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GREENHOUSE GAS EMISSIONS AND ITS IMPACT ON FIRM PERFORMANCE: A REVIEW OF LITERATURE

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ABSTRACT

This paper has made an attempt to explore the direction of relationship between GHG emissions and firm performance. By invoking the use of review of literature, this paper has holistically documented the various studies done in context of GHG emissions and its impact on firm performance. Additionally, the reasons responsible for divergent evidences of the relationship between GHG emissions and firm performance have also been highlighted. It was found that variability in the type of metrics used for measuring GHG performance and firm performance was a major reason behind the diverse evidences. The country in which the study has been set and the existence of time lag in the relationship also played a major role behind the inconsistency of the results. Another key factor was the existence of carbon disclosures as a mediating variable and the industry context as a moderating variable came across as an important factor behind the non-uniformity of the results.

KEYWORDS: GHG emissions, greenhouse gases, environment, firm performance, performance

INTRODUCTION

The present era is rife with reports of deteriorating environment and an alarming rate of climate change all around the globe. Therefore, corporate response to the adverse change in climate is unescapable. There is an increasingly immense pressure and focus on the companies around the globe to pay heed to climate change (Molina-Azorin et al., 2009). On one hand, some corporates all around the world contribute to GHG emissions and on the other, they are also putting in effortsto cope up with the same by reducing their emissions. Therefore, it is of great interest for both, industry as well as academic community to study the impact of greenhouse gas (GHG) emissions on the firm performance (Busch and Hoffman, 2011). This relationship exists due to the fact that the amount of GHG emissions has a bearing on the environment where the business operates (Wang et al., 2014).

Given the fact that there can be a meaningful impact of the carbon emissions on the business (Sakaand Oshika, 2014), the amount of studies attempting to decode the relationship between GHG emissions and firm performance is on a rise (Wang et al., 2014). However, the results of these studies report different types of relationships. A large number of studies report a positive relationship, however, on the other hand a negative and even no relationship between GHG emissions and firm performance has been put forward. Therefore, it becomes inevitable for the research community to document the results of the prior research studies with regard to the impactof GHG emissions and firm performance.

The remaining paper is organized in the following manner. Firstly, the theoretical background of the paper has been built. Secondly, the review of literature has been undertaken which has been bifurcated as negative relationship and positive relationship between GHG emissions and firm performance. Thereafter the reasons behind the divergent results have been identified in the third section. Fourth, the limitations of this study and the future directions for carrying out further research in context of the relationship between greenhouse gas emissions and firm performance have been discussed.

THEORETICAL BASE AND BACKGROUND

The theoretical explanation behind the relationship between GHG emissions and firm performance can be found in the instrumental stakeholder theory. This theory puts forth the idea that if a firm aims to be thriving and prosperous in the future, heed must be paid to the interest of the various stakeholders (Rokhmawati et al., 2015). As per the definition given by Freeman (1948, p.46), thestakeholders are referred to any individual or a group of individuals who might get affected or affect the objectives and goals of the firm. If the concerns of the stakeholders of the firm are not attended to, the ability of a firm to reach its goals will be hampered (Jensen, 2001).

In the present scenario, given the increasing dialogue about creating an economy which is low carbon, the stakeholders are now getting inclined towards the need to cut down the GHG emissions. It is needless to state that there is a major need for businesses around the world to inculcate sustainability within all zones of its activities. Being sustainable is important as it takes into account the needs of the current generation without compromising those of the future generation (Lee et al., 2015). Beginning from Kyoto Protocol, the earth has witnessed various initiatives like UNFCCC (United Nations Framework Convention on Climate Change) which all suggest a low carbon economy (Lee et al., 2015) which can never happen without the efforts of the corporate sector.

OBJECTIVES

The objective of this paper is to comprehensively present the evidences from the prior literature with regard to the impact of GHG (greenhouse gas) emissions on firm performance. Further this paper has an aim of presenting the various reasons responsible for the divergent results found in the extant scholarly studies.

METHODOLOGY

This paper makes use of the review of literature methodology in order to bring forward the findings from the extant literature regarding the impact of GHG emissions on firm performance. As suggested by Molina-Azorin et al. (2009), for the purpose of shortlisting of the literature review, an internet search on various databases such as Google Scholar, Emerald Insight and Science Direct. The existence of terms and keywords like GHG emissions, carbon emissions, CO2 emissions, carbon dioxide emissions, corporate environmental performance were used as screens in the title of the paper. To make the search more inclusive, the terms firm value as well as financial performance were also considered as firm performance. Since, carbon dioxide is a part of greenhouse gases, the studies that exclusively deal with impact of carbon emissions on the firm performance were also taken into account. However, during the search, many papers were excluded. First, those papers which were conceptual were eliminated. Second, the scholarly research papers that dealt with GHG management or its reduction were also not considered. Third, the papers which focused on corporate environmental performance but had a much wider scope

i.e. quantified environmental performance beyond the lens of GHG emission were also not reviewed.

FINDINGS

The review of literature has unearthed that there exists both positive as well as negative relationship between GHG emissions and firm performance. Here, a positive relationship refers to the situation where increase in the amount of GHG emissions would improve the financial performance. However, a negative relationship between the two refer to the condition where rise in the extent of GHG emissions would deteriorate the performance of the firms. The various scholarly evidences showing both- positive and negative linkage between GHG emissions and firm performance are presented in this section. These evidences are also followed by the reasons responsible for the variation in the results of the prior literature.

POSITIVE LINKAGE BETWEEN GHG EMISSIONS AND FIRM PERFORMANCE

Wang et al. (2014) revealed positive relationship between GHG emissions and financial performance in the Australian context. The sample consisted of 69 public firms listed on the ASX 200 for the year 2010. The GHG performance was measured using he log of total company emissions and financial performance was gauged by invoking the use of Tobin's q.

Gallego-Alvarez et al. (2014) also carried out a research on a sample of 89 firms for a studyperiod of three years (2006-2009). The carbon emissions were quantified using the variations in the amount of carbon emissions i.e. increase or decrease. The firm performance was measured using ROA as a proxy of operational performance and ROE as a metric for financial performance.The results brought forward that reduced emissions lead to a positive financial performance. However, no evidence was found in context of the relationship between decreased carbon emissions and operational performance.

Oestreich and Tsiakas (2015) investigated the impact of carbon emissions on stock returnsin case of Germany on a sample of 65 firms for a period of 2003 to 2012. It was found that there is a positive linkage between carbon emissions and stock returns.

Rokhmawati et al. (2015) examined the effect of GHG emission, environmental performance and social performance on the financial performance in case of Indonesia. The sampleconsisted of 102 firms for the year 2011. The GHG emission was measured using carbon dioxide intensity (Carbon dioxide/ Cost of goods sold) and the financial performance was measured usingreturn on assets (ROA). It was found out that increased carbon dioxide intensity results in deterioration of financial performance.

NEGATIVE LINKAGE BETWEEN GHG EMISSIONS AND FIRM PERFORMANCE

Busch and Hoffman (2011) investigated the link between the carbon and financial performance using a sample of 821 firms for 2006 (one year). The financial performance was quantified using ROA, ROE and Tobin's *q* whereas the carbon performance was measured using the ratio of carbon emission to cost of goods sold. A negative linkage between the two was revealed.

Clarkson et al. (2011) conducted a study in context of the United States on a sample of 242companies pertaining to most polluting industries for the time period of 1990-2003. Toxic releaseinventory was considered as an indicator of environment performance while Tobin's q was used as a metric for financial performance. It was brought about that carbon emissions and firm performance had a negative link in case of United States.

Qi et al. (2014) studied the impact of environmental performance on financial performanceon a sample of 39 firms pertaining to the Chinese industry for period 1990-2010. The environmental performance was gauged using Sulphur dioxide emissions and return on assets (ROA) was used as an indicator of financial performance. It was found out that lower amount of Sulphur dioxide emissions lead to a better financial performance.

Delmas et al. (2015) investigated the relationship environmental and financial performance (both long-term and short-term) on a sample of 1095 firms for period ranging from 2004 to 2008 in context of USA. The environmental performance was quantified using natural log of total GHG emissions. The short-term financial performance was gauged using ROA as short term measure of performance whereas Tobin's *q* was used as long term measure of performance. It was brought about that good carbon performance leads to a decline in short term financial performance. However, it was also pinpointed that good carbon performance enhances the long term financial performance.

Lee et al. (2015) conducted a study with an aim to examine the impact of carbon emissions and research & development on the performance of firm in the Japanese context. The sample size was 362 firms for the time period ranging from 2003 to 2010. The carbon emissions were measured using the ratio between carbon emissions to value of assets whereas the financial performance was gauged using Tobin's q. The study put forth that higher amount of carbon emissions bring down the value of the firm. It was also pinpointed that investors do not have a preference for firms which emit greater amount of greenhouse gases.

Liu et al. (2016) attempted to understand the relationship between corporate carbon emission and firm performance and checked if carbon disclosure mediated the relationship in case

of United Kingdom. A sample of 62 firms for the years 2010-2012 was considered. To measure the carbon emissions, a carbon disclosure index was built in order to quantify carbon emissions and return on equity (ROE) and return on assets (ROA) were used as proxies for measuring financial performance. It was put forward that the carbon emissions had a negative impact on the firm performance.

Similarly, Ganda and Milondzo (2018) endeavored to investigate the impact of both Scope1 and Scope 2 carbon emissions on firm performance measured through ROE, ROS and ROI on asample 63 South African firms for the year 2015. It highlighted the existence of a negative relationship between carbon emissions and firm performance.

REASONS BEHIND DIVERGENT RESULTS

Measures of carbon emissions

Busch and Lewandowski (2017) have stated that carbon emissions have been quantified in two different manners i.e. absolute indicators and relative indicators. Here, absolute indicators refer to the total of emissions contributed by an individual firm. However, the relative measures of carbon emissions are referred to those which are in ratio form which are calculated by dividing the carbon emissions by another metric like revenue and cost of goods sold. Therefore, the relationship between GHG emissions and firm performance gets altered when different indicators of carbon emissions are used.

Measures of financial performance

The measures used as proxies for financial performance are diverse in nature. They include both accounting based measures like return on assets (ROA), return on sales (ROS), return on equity (ROE) and return on investment (ROI). On the other hand, there are market based indicators like

Tobin's q. Delmas et al. (2015) have pinpointed that accounting based indicators like return on (ROA) as well as market based indicators like Tobin' q have high tendencies of getting maneuvered. Also, as the indicator being used for measuring firm performance is changed, the relationship between GHG emissions and firm performance also gets changed.

Duration of the study

Albertini (2013) has stated that the duration of time period considered in the study has a role to play in the contrasting evidences found in the prior studies. It has been stated by Hart and Ahuja (1996) that there exists a time lag between the variation in emissions and its bearing on the firm performance.

The Country factor

Wang et al. (2014*)* suggest that the country of the study plays an important role in deciding the relationship between GHG emissions and firm performance. As per a study carried out by Telle (2006), the relationship between GHG emissions and firm performance is nonexistent in case of Norway. Wang et al. (2014) has reasoned out that the country factor plays a significant role due tothe fact that the regulatory laws as well as the structure of economy are peculiar to each country.

Carbon disclosures as mediating variable

Prior studies reveal that the relationship between carbon emissions and firm performance is mediated carbon disclosures. Scholarly studies like Saka and Oshika (2014) put forth that carbon disclosures act as a mediating variable as it helps in reducing information asymmetry among various stakeholders such as customers and investors. This in turn leads to a better allocation of scarce resources. It is also argued by Liu et al. (2016) that if companies do not make an effort to disclose the amount of carbon emissions, investors and other stakeholders will not be able to assessthe carbon performance of the firm. This might lead to adverse impact as the market may award penalty to such companies.

Table I Summary of important studies from the review of literature

Author(year)	Country of study	Sample Size	Period of study	Metric for GHG Emissions	Metric for Firm Performance	Main Findings
Busch and Hoffmann (2011)	International	821 Firms	2006 (1 year)	Carbon emissions/ Sales	ROA, ROE, Tobin's q	Negative linkage
Yongqing etal. (2013)	Australia	210 firms	2006-2010	Carbon emissions	Asset value, operating cash flow	No linkage
Gallego-Alvarez et al. (2014)	International	89 firms	2006-2009 (3 years)	GHG emission variation	ROE, ROA	Reduction inGHG emissionslead to positive financial performance

Pintea et al. (2014)	Romania	14 firms	2005-2010 (6 years)	Carbon emissions	ROA, ROE	No significant link
Saka and Oshika (2014)	Japan	105 firms	2006-2008 (3 years)	Carbon emissions	Market valueof equity	Negative linkage
Wang et al. (2014)	Australia	69 firms	2010 (1 year)	Log of total company emissions	Tobin's q	Positive Linkage
Qi et al. (2014)	China	39 firms	1990-2010 (20 years)	Sulphur Dioxide emissions	ROA	Negative link
Delmas et al. (2015)	United States	1095 firms	2004-2008 (5 years)	Log of total carbon emissions	ROA and Tobin's q	Negative linkage
Lee et al. (2015)	Japan	362 Firms	2003-2010	Carbon emissions/ Value of assets	Tobin's q	Negative linkage
Oestreich and Tsiakas(2015)	Germany	65 Firms	2003-2012	Carbon emission allowances	Monthly stock returns	Positive Linkage
Rokhmawatiet al. (2015)	Indonesia	131 firms	2011 (1 year)	Carbon emission ntensity (Carbon emissions divided by cost of goods sold)	ROA	Positive linkage
Baboukardos (2017)	United Kingdom	742 firms	2011-2014 (4 years)	Total GHG emissions	Market value of equity	Negative linkage

Ganda and Milondzo (2017)	South Africa	63 firms	2015	Carbon emissions	ROE, ROI and ROS	Negative linkage

Source: Compiled by the researcher

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This paper puts forward that despite there being studies suggesting both positive as well as a negative relationship between corporate GHG emissions and firm performance, there are still higher number of studies that substantiate a positive link.

In a major chunk of studies that have been reviewed for the purpose of this paper have consideredthe direct relationship between GHG emissions and firm performance.

Our study also concludes that there is a serious lack of literature that focus on the relationship between GHG emissions and firm performance in Indian context. India is one of the fastest growing developing economies and has labelled as the fourth highest emitter of carbon dioxide inthe year 2017 (The Hindu Business Line, 2018). Also, India has committed to the United NationsFramework Convention on Climate Change to trim down the carbon emissions by the year 2030 from the 2005 levels. Therefore, the need of the hour suggest that the corporates functioning in India should be made aware of the kind of relationship between carbon emissions and financial performance of firms.

Also, the policy setters could be benefited from such a study in the Indian context. Lastly, this study focuses on the impact of environmental variables on firm performance. However, Molina- Azorin (2009) suggest that there can be existence of two way relationship between environmental variables and firm performance. However, this study has not focused on how the financial

performance of the firm can have a bearing on the environmental variables of performance. This might be true due to the fact that firms with a better performance are in a better position to devotelarge amount of resources towards projects that are aimed at preventing harms to the environment(Molina-Azorin, 2009). Given this, a study that lays emphasis on the impact of financial performance on the environmental performance of the firm can be conducted.

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