Carbon Emission Reduction and Financial Performance in an Emerging Market: Empirical Study of Indian Firms

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Abstract: The study aims to examine the impact of carbon emission reduction on financial performance in an emerging market context. Thirty eight Indian-listed firms were drawn from the Bombay Stock Exchange for the sample, and firms' data were collected from sustainability reports and Capitaline Plus corporate database. Carbon productivity and market-to-book ratio were used as a proxy to measure carbon emission reduction and financial performance, respectively. Results show a positive association between carbon emission reduction and financial performance after employing the appropriate panel regression model. This study contributes to the ongoing "pays to be green" literature, and the findings of this study complement the "win–win" research by empirically showing that corporate effort to reduce carbon emission generates a positive impact on firm's financial performance. Moreover, the findings provide crucial managerial and policy implication.

Keywords: carbon emission reduction, carbon productivity, emerging market, financial performance, market-to-book ratio.

INTRODUCTION

There is a growing consensus that increasing greenhouse gases (GHG), or prominently known as carbon, exceeds the average standard in the atmosphere leading to the phenomenon of climate change, which is expected to have significant consequences for much of society (Rokhmawati & Gunardi, 2017; Setiawan & Iswati, 2019). Climate change issue is becoming a primary concern for the society as it threatens man and environment at a global scale, both in developed and developing countries. While curbing carbon emission is vital in serving its purpose to mitigate climate change, there is an ambiguity on how it affects firms' operation and their financial implication. Green investment as a part of firms' sustainability drive has become a strategic issue in their decision making as ensuring economic success cannot be compromised (Lestari et al., 2019; Ong et al., 2020). Traditionally, environmental investments are considered a cost concerning activities incurring losses for firms; however, other argue that such actions are necessary to improve the relationship with stakeholders and to achieve profitability in the long run (Trumpp & Guenther, 2017; Zamil & Hassan, 2019). Regardless of the conflicting arguments, stakeholders have raised concerns regarding climate change and

increasing carbon emission (Rokhmawati et al., 2017). Consequently, firms can no longer afford to ignore the issue as it can inevitably pose a challenge to their legitimacy claim.

The analysis of the relationship between carbon emission reduction and financial performance is revolved around two contradicting approaches: "win-lose" argument and "win-win" arguments (Boiral et al., 2012). "Win-lose" reasoning argues that firms effort to reduce carbon emission results in a cost that could be detrimental to their competitiveness. Also, King & Lenox (2002) noted that the voluntary reduction of adverse environmental impact is in diversion from firms' primary objective of maximising (short term) shareholders' value. Under the "win-win" argument, firms improve their corporate competitiveness by continuously reducing their carbon emission level. This win-win argument is currently dominant in the literature and possibly justifies the current research focus on economic motivations for efforts to reduce carbon emissions. In regards to the empirical literature, the relationship between carbon emission reduction and financial performance is mixed (Boiral et al., 2012; Nishitani & Kokubu, 2012).

In regards to the empirical literature concerning these two approaches, the findings are also mixed. Studying for Japanese manufacturing companies, Nishitani & Kokubu (2012) find that firms with substantial market discipline imposed by investors are likely to lower their GHG emissions and consequently, firms that curb their level of emissions are likely to enhance their firm value. In the Australian context, Luo & Tang (2014) find a positive association between corporates' direct emissions (Scope 1) and abnormal firm returns, but indirect emissions (Scope 2) did not have a significant association. The study also finds that most firms had weak climate policies and investors are highly likely to penalise the firms for specifically emitting large amount of GHGs. Matsumura et al. (2014) also carried out an analysis between carbon emission and firm value for US (United States) S&P 500 firms and find that market penalises all firms for their carbon emissions and face a further penalty for non-disclosure of their emission details. Studying for Japanese listed firms, Saka & Oshika (2014) investigated the effect of carbon emission on firm value and find that negative association between carbon emissions and market value of equity, suggesting an economic motivation in curbing emissions. Studying for large global firms, Gallego-Álvarez et al. (2015) observe a positive influence of carbon emission reduction on financial performance as measured by Return on Equity but an insignificant impact on operating performance as measured by Return on Asset. In the South African context, Ganda & Milondzo (2018) give support for the win-win argument that carbon reduction initiatives can effactually improve financial performance as indicated by the negative association between carbon emissions and profitability.

In contrast, García-Sánchez & Prado-Lorenzo (2012), drawing a sample from US S&P 500, find a negative linear effect of sustainable GHG emission practice on a firm's financial performance, indicating that no economic benefits are associated with particular environmental behaviour. Hatakeda et al. (2012) find positive relationship between GHG emission and profitability in case of Japanese industries suggesting the benefit of reducing GHG emission is negative. Studying for Australian public firms, Wang et al. (2014) report a positive association between GHG emissions and Tobin's q advocating that investment to reduce GHG emission may be deterrent to firm's competitiveness. In the case of US firms, Delmas et al. (2015) report that reduction in GHG emission causes a decline in short-term financial performance as measured by ROA. However, the study also finds that investors attach the importance of improved GHG reduction, expressed by an increase in Tobin's q.

The interest of this study is motivated by the following issue. Firstly, the issue of climate change is a high-profile environmental concern with significant economic and scientific risk and uncertainties. However, it has received fewer researchers' attention in corporate environmental-economic performance literature (Delmas et al., 2015). Secondly, there is a lack of unanimity in the present research on carbon emission reduction and firm performance (Boiral et al., 2012; Gallego-Álvarez et al., 2015; Hermawan et al., 2018). Thirdly, the existing empirical studies focus on a developed and western setting; there is the scantiness of such research on

corporate environmental behaviour in an emerging market setting (Shamil et al., 2014). Studies suggest that there is a need to focus on the corporate environmental and sustainability practices and the financial implication of such activities (Kuzey & Uyar, 2017; Gupta & Gupta, 2020). Thus, it is noteworthy to empirically explore the economic motivation behind corporate behaviour regarding climate change and how essential it is to curb carbon emission in improving firm performance from an emerging market context.

The purpose of this study is to investigate the impact of carbon emission performance on financial performance, employing a sample of listed Indian firms from Bombay Stock Exchange (BSE) which provided carbon emission data in their sustainability reports for the period 2015-16 to 2018-2019. India is classified as an emerging market and a developing economy (International Monetary Fund, 2019) and one of the highest contributors of carbon emission in the world (Le Quéré et al., 2018). With India ratifying the Paris Agreement in 2015, the nation committed to reduce emissions intensity of its GDP by 33 to 35 % by 2030 from 2005 levels. Thus, it is expected of the country's corporates to align their policy to mitigate carbon emissions in line with the nation's commitment.

The present study is a modest attempt to add some contribution to the existing literature. It extends the on-going research on the interaction between carbon emission and firm performance in an emerging market setting which is characterised by rapid industrial development challenged by passive environmental stewardship (Jayanti & Gowda, 2014). The findings complement the literature which shows support for the "win-win" argument regarding the current debate on "pays to be green" literature. The findings of this study provide some important implication for Indian businesses and policymakers to adopt carbon mitigating policy.

METHODS

The target population of the study is from the Bombay Stock Exchange (BSE) top 200 firms. The study excluded financial firms owing to their incomparable financial data with the non-financial firms (Kılıç & Kuzey, 2019). Further, the study selected only those firms which provided their complete carbon emission data continuously for the period under study. Thus, the final sample for the present study consists of 38 companies for four years from 2015-16 to 2018-19. The base year 2015-16 is chosen to examine the current scenario in an Indian setting in light of the Paris Agreement. The final sample of 152 firm-year observations is deemed theoretically accepted for multiple regression analysis as previous research has used fewer observations (Chapple et al., 2013; Wang et al., 2014; Ganda & Milondzo, 2018). The data are collected from two sources. Carbon emission data are collected from sustainability/responsibility reports of the firms. The financial data for the companies are collected from 'Capitaline Plus' corporate database.

The study examines the impact of carbon emission reduction on financial performance, the dependent variable. Prior studies have used both accounting-based indicators as well as market-based indicators of financial performance. The study focuses on the market aspect of financial performance and thus employs the market-to-book ratio (MBR) as a proxy for financial performance. The measure for a market-based indicator permits the study to examine the relationship between carbon emission reduction and financial performance during a period characterised by heightened stakeholders' concerns for climate change and investors scrutiny of corporate carbon emission (Delmas et al., 2015). Studies such as Prado-Lorenzo et al. (2009); Choi et al. (2013) used MBR as an indicator of financial performance. MBR is measured by dividing the market value by book value of the common stock. The market value of the common stock is measured as the product of the number of outstanding share and share price at the end of the financial year.

The following measures of carbon emission reduction have been used in prior literature: total emissions (Matsumura et al., 2014; Wang et al., 2014), the ratio of GHG emission to sales (Gallego-Álvarez et al., 2014; Hassan & Romilly, 2018; Bui et al., 2020), the ratio of sales to GHG emission (Nishitani & Kokubu, 2012) and variation in GHG emission (Gallego-Álvarez et al., 2015; Lewandowski, 2017). Carbon productivity (CP) is the study's proxy for corporate carbon emission reduction and is defined as the ratio of a firm's net sales to the total of Scope 1 and Scope 2 emission (Nishitani & Kokubu, 2012). CP is considered a good proxy for carbon emission reduction as it reveals the economic value a firm adds in relation to its environmental impact (Busch & Lewandowski, 2018). The higher value of CP indicates better emission reduction conduct of the firm. Furthermore, Scope 1 refers to direct emissions related to the combustion of fossil fuels or the processing of chemicals and materials from sources that are owned or controlled by the company. Scope 2 refers to indirect emissions from the generation of purchased electricity consumed by the firm.

The study controls for various variables such as firm size (SIZE), firm growth (GROWTH), research and development expenditure (RDINT) and sector activity (SECTOR) follows various literature. Large firms appear to be more competitive than the smaller firms due to their higher market share, considerable customer base better opportunities to diversify their products which can lead to increased profitability and enhances market value. Therefore, the study controls the influence of SIZE on financial performance by using the natural logarithm of a firm's total asset as a proxy. The firm's growth rate (GROWTH) is measured as the annual firm's change in sales (King & Lenox, 2001). The market may perceive firm growth as an opportunity and likely to have an impact on a firm's financial performance. The study controls for Research and Development intensity (RDINT) to control the effect of innovation on firm performance. RDINT is calculated by dividing R&D expensed by net sales (Hart & Ahuja, 1996). Industry dummy (SECTOR) is controlled in the study to capture intensive sector effect on financial performance as sample firms are varied across different sectors (Wang et al., 2014). The dummy variable takes the value of '1' if the company is carbon-intensive and '0' otherwise. Based on prior literature (Kılıç & Kuzey, 2019), sectors such as pulp and paper, energy, chemicals, metals, utilities, machinery, mining, cement, glass and transportation were categorized as carbon-intensive industries.

Table 1 Definition and Measurement of the Study's Variables

Variables	Definition and Measurement
MBR	Market to Book Ratio, measured as the market value divided by the book value of common stock
CP	Carbon Productivity, measured as the firm's net sales divided by the total of Scope 1 and Scope 2 emission
SIZE	Firm Size, measured as the natural logarithm of total assets
GROWTH	Firm Growth, measured as change in sales divided by the beginning of the period sale
RDINT	Research & Development Intensity, measured as annual R&D expenses divided by net sales
SECTOR	Dummy variable that represents the intensive sectors

The study used various tests to employ a suitable regression model to examine the impact of carbon emission reduction on firms' financial performance. First, the Breusch-Pagan Lagrange Multiplier (LM) test was employed to choose between the suitability of pooled ordinary least squares (POLS) and panel regression method. The result of the test advocate the use of panel regression (chibar2 value= 171.76; p-value=0.000). Further, the Hausman specification test was employed to select between the fixed-effect model (FEM) and the random effect model (REM) of panel regression. The outcome of the test indicates the appropriateness of the random effect model (chi square=5.12; p=0.2754). In comparison to FEM, the REM is considered more efficient but less consistent. Further, it assumes that variables are non-random and not correlated with the explanatory

variables (Greene, 2018). The following empirical model is employed to examine the impact of carbon productivity on MBR after controlling the influence of various firm-specific characteristics.

$$MBR_{it} = \beta_0 + \beta_1 CP_{it} + \beta_2 SIZE_{it} + \beta_3 GROWTH_{it} + \beta_4 RDINT_{it} + \beta_5 SECTOR_{it} + \varepsilon_{it}$$

Where $\beta_1 ... \beta_5$ are the slopes of the explanatory variables, β_0 is the intercept, ε_{it} is the error term, i refer to the firm and t is time.

RESULTS AND DISCUSSION

Table 2 presents the descriptive statistics of the study variables. The dependent variable MBR has a mean of 3.833, indicating that the market value of equity for the sample firm on an average is nearly four times the book value of equity. MBR also varies widely from 0.44 to 15.030, indicating a mix of low and high performing firms. The descriptive statistics of CP (average of 71.893 and range between 0.048 and 535.355) also indicate that the carbon emission reduction varies widely among the firms.

Table 2 Descriptive Statistics

	Mean	SD	Min	Max
MBR	3.833	2.839	0.440	15.030
CP	71.893	102.219	0.048	535.355
SIZE	9.961	1.087	7.843	12.197
GROWTH	0.082	0.162	-0.704	0.559
RDINT	0.011	0.025	0.000	0.154
SECTOR	0.500	0.502	0.000	1.000

Table 3 presents the correlation coefficients for the study's variables. The correlation matrix reveals that MBR is positively correlated with CP, and the coefficient is statistically significant. Among the control variables, MBR is negatively correlated with SIZE, and the coefficient is statistically significant at 1% level. MBR is positive but statistically insignificant with GROWTH. MBR is negative and insignificant with RDINT and SECTOR.

Table 3 Correlation Coefficient of all the Variables

	MBR	CP	SIZE	GROWTH	RDINT	SECTOR
MBR	1					
CP	0.350**	1				
SIZE	-0.448**	0.130	1			
GROWTH	0.157	0.138	0.0546	1		
RDINT	-0.0671	0.0293	-0.0848	-0.0292	1	
SECTOR	-0.147	-0.410**	0.134	-0.128	-0.307**	1

Note: *, ** Significant at 0.05 and 0.01 levels, respectively

Variance Inflation Factor (VIF) test is calculated for all the explanatory variables, and the highest obtained value is 1.41, which is much below the threshold level of 10. Additionally, the degree of association among the explanatory variables is low, as shown in the correlation coefficient table. The diagnostic suggests that multicollinearity may not be a threat to the analysis. Regarding normality, the study employs Jarque-Bera and Shapiro-Wilk test, and the analysis reports the variables do not confirm the normality distribution (results not

presented). However, the assumption of normality may not be considered necessary to achieve the outcomes in multiple regression analysis (Greene, 2018). The observed overall R^2 and highly significant value of Wald chi-square indicate the goodness of fit of the model.

Table 4 Random Effect Regression Result

Variables	Coefficient	p-value
CP	.0070	0.000***
SIZE	-.9972	0.000***
GROWTH	1.1075	0.011**
RDINT	-7.9018	0.313
SECTOR	-.03041	0.968
_cons	13.2726	0.000***
No. of Observation	152	
R^2 overall	0.3943	
Wald chi-square	29.70***	
Hausman test (p-value)	0.2754	

Note: *, ** and *** represents significance levels at 0.10, 0.05 and 0.01 respectively.

The regression results are presented in Table 4. The result reveals that the coefficient of CP is positive and significant at 1% level. The findings affirm a positive and significant relationship between carbon emission reduction and financial performance in an Indian setting. The result of a positive impact of CP on financial performance is consistent with the findings of Nishitani & Kokubu (2012); Ganda & Milondzo (2018). The use of MBR as a proxy for financial performance displays the expectation of one of the key stakeholders: stockholders. The findings suggest that the stakeholders are particularly aware of the threat of climate change and are conscious of firms' emission level. They are likely to reward those firms who proactively curb emissions and penalise those who do not. From the instrumental stakeholder perspectives (Jones, 1995), the effective management of relationship with key stakeholders contributes to better market performance. Therefore, the study argues that firms foster a "win-win" environment by retaining the claim of their key stakeholders and by proactively mitigating their carbon emission. In case the firms fail to reduce their carbon emission level, there would be consequences for such failure may interfere negatively with the expectations and claims of the shareholders. In this sense, market participants consider carbon reduction efforts as a virtue, i.e. firms with higher carbon productivity generate a "carbon premium" (Busch & Hoffmann, 2011).

Further, Busch & Hoffmann (2011) comment that mitigation of GHG emission can be regarded as an integral part of risk management and business strategy owing to the positive association between carbon emission reduction and financial performance. Carbon emission and its direct impact on climate change poses a severe risk to the global economy and could have adverse economic consequences on the businesses (Stern, 2007). Thus, companies need to mitigate their carbon emission as a part of their strategy. Every risk management activity may involve initial costs but then helps the firms to alleviate the negative consequences in the later stage. Similarly, reduction of carbon emissions puts additional constraints on the business at present but can be understood as a precautionary measure that helps prepare the company for a more carbon-constrained business environment in the future (Busch & Hoffmann, 2011).

Among the control variables, the coefficient of SIZE is negative and significant at 1% level with MBR suggesting that larger the firm lesser is their market value. The result of the negative association between firm size and financial performance was not expected. However, the result indicates that larger firms may be more inefficient and are associated with higher cost leading to decreased benefits and thus detrimental to market

performance. Some of the prior studies also report a negative association between firm size and financial performance (Delmas et al., 2015; Trumpp & Guenther, 2017).

GROWTH is positive and significantly associated with MBR at 5% level. The positive association is expected as the market rewards those firms with high potential for growth as measured by the annual change in sales. The result is consistent with the findings of Wang et al. (2014); Delmas et al. (2015); Gallego-Álvarez et al., (2015).

In contrast to the expectation, the coefficient of RDINT shows a negative but insignificant association with MBR indicating that the variable may not be a determining factor in financial performance. The finding of an insignificant association is consistent with the results reported by Lewandowski (2017); Alexopoulos et al. (2018).

SECTOR is also negative and insignificant with MBR. Thus, this specific characteristic of a firm is not significant with its financial performance. However, there is a negative correlation between SECTOR and CP ($p < 0.01$) as expected because carbon-intensive sectors are high emitters and consequently, have lower CP. The finding of an insignificant association is consistent with García-Sánchez & Prado-Lorenzo (2012); Wang et al. (2014).

The study undertakes sensitivity analysis to check whether the non-normality of the data is adversely affecting the present regression result. According to Hair Jr. et al. (2010), transforming the variables can be essential to achieve normality. The study transforms the dependent variable by taking the square root of the variable. The Shapiro-Wilk test indicates the achievement of normality of the residuals ($p = 0.067$) as the p-value is higher than the alpha level of 0.05, thus accepting the null hypothesis of a normal distribution. The regression results are provided in Appendix 1 and it shows that all the significant variables in the main regression result retain their respective original significance level. Thus, the sensitivity check indicates that the main regression results are not adversely affected by the non-normality distribution of the data.

The present study and findings have important managerial and policy implications. The research indicates that it is crucial for firms to analyse the financial impact of curbing carbon emissions as a part of the climate action initiative. The empirical results suggest that there is a high awareness of climate change among the market, and investors perceive high carbon emissions as a threat. For managers and decision-makers, mitigating carbon emissions as a part of their sustainability drive may impose additional costs and constraints on manufacturing and production, but it can lead to better opportunities in the market. Managers must consider proactive sustainable investments as a mechanism to achieve higher economic performance (Gallego-Álvarez et al., 2015). Thus, firms are expected to implement efficient environmental management and strategy to reduce their emission to achieve a win-win scenario in the long run. For the policymakers, the study's findings indicate that accomplishing a low-carbon economy is in an optimistic scenario, as shown in this study in terms of the economic motivations for efforts to mitigate carbon emission. However, more efforts are needed to communicate the awareness of carbon emission properly, motivate firms to reduce their emission level through suitable regulation and ensure the timely availability and accessibility of the corporate carbon emission information for businesses and market participants.

CONCLUSION

Given the inconclusive link between environmental-economic performances over the years, the present study is a modest attempt to investigate the relationship between corporate carbon emission reduction and financial performance. The empirical evidence was obtained using a sample of 38 non-financial Indian firms listed in BSE

top 200 for a period of 4 years from 2015-16 to 2018-19. The study uses carbon emission data from the companies' sustainability reports to measure the carbon productivity, and other financial data are collected from 'Capitaline Plus' corporate database. The study finds that CP is positive and statistically significant with financial performance after employing REM. The findings of the study show support for the "win-win" literature in the light of contradicting evidence between good environmental practice and firm performance. Though the study makes an effort in examining the impact of carbon emission reduction on financial performance, the analyses reported are not free from limitation. First, there is a caveat in our measure of carbon emission reduction, which is not uncommon to environmental research. The study's measure for carbon emission reduction is based on the output-based measures and may limit the analysis of the study. Future studies can incorporate a process-based measure to examine the carbon emission reduction and financial performance in order to give a more vivid picture. Second, the study uses only one aspect of financial performance, i.e. MBR. Future studies can incorporate a more sophisticated model of financial performance with the aim of achieving more robustness. The study also suffers from a small sample and concerns a limited period which may limit the analysis, suggesting that future studies can build a more comprehensive panel data.

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APPENDIX

Appendix 1 Random Effect Regression Result (DV: Square-root of MBR)

Variables	Coefficient	p-value
CP	.0013	0.005***
SIZE	-.2428	0.000***
GROWTH	.2405	0.028**
RDINT	-1.9222	0.324
SECTOR	-.10351	0.554
_cons	4.2196	0.000***
No. of Observation		152
R^2 overall		0.39837
Wald chi-square		25.51***