РАЗДЕЛ 3
КОРПОРАТИВНОЕ УПРАВЛЕНИЕ В РАЗВИВАЮЩИХСЯ СТРАНАХ

SECTION 3
CORPORATE GOVERNANCE IN DEVELOPING COUNTRIES

IMPACT OF CARBON EMISSIONS ON TOTAL ASSETS AND OPERATING COSTS: AN ANALYSIS OF THE JSE100 COMPANIES

Alfred Bimha*

Abstract

There is a definite concern in the rise of carbon emissions globally from traditional methods of production (Stern, 2008; IPCC, 2007). More so it is now widely acclaimed that by adopting production processes that reduce carbon emissions to low levels, companies will succeed in reducing their operating costs (Dietz et.al, 2009; Sims et.al, 2003). There has been limited study in investigating how the present state of companies' carbon emissions output is related to their operating costs and total assets. Therefore the study intends to establish the level of interactions between the carbon emissions, total assets and the operating costs they report annually. A panel data analysis was done on these three variables using a sample of the top 100 Johannesburg Stock Exchange (JSE) reporting companies in South Africa. The study utilized the data of companies that report their emissions to the Carbon Disclosure Project (CDP) annually and are the top 100 JSE Companies by market capitalization and categorized the CDP reporting companies into 7 industrials sectors. The 7 industrial sectors are Consumer Discretionary, Consumer Staples, Energy and Materials, Financials, Health Care, Industrials and IT and Telecoms. The results indicate that in the short run there is no strong relationship between carbon emissions output and operating costs. More so, the carbon emissions have a very weak and statistically insignificant relationship with total assets.

Keywords: Carbon Emissions, JSE100, South Africa, Panel Data Analysis

** Department of Finance, Banking and Risk Management, University of South Africa, P O Box 392, UNISA, 0003*
Tel: +27(0) 12- 429-2041
Email: bimhaa@unisa.ac.za

1. Introduction

Climate change is a phenomenon that is now a main agenda on almost all corporate boards worldwide (Wiedmann & Minx, 2007). The increased interest in climate change by most firms stems from the rationale that human-induced activities and corporate operations are the main cause of global warming which leads to an adverse change in climate patterns (Pearce et.al, 1996; Verweij et.al, 2006; Stern, 2007). Various ways of dealing with climate change through corporate behavioral change have been developed. Currently the popular corporate ways of solving climate change include measuring and disclosing carbon emissions of business operations and adapting or innovating to

carbon emissions free production processes (Dietz et.al, 2009; Sims et.al, 2003). The assertion by Kolk et.al (2008) that firms are engaged in continual progress of reducing carbon emission raises the question of how the companies that are currently disclosing their emissions in annual public statement are being viewed in the financial markets.

The mantra of growing green economies and industries makes it imperative to study the status quo of a company's production processes and the ongoing change from high carbon production processes to lower ones (Pearce et.al., 1989; Fankhaeser et.al, 2008; Makower & Pike, 2009; Stern, 2007). The move from high carbon production processes to lower ones presents a challenge of revamping production processes and the assets used for production (Stern, 2007; Winkler & Marquand, 2009). More so the South African National Development Plan insists on delinking economic activity from environmental degradation and the use of carbon –intensive energy (National Planning Commission, 2011). The National Treasury in South Africa intends to introduce a carbon tax in 2015 and hence it is imperative to measure the amount of carbon emissions in relation to assets size of a firm and its operating costs to determine its vulnerability to increased costs of carbon tax. Hence in this study, the investigation of how the seven (7) sectors of the (Johannesburg Stock Exchange Top 100 companies) JSE100 companies' assets and operating costs are related to the carbon emissions they produce is done. Such a study is significant in determining the transition from a company dependning on high carbon production processes to lower ones. The main interest is looking at how the high carbon intensive sectors of the JSE100 are fairing compared to the low carbon intensive sectors. More so the research will establish the sectors that are more susceptible to carbon emissions. Such information will be beneficial to investors who intend to invest in sectors that are addressing climate change and also the policy makers in South Africa with regards to implementing the carbon tax.

The main aim of this study is to establish the extent of the relationship that exists between carbon emissions of the JSE 100 CDP (Carbon Disclosure Project) reporting companies and their operating costs and total assets. The study will first present and critic relevant work and literature and establish a theoretical framework of how carbon emissions can be linked to operating costs, company assets and firm performance in general. The next section will present the methodology used to undertake this study and a section on results and their discussion will follow ending with a conclusion.

2. Literature Review

Climate Change and Measurement of Carbon Emissions

The phenomena of climate change has to do with how natural and human induced activities that produce green house gases (GHG) lead to a formation of a blanket around the earth's globe. The blanket formed by the GHGs traps the sun rays leading to increased earth's surface temperature which will affect the atmospheric weather patterns leading to adverse weather of typhoons, floods, drought, melting of glaciers, uncontrollable fires, rising of ocean wave levels amongst a host of similar weather repercussions (Andronova & Schesinger, 2000; Gore, 2006). Such adverse weather conditions are not favorable to economic activities of agriculture, mining and other manufacturing activities. There is a high link in energy use and emission of green house gases by most sectors of the economy or at a national scale (Schipper et.al, 1997; Richmond & Kauffman, 2006; Soytas et.al, 2007). Most of the studies have concentrated on analyzing the relationship between energy use, economic growth and carbon emissions and mostly at national level and at the perceived highly carbon intensive industries (Oil and gas, electricity generation, coal mining, transport, heavy manufacturing and so forth).

However companies have other sources of carbon emissions besides energy use and these are reflected in the scopes 1, 2 and 3 of carbon emissions measured using the Greenhouse Gas Protocol Corporate standards (GHG Protocol). The GHG Protocol Corporate Standards are used by companies in preparing a GHG emissions inventory. There are three scopes of quantifying carbon emissions from a company's activities; scope 1 is all GHG direct emissions; scope 2 are the indirect emissions from consumption of purchased electricity, heat or steam and scope 3 pertains to other indirect emissions such as extraction and production of purchased materials and fuels, transport related activities in vehicles not owned or controlled by the company and outsourced activities (GHG Protocol, 2008). With this background it is essential to link the carbon emissions of companies to the operating costs they incur and the assets they use to produce income. A company that is incorporating low carbon production processes should have lower carbon emissions output compared to one which is still using high carbon emission processes (Enkvist et.al, 2008).

Financial or Economic Performance and Environmental Performance

The main concern in literature is coming up with metrics that measure environmental performance at

firm level. Environmental performance alongside other components of economic sustainability and social responsibility are summed up and termed corporate sustainability. It is envisaged that a sustainable firm is one who has a balance of these three components (Dyllick & Hockerts, 2002; Elkington 2007). However for this study the intersection of economic and environmental sustainability is of interest since the aim is to find out how economic sustainability relates to environmental sustainability.

In literature there is a wide coverage of the relationship of financial performance and environmental performance of firms. There is a concern of how the disclosure of environmental information affects a firm's share price. Cohen and Konar (2006) found a negative correlation between bad environmental practices and intangible assets of firms. However they asserted that conflicting results from studies of financial performance and environmental performance relationship are attributed to small samples and unclear environmental criteria. Busch and Hoffman (2011) in the same vein established a credible proxy for environmental performance being the carbon emissions measured by a firm and relates them to the financial indicators of units of production, turnover or sales, total costs, cost of goods sold, value added, earnings before interest and tax and market capitalization or equity. The carbon performance metrics or indicators suggested by Busch and Hoffman cover carbon emissions dependency, intensity, exposure and management. However, King and Lennox (2001) also found a positive relationship between low pollution output and high financial performance but this is attributed to specific firm characteristics and strategic position. Using a resource based perspective of the firm Russo and Fouts (1997) indicated that there is a positive relationship between environmental performance and financial performance and this relationship tend to strengthen as the industry grows.

In another study by Orlitzky et.al (2003), they did a meta-analysis of 52 studies which looked at the relationship between Corporate Social/Environmental Performance (CSP) and Corporate Financial Performance (CFP). The main outcome of the study indicates that there is a high correlation between corporate social responsibility and accounting measures and the corporate environmental responsibility had a lower correlation to accounting measures. This is in contrast to studies reviewed above though they give contexts to when a high correlation between environmental performance and financial performance is realized. Albertini (2013) also did a similar meta-analysis study and had the same outcome as Orlitzky however Albertini reiterated the need to standardize environmental performance measures so as to derive consistent results. Another study by Veen and Venugopal (2014) also agree that the positive relationship between economic performance and environmental performance are achieved under different contexts. Telle (2006) argues that most studies which proved a positive relationship between economic performance and environmental performance did not take into cognizance the problem of omitted variable bias seriously. In this case omitted variables include good management and use of more efficient technology. These are considered to cause improved positive effect of economic performance and environmental performance, however when firm specific characteristics are considered the positive effect tends to vanish away or change.

The main concern however, is the absence of studies on how operating costs relate to amount of carbon emissions produced by firms. There has been no wide study around this relationship and this study aims at unraveling this relationship and initiates an insightful understanding of it. As can be observed there is more literature which confirms a positive relationship between financial or economic performance and environmental performance albeit under different contexts of firms size, type of industry and firm specific characteristics of management and type of technology being used. From empirical studies done so far the most popular econometric methods of testing this relationship has been simple regression (Bragdon and Marlin 1972; Jaggi and Friedman, 1992; Orlitzky, 2001), and with this insight, the next section sets out to establish the methodology.

3. Methodology

Sample and Data Collection

The sample of the study consists of the companies that are listed on the Johannesburg Stock Exchange (JSE) that report to the Carbon Disclosure Project (CDP) annually since 2007. The targeted companies for the CDP report are the top 100 companies by market capitalization. The carbon disclosure project is an independently run research survey that solicit information from voluntary companies targeted each year through a questionnaire to provide data of measured and disclosed carbon emissions, management of reducing carbon emissions and strategies being adopted in reducing these emissions amongst a host of questions. The study has incorporated the companies that participated each year in the CDP survey since 2009, and therefore the sample size differs each year. Panel data is collected from 2009 to 2013 and it can be observed that there are no consistent carbon emissions data for most companies since 2007, only beginning in 2009 is significant data observed. Therefore the companies

with reported emissions in the CDP report are considered from 2009 to 2013 and Table 1 presents the number of companies that participated in each sector.

Table 1. Sample data Characteristics

Year	2013	2012	2011	2010	2009
Number of responding companies JSE 100	79	75	78	67	55
Responding companies by sector (in the sample)					
Consumer Staples	5	6	7	5	3
Consumer Discretionary	7	8	8	7	3
Energy and Materials	8	20	20	19	16
Financials	7	16	18	15	10
Health Care	5	4	4	3	3
Industrials	9	8	9	8	9
IT & Telecommunications	2	3	3	3	2
Total	43	65	69	60	46
% of sample to CDP JSE responding companies	54%	87%	88%	90%	84%

Source: CDP Reports 2009, 2010, 2011, 2012, 2013

The Mcgregor BFA database was used in collecting the financial data of total operating cost and total assets of each CDP participating company and the carbon emissions data was collected from CDP annual reports. Unbalanced panel data is used since some companies were not consistently reporting their emissions every year. This panel data set contains the observations on the variables X_1 ,X_2 and Y and the data are denoted as follows:

$(X_{it1}, X_{it2}, Y_{it})$, $i = 1, \ldots,n$; and $t = 1,\ldots,T$

Where the first subscript, i refer to the entity being observed, and the second subscript, t, refers to the date at which it is observed and 1 denotes variable 1 and 2 denotes variable 2. Reinterpreting this to our data:

X_1 will be total assets
X_2 will be total operating costs
Y will be either scope 1 or scope 2 emissions

The data is structured in sectors as they appear in the CDP reports being (seven) 7 in number and these include: Consumer Staples, Consumer Discretionary, Energy and Materials, Financials, Industrials, Health Care, and finally IT and Telecommunications. Scope 3 (other indirect) emissions have been left out since they only appear in the CDP report of 2012 only and Scope 1 and 2 are only used. Operating costs and total assets are chosen on the basis of being proper proxies of the sources of emissions. These two variables embody the operational parameters of scoping sources of emissions in a production process of a firm (GHG Protocol, 2008). The scope of the study is mainly on the cost - emissions relationship and not the profit – emissions relationship.

Model Estimations

The aim of the study was to find the relationship that exists between operating costs of a company, the total assets it has and the carbon emissions it produces and the following hypotheses are postulated to fulfill the research aim:

Hypothesis: There is correlation between Total Assets, Total Operating costs and Carbon Emissions on each of the 7 categorized sectors of the JSE 100 CDP reporting companies.

H_o: There is no correlation between Scope 1 carbon emissions and total assets

H_a: There is correlation between scope 1 carbon emissions and total assets

H_o: There is no correlation between Scope 2 carbon emissions and total operating costs

H_a: There is a correlation between Scope 2 carbon emissions and total operating costs

The study makes use of Panel Least Squares Multiple Regression model to analyze the relationship between scope 1 and 2 emissions, and total assets and operating costs. This regression model was deemed appropriate since the study makes use of panel (longitudinal) data. Panel data consists of two or more units with two or more periods. In the case of the data collected, there are four variables (Scope 1 emissions, Scope 2 emissions, operating costs and total assets) and 5 periods (2009 to 2013).

The general panel least regression model is as follows:

$Y_{it} = \beta_1 X_{it1} + \beta_2 X_{it2} + \mu_{it}$ for $i = 1, 2, \ldots, N$ and $t = 1, 2, \ldots, T$

Where:

Y_{it} is the value of Y for the *ith* unit for the *tth* time period

X_{it1} is the value of X_1 for the *ith* unit for the *tth* time period

X_{it2} is the value of X_2 for the *ith* unit for the *tth* time period

μ_{it} is the error for the *ith* unit for the *tth* time period

Two regression models are estimated based on the above model estimation as follows:

First equation (Model 1):

$Scope1_{it} = \beta_1 Total\ Assets_{it1} + \beta_2 Operating\ Costs_{it2} + \mu_{it}$ for $i = 1, 2, \ldots, N$ and $t = 1, 2, \ldots,$

Where:

$Scope1_{it}$ is the value of Y for the *ith* unit for the *tth* time period

$Total\ Assets_{it1}$ is the value of Total Assets for the *ith* company for the *tth* time period

$Operating\ Costs_{it2}$ is the value of Operating Cost for the *ith* unit for the *tth* time period

μ_{it} is the error for the *ith* company for the *tth* time period

Second Equation (Model 2):

$Scope2_{it} = \beta_1 Total\ Assets_{it1} + \beta_2 Operating\ Costs_{it2} + \mu_{it}$ for $i = 1, 2, \ldots, N$ and $t = 1, 2, \ldots,$

Where:

$Scope2_{it}$ is the value of Scope 2 carbon emissions for the *ith* unit for the *tth* time period

$Total\ Assets_{it1}$ is the value of Total Assets for the *ith* company for the *tth* time period

$Operating\ Costs_{it2}$ is the value of Operating Cost for the *ith* unit for the *tth* time period

μ_{it} is the error for the *ith* company for the *tth* time period

These two equations will be run for each sector and this will bring the total fixed effects regression model runs to fourteen (14) since the panel data is categorized into 7 sectors. The descriptive results of the data to be analyzed are presented in table 2, whilst table 3 and 4 present the results of the two regression models.

4. Results and Analysis

Table 2 shows the descriptive statistics of each sector and its variables. It can be observed that the Financials sector has the largest aggregated amount of total assets valued at R28.4 trillion followed by Energy and Materials Sector at R10.1 trillion, however the lowest total assets are recorded in the Health Care Sector with R433 billion . With regards to operating costs the Energy and Materials Sector has the highest sum value of R514 billion and the least sum value of operating cost is in the health care sector at R19 billion. Scope 1 and 2 emissions aggregated values are highest in the Energy and Materials sector with 586 million tCO_2e and 358 million tCO_2e respectively whilst the lowest aggregated scope 1 and 2 emissions is found in the Health Care Sector valued at 352,220 tCO_2e and 2,444,540 tCO_2e respectively. The accept or reject criteria based on the results presented in tables 3 and 4 of the regressions done is detailed in table 5.

In this study two regression models are run per each sector and in the first model scope 1 (direct) carbon emissions is the dependent variable and total assets and operating costs are the independent (explanatory) variables the results are displayed in table 3. It can be observed that the intercepts of the Consumer Discretionary and IT and Telecommunications sector are negative and statistically insignificant. The rest of the sectors have positive coefficients and are statistically significant. Consumer Staples, Energy & Materials, Financials and Health Care sector indicate that an increase in operating costs will lead to an increase in scope 1 (direct) carbon emissions output. The largest increase is experienced in Energy and Materials sector were an increase by one tCO2e of scope 1 (direct) carbon emissions is explained by 89% increase in operating costs. However by and large the decrease and increase of total assets of a company are insignificant to the decrease or increase of the scope 1 (direct) carbon emissions of the sectors under study.

In the second regression model scope 2 (indirect) carbon emissions is the dependent and total assets and operating costs are the independent (explanatory) variables and the results are displayed in table 4. The intercepts of all the sectors are statistically significant except for the health care sector which is insignificant. With regards to Energy & Materials sector the operating cost coefficient is the highest amongst the sectors and statistically significant were an increase by one ton of carbon emission (CO2e) of the scope 2 (indirect) carbon emissions is explained by a 43% increase in operating costs. However similar to model one, total assets coefficients explain a marginal increase in scope 2 (indirect) carbon emissions across the sectors though the coefficients of Consumer Discretionary sector, Consumer Staples sector, Financials sector and Health Care sector are statistically significant.

By classifying sectors into high carbon intensive sectors and low carbon intensive sectors, the implications of the results of this study can easily be understood. The high carbon intensive sectors are Energy and Materials sector and the Industrials sectors. These sectors rely mainly on high volumes of carbon intensive input materials into their production processes such as cement, oil, coal, water and electricity. The low carbon intensive sectors rely less on the carbon intensive input materials and these include the Consumer Staples, Consumer Discretionary, Financials and Health Care sectors. IT and Telecommunications seem to be between a high carbon intensive sector and a low carbon intensive sector judging from the intercept, which is midway for both scope 1 and scope 2 emissions. From the results of the two models it can be observed that high carbon intensive sectors tend to have increased operating costs leading to increased carbon emissions both directly and indirectly compared to the low carbon intensive sectors. However most of the negative coefficients of total assets and operating costs on both runs are statistically insignificant for most of the low carbon intensive sectors confirming how their operations and the assets they hold are climate friendly and thus leading to low carbon emissions.

Table 2. Descriptive Statistics for the Data Variables

		Mean	Median	Standard Deviation	Minimum	Maximum	Sum	Count
Consumer Discretionary Sector	*Scope1 (tCO_2e)*	164,165	15,663	299,294	412	873,154	4,432,443	27
	Scope2(tCO_2e)	174,060	144,554	129,962	19,106	569,719	4,699,627	27
	Total Assets(R'000)	17,807,567	7,078,000	24,585,153	3,690,330	104,204,000	480,804,314	27
	Operating Cost(R'000)	5,088,716	1,123,536	12,630,643	197,343	48,771,000	137,395,337	27
Consumer Staples Sector	*Scope1(tCO_2e)*	392,146	161,323	462,186	5,916	1,513,037	12,940,816	33
	Scope2(tCO_2e)	388,038	297,134	318,987	32,112	1,208,967	12,805,242	33
	Total Assets(R'000)	49,611,733	12,193,600	76,459,075	1,827,046	247,506,417	1,637,187,185	33
	Operating Cost(R'000)	2,910,533	941,300	3,992,682	124,766	12,980,641	96,047,588	33
Energy and Materials Sector	*Scope1(tCO_2e)*	7,063,801	896,529	15,519,829	2,262	66,895,000	586,295,479	83
	Scope2(tCO_2e)	4,315,658	2,107,933	5,966,283	176,980	28,798,955	358,199,641	83
	Total Assets(R'000)	121,847,392	41,004,000	232,198,357	4,063,000	1,313,087,395	10,113,333,567	83
	Operating Cost(R'000)	6,197,736	1,662,000	12,440,006	2,936	71,089,443	514,412,053	83
Financials Sector	*Scope1(tCO_2e)*	30,753	2,434	80,239	-	366,625	2,029,684	66
	Scope2(tCO_2e)	158,043	62,177	166,472	856	672,612	10,430,866	66
	Total Assets(R'000)	430,941,608	227,492,500	544,622,695	8,635,964	1,994,711,775	28,442,146,115	66
	Operating Cost(R'000)	1,669,802	846,529	2,161,892	21,478	11,363,671	110,206,940	66
Health Care Sector	*Scope1(tCO_2e)*	19,568	16,365	11,266	-	41,931	352,220	18
	Scope2(tCO_2e)	135,808	145,778	91,358	27,130	366,360	2,444,540	18
	Total Assets(R'000)	24,060,977	25,701,750	15,227,685	4,333,196	49,495,000	433,097,589	18
	Operating Cost(R'000)	1,092,065	970,737	798,392	220,258	3,430,000	19,657,167	18
Industrials Sector	*Scope1(tCO_2e)*	370,219	146,412	861,867	321	5,400,000	14,438,553	39
	Scope2	604,863	92,869	2,042,372	6,376	9,520,000	23,589,672	39
	Total Assets(R'000)	19,731,880	18,928,600	12,667,548	5,131,000	56,798,678	769,543,326	39
	Operating Cost(R'000)	1,544,694	1,201,300	1,198,892	236,845	4,108,127	60,243,074	39
IT & Telecommunications Sector	*Scope 1(tCO_2e)*	157,802	48,599	240,428	8,100	744,074	1,893,627	12
	Scope 2(tCO_2e)	403,234	381,590	193,306	55,186	721,969	4,838,813	12
	Total Assets(R'000)	71,568,474	49,636,000	48,111,897	16,766,689	147,449,000	858,821,689	12
	Operating Cost(R'000)	10,220,663	8,428,500	5,690,448	622,284	19,594,000	122,647,956	12

Table 3. Results from Model 1 (Scope 1 relationship with Total Assets and Operating Costs)

Sector	Consumer Discretionary	Consumer Staples	Energy and Materials	Financials	Health Care	Industrials	IT & Telecommunications
Constant/Intercept	-8,544.31 *(43,956.17)*	146,828.10 *(73,022.62)* **	4,387,582 *(1,808,839)* **	42,170.10 *(12,545.80)* ***	9,559.24 *(3,833.84)* **	503,781.60 *(265,941.10)* *	-108,825.60 *(101,793.30)*
Operating Costs	0.01189 *(0.00293)* ***	0.090573 *(0.063346)*	0.894163 *(0.633011)*	0.010513 *(0.010906)*	0.011293 *(0.002865)* ***	-0.036402 *(0.272154)*	-0.010261 *(0.027391)*
Total Assets	0.006301 *(0.001502)* ***	-0.000369 *(0.003308)*	-0.023518 *(0.033914)*	-0.0000672 *(0.0000433)*	-0.0000966 *(0.00015)*	-0.003919 *(0.025757)*	0.005191 *(0.00324)*
R-Squared Adjusted R-squared	0.662236 0.634089	0.523014 0.491215	0.143722 0.122315	0.053516 0.023469	0.548824 0.488667	0.011127 -0.04381	0.656857 0.580603
S.E. of regression	181,045	329,673.30	14,539,730	79,291.92	8,056.25	880,544.10	155,703.00
Total panel (unbalanced) observations	27	33	83	66	18	39	12

Table 4. Results from Model 2 (Scope 2 relationship with Total Assets and Operating Costs)

Sector	Consumer Discretionary	Consumer Staples	Energy and Materials	Financials	Health Care	Industrials	IT & Telecommunications
Constant	116,758.10 *(24,947.20)* ***	171,022.10 *(34,147.45)* ***	1,683,271.00 *(347,059.80)* ***	81,373.76 *(21,480.51)***	20,991.87 *(30,293.52)*	1,441,560.00 *(610,352.80)* **	416,539.40 *(138,438.80)* **
Operating Costs	-0.001178 *(0.001659)*	0.195405 *(0.029622)* ***	0.433995 *(0.121455)* ***	-0.012041 *(0.018673)*	0.057824 *(0.022640)* **	0.437598 *(0.624612)*	0.008651 *(0.037252)*
Total Assets	0.003555 *(0.000852)* ***	-0.007089 *(0.001547)* ***	-0.000471 *(0.006507)*	0.000225 *(0.0000741)* ***	0.002147 *(0.001187)* *	-0.07666 *(0.059115)*	-0.001421 *(0.004406)*
R-Squared Adjusted R-squared S.E. of regression	0.422988 0.374903 102,751.60	0.781025 0.766427 154,164.60	0.786700 0.781368 789,721.00	0.355394 0.334930 135,761.10	0.571601 0.514481 63,657.34	0.072439 0.020908 2,020,908	0.018187 -0.199994 211,756.00
Total panel (unbalanced) observations	27	33	83	66	18	39	12

Standard error is in brackets

,,*** indicates significance at 90%, 95% and 99% level, respectively*

Table 5. Accept/Reject criterion

Sector	Model 1		Model 2	
	Operating Cost	*Total Assets*	*Operating Cost*	*Total Assets*
Consumer Discretionary	***Reject H_o , Accept H_a***	***Reject H_o Accept H_a***	Accept H_o , Reject H_a	***Reject H_o Accept H_a***
Consumer Staples	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Reject H_o Accept H_a	***Reject H_o Accept H_a***
Energy & Materials	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Reject H_o Accept H_a	Accept H_o , Reject H_a
Financials	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Accept H_o , Reject H_a	***Reject H_o Accept H_a***
Health Care	***Reject H_o Accept H_a***	Accept H_o , Reject H_a	***Reject H_o Accept H_a***	***Reject H_o Accept H_a***
Industrials	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Accept H_o , Reject H_a
IT & Telecommunications	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Accept H_o , Reject H_a	Accept H_o , Reject H_a

Conclusion

The study aimed at presenting the general relationship of carbon emissions, total assets and operating costs of the companies in the seven sectors of the CDP JSE 100. The results have shown that high carbon intensive sectors (Energy & Materials and Industrials) tend to have a strong correlation between operating costs and carbon emissions. On the other hand the low carbon intensive sectors (Consumer Discretionary, Consumer Staples, Financials, Health Care and IT & Telecommunications tend to have a weak correlation between operating costs and carbon emissions. In relation to the link between total assets and carbon emissions all sectors showed a weak correlation and mostly statistical insignificance of the relationship. This might be a possibility that most of the companies are replacing the perceived carbon emissions 'causing' assets with assets that facilitate the limitation of emission of carbon into the environment. Such assets might be fuel efficient cars, green buildings, clean source of energy (wind power, solar power) and carbon emission free production machines amongst a host of measures.

However in our study the main issue was the limited range of data (from 2009 to 2013). Our data was panel in structure but was only limited to five years and this could have possibly caused most of the results to be statistically insignificant. Added to that was the issue of unbalanced panel data and this could have biased our results. However the given data was run through an unbalanced panel regression model which removed this problem thus our results were improved to an extent. However there is need to do an intense sector by sector to unravel the intricate dynamics of the relationship of carbon emissions to total assets and operating costs. Broader models should be adopted to come up with more statistically significant models that can establish the relationship in detail. It is envisaged that as the data range grows annually, the relationship can be predicted more accurately. However the data that was used has to a certain extent confirmed a general relationship on the variables under study. Scope 3 (other indirect) carbon emissions were not considered for this study due to their unreadily availability for the years under review. It will be encouraged that for future study scope 3 be included in the analysis. Future research should also decompose the operating costs of each sector and regress or correlate them to the carbon emissions in order to deepen and subjectively compare this relationship across the sector and this also applies to the total assets.

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