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 paper 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 paper indicate that investors are getting more return compared to market if they invest in stocks that perform well in sustainability criterion.

***JEL** Classification Numbers*: C_{20}, G_{22}, M_{14}, Q_{42}

Key Words: Beta, CAGR, Carbon neutrality, Five-factor model, Jensen's Alpha, Sustainability, Sharpe Ratio, Treynor Ratio, S&P BSE GREENEX, S&P BSE CARBONEX, S&P BSE ESG 100.

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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 paper attempts to evaluate the risk premium of investment for going green focusing on Indian equity market investors. The paper 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^{o} 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 toward 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 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 per cent 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 and 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 and 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 utilization could be an investment destination for people who are concerned about these factors. Moreover investors have the potential to pressurize corporations to adopt these practices by channelling their investible capital toward 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; Hourcade and Shukla 2013; Grubb 2014). It channelizes the required fund efficiently toward 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 etc. 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 as they 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, i.e. 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. 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 paper 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 paper: (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, (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 paper is organised as follows. Section 2 gives brief review of the existing literature. Section 3 describes the data and methodology used in this paper. The results are discussed in section 4 and section 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 paper 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 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 paper by Martí-Ballester, (2019, a) use 4 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 (2019, b) on 44 alternative energy mutual fund commercialized in Spain, from 2007-2017 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 Su (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 Prajapati 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 (Sheth, et al., 2017; Somaiya, 2022; Bhahyasree and Kishori, 2016) 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 paper 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 (Siddique et al., 2020; Brammer & Pavelin, 2008). When environmental management is added to a firm's operation, it leads to increased perceived valuation of the firm (Klassen and Mc Laughlin 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 papers 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 paper 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 paper 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 paper. The major hypothesis that this study investigates is: H_0: Performance of green and non-green portfolio are 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.

➢ 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:

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

Where,

$V_{INITIAL}$ = Value of the investment at the beginning of investing period

V_{FINAL} = Value of the investment at the end of investing period

T = Time in years

➢ 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.

$$\text{Standard Deviation} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(R_i - \bar{R})^2}$$

Where,

N = number of period

R_i = Return on i^{th} period

$\bar{R}$ = Average return

- **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.

Beta = $\frac{Covariance(R_p,R_m)}{Variance\ (R_m)}$

Where,

$Covariance(R_p, R_m)$= Covariance between the return of portfolio and the market

$Variance\ (R_m)$ = Variance of market return

- **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.

Sharpe ratio = $\frac{R_p - R_f}{Standard\ Deviation\ of\ the\ portfolio}$

Where,

R_p = Return on portfolio

R_f = Risk free rate of return

- **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 = $\frac{R_p - R_f}{Beta\ of\ the\ portfolio}$

Where,

R_p = Return on portfolio

R_f = Risk free rate of return

- **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.

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

Where,

R_p = Return on portfolio

R_f = Risk free rate of return

R_m = Return on market benchmark

β_p = Beta of the portfolio

- **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 paper 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.

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

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.

$(R_m - R_f)^2$ 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 visualization. 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 paper introduces two new variable X_6 and X_7.

Where,

X_6 = Dummy variable (D); D= 0 for time period before COVID-19 pandemic

D= 1 for time period after COVID-19 pandemic

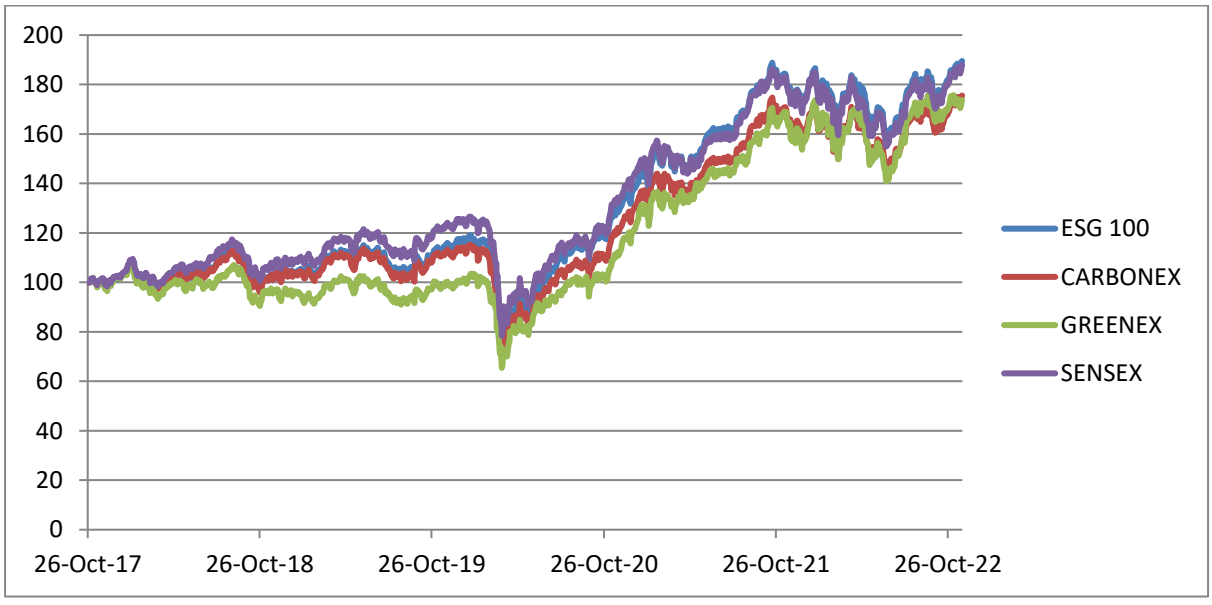
$X_7 = D^* X_1 = D^*(R_m - R_f)$ **;** this variable captures any change in slope of the return line caused by COVID-19 pandemic

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

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

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.

Diagram 1: Line plot of ESG 100, CARBONEX GREENEX and SENSEX



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

Two models have been built to capture the effect of COVID-19 pandemic; Model 1 incorporates only variable X_6 and Model 2 incorporate both of the variables X_6 and X_7.

Model 1:

$$(R_p - R_f) =$$

$$\alpha + \beta_1 (R_m - R_f) + \beta_2 SMB + \beta_3 HML + \beta_4 WML + \beta_5 (R_m - R_f)^2 + \beta_6 \text{ D} + \varepsilon_t$$

When, D=0, the equation of model 1 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 1 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 2:

$$(R_p - R_f) =$$

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

When, D=0, the equation of model 2 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 2 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.

Table 1: CAGR

Index	CAGR

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

Source: Author's computation

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.

Table 2: BETA and Standard Deviation

Index	BETA	STANDERD 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

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 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 **X5= (Rm-Rf)²** is not significant at 5% level of significance. Hence we can represent the five factor model for GREENEX as follows.

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

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
X1= Rm- Rf	1.040523502***	0.007092405	146.709538	0.0000000
X2= SMB	-0.16307261***	0.009671831	-16.8605731	0.0000000
X3= HML	-0.058653334***	0.009351017	-6.27240179	0.0000000
X4= WML	-0.08335325***	0.008065457	-10.3345967	0.0000000
X5= (Rm-Rf)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 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 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
X1= Rm- Rf	1.06335***	0.007182	148.0623	0.000
X2= SMB	-0.14433***	0.00825	-17.4946	0.000
X3= HML	-0.06575***	0.007726	-8.5103	0.000
X4= WML	-0.04259***	0.007215	-5.9037	0.000
X5= (Rm-Rf)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 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.

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

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
X1= Rm- Rf	1.07404***	0.013044	82.3422	0.000
X2= SMB	-0.14973***	0.015483	-9.671	0.000
X3= HML	-0.0738***	0.015603	-4.7295	0.000
X4= WML	-0.02833**	0.013659	-2.0745	0.038
X5= (Rm-Rf)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 summarizes the results obtained through the regression. Among the two models, Model 1 incorporates only variable X_6 and Model 2 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 summarized below.

For GREENEX:

Model 1:

$(R_p - R_f)$ =

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

0.0315 + **1.0408** $(R_m - R_f)$-0.1628 SMB- -0.0583 HML -0.0833 WML

Model 2:

$(R_p - R_f) =$

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

= **1.0880** $(R_m - R_f)$-0.1636 SMB-0.0573 HML -0.0892 WML

For CARBONEX:

Model 1:

$(R_p - R_f)$

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

$= -0.00223 + \mathbf{1.064644} (R_m - R_f) - 0.14345\, SMB - 0.06523\, HML - 0.04269\, WML - 0.00453\, (R_m - R_f)^2$

Model 2:

$(R_p - R_f)$

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

$= -0.01029 + \mathbf{1.107062} (R_m - R_f) - 0.14198\ SMB - 0.06126\ HML - 0.04776\ WML - 0.0037\ (R_m - R_f)^2$

For ESG 100:

Model 1:

$(R_p - R_f)$

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

$= \mathbf{1.0751} (R_m - R_f) - 0.1484\, SMB - 0.0725\, HML - 0.0283\, WML - 0.0068\, (R_m - R_f)^2$

Model 2:

$(R_p - R_f)$

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

$= \mathbf{1.1087} (R_m - R_f) - 0.1477\ SMB - 0.0677\, HML - 0.0386\, WML - 0.0065\, (R_m - R_f)^2$

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 2 compared to model 1, 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.

Table 7: Summary of Regression Result of Five-factor Model with the effect of COVID-19 pandemic

	GREENEX		**CARBONEX**		**ESG 100**	
	MODEL 1	**MODEL 2**	**MODEL 1**	**MODEL 2**	**MODEL 1**	**MODEL 2**
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)

X1= R_m- R_f	1.0408*** (146.6300)	1.0297*** (130.988)	1.06464*** (147.913)	1.047649*** (126.1056)	1.0751*** (82.0224)	1.0300*** (53.8446)
X2= 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)
X3= 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)
X4= 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)
X5= $(R_m-R_f)^2$	-0.0016 (-1.2991)	-0.0011 (-0.8821)	-0.00453** (-2.3977)	-0.0037* (-1.95211)	-0.0068** (-2.5162)	-0.0065** (-2.4008)
X6 =D1	-0.0189 (-0.9167)	-0.0262 (-1.2666)	-0.03725** (-2.3202)	-0.04443** (-2.75828)	-0.0212 (-0.8200)	-0.0249 (-0.9654)
X7= D1* X1	----------	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.

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 paper 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. 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 paper 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 concern of investors toward 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 toward 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, don't practice sustainability. Their 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 incentivize 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 investor's 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.

References:

Agarwalla, S. K., Jacob, J. and Varma, J. R. (2013). Four factor model in Indian equities market, Working Paper W.P. No. 2013-09-05, Indian Institute of Management, Ahmedabad.

Bassi, A., (2009). An integrated Approach to Support Energy Policy Formulation and Evaluation, (PhD Thesis) University of Bergen.

Bhagyasree, N. and Kishori, B. (2016). A Study on Performance Evaluation of Mutual Funds Schemes in India.

Bielenberg, A., Mike K., Jeremy O., and Melissa, R., 2016. "Financing Change: How to Mobilize Private-Sector Financing for Sustainable Infrastructure." McKinsey Center for Business and Environment.

Bollen, NPB., Busse, J.A. (2001). On the timing ability of mutual fund managers. *The Journal of Finance,* 56(3):1075–94.

Brammer, S., & Pavelin, S. (2008). Factors influencing the quality of corporate environmental disclosure. *Business Strategy and the Environment*, 17(2), 120-36. https://doi.org/10.1002/bse.506

Carhart, M.M., (1996). On the persistence in mutual fund performance. *The Journal of Finance,* 52(1):57–82.

Fama, E., French, KR., (1993). Common risk factors in the returns on stocks and bonds. *The Journal of Finance,* 33(1):3–53. doi:10.1111/j.1540-6261.1997.tb03808.x. JSTOR 2329556

Chariri, A., G. R. S. B. Bukit, O. B. Eklesia, B. U. Christi, and D. M. Tarigan. (2018). Does green investment increase financial performance? Empirical evidence from Indonesian companies. E3S Web of Conferences, vol. 31, 09001. EDP Sciences, Semarang.

Friede, G., Busch, T. and Bassen, A., (2015) ESG and financial performance: aggregated evidence from more than 2000 empirical studies, *Journal of Sustainable Finance and Investment*, 5(4), 210-233, DOI: 10.1080/20430795.2015.1118917

Grubb, M., 2014. Planetary Economics: Energy, Climate Change and the Three Domains of Sustainable Development. Oxford: Routledge.

Hourcade, J.C., and Shukla, P., 2013. “Triggering the Low-Carbon Transition in the Aftermath of the Global Financial Crisis.” Climate Policy 13 (sup01): 22–35.

Kim, D.H., Wu, Y.C. and Lin, S.C., 2020. Carbon dioxide emissions and the finance curse. *Energy Economics*, 88, 104788. https://doi.org/10.1016/j.eneco.2020.104788.

Klassen, R. D., & McLaughlin, C. P. (1996). The impact of environmental management on firm performance. *Management Science*, 42(8), 1199-1214. https://doi.org/10.1287/mnsc.42.8.1199

Lawson, R., Lyman, J.R. and Mc Carthy, E.R., (2008). A 21st Century Marshall Plan for energy, water and agriculture in developing countries, The Atlantic Council of the United States, Washington D.C.

Martí-Ballester, C.-P. (2019, a). Do European renewable energy mutual funds foster the transition to a low-carbon economy? *Renewable Energy*, *143*, 1299–1309. https://doi.org/10.1016/j.renene.2019.05.095

Martí-Ballester, C.-P. (2019, b). Analyzing Alternative Energy Mutual Fund Performance in the Spanish Market. In E. Motoasca, A. K. Agarwal, and H. Breesch (Eds.), *Energy Sustainability in Built and Urban Environments* (pp. 201–213). Springer Singapore. https://doi.org/10.1007/978-981-13-3284-5_9

Polzin, F. and Sanders, M., (2020). How to finance the transition to low-carbon energy in Europe? *Energy Policy*, 147, 111863. https://doi.org/10.1016/j.enpol.2020.111863.

Porter, M.E., Kramer and M.R., (2006). Strategy and society: the link between competitive advantage and corporate social responsibility, Harvard Business Review, 84, 78–92.

Prajapati. P., Kalpesh., and Patel, K., Mahesh (2012). “Comparative study on Performance Evaluation of Mutual Fund Schemes of Indian Companies”, Researchers World, Journal *of Arts, Science and Commerce*, 3(3), 47-59.

Qamruzzaman, Md. (2014). Comparative Study on Performance Evaluation of Mutual Fund Schemes in Bangladesh: An Analysis of Monthly Returns. 5.

Reboredo, J. C., Quintela, M. and Otero, L. A., (2017). Do investors pay a premium for going green? Evidence from alternative energy mutual funds. *Renewable and Sustainable Energy Reviews*, *73*, 512–520. https://doi.org/10.1016/j.rser.2017.01.158

Sheth, KN., Mittal, H. and Prajapati, F., (2017). Performance Evaluation of Public and Private Mutual Funds Schemes in India.

Siddique, S., & Sciulli, N. (2020). Environmental Initiatives and Disclosures by Large companies: The Views of Investors. *Australasian Accounting, Business and Finance Journal*, 14(3), 18-37. http://dx.doi.org/10.14453/aabfj.v14i3.3

Sinha, A., Mishra, S., Sharif, A. and Yarovaya, L., (2021). Does green financing help to improve environmental and social responsibility? Designing SDG framework through advanced quantile modelling. *Journal of Environment Management* 292, 112751. https://doi.org/10.1016/j.jenvman.2021.112751

Somaiya, J., (2022). EFFECT OF CORONA PANDEMIC IN PERFORMANCE EVALUATION OF SELECTED ELSS MUTUAL FUNDS IN INDIA. *International Journal of Management*, Public Policy and Research. 1 (4) .

Umar, M., Ji, X., Kirikkaleli, D., Shahbaz, M., Zhou, X., (2020, b). Environmental cost of natural resources utilization and economic growth: Can China shift some burden through globalization for sustainable development? *Sustainable Development* 28 (6), 1678–1688. https://doi.org/10.1002/sd.2116.

Xianfang, S., (2020). Can Green Investment Win the Favour of Investors in China? Evidence from the Return Performance of Green Investment Stocks, *Emerging Markets Finance and Trade*, https://doi.org/10.1080/1540496X.2019.1710129