Quantifying the Association between Carbon Footprints and Financial Performance of Indian Firms

Poonam Kumari,
Research Scholar
Department of Commerce, School of Commerce and Management,
Central University of Rajasthan, Ajmer, India

Dr. Sanjay Kumar Patel,
Assistant Professor
Department of Commerce, School of Commerce and Management,
Central University of Rajasthan,
Ajmer, India

Abstract

The intensifying pressure of climate change, excessive exploitation of natural resources, destruction of ecosystem and rising of global warming due to carbon element has grab attention of not only government, but also of companies. The purpose of the study is to examines the effect of carbon emissions on corporate financial performance indicators (ROE, ROA, ROIC and ROS) of 41 Indian CDP companies for 2018 fiscal year. The present study used multiple regression analysis to find the association between carbon emissions intensity of CDP companies and financial performance indicators. The results of the study indicate that the companies which focus on the carbon emissions reduction and green investment are more able to manage its financial performance. Thus, this study delivers the useful insights to companies that how better utilization of resources and efficiency can improve the financial performance of firms. The study adds to the existing studies of carbon emissions reduction and corporate financial performance. Furthermore, it supports the literature in the way that carbon emissions reduction can generate better financial performance.

Keywords: Carbon emissions intensity, Financial performance, Climate change,Global warming, Indian CDP companies.

Introduction

Of the greenhouse gases, carbon dioxide is the major gas that causes global warming and drives climate change. It is the biggest environmental challenge, emerged due to change in the composition of greenhouse gases into the atmosphere. The gap between necessary reduction in carbon emissions and reduction being achieved has been growing (The Emissions Gap Report , 2015).Due to the rise in the use of non-renewable energy resources, carbon emissions level has been rising at very high speed (Department of Environmental Affairs, 2018). Thus, promptaction need to be taken by government and businesses, otherwise the consequences may emerge at a huge level.

Among all the largest greenhouse gas emitters, businesses play a significant role. Only 90 corporations consist of the two-third portion of total greenhouse gas emissions (Heede, 2014).Even though, evidence suggests that corporate energy management not only helps in

cost-saving, but it also demonstrates the carbon reduction commitment and enhances reputation (Alcock, 2008). Therefore, if the target of 1.5-degree Celsius temperature is to be achieved, huge carbon emissions reduction in all aspects of society is required (IPCC Special Report, 2018).Moreover, society has also paid attention to the environmental issues of businesses and its information disclosure in financial statements that strengthen the need for carbon management(Aceituno, Lazaro, & Sanchez, 2012)(Hopwood, 2009).

In this way, the carbon emissions may affect financial performance in various terms, such as stakeholders may concern about environmental issues, government regulations (carbon tax), future fossil fuel scarcity, etc. Most of the previous studies do not capture carbon emissions factor using an environmental dimension in association with the financial performance of the firm, but were cautious about the idea. Thus, there is existing lack of information among firms regarding the outcome of carbon emissions on financial performance. The studies on green investment argued that green investment raises a firm's profitability (Narayan & Sharma, 2015)(Philip & Shi, 2016). Thus, gradually stakeholders are raising concern about growing carbon emissions and long term sustain in the market. So the question arise, does the carbon emission scope affect the corporate empirical outcomes?

Literature evidenced that lowering carbon emissions can gradually manage financial performance (Ganda., 2018)(Cucchiella, Gastaldi, & Miliacca, 2017)(Gallego-Alvarez I. S., 2015). By contrast, some authors evidenced mixed relationship of carbon emissions and financial performance based on different sectors of emitters (Dragomir, 2012)(Chan, Li, & Zhang, 2013)(Damert, Paul, & Baumgartner, 2017). Thus, the present study entices to reduce the research gap by examining the relationship between carbon emissions (dimensional effect of scope 1 & 2) and financial performance by using multiple regression analysis on Indian CDP firms. The results of the analysis may help corporations to adopt policies for preserving the environment from carbon emissions. Thus, the conclusion supports the view that there is a need for corporate greening initiative and overall change in the mindset of managers and accountants (Ganda., 2018).

The present study has taken in account the disaggregation of carbon emissions into scope 1, 2 and 1&2 and uses multiple regression analysis for examining the effect of carbon emissions on different financial performance indicators (ROA, ROE, ROS and ROIC). It follows the institutional theory for explaining the corporate behaviour, in which institutions emphasis on the normative impact of environment on organizations activities. The study found that carbon emissions reduction can positively affect the financial performance of firms. Companies which integrate the green investment can better organize its financial performance.

The remainder of the study is systematized as follows: next section evaluates the literature review of the paper. Thereafter, discusses the research methodology of the study. After that next section presents the findings and discussion of the study. Finally, the conclusions of the study are presented.

Literature Review and Hypothesis Development:

Many corporations have been criticized for its activities impact on environment, despite of economic progress (Reverte, 2009). Even though, firms have enticement to curb environmental issues to sustain against the backdrop of stakeholder's interest(Iwata, Hiroki, Okada, & Keisuke, 2010). Furthermore, society is paying greater attention towards social and environment performance of firms since 1970's (Aceituno, Lazaro, & Sanchez, 2012). Thus, for making sustainable future, there is large of organizations worldwide who suggested the inclusion of ecological reporting in financial statements (ICAEW, 1992).

Sustainability concept includes the environmental practices in itself; "Sustainable development is the resources left to each generation allow it to achieve a higher standard of living than its predecessors" (Burress, 2005)(Freitas, Alves, & Pesqueux, 2012). Most companies don't actively manage sustainability, even though 55% of sustainability defined by environmental factors such as emissions, waste, energy efficiency etc (Mckinsey survey, 2010). Companies not only face challenge of reducing greenhouse gas emissions but it also faces the effect of climate change on their day to day business activities (Weinhofer & Hoffmann, 2010). Therefore, the necessity to mitigate climate change has significantly increased the requirement of reducing greenhouse gases emission (Saizarbitoria, Azorín, & Gavin, 2011)(Boiral, Henri, & Talbot, 2011). This has increased the need to justify the relationship between greenhouse gases emissions and financial performance of firms.

Some of the previous studies on the association between carbon emissions and corporate financial performance showed that firms green investment gives no or few financial benefits to the companies. Researches indicate that there exist negative association between the firm's environment management and financial performance, and it argued that by focusing on environmental activities, firm gets distracted from its core activities and thus resulting less profits (Walley & Whitehead, 1994)(Rothenberg,

2008). By going more specific, some studies found that there is positive association between carbon emissions intensity and firms financial performance; when firms emit higher carbon emissions, itresulted inhigher financial performance and vice-versa (Delmas & Nicholas, 2010)(Hatakeda, Kokubu, Kajiwara, & Nishitani, 2012)(Wang, Li, & Gao, 2014).

By contrast, some studies found negative association between the carbon emissions intensity and financial performance; higher the emissions of carbon, lower the financial performance and vice-versa (Iwata, Hiroki, Okada, & Keisuke, 2010)(Busch & Hoffmann, 2011)(Lee, Min, & Yook, 2015). A research stated that decisive position of a firm leads to its carbon reduction and improving financial performance(King & Lenox, 2001). Moreover, an environmental responsible company believes that reducing carbon emissions can lead to increase in corporate profit (Hart, 1996)(Hayami, Nakamurab, & Nakamurac, 2014). Dirty companies using environmental management practices generate positive returns and the effect of environmental management practices found greater as compared to clean companies (Lucas & Noordewier, 2016).

However, another group of researchers found that the financial information is unrelated to firm's environmental performance and there is no significant relationship between carbon emissions and operational efficiencies (Yu, et al., 2016)(Dragomir, 2012). Some studies had also demonstrated few mixed results. Monetary matrices indicators showed U-shaped relationship, instead of straight-line relationship between carbon emissions and financial performance (Broadstock, Collins, & Vergos, 2017). Moreover, it was found that companies with intermediate carbon performance had higher financial returns, instead of too high or too low.

Table 1: Summary of studies linking carbon emissions and financial performance

Study	Country	Technique
Positive significant relationship		
Delmas and Nairn-Birch (2010)	USA	Regression analysis
Hatakeda et al., (2012)	Japan	Regression analysis
Wang (2013)	Australia	Regression analysis
Negative significant relationship		
Hart et al., (1996)	USA	Regression analysis
King and Lenox (2002)	USA	Regression analysis
Boiral et al., (2011)	Canada	Structural equation model
Alvarez et al., (2014)	Brazil	Regression analysis
Lee et al., (2015)	Australia	Regression analysis
Busch and Lewandowski (2017)	Germany	Meta-analysis
Cucchiella et al., (2017)	Italy	Regression analysis
Fortune Ganda (2018)	South Africa	Regression analysis
No significant relationship		
Yu et al., (2016)	USA	DEA-Slack based model
Studies with mixed results		
Iwata and Okada(2010)	Japan	Regressions analysis
Delmas(2011)	USA	Regressions analysis
Chan et al., (2013)	USA	Regressions analysis
Broadstock et al., (2017)	UK	Regressions analysis
Stefan Lewandowski (2017)	Germany	Regressions analysis
Fortune Ganda(2018)	South Africa	Regressions analysis

Source: summary compiled by author

The table clearly indicate that most of the prior research on carbon emissions and its impact on financial performance had been conducted in developed countries only. At present, there have been few studies on carbon emissions in India, so the current study attempts to reduce the gap through analyzing the association between carbon emissions intensity and financial performance of Indian CDP companies by using regression analysis. The present study has analysed the carbon emissions by bifurcating it into different scopes i.e. scope 1(direct emissions), scope 2(indirect emissions) and scope 1&2, and hypothesised that:

H01: Scope 1(direct emissions) carbon emissions intensity generates no effect on financial performance indicators.

H02: Scope 2(indirect emissions) carbon emissions intensity generates no effect on financial performance indicators.

H03:Scope 1&2(direct and indirect emissions) carbon emissions intensity generates no effect on financial performance indicators.

Research Methodology:

The present study analyses the association between carbon emissions intensity and financial performance of corporations. Therefore, to examine the effect, the study investigates the impact of dimensions of carbon emissions intensity i.e. scope 1(direct emissions), scope 2(indirect emissions) and scope 1&2(direct as well as indirect) on corporate financial performance indicators (ROA, ROE, ROS and ROIC) using multiple regression technique. The study leads a series of tests for normality, heteroscedasticity and multicollinearity. Moreover, the assumption of multicollinearity can be checked through descriptive table, which indicates that there is low degree of correlation between variables and not close to one.

Sample description:

To test the proposed hypotheses, the study used carbon emissions data that was acquired from CDP India 2018 report. It consists of 41 companies from different sectors, which disclosed their carbon emissions during 2018 in accordance with CDP demands. The study has disaggregated the sample between clean companies and dirty companies (Mani & Wheeler, 1998), as per which telecommunication, financials, health care, consumer discretionary and consumer staples are included in clean sector and energy, materials, pharmaceuticals and industrials are included in dirty sector. In the present study, in total there are 41 companies which has disclosed their carbon emissions as per CDP demands during 2018, among which 23 firms determined as clean and remaining 18 firms **are determined as dirty.**

Variables:

Dependent variable:

The present study analyses the impact of carbon emission intensity on corporate financial performance indicators that is the dependent variable. As shown in the table 2, ROE, ROA, ROS are the most used variables in past. Similarly, this research used four accounting-based measures i.e. ROE, ROA, ROS and ROIC as dependent variables. ROE has been used as it is the indicator of shareholders return, which is the ratio of net income and shareholders' equity. Next, ROA is the indicator of operational performance, which can be calculated as ratio of operating income and total assets. ROS is an indicator of operational efficiency which refers to the ratio of net income and total net sales. ROIC indicates that how well a firm is utilising its capital to generate returns. Therefore, the analysis focuses on the accounting-based measures, as dependent variable. BSE and NSE have provided the financial data for calculating ROE, ROA, ROS and ROIC.

Table :2 Measures of corporate financial performance.

Authors	Financial Performance
Hart & Ahuja (1996) (+)	ROA, ROE
Busch & Volker (2011) (-)	ROA, ROE, Tobin's q
Alvarez (2014) (+)	ROA, ROE, ROS, ROCE
Wang et al. (2014) (+)	Tobin's q
AudewiRokhmawari (2015) (+, -)	ROE, ROA, ROS, ROIC, ROI
Fortune Ganda (2017) (+)	ROA, MVA
Lewandowski (2017) (, -)	ROS, Tobin's q
Ganda (2018) (+)	ROS, ROI, ROE
Zang (2018)(+)	Tobin's q

Source: Author's review, Alvarez et al.,2014).

Independent variables:

Previous researches have used emission of toxic substances, total emissions, GHG emissions etc., as measure of environmental performance indicator (Hart & Ahuja, 1996; King & Lenox, 2002; Busch & Hoffmann, 2011). The analysis of the paper includes bifurcation of carbon emissions into scope 1(direct emissions), scope 2(indirect emissions) and scope 1&2(direct and indirect emissions). Scope 1 covers the direct emissions from manufacturing activities such as fuel combustion, emissions from production, vehicles etc., Scope 2 covers the releasing of indirect emissions from the generation of purchased electricity from outside the company. This study does not covered scope 3, which covers the additional indirect emissions from purchase of goods and services, waste disposal etc., because the criteria used for its reporting are different by each firm (Global reporting). Moreover, the present analysis has used carbon emissions intensity, which is the proportion of carbon emissions and net assets (average of 2017 and 2018). Carbon emissions intensity calculates the effectiveness of each unit currency of net assets that generate carbon emissions.

Control variables:

The study has used three control variables for analysis that includes firm size, growth and leverage. Firm size has been calculated as the addition of natural log of average of net sales of 2017 and 2018 (Ganda, 2018). Firm size is a factor that influences the voluntary environmental disclosure (Freedman &Jaggi, 2005). It has been suggested to be used as control variable because there are some advantages that are associated with large companies such as financial base, market reach, experience etc. (Artiach. T, 2010). Growth calculated as the annual change in sales of firm (King and Lenox, 2001). It indicates the capability of firm to grow revenue over fixed period of time and it's an important factor for firm because low sales may result in takeover of firm (Iwata et al., 2011). Leverage denotes the financial risk of the firm, which is calculated as the division of total debts and total assets (average of the sum of previous year total assets and current year total assets) (Russo and Fouts, 1997). BSE and NSE have provided the financial data for calculating firm size, growth and leverage. To test the proposed hypotheses, multiple regression model has been developed in consideration with dependent variables, independent variables and control variables. For analysing the effect of carbon emissions intensity on the financial performance indicators, proposed model has been given below:

Financial performance i, t = $\beta 0$ + $\beta 1$(carbon emissions intensity i, t) + $\beta 2$(firm size i, t) + $\beta 3$(growth i,t) + $\beta 4$(capital intensity i,t) + ε i,t

Where,

Financial performance i, t= ROE, ROA, ROS and ROIC

$\beta 0$= Constant

$\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$ = regression coefficients

i = firm

t = time

Carbon emissions intensity i, t = scope 1(direct emissions) carbon emissions intensity; scope 2(indirect emissions) carbon emissions intensity and scope 1&2(direct as well as indirect emissions) carbon emissions intensity

εi, t = error term

Results and Discussion:

This section analysis the results of the study; firstly, the descriptive statistics and correlation matrix between different dependent, independent and control variables and secondly, the model estimation for clean and dirty companies. Table 3 demonstrates the descriptive results of dependent, independent and control variables. It is the summarized analysis of 41 CDP Indian companies. The 41 observations came from the 41 CDP Indian companies observed during 2018 fiscal year. As shown in the table 3, mean of ROE was -2.237(0.112), which indicate the return to equity shareholders for a specific company. Furthermore, mean value of ROA was -2.259(0.475), which gives a manager an idea about how efficient a company is in managing its assets. Mean of ROIC was -1.791(0.217), which indicate the returns on a company's invested capital. Then, mean of ROS was -4.213(0.026), which demonstrate the return in relation to a company's sales. The mean of scope 1 carbon emissions intensity was 1.732(2.015), which means that a random company selected from the sample gives a mean of 1.732. Similarly, mean of scope 2 carbon emissions intensity was 1.989(1.565) and mean of scope 1&2 carbon emission intensity was 3.585(2.404). Furthermore, the mean value of control variables, namely, firm size, growth and leverage were 2.436, -2.247 and -0.916, respectively.

Table 3: Descriptive analysis of sample companies.

Variables	Observations	Mean	Standard	Minimum	Maximum
ROE	41	-2.237	0.112	-0.242	0.332
ROA	41	-2.259	0.475	-0.190	1.900
ROIC	41	-1.791	0.217	-0.034	0.936
ROS	41	-4.213	0.052	-0.049	0.183
Scope 1 CEI	41	1.732	2.015	-4.095	7.692
Scope 2 CEI	41	1.989	1.565	-1.172	4.769
Scope 1&2 CEI	41	3.585	2.237	-1.119	7.693
Firm size	41	2.436	1.434	2.170	2.719
Growth	41	-2.247	0.248	-6.511	-0.976
Leverage	41	-0.916	0.284	-1.925	0.083

Table 4 reports the correlation matrix of variables. It demonstrates that ROE is positively correlated with ROA, ROIC, ROS, direct carbon emissions, indirect carbon emissions, both direct as well as indirect carbon emissions, firm size and growth, but negatively correlated with leverage. ROA has positive correlation with ROIC, ROS and growth, but demonstrates negative relationship with direct, indirect, both direct and indirect carbon emissions, firm size and leverage. ROIC develops positive correlation with ROS, firm size, growth and leverage, but has negative relationship with all independent variables (direct, indirect, both direct as well as indirect carbon emissions). ROS demonstrate positive correlation with growth and leverage, but negative correlation with all independent variables (direct, indirect, both direct as well as indirect carbon emissions, one control variables i.e. firm size.

Scope 1 carbon emissions intensity has been positively correlated with scope 2, scope 1&2 carbon emissions intensity and firm size, but negatively associated with growth and leverage. Scope 2 carbon emissions intensity has been positively correlated with scope 1&2 carbon emissions intensity, firm size, but has negative correlation with growth and leverage. Then, scope 1&2 carbon emissions intensity is positively correlated with control variable firm size and negatively related with other control variables i.e. growth and leverage.

Table4: Correlation coefficient matrix of variables.

	ROE	ROA	ROIC	ROS	Scope 1	Scope 2	Scope 1&2	Firm size	Growth	Leverage
ROE	1									
ROA	0.340	1								
ROIC	0.426	0.643	1							
ROS	0.538	0.636	0.669	1						
Scope 1	0.335	-0.106	-0.059	-0.198	1					
Scope 2	0.127	-0.069	-0.037	-0.201	0.423	1				
Scope 1&2	0.307	-0.067	-0.052	-0.168	0.971	0.472	1			
Firm size	0.313	-0.136	0.127	-0.288	0.251	0.208	0.222	1		
Growth	0.391	0.277	0.187	0.181	-0.034	-0.124	-0.030	0.061	1	
Leverage	-0.247	-0.136	0.059	0.105	-0.581	-0.224	-0.561	-0.245	0.079	1

Table 5 shows the outcome of clean industries at 3 different significance levels for scope 1(direct emissions) carbon emissions intensity. The results indicate that the impact of direct carbon emissions intensity on financial performance indicators i.e. ROE, ROA, ROIC and ROS are significantly negative. This shows that, when the carbon emissions intensity of scope 1 increases, ROE, ROA, ROIC and ROS decreases. Thus, the results of clean companies in case of scope 1 carbon emissions intensity indicates that, stakeholders (shareholders, investors, customers, employees) consider the company's carbon performance as one indicator of environmental performance. Moreover, shareholders, customers, managers and investors exhibit the negative sentiments towards environmentally degraded firms. As per Global Sustainable Investment Review (2018), in response to change in investment pattern, domestic market is expected to evolve with new green businesses through diversification and reduction in carbon footprints. As shown in the table, p-value is less than the significance level in all financial performance indicators, thus, the alternate hypothesis has been accepted that direct carbon emissions intensity of clean companies effects the financial performance indicators.

Table 5: Scope 1 Carbon Emissions Intensity and Financial Performance of Clean Companies.

	ROE	ROA	ROIC	ROS
Scope 1 carbon emissions intensity	-0.02018 (0.002***)	-0.09000 (0.067*)	-0.04083 (0.039**)	-0.0138 (0.000***)
Firm Size	-0.00891 (0.636)	-0.11300 (0.388)	0.06543 (0.248)	-0.02439 (0.018**)
Growth	0.01732(0.216)	0.06845 (0.233)	0.01093 (0.614)	0.00749 (0.241)
Leverage	-0.25363 (0.000***)	0.49300 (0.283)	0.48584 (0.013**)	0.04034 (0.382)
Constant	0.41339 (0.084*)	1.50134 (0.350)	-0.66069 (0.330)	0.31204 (0.020**)
R^2	0.59	0.38	0.54	0.62
No. of firms	23	23	23	23

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 6 presents similar results as of table 5, that there is negative association between indirect carbon emissions intensity and financial performance indicators i.e. ROE, ROA, ROIC and ROS. Moreover, ROE, ROA, ROIC and ROS shows negative significant results. The results indicate that stakeholders (shareholders, investors, customers, employees) are concerned about both direct as well as indirect emissions generated from the companies and they exhibit the negative sentiments towards environmentally degraded firms. Next, ROA generated negative but insignificant relationship with scope 2 carbon emissions intensity at 5% significance level, which indicate that management also exhibit negative sentiments towards environmentally degraded firms, but they may not consider carbon emissions as serious issue in management of its assets. As shown in the table, alternate hypothesis has been accepted in case of ROE, ROA, ROIC and ROS, which means scope 2 carbon emissions has significant effect on financial performance.

Table 6: Scope 2 Carbon Emissions Intensity and Financial Performance of Clean Companies.

	ROE	ROA	ROIC	ROS
Scope 2 carbon emissions intensity	-0.03251 (0.003**)	-0.52632 (0.060*)	-0.07592 (0.040**)	-0.02132 (0.000***)
Firm Size	-0.00064 (0.873)	3.63692 (0.350)	0.08439 (0.118)	-0.01894 (0.066)
Growth	0.00996 (0.384)	0.22326 (0.249)	-0.00469 (0.769)	0.00252 (0.674))
Leverage	-0.23427 (0.002**)	0.23615 (0.708)	0.52028 (0.006**)	0.05402 (0.270)
Constant	0.35109 (0.156)	-0.16394 (0.330)	-0.79314 (0.237)	0.27000 (0.047**)
R^2	0.550	0.317	0.551	0.601
No. of firms	23	23	23	23

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 7 also shows similar findings with table 5 and 6, which indicate negative significant result in respective to scope 1&2 carbon emissions intensity and ROE, ROIC and ROS, and negative insignificant result in respective to ROA. Therefore, combined impact of direct and indirect carbon emissions intensity leads to decrease in firm's profitability.

Table 7: Scope 1 & 2 Carbon Emissions Intensity and Financial Performance of Clean Companies.

	ROE	ROA	ROIC	ROS
Scope 1&2 carbon emissions intensity	-0.02981 (0.003**)	-0.52448 (0.047**)	-0.0685 (0.048**)	-0.02202 (0.000***)
Firm Size	-0.00548 (0.785)	0.258849 (0.461)	0.073021 (0.199)	-0.02191 (0.030**)
Growth	0.013782 (0.285)	0.285009 (0.200)	0.004162 (0.828)	0.005147 (0.398)
Leverage	-0.24742 (0.001***)	0.220056 (0.707)	0.490629 (0.009**)	0.043051 (0.357)
Constant	0.428407 (0.090*)	-0.90328 (0.461)	-0.61474 (0.396)	0.325407 (0.015**)
R^2	0.572	0.389	0.560	0.612
No. of firms	23	23	23	23

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 8 indicate that there is negative association between the scope 1 carbon emissions intensity and ROE, ROA and ROIC. Thus, it can be said that increase in firm's carbon emissions decreases profitability. Nonetheless, in case of ROIC present study demonstrates negative significant results which means the null hypothesis is rejected and there is significant impact of scope 1 carbon emissions intensity on investment. Additionally, green investments have been gaining popularity as more investors starts thinking about environment due to rise in global warming and natural disasters . (Sekhar, 2011). Concurrently, India renewable energy sector attracts domain for domestic as

well as foreign investment (Ministry of New and Renewable Resources, 2018). Contrary, in case of ROE, p-value is greater than 0.10, which means the null hypothesis is accepted and can be interpreted as scope 1 carbon emissions intensity of dirty companies generates no impact on shareholders, management and customers. This can be justified as corporate stakeholders of dirty companies may not be interested in emissions, as it is the accountability of the company. Similarly, ROA and ROS indicate positive relationship with emissions, which means that dirty companies profitability increases with emissions.

Table 8: Scope 1 Carbon Emissions Intensity and Financial Performance of Dirty Companies.

	ROE	ROA	ROIC	ROS
Scope 1 carbon emissions intensity	-0.00242 (0.866)	0.060663 (0.759)	-0.00977 (0.090*)	0.182764 (0.112)
Firm Size	0.03124 (0.096)	-0.03280 (0.312)	0.03305 (0.003**)	0.00130 (0.740)
Growth	0.084425 (0.786)	0.79068 (0.118)	0.37575 (0.017**)	-0.03532 (0.555)
Leverage	-0.07535 (0.475)	-0.29714 (0.152)	-0.11898 (0.057*)	-0.02986 (0.238)
Constant	-0.25647 (0.188)	0.62944 (0.096**)	-0.21668 (0.055*)	0.01678 (0.705)
R^2	0.181	0.376	0.698	0.151
No. of firms	18	18	18	18

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 9 indicates the association of indirect carbon emissions intensity for dirty companies and firm financial performance indicators, in which ROA, ROIC and ROS are negatively related to carbon emissions and ROE is positively related to emissions. The results demonstrate that investors, managers and customers are environmentally conscious of the firm's impact on environment. The p-value of ROA is less than 0.10, thus alternative hypothesis has been accepted and it can be said that there is significant impact of emissions on profitability of the firms. Nonetheless, ROE shows positive relationship because may be equity shareholders are not very much anxious about the indirect emissions in short term.

Table 9: Scope 2 Carbon Emissions Intensity and Financial Performance of Dirty Companies.

	ROE	ROA	ROIC	ROS
Scope 2 carbon emissions intensity	0.01683 (0.580)	-0.45478 (0.000)	-0.01655 (0.124)	-0.13656 (0.246)
Firm Size	0.034422 (0.098)	-0.38797 (0.070)	0.028962 (0.008)	-0.15711 (0.331)
Growth	0.007387 (0.876)	3.796712 (0.224)	0.330083 (0.036)	0.26262 (0.762)
Leverage	-0.01661 (0.758)	-1.67492 (0.270)	-0.19646 (0.035)	-0.62186 (0.610)
Constant	-0.35992 (0.263)	0.587875 (0.184)	-0.13855 (0.251)	-2.11203 (0.369)
R^2	0.228	0.379	0.727	0.115
No. of firms	18	18	18	18

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 10 demonstrate that the scope 1&2 carbon emissions intensity is negatively associated with ROE and ROIC. Thus, increase in firm's carbon emissions decreases profitability.In case of ROIC present study demonstrates negative significant results, which means null hypothesis is rejected and there is significant impact of scope 1&2 carbon emissions intensity on investment. Contrary, in case of ROE, ROA and ROS, p-value is greater than 0.10, which means the null hypothesis is accepted and can be interpreted as scope 1&2 carbon emissions intensity generates no impact on shareholders, management and customers. This can be justified as corporate stakeholders of dirty companies may not be interested in emissions, as it's the accountability of the company.

Table 10: Scope 1&2 Carbon Emissions Intensity and Financial Performance of Dirty Companies.

	ROE	ROA	ROIC	ROS
Scope 1 & 2 carbon emissions intensity	-0.00521 (0.753)	0.082868 (0.718	-0.01334 (0.061*)	0.182045 (0.171)
Firm Size	0.03078 (0.081)	-0.29268 (0.243)	0.031611 (0.001)	-0.12062 (0.409)
Growth	0.10694 (0.731)	1.625948 (0.642)	0.397903 (0.027)	-1.79965 (0.563)
Leverage	-0.07245 (0.447)	-0.09002 (0.764)	-0.11732 (0.056)	-0.35205 (0.706)
Constant	-0.23973 (0.209)	0.578521 (0.857)	-0.18072 (0.102)	-0.02077 (0.112)
R^2	0.185	0.131	0.717	0.198
No. of firms	18	18	18	18

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 11 presents the results of all companies (clean and dirty). It indicates that carbon emissions intensity is positively associated with ROE, but negatively associated with ROA, ROIC and ROS. For all industries, corporate shareholders do not view green initiatives as far as companies follow to the government laws and regulations. Moreover, they may not aware of the corporates effect on climate change. On the other hand, negative links between direct carbon emissions – ROA, ROIC and ROS support the conclusion that managers, investors and customers view green investment activities of Indian CDP firms as acute for short and long term sustaining in future.

Table 11: Scope 1 Carbon Emissions Intensity and Financial Performance of all companies (clean and dirty).

	ROE	ROA	ROIC	ROS
Scope 1 carbon emissions intensity	0.07359 (0.337)	-0.10521 (0.241)	-0.02376 (0.762)	-0.03360 (0.766)
Firm size	1.61871 (0.253)	-1.93236 (0.297)	0.99507 (0.393)	-2.95654 (0.131)
Growth	0.34121 (0.050**)	0.36755 (0.002***)	0.12373 (0.511)	0.25365 (0.071*)
Leverage	-0.12810 (0.803)	-0.74986 (0.104)	0.09853 (0.818)	-0.07777 (0.908)
Constant	-5.66045 (0.109*)	2.76951 (0.572)	-3.81975 (0.200)	3.49358 (0.482)
R^2	0.321	0.187	0.053	0.137
No. of firms	41	41	41	41

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 12 reports that the association of indirect carbon emissions intensity is negatively linked with ROA, ROIC and ROS. The findings of the table show similar results as shown in table 9 (scope 2 carbon emissions intensity and dirty industries) and table 11 (scope 1 carbon emissions intensity and all companies). It can be inferred from the results that majority of corporate stakeholders demonstrates their concern towards corporates carbon emissions reduction and environmental policies.

Table 12: Scope 2 Carbon Emissions Intensity and Financial Performance of all companies (clean and dirty).

	ROE	ROA	ROIC	ROS
Scope 2 carbon emissions intensity	0.05922 (0.577)	-0.03703 (0.674)	-0.04706 (0.440)	-0.11669 (0.534)
Firm size	1.72655 (0.297)	-2.18048 (0.248)	1.01602 (0.374)	-2.82504 (0.147)
Growth	0.35067 (0.059*)	0.36123 (0.005***)	0.11719 (0.528)	0.23288 (0.096*)
Leverage	-0.31633 (0.404)	-0.46262 (0.243)	0.14922 (0.595)	-0.02464 (0.955)
Constant	-6.05404 (0.144)	3.50776 (0.485)	-3.78832 (0.184)	3.33295 (0.497)
R^2	0.283	0.147	0.054	0.146
No. of firms	41	41	41	41

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

Table 13 reports the combined effect of direct as well as indirect carbon emissions on different financial performance indicators. It indicates that combined scope 1&2 develops negative links with ROA, ROIC and ROS. It gives same results as scope 1 and 2 in table 11 and 12.

Table 13: Scope 1&2 Carbon Emissions Intensity and Financial Performance of all companies (clean and dirty).

	ROE	ROA	ROIC	ROS
Scope 1&2 carbon emissions intensity	0.093331 (0.373)	-0.11799 (0.339)	-0.02668 (0.656)	-0.05963 (0.402)
Firm size	1.693725 (0.252)	-2.06434 (0.273)	0.964747 (0.408)	-2.96155 (0.134)
Growth	0.340504 (0.055*)	0.368365 (0.002***)	0.122764 (0.518)	0.252784 (0.076*)
Leverage	-0.16434 (0.743)	-0.66919 (0.155)	0.117042 (0.773)	-0.09241 (0.886)
Constant	-6.04561 (0.114)	3.357624 (0.508)	-3.68555 (0.213)	3.62322 (0.479)
R2	0.315	0.165	0.056	0.146
No. of firms	41	41	41	41

Notes: 1. The asterisks of ***, **, * are 1%, 5%, and 10% of significance level, respectively. 2. The values in parentheses are heteroscedasticity robust p-values.

This study has used carbon emissions as proxy of environmental performance indicator to test the hypothesis that emissions of carbon effect the financial performance of firms. Table 14 indicates the summary of results on association of carbon emissions intensity and financial performance indicators, from which majority shows negative relationship. Results with negative relationship agrees with the studies of Zhang & Wang, 2014; Lee, Min, & Yook, 2015 and Gallego-Alvarez et al., 2015. Moreover, results with positive relationship agrees with the studies of Salahuddin, Alam, & Ozturk, 2016 and Yu et al., 2016. Some studies showed mixed relationship such as Chan, Li & Zhang, 2013; Broadstock, Collins &Vergos, 2017.In case of clean companies, all four financial performance indicator shows negative relationship with carbon emissions, which indicates that stakeholders of clean companies are concerned about the emissions into atmosphere. While in case of dirty industries, shareholders and investors are concerned about the direct carbon emissions. Moreover, managers, investors and customers are concerned about the indirect carbon emissions. So, companies should focus on reducing its emissions to improve the financial performance and long term sustain in market.

Table 14: Summary of relationship between types of carbon emissions intensity and financial performance indicators.

Industry	Type of Carbon Emissions	Relationship with Financial Performance Indicators			
		ROE	ROA	ROIC	ROS
Clean companies	Scope 1	(-)	(-)	(-)	(-)
	Scope 2	(-)	(-)	(-)	(-)
	Scope 1&2	(-)	(-)	(-)	(-)
Dirty companies	Scope 1	(-)	(+)	(-)	(+)
	Scope 2	(+)	(-)	(-)	(-)
	Scope 1&2	(-)	(+)	(-)	(+)
Combined (clean and dirty)	Scope 1	(+)	(-)	(-)	(-)
	Scope 2	(+)	(-)	(-)	(-)
	Scope 1&2	(+)	(-)	(-)	(-)

Whereas, equity shareholders of combined companies show positive relationship with carbon emissions, which indicate that shareholders may not be very anxious about the carbon emissions problem in short term. Otherwise, other stakeholders show negative relationship. Thus, it can be said that Indian stakeholders are highly critical about carbon emissions, in majority cases increase in emissions diminish corporate financial performance.

Conclusion:

The present study analysed the association between carbon emissions intensity and corporate financial performance indicators. It used the carbon data of 41 Indian CDP companies for 2018 fiscal year and multiple regression analysis was used for analysis. In case of clean firms, direct carbon emissions intensity was significantly negatively correlated with all four financial performance indicators i.e. ROE, ROA, ROIC and ROS. Similarly, indirect carbon emissions intensity of clean companies was also significantly negatively correlated with ROE, ROA, ROIC and ROS. Hence, both direct and indirect carbon emissions intensity was significantly negatively associated with ROE, ROA, ROIC and ROS.

In case of dirty firms, the direct carbon emissions intensity was negatively correlated with ROE and ROIC; in contrast, positively correlated with ROA and ROS. Furthermore, the indirect carbon emission intensity was negatively correlated to ROA, ROIC and ROS; but positively linked with ROE. Both direct as well as indirect carbon emissions was negatively related with ROE and ROIC, but positively related with ROA and ROS.

Finally, the direct carbon emissions intensity of combined (clean and dirty) firms was negatively linked with ROA, ROIC and ROS except ROE. Similarly, the indirect carbon emissions intensity was also negatively linked with ROA,

ROIC and ROS, but positively associated with ROE. Moreover, both direct as well as indirect carbon emissions intensity in case of all firms was negatively linked with ROA, ROIC and ROS; but positively with ROE.

Thus, it can be concluded that present study showed mixed results, but majority of cases found negative association between carbon emissions intensity and corporate financial performance indicators of Indian CDP firms.

Implications of the study:

The present study supported the viewpoint that reduction of carbon emissions can improve the financial performance. From the results of the study, it can be said that firms have incentives to reduce their dirty footprints from environment. Additionally, policy makers should make tough standards for carbon emissions reduction both at direct as well indirect level. Along with rules, incentives should be provided for adopting green technologies to mitigate the impact of global warming. In developing countries, carbon reduction technologies remain on the expensive side, so the inducements for adoption of green technology, along with cost efficiency is required. Furthermore, for developing understanding on climate change in society, various carbon emissions reduction policies should be implemented.

Scope for further research:

In addition to the present study, further research can consider different variables to show the environmental performance and instead of analysing one-year data, panel data can improve the scope for determining the association between carbon footprints as environmental performance indicator and firm's financial performance. Moreover, future research can be done on the effect of carbon footprints on corporate financial performance using different economies data such as under-developed, developing and developed economies.

References:

Alcock, N. (2008). Businesses must face the realities of a low carbon economy. Strategic Direction, 24(6), 13-15.

Andrewa, J., & Cortese, C. (2011). Accounting for climate change and the self-regulation of carbon disclosure. Accounting Forum, 130-138.

Boiral, O., Henri, J. F., & Talbo, D. (2011). Modeling the Impacts of Corporate Commitment on Climate Change. Business Strategy and the Environment, 1-22.

Boiral, O., Henri, J.-F., & Talbot, D. (2012). Modeling the impacts of corporate commitment on climate change. Business Strategy and the Environment, 21(8), 495-516.

Broadstock, D. C., Alan Collins, L. C., & Vergos, K. (2017). Voluntary disclosure, greenhouse gas emissions and business performance: Assessing the first decade of reporting. The British Accounting Review, 1-42.

Burress, D. (2005). What Global Emission Regulations: Should Corporations Support? Journal of Business Ethics, 317-339.

Busch, T., & Hoffmann, V. H. (2011). How Hot Is Your Bottom Line? Linking Carbon and Financial Performance. Business & Society, 233-265.

Busch, T., & Lewandowski, S. (2017). Corporate Carbon and Financial Performance. Journal of Industrial Ecology, 1-15.

Carroll, A. B., & Shabana, K. M. (2010). The Business Case for Corporate Social Responsibility: A Review of Concepts, Research and Practice. International Journal of Management Reviews, 85-105.

Chan, H. S., Li, S., & Zhang, F. (2013). Firm competitiveness and the European Union emissions trading scheme. Energy Policy, 1056-1064.

Cucchiella, F., Gastaldi, M., & Miliacca, M. (2017). The management of greenhouse gas emissions and its effects on firm performance. Journal of Cleaner Production, 1-27.

Dahlmann, F., Branicki, L., & Brammer, S. (2019). Managing Carbon Aspirations: The Influence of Corporate Climate Change Targets on Environmental Performance. Journal of Business Ethics, 1-24.

Damert, M., Paul, A., & Baumgartner, R. J. (2017). Exploring the determinants and long-term performance outcomes of corporate carbon strategies. Journal of Cleaner Production, 1-36.

Delmas, M. A., & Nairn-Birch, N. S. (2010). An Empirical Analysis of Corporate Carbon Footprints and Financial Performance. California: UCLA Institute of the Environment and Sustainability.

Doda, Baran, Gennaioli, Caterina, Goundson, Andy, Rory. (2015). Are corporate carbon management practices reducing corporate carbon emissions? Corporate Social Responsibility and Environmental Management, 1-15.

Dragomir, V. D. (2012). The disclosure of industrial greenhouse gas emissions: a critical assessment of

corporate sustainability reports. Journal of Cleaner Production, 222-237.

Freitas, I., Alves, M., & Pesqueux, Y. (2012). Corporate Social Responsibility and Sustainable Development. Journal of Business Administration, 148-152.

Frias-Aceituno, J. V., Rodriguez-Ariza, L., & Garcia-Sanchez, I. (2012). The Role of the Board in the Dissemination of Integrated Corporate Social Reporting. Corporate Social Responsibility and Environmental Management, 1-15.

Gallego-Alvarez, I. S.-F. (2014). Carbon emission reduction: the impact on the financial and operational performance of international companies. Journal of Cleaner Production, 1-11.

Gallego-Álvarez, I., Cuadrado-Ballesteros, B., & Martínez-Ferrero, J. (2018). Determinants of carbon accounting disclosure: an analysis of international companies. International Journal of Global Warming, 15(2), 123-142.

Gallego-Álvarez, I., García-Sánchez, I. M., & Vieira, C. d. (2014). Climate Change and Financial Performance in Times of Crisis. Business Strategy and the Environment, 23, 361-374.

Gallego-Alvarez, I., Martínez-Ferrero, J., & Cuadrado-Ballesteros, B. (2016). Accounting Treatment for Carbon Emission Rights. Systems, 4, 1-15.

Ganda, F., & Milondzo, K. S. (2011). The Impact of Carbon Emissions on Corporate Financial Performance: Evidence from the South African Firms. Sustainability, 10, 1-22.

Ganda., F. (2018). The influence of carbon emissions disclosure on company financial value in an emerging economy. Environ Dev Sustain, 1723-1738.

Hart, S. L. (1996). Does It Pay To Be Green? An Empirical Examination of the Relationship between Emission Reduction And Firm Performance. Business Strategy and the Environment, 5, 30-37.

Hassan, O. A., & Romilly, P. (2017). Relations between corporate economic performance, environmental disclosure and greenhouse gas emissions: New insights. Business Strategy Environment, 1-17.

Hatakeda, T., Kokubu, K., Kajiwara, T., & Nishitani, K. (2012). Factors Influencing Corporate Environmental Protection Activities for Greenhouse Gas Emission Reductions:The Relationship Between Environmental and Financial Performance. Environ Resource Econ, 455-481.

Hayami, H., Nakamurab, M., & Nakamurac, A. O. (2014). Economic performance and supply chains: The impact of upstream firms' waste output on downstream firms' performance in Japan. International Journal of Production Economics, 1-51.

Heede, R. (2014). Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010. Climatic Change, 229-241.

Heras-Saizarbitoria, I., Molina-Azorín, J. F., & Dick, G. P. (2011). ISO 14001 certification and financial performance: selection-effect versus treatment-effect. Journal of Cleaner Production, 19, 1-11.

Hoffman, A. J. (2004). Climate Change Strategy: The Business Logic behind Voluntary Greenhouse Gas Reductions. California Management Review, 1-44.

Hoffmann, V. H., & Busch, T. (2018). Corporate Carbon Performance Indicators. Journal of Industrial Ecology, 12(4), 505-520.

Hopwood, A. G. (2009). Accounting and the environment. Accounting, Organizations and Society, 433-439.

(2011). How companies manage sustainability. Mckinsey&Company.

(2018). India Brand Equity Foundation. Ministry of New and Renewable Energy.

(2018). IPCC Special Report. Switzerland: Intergovernmental Panel of Climate Change.

Iwata, Hiroki, Okada, & Keisuke. (2010, December 28). How does environmental performance affect financial performance? Evidence from Japanese manufacturing firms. Japan.

King, A. A., & Lenox, M. J. (2001). Does It Really Pay to Be Green? Journal of Industrial Ecology, 5(1), 105-116.

Lee, K.-H., Min, B., & Yook, K.-H. (2015). The impacts of carbon (CO2) emissions and environmental research and development (R&D) investment on firm performance. International Journal of Production Economics, 167, 1-11.

Lewandowski, S. (2017). Corporate Carbon and Financial Performance: The Role of Emission Reductions. Business Strategy and the Environment, 1-16.

Lucas, M. T., & Noordewier, T. G. (2016). Environmental Management Practices and Firm Financial Performance: The Moderating Effect of Industry Pollution-Related Factors. International Journal of Production Economics, 1-30.

Mahmood, Z., Ahmad, Z., Ali, W., & Ejaz, A. (2017). Does Environmental Disclosure Relate to Environmental Performance? Reconciling Legitimacy Theory and Voluntary Disclosure Theory. Pakistan Journal of Commerce and Social Sciences, 11(3), 1134-1152.

Mani, M., & Wheeler, D. (1998). In search of pollution havens? Dirty industry in the world economy, 1960 to 1995. The Journal of Environment and Development, 215-247.

Manrique, S., & Martí-Ballester, C.-P. (2017). Analyzing the Effect of Corporate Environmental Performance on Corporate Financial Performance in Developed and Developing Countries. Sustainability, 9, 1-30.

Narayan, K., & Sharma, S. (2015). Is Carbon Emissions Trading Profitable? Economic Modelling, 47, 84-92.

Philip, D., & Shi, Y. (2016). Optimal Heding in Carbon Emissions Markets using Markov Regime Switching Models. International Journal of Financial Markets Institutions and Money, 43, 1-15.

Raquel, C., Grima, A.-Z., & Garcia, M. (2018). New Trends in Corporate Reporting: Information on Carbon Footprints in Spain. Journal of Business Management, 537-550.

Reverte, C. (2009). Determinants of Corporate Social Responsibility Disclosure Ratings by Spanish Listed Firms. Journal of Business Ethics, 351-366.

Review, G. S. (2018). Catalysing Private Capital for Green Investments in India. Shakti Sustainable Energy Foundation.

Rothenberg, C. E. (2008). Firm Performance: The Interactions of Corporate Social Performance with Innovation and Industry Differentiation. Strategic Management Journal, 29(7), 781-789.

Salahuddin, M., Alam, K., & Ozturk, I. (2016). The effects of Internet usage and economic growth on CO2 emissions in OECD countries: A panel investigation. Renewable and Sustainable Energy Reviews, 62, 1226-1235.

Sekhar, G. S. (2011, June). Green Funds & Green Investing: A New Route to Green India. Visakhapatnam, Andhra Pradesh, India. Retrieved from http://ssrn.com/abstract=1872370

Shahgholian, A. (2019). Unpacking the relationship between environmental profile and financial profile; literature review toward methodological best practice. Journal of Cleaner Production, 233, 181-196.

Slawinski, N., Pinkse, J., Busch, T., & Banerjeed, S. B. (2014). The role of short-termism and uncertainty in organizational inaction on climate change: multilevel framework. 1-46.

(2015). The Emissions Gap Report . Kenya: United Nations Environemental Programme .

Wagner, M., Phu, N. V., & Azomahou2, T. (2002). The Relationship Between the Environmental and Economic Performance of Firms: An Empirical Analysis of the European Paper Industry. Corporate Social Responsibility and Environmental Management, 9, 133-146.

Walley, N., & Whitehead, B. (1994). It's not easy being green. Harvard Business Review, 72(3), 46-52.

Wang, L., Li, S., & Gao, S. (2014). Do Greenhouse Gas Emissions Affect Financial Performance? – an Empirical Examination of Australian Public Firms. Business Strategy and the Environment, 23, 505-519.

Weinhofer, G., & Hoffmann, V. H. (2010). Mitigating Climate Change – How Do Corporate Strategies Differ? Business Strategy and the Environment, 19, 77-89.

Yu, Y., D.Wang, D., Li, S., & Shi, Q. (2016). Assessment of U.S. firm-level climate change performance and strategy. Energy Policy, 92, 432-443.

Zhang, B., & Wang, Z. (2014). Inter-firm collaborations on carbon emission reduction within industrial chains in China: Practices, drivers and effects on firms' performances. Energy Economics, 42, 115-131.

Zhang, Y.-J., & Liu, J.-Y. (2018). Does carbon emissions trading affect the financial performance of high energy-consuming firms in China? Natural Hazards, 1-21