Pakistan Journal of Commerce and Social Sciences
2020, Vol. 14 (1), 99-119
Pak J Commer Soc Sci

Linking Environmental Management Practices to Environmental Performance: The Interactive Role of Environmental Audit

Shoaib Aslam
Lahore Business School, The University of Lahore, Pakistan
Email: shoaibiub@gmail.com

Ramiz Ur Rehman,
Lahore Business School, The University of Lahore, Pakistan
Email: rameez.urrehman@lbs.uol.edu.pk

Muhammad Asad
School of Management, University of Bradford, West Yorkshire Bradford, UK
Email: masad3@bradford.ac.uk

Abstract

Drawing on institutional theory using data of S&P 500 listed firms over the period 2007 to 2018, this study examines the role of external environmental audit between environmental management practices (EMP) and environmental performance. In particular, we explore whether the integration of environmental audit with environmental management practices contribute to desire environmental performance. This study adopts generalized least squares (GLS), linear regression with random effects to examine the relationship among variables. Empirical findings suggest that firms adopting the external environmental audit instrument with the internal mechanism of EMP are found more effective to exhibit better environmental performance. Furthermore, the findings also confirm that the internal instrument of environmental management practices have valuable capability to produce better environmental performance. Finally, the results show that the operational implications of environmental audit need to be more focused by researchers.

Keywords: environmental management practices, environmental performance, environmental audit, clean technology, environmental investment.

1. Introduction

Over the last three decades, the implementation of green initiatives in industrial units has gained more interest among academicians, practitioners and regulators (Dang et al., 2019; Endo, 2020; Haque & Ntim, 2020). Rising global temperature has created environmental awareness in the society. United Nations Environment Programme (2020) describes "Environmental sustainability is a never-ending journey, where continuous improvement and developments should always take place and bring up new achievements and challenges.

The business community needs to understand its responsibility to overcome global warming issues and create values in a sustainable way (Manirque & Marti-Ballester, 2017). Firms are expected to reduce environmental degradation by extracting low carbon emissions (Bae & Seol, 2006). Despite the social and regulators pressures, firms are failed to address their environmental concerns (Dahlmann et al., 2019). The eruption of the Volkswagens scandal about the emission hazardous is a big question mark on the implementation of green initiatives for achieving desired environmental performance (Hartmann & Vachon, 2018; Heras-Saizarbitorial et al., 2020; Testa et al., 2018).

Consequently, in response to the environmental unprecedented threats, modern firms are more motivated in the adoption of the voluntary proactive green initiatives to meet their environmental challenges (Li et al., 2017). The importance of the eco-centrism paradigm has emerged (Banerjee, 2002). Even though the cost of being green is high but it cannot be forgone. (Porter & Van der Linde, 1995). Corporate environmental reporting is recognized as a multilayer construct (Dragomir, 2018). It can be further divided into two border category corporate environmental management practices (EMP) and corporate environmental operational performances that are difficult to link automatically (Henri & Journeault, 2008). "Environmental management practices are the techniques, policies, and procedures a firm uses that are specifically aimed at monitoring and controlling the impact of its operations on the natural environment" (Montabon et al., 2007. Environmental performance is examined to know the production performance that considers environmental factors.

The controversy on the relationship between EMP and environmental performance is not new (Heras-Saizarbitorial et al., 2020; Nawrocka & Parker, 2009; Testa et al., 2018). In this regard, the environmental audit plays a key role in implementing effective EMP for achieving the desired environmental results (Soh & Martinov-Bennie, 2015; Prajogo et al., 2016; Qian et al., 2018). Adoption of environmental audit, stimulate the impact of internal environmental practices on environmental performance (Ruban & Ryden, 2019; Tuczek et al., 2018). However, prior studies have delivered limited evidence on how environmental audit influence on the relationship between EMP and environmental performance. Prior literature proves that the integration of EMP with environmental audit positively influence the environmental outcomes (Prajogo et al., 2016; Ruban & Ryden, 2019; Tuczek et al., 2018). An environmental audit is the third party assurance about the compliance of EMP reported and adopted by the firm. An environmental audit is not only useful for internal assessment of the organization's environmental governance but also legitimate the organization external position in society. Environmental audit with EMP is the preventive step towards the least corporate environmental effects on the ecological system (Hakim & Yunus, 2017). Firms are recognizing the importance of

external environmental audit programs to strengthen their internal environmental strategies (Bae & Seol, 2006). EMP can be better monitored by the environmental audit (Lu et al., 2020).

Motivated by the above background, this study examines the effect of internal EMP on environmental performance, and investigates whether this relationship is moderated by the environmental audit. This study supports the corporate EMP literature in several ways. First, this study contributes to the corporate environmental accountability literature by conceptually and empirically examining whether integration of environmental audit with environmental initiatives significantly improve the environmental performance. Second, extensive literature is available on positive and negative direct relationships between EMP and environmental performance, while the few addresses how this relationship becomes more strengthen. Prajogo et al. (2016) argued that an environmental audit is an effective tool to monitor the implementation of environmental strategies. Considering this direction, this study confirmed that external assurance has a valuable capability to positively moderate the link between EMP and environmental performance. Finally, this study confirms that EMP has more influence on environmental performance when an external environmental audit program is conducted.

2. Theoretical Framework and Hypothesis Development

Institutional theory postulate that firms are bounded to adopt the meta-standards for achieving the social legitimacy position (DiMaggio & Powell, 1983). Firms are generating isomorphism status among the competitors by justifying their operations (Testa et al., 2018). DiMaggio and Powell (1983) explained that similarity in processes and structures of the organization is known as institutional isomorphism. Mimetic, coercive and normative are the three main pressures that inclined the firms towards the institutional isomorphism (DiMaggio & Powell, 1983). Corporate environmental accountability can be better understood by the help of institutional theory (Aerts et al., 2008). Sometime market-based pressure and regulatory pressure are not directly affecting the environmental performance but significantly encouraging the firms for the adoption of environmental sensitive programs (Anton, Deltas, & Khanna, 2004). However, all environmental actions did not produce the same desired results but organizational environmental legitimacy can be judge by their environmental instance (Berrone et al., 2017). Without a similar environmental strategic position, firms are unable to compete in the market (Dang et al., 2019).

2.1 Linking Environmental Management Practices to Environmental Performance

Previous research on the relationship between EMP and environmental performance is often inconsistent like most other business research problems (Al-Tuwaijri et al., 2004). One of the major reasons behind inconclusive results between EMP and environmental performance is the exposition of these two concepts. Several attempts have been made to explore the relationship between EMP and environmental performance, but over the time literature infers new horizons about this relationship. Almost all the early studies based on annual reports disclosures confirmed that there is a weak or no association between EMP and environmental performance (Ingram & Frazier, 1980; Rockness, 1985). Moreover, disclosure quality can be determined from annual reports by measuring the relationship between the identified goals and actual independent performance. Whereas, too much subjectivity is involved in measuring the environmental information from firms' annual reports disclosures (Ingram & Frazier, 1980). Environmental and social disclosures in annual reports are used to mitigate public pressure rather than profitability measures and consider legitimacy as the outcome of the firms. By examining the scope and accuracy in annual reports about the context of environmental disclosure (Fekrat et al., 1996) found that there exists no clear support for the association between EMP and environmental performance. Deegan and Gordon (1996) documented that EMP disclosure is self-laudatory for promoting a positive image.

After the incorporation of GRI and ISO guidelines, a high degree of uniformity and reliability is found in voluntary environmental reporting that bonded the firms to disclose their positive and negative environmental aspect (Baboukardos, 2018). Now, no confusion has remained left about the terms environmental voluntary disclosure, environmental management practices, and environmental performances. In late 1996, ISO published guidelines for corporate environmental reporting that knows as ISO 14000 series. ISO 14000 series contained environmental management standards topics “such as life cycle analysis, eco-labeling, environmental auditing and environmental performance evaluation” (Andrews et al., 2010). The target of the lower toxic released ratio can be achieved by the adoption of EMP comprehensively (Anton, Deltas, & Khanna, 2004). Empirically, few quantitative studies are agreed that EMP influences the eco-efficiency of the firms (Hertin et al., 2008). Nawrocka and Parker (2009) conducted a meta-study by analyzing the twenty-three studies connecting environmental initiatives with environmental performance. The result of the relationship is unclear due to two main reasons. Firstly, there is no clear argument about the measurement of environmental performance. Secondly, there is neither clarity nor a strong argument on how and why EMP leads to better environmental performance. Finally, it is better to research how and why EMP affects the environmental outcomes; rather they do so or not.

There is a non-linear relationship found between EMP disclosure and environmental performance and complexity to decide about good and bad outcomes from qualitative environmental measures (Meng et al., 2014). Even poor performers disclosed more information about the environmental concerns after being exposed as environmental violators. Environmental disclosure is a useful measure to forecast the firms' legitimacy (Cormier & Magnan, 2015). Theoretically and empirically, the relationship between EMP disclosure and environmental performance remains ambiguous (Hummel & Schlick, 2016). In contrast, (Tadros & Magnan, 2019) claimed that environmental disclosure seems to be the case of reporting bias because it is found that high environmental performance firms disclosed more information about their green initiative. Adoptions of EMPs have a positive impact on environmental performance (Ardito & Dangelico, 2018). Based on previous literature, it is difficult to understand the association between EMP and environmental performance. So, this study proposes the hypothesis that:

- **H_1:** Environmental management practices have a significant impact on corporate environmental performance.

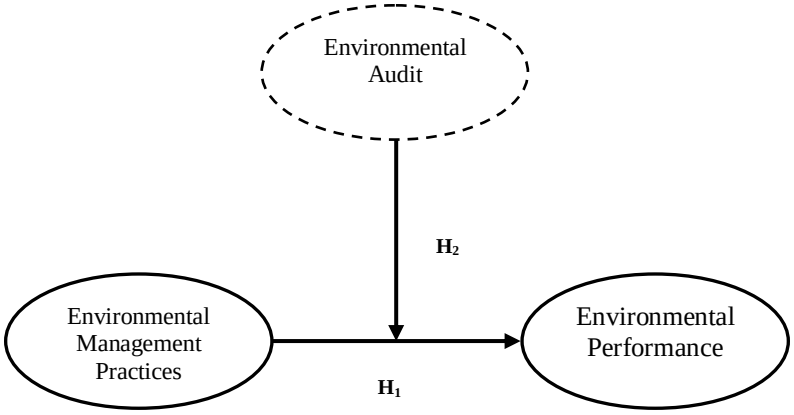
2.2. The interactive Role of External Audit

EMP as the voluntarily adopted internal instrument has been widely challenged. ISO 14001 environmental management certification is more demanding and potentially applicable to all kinds of organizations, but not the guarantee for the pro-environmental behavior (Heras-Saizarbitorial et al., 2020). The voluntarily self-regulatory instrument can be implemented in different ways. The major reason behind the adoption of such environmental certification and internal EMP is to achieve the internalization requirement (Testa et al., 2017). External assurance about the internal EMP is a useful tool to obtain desired environmental results (Hakim & Yunus, 2017). External assurance through environmental audit programs confirmed the compliance of the internal motives of firms' ecocentric behavior (Prajogo et al., 2016). Organizations are conducting an external environmental audit for the continuous improvement strategy program (Bae & Seol, 2006). Comparatively, environmental audit is less explored with confirmation of internal EMP instrument effectiveness to achieve better environmental performance (Dogui et al., 2014). Accordingly, this study postulated the following hypothesis.

- **H_2:** Environmental audit moderates the relationship between EMP and environmental performance.

Based on the above discussion, the study framework is presented in Figure 1.

Figure 1: Framework of this Study



3. Research Methodology

To examine the study hypotheses, the target population for this study is S&P 500 listed firms. This study purposively selected S&P 500 listed firms because the United States is the second-largest carbon emitter after China. Moreover, several companies have adopted the external environmental audit program since 2006 (Bae & Seol, 2006). Firm-level data were compiled from two sources: the Asset4 database for environmental performance and EMP and financial data were extracted from the Thomson Reuters Worldsocpe database. The initial sample is based on 4,848 firm-year observations from 404 non-financial listed firms in the S&P 500, covering 12 years (2007-2018). After screening, we remove 2,253 firm-year observations due to missing information about environmental performance variables. The final sample of the study is 2,595 as table 1 depicts the industry-wise detail of the sample.

Table 1: Distribution of Sample Industry-Wise

Industry	No. of Observations	Percent
Consumer Discretionary	376	14.49
Consumer Staples	317	12.22
Energy	242	9.33
Health Care	299	11.52
Industrials	444	17.11
Information Technology	404	15.57
Materials	202	7.78
Telecommunication Services	48	1.85
Utilities	263	10.13
Total	2,595	100.00

3.1 Measures

Environmental performance is considered as a cardinal element in the framework of the corporate environmental accountability model. Environmental performance is measured by the natural log of the total carbon emission in tons (Haque & Ntim, 2018). Most of the previous studies proposed different measurement scales for EMP (Hartmann & Vachon, 2018: Montabon et al., 2007). While this study chosen a comprehensive EMP scale developed by Xie and Hayase, (2007) and statistically confirmed by Trump, Endrikat, Zopf, & Guenther, 2015). The EMP is calculated as a composite variable by five constructs that are environmental policy, environmental objectives, environmental processes, environmental organizational structure, and environmental monitoring. The detail of the EMP scale is mentioned in Annexure 1. An environmental audit is measured as, score 1 if the company has an external audit program for external assurance of their environmental and social activities otherwise 0 (Bae & Seol, 2006).

In line with the previous literature different firm characteristics are employed as control variables (Haque & Ntim, 2018; Hartmann & Vachon, 2018). The size of the firm is more likely an impact on the firms' capacity to adopt internal and external instruments for achieving the desired environmental performance. So, the size is controlled by the natural log of the total assets "firm size" and the natural log of the total employees denoted as "number of employees" (Hartmann & Vachon, 2018). The financial risk of the firm is controlled by the capital structure measured as total debt to equity ratio denoted as "leverage" and the profitability is controlled by the proxy of return on assets (ROA).

Board Size is measured by the natural log of the total number of members in the board committee is considered as a corporate governance control variable (Haque & Ntim, 2020). Whereas, technological orientation can positively influence the focal link between EMP and environmental performance (Li & Ramanathan, 2018) it is denoted as clean technology score 1 if the firm is using otherwise score 0. Firms disclosing their environmental investment initiatives information for signaling their pro-environmental behavior (Baboukardos, 2018). Environmental investment initiative is measured as score 1 if the company disclosed otherwise 0. This study winsorize all continuous variable at the level of 1% and 99% to control the effect of outliers. The source of all data sets used in this study is mentioned in table 2.

Table 2: Source of Data Set

Variables	Source
Dependent variable:	
Environmental Performance	ASSET4, ESG
Independent variable:	
Environmental Management Practices	ASSET4, ESG
Moderating variable:	
Environmental Audit	ASSET4, ESG
Control Variables:	
Firm Size	Worldscope
Number of Employees	Worldscope
Board Size	ASSET4, ESG
Leverage	Worldscope
Clean Technology	ASSET4, ESG
Environmental Investment	ASSET4, ESG
Return on Assets	Worldscope

Note: Measurement of each variable is mentioned in detail in section 3.1

3.2 Empirical Model

In equation 1, $EP\text{-}1_{it}$ denote for first lagged of environmental performance as a dependent variable, of firm i at time t. EMP donates environmental management practices as the main explanatory variable of the study. However, the measurement scale is mentioned in Annexure 1. Leverage, clean technology, number of employees, environmental investment initiatives, board size, firm size and return on assets are used as control variables denoted as Lev, C_Tech, Emp, Env_Inv B_Size, ROA, F_Size, respectively.

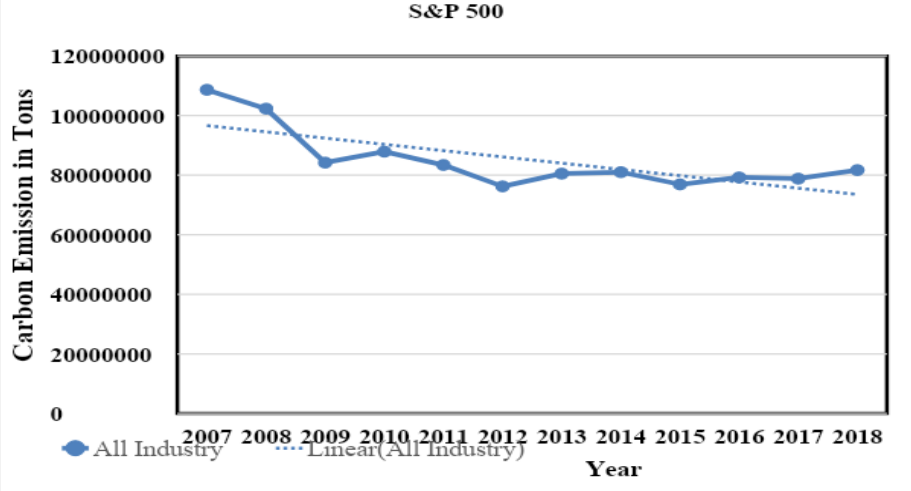
Detail measurement of all the study variables is mentioned in the variable measurement section 3.1. The time fixed effect is denoted by μit and ε_{it} for the error term.

$$EP\text{-}1_{it}=\beta 0+\beta 1\sum^{5}EMP_{it}+\beta 2Lev_{it}+\beta 3C\_Tech_{it}+\beta 4Emp_{it}+\beta 5Env\_Inv_{it}+\beta 6B\_Size_{it}+\beta 7ROA_{it}+\beta 8F\_Size_{it}+\mu it+\varepsilon_{it}. \quad (1)$$

In equation 2, $EP\text{-}1_{it}$ denote for first lagged of environmental performance as a dependent variable, of firm i at time t. EMP donates environmental management practices. However, the measurement scale is mentioned in Annexure 1. An environmental audit is denoted by E_Audit. Leverage, clean technology, number of employees, environmental investment initiatives, board size, firm size and return on assets are used as control variables denoted as Lev, C_Tech, Emp, Env_Inv B_Size, ROA, F_Size, respectively. Detail measurement of all the study variables is mentioned in the variable measurement section 3.1. The time fixed effect is denoted by μit and ε_{it} for the error term.

$$EP\text{-}1_{it}=\beta 0+\beta 1\sum^{5}EMP_{it}+\beta 2E\_Audit_{it}+\beta 3(\sum^{5}EMP*E\_Audit)_{it}+\beta 4Lev_{it}+\beta 5C\_Tech_{it}+\beta 6Emp_{it}+\beta 7Env\_Inv_{it}+\beta 8B\_Size_{it}+\beta 9ROA_{it}+\beta 10F\_Size_{it}+\mu it+\varepsilon_{it}. \quad (2)$$

Figure 2: Year-Wise Distribution of Total Carbon Emissions



4. Empirical Results and Discussion

Figure 2 shows the total carbon emissions produced by the S&P 500 listed firms and the trend for 2007 to 2018. The overall trend of total carbon emissions production is showing a decreasing trend. Between the periods of 2007 to 2009, carbon emissions decreased more rapidly due to less production in this financial crisis period. Whereas the trend between the periods of 2010- 2012 is much controlled and showing steadily decreasing due to the reduction in greenhouse gas emission in automobile and power plant sectors and provide funding for solar energy projects. Moreover, in 2013 and 2014 there is a slightly increasing trend but again come down in 2015. The major cause behind this slightly increasing trend is the GDP increase rate in this period. Even from 2016 to 2018 the GDP growth rate jump from 1.57% to 2.86%, there is not as much increasing trend shown. The major reasons behind this decreasing trend over the 12 years are the government environmental regulations, adoption of proactive environmental initiatives at firms' level, use of clean technology and use of environmentally friendly energy sources. The carbon emissions production pattern of S&P 500 firms will help to maintain environmental legitimacy and lead towards economic survival and growth.

Table 3: Descriptive Statistics

Variable	Obs.	Mean	SD	Min	Max
Environmental performance	2,595	13.99	1.87	11.22	16.95
EMP	3,941	12.03	6.91	1	31
Environmental audit	4,846	0.16	0.36	0	1
Leverage	3,574	0.290	0.16	0.00	0.797
Clean technology	4,848	0.12	0.33	0	1
Number of employees	3,662	10.11	1.34	6.67	12.96
Environmental investment	4,848	0.17	0.37	0	1
Board size	4,402	2.37	1.94	1.80	2.77
ROA	3,743	0.071	0.06	-0.19	0.26
Firm size	3,743	16.51	1.18	13.79	19.41

Note: please see section 3.1 for variable definitions.

Table 4: Correlation & VIF

Variables	1	2	3	4	5	6	7	8	9	10	VIF
Environmental performance (1)	1										1.44
EMP (2)	-0.004	1									1.44
Environmental Audit (3)	0.106	0.327	1								1.27
Leverage (4)	0.161	0.017	0.059	1							1.05
Clean Technology (5)	0.265	0.051	0.067	-0.004	1						1.09
Number of Employees (6)	0.124	0.301	0.045	-0.056	-0.036	1					1.56
Environmental Investment (7)	0.355	0.142	0.159	0.019	0.209	0.010	1				1.13
Board Size (8)	0.219	0.157	0.123	0.110	0.036	0.254	0.057	1			1.18
ROA(9)	-0.263	0.207	0.024	-0.161	-0.062	0.161	-0.005	-0.052	1		1.14
Firm Size (10)	0.525	0.153	0.197	0.017	0.151	0.488	0.239	0.338	-0.141	1	1.68

Note: please see section 3.1 for variable definitions.

Table 3 presents the descriptive statistics of the study variables. The S&P 500 listed firms' environmental performance mean value is 13.99 with the standard deviation of 1.87, showing that environmental performance data is less spread (more clustered) around the mean value. Whereas, the EMP value is widespread ranging from 1 to 31 with the mean value of 12.03 and SD value is 6.97. While, the mean value of environmental

audit shown that almost 16 percent of S&P 500 firms are adopted external environmental audit program. The mean value of leverage 0.29 showing that S&P 500 firms narrowly depend on external finance, which is comparable with (Moussa et al., 2020). The mean value of clean technology shown that only 12% of the sample firms are adopted clean technology measures. Almost 17% of firms have adopted the practices of environmental investment initiatives. The minimum ROA value is ranging from -0.19 to 0.26 percent. The mean value of board size, firm size, and number of employees 2.37, 16.51, 10.11 with SD 1.97, 1.18, 1.34 respectively are showing that widespread existed in S&P 500 listed firms. Table 4 depicts the bivariate correlation among all study variables. Environmental performance is negatively correlated with EMP as expected. While environmental performance is positively correlated with an environmental audit which means that those who are more polluters are adopting external audit programs to monitor their environmental targets. Moreover, all the correlations values are relatively low and VIF values are within the acceptable range. So multicollinearity does not exist in our model (Gujarati, 2009).

Table 5: Results of Regression Analysis

	Model 1	**Model 2**
Variables	Environmental Performance	Environmental Performance
EMP	-0.0174**	-0.0139*
	(0.0068)	(0.00761)
Environmental audit		0.7376***
		(0.2002)
Environmental audit*EMP		-0.0372***
		(0.0117)
Leverage	-0.3178*	-0.3247*
	(0.1849)	(0.1802)
Clean technology	0.1740**	0.1510**
	(0.0736)	(0.0763)
Number of employees	0.0572**	0.0617**
	(0.0258)	(0.0278)
Environmental investment	0.4493***	0.4273***
	(0.0904)	(0.0913)
Board size	-0.4982***	-0.5376***
	(0.1844)	(0.1906)
ROA	-2.5959***	-2.5354***
	(0.4783)	(0.4761)
Firm size	0.0534**	0.0514**
	(0.0256)	(0.0250)
Constant	14.8068***	14.8575***
	(0.4375)	(0.4498)
Year effects	fixed	fixed
Firm effects	random	random
Standard errors	robust	robust
Observations	1,619	1,619

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5 presents the hierarchical regression results. The results of model 1 confirm the hypothesis 1 that environmental management practice significantly improves the firms' environmental performance (β= -0.0174, $p < 0.05$). The results are consistent with the

prediction of the institutional theory that the adoption of EMP enhance environmental performance. The findings give more support to proactive EMP for achieving desired environmental performance and are in line with the previous studies (Arda et al., 2019; Famiyeh et al., 018; Moussa et al., 2020). The results are opposing the argument of (Heras-Saizarbitoria et al., 2020; Testa et al., 2018) that there are different ways to implement the EMPs instruments which can be influence on real environmental performance.

H_2 predicted that the interaction between environmental management practices and environmental audit is likely to have a significant impact on environmental performance. In model 2 the direct relationship between EMP and environmental performance remains significant at (β= -0.0139, $p < 0.10$). The main effect of the environmental audit is also significant but the sign has flipped (β= 0.7376, $p < 0.01$). The interaction effect is negative and significant as predicted (β= - 0.0372, $p < 0.01$). The results are in line with the (Hakim & Yunus, 2017; Prajogo et al., 2016). Firms are legitimating their operations by adopting external assurance about their operations. External assurance on management environmental practices is also a useful tool to justify the normative pressure of the firms. The target of environmental peace will not be achieved without advancing the structure and monitoring process on environmental activities. Control variables firm size is positively significant at (β= 0.0514, $p < 0.10$), which shows that the larger firms are producing a more huge amount of carbon emissions. Board size, leverage and profitability are negatively significant at (β= -0.5376, $p < 0.01$), (β= -0.3247, $p < 0.10$), and (β= -2.5354, $p < 0.01$) as predicted. Moreover, Environmental investment initiatives, clean technology and number of employees as a control variables are positively significant at (β= 0.4273, $p < 0.01$), (β= 0.1510, $p < 0.05$) and (β= 0.0617, $p < 0.05$).

5. Conclusion

This study examined the interactive role of environmental audit between EMP and environmental performance for S&P 500 traded companies, covering 12 years (2007-2018) with the institutional isomorphism framework. Several insights can be drawn from the estimated results of the study.

5.1 Contributions

First, the results of this study contribute and extend the existing literature by suggesting that internal environmental management practices are not only symbolic, rather a mandatory to achieve desire environmental performance. Second, the results show that external environmental audit is a useful tool to monitor the firm voluntary adoption of environmental practices. Third, the results empirically support the institutional theory that

firms are legitimating their actions at their private cost by adopting internal and external environmental practices to secure the desire environmental results.

5.2 Research Implication

The results of this study provide valuable guidelines to policymakers, managers, and investors. The results indicate that the adoption of EMP is no more option rather dying need to achieve the desired environmental performance. Internal voluntary adoption of EMP is more justified by the external assurance programs. Therefore, policymakers need to formulate proper guidelines about the internal and external environmental assurance programs. Managers need to understand the importance of EMP to achieve the potential competitive advantage. Moreover without the complementary adoption of continuous improvement tools of environmental practices zero-emission targets will not be achieved. Furthermore, rating agencies, analysts and fund managers need to consider external environmental assurance programs with internal EMP to rate the environmentally friendly companies.

5.3 Limitation and Future Research

Although the results are robust and important but have some limitations that may warrant future research considerations. First in this study, considered a single proxy of environmental performance by the log of total carbon emissions produced. Future research can extend the study by proposing a new measurement of environmental performance by using more than one environmental performance indicators. This study shedding light on internal and external environmental assurance programs, future research should focus on the moderating role of environmental investment between EMP and environmental performance. Finally, the focus of this study in US firms, future studies can add some other countries, which have different institutional and regulatory contexts.

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Annexure 1: Environmental Management Practices Scale

Environmental Policy

1. Does the company have a policy to improve its energy efficiency?
2. Does the company have a general, all-purpose policy regarding resource efficiency?
3. Does the company have a policy to improve its use of sustainable packaging?
4. Does the company have a policy to improve its water efficiency?
5. Does the company have a policy to lessen the environmental impact of its supply chain?
6. Does the company have a dematerialization policy?
7. Does the company have an eco-design policy?
8. Does the company have a product life-cycle assessment policy?
9. Does the company have a general, all-purpose policy regarding environmental product innovation?

Environmental Objectives

1. Has the company set targets or objectives to be achieved on energy efficiency?
2. Has the company set targets or objectives to be achieved on general resource efficiency?
3. Has the company set targets or objectives to be achieved on its use of sustainable packaging?
4. Has the company set targets or objectives to be achieved on water efficiency?
5. Has the company set targets or objectives to be achieved on the environmental impact of its supply chain?

Environmental Processes

1. Does the company use environmental criteria (ISO 14000, energy consumption, etc.) in the selection process of its suppliers or sourcing partners?
2. Does the company describe, claim to have or mention processes in place to include its supply chain in the company's efforts to lessen its overall environmental impact?
3. Does the company claim to use environmental criteria (e.g., life-cycle assessment) to source or eliminate materials?

4. Does the company describe, claim to have or mention processes in place to improve its energy efficiency?
5. Does the company describe, claim to have or mention processes in place to improve its resource efficiency in general?
6. Does the company describe, claim to have or mention processes in place to improve its use of sustainable packaging?
7. Does the company describe, claim to have or mention processes in place to improve its water efficiency?

Environmental Structure

1. Does the company train its employees on environmental issues?
2. Does the company have an environmental management team?
3. Does the company claim to have an EMAS certification?
4. Does the company describe, claim to have or mention processes in place to maintain an environmental management system?

Environmental Monitoring

1. Does the company claim to use key performance indicators (KPI) or the balanced scorecard to monitor energy efficiency?
2. Does the company claim to use key performance indicators (KPI) or the balanced scorecard to monitor resource efficiency in general?
3. Does the company claim to use key performance indicators (KPI) or the balanced scorecard to monitor its use of sustainable packaging?
4. Does the company claim to use key performance indicators (KPI) or the balanced scorecard to monitor water efficiency?
5. Does the company claim to use key performance indicators (KPI) or a balanced scorecard to monitor the environmental impact of its supply chain?
6. Does the company conduct surveys of the environmental performance of its suppliers?

Adapted from (Trump et al., 2015), score 1 if the information is available otherwise 0.