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FEASIBILITY OF INVESTING IN CARBON EFFICIENT EQUITY PORTFOLIOS

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Abstract

The paper investigates the returns and risk given by the carbon efficient equity indices in India, USA, Japan, and Brazil, and compares them with that of their corresponding benchmark market indices. Data with respect to the considered indices were collected from the official websites of the respective stock exchanges. It was found that there was no difference in the return and risk given by the carbon efficient equity indices with that of their benchmark market indices. There was also no substantial difference with respect to the return generated by the carbon efficient equity indices among the four countries. This study is first of its kind and hence original in nature.

Keywords: Carbon Efficient Index, Green Investment, Return, Stock Market, Market Index
Paper type Research paper
JEL Classification: G140, G140, G190

1. Introduction

Sustainable and responsible investment has changed the outlook of investors. It has also changed the outlook of the companies regarding Environmental, Social, and Corporate Governance criteria (ESCG) to generate long-term competitive financial returns and positive societal impact. The environmental parameters focus on climate change and related risks. It considers the measures adopted by companies to reduce toxic releases and wastes into the environment. The social parameters of a company relates to the behaviour toward its stakeholders and its concerns with the workplace health and safety norms. The governance parameter includes board structure and accountability of the individuals in the helm of affairs of the companies.

Investors usually prefer those companies that perform well in terms of ESCG criteria. This is because they are assumed to be a better and safer investing

avenue to make investments (Tripathi & Bhandari, 2012). Eccles, Ioannou, and Serafeim (2011) observed that in the long run, the stock performance of companies that have implemented superior ESCG policies would improve as compared to those companies that had not used any of these policies.

Sustainable and socially responsible investment can be encouraged by increasing awareness about the environment and social responsibility of the investors. In many countries, numerous awareness programmes are conducted for promoting environmental and socially responsible investments. New rules, regulations, and policies, such as the Kyoto Protocol, the European Emissions Trading Scheme, US Environmental Protection Agency and Clean Air Act, 1963 and etc. are the result of increasing concern for environmental protection (Amenc, Goltz, & Tang, 2010).

Of late, green and clean environment has become a global concern. It affects every individual, community, and company. Environmental protection and preservation of the planet is the responsibility of every individual and community on earth. Even business houses should take action on environmental issues being part of the environment. Therefore, companies that are environmental friendly should be encouraged and promoted.

Investors should also extend a helping hand to such companies by investing in their stock. So, it is essential to recognise these companies for making investment by the investors. For this purpose, most of the top stock exchanges in the world have developed carbon efficient equity indices. These equity indices consist of the stocks of those companies that fulfil the norms set to decrease the carbon emission into the environment. Carbon efficient investment provides an alternate model that proposes growth and ecosystem's protection simultaneously. It has been found that the motivating factor for making investment in carbon efficient companies are socially and environmentally responsible behaviour of the investors (Amenc et al. 2010). Carbon efficient investment encourages companies to undertake more carbon efficient and environmental friendly practices. A recent report by United Nations Environment Programme (UNEP) showed that in the short run period, carbon efficient investment may bring slow economic growth for a few years, but in the long run, it may lead to faster economic growth.

This discussion has led to several questions.

- Is the return of the carbon efficient indices really higher than the corresponding benchmark market indices?
- Do investors have to sacrifice their attractive return from well diversified equity portfolios by investing in carbon efficient portfolios?
- Is there a higher degree of risk involved in carbon efficient equity indices than that of traditional market indices?
- Is it return of investors from carbon efficient indices is independent of countries?

- Is it possible for investors to contribute toward the protection of environment by investing in company stock for their own profit?

Hence, this study made an attempt to find out if investment based on Carbon Efficient Equity Indices is economically viable through a comparative study of selected countries.

The rest of the paper is organised as follows. Section 2 focuses on the concept of carbon efficient index in the stock market, while Section 3 discusses the screening criteria for carbon efficient index. Meanwhile, Section 4 describes the rationale for considering four countries, followed by Section 5 with the review of literature and the research gaps. Next, Section 6 is about the objective of the study and Section 7 discusses about the hypothesis of the study. Section 8 sheds light on research methodology adopted to carry out the study, while Section 9 focusses on the analysis and findings. Section 10 discusses about the conclusion of the study, and the last section gives a view about the scope of future research.

2. Carbon Efficient Equity Indices in Stock Markets

Carbon efficient equity indices provide investors a platform to invest in companies that reduce the emission of carbon into the environment, their reflecting the company's commitment to lessen risks that arise from global warming. Thus, it encourages investment in environmentally responsible companies. With a view to promote carbon efficient investing, the stock exchanges of many countries have emphasised on the development of green index or carbon efficient equity index.

This kind of index is created mainly to help investors as well as the mutual fund managers to plan an appropriate portfolio for investors who would like to invest in such companies that demonstrate environmentally responsible behaviour. Moreover, this also acts as an appreciation and recognition for those companies that have shown environmentally responsible behaviour toward the environment. The presence of a separate index to measure the performance of carbon efficient companies in the stock market is beneficial for investors as they can make an improved and informed investment decision (Tripathi & Bhandari, 2012).

The concept of green investment has evolved in advanced economies since 1980s, but it is still in its nascent stage in the developing economies like Brazil, China, and India. For the promotion of green investment in India, the Bombay Stock Exchange (BSE) launched the S & P BSE-CARBONEX on 30 November 2012, which is a 100 stock portfolio. Similarly, 50 stock carbon efficient index ICO2 was launched in Brazil on 30 September 2009, S & P Carbon Efficient Index was launched in the USA on 10 December 2009, and S & P/TOPIX 150 Carbon Efficient Index was launched on 16 September 2011 in Japan. Similarly, there are many such indices across different stock exchanges.

3. Screening Criteria for Carbon Efficient Index

The screening criteria for companies to be included in the carbon efficient index are their compliance with carbon emission norms set by the regulators of their respective countries. The criteria may also extend to include transparent policies regarding the emission of greenhouse gases. The companies are selected on the basis of following norms:

- disclosure regarding company's carbon emission in environment;
- strategy and governance adopted to reduce the carbon emission into environment, and
- performance and achievement of the company with respect to protection of the environment and ecosystem.

Stocks to be included in the carbon efficient equity index are chosen from a benchmark equity index. On the basis of above specified criteria, they become the constituent of the carbon efficient index. The considered carbon efficient indices for this study along with their corresponding benchmark market indices is presented in Table 1.

Table 1: Carbon Efficient Index and Corresponding Benchmark Market Index

No.	Stock Exchange	Carbon Efficient Index	Corresponding Market Index
1	Bombay Stock Exchange (INDIA)	BSE-CARBONEX	BSE-100
2	New York Stock Exchange S & P (USA)	S & P 500 CARBON	S & P 500
3	Tokyo Stock Exchange (JAPAN)	TOPIX CARBON	TOPIX 150
4	BM&F Bovespa (BRAZIL)	ICO2	IBrX

Source: Collected from respective stock exchanges

4. Rationale for Choosing Selected Countries

USA and Japan are the two biggest economies of the world, whereas India and Brazil are the two emerging economies of the world. Therefore, one developed country from the west, i.e., USA and one developed country from east (Asia), i.e., Japan were considered in this study. From the emerging economies, one emerging economy from Asia, i.e., India was also chosen. The GDP growth rate of India is highest in the world next to China. China is a communist economy and in a communist economy, most of the investment is fueled and regulated by the government. However, India is a democratic country having a mixed economic system where individual investment has a huge role to play. Moreover, from India the stock exchange chosen was the Bombay Stock Exchange, which is

the biggest stock exchange in the world in terms of number of companies listed. Therefore, India was given preference over China for inclusion in this study. Brazil is also one of the emerging economy of the world and its consideration is important in the study because it is a Latin American country. So, its inclusion in the study brings inclusion of one sample from Latin America. The consideration of these four economies was also justified from the perspective of rate of gross capital formation out of total GDP. They are 31.38%, 19.35%, 21.13% and 20.08% for India, USA, Japan, and Brazil respectively, which are considered to be very significant for the study. Moreover, Urrutia (2014) concluded that emerging markets are less efficient than in developed markets. Therefore, two indices from the two leading economies of the world, namely the USA and Japan, and two indices from the world's emerging economies namely India and Brazil, were considered. An overview of the selected countries is presented in Appendix 1.

5. Previous Studies and Research Gap

Concern about the Earth's climate had been growing since 1970 and since then, carbon emitting companies are under scrutiny (The Discovery of Global Warming, 2003-2009). Russo and Fouts (1997) found a positive association between environmental performance and economic performance. Porter and Linde (1995) found that pollution leads to inefficiency of the firm and environmental improvement can benefit resource productivity.

Dowell, Hart, and Yeung (2000) found that firms' adopting a single stringent global environmental standard have much higher market value. Muoghalu, Robison and Glascock (1990) found that firms that are named in lawsuits regarding the inappropriate disposal of harmful waste suffered financial losses.

Hamilton, Jo, and Statman (1993) hypothesised that there is no significant difference in return and performance of socially responsible mutual funds and conventional mutual fund. Kreander (2005) found no significant difference in the performances using Sharpe, Treynor and Jensen measures between ethical and non-ethical funds in four countries. However, Konar and Cohen (2001) observed that poor environmental performance is negatively correlated with goodwill and brand recognition of the firms among investors.

Studies on performance of green mutual funds and stocks have mostly shown positive or neutral results. Cohen, Fenn, and Konar, (1995) observed that there is no negative consequence of carbon efficient investment. Tripathi and Bhandari (2012) found similar results for the Indian stock market. There are various studies related to the risk and return of thematic indices with that of benchmark indices. Hakim and Rashidian (2004) found that investors in the Islamic index do not suffer a discernible cost for complying with the Sharia restriction. Singh and Das (2013) found that there is no significant difference in the return and risk between Islamic index and its benchmark index. Table 2 summarises the studies on the performance of carbon efficient investment conducted by Tripathi and Bhandari (2012).

Table 2: List of Studies on Carbon Efficient Investment

Form	Author	Method	Time period	Results
Negative results	Mahapatra (1984)	Compared pollution control expenditures across six industries to the average market returns in those industries.	1967–1978	Pollution control expenditure limits the financial performance of the company.
	White (1991)	Compared the performance of six environmental mutual funds to S&P500 on both a nominal and a risk-adjusted basis	One-year period Ending 28 June 1991	SRI funds underperformed.
	Olsson (2007)	The daily value-weighted returns of 30 US industry portfolios were analysed.	Jan 2004–July2006	The environmental "riskiness" of portfolios has no statistically significant impact on returns.
Neutral results	Cohen, Fenn, and Konar (1997)	Two portfolios with heavy and light polluters were constructed and their performances were compared.	1987–1989, 1990 and 1991	Environmental and financial performance: no penalty or positive return given to the green investor's convictions.
	King and Lenox (2001)	652 US manufacturing firms were analysed	1987–1996	Association of pollution reduction and financial gain, but no direction of causality.
	Boulatoff and Boyer (2009)	The performance of 310 global green investing stocks was analysed.	2003–2007	The performance of the environmental stocks is sector dependent.
	Dixon (2010)	A framework was developed to investigate the performance of sustainability-themed investing.	Before 31 May2010	Sustainability-themed investing could improve returns, but with increased risk at the same time.

(continued)

Form	Author	Method	Time period	Results
Positive results	Erfle and Fratantuon (1992)	Analysed 49 companies in CEP's8 reputation indices of environmental performance.	Before 1989	Significant positive correlation between firm environmental performance and return on assets, return on equity, and return on investment.
	Diltz (1995)	Daily returns of 28 common stock portfolios were analysed.	1981–1991	Environmental performance has significantly positive impact on the portfolio returns.
	Konar and Cohen (2001)	Compared the environmental and financial performance of 321 manufacturing firms in the S&P500.	1989	There is a significant positive relationship between environmental performance and the intangible asset value of publicly traded firms in the S&P 500.
	Derwall et al. (2005)	Compared the financial performance of high environmental rating stocks to that of low ones.	1995–2003	Portfolios consisting of stocks with high environmental ratings provided substantially higher average returns than those of stocks with low ratings.
	Semenova and Hassel (2008)	Industry risk moderates the relationship between environmental and financial performance.	2003–2006	The effect of environmental performance on market value is greater in low-risk industries than in high-risk industries.

Source: EDHEC Risk Institute

It is assumed that the majority of carbon is emitted by the developed as well as the emerging economies of the globe. Worlds developed countries are responsible for the increase in carbon di oxide in the atmosphere. But of late, world's developed countries are increasingly outsourcing their carbon pollution to emerging economies like India, Brazil, and China. Carbon is emitted in developing countries, while manufacturing goods for the developed countries (Goldenberg, 2014). Global warming can be controlled if companies act upon their carbon efficiency. In this regard, it is the responsibility of the society also

to encourage those companies that are working toward the reduction in carbon emission. Therefore, it is very important that carbon efficient investment must be promoted and practised by the investors in emerging countries as well as the developed countries. Apart from this, lower downside risk and good performance of green stocks during an economic slowdown is also a reason for green investment (Amenc et al., 2010). Palomino, Rubio, and Canas (2015) found that during the times of financial crisis, environmental and social performance might have positive effects on stock index performance. Viviers, Bosch, Smit, and Bujjs (2008) did a study on ethical, and socially, and environmentally responsible investing. However, they viewed fiduciary responsibility as one of the most important barriers to return on investment in South Africa.

Since carbon efficient indices are relatively new, very few studies have been conducted to compare the return and risk of these indices among various countries as well as their comparison with their corresponding benchmark market indices. Based on the above discussion, the present study attempted to bridge the gap in the existing literature to investigate into the return and risk of carbon efficient indices, and their comparison with their corresponding benchmark market indices in the four selected stock exchanges across the world. The comparison between the carbon efficient indices of developed countries with that of emerging countries will be helpful in knowing the fact that whether economic development of a country is in any way associated with the return to be generated by the countries' stock indices?

6. Objectives of the Study

The current study attempted to achieve the following objectives:

a. to examine and compare the return given by the carbon efficient indices with their corresponding benchmark market indices,
b. to examine and compare the risk given by the carbon efficient indices with their corresponding benchmark market indices, and
c. to compare among the returns generated by the carbon efficient indices of India, USA, Japan, and Brazil.

7. Hypotheses of the Study

The study tested the following hypotheses:

a. H_{01}: There is no significant difference in the return given by the considered carbon efficient indices with their corresponding benchmark market indices.
b. H_{02}: There is no significant difference in the risk given by the considered carbon efficient indices with their corresponding benchmark market indices.
c. H_{03}: There is no significant difference in the return generated by the carbon efficient indices of India, USA, Japan and Brazil.

8. Research Methodology

The study is a descriptive and empirical in nature. The following methodology was adopted to achieve the stated objectives:

8.1 Data Collection

Daily closing values of considered indices of India, USA, Japan, and Brazil were used for the study. The data were collected from the official websites of Bombay Stock Exchange, New York Stock Exchange, BM & F Bovespa, and Tokyo Stock Exchange. Daily closing values of indices (as mentioned in Table 1) were taken from 1 October 2010 to 31 December 2014.

8.2 Data Analysis

To attain the objectives of the study, parametric test like student t-test, and non-parametric tests like Mann-Whitney U test, Kolmogrov-Smirnov test, Shapiro-Wilk test, and Levene's test were used. Student t-test was performed for finding the significance of difference of means of returns which requires that the sample to be drawn from a normal population (Gupta & Kapoor, 1994). Mann-Whitney-U test was used to find out the significance of difference of means of returns if the distribution is not normal. Kolmogrov-Smirnov and Shapiro-Wilk tests were used to check normality of the data (Lilliefors, 1967; Shapiro & Wilk, 1965). The Shapiro-Wilk test was used to assess the goodness of fit if the sample size is less than 2000 (UNT, 2014). Levene's test was used to investigate the significance of difference of variance of returns of the considered indices. For calculating monthly return, following formula was used:

$$R_i = LN\ (P_t / P_{t-1})$$

where,

LN=Logarithmic return ,
R_i = The return obtained,
P_t = Price at the end of the month, and
P_{t-1}: Price at the staring of the month.

Logarithmic returns were used as they are more likely to be normally distributed which is required for further statistical tests (Strong, 1994).

9. Analysis and Findings

The return, standard deviation, variance, and covariance of carbon efficient indices along with their corresponding benchmark market indices are calculated and shown in Table 3.

Table 3: Descriptive Statistics of Different Indices

Particulars	Expected Return	Standard Deviation	Variance	Covariance
BSE 100	-0.28%	5.21%	0.27%	0.003
BSE CARBONEX	-0.27%	5.21%	0.27%	
S&P 500	1.13%	3.60%	0.13%	0.001
S& P 500 CARBON	1.17%	3.58%	0.13%	
TOPIX 150	1.03%	5.80%	0.34%	0.003
TOPIX CARBON	1.07%	5.63%	0.32%	
IBrX	-0.52%	4.05%	0.16%	0.001
ICO2	-0.37%	3.80%	0.14%	

Source: Compiled from the data extracted from the websites of respective stock exchanges.

The analysis and findings of the present paper is divided into two parts. The first part deals with the return from equity indices and second part deals with the risk of investing in considered equity indices.

9.1 Return from the considered equity indices

Monthly returns of carbon efficient indices and monthly return of their corresponding market indices were calculated as per Equation 1. Kolmogorov-Smirnov test and Shapiro-Wilk test were performed on monthly returns of these indices to test the normality of data. Results of the Kolmogorov-Smirnov test and Shapiro-Wilk test are shown in Table 4.

Table 4: Kolmogorov-Smirnov and Shapiro-Wilk Test on Monthly Returns

Particulars	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
BSE 100	.115	39	.200(*)	.972	39	.443
BSE CARBONEX	.114	39	.200(*)	.972	39	.444
S&P 500	.153	39	.021	.905	39	.003
S&P500 U.S. Carbon Efficient Index	.159	39	.015	.912	39	.005
TOPIX 150	.061	39	.200(*)	.988	39	.946
TOPIX Carbon Efficient Index	.058	39	.200(*)	.989	39	.960
IBrX-50	.114	39	.200(*)	.972	39	.437
ICO2	.115	39	.200(*)	.959	39	.171

Source: Compiled from the data extracted from the websites of respective stock exchanges.

The significance value (*i.e., p*-value) of Kolmogorov-Smirnov test and Shapiro-Wilk test in Table 4 shows that the monthly returns of all indices are normally distributed except S & P 500 and S & P 500 U.S. Carbon Efficient Index. This is because the significance value for all the indices are greater than 0.05 (5% level of significance), except for S & P 500 and S & P 500 U.S. Carbon Efficient Index. Therefore, non-parametric test is appropriate to test the significance of difference of mean of returns of S & P 500 with that of the mean return of S & P 500 U.S. Carbon Efficient Index. However for rest of the indices, the t-test can be applied to test the significance of difference of mean of monthly returns of carbon efficient indices with that of mean of their benchmark market indices, since they are following normal distribution as evident from Table 4.

The appropriate non-parametric test for the test of significance of difference of two sample mean is Mann-Whitney-U Test, if the distribution is not normal. The result of Mann-Whitney-U test are shown in Table 5 and Table 6 for monthly returns of S & P 500 and S & P 500 U.S. Carbon Efficient Index, respectively.

Table 5: Mann-Whitney-U Test of Monthly Returns of S&P 500 and S&P USA Carbon Efficient Index

Particulars	Index	N	Mean Rank	Sum of Ranks
Monthly Returns	S&P500	39	39.13	1526
	S&P US Carbon Efficient Index	39	39.87	1555
	Total	78		

Source: Compiled from the data extracted from the websites of respective stock exchanges.

Table 6: Test Statistics of Mann-Whitney U Test on Monthly Returns of S&P 500 and S&P US Carbon Efficient Index

Particulars	Monthly Returns
Mann-Whitney U	746
Wilcoxon W	1526
Z	-.145
Asymp. Sig. (2-tailed)	.885

Source: Compiled from the data extracted from the websites of respective stock exchanges.

Based on Tables 5 and 6, the Mann-Whitney-U test of monthly returns of S & P 500 and S & P U.S Carbon Efficient Index showed the approximate significance value of two tailed test to be 0.885, which is greater than 0.05 (5% level of significance). This means that the difference between the two means

was not significant. Therefore, it is inferred that there is no significant difference between the monthly returns of these two indices, given the test and methodology.

With respect to the carbon efficient indices of India, Brazil, and Japan, the t- test was used to find out the significance of difference of means of monthly return with their corresponding benchmark market indices. The result is presented in Table 7.

Table 7: T-test statistic of Carbon Efficient Indices with their Market Indices

Carbon Efficient Index	Corresponding Benchmark Index	Calculated value of t-test statistic
S & P BSE-CARBONEX	S & P BSE-100	-0.003
TOPIX 150 CARBON	TOPIX 150	-0.03
ICO2	IBrX	-0.11

Source: Compiled from the data extracted from the websites of respective stock exchanges.

At the 5% level of significance, the tabulated value of t-statistics is ± 1.96. Tabulated value is greater than the calculated value of t, as shown in Table 7, for all the three considered stock exchanges. It means that it falls within the acceptance region. Therefore, it is inferred that there is no significant difference between the return of carbon efficient equity indices of the considered stock exchanges with that of their corresponding benchmark market indices, given the test and methodology.

Thus, hypothesis H_{01} there is no significant difference in the return given by the considered carbon efficient indices with that of their corresponding benchmark market indices is accepted. This means that the return generated by investing in carbon efficient indices would not be different than that of benchmark market indices. Therefore, investing in carbon efficient indices would not be economically disadvantageous and investors do not have to sacrifice their financial benefit for investing in carbon efficient equity indices.

The next objective was to find out, is there any significant difference in the return given by the carbon efficient indices of different stock exchanges? Student's t-test was performed to investigate the significance of difference of mean among the carbon efficient indices of considered stock exchanges. Table 8 shows the results of t-test among the returns of carbon efficient indices.

Table 8: T-test statistic of Return of Carbon Efficient Indices of Different Stock Exchanges

Particulars	BSE CARBONEX	TOPIX 150 CARBON
TOPIX 150 CARBON	-1.09	-
ICO2	0.10	1.33

Source: Compiled from the data extracted from the websites of respective stock exchanges.

At 5% level of significance, the tabulated value of t-statistics is ± 1.96. T-test statistics of carbon efficient indices in Table 8 are less than tabulated value. Therefore, it is inferred that there is no significant difference among the means of monthly return of carbon efficient indices of different stock exchanges. Thus, hypothesis H_{03} there is no significant difference in the return generated by the carbon efficient indices of India, Japan, and Brazil is accepted.

This leads to the interpretation that the return given by the carbon efficient indices of the four countries are not different. This finding is of more use for foreign institutional investors. It is inferred that one cannot extra ordinarily benefit by investing in carbon efficient indices of a particular country.

10. Variance of indices

To test the significance of difference of variance of different carbon efficient indices with that of their corresponding benchmark market indices, non-parametric Levene's test was used.

Levene's test was performed on the daily values of S & P BSE-100 and S & P BSE CARBONEX of India; S&P 500 and S&P U.S carbon efficient index of USA; S & P TOPIX 150 and S & P TOPIX 150 Carbon Efficient Index of Japan; and IBrX and ICO2 of Brazil to test the homoscedasticity (homogeneity of variance). At 5% level of significance, it was found that the p- value exceedsed 0.05 in case of India, USA, and Brazil, and hence the null hypothesis H_2 was accepted. Thus, this means that there was no significant difference in the variance of S & P BSE-100 and S & P BSE CARBONEX of India, S&P 500 and S&P U.S carbon efficient index of USA, and IBrX and ICO2 of Brazil.

Levene's test was performed on the daily prices of S & P TOPIX 150 and S & P TOPIX 150 Carbon Efficient Index of Japan. At 5% level of significance, it was found that the p-value was less than 0.05. Therefore, it can be interpreted that there was significant difference in the variance of S & P TOPIX 150 and S & P TOPIX 150 Carbon Efficient Index. Referring to Table 3, it can be concluded that risk of investing in S & P TOPIX 150 is relatively higher than S & P TOPIX 150 Carbon Efficient Index. Therefore, hypothesis H_2 cannot be accepted for Japan, given the test and methodology. The possible reason for this is that Japan was affected by a tsunami event in first quarter of 2011. Due to this, its stock market had to be closed for some time and after this natural calamity, the Japanese economy took some time to recover.

11. Conclusion and Policy Implications

The empirical evidences presented in this paper augment toward understanding of carbon efficient indices. The results obtained indicated that there is no significant benefit as well as perhaps penalty some investing in carbon efficient

indices. This paper contributes to the recent debate about the performance of carbon efficient stock indices in comparison to the traditional well benchmark indices.

It was found that there is no significant difference in the return given by the carbon efficient indices of the selected stock exchanges with their corresponding benchmark market indices. It was also found that there is no significant difference in the return generated by the four selected carbon efficient indices. This finding is consistent with the finding of Hamilton, et al. (1993), Kreander (2005), and Cohen et al. (1997). However, Derwall et al. (2005) gave a contradicting view to this finding. They found that portfolios consisting of stocks with high environmental ratings provided substantially higher average returns than those of stocks with low ratings.

Morck, Yeung, and Yu (2000) found that stock prices move together more in poor economies than in rich economies. However, in this study, it was found that carbon efficient portfolios move together in developed as well developing countries. The parity in return is largely because of the magnitude and persistence of return due to innovations that originate in either market and transmited to the other market (Karolyi, 1995). The difference in the return, if any, generated by different indices is due to difference in the construction of the index (Roll, 1992).

It was found that there is no significant difference in the variance of the carbon efficient indices than that of their benchmark indices. Tripathi and Bhandari (2012) had similar findings while evaluating green stocks in comparison to non-green stocks in the Indian market. However, Dixon (2010) found that sustainability themed investing could improve returns but with increased risk at the same time

Thus, it may be concluded that one can generate the same return by investing in carbon efficient portfolios as could have been made by investing in other portfolios, while at the same time, risk is also not significantly different. Therefore, it is advisable for an investor who is conscious toward the environment, to invest in carbon efficient indices. By doing so, one will not be required to compromise on the return and at the same time the investors will have the satisfaction of investing in the environment friendly company's stocks and not contributing anything toward the companies that are deteriorating the environment.

Since, there is no significant difference in the return of carbon efficient indices of different countries, it is inferred that foreign institutional investors cannot benefit by investing in carbon efficient indices of a particular country. Institutional investors attach weight to the carbon efficient investment as a part of their initiative toward climate change and hence prefer to invest in carbon efficient companies and disclose it in their annual report (Cotter & Najah, 2012).

Given the fact that the return from carbon efficient equity indices is not significantly different across the countries, there is probability that foreign institutional investors would prefer to remain in the country where they are

currently operating, because investors prefer to invest in known companies (Singh & Bhowal, 2010a; Singh, 2010), while other things remaining constant. Thus, in order to attract foreign investors, all that is needed is to provide a good atmosphere of governance (Singh, Tiwari, Kushwaha, & Bhattacharjee, 2015). Since the differences in return from various indices are not significant, carbon efficient index can also be considered for passive investing for the time being by investors because passive funds benefit from employing less rigid rebalancing and investment strategies (Frino, Gallagher, & Oetomo, 2005).

It is required to popularise this index by imparting investment education so that people can make a judicious choice of investing in a company that is environment friendly (Singh & Bhowal, 2010b). This would also be a reward to those companies, in the form of more investors as well as recognition, which are showing responsible behaviour toward the environment.

12. Scope of Further Research

In this study, logarithmic returns of the stock indices were calculated, therefore there is a scope of further research on carbon efficient indices using the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT). Only carbon efficient indices of the United States of America, Japan, India, and Brazil were considered in this study, thus more green indices from other nations of the world can be studied using longitudinal and cross sectional studies.

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Appendix

Appendix 1: Overview of Sample Countries

No.	Country	GDP (PPP)		GDP (Nominal)		HDI (2013)	Income Group	National emissions (thousands of tonnes of carbon) 2007	Emissions per person (tonnes of carbon) 2006
		Total	Per capita	Total	Per capita				
1.	Republic of India	$7.997 trillion (3rd)	$6,266 (124th)	$2.308 trillion (7th)	$1,808 (141st)	Steady 0.586 medium · 135th	Lower Middle Income	479,039	0.37
2.	United States of America (USA)	$17.418 trillion (2nd)	$54,596 (10th)	$17.418 trillion (1st)	$54,596 (10th)	Steady 0.914 Very High 5th	High Income: OECD	1,547,460	5.18
3.	Japan	$4.843 trillion (4th)	$38,216 (29th)	$4.210 trillion (3rd)	$33,223 (25th)	Decrease 0.890 very high 17th	High Income: OECD	357,534	2.80
4.	Federative Republic of Brazil	$3.259 trillion (7th)	$15,941 (74th)	$2,247 trillion (8th)	$11,281 (60th)	Increase 0.744 high · 79th	Upper Middle Income	110,833	0.51