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Corporate Governance and Environmental & Social Governance Practices: An Empirical Analysis of Companies Listed on the Pakistan Stock Exchange

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Abstract
This study examines the influence of the Chief Executive Officer's personal and professional characteristics on research and development spending and corporate environmental and social governance practices in Pakistan. The study investigates 150 listed firms in the Pakistan Stock Exchange from 2015 to 2022. The study employed regression analysis OLS, fixed effects, and random effects to comprehensively investigate the nexus between CEO characteristics, research and development spending, and firm ESG commitments. The empirical estimations denoted that CEO tenure and duality negatively affect the firm R&D spending and ESG practices. While CEO education and experience support the firm R&D spending significantly contributed towards the corporate ESG commitments. Moreover, the aged CEOs also found hesitant to follow and invest in the technological trends and ESG activities. The study also finds that firm size positively affects firm spending on R&D along with corporate ESG practices, while firm leverage has a negative impact on R&D spending and ESG activities. The findings of this study provide valuable insights for scholars, business owners, investors, business elites, and policymakers in Pakistan and other developing economies with similar corporate governance mechanisms.
Key words: CEO Characteristics; Firm R&D spending; Corporate Governance; Corporate Environmental & Social Governance; Pakistan Stock Exchange (PSX)

Introduction
Corporate governance has been focused on by researchers for the last two decades as the world-renowned firms collapsed due to a lack of effective corporate governance frameworks. Corporate governance is a contributing factor in any economy of the country as successful corporations can impart the economic growth

of a country. Keeping in view the dire need for a well-established mechanism of corporate governance, firms are desperate to develop strong corporate governance mechanisms to get the trust and confidence of the stakeholders and to move ahead in terms of investments, growth, and efficiency. While strengthening the corporate framework, firms are making efforts to establish a strong professional board and management with experience, profession, and competencies to overcome their corporate issues. The characteristics of a CEO have gained importance since the demise of the corporate meltdown in 2008. Corporate governance mainly nowadays revolves around the CEO and board characteristics as in most instances the corporate uplifting has been acknowledged due to the effective use of board and CEO characteristics. In light of this scenario, The Chief executive officer's role got importance among Executives to govern a firm. Hence, CEO characteristics have also been a key research focus in corporate governance, among developed countries. However, CEO characteristics have been extensively addressed but the findings have not yet converged. Similarly, the CEO plays a very important role in firms' strategic decision-making, investments, R&D spending, and operational performance (Chen, H. L. 2014; Wang, G., et al., 2016). Furthermore, Bear, S Rahman, et al. (2010) hypothesized that the chief executive has a significant impact on the strategic decision-making developments in the broader context of the external environment, firm R&D spending, and corporate social responsibility. The upper-echelon theory also supports the notion that strategic decision-making is influenced by top managers' values and perceptions (Hambrick & Mason, 1984). Moreover, in light of the upper echelon theory, researchers have often argued that the CEO attributes can be used to explain the extent of a firm R&D spending (Gils, P. M. 2022) and corporate environmental and social responsibilities (Villalba-Ríos, et al. 2022; Venugopal, A., & Nerur, et, Al. 2023). However, CEOs are considered the important players who have the power to support or challenge R&D spending by devoting their time and energy to it, or the other way around. Hence, influential CEOs can choose which R& Dprojects to fund based on current initiatives (Chen et al., 2014). While, existing studies denoted the long-term, favorable, and direct relationship between CEO administration and R&D spending (Naaman, C., & Sun, L. 2022; Makri et al., 2006).

Stakeholders play a crucial role in the process of value creation according to stakeholders' theory (Rensburg, R., & De Beer, E. 2011; Vos 2003). The existing research demonstrates that sustainability does not necessarily translate into financial gain, but novel research suggests that corporate social responsibility (CSR) and corporate ESG engagements may provide value for shareholders and in certain cases, even support high levels of research and development (Coluccia et al., 2020). Corporate ESG practices are the key essential to the accomplishment of the long-term value that would help to increase the firm competitive edge and advancement (Ludke, R. 2022; Godos-Díez et al., 2018). Nowadays, stakeholders consider the ESG practices and standards within the organization along with the firm financial performance and growth of the businesses (López-Arceiz et al., 2018; Galera, A. N., De Los Ríos Berjillos, et al., 2014; Van Duuren et al., 2016; Ludke, R.

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2022). Subsequently, to seem more socially and ecologically conscious, an increasing number of businesses are disclosing ESG practices. A company's R&D intensity and other capacities may be improved by ESG practices, which subsequently strengthen the firm competitive advantage (Coluccia et al., 2020).
This study examines and highlights the influence of the personal and professional qualities of the chief executive that can influence the firm R&D spending and corporate ESG practices within the context of Pakistan. There is much evidence in the prior literature that the Chief executive traits affect the firm performance. The focus on Pakistani firms in this study emphasizes the need to improve understanding of the nexus between CEO traits and firm R&D spending and corporate ESG engagement. The study in hand contributes to the body of knowledge in several ways, it extends the prior research by examining the link between CEO personal and professional traits with firm R&D spending and corporate social responsibilities in the case of an emerging economy like Pakistan. In addition to this, the study identifies the prevailing practices being practiced in Pakistani-listed firms. Furthermore, it provides positive insights to the scholars, investors, and shareholders. The literature has mixed results about the characteristics of CEO and firm's performance, especially for developing countries. One of these investigations, which is established for the hypothetical and exact piece of the current study, reports a connection between CEOs characteristics namely CEO tenure, CEO duality, CEO education, experience, and the age of CEO with firm R&D spending and ESG activities. It is, however, not obvious how solid the effect of the referenced CEO qualities on the company's R&D spending and ESG practices genuinely is and how much significance one ought to at last join to the detailed relationship. The reason for this exploration proposition is along these lines to look at how emphatically a CEO's attributes impacted the R&D spending and ESG commitments of the Pakistan Stock Exchange listed firms. In the Pakistani context, this study is a novel work as the Chief Executive traits and firm R&D spending and ESG practices are rarely touched. Furthermore, to validate the results this study used the generalized method of moments, pooled ordinary least squares, FE, and RE models in a single study, which is a methodological addition in the Pakistani context. Related literature is determined to single odd estimation therefore no such concrete study exists in the existing corporate governance domain. The rest of the study settings are organized as follows. Section 2 highlights the relevant literature followed by the methodology of the study in Section 3. In section 4 empirical results of the study are documented. The robustness of the tests falls under section 5. Section 6 presents the discussion and conclusion of the study.

Literature Review and hypothesis development

In Corporate Governance, CEO characteristics as a topic have a very vast literature. The issue with such tremendous literature is that it has been composed of different viewpoints from sociological, natural, institutional, and ordinary administration hypotheses and effectiveness speculations. The aim of the writing on CEO personal and professional characteristics, firm R&D spending, and corporate ESG practice is

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to provide insights to help divergent outcomes.

The nexus between CEO tenure and firm R&D spending has been a matter of considerable debate in academic and public arenas. However, CEO tenure is a very important debatable attribute, whether it has a significant or insignificant impact on R&D spending and corporate ESG activities. Existing literature presents mixed empirical findings as a whole. For instance, Chen, H. L. (2013) demonstrates that CEO tenure and R&D spending have a considerable positive correlation. Hsu, W. T. & Chen, et, al. (2020) also hypothesize the positive correlation between Chief Executive tenure and a company's expenditure on R&D. Furthermore, proposed that CEO tenure also serves as an indicator for enlarging the investment in technology and increasing overall firm growth. Chen, H. L. (2013) cited that CEO tenure has positively affected the research and development spending and investments of the companies.

Similarly, many scholars reported that CEO tenure has negatively affected the firm R&D spending and ESG commitments (Mezghanni, B. S. 2010, May; Li, M., & Yang, J. 2019). Kao, L., & Chen, A. (2020) also found that the tenure of the CEOs has insignificantly affected the firm R&D spending and corporate ESG practices. Prior studies have reported mixed findings regarding the influence of CEO tenure on a firm's R&D investments and ESG commitments. In light of the above discussion, we propose the following hypothesis to explore how CEO tenure shapes strategic decision-making in these areas.

H1. CEO Tenure has a negative effect on firm R&D spending
H1a. CEO Tenure has a negative effect on firm ESG Practices

CEO duality is another important debatable attribute among executive Characteristics. In most of the firms, if CEOs serve as CEO and chairman this practice is known as "CEO duality". It is regarded as a two-edged weapon because holding both positions justifies the CEO's power and control (Rehman, A., et al., 2021). Opponents of this perspective argue that the combination of CEO and chairperson roles can hinder the board's effectiveness in fulfilling its governance responsibilities, often stemming from the inherent conflict of interest between the CEO and the board of directors (Oradi and Izadi 2019; Ozdemir et al., 2022). CEO duality in board composition, a characteristic influenced by the upper echelon theory (Finkelstein et al., 1992; Jermias 2007), posits that characteristics and risk-taking tendencies of top-level managers can influence strategic decisions and subsequent organizational performance and investment decisions (Hambrick & Mason, 1984). Being the CEO and chairperson of the firm is believed to actively influence organizational development and R&D initiatives (Lin J, 2014). However, the existing research on the impact of a CEO dual position on R&D intensity and firm performance presents divergent findings. CEO duality, advocated by Blibech & Berraies, 2018 establishes a robust communication channel, mitigating potential miscommunication between board members and the CEO, ultimately contributing to enhanced overall performance. This perspective suggests that having the same individual in both roles can prevent miscommunication and reduce incongruities in expectations and actions among top-line managers and executive directors. Li and Tang (2010) further assert that CEOs wield more influence when duality is present, while Chen et al. (2014) demonstrate that duality encourages risk-taking behaviors among Chief Officers.

However, Critics argue that CEO duality undermines the board's ability to function effectively and increases the likelihood of opportunistic actions by the individual serving as both CEO and chairperson. Research by Şener & Elçi, (2009) highlights the negative impact of CEO duality on the connection between R&D investment and innovation. Similarly, Herrmann et al. (2014) identify a detrimental relationship between duality and R&D intensity in international firms based in the United States. Further, Li and Yang (2019) emphasize the adverse effects of CEO duality on R&D expenditure in high-tech firms during their IPOs. In contrast, separating the CEO and chairperson roles enables better oversight of directors' decisions and minimizes potential agency issues (Jensen, 1996). Kao and Chen (2020) support the notion that non-duality enhances the positive correlation between CEO tenure and exploratory innovation. Consequently, it is expected that CEO duality negatively affects R&D spending.

H2: CEO duality insignificantly affects the firm R&D spending
H2b: CEO duality insignificantly affects the firm ESG practices.

The upper echelons theory posits that the educational background of CEOs has a significant impact on organizational policies and innovation capabilities (Hambrick & Mason, 1984; Barker & Mueller, 2002; Harymawan et al., 2020). Research indicates that leaders' educational attainment positively influences their social skills, with managers holding post-graduate degrees demonstrating enhanced problem-solving abilities compared to those with undergraduate education (Hambrick & Mason, 1984; Barker & Mueller, 2002). Highly educated individuals are more likely to perceive change as an opportunity for growth rather than a threat (Dutton & Jackson, 1987), resulting in highly educated CEOs being less risk-averse and more receptive to new ideas, changes, and developments in R&D (Bantel & Jackson, 1989). Chen (2004) and Escribá-Esteve et al. (2009) suggested that advanced education, such as an MBA, adopts conformity and conventionality among business professionals. CEOs with higher educational qualifications are often better positioned to analyze market trends and adapt to unexpected situations, enabling them to make strategic investment decisions effectively (Finkelstein et al., 1996; Oradi et al., 2022).

Several studies have highlighted a positive relationship between the education level of top management teams and R&D investment (Finkelstein et al., 1996; Escribá-Esteve et al., 2009). Higher education among top executives is often linked to a greater openness to change, innovation, and new ventures (Escribá-Esteve et al., 2009; Harymawan et al., 2020). Additionally, well-educated management teams are more inclined to support long-term initiatives (Dalziel et al., 2011). Education contributes to enhanced analytical abilities, improved handling of complex information, and a broader knowledge base. A CEO's educational background significantly influences their cognitive capabilities and problem-solving skills, increasing their willingness to pursue new projects. Previous research demonstrates a strong association between CEO education and factors such as innovation (Chang et al., 2017), technology adoption (Lindorff & Prior Jonson, 2013), advanced information analysis (Escribá-Esteve et al., 2009), and R&D spending (Malmendier & Tate, 2005). Consequently, organizations led by highly educated CEOs are more likely to allocate resources to R&D, as R&D investments often align with technological advancements, cognitive complexity, and the risk-taking tendencies of such CEOs (Bantel & Jackson, 1989; Chen et al., 2004; Loukil et al., 2022; Camelo-Ordaz et al., 2015). Building on these findings, we propose the following hypothesis.

H3. CEO Education significantly affects the firm's R&Dspending.
H3c. CEO Education significantly affects the firm's ESG practices.

Another important attribute that is widely discussed in the literature is the experience of the CEOs. The existing literature highlights the significance of a CEO's professional expertise in a firm R&D spending (Guner, Malmendier, & Tate, 2008). Prevailing research validates that executives and directors with strong credentials, aptitude, and experience are more likely to improve business growth and firm strategic directions like R&D spending and investment decisions (Dalziel, et al., 2011; Kor, Y. Y. 2006; Daellenbach, U. S, et al., 1999). However, many researchers hypothesized the significant association between CEO experience and firm R&D spending and corporate ESG disclosure. For instance, Hafner-Burton, Hughes, and Victor (2013) mentioned that experienced CEOs have more specific knowledge of firms and by utilizing their cognitive ability could make better decisions to monitor and execute the problems and to deliver valuable resources that may improve public confidence. Jiang, H., & Liu, C. (2020) explored the significant positive nexus between CEO experience and firm R&D spending. Heyden, M. L., et al., (2018) suggests that CEOs with substantial experience tend to prioritize long-term growth and innovation, leading to increased R&D spending. This aligns with the upper echelons theory, which posits that executives draw upon their past experiences to inform strategic choices (Hambrick & Mason, 1984). The influence of CEO experience extends beyond financial considerations to encompass a firm's commitment to ESG practices. CEOs with a wealth of experience are often more attuned to the broader societal and environmental implications of business operations. Unruh, G. et al., (2016) indicate that CEOs with a track record of managing ESG-related challenges are more likely to integrate sustainability practices into the core strategy of the firm. CEO experience can impact ESG practices through various channels, including stakeholder management, regulatory compliance, and the incorporation of ESG metrics into performance evaluations. Grove, H., Clouse, M., & Xu, T. (2022) highlight the role of CEO experience in

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navigating complex ESG-related issues, emphasizing the importance of prior experiences in handling sustainability challenges.

CEOs with professional qualifications and relevant experience can make wise strategic decisions and take R&D initiatives (Wang, Q., Pei, X., & Liang, H. (2022). According to Erickson, Park, et al. (2005), experienced CEOs are better positioned to oversee operational activities effectively and efficiently manage ESG activities. Experience enables CEOs to draw upon past encounters to make effective decisions in the present (Le, S., & Kroll, M. 2017). The strategic decisions made by executives significantly affect firms, and experience plays a crucial role in shaping these decisions. There is ample evidence that CEO experience positively influences how businesses allocate resources, including R&D spending and corporate ESG commitments. Kang, S. Y. (2023) argued that CEOs and executive directors with more experience possess a deeper understanding of the external environment, allowing them to navigate complexities such as R&D investment and ESG initiatives more effectively. Hence the study considers the following hypothesis.

H4. CEO Experience positive effectiveness on Firm R&D spending
H4d. CEO Experience positive effect on Firm ESG practices

CEO age is another attribute that can significantly impact a firm's allocation of resources toward R&D spending and its commitment to ESG practices. The existing research exploring CEO characteristics suggests that the age of the CEO plays a role in shaping the firm's R&D investment intensity and corporate ESG goals (Hussain, M. J., et al., 2023). However, Al-Shammari, et al., (2022) argue that firms led by younger CEOs tend to allocate more resources towards R&D spending and are more proactive in adopting ESG practices, ultimately leading to better performance. On the other hand, Hsu, W. T. et al., (2013) suggest that older CEOs demonstrate a higher level of commitment and experience, which can contribute to the firm's success and overall corporate performance.

While few studies, such as Amran (2011) and Dwivedi et al. (2018), assert that older CEOs are more instrumental in enhancing firm value, others, including Jiang, H., & Liu, C. (2020), Pletzer et al. (2015), and E-Vahdati, S., & Binesh, F. (2022), suggest that the age of the CEO has no significant impact on the firm's performance or its R&D spending and ESG practices. Therefore, it remains inconclusive within the literature whether younger or older CEOs are more effective in driving R&D spending, and ESG commitments.

H5: The age of CEOs has an adverse effect on a firm's R&D spending and ESG practices.
H5e: The age of CEOs has an adverse effect on a firm's R&D spending and ESG practices.

Methodology
Data Sample

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In social sciences selecting an appropriate research paradigm for comprehensive investigation is very important (Burrell and Morgan, 2017). The positivist paradigm is used in the current study to develop the hypothesis, which is tested through statistical analysis. However, deductive approaches are implemented in the study rather than inductive approaches. Therefore, quantitative research is designed to explore the nexus between COE attributes and firm R&D spending and ESG practices. Thus, the study analyzed a sample of 150 listed companies in the Pakistan Stock Exchange. The study utilized those firms' data whose data is available during the period from 2015 to 2022. CEO's demographic and professional attributes and firm R&D spending extracted from the Company's financial accounts/reports and official websites of the respective company., we approached the different data streams and social sites like Thomson Router, Bloomberg, LinkedIn, and Wikipedia of sample firm CEOs. Further, the corporate Environmental and Social Governance score is imported from Eikon Thomson Reuters's database https://eikon.refinitiv.com/. In the current study two control variables, FS and FL are also employed and data is collected from respective company annual accounts and SBP reports.

Variables, Definition, and Measurements

The study utilized R&D spending and ESG activities as Dependent variables. In this study Firm research and development spending was recognized as (R&D), environmental and social governance practices (ESG). The R&D spending and ESG proxy are commonly used by researchers in the existing literature. R&D is the most widely used indicator of financial performance in the existing body of literature. It represents the effectiveness of a firm's assets in generating returns. The effective and efficient utilization of the firm's assets contributes to the maximization of returns. In this study, we assess and define the firm's ROA as the firm's total net income divided by the sum of total current and fixed assets for a specific period. ROE is another important proxy of financial performance that predicts the effective utilization of the shareholder's equity and investment to generate income for the firm. It is also calculated as the total income of the firm divided by the equity of the firm for a specific period. The third proxy Tobin's Q also represents financial performance in this study. This proxy shows the firm's market performance. This study operationally defines it as the market value of equity and book values of total assets minus the book values of equity divided by the total assets' book values. Many researchers documented Tobin's Q in their research (M. Binacci et al. 2016b).

This study used CEO Compensation and Experience as independent variables. In the modern-day business world, the salary of the CEO and board can be an effective strategy to enhance the firm's performance. CEO compensation is the salary along with bonuses and other privileges. To measure this variable, the study used a natural log of the total salary, bonuses, and other privileges. Many previous studies have used this measurement (Abbasi, Banbhan, & Shaikh, 2021). The study verifies the experiential prods the theoretic consideration about the effect of the

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CEO and their experience and their competencies in a firm. The effect of a CEO having much experience is international, firm, and functional experiences (Costa, & Brettel, et al. 2018).

The study used the firm size as a control variable where we take a natural log of total assets that appear at the end of the year in the financial accounts of a firm (B. D. Nguyen & Nielsen, 2010). FL which is also taken as a control variable in this study. The control variable has been contained to the study because of supposition and their effectivity on the profitability of the firm, as the previous study also validates similar findings (Akbas & Karaduman, 2012).

Table 1: Variable definition and measurement

Sr. No	Variables	Sign	Definition/ Measurement	Reference
A)	**Dependent Variables**			
1	Firm R&D spending	r&d	Corporate research and development spending divided by total sales (missing data is recorded as "0")	Asad, M., Akbar, S., Li, J., & Shah, S. Z. A. (2023)
2	Corporate Environmental & Social Governance	ESG	For ESG proxy the study utilized a 0 to 100 score	Almulhim, A. A., & Aljughaiman, A. A. (2023)
B)	**Independent Variables**			
1	CEO Tenure	TEN	CEO tenure by holding the position of CEO since his/her appointment.	Peni, (2014), Chen et al., (2019), Cucculelli, (2018)
2	CEO Duality	DUAL	The dummy variable of 1, increase CEO holds both positions and 0 otherwise	H. T. S. Pham & Tran, (2019); A. Ujunwa, (2012); Chang et al, (2019); Qadorah et al., (2018)
3	CEO education	EDU	dummy variable e.g., 1 for CEO having postgraduate business education and professional business education (ACCA, ICMA, CPA, CA) and 0 otherwise	(Darmadi S, 2013; A. Ujunwa, 2012), Setiawan & Gestanti, 2018

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4	CEO Experience	EXP	reflected in his or her initial compensation	(Bragaw & Misangyi, 2017)
5	CEO Age	AGE	Age is considered by categorizing CEOs into four age groups, i.e. (i) below 46 years, (ii) 46–55, (iii) 56–65, and (iv) above 65	(Amran, 2011; I. H. Lee & M. R. Marvel, 2014) ,Jadiyappa,et al., 2022, Ullah et al., 2019
C)	**Control Variables**			
1	Firm Size	FS	The natural log of total assets appears at the end of the year in the annual reports of a firm.	(V. Nguyen, 2020)
2	Firm Leverage	FL	The ratio of total debts to total assets	(Iqbal & Usman, 2018)

Econometric Model and Estimation Techniques

The study has used various panel estimation models of data analysis techniques to measure the nexus of the CEO characteristics and firm R&D spending and corporate ESG commitments. The Panel data attitudes are greater to cross-sectional and time-series for its single qualities (Crossley, Fisher, & Low, 2021). Among explanatory variables, the panel data ignored the heterogeneity problem and also considered the multicollinearity issues (Barros, L. A. et al., 2020). The study employed Methodology considering prior studies that used Pooled Ordinary Least Square, FE, RE model, and Generalized Method of Moment. Pooled OLS is the appropriate estimation technique for panel data and it covers equally observable and unobservable variables and simultaneously provides reliable and effective results (Adekeye, K.et al., 2021). Kontopantelis et. Al, (2013) defined the importance of heterogeneity in case of unobservable effects, that can't be ignored, stand volatile, and capture the heterogeneity, by considering this fixed and Random effect models are utilized. Further, GMM estimation is also employed to address the econometric issues that cannot be occupied by OLS, FE, and RE estimators. The study prefers GMM to employ the first differences between the regressor and dependent variables. The lagged dependent variable is instrumented with precedent levels in GMM to get rid of the autocorrelation issue. When independent variables are sedulous, this modeling strategy may produce an ineffective result (Arellano & Bover, 1995). Therefore, we use the following panel estimation techniques.

Generalized Method of Movement

$$R\&D_{it} = \beta_o + \beta_1 R\&D_{i,t-1} + \beta_2 TEN_{i,t} + \beta_3 DUAL_{i,t} + \beta_4 EDU_{i,t} + \beta_5 EXP_{i,t} + \beta_6 AGE_{i,t} + \beta_7 FS_{i,t} + \beta_9 FL_{i,t} + \varepsilon_{i,t} \quad (1)$$

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$$ESG_{it} = \beta_o + \beta_1 ESG_{i,t-1} + \beta_2 TEN_{i,t} + \beta_3 DUAL_{i,t} + \beta_4 EDU_{i,t} + \beta_5 EXP_{i,t} + \beta_6 AGE_{i,t} + \beta_7 FS_{i,t} + \beta_9 FL_{i,t} + \varepsilon_{i,t} \quad (2)$$

$Y_{i,t}$ is the Dependent variables
$X_{i,t}$ is the vector of explanatory variables
β is a vector of limitations to be assessed
Y_i is the individual result
$\varepsilon_{i,t}$ Is the error term

Pooled Ordinary Least Square Model

$$Y_{i,t} + \beta_{X\,i,t} + az_i + \varepsilon_{i,t} \quad (3)$$

Fixed Effect Model

$$Y_{i,t} + \beta_{X\,i,t} + a_i + \varepsilon_{i,t} \quad (4)$$

Random Effect Model

$$Y_{i,t} + \beta_{X\,i,t} + a + \mu_i \varepsilon_{i,t} \quad (5)$$

In addition, the study used two models for each estimator to account for R&D and ESG in models 1, and 2, respectively.

Empirical Results
Correlation Analysis

Table 02 presents the correlation analysis of the study. CEO tenure demonstrates a positive but weak correlation with R&D and ESG proxies in the context of Pakistan. Similarly, this implies that CEOs with dual positions are not supporting the R&D investments and ESG commitments. Likewise, CEO education and experience have a positive strong correlation with firm R&D spending and ESG practices, which means that highly educated and experienced CEOs are better at investment decisions like R&D and adopt innovative technological trends. Moreover, aged CEOs are also not a good choice for R&D spending and ESG practice in the context of Pakistan. Firm size demonstrates a strong significant correlation between R&D spending and ESG activities. Firm leverage shows a negative correlation with firm R&D and ESG commitments in the context of Pakistani listed firms.

Table 2: Correlation Analysis

	1	2	3	4	5	6	7	8	9
R&D	1.000								
ESG	0.121	1.000							
TEN	0.098	0.091	1.000						
DUAL	-0.361	-0.311	0.006	1.000					

EDU	0.425	0.429	0.029	1.000	1.000				
EXP	0.421	0.411	0.003	0.007	0.014	1.000			
AGE	-0.078	-0.069	0.009	0.031	0.105	0.081	1.000		
FS	0.521	0.571	0.109	0.173	0.079	0.781	0.111	1.000	
FL	-0.571	-0.519	-0.000	0.015	-0.014	-0.019	0.071	0.089	1.000

GMM Estimation Technique

The study uses two separate models that are R&D and ESG respectively. It means that model-1 is for R&D being used as a dependent variable while model-2 represents the ESG as a dependent variable in the GMM modeling approach that has been used in this research. In Table 3, the results of the GMM technique establish that the CEO tenure has a negative and statistically insignificant effect in the context of Pakistan, on the firm R&D spending and corporate ESG commitments as predicted in both models, the coefficients are statistically insignificant. In this regard, many previous footprints suggested the same kind of findings (Xu, J. et al., 2021). Likewise, the duality is negative but statistically significant for R&D spending and ESG activities. Similarly, the CEO's education and experience also show a positive and statistically significant impact on firm R&D spending and ESG practices, asserting that more experience of the CEO can be vital to uplift the firm. Results of this study have been also previously validated in many studies (Sampson, R. C. 2005; E-Vahdati, S., & Binesh, F. 2022; Chen, C., et al., 2024). The study contribution of the control variable firm size is statistically positive and significant to the firm R&D spending in both models that are being used in the GMM estimator, firm Leverage coefficients of this study demonstrate that firms with supplementary debts do not enjoy the financial revivals and it has a negative significant effect on corporate ESG commitments.

Table 3: GMM Result

	Model-1 GMM	Model-2 GMM
TEN	-0.181	-0.119
	(0.422)	(0.159)
DUAL	-0.302***	-0.839***
	(0.000)	(0.001)
EDU	0.352***	0.331***
	(0.000)	(0.000)
EXP	0.345***	0.326***
	(0.000)	(0.000)

AGE	-0.288***	-0.249**
	(0.000)	(0.029)
FS	0.399***	0.401***
	(0.000)	(0.000)
FL	-0.401***	-0.331***
	(0.000)	(0.000)
	0.412***	-
	(0.000)	-
	-	0.378***
	-	(0.000)
J-stat	0.789	0.759
AR (1)	(0.000)	(0.000)
AR (Bhagat et al.)	0.612	0.528

Note: *** means the significance level at 1 percent level.

Robustness of Tests

Table 4 shows the findings of the OLS, Fixed, and Random effect approach that the tenure of chief executive has a negative and insignificant effect on the firm R&D spending in the Pakistani context as projected in all three models, the coefficients in all three models insignificant. Concerning this many previous studies suggested the same kind of findings (Peng, C. W. 2017; Azzam, A. A., & Alhababsah, S. 2022). Likewise, the CEO's education and experience predict a positive and statistically significant impact on corporate R&D spending, declaring that a highly educated and more experienced CEO can be important to improve the growth of a firm. The findings of this research have been also previously confirmed in many prior studies (Morresi, O. (2017; Gounopoulos, D. et al., 2021). Moreover, aged CEOs are also found negative but statistically significant with firm R&D spending. The size of the firm also shows a statistically significant effect on firm engagement in R&D spending. Firm leverage coefficients determine the negative and statistically significant nexus with firm R&D spending validating that the supplementary debt load of a firm will badly affect the firm R&D spending. The random effect model has more descriptive power than the rest of the models.

Table 4: R&D Dependent Variable

	OLS	FE	RE
TEN	-0.068	-0.929	-0.937
	(0.128)	(0.111)	(0.101)
DUAL	-0.222	-0.229	-0.281
	(0.016)	(0.001)	(0.000)
EDU	0.228**	0.271	0.288
	(0.001)	(0.000)	(0.000)
EXP	0.351***	0.331***	0.328***
	(0.000)	(0.000)	(0.000)

AGE	-0.241	-0.359	-0.367
	(0.000)	(0.000)	(0.000)
FS	0.351	0.391	0.386
	(0.000)	(0.000)	(0.000)
FL	-0.370	-0.369	-0.377
	(0.000)	(0.000)	(0.000)
R2	0.401	0.430	0.476
F-Value	21.24 (p<0.000)	38.126 (p<0.000)	----
Wald Chi	----	----	49.119 (p<0.000)
LM Test			
For Pooled vs FE or RE		321.288	
		(0.000)	
The values show that FE and RE are appropriate models.			
Hausman Test	13.410		
F. Effect of R. effect	(0.229)		

The results of Table 5 demonstrate that the tenure of the CEO is negative and statistically insignificant in the Pakistani context in all three estimated models because the coefficient values in all three mentioned models are insignificant. That is why many previous researches also showed a similar kind of outcome. Likewise, the CEO's education and experience have a positive and statistically significant impact on corporate ESG practices, stating the education and expertise of the CEO can play a significant role in improving the socially responsible organization. The results of this study are in line with previously documented studies. Likewise, the age of the chief executive is negative but statistically significant with the coefficient of all three models which means the aged CEOs are not supporting the corporate ESG activities. Similarly, firm size is a significant and positive influence on firm ESG engagements; moreover, the leverage of the firm is negative and statistically significant impacts the firm commitments, confirming that more debts of a firm will harm fulfilling the social responsibilities. The random effect model is relatively a suitable option as compared to three robustness estimations because the descriptive power of the random effect model is greater than the other two models.

Table 5: ESG Dependent Variable

	OLS	FE	RE
TEN	-0.073	-0.902	-0.947
	(0.138)	(0.117)	(0.112)
DUAL	-0.216*	-0.234**	-0.291***
	(0.015)	(0.001)	(0.001)
EDU	0.236**	0.265***	0.298***
	(0.002)	(0.001)	(0.000)
EXP	0.346***	0.325***	0.331***

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	(0.000)	(0.000)	(0.000)
AGE	-0.235**	-0.363***	-0.373***
	(0.001)	(0.002)	(0.000)
FS	0.344***	0.391***	0.392***
	(0.000)	(0.000)	(0.000)
FL	-0.366***	-0.374***	-0.386***
	(0.000)	(0.000)	(0.000)
R^2	0.402	0.427	0.471
F-Value	29. 32 (p<0.000)	43.22 (p<0.000)	----
Wald chi2	----	----	52.09 (p<0.000)
LM Test			
For Pooled vs FE or RE		317.295 (0.001)	
The values show that FE and RE are appropriate models.			
Hausman Test Fix effect or random effect.	14.35 (0.241)		

Discussion and Conclusion

The study analyzed 150 listed Pakistani firms for the period of 2015 to 2022 to unravel the nexus between CEO characteristics and Firm R&D spending and ESG practices. The empirical results of the study show that CEO tenure negatively impacts the firm R&D spending and corporate ESG practices in the Pakistani context. We explored that the longer tenure of the CEOs does not support the R&D initiatives and firm environmental and social governance activities. Some of them are political incentives that have a positive effect on the performance of a firm. Some compensations are in the form of bonuses, i.e., monetary compensation. Some of them are promotion compensation. All kinds of CEOs' compensation display a positive effect on the firm's financial performance. The outcome depicts the previous research, which also established the important contribution of CEO compensation in uplifting a solid performance (Sun et al., 2013). While some of the previous studies confirm that CEO compensation does not affect the financial performance of the firm. However, some of the literature confirms that there is an insignificant nexus between CEO compensation and firm financial performance. However due to its positive effects corporate culture should strive to hold a CEO who is highly paid as much more is expected from him to improve the financial performance of the firm. Therefore, it is hard to generalize these findings with the rest of the countries. The results also noted that CEO experience is very vital for the growth and efficiency of firms in Pakistan as the results in this case are significant asserting that CEO experience enhances business growth and improves the firm performance significantly in the Pakistani context. The experience of the CEO plays a vital role in the financial performance of a firm. The results are also in line with much previous research, which also validates the significant contribution of CEO experience in inspiring the firm's financial performance.

In our research, the contribution of the control variables is the FS and Leverage. The fit size displays a positive nexus with the financial performance. However, the firm Leverage shows an adverse relationship with the performance of firms (Ibhagui & Olokoyo, 2018). The findings display that the coefficient of the firm size is statistically significant, signifying that a firm with more asset value can better perform. In divergence, the coefficient of the Leverage shows statistically significant and negative effects meaning that the more debt burden affects the financial performance of a firm. Based on the findings the study offers certain recommendations and managerial implications for the investors, stakeholders, and management of the listed firms. Due to the positive effect of CEO compensation and CEO experience, firms should be very selective in selecting their CEOs and must weigh them based on their experience and should pay more to those who possess more experience and expertise.

The study in hand is a good addition to the existing body of literature relating to CEO characteristics. The study offers certain policy implications and provides valuable insights for policymakers, shareholders, investors, and business managers. Future research can include additional CEO characteristics like ethnicity, executive business, and professor on board and can test the numerous mediating variables. Further, research can be compared with different sectors of Pakistani firms and corporate firms of Pakistan and Bangladesh. Other studies can also investigate the firms of emerging market economies to picture more robust outcomes. Studies can also compare firms of the developing and developed world. This research has some limitations. Firstly, the data was collected by hand from different publicly available sources. If there is any issue relating to data disclosure or professional accounting standards, then the validity of the findings will be limited. In addition, the sample of 250 firms was acquired from the entire population which is relatively small. Furthermore, the external validity is also questionable due to data comprising only the Pakistani listed firms.

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