available from Reserve Bank of India.

Data regarding all of the five variables are found stationary at level using ADF test, PP test and KPSS test. All analysis is done using Microsoft Excel and R software.

We use statistical and financial ratios like Compound annual growth rate (CAGR), standard deviation, beta, Sharpe ratio, Treynor ratio and Jensen's alpha to measure and compare the risk return performance of the given indexes. Also five-factor model of asset- pricing is implemented for same purpose and contribution of each factor on return is analysed.

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3.1 | Compound annual growth rate (CAGR)

CAGR is used to measure the mean annual return that an asset is providing when invested for more than a year. This number gives the yield of an investment on an annually compounded basis. This is calculated as follows:

$$\text{CAGR} = \left(\frac{V_{\text{FINAL}}}{V_{\text{INITIAL}}}\right)^{\frac{1}{T}}, \quad (1)$$

where, V_{INITIAL} is the value of the investment at the beginning of investing period, V_{FINAL} is the value of the investment at the end of investing period, and T is the time in years.

3.2 | Standard deviation

Standard deviation reflects fund's volatility, how much the return deviates from its average value. Standard deviation is zero if the portfolio gives constant return over the investment period. Higher standard deviation means higher volatility of return. It is measures as follow.

$$\text{Standard deviation} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(R_i - \overline{R}\right)^2},$$

where, N is the number of period, R_i is the return on ith period, and $\overline{R}$ is the average return.

3.3 | Beta

Beta measures the volatility or systematic risk of a security with comparison to the market as a whole. It is useful to compare the return of a fund with any other fund or index or the benchmark. When the value of beta is close to 1, the volatility of the fund is similar to that of the benchmark. It is calculated as follows.

$$\text{Beta} = \frac{\textit{Covariance}\left(R_p, R_m\right)}{\textit{Variance}\left(R_m\right)},$$

where, $\text{Covariance}\left(R_p, R_m\right)$ is the covariance between the return of portfolio and the market and $\text{Variance}\left(R_m\right)$ is the variance of market return

3.4 | Sharpe ratio

Sharpe ratio is defined as portfolio risk premium divided by portfolio risk. The excess return over the risk-free rate of return is referred as portfolio risk premium. High Sharpe ratio of a fund shows better performance than a fund with lower Sharpe ratio. It is convenient to rank many portfolios using Sharpe ratio. It is calculated as follows.

$$\text{Sharpe ratio} = \frac{R_p - R_f}{\text{Standard deviation of the portfolio}},$$

where, R_p is the return on portfolio and R_f is the risk free rate of return.

3.5 | Treynor ratio

When we divide risk premium by beta of the portfolio or systematic risk instead of total risk (standard deviation), we get Treynor ratio.

Treynor ratio $= \frac{R_p - R_f}{\text{Beta of the portfolio}}$, where, R_p is the return on portfolio and R_f is the Risk free rate of return.

3.6 | Jensen's alpha

Based on systematic risk, Jensen's alpha is designed to measure the risk adjusted performance of a portfolio in relation to the expected market return. Similar to CAPM, daily returns of the portfolio and daily returns of the market are regressed for computing systematic risk. The difference between actual return and calculated return is a measure of performance related to the market. Positive alpha indicates that the portfolio has outperformed the market and negative alpha indicates underperformance. Jensen's alpha (α) is calculated as follow.

$$\text{Jensen}'\text{s alpha}\,\alpha = R_p - \left\{R_f + \beta_p\left(R_m - R_f\right)\right\},$$

where, R_p is the return on portfolio, R_f is the risk free rate of return, R_m is the return on market benchmark, and β_p is the beta of the portfolio.

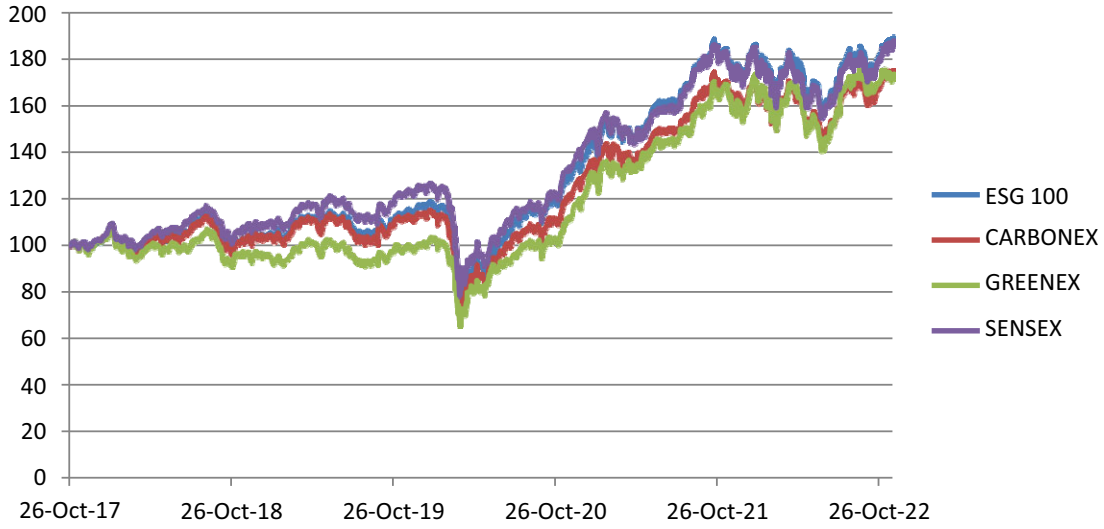
3.7 | Five factor model

Asset pricing models are continuously improving since additions of new factors over time are making improvements over the previous models. The multi-factor model that is used in this article is a five-factor model including the market benchmark, along with factors to capture small scale risk exposure and bankruptcy risk proposed by Fama and French (1993), the momentum risk factor that was introduced by Carhart (1996) and a timing risk factor as given by Bollen and Busse (2001). The following regression equation describes the model.

Model 1:

$$\left(R_p - R_f\right) = \alpha + \beta_1\left(R_m - R_f\right) + \beta_2\, SMB + \beta_3 HML + \beta_4 WML + \beta_5\left(R_m - R_f\right)^2 + \varepsilon_t,$$

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Note: Data of all indexes are re-based at 100. Source: Author's computation.

DIAGRAM 1 Line plot of ESG 100, CARBONEX GREENEX and SENSEX. Data of all indexes are re-based at 100. Source: Author's computation.

where, $(R_p - R_f)$ is excess return given by portfolio compared to risk free rate of return, $(R_m - R_f)$ is excess return provided by market benchmark compared to risk free rate of return, SMB (Small Minus Big) is a factor that measures the exposure to small scale risk. It is calculated as the difference between returns of small cap portfolio and returns of large cap portfolio, HML (High Minus Low) is the factor that captures the exposure to bankruptcy risk. All stocks are ranked according to the book value to market price ratio (B/M) and the difference of return of portfolio consisting high B/M ratio and low B/M ratio is taken here, WML (Winner Minus Looser) is the momentum risk factor also known as MOMT. Two portfolios are made according to the return in previous period and the difference of top performers (Winners) and bottom performers (Losers) are taken, and $(R_m - R_f)^2$ is the timing risk factor that captures the market timing ability of the managers of a portfolio. It is calculated as square of the excess return that market benchmark gives over risk free rate of return.

The impact of each factor on excess return of the portfolio is measured by β parameters. When all β's are different from zero we get the five factor model with augmented time risk factor. We get the CAPM when $\beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$; we get three factor model when $\beta_4 = \beta_5 = 0$; and we get four factor model when $\beta_5 = 0$.

The data of the all indexes are plotted for visualisation. In order to graphically compare the return and volatility among the indexes, data of all indexes are re-based at 100. It is observed from the graph (Diagram 1) that before COVID-19 pandemic, till March 2020 SENSEX was higher than the other indexes. After SENSEX there was ESG 100, then CARBONEX, followed by GREENEX. But after the pandemic, SENSEX and ESG100 are moving together and GREENEX and CARBONEX are moving together but slightly below the former pair. For finding any significant change in return caused by COVID-19 pandemic, this article introduces two new variable X_6 and X_7.

Where, X_6 = Dummy variable (D); D = 0 for time period before COVID-19 pandemic and D = 1 for time period after COVID-19 pandemic. $X_7 = D^* X_1 = D^*(R_m - R_f)$; this variable captures any change in slope of the return line caused by COVID-19 pandemic.

The five-factor model along with these two new variables now turns into this equation.

Model 2:

$$(R_p - R_f) = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 + \beta_6 D + \beta_7 D * (R_m - R_f) + \varepsilon_t.$$

If the variables X_6 and X_7 are found significant for some index, then we can say that the COVID-19 pandemic has altered the return behaviour of the given index.

Two models have been built to capture the effect of COVID-19 pandemic; Model 2a incorporates only variable X_6 and Model 2b incorporate both of the variables X_6 and X_7.

Model 2a:

$$(R_p - R_f) = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 + \beta_6 D + \varepsilon_t,$$

when, D = 0, the equation of model 2a gives

$$E[(R_p - R_f) | D = 0] = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2,$$

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when, D = 1, the equation of model 2a gives

$$E[(R_p - R_f)|D = 1] = (\alpha + \beta_6) + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2.$$

Model 2b:

$$(R_p - R_f) = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 + \beta_6 D + \beta_7 D * (R_m - R_f) + \varepsilon_t,$$

when, D = 0, the equation of model 2b gives

$$E[(R_p - R_f)|D = 0] = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2,$$

when, D = 1, the equation of model 2b gives

$$E[(R_p - R_f)|D = 1] = (\alpha + \beta_6) + (\beta_1 + \beta_7) * (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2.$$

4 | RESULTS AND DISCUSSION

4.1 | Statistical and financial ratios

For the purpose of comparison of the return that the indexes provided, we compute the CAGR of market benchmarks and that of the indexes that we use for our analysis purpose. For the sake of comparison of all returns, we have computed the CAGR by taking data from October 2017 to March 2022. The result is presented in Table 1, from which we observe that ESG 100 index has given the highest return, higher than the market benchmark. But GREENEX and CARBONEX have given returns that are slightly lower than the market benchmark.

Next we present the measures of volatility i.e. beta and standard deviation of each index, given in Table 2. Beta represents the volatility of the portfolio compared to the market as a whole, for this reason the beta of the market is 1. Deviation from 1 represents more volatile portfolio. Here all three indexes have beta that are close to 1, highlighting the fact that they have almost similar risk that of the market. If we look at the standard deviation we find that CARBONEX has lower standard deviation than that of the market and others have slightly higher than market. From this observation we can say that CARBONEX has slightly lower risk than market and others have slightly higher risk than market.

Now we present the financial ratios in Table 3 that consists of Sharpe ratio, Treynor ratio and Jensen's alpha. Sharpe ratio gives excess return per unit total risk; higher Sharpe ratio means higher risk adjusted return. ESG 100 has the highest Sharpe ratio of 4.95, followed by GREENEX with 2.98 and then CARBONEX with 1.33. Similarly Treynor ratio gives excess return per unit of systematic risk; higher Treynor ratio means higher risk adjusted return. ESG 100 has the highest Treynor ratio of 5.74, followed by GREENEX with 3.68 and then CARBONEX with 1.37. Both of the ratios gives same insight that ESG 100 gives highest risk adjusted return followed by GREENEX and CARBONEX. Positive Jensen's alpha indicates outperformance and negative alpha indicates underperformance relative to the market. Here ESG 100 has positive alpha and both GREENEX and CARBONEX have negative. ESG 100 has outperformed the market whereas both GREENEX and CARBONEX have underperformed; this result coincides with that we get from CAGR.

TABLE 1 Compound annual growth rate.

Index	CAGR
SENSEX	13.80%
NIFTY	12.69%
GREENEX	11.73%
CARBONEX	12.10%
ESG 100	14.17%

Source: Author's computation.

TABLE 2 Beta and standard deviation.

Index	Beta	Standard deviation
GREENEX	1.068	1.32
CARBONEX	1.059	1.09
ESG 100	1.075	1.25
MARKET(SENSEX)	1.000	1.16

Source: Author's computation.

TABLE 3 Financial ratios.

Index	Sharpe ratio	Treynor ratio	Jensen's alpha
GREENEX	2.98	3.68	−0.45
CARBONEX	1.33	1.37	−2.89
ESG 100	4.95	5.74	1.76

Source: Author's computation.

4.2 | Five-factor model

The results of the regression using five-factor model are presented in the following tables. Table 4 gives the case of GREENEX where the multiple R is 0.9468 and adjusted R^2 is 0.8963, which indicates that the model is well fitted. The fifth factor $X_5 = (R_m - R_f)^2$ is not significant at 5% level of significance. Hence, we can represent the five factor model for GREENEX as follows.

$$(R_p - R_f) = 0.028694383 + 1.040523502 (R_m - R_f) - 0.16307261 SMB - 0.058653334 HML - 0.08335325 WML.$$

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TABLE 4 Regression result of five-factor model on GREENEX returns.

ANOVA	*df*	SS	MS	*F*	Significance *F*
Regression	5	5219.36383	1043.87277	5771.1515	0
Residual	3334	603.0463419	0.18087773		
Total	3339	5822.410171			
	Coefficients		**Standard error**	***t* Stat**	***p*-Value**
Intercept	0.028694383***		0.007561268	3.7949167	0.0001503
$X_1 = R_m - R_f$	1.040523502***		0.007092405	146.709538	0.0000000
X_2 = SMB	−0.16307261***		0.009671831	−16.8605731	0.0000000
X_3 = HML	−0.058653334***		0.009351017	−6.27240179	0.0000000
X_4 = WML	−0.08335325***		0.008065457	−10.3345967	0.0000000
$X_5 = (R_m - R_f)^2$	−0.001582741		0.001207543	−1.3107122	0.1900453
Regression statistics					
Multiple *R*			0.9468		
R square			0.8964		
Adjusted *R* square			0.8963		
Standard error			0.4253		
Observations			3340		

Note: *** and ** denote 1% and 5% level of significance, respectively.

TABLE 5 Regression result of five-factor model on CARBONEX returns.

ANOVA	*df*	SS	MS	*F*	Significance *F*
Regression	5	3096.881	619.3761467	5877.68099	0
Residual	2845	299.7994	0.105377639		
Total	2850	3396.68			
	Coefficients		**Standard error**	***t* stat**	***p*-Value**
Intercept	0.02882***		0.006368	4.526	0.000
$X_1 = R_m - R_f$	1.06335***		0.007182	148.0623	0.000
X_2 = SMB	−0.14433***		0.00825	−17.4946	0.000
X_3 = HML	−0.06575***		0.007726	−8.5103	0.000
X_4 = WML	−0.04259***		0.007215	−5.9037	0.000
$X_5 = (R_m - R_f)^2$	−0.00494**		0.001881	−2.6245	0.0087
Regression statistics					
Multiple *R*			0.9548		
R square			0.9117		
Adjusted *R* square			0.9116		
Standard error			0.3246		
Observations			2851		

Note: *** and ** denote 1% and 5% level of significance, respectively.

Table 5 gives the case of CARBONEX where the multiple *R* is 0.9548 and adjusted R^2 is 0.9116, which indicates that the model is well fitted. All of the five factors are significant at 5% level of significance. Hence, we can represent the five factor model for CARBONEX as follows.

$$(R_p - R_f) = 0.02882369 + 1.063353785\,(R_m - R_f) - 0.144333515\,SMB - 0.065751781\,HML - 0.04259426\,WML - 0.004936578\,(R_m - R_f)^2.$$

Table 6 gives the case of ESG 100 where the multiple *R* is 0.9425 and adjusted R^2 is 0.8877, which indicates that the model is well fitted. The intercept term is not significant at 5% level of significance. Hence, we can represent the five factor model for ESG 100 as follows.

$$(R_p - R_f) = 1.074042804\,(R_m - R_f) - 0.149733648\,SMB - 0.073796069\,HML - 0.028334945\,WML - 0.007008251\,(R_m - R_f)^2.$$

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TABLE 6 Regression result of five-factor model on ESG 100 returns.

ANOVA	*df*	SS	MS	*F*	Significance *F*
Regression	5	1519.406	303.8812	1734.483639	0
Residual	1091	191.143	0.1752		
Total	1096	1710.549			
	Coefficients	**Standard error**	***t* Stat**	***p*-Value**	
Intercept	0.02126	0.013089	1.6242	0.1046	
$X_1 = R_m - R_f$	1.07404***	0.013044	82.3422	0.000	
X_2 = SMB	−0.14973***	0.015483	−9.671	0.000	
X_3 = HML	−0.0738***	0.015603	−4.7295	0.000	
X_4 = WML	−0.02833**	0.013659	−2.0745	0.038	
$X_5 = (R_m - R_f)^2$	−0.007**	0.00269	−2.6057	0.0093	
Regression statistics					
Multiple *R*		0.9425			
R Square		0.8882			
Adjusted *R* square		0.8877			
Standard error		0.4186			
Observations		1097			

Note: *** and ** denote 1% and 5% level of significance, respectively.

It is evident from the above results that ESG 100 index has given more return than the market while the risk is similar to that of the market. GREENEX and CARBONEX have given returns that are not much lower than the market. Hence we can say that the investors are neither losing their capital nor sacrificing the return on their capital by being concerned about the environment and sustainability. Five-factor analysis suggests that all the factors of the model are relevant for explaining the variation of excess return earned by the portfolio. As a company takes green initiatives, it improves company's reputation in such a way that results into high social acceptance and higher share price. Environmentally sensitive investors increases the demand of theses company's share as they take into account social, ecological and environmental decisions of the firm besides financial performance.

4.3 | Effect of COVID-19 on return behaviour

Table 7 summarises the results obtained through the regression. Among the two models, Model 2a incorporates only variable X_6 and Model 2b incorporate both of the variables X_6 and X_7. It is found that the variable $X_6 = D_1$ is significant for CARBONEX only. It is not significant for the other two indexes. But the variable $X_7 = D_1{}^* X_1 = D_1{}^* (R_m - R_f)$ is significant for all of the three indexes. The models that we obtain are summarised below.

For GREENEX:

Model 2a:

$$(R_p - R_f) = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 0.0315 + \mathbf{1.0408} (R_m - R_f) - 0.1628 SMB - -0.0583 HML - 0.0833 WML.$$

Model 2b:

$$(R_p - R_f) = (\alpha + \beta_6) + (\beta_1 + \beta_7) * (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 = \mathbf{1.0880} (R_m - R_f) - 0.1636 SMB - 0.0573 HML - 0.0892 WML.$$

For CARBONEX:

Model 2a:

$$(R_p - R_f) = (\alpha + \beta_6) + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 = -0.00223 + \mathbf{1.064644} (R_m - R_f) - 0.14345 SMB - 0.06523 HML - 0.04269 WML - 0.00453 (R_m - R_f)^2.$$

Model 2b:

$$(R_p - R_f) = (\alpha + \beta_6) + (\beta_1 + \beta_7) * (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 = -0.01029 + \mathbf{1.107062} (R_m - R_f) - 0.14198 SMB - 0.06126 HML - 0.04776 WML - 0.0037 (R_m - R_f)^2.$$

For ESG 100:

Model 2a:

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TABLE 7 Summary of regression result of five-factor model with the effect of COVID-19 pandemic.

	GREENEX		CARBONEX		ESG 100	
	MODEL 2a	MODEL 2b	MODEL 2a	MODEL 2b	MODEL 2a	MODEL 2b
Intercept	0.0315*** (3.8606)	0.0310*** (3.8061)	0.035*** (5.0745)	0.0341*** (4.958)	0.0307 (1.7598)	0.0284 (1.6315)
$X_1 = R_m - R_f$	1.0408*** (146.6300)	1.0297*** (130.988)	1.0646*** (147.913)	1.047649*** (126.1056)	1.0751*** (82.0224)	1.0300*** (53.8446)
X_2 = SMB	−0.1628*** (−16.8252)	−0.1636*** (−16.9250)	−0.14345*** (−17.3817)	−0.14198*** (−17.2338)	−0.1484*** (−9.5344)	−0.1477*** (−9.5271)
X_3 = HML	−0.0583*** (−6.2276)	−0.0573*** (−6.1309)	−0.06523*** (−8.44531)	−0.06126*** (−7.88997)	−0.0725*** (−4.6235)	−0.0677*** (−4.3151)
X_4 = WML	−0.0833*** (−10.3276)	−0.0892*** (−10.8033)	−0.04269*** (−5.92156)	−0.04776*** (−6.5446)	−0.0283** (−2.0742)	−0.0386*** (−2.7617)
$X_5 = (R_m - R_f)^2$	−0.0016 (−1.2991)	−0.0011 (−0.8821)	−0.00453** (−2.3977)	−0.0037* (−1.95211)	−0.0068** (−2.5162)	−0.0065** (−2.4008)
$X_6 = D_1$	−0.0189 (−0.9167)	−0.0262 (−1.2666)	−0.03725** (−2.3202)	−0.04443** (−2.75828)	−0.0212 (−0.8200)	−0.0249 (−0.9654)
$X_7 = D_1{}^* X_1$	-	0.0583*** (3.2445)	-	0.059413*** (4.063541)	-	0.0786** (3.2212)
R square	0.8965	0.8968	0.91190	0.91241	0.888	0.889
Adjusted *R* square	0.8963	0.8966	0.911718	0.912197	0.888	0.889
Number of observations	3340	3340	2851	2851	1097	1097

Note: ***, ** and * denote 1%, 5% and 10% level of significance, respectively.

$$(R_p - R_f) = \alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2$$
$$= \mathbf{1.0751} (R_m - R_f) - 0.1484\, SMB - 0.0725\, HML - 0.0283\, WML - 0.0068\, (R_m - R_f)^2.$$

Model 2b:

$$(R_p - R_f) = (\alpha + \beta_6) + (\beta_1 + \beta_7) * (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2$$
$$= \mathbf{1.1087} (R_m - R_f) - 0.1477\, SMB - 0.0677\, HML - 0.0386\, WML - 0.0065\, (R_m - R_f)^2.$$

The coefficient of both of the variables X_1 and X_7 are found to be positive for all of the three indexes. As a result the values of the coefficients of $(R_m - R_f)$ has increased in model 2b compared to model 2a, which results into a steeper return curve for the indexes GREENEX, CARBONEX and ESG 100 after the pandemic. From this we can conclude that the return has increased for these indexes after the pandemic compared to that before the pandemic.

5 | CONCLUSION

This study has examined the premium of investors focusing on carbon neutral or green economy. The study observed that increasing numbers of investors are interested to invest in green and sustainability focused stocks. This trend has increased at a faster rate after the COVID pandemic. However, there is lack of study regarding financial performance of such stocks. This article analysed Indian stocks markets daily data by applying several financial rates, ratios and five-factor model of asset pricing. Beta, CAGR, Standard Deviation, Sharpe Ratio, Treynor Ratio, and Jensen's Alpha are used to analyse risk–return trade-off associated with green and sustainable investment.

This study has found that ESG 100 index has given more return than the market while underlying risk is similar to that of the market. Other two indexes, GREENEX and CARBONEX have given returns that are not much lower than the market and the risk is also almost similar to that of the market in these cases. So, we can conclude that the investors are neither losing their capital nor sacrificing the return on their capital by being concerned about the environment and sustainability. Since there is absence of studies on comparison of risk-return of green and sustainability focused indexes in Indian context, our result is not directly comparable with prior works. Our result contradicts with the existing works on mutual funds or green funds in India and abroad which concludes that green investors are paying a premium (Martí-Ballester, 2019a, 2019b; Reboredo et al., 2017; Xianfang, 2020). In this context five-factor analysis suggests that exposure to small scale risk, exposure to bankruptcy risk, momentum risk and timing risk factor are relevant for explaining the variation of excess return earned by the portfolio.

The article also found that the return has increased for these indexes ESG 100, GREENEX and CARBONEX after the pandemic compared to that before the pandemic. This is due to increased

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concern of investors towards environment and decarbonisation after the pandemic. More number of investors started investing in stocks of companies that are reducing carbon emission and are practicing sustainability.

The relatively poor performance of GREENEX and CARBONEX compared to the benchmark are due to a smaller number of stocks included in the indexes, implying less diversification. This situation will improve in future if more corporates commit towards sustainability and carbon-neutrality thereby inclusion of increased number of good performing stock in the indexes. This will in turn increase the long-term return of the green investors. Relative return of the stocks that are currently investing in green will increase in future compared to the firms that are polluting, use black energy, do not practice sustainability. On the other hand, these polluting firms' profitability will reduce in future because of their forced shifting through government policies to greener and sustainable production which will increase their operating cost resulting from increased production cost and new investment in green technology.

The findings of this study will be useful for individual and institutional investors in their decision regarding choosing stocks for investment. In order to ensure long term sustainability of investment, investors of Indian market should consider green sustainability criterion. Mutual fund managers, who have the potential to diversify their portfolio, should use this opportunity to increase the return of their investors who expect good return while support decarbonised and sustainable economy. It is noticeable from the study that adding environmental management to the daily operations of a firm will benefit them in the form of increased investment. This finding will motivate the corporations to move towards green and sustainable operation. They should invest in R&D for more eco-friendly operations. Government should incentivise the high initial green investment of the firms. This will reduce the cost and increases their profit. As a result the private investors get incentive to invest in those green and sustainability business strategies. This study can be extended by studying the differential impact of green operation on investors' perceptions. Financial performance of alternative energy mutual funds and renewable energy companies can also be studied in a similar way to assess the condition of investors. Future research should anticipate the impact of technological innovation, climate and renewable energy related policies on green investor's profitability.

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