



From Capability to Sustainability: Managerial Ability, ESG Practices and Carbon Performance

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ARTICLE INFO

Article History:

Received:	May	07, 2026
Revised:	June	03, 2026
Accepted:	June	12, 2026
Available Online:	June	19, 2026

Keywords:

Managerial ability; ESG practices; Carbon performance; Sustainability; Environmental management; Pakistan; Emerging markets

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DOI: <https://doi.org/10.59075/tamsaal.v4i6.90>



ABSTRACT

The growing severity of climate change has increased pressure on firms to improve environmental sustainability and reduce carbon emissions. Although existing studies have examined the role of ESG practices in achieving sustainability objectives, limited attention has been given to how managerial capabilities contribute to corporate carbon performance and the mechanisms through which this relationship occurs. This study addresses this research gap by investigating the impact of managerial ability on carbon performance and examining the mediating role of ESG practices in the relationship between managerial capability and environmental outcomes. Using a longitudinal panel dataset of 180 non-financial firms listed on the Pakistan Stock Exchange from 2016 to 2025, this study analyzes approximately 1,800 firm-year observations. Managerial ability is measured using the efficiency-based approach proposed by Demerjian et al. (2012), ESG practices are constructed through a comprehensive disclosure index, and carbon performance is assessed using firm-level carbon efficiency indicators. Empirical analysis employs fixed-effects regression, mediation analysis, and System Generalized Method of Moments (System GMM) to control unobserved heterogeneity and potential endogeneity issues. The findings indicate that managerial ability has a significant positive effect on corporate carbon performance, suggesting that capable managers are more effective in implementing environmental strategies and improving resource efficiency. Furthermore, managerial ability positively influences ESG practices, and ESG practices significantly enhance carbon performance. The mediation analysis confirms that ESG practices partially transmit the effect of managerial ability on carbon performance, highlighting the importance of sustainability-oriented organizational mechanisms. This study contributes to the literature by integrating Upper Echelons Theory, Resource-Based View, and Stakeholder Theory to explain how managerial capabilities are transformed into environmental improvements through ESG implementation. The findings provide valuable implications for managers, investors, and policymakers seeking to strengthen corporate sustainability practices and accelerate carbon reduction efforts in emerging economies.

Introduction

Climate change is among the greatest challenges faced by businesses, governments and societies around the world. The pressure on businesses to implement sustainable operational policies and strategies and minimize their environmental impacts has been growing due to increasing GHG emissions, environmental degradation, and risks to the environment due to climate change. As a result, corporate sustainability has moved from "doing the right thing" to an integral part of strategic management. Environmental, Social and Governance (ESG) practices have become a significant framework within which organizations can integrate sustainable goals, stakeholder expectations and processes for responsible governance in their decision-making processes (Friede et al, 2015; Gillan et al, 2021).

Carbon performance has been getting more and more attention by both academics and managers among the various sustainability indicators, as carbon emissions are one of the main sources of global climate change. Corporate carbon performance is an indicator of the ability of companies to reduce GHGs, to increase the efficiency of their energy use and to adopt environmental responsible practices (Matsumura et al., 2014). Prior research has shown that companies with a better environmental strategy are more likely to be more carbon efficient and to realize better long-term sustainability results (Busch and Hoffmann, 2011; Trumpp et al., 2015). But there is a wide range of practices among companies in ascertaining how well they convert their sustainability promises into real environmental changes, which indicates that internal organizational capacities need to be explored.

Managerial ability is a basic organizational skill that impacts the way companies use resources, formulate strategies and tackle new environmental issues. The Upper Echelons Theory suggests that the nature of an organization's outcomes is heavily influenced by its executives' characteristics, since their actions have a direct impact on the strategic options used, resource allocation, and corporate priorities (Hambrick & Mason, 1984). Better managers typically have improved analytical, experience and decision making abilities, which allow them to recognize sustainability opportunities and to incorporate environmental concerns into their business plans (Demerjian et al., 2012). There is recent evidence that the manager's competence plays a significant part in the improvement of companies' carbon performance, as it boosts the firm's capacity to implement environmental strategies and decrease emissions (Zhao et al., 2023).

The managerial capability – sustainability outcomes link can also be viewed as a valuable internal resource for the firms, which can be leveraged to gain competitive advantage by effectively utilizing the resources (Barney, 1991). So, from this viewpoint, it is possible for good managers to contribute to sustainability changes by creating effective ESG policies, strengthening environmental governance and allocating resources to green innovation. Therefore, the managerial capacity can be a crucial determinant of corporate ESG performance and environmental sustainability.

While there has been a considerable body of research into the finances and markets implications of ESG practices, little research has focused on the channels of action that impact carbon outcomes from managerial competence. The literature shows that the practices of ESG have positive effects on enhancing transparency, engaging stakeholders, and enhancing decision-making processes for sustainability (Eccles et al., 2014; Fatemi et al., 2018). ESG practices also can be an organizational journey to transform managerial skills into environmental outcomes,

however. Recent research has underscored the significance of organizational sustainability systems in achieving the connection between managerial skills and carbon emission reductions, with the performance of ESG emerging as a mechanism that helps realise this link.

This is a relationship that needs to be examined in the context of the emerging markets. The institutions may be less developed in the developing countries, as may be sustainability disclosure standards and environmental regulations. The study context is relevant for Pakistan as the country is highly vulnerable to climate change and is also undergoing rapid industrial development with the increased environmental pressures. While the increase in ESG-related practices by Pakistani companies is a positive trend encouraged by investor expectations, regulatory requirements and international standards for sustainability, there is limited evidence of the role of management quality in enhancing carbon performance (Ahmad et al., 2024).

This study aims to fill this research gap by investigating if managerial ability affects corporate carbon performance and if ESG practices acts as a mediator between managerial ability and carbon performance. This study uses panel data for non-financial companies (NFC) with listing on the Pakistan Stock Exchange from 2016 to 2025 to shed light on the role of managerial skills in achieving environmental sustainability goals in an emerging economy.

This study contributes to the literature in many ways. First, it takes sustainability research to a next level, going beyond the direct impact of sustainability practices on environmental results and drawing attention to managerial capabilities as an internal organisational factor. Second, it adds to the Upper Echelons Theory in terms of showing how managerial attributes relate to corporate environmental strategies. Third, it expands the RBV literature to demonstrate how managerial skill can be translated into sustainability benefits when it is applied to implementing ESG. Last, this study offers new evidence from an emerging economy where sustainability transitions are not well studied, namely in Pakistan.

The rest of this paper is structured as follows: In section 2 the relevant literature is reviewed and hypotheses are formulated. The methodology and characteristics of the data is spelled out in Section 3. Empirical findings and robustness analyses are given in Section 4. Theoretical and practical implications, limitations and future research directions are discussed in Section 5.

Literature Review and Hypothesis Development

Theoretical Foundation

Upper Echelons Theory

The Upper Echelons Theory (Hambrick and Mason, 1984) suggests that the behaviour of the top managers has a profound effect on the performance of the organization. This view sees managers as strategic decision makers whose capabilities are influencing the decisions, resource allocations and longer-term strategic direction of the organization. Managerial characteristics are especially significant in shaping firms' environmental strategies because of the uncertainty, long-term investment and multiple stakeholder expectations that drive many sustainable decisions.

Good managers are more likely to view environmental issues from a strategic perspective and see them as opportunities, rather than just compliance requirements, in a corporate context of sustainability. Managers who have strong analytical abilities and decision-making skills will be

better able to assess the environmental risks, allocate resources efficiently, and develop strategies that promote sustainability. Some past work has indicated that managerial competency influences firms' environmental actions due to a higher information processing capacity and more proactive behavior on the part of high-ability managers (Demerjian et al., 2012; Hambrick & Mason, 1984).

New research also shows that managerial skills affect corporate environmental results. Zhao et al. (2023) discovered that managerial competency is a significant factor to enhance carbon performance in highly polluting firms because of its ability to utilize resources effectively and inform environmental decision making. Likewise, recent studies suggest that the management team's capability can affect ESG performance as well since their quality is essential in the implementation of sustainability systems and the incorporation of ESG aspects in corporate strategies (Cao et al., 2025).

Thus, UET serves as the theoretical basis to understand how the managerial abilities of firms can drive their carbon performance and ESG implementation.

Resource-Based View

According to Barney (1991) in his Resource Based View (RBV), the firm can generate competitive advantages from the use of valuable, rare, inimitable and non-substitutable resources. From this point of view, managerial capability is a key intangible organizational resource as it increases a firm's capacity to use the other organizational resources effectively (physical, financial and knowledge resources).

Companies need to build up their internal capabilities to facilitate environmental innovation, the efficient use of resources and the reduction of emissions to achieve the sustainability transformation. Experienced managers have the ability to establish sustainable organizational practices, enhance environmental governance processes, and embed environmental, social and governance goals into business strategies. For this reason, managerial skills are regarded as an internal factor that can help firms to obtain better environmental performances.

This is backed by previous studies, which have found that managerial competence is linked to ESG performance, as competent managers are able to coordinate and respond to the expectations of stakeholders in sustainability efforts more effectively (Cao et al., 2025). ESG practices, from the RBV point of view, are organizational capacities that have been built as a result of effective managerial decisions and that subsequently lead to better carbon performance.

Managerial Ability and Corporate Carbon Performance

Carbon performance is now a critical metric for measuring corporate environmental sustainability, as it directly measures the effectiveness of the company's efforts to reduce greenhouse gases and enhance operational efficiency. But in addition to environmental technologies, excellent carbon performance would require good managerial choices in relation to resource allocation, innovation uptake and implementing sustainability strategy.

Highly skilled managers should have a greater capacity to enhance carbon performance as they can solve problems better and have better knowledge processing skills. Demerjian et al. (2012) define managerial ability as the ability of the managers to utilize the organizational resources

productively. The capabilities enable the manager to detect inefficiencies in the operation, to choose the cleaner technologies, and to develop effective strategies to reduce emissions.

Recent empirical studies have confirmed the managerial ability-carbon performance link. Zhao et al. (2023) investigated the effect of managerial competence on the carbon performance of Chinese companies with high pollution levels. They conclude that the high quality managers improve the efficiency of the environment by optimizing production processes and by adopting good practices to reduce carbon emissions.

As well, managers with greater ability are more apt at seeing the threats of climate change and incorporating environmental goals into company strategies. Good managers can combine short-term profit goals with long-term sustainability considerations to enhance firms' environmental performance.

But most studies have been conducted in developed economies or in industries which are heavily regulated, and there is little evidence from emerging markets like Pakistan. Managerial capability could be even more important in the carbon outcomes in developing countries, where environmental regulations and sustainability mechanisms are less robust and therefore are less likely to drive the desired changes.

Given the above arguments, it is proposed that the following is a hypothesis:

H1: The managerial ability is positively related to company carbon performance.

Managerial Ability and ESG Practices

Environmental, Social and Governance (ESG) practices are an integrated approach that companies integrate sustainability issues into strategic decision-making, stakeholder management and corporate governance. External factors like regulatory demands, investor expectations and societal expectations compel companies to act on ESG, but whether they do it well or not depends on how well the internal organization can do it. One of the internal capabilities that has become a key driver of the sustainability performance of companies is managerial skill.

The Resource Based View (RBV) posits that the managerial ability is a valuable intangible resource that can help firms perform better by optimizing the use of organizational resources (Barney, 1991). Managers who have higher capabilities have more robust skills in problem-solving, information-processing and have a broader strategic perspective, enabling them to recognise the opportunities to achieve sustainability and to embed environmental, social and governance (ESG) goals within business activities. Thus, the more capable the managers are, the more likely they will be to create effective environmental policies, improve sustainability disclosure and strengthen their ESG systems.

Demerjian et al. (2012) defined managerial competence as managers' effectiveness in generating outputs from an organization's resources, holding constant the attributes of the organization. This measure is popular in the recent literature on the relationship between management ability and corporate performance. The expectation of capable managers is that investments in sustainability can benefit the organization, e.g., by enhancing its reputation, stakeholder trust, operational efficiency and risk reduction (Eccles et al., 2014; Fatemi et al., 2018) in the long-term.

There are recent empirical studies that confirm the positive correlation between manager skill and ESG performance. Awareness of the higher value added of manager skill to ESG performance is demonstrated by Cao and others (2025), which find that better managerial skill has a significant positive effect on ESG performance due to the performance improvement of able managers in coordinating ESG-related activities and implementing environmental, social and governance mechanisms. Ahmad et al. (2024) also revealed that managerial competence enhances the performance of ESG in emerging Asian countries by boosting the capacity to address institutional and stakeholder demands.

Such a correlation between managerial ability and ESG practices is not consistent, however. However, according to some studies, highly capable managers might consider economic goals and short-term efficiency over sustainability investments, especially when focusing on long-term economic gains from environmental measures. An example of this is the situation where managerial skills can have a negative impact on ESG results, as some more capable managers can make strategic compromises for sustainability goals at the expense of short-term profits (Lin, 2025). The contrasting results show different effects for the managerial effect on ESG practices based on the institutional conditions, stakeholder pressure and orientation of sustainability of organizations.

Managerial skill might be even more important in emerging markets like Pakistan, where the sustainability institutions are weaker and the regulatory regime is not as strict. Managers have the ability to overcome institutional constraints through self-imposed movement towards ESG practices, to enhance sustainability reporting, and to establish environmental management systems.

The above theoretical arguments and past empirical findings suggest the following hypothesis:

H2: Managerial ability has a positive impact on ESG practices.

ESG Practices and Corporate Carbon Performance

ESG practices have emerged as a crucial tool for enhancing the environmental performance of corporations, as they push companies to incorporate sustainability aspects into their operations and strategic planning. The environmental aspect of ESG is given special consideration for reducing emissions, energy efficiency, pollution control, and climate risk management. By effective implementation of ESG, companies can develop environmental management systems in a manner that helps them to reduce carbon and enhance ecological performance.

Stakeholder Theory offers a theory behind the correlation between ESG practices and carbon performance. Freeman (1984) suggested that companies need to take into account several types of stakeholders such as governments, investors, communities, and environment (green) organizations to obtain sustainable growth. The growing awareness of climate change among stakeholder groups has placed a high priority on companies to cut their carbon footprints and show environmental stewardship.

Previous studies have shown that companies with better ESG practices tend to have more positive environmental results. According to Eccles et al. (2014), companies with high sustainability practices are able to have more efficient organizational processes, and

consequently to perform better in the long run. Likewise, in thousands of empirical studies, Friede et al. (2015) showed that ESG practices have positive effects on organizational outcomes.

In terms of carbon performance in particular, Busch and Hoffmann (2011) proposed that proactively engaging with the environment could facilitate a company's reduction of its carbon intensity by better resource efficiency and technological innovation. Trumpp et al. (2015) also highlighted the importance of the capacity of the company to integrate environmental goals into operational processes and strategic planning in determining environmental performance of the company.

There can be several ways that ESG practices can enhance carbon performance. First, companies with ESG goals are more likely to set emission reduction targets, and put in place environmental monitoring systems. Second, more robust ESG governance induces managers and employees to be more environmentally responsible. Third, disclosure of ESG drives greater transparency and accountability and minimizes information asymmetry between firms and stakeholders (Fatemi et al., 2018).

Recent empirical studies also support the positive link between ESG performance and CO₂ emissions reduction. Organizational capability to reduce carbon emissions, in turn, affects ESG performance, which partially mediates the relationship between managerial ability and carbon emission reduction, as presented by Setiabudi et al. (2026), showing that ESG systems are among the pathways through which organizational capability impacts environmental outcomes.

Despite the growing global focus on ESG, there are still limited data on ESG from developing countries. The greater financial limitations and weaker environmental laws and public awareness of sustainability in emerging markets could affect the impact of the implementation of ESG. Hence, the case of Pakistan offers insights on the relationship between ESG and carbon performance, particularly in the developing markets.

The above arguments lead to the following hypothesis:

H3: ESG practices are effective in improving corporate carbon performance.

Mediating Role of ESG Practices Between Managerial Ability and Carbon Performance

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While managerial ability can have a direct impact on carbon, there is a lack of understanding of how managerial capability becomes an environmental benefit. This study suggests that the ESG practices are a key mechanism of mediation between managerial ability and carbon performance.

The Upper Echelons Theory suggests that the manager's decisions in terms of strategic choices and allocation of resources are what affect organizational outcomes (Hambrick & Mason, 1984). But a management skill does not necessarily translate to better environmental results. Rather, the capacities of managers need to be translated into systems and sustainability that tangibly contribute to environmental gains.

ESG practices make such an organizational mechanism. Managers who are more able have greater awareness of the strategic value of sustainability and are more likely to have set up environmental policies, stakeholder engagement, governance procedures and sustainability reporting. This benefits carbon performance through encouraging practices to reduce emissions, increase operational efficiencies, and promote environmental innovations.

The mediation effect of the ESG practices is also in line with RBV theory. Managerial ability is an internal resource, and ESG practices are its organizational capabilities that have been acquired by making a good use of the resources. Only successful institutionalization of ESG practices by capable managers can provide superior environmental outcomes for a firm that are likely to be more difficult to achieve by other firms.

There is recent evidence for this mediation viewpoint. Setiabudi et al. (2026) revealed that the performance of ESG is an intermediary variable that environmental, social, and governance performance affects the reduction of carbon emissions in both developed and developing countries based on managerial ability. This discovery points to the need for sustainable organizational systems to produce environmental benefits in order to have managerial ability.

H4: ESG practices mediate the relationship between managerial ability and corporate carbon performance.

Conceptual Framework

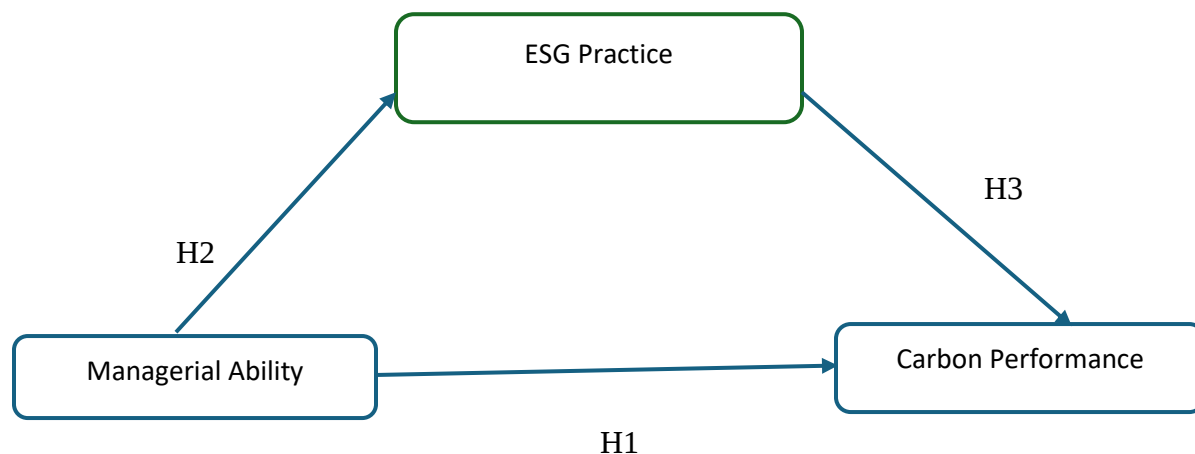


Figure 1: Showing relationship between dependent and independent variable with moderated variable.

Research Design and Data Collection

The study uses a quantitative research design, using a longitudinal panel-data approach to examine the relationship between managerial ability, the implementation of ESG practices and the corporate carbon performance in the Pakistani corporate context. A panel data methodology is suitable since it allows to compare between firms and over time, while accounting for the effects of unobservables that affect the sustainability results within the firm (Wooldridge 2010). This study is based on non-financial companies that are listed on Pakistan Stock Exchange (PSX) from 2016 to 2025. Pakistan is the right place to conduct research due to its rising climate-related

challenges and the rising pressure on the government, investors, and international bodies to perform better in terms of sustainability and environmental responsibility. ESG reporting and carbon management are still in development in Pakistani companies, and there is little empirical research on how the internal managerial capabilities are associated with better environmental outcomes. Initially all the firms listed on the Pakistan Stock Exchange were included. As per the previous sustainability studies and corporate governance studies, financial sector firms were not included as banks, insurance companies or financial institutions are regulated differently and also have different financial reporting systems from non-financial firms. Additionally, firms that lacked full financial data or annual reports and others with insufficient ESG and environmental disclosure data were eliminated to guarantee data consistency and quality.

With the application of the selection criteria 180 non-financial firms were selected for the final sample covering the period 2016-2025. This resulted in an expected panel dataset of approximately 1,800 firm-year observations (180 firms $\times$ 10 years). The chosen firms are from various industrial areas and for empirical analysis sufficient sectoral diversity has been ensured by the selected firms, which are manufacturing, textile, cement, energy, chemicals, fertilizer, automobile, technology and consumer goods sectors.

Annual reports and financial databases are used to gather financial information such as total assets, profitability, sales revenue, leverage, and other firm characteristics. Data regarding ESG is sourced from company annual reports, sustainability reports as well as environmental disclosures of sample companies. Carbon performance information comes from the environmental disclosures, sustainability reports and any statements companies are able to make about carbon emissions.

A ten-year time span (2016-2025) is deemed adequate as it provides sufficient temporal variation to reflect change in the sustainability strategies and performance of firms. Moreover, the study period is long enough for it to consider the changing practices of ESG in Pakistan as more and more people and other institutions are focused on climate governance and sustainable business practices.

Sample Selection Procedure

The sample selection process was conducted systematically to ensure the availability and reliability of required financial, ESG, and environmental information. The final sample determination is presented below.

Sample Selection Criteria	Number of Firms
Total firms listed on Pakistan Stock Exchange	520
Less: Financial sector firms excluded	(150)
Non-financial firms considered	370
Less: Firms with incomplete financial information	(120)
Less: Firms without sufficient ESG/environmental disclosures	(70)
Final sample firms	180
Study period	2016–2025
Total firm-year observations	1,800

Data Structure and Panel Characteristics

The final dataset represents a firm-year panel structure, where each observation corresponds to a specific firm in a particular year. The panel framework provides several methodological advantages, including controlling for omitted variables, reducing estimation bias, and improving the reliability of causal inference (Baltagi, 2021).

The general structure of the dataset can be expressed as:

$$Dataset = Firm_i \times Year_t$$

where i represents individual firms (1–180) and t represents annual observations from 2016 to 2025. This longitudinal structure allows the study to examine whether changes in managerial ability and ESG practices are associated with improvements in corporate carbon performance over time.

Justification of Sample Size

For this study, the selected sample size of 180 firms and about 1,800 firm-year observations is deemed to be adequate because detailed non-financial information is not easily available for all the listed companies for ESG and carbon performance analyses. Smaller samples are typically used in emerging markets in similar studies where there are restrictions in the availability of sustainability disclosures.

Furthermore, the panel length of 10 years allows for the use of regression analysis, fixed-effects estimation, mediation analysis, and robustness testing with dynamic panel methods like System Generalized Method of Moments (System GMM). As such, the chosen sample is representative of the population with adequate statistical power and quality of data and is comparable between companies.

Econometric Model Specification

To examine the relationships among managerial ability, ESG practices, and carbon performance, this study employs panel data regression models with firm fixed effects and year fixed effects. Fixed-effects estimation controls for unobservable firm-specific characteristics that remain constant over time, while year fixed effects capture macroeconomic and regulatory changes affecting all firms. The empirical models are specified as follows.

Model 1: Effect of Managerial Ability on Carbon Performance (H1)

$$CP_{it} = \beta_0 + \beta_1 MA_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 AGE_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Model 1 examines the direct effect of managerial ability (MA) on corporate carbon performance (CP). The coefficient β_1 measures whether firms managed by highly capable managers achieve better carbon performance after controlling for firm characteristics. A positive and statistically significant value of β_1 supports Hypothesis 1, indicating that managerial ability contributes to improved environmental performance through efficient resource utilization and strategic environmental decision-making. Firm size (SIZE), leverage (LEV), profitability (ROA), and firm

age (AGE) are included as control variables because they may also influence firms' environmental performance.

Model 2: Effect of Managerial Ability on ESG Practices (H2)

$$ESG_{it} = \alpha_0 + \alpha_1 MA_{it} + \alpha_2 SIZE_{it} + \alpha_3 LEV_{it} + \alpha_4 ROA_{it} + \alpha_5 AGE_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Model 2 investigates whether managerial ability influences the implementation of ESG practices. The coefficient α_1 represents the impact of managerial ability on ESG performance. A positive and significant coefficient indicates that capable managers are more likely to establish sustainability policies, improve ESG disclosure, and integrate environmental, social, and governance considerations into corporate strategy. This model provides empirical evidence for Hypothesis 2.

Model 3: Effect of ESG Practices on Carbon Performance (H3)

$$CP_{it} = \gamma_0 + \gamma_1 ESG_{it} + \gamma_2 SIZE_{it} + \gamma_3 LEV_{it} + \gamma_4 ROA_{it} + \gamma_5 AGE_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Model 3 evaluates whether ESG practices improve corporate carbon performance. The coefficient γ_1 measures the effect of ESG implementation on carbon performance after controlling for firm-specific characteristics. A positive and statistically significant coefficient supports Hypothesis 3, suggesting that firms with stronger ESG practices are more effective in reducing carbon emissions and improving environmental efficiency.

Model 4: Mediation Model (Testing H4)

$$CP_{it} = \delta_0 + \delta_1 MA_{it} + \delta_2 ESG_{it} + \delta_3 SIZE_{it} + \delta_4 LEV_{it} + \delta_5 ROA_{it} + \delta_6 AGE_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Model 4 examines the mediating role of ESG practices in the relationship between managerial ability and carbon performance. Both managerial ability and ESG practices are entered simultaneously into the regression model. If the coefficient of ESG practices (δ_2) is positive and statistically significant, while the coefficient of managerial ability (δ_1) decreases compared with Model 1 but remains significant, ESG practices partially mediate the relationship. If δ_1 becomes statistically insignificant, full mediation is indicated. This model is used to test Hypothesis 4, explaining the mechanism through which managerial ability influences carbon performance.

Dynamic Panel Robustness Model (System GMM)

To address potential endogeneity, reverse causality, and dynamic persistence in carbon performance, this study employs the System Generalized Method of Moments (System GMM) estimator.

$$CP_{it} = \theta_0 + \theta_1 CP_{i,t-1} + \theta_2 MA_{it} + \theta_3 ESG_{it} + \theta_4 SIZE_{it} + \theta_5 LEV_{it} + \theta_6 ROA_{it} + \theta_7 AGE_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

The System GMM model incorporates the lagged dependent variable ($CP_{i,t-1}$) to capture the dynamic nature of carbon performance over time. This estimator addresses potential endogeneity arising from omitted variables, simultaneity, and reverse causality by using internal instruments derived from lagged values of the variables. The validity of the model is assessed using the Hansen test for over-identifying restrictions and the Arellano–Bond AR(2) test for second-order serial correlation. A significant positive coefficient for managerial ability and ESG practices in this model confirms that the main findings are robust even after controlling for endogeneity concerns.

Empirical Results and Analysis

Descriptive Statistics

The descriptive statistics show that there are significant differences in the managers' capability, ESG practices and carbon performance between companies in Pakistan. The overall mean score of 0.486 indicates that sampled companies have implemented around 49% of the evaluated ESG disclosure practices, indicating that sustainability reporting is in its nascent stages in Pakistan. The mean of managerial ability score is 0.612 which is considered as moderate efficiency of the selected companies in using the organizational resources.

The standard deviations show that there is adequate variation between the firms which is required for regression analysis. The carbon performance variable is variable across companies, reflecting differences in environmental efficiency and carbon management practices.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Carbon Performance (CP)	1800	0.342	0.214	0.021	1.245
Managerial Ability (MA)	1800	0.612	0.153	0.214	0.921
ESG Practices (ESG)	1800	0.486	0.172	0.120	0.870
Firm Size (SIZE)	1800	16.842	1.524	13.210	21.654
Leverage (LEV)	1800	0.421	0.193	0.050	0.890
Profitability (ROA)	1800	0.087	0.072	-0.210	0.340
Firm Age (AGE)	1800	3.421	0.612	1.098	4.890

Table 1 presents the descriptive statistics of all variables used in the empirical analysis. The results include the mean, standard deviation, minimum, and maximum values.

Correlation Analysis

The correlation results show that managerial ability is positively associated with carbon performance ($r = 0.312$, $p < 0.01$), suggesting that firms with more capable managers tend to achieve better environmental outcomes. Similarly, ESG practices demonstrate a significant positive correlation with carbon performance ($r = 0.426$, $p < 0.01$). This indicates that firms implementing stronger ESG mechanisms generally exhibit superior carbon management. The correlation between managerial ability and ESG practices is also positive and significant ($r = 0.391$, $p < 0.01$), providing preliminary support for the proposed theoretical relationship. No

correlation coefficient exceeds 0.70, suggesting that multicollinearity is unlikely to affect regression estimates.

Table 2: Correlation Matrix

Variables	CP	MA	ESG	SIZE	LEV	ROA
CP	1					
MA	0.312***	1				
ESG	0.426***	0.391***	1			
SIZE	0.284***	0.215***	0.367***	1		
LEV	-0.116**	-0.052	-0.091*	0.132**	1	
ROA	0.218***	0.256***	0.192***	0.165***	-0.143**	1

Notes: *** p<0.01, ** p<0.05, * p<0.10

Multicollinearity Test

The VIF values range between 1.17 and 1.56, which are considerably below the recommended threshold of 5 (Hair et al., 2019). Therefore, multicollinearity does not represent a concern in the regression models.

Table 3: Variance Inflation Factor (VIF) Analysis

Variables	VIF	Tolerance
Managerial Ability	1.42	0.704
ESG Practices	1.56	0.641
Firm Size	1.38	0.725
Leverage	1.21	0.826
ROA	1.19	0.840
Firm Age	1.17	0.855

Panel Regression Results

The coefficient of managerial ability is positive and statistically significant ($\beta = 0.284$, $p < 0.01$), indicating that firms with more capable managers achieve superior carbon performance. This finding supports H1. The result confirms the Upper Echelons Theory perspective that managerial characteristics influence strategic environmental decisions. Capable managers are better able to allocate resources efficiently, adopt cleaner technologies, and implement effective emission reduction strategies. The results indicate that managerial ability has a significant positive influence on ESG practices ($\beta = 0.391$, $p < 0.01$). Therefore, H2 is supported. This finding suggests that highly capable managers are more likely to establish sustainability frameworks, improve ESG disclosure, and integrate environmental responsibility into corporate strategies.

ESG practices demonstrate a significant positive relationship with carbon performance ($\beta = 0.351$, $p < 0.01$). Thus, H3 is supported. The finding indicates that firms with stronger ESG systems achieve better environmental outcomes because ESG mechanisms promote emission monitoring, sustainability governance, and environmental innovation.

Table 4: Fixed Effects Regression Results**Dependent Variable: Carbon Performance**

Variables	Model 1	Model 2
Managerial Ability	0.284*** (0.041)	0.176*** (0.039)
ESG Practices		0.351*** (0.052)
Firm Size	0.094***	0.071***
Leverage	-0.082**	-0.061**
ROA	0.143***	0.112***
Firm Age	0.039*	0.028*
Constant	0.218***	0.167***
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	1800	1800
R²	0.31	0.42

Notes: ***p<0.01, **p<0.05, *p<0.10

Mediation Analysis

The mediation results demonstrate that ESG practices significantly mediate the relationship between managerial ability and carbon performance.

The indirect effect of managerial ability through ESG practices is positive and significant ($\beta = 0.137$, $p < 0.01$). Since the direct effect of managerial ability on carbon performance remains significant after including ESG practices, ESG practices partially mediate this relationship.

Therefore, H4 is supported. This finding indicates that managerial ability improves carbon performance not only directly but also indirectly by enabling firms to develop stronger ESG systems.

Table 5: Mediation Effect of ESG Practices

Relationship	Direct Effect	Indirect Effect	Total Effect	Result
MA → CP	0.176***		0.284***	Significant
MA → ESG → CP		0.137***		Partial Mediation

Robustness Test: System GMM

The System GMM results confirm the robustness of the main findings. Managerial ability and ESG practices remain positively associated with carbon performance after controlling for potential endogeneity concerns.

The Hansen test confirms instrument validity, while the insignificant AR(2) test indicates the absence of second-order serial correlation. Therefore, the results provide additional confidence in the estimated relationships.

Table 6: System GMM Estimation**Dependent Variable: Carbon Performance**

Variables	Coefficient
Lag Carbon Performance	0.421***
Managerial Ability	0.193***
ESG Practices	0.284***
Firm Size	0.064**
Leverage	-0.052*
ROA	0.091***
Hansen Test (p-value)	0.312
AR(2) Test (p-value)	0.421
Observations	1800

Hypothesis Summary

Hypothesis	Relationship	Result
H1	Managerial Ability → Carbon Performance	Supported
H2	Managerial Ability → ESG Practices	Supported
H3	ESG Practices → Carbon Performance	Supported
H4	ESG Practices mediates MA–CP relationship	Supported

Discussion

The results show that managerial capability has a positive significant impact on company's carbon performance, which confirms Hypothesis 1. The finding makes it clear that more capable managers help their firms obtain better environmental results by optimizing their resources, planning their businesses for sustainability, and implementing their sustainability programs efficiently. The result aligns with the argument of Upper Echelons Theory that organizational outcomes are determined by the attributes and abilities of their highest-level decision makers (Hambrick & Mason, 1984). Managers who are more capable have better cognitive skills, more experience and greater analytical ability, enabling them to identify environmental risks and to embed sustainability goals into company strategies.

This finding builds on the existing literature on managerial capacity and shows that managerial competence can not only boost financial efficiency, it can also help achieve environmental sustainability. Previous research has focused mainly on managerial capacity and its impact on firm performance, innovation and operational efficiency (Demerjian et al., 2012), but this work emphasizes the greater importance of managerial capacity as a way of mitigating climate change. The discovery aligns with the results presented by Zhao et al. (2023) who reported that managerial competence boosts carbon performance by increasing firms' competency to optimize their resources and to implement strategies to reduce emissions. This positive correlation between managerial capability and the carbon performance is especially important in Pakistan as the country's institutional setting is still in a state of flux, with evolving environmental laws and a lack of sustainability infrastructure. In such settings, managerial discretion becomes more significant as it is possible to offset the institutional shortcomings by taking environmental measures, enhancing energy efficiency, and investing in cleaner technologies voluntarily. The

results, however, also add to the on-going debate over the relative importance of external pressures vs. internal resourcefulness in influencing sustainability outcomes. The findings indicate that stakeholder and regulatory pressures may drive firms to mitigate emissions, but that managerial ability is an important internal factor that influences their ability to respond to environmental pressures.

The findings show the positive relationship between managerial ability and ESG practices, which supports Hypothesis 2. This discovery indicates that effective management is more inclined to see the strategic significance of sustainability and adopt a formal ESG mechanism in their organization. The outcome is consistent with the Resource-Based View (RBV) which sees managerial capability as an important intangible resource that can help a firm build unique organizational capabilities (Barney, 1991). Managers with more skill will be more likely to be able to assess long-term benefits of sustainability investments when they incorporate ESG into strategic decision-making. Implementing ESG can be challenging for organizations and demands a significant level of coordination, information processing, and resource allocation. Hence, companies with competent management are likely to have a successful sustainability reporting system, environmental policy, and governance.

The finding is in line with earlier studies on managerial attributes and their impact on corporate ESG performance. For instance, Eccles et al. (2014) demonstrated that companies with higher sustainability orientations will create better organizational processes and gain performance benefits over the long term. Likewise, Fatemi et al. (2018) highlighted that the success of ESG implementation requires both disclosure and internal managerial commitment and governance. The findings offer fresh insights in Pakistan where ESG practices are less advanced than in the developed world. Adopting sustainability in emerging markets can be more influenced by interpretation and voluntary choices of management rather than enforcement. As a result, good managers are key to making sustainability work more than just a compliance issue, but a strategy for the organization.

The results suggest that there is a significant positive association between ESG practices and corporate carbon performance, which is evidenced by the results, thus supporting Hypothesis 3. The findings also support the idea that firms with more effective ESG systems generate better environmental results by better monitoring, accounting, and making decisions that are more focused on environmental sustainability. This finding corresponds with the Stakeholder Theory, which proposes that companies will act responsibly in line with expectations from investors, regulators, customers and communities (Freeman, 1984). Companies can begin tackling stakeholder concerns about climate change and environmental responsibility by implementing ESG practices.

The positive correlation between ESG practices and carbon performance aligns with previous studies which found that companies with a sustainability focus are more likely to implement environmental innovations, enhance energy efficiency and cut their emissions (Busch & Hoffmann, 2011; Trumpp et al., 2015). ESG mechanisms motivate companies to set environmental goals, track environmental-related activities, and increase transparency when it comes to environmental impacts. This is especially significant for Pakistan as these issues of carbon disclosure and environmental management are still in their infancy. Companies that have better ESG practices could benefit from increased regulatory compliance, responsible investor attraction and stakeholder legitimacy. Thus, ESG practices are not just environmental

management tools but also are strategic approaches to enhance corporate sustainability performances.

However, the results should be viewed in the context of being a result of the institutional structure in Pakistan. While in developed markets ESG practices are largely motivated by the need to comply with the mandatory climate regulations, in Pakistan, firms may consider ESG initiatives mainly because of the expectations of international markets, pressure by investors, or reputation. Therefore, more comprehensive measures to implement ESG regulations can further improve the impact of sustainability action. Mediation analysis results indicate that the relationship between managerial ability and carbon performance is partially mediated by ESG practices, which lend support to Hypothesis 4. The central contribution of this study that is the result of this finding is that it tries to explain the mechanism by which managerial capabilities relate to environmental outcomes. While effective management is a direct driver of carbon performance, their impact will be amplified through formal ESG systems and sustainability initiatives. This implies that managerial skills are not enough, managerial skills need to be institutionalized in the organization's processes in order to enable environmental responsibility.

The mediation finding provides support for the extension of the Upper Echelons Theory, which emphasizes that managerial attributes shape the organizational environment via strategic decisions. It further builds on the RBV approach by demonstrating that managerial skill is a resource that is built and enhanced by ESG practices, which are then manifested as an organizational capability that can be translated into sustainability benefits. The discovery aligns with the recent sustainability literature which proposes that ESG performance serves as a link between managerial features and environmental performance. This study emphasizes the role of ESG mechanisms as a transmission mechanism, whereas previous studies have mainly focused on the direct links between managerial characteristics and sustainability performance.

Conclusion

In this study, the correlation between Managerial ability, ESG practices and Corporate Carbon performance of 180 non-financial companies from Pakistan Stock Exchange for the time frame 2016-2025 has been investigated. Given the rising significance of corporate sustainability and climate responsibility, the study examines the role that managerial ability has on the environmental impact of the firm and whether the ESG practices offer a pathway for managerial ability to help guide firms to improved carbon performance. The results show that managerial competence is important for improving the carbon performance of the company. Companies led by more competent executives have a greater chance at using resources effectively, implementing environmental strategies, and responding to climate related issues. The results corroborate the predictions of the Upper Echelons Theory, confirming that managerial characteristics have an impact on organizational strategic environmental choices and sustainability results. In addition, the research shows that managerial capability is positively associated with ESG practices, indicating that more capable managers are more likely to develop systems in their organizations that are more oriented towards sustainability, strengthen ESG disclosure and incorporate environmental aspects into business plans. The findings also indicate that ESG practices make a significant contribution to carbon performance through environmental governance, greater accountability and assisting with emission reduction programs. One of the most important findings of this study is the discovery of ESG practices as a mediator between managerial ability

and carbon performance. The results show that management skills do not automatically lead to improved environmental results, but rather management skills to structured ESG practices and these structured practices to measurable improvements in sustainability. This evidence contributes to the sustainability literature by providing evidence of how internal managerial resources will be transformed into environmental benefits via organizational sustainability mechanisms. Theoretically, the study fills the gap by applying the Upper Echelons Theory, Resource Based View and Stakeholder Theory to create a model that explains the relationship between managerial capability and environmental sustainability. In practice, the results highlight the need to build the leadership skills and improve the ESG frameworks of companies from emerging markets. This study concludes that, through the effective managerial capacities and the robust implementation of ESG, the companies' work in the field of carbon reduction and sustainable development can be accelerated.

Implications of the Study

On a practical level, the results suggest that in addition to recruiting qualified managers, institutions ought to establish institutional frameworks that allow managers to use their skills for the implementation of sustainability strategies. The ability to manage may not necessarily be matched with carbon improvements without ESG frameworks.

This study makes a number of theoretical contributions. First, it builds on the concept of Upper Echelons Theory in that it shows that managerial characteristics affect not just financial performance but also environmental sustainability performance. The research illustrates the role that managerial competence plays in organisational responses to climate issues. Second, the study extends the RBV concept by making an identification that ESG practices are an organizational capability which is built through the managerial resources. The results show that beneficial internal resources have to be made into sustainability habits to create environmental benefits. Third, the study introduces the concept of integration between Stakeholder Theory and managerial capabilities perspectives, as it demonstrates that the internal managerial resources and external sustainability expectations work together to create the environmental outcomes of corporations.

Limitations

Although this study makes important theoretical and empirical contributions, there are a number of limitations to recognize.

Firstly, the study is limited only to non-financial firms listed on Pakistan Stock Exchange, which restricts the generalizability of results across the countries, industries and institutional environments. While Pakistan is a case of an emerging market, sustainable practices and regulatory frameworks are vastly different across economies. Hence, further studies are needed to test if the relationships identified are consistent across other developed and developing markets.

Second, sustainability reporting and disclosure are a key basis for ESG measures and are publicly available. While disclosure-based ESG measures have been well adopted in previous research, they may not necessarily reflect the actual sustainability performance due to the variation in disclosure quality, transparency, and communication among companies. Potential

future studies should include third party ESG ratings, environmental audits, or verified carbon emission data to enhance the accuracy of measurement.

Third, Fourth, this study is of a quantitative nature that relies on the panel data approach, and only statistical relationships are identified, but not the managerial decision making processes. Qualitative methods, including interviews with executives and sustainability managers, may offer more insight into the process of how companies create and execute their ESG strategies.

Future Research Directions

In light of the above limitations, several suggestions are made for future research.

First, future studies need to broaden geographic scope, making comparative analyses across various emerging economies and/or between developing and developed markets. For example, this study might explore the impact of institutional quality, environmental regulation or stakeholder pressure on the managerial ability–ESG–carbon performance nexus.

Second, future research can explore other moderators which might affect the effectiveness of managerial ability in improving environmental outcomes. Environmental regulations, green innovation capability, digital transformation, board sustainability expertise, institutional ownership, and the quality of the corporate governance are potential moderators.

Third, future research should investigate other aspects of environmental performance other than carbon emissions, such as energy efficiency, green innovation, circular economy practices, waste reduction and biodiversity protection. A more comprehensive sustainability view might offer greater insights into managerial capacities' role in corporate environmental transformation.

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