

## Article

# Gender Diversity and Firms' Sustainable Performance: Moderating Role of CEO Duality in Emerging Equity Market

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**Abstract:** The objective of the study is to investigate the impact of female representation on boards and female CEOs on firms' sustainable performance in the context of an emerging economy. We also introduce the CEO duality as a moderator variable between sustainable firm performance and board gender diversity. For this purpose, the study uses a panel data sample from 2005 to 2020 for non-financial listed firms in Pakistan. We use the firm's operational self-sufficiency for the sustainable performance of firms. For robustness, the study also uses other accounting-based and market-based proxies. We apply the static (fixed and random effect) and dynamic panel estimation (GMM) techniques to deal with the heterogeneity and dynamic endogeneity issues in panel data estimation. The finding shows a significant positive impact of female directors on board and female CEOs on sustainable performance, whereas CEO duality does not moderate this relationship. Furthermore, we find that CEO duality has a significant negative impact on firms' sustainable performance, which supports the agency theory hypothesis. The study also controls corporate board level factors, including board size and board independence, and uses leverage, firm size, capital expenditure, and tangible assets as firm-level control. The results also reveal that board size and board independence have a significant positive impact on firms' sustainable performance. Furthermore, firm size, tangibility, and firm age have a significant positive, whereas leverage and capital expenditure have a negative impact on firms' sustainable performance. Finally, the study has policy implications for stakeholders.

**Keywords:** sustainable performance; self-sufficiency; board gender diversity; CEO duality; emerging economy



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## 1. Introduction

Corporate governance is an old as well as challenging topic. It has gained attention due to worldwide high-profile scandals of the earlier 21st Century. These issues affect the market price of shares at a higher level, such as Enron, Volkswagen, Lehman Brothers, Kobe Steel, Equifax, etc. [1]. It is reported that a better corporate governance mechanism plays a significant role in any organization. As a result, it improves sustainable performance, better allocation of resources, and creates a better relationship with shareholders compared to poor corporate governance mechanisms [1,2]. Corporate board members are the important mechanism of corporate governance in any firm; they hold the responsibilities for leading and controlling the firm and performing duties on behalf of its shareholders [3]. Board gender diversity is a factor for corporate boards under the umbrella of corporate governance [4,5]. Gender diversity on corporate boards has gained attention from practitioners, researchers, investors, shareholders, and policymakers [6]. With the passage of time, the presence of women on boards has had increasing consideration across the world and emerging economies [7–9]. In this regard, researchers and practitioners claim that one

of the best ways to improve and increase sustainable performance in every organization is through a higher representation of women on boards [10,11]. It has been identified that firms should reflect society and operate with a different homogenous group of members or board of directors [12]. The burden for innovation in firms creates a negative impact on firms' sustainable performance [13,14], however, a heterogeneous group of board members can provide a more diverse body of knowledge, creating significant innovation and decision-making capability [15].

There has been a rise in awareness regarding the need for gender diversity on corporate boards, which has resulted in a number of countries passing legislation and instituting policies that encourage the nomination and involvement of women on corporate boards. The inclusion of a greater number of women on corporate boards is thought to promote not only social equity but also governance and company performance, which has given rise to a number of initiatives aimed at increasing the proportion of women in positions of power within corporations. The presence of female directors on board in a CEO position has become more crucial, especially in developing countries like Pakistan. Because of Pakistan's perspective, females as CEOs play a significant role in enhancing sustainable performance [16].

In the present literature, the proportion of female CEOs has created great interest, as the aspects of having female CEOs can impact firms' sustainable performance [17]. Most importantly, the decision-making and problem-solving power of the corporate board increase if the women on board perform duties as CEO [8]. Chen and Elder [18] claim that women on boards can curb managerial opportunism by monitoring their abilities. Researchers have shown female CEOs perform a significant role in firm innovation by reducing asymmetric information among shareholders and managers and reducing agency conflicts [19]. Generally, women are working in middle-level management rather than higher board of directors or CEO positions. This situation exists not only in developed countries but also in developing emerging economies like Pakistan.

The proportion of female directors on board is neglected in Pakistani firms, particularly in top-level management positions such as CEO [16]. The corporate culture and environment in Pakistan is dominated by men, which does not allow women to climb the ladder onto the corporate board [8]. Consequently, there is a need to examine the association between women on boards and female directors as CEO on firms' sustainable performance. By removing the glass ceiling for female directors as CEO or higher-level management in emerging economies, the result is that women can perform an excellent role in developing the economy through the sustainable performance of firms.

The literature on firms' sustainability performance started at the end of the 20th century [20,21]. The concept of sustainability consists of three main dimensions within the business context, including the social, environmental, and economic factors [22]. Sustainability is one of the significant issues for society and is about developing society by creating a proper balance between the economic, environmental, and social objectives [23]. This study highlights the issue of firms' sustainability performance with different proxies related to accounting base and market base measures.

The terminology of CEO duality in the financial literature is used if the CEO performs the dual role, i.e., simultaneously CEO and chairperson of the firm [24,25]. The previous research provided mixed results related to CEO duality for enhancing sustainable performance. The outcomes of the literature on CEO duality are inconclusive; many researchers offer evidence in favor of CEO duality, although this is sometimes insignificant, and most studies claim a negative impact on performance [24,26]. Supporting agency theory, researchers have argued for the negative effect of CEO duality on firm sustainability [21]. Agency theory suggests the CEO does not work in the shareholder's interest. Instead, they perform duties in their self-interest and benefit, which ultimately leads to agency conflicts with shareholders and executives, resulting in a negative impact on the performance of the firm.

Alternatively, CEO duality can have a positive impact as per the stewardship theory. This theory assumes that the CEO performs duties as a good steward with a more robust and flexible corporate leadership structure, enhancing managerial efficiency, and positively impacting the firm's sustainable performance [27,28]. In addition, the CEO would be expected to have greater knowledge of the firm and its industry than an external chair [29], so they have a greater commitment to the firm, and thereby, provide greater insider representation to the firm [30].

As an emerging country, Pakistan refurbished its corporate governance mechanism by issuing corporate codes for the first time in 2002, and these codes were revised by the securities and exchange commission of Pakistan in 2012. According to the dual role of the CEO, the first code advised the suppression of CEO and chairperson's offices. In 2012, the latest codes stated that these two positions must be separated [31]. Furthermore, the constitution of Pakistan provides equal rights for males and females. But in some Pakistani organizational cultural environments, men remain the dominant persons to perform duties on the board of directors rather than female participants, creating a cultural disparity between men and women when they reach higher ranks in any organization.

The conservative concept of gender diversity has been changing in Pakistan. The Government of Pakistan are planning a document vision in 2025 to recognize gender diversity in organizations, giving new opportunities for women to perform well in the economic, social, and corporate environment. A research survey conducted by CERB on gender diversity in Pakistan shows that the average board size is seven members in specific industries like banking and finance, cement, textile, and having an average of 1 to 4 women on the board of directors. The effects and interest increase consideration on the corporate board and provide opportunities to investigate whether female participation is related to firm sustainable performance. Therefore, there is a need to investigate the impact of female representation on boards and female CEOs on firms' sustainable performance in the context of the emerging economy.

The objective of the study is to investigate the impact of female representation on boards and female CEOs on firms' sustainable performance in the context of an emerging economy. We also introduce the CEO duality as a moderator variable between sustainable firm performance and board gender diversity. Researchers collected corporate governance-related variables and financial information of 200 non-financial firms listed on the PSX from 2005 to 2020 to analyze the stated association. To reduce the endogeneity and unobserved heterogeneity problem in corporate governance literature, the researcher uses GMM estimation techniques to examine the study model. To check the robustness of results, researchers used four alternative measures of firm sustainable performance, likewise accounting-based (ROA, ROE) and market-based measures (Tobin's Q, MBR). Researchers use corporate board level control variables such as board size and board independence with firm sustainable performance. Additionally, the study also added several firm-level control variables such as financial leverage, firm size, capital expenditure, tangible assets, and firm age.

This study contributes to the existing literature in the following ways. To the best knowledge of researchers, we have introduced for the first time the moderating role of CEO duality in the relationship of board gender diversity and female CEO with firms' sustainable performance. As CEO duality enhances the power of the CEO, there is an inherent conflict between a board of governance and the CEO-chair, thereby, the functions of the board of governance are compromised in disciplining the CEO. It, therefore, creates agency conflict and the agent cannot act in the interest of principle. This opposed relationship typically involves costs that are called agency costs which are payable by an organization. Researchers investigate how this agency cost is minimized by using CEO duality as a moderator variable in the association between gender diversity and firm sustainable performance. Besides this, we also contributed to the literature related to the influence of women on board and firm sustainable performance in the emerging economy, especially in Pakistan. Literature exists on gender diversity, while only a few studies show

the importance of women as CEO for corporate governance mechanisms and their impact on sustainable performance [32,33]. Furthermore, we also examine the impact of board size and board independence on firms' sustainable performance. This study provides empirical evidence that firms' sustainable performance is increased when there are more women on the board.

The next section discusses the theoretical background and research methodology, which is followed by the results and discussion section.

## 2. Theoretical Background of Study

This section discusses the main underpinning theories, including the agency theory, stewardship theory, and the institutional background.

### 2.1. Agency Theory

The separation of ownership and control is the essence of agency theory [34]. The agency theory explains the principal and agent relationship [35]. This theory takes the contractual view of firm shareholders as principals and managers as agents [36]. According to this study, CEO duality and its impact on performance are among the most important and challenging issues in financial literature [37]. In this situation, the CEO performs a dual role as the CEO and Chairperson of the firm [38]. The agency theory suggests that the power should be separated to allow the corporate board to control the CEO [25].

Consequently, the CEO performs a dual role in the organization and acts professionally for their private interest. Whether the CEO might pursue profit that departs from the investor's benefits [35], this situation naturally leads to the agency problem between shareholders and executives and highlights the negative impact of CEO duality on firm sustainable performance. Mirza, Andleeb [39] documented a greater presentation of gender diversity on the board that decreases agency costs. These overcome the agency problems to hire more female directors onto the corporate board [40]. In this framework, the higher representation of female directors on the board reduces agency costs through better corporate control [15,41]. The prior literature shows strong and diverse corporate governance mechanisms that can improve financial performance to reduce agency problems [42] and enhance corporate board monitoring [36,43].

### 2.2. Stewardship Theory

According to previous studies, there is no optimal board leadership structure [44]. Firms have selected the most appropriate corporate boards depending on their requirements and needs according to the organizational environment [45]. The research investigates two dominant theories—the stewardship theory and the agency theory—that support the specific factors of this study like gender diversity, CEO duality, and firm sustainable performance [25,37]. According to stewardship theory, managers and executives are intrinsically motivated and perform duties as good stewards [46]. They are not motivated on an individual basis, but as stewards, their motivation is aligned with the objectives of their principals [47]. The firm's CEO performs duties as a steward and gets full power and becomes responsible as the owner of capital [48]. Therefore, according to stewardship theory, it might be possible that the CEO provides a significant role in the firm's sustainable performance with higher authorization and through the steward's personality [27,46,49]. In addition, as stewards, female directors on board perform a significant role in the firm's sustainable performance, paying more attention to collaboration, networking, team player, and personal development [50,51]. Eagly, Johannesen-Schmidt [52] claim that women perform as transformational leaders with aligned and communal behavior. Along with transformational leadership style and collective behavior, stewardship theory suggests that female representation on board would be more effective and efficient than male counterparts working as top management and directly enhancing firm sustainable performance [15,51].

### 2.3. Institutional Background

The constitution of Pakistan provides equal rights for males and females, however, its institutional culture is quite different than other developing emerging economies. Nevertheless, the conservative concept of gender diversity has been changing in Pakistan and women are performing a significant role in every field of life. Such examples include the great politician Madr-e-Millat Fatima Jinnah, and the first Prime Minister Benazir Bhutto Shaheed; in the field of finance, the first Governor of the State Bank of Pakistan was Shamshad Akhter; in the IT field, Arfa Kareem is Microsoft Certificated and Shukirya Khanam was the first Pakistani woman pilot; Malka Taranum Noor Jahan performed a significant role in the music industry and got the highest civilization awards Tamgha-e-Imtiaz and Sitar-e-Imtiaz. Around 45 percent of females in Pakistan run traditional businesses such as parlors, bakeries, and boutiques, and the majority perform duties in the IT, medical, and education sectors (The Observer, 2017). The growth rate of female participation from 2003 to 2004 was 15.9 percent, at the end of 2014, which increased by 18.9 percent respectively [8]. These effects show that females perform a significant role in Pakistan's economic growth. A research survey conducted by CERB on gender diversity in Pakistan and according to CERB reports, the average board size is seven members in specific industries like banking and finance, cement, textiles and have an average of 1 to 4 females as the board of directors. The effects and interest increase consideration on the corporate board and provide opportunities to investigate whether female participation is related to firm sustainable performance.

## 3. Literature Review

This section discusses the literature related to female directors on board, gender CEO, and sustainable firm performance.

### 3.1. Female Directors on Board and Firm Sustainable Performance

Gender diversity is one of the most important and interesting human aspects that has been emphasized in many types of research [8,9,12,18,51,53]. Past research has documented that firms' sustainable performance is importantly linked to gender diversity [54,55]. A board with different genders and cultures is more likely to make suggestions, ask questions, and better allocate time than a board with a traditional background [56]. Boards with more diverse experience, education, and skills would make better decisions that enhance the firm's sustainable performance [54,57]. Researchers identified that female directors improve firms' sustainable performance by bringing unique expertise such as diverse skills, experience, education, and knowledge [51,58]. Previous literature showed female directors increase the efficiency of internal corporate governance [54], public disclosure of stock price information [15], outside independent directors [59], problem-solving, and board consideration [46]. Therefore, it proves female representation on the corporate board reduces agency problems and increases firms' sustainable performance through efficient monitoring and control. Thus, the study proposes the first hypothesis.

**Hypothesis 1 (H1).** *Women on boards have a significant positive impact on firm sustainable performance.*

### 3.2. Female CEO and Firms' Sustainable Performance

Previous researchers documented that female directors help to restrain agency problems and asymmetric information [60]. The female CEO commences fewer acquisitions than the male CEO and issues a lower level of debt, thus a higher level of return announcements [61]. In executing a strong corporate governance mechanism, female CEOs perform a significant role and improve investment decision-making [62]. The comprehensive study documented that women on boards as CEOs play an important role in enhancing firms monitoring intensity [8]. Researchers noted that those firms having women as CEOs perform very well through lower leverage ratio, lower level of capital expenditure, higher

level of tangibility ratio, and holding more cash, due to risk-averse strategies and a lower level of systematic risk than those having male CEOs [63]. Female CEOs perform as efficient monitoring and control as male CEOs [21,62]. As a context of risk-averse behavior, thus women on boards as CEOs are more risk-averse than male CEOs [64], therefore improving corporate control. Thus, female CEOs are likely to have a more positive impact on firm sustainable performance. Based on previous research, this study suggests the following hypothesis;

**Hypothesis 2 (H2).** *Female CEOs have a significant positive impact on firm sustainable performance.*

### 3.3. *The Moderating Role of CEO Duality in the Relationship between Board Gender Diversity, Female CEOs, and Firms' Sustainable Performance*

CEO duality decreases board power and independent directors' authority, and ratifies CEO entrenchment [65,66]. In the dual role, the CEO might be less active in monitoring and controlling onboard activities that decrease firms' sustainable performance [67]. Moreover, in emerging countries with weak governance and political and organizational structure, CEO duality is a reason that they misuses their dual power [3,21]. Therefore, the CEO hires closely linked persons as the board of directors who are helpful to perform activities in the self-interest of the CEO [26]. While stewardship theory views the CEO as a steward and has responsibility for all-important duties as executive, the CEO performs on behalf of the shareholders or owners [46,47]. In addition, because of steward theory, female CEOs want to be a good steward of the corporate board [27,50]. From a stewardship theory perspective, CEO duality is positively related to persuasive leadership authorities. According to agency theory, CEO duality is negatively associated with agency conflicts between the CEO and shareholders. Therefore, all studies suggest that CEO duality is a challenging and interesting topic, and so creates more investigations for new researchers and practitioners. However, under the umbrella of corporate governance [4,5,21], CEO duality has established a moderating relationship between board gender diversity, gender CEO, and firms' sustainable performance. According to previous literature with stewardship theory and agency theory, this study suggests the following hypothesis:

**Hypothesis 3a (H3a).** *CEO duality moderates the relationship between female directors on boards and firms' sustainable performance.*

**Hypothesis 3b (H3b).** *CEO duality moderates the relationship between the female CEO and firms' sustainable performance.*

### 3.4. *Corporate Governance Controls*

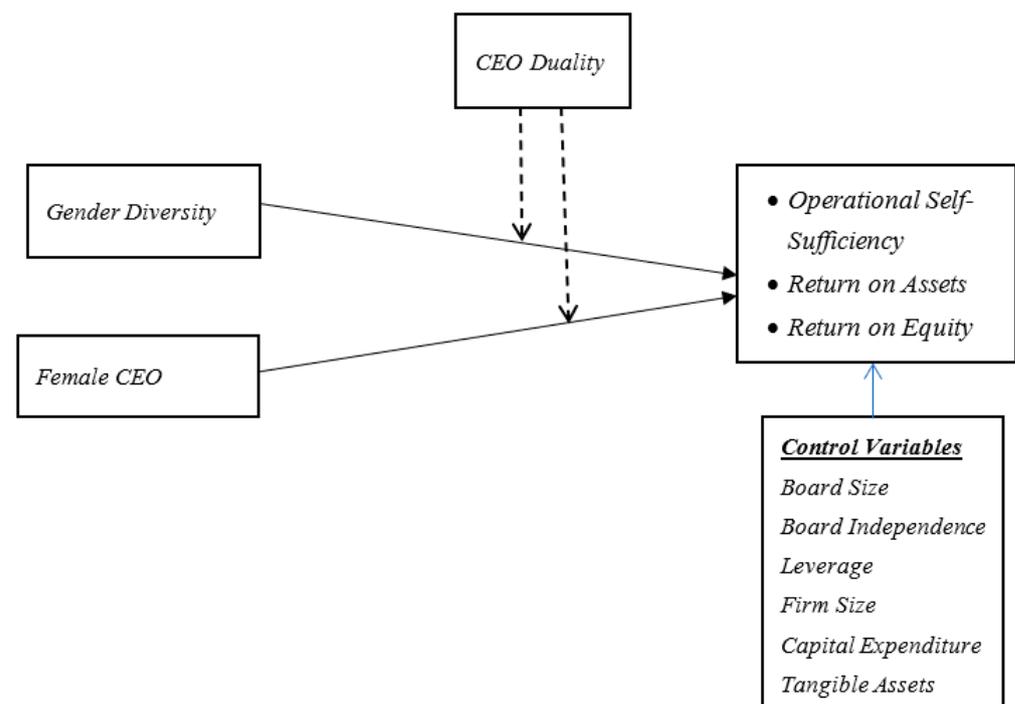
The board of directors controls the mechanism in which they use their power to manage decision-making. Board size performs a key role in monitoring and maintaining systems and builds a procedure that alienates the manager's objective with shareholders' interest [8]. They perform a vital role in corporate policy-making, implementation, and review [62]. Zahra and Pearce [68] identified that the large size of the board is important for a firm because they include more qualified and experienced board members with quality education and skills. Researchers noted the effect of corporate governance on Ghanaian SMEs and reported that board size has a significant positive impact on firms' sustainable performance [37,43]. Large board size can push the managers to follow-up costs of debt to increase firms' sustainable performance and create a positive relationship with firm leverage [69]. A larger corporate board size has superior monitoring capability and higher leverage to raise the firm's value [70]. Researchers have found evidence regarding the existence of outside directors; they seem to control corporate mechanisms on the discretionary behavior of managers [62] as well as on the actions of owners [71]. The presence of outside directors improves the quality of financial statements [18,72]. Arora and Bodhanwala [73] documented that adequate representation of board independence improves firms' sustainable performance [22]. Based on the above empirical evidence

and literature, the previous studies discussed agency theorists who underline the positive impact of board independence and firms' sustainable performance [14]. From an agency theory perspective, independent directors carry out their activities to monitor and control management because they have the incentive to develop firms' reputation through the decision-making process [74]. Many studies have examined the positive relationship between board independence and firms' sustainable performance [75].

### 3.5. Firm-Level Accounting Controls

The leverage of the firm can lead to external corporate control [76]. Saini, Singhania [75] documented that leverage has a negative association with firm sustainable performance. They explain high leverage decrease the firm sustainable performance due to the high cost of borrowing [21]. Researchers noted that the high proportion of female directors on boards have significantly lower leverage than firms that have a low ratio of gender diversity [77]. These tentative roles show that women are more risk-averse [64]. Therefore, it creates a negative association between leverage and firm performance [36]. Researchers documented that being a large sized firm increases firms' sustainable performance compared to small firms, through higher market power [8]. Therefore, firm size is considered an important factor in firms' sustainable performance [14,46]. Generally, firms invest a considerable amount in capital expenditure to maintain a competitive position in the market, maximize revenue, and enhance financial performance [78]. Researchers documented female CEOs keep a lower level of capital expenditure than male CEOs, so they defend a lower level of systematic risk [63]. The research documented that firms' tangible assets consist of more than fifty percent of its total assets and contribute significantly to firms' sustainable performance [22]; this comprises property, plant, machinery, and equipment and is used as a factor of production, supply of goods and services, and other administration purposes [79]. With experience and greater age, firms are more organized, equipped, and standardized, so those results are better for firms' sustainable performance [80]; the performance of the firms depends on firm maturity and its period [81]. Yasser [82] claims smaller firms have a faster growth rate than larger firms through more variable growth patterns.

Based on the theoretical and empirical discussion, we have developed the following framework of study (Figure 1).



**Figure 1.** The theoretical framework of the study.

## 4. Research Methodology

This section discusses the data, sample selection, and research methodology.

### 4.1. Data and Sample Selection

The study investigates the impact of gender diversity and females as CEO on firms' sustainable performance for Pakistani listed firms. For this purpose, the researcher used the following criteria for sample selection. First, consistent with past corporate governance literature, the financial sector is excluded from the initial sample because they are highly leveraged with different policies for profit maximization [83]. Second, the study consists of secondary data obtained from the PSX website, annual reports of firms, State Bank balance sheet analysis (BSA) to find out the market value of firms; researchers claim the PSX 100 index captures 85 percent of the market [77]. Third, the data stream for the fifteen years started from 2005 to 2020 on a yearly basis. Fourth, the initial data sample comprised 250 non-financial firms listed on PSX. Finally, those firms were excluded from the model based on the unavailability of board members' profiles, as well as firms that were merged, delisted, acquired, or demolished by the end of financial years 2020, which were deleted from the sample data. Therefore, 200 firms with 2415 firm-years observations were selected for this research.

### 4.2. Measurement of Variables

In this research, firms' sustainable performance is a dependent variable and measured by operational self-sufficiency (OSS) [57]. The OSS explains how firms are able to cover their operating expenses with their operating income [84]. The study measures the firm sustainable performance by total revenues to total expenses. To check the robustness, the study uses four different dimensions which are ROA and ROE—accounting-based [53], and Tobin's Q and MBR—market-based measures [10]. The ROA is a profitability ratio that shows how much profit firms can generate through their assets [64,85]. It is measured as net income divided by total assets [86]. The ROE shows the accounting performance with return on shareholders' equity investment [10]. The ROE is calculated as net income divided by total shareholder equity [17]. Tobin's Q calculates the sum of the market value of equity and book value of equity of debt divided by total assets [87,88]. The MBR is measured by the natural logarithm of the market value of equity divided by the book value of shareholder equity [8,83]. In this study, female directors and female CEOs are some key independent variables. The female directors are measured as female directors divided by the number of board members [86]. While females as CEO is calculated as a dummy variable, 1 indicates if females perform duties as CEO, and 0 otherwise [89]. In addition, CEO duality is the moderator of the study and is measured by a dummy variable; 1 indicates if the CEO performs a dual role, 0 otherwise [46,66]. In this research, board size and board independence are taken as control variables at the corporate board level. Board size is measured through the total number of directors on the board [87]. While, board independence is measured through a total number of outside directors divided by a total number of board members [8]. The study uses several control variables theatrically related to firm performance. Leverage is measured through total liabilities divided by total assets [8]. The natural logarithm of total assets [83]. Capital expenditure is calculated as total capital expenditure divided by total assets [90]. In short, tangible assets are measured through all tangible assets divided by total assets [8]. Firm age is calculated as a natural logarithm of the number of years since firms were incorporated [82,91].

### 4.3. Econometric Modeling

To econometrically investigate the impact of gender diversity and female CEOs on firm performance, with the interaction term CEO duality, the study applies multivariate estimation techniques for data analysis. On the way to choosing the most suitable approach between panel fixed and random effect regression, the researcher used the Hausman test [92]. The Hausman test specification shows there is no correlation between the error

term and predictor variable. Ahn and Moon [93] claim that the Hausman test specifies the distance between fixed and random effects. A significant value of the Hausman test rejects the null hypothesis; thus, the accidental product is consistent [94]. The results of the Hausman test, the difference and probability value are significant ( $p < 0.0001$ ) for all dependent measures, which leads to rejecting the null hypothesis and indicates a fixed-effect model should be used. The researcher applies the fixed effect technique with standard error at the firm level to identify the serial correlation and heteroscedasticity issue. A study explains the following statistics.

$$H = \left( \hat{\gamma}^{FE} - \hat{\gamma}^{RE} \right) \left[ \text{Var} \left( \hat{\gamma}^{FE} \right) - \text{Var} \left( \hat{\gamma}^{RE} \right) \right]^{-1} \left( \hat{\gamma}^{FE} - \hat{\gamma}^{RE} \right) \sim \chi^2(k)$$

To investigate simple compression with two alternative analyses, researchers use two different dimensions to measure firm performance and check the robustness of the results. The ROA and ROE use accounting-based changes and market-based measures Tobin's Q and MBR prevent robustness. In panel data analysis, a potential problem exists when selecting a fixed or random-effect model called the endogeneity problem [94]. The endogeneity problems occur when independent variables are correlated with their error term in the regression model [56]. The fixed and random effects are inconsistent techniques to identify the time-varying component in error terms and do not properly address the possible endogeneity issues. Therefore, the researcher applies the generalized method of moments GMM, which provides potential panel data instruments that address unobserved heterogeneity, endogeneity, heteroscedasticity, and simultaneity problems in panel data estimator techniques [10]. Furthermore, all equations of this study are as follows:

We estimate the following Equations (1) and (3) to examine the impact of female representation on boards, and female CEOs on firm's sustainable performance in the context of an emerging economy. We estimate the Equations (2) and (4) to examine the CEO duality as a moderator variable between sustainable firm performance and board gender diversity and female CEOs.

$$OSS_{it} = \beta_0 + \beta_1 OSS_{it-1} + \beta_2 FD_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it} \quad (1)$$

$$OSS_{it} = \beta_0 + \beta_1 OSS_{it-1} + \beta_2 FD_{it} + \beta_3 FD_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it} \quad (2)$$

$$OSS_{it} = \beta_0 + \beta_1 OSS_{it-1} + \beta_2 FMC_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it} \quad (3)$$

$$OSS_{it} = \beta_0 + \beta_1 OSS_{it-1} + \beta_2 FMC_{it} + \beta_3 FMC_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it} \quad (4)$$

Robustness test—Panel A (accounting-based measures): We estimate the following equations to examine the impact of female representation on boards, and female CEOs on firms' accounting base performance in the context of an emerging economy.

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \beta_2 FD_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \beta_2 FD_{it} + \beta_3 FD_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \beta_2 FMC_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \beta_2 FMC_{it} + \beta_3 FMC_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 ROE_{it-1} + \beta_2 FD_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 ROE_{it-1} + \beta_2 FD_{it} + \beta_3 FD_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 ROE_{it-1} + \beta_2 FMC_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 ROE_{it-1} + \beta_2 FMC_{it} + \beta_3 FMC_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

Robustness test—Panel A (market-based measures): We estimate the following equations to examine the impact of female representation on boards, and female CEOs on firms' market base performance in the context of an emerging economy.

$$TBQ_{it} = \beta_0 + \beta_1 TBQ_{it-1} + \beta_2 FD_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$TBQ_{it} = \beta_0 + \beta_1 TBQ_{it-1} + \beta_2 FD_{it} + \beta_3 FD_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$TBQ_{it} = \beta_0 + \beta_1 TBQ_{it-1} + \beta_2 FMC_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$TBQ_{it} = \beta_0 + \beta_1 TBQ_{it-1} + \beta_2 FMC_{it} + \beta_3 FMC_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$MBR_{it} = \beta_0 + \beta_1 MBR_{it-1} + \beta_2 FD_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$MBR_{it} = \beta_0 + \beta_1 MBR_{it-1} + \beta_2 FD_{it} + \beta_3 FD_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

$$MBR_{it} = \beta_0 + \beta_1 MBR_{it-1} + \beta_2 FMC_{it} + \beta_3 BSIZE_{it} + \beta_4 BIND_{it} + \beta_5 CEOD_{it} + \beta_6 LEV_{it} + \beta_7 FS_{it} + \beta_8 CA_{it} + \beta_9 TAR_{it} + \beta_{10} FA_{it} + \varepsilon_{it}$$

$$MBR_{it} = \beta_0 + \beta_1 MBR_{it-1} + \beta_2 FMC_{it} + \beta_3 FMC_{it} \times CEOD_{it} + \beta_4 BSIZE_{it} + \beta_5 BIND_{it} + \beta_6 CEOD_{it} + \beta_7 LEV_{it} + \beta_8 FS_{it} + \beta_9 CA_{it} + \beta_{10} TAR_{it} + \beta_{11} FA_{it} + \varepsilon_{it}$$

where  $OSS_{it}$  (operational self-sufficiency), represents the dependent variable.  $ROA_{it}$  (Return on Assets),  $ROE_{it}$  (Return on Equity) denotes accounting-based measures,  $TBQ_{it}$  (Tobin's Q),  $MBR_{it}$  (Market to Book Ratio) represents market-based measures.  $FD_{it}$  (female directors)  $FMC_{it}$  (female CEOs) represents independent variables.  $CEOD_{it}$  (CEO duality) show moderator variable.  $BFSIZE_{it}$  (board size),  $BIND_{it}$  (board independence) denotes governance level control variables.  $LEV_{it}$  (Leverage),  $FS_{it}$  (Firm Size),  $CA_{it}$  (Capital Expenditure),  $TAR_{it}$  (Tangible Assets)  $FA_{it}$  (Firm Age), demonstrate firm-level control variables. The  $\beta_0$  represents constant,  $\beta$  is the slope,  $\varepsilon$  is the error term, and  $it$  shows panel data.

## 5. Empirical Results

### 5.1. Summary of Descriptive Statistics

Table 1 reports the summary of descriptive statistics of the entire variables in this study. The mean value of OSS was 4.22 with 2.2 standard deviation, which means average firms are sustainable to cover their operating expenses. The average value was ROA 0.048 and ROE 0.048 with standard deviation values of 0.035 and 0.064, respectively, indicating that the average return from the accounting-based measure is lower for PSX-listed firms from 2005 to 2020. While, the market-based measure showed higher values, as Tobin's Q and MBR average value was 5.72 and 0.71, with a standard deviation of 3.36 and 0.31, respectively. Regarding female representation, the obtained value of mean was 0.40 with a

0.32 standard deviation. It indicates that female directors captured 40 percent of the total board size. This research finds that approximately 43 percent of all PSX listed firms have at least one female CEO, which indicates male persons were dominant in executive positions. The descriptive summary shows that 36 percent of PSX firms in the emerging market have a dual leadership structure. Thus, the CEO performs the dual role with the Chairman of the firm for a board of directors. As corporate governance control variables, the board size range was 3 to 15 board members with an average value of 8 approximately. The average board size was 8 board members sitting on the corporate board, validated through past studies [82]. The board independence means the value was 0.34 with a 0.08 standard deviation, meaning that board independence comprised 34 percent of a corporate board. Moving to the firm's level control variables, the obtained mean value of leverage was 0.24 with a 0.16 standard deviation, meaning that the firm's average leverage ratio was 24 percent. Besides, the mean value of firm size was 6.77, with a 0.616 standard deviation. The average capital expenditure was 47 percent, with a 0.18 standard deviation for PSX-listed firms. The asset tangibility shows a mean value was 0.47 with a standard deviation of 0.16. Lastly, the firm age means the value was 1.3 with a standard deviation of 0.17. Table 1 specifies the summary of descriptive statistics.

**Table 1.** Summary of descriptive statistics.

	Mean	Standard Deviation	Minimum	Maximum
OSS	4.221	2.245	0.215	13.14
TQ	5.723	3.365	0.835	16.22
ROA	0.048	0.035	0.001	0.148
ROE	0.097	0.064	0.003	0.251
MORE	0.718	0.312	0.021	1.377
FD	0.400	0.412	0.000	6.000
FMC	0.430	0.321	0.000	1.000
BS	8.000	0.613	3.000	15.00
BIND	0.341	0.085	0.000	5.000
CEOD	0.362	0.481	0.000	1.000
LEV	0.243	0.163	0.000	0.625
FS	6.770	0.616	5.202	8.581
CE	0.429	0.185	0.019	0.877
TAR	0.477	0.162	0.152	0.845
FA	1.300	0.176	0.903	1.556

## 5.2. Correlation Analysis

Table 2 describes the coefficient of correlation analysis for all variables used in the model. It indicates that no potential multicollinearity exists in this model as the level of association among the variables is relatively low. Therefore, there is no perfect correlation between all variables. Through this technique researcher also examined the strength and direction of two quantitative variables. The results demonstrate that the correlation value of female directors and female CEOs has a positive and significant impact on firm sustainable performance measures, suggesting that female representation and female executive positively correlated with firm sustainable performance. The study finds a significant positive correlation of board-level control variables with firm sustainable performance. While leverage, capital expenditure, and CEO duality are negatively correlated with firm sustainable performance. Besides that, other control variables like firm size, age, and tangibility are positive and significantly correlated with firm sustainable performance measures.

**Table 2.** Correlation analysis.

	OSS	TQ	ROA	ROE	MORE	FD	FMC	BS	BIND	CEOD	LEV	FS	CE	TAR	FA
OSS	1														
TQ	0.142	1													
ROA	0.215	0.554	1												
ROE	0.124	0.479	0.864	1											
MORE	0.264	0.624	0.274	0.434	1										
FD	0.32 *	0.91 *	0.062 *	0.084 *	0.132	1									
FMC	0.054	0.042	0.66 *	0.029 *	0.014	−0.309	1								
BS	0.06 *	0.071 *	0.88 *	0.109	0.084	0.280	−0.143	1							
BIND	0.024	0.073	0.118	0.138	0.131	0.03 **	0.111	−0.220	1						
CEOD	−0.321	−0.132	−0.07 *	−0.17 *	−0.87 *	−0.122	0.464	−0.225	0.263	1					
LEV	−0.254	−0.322	−0.308	−0.034	−0.052	0.60 *	0.115	−0.38 *	0.051	0.223	1				
FS	0.062	0.078	0.205	0.282	0.013	0.01 *	−0.049	0.145	−0.135	−0.8 **	0.194	1			
CE	−0.025	−0.213	−0.164	−0.172	−0.158	0.54 *	−0.78 *	−0.57 *	−0.018	0.08 *	0.80 *	0.012	1		
TAR	0.265	0.288	0.345	0.059	0.172	0.062	−0.120	0.05 *	−0.02 *	−0.190	−0.627	−0.126	−0.113	1	
FA	0.02 *	0.029 *	0.045	0.83 *	0.089	−0.30 *	0.053	−0.077	−0.111	−0.13 *	0.098	0.053	0.04 *	−0.108	1

Notes: The table demonstrates the coefficient of correlation of all study variables. The aberration and definition of variables are summarized in earlier econometric modeling. In this table, the probability value is significant at \*  $p < 0.05$  and \*\*  $p < 0.01$  (two-tailed).

### 5.3. Fixed Effect and Random Effect Models

The value of the Hausman specification is significant, thus, the fixed effect is optimal for this case. Therefore, this study estimates the fixed effect, assessing the impact of gender diversity and gender CEOs on firm performance with an interaction term of CEO duality. According to the findings, the female directors on boards and female CEOs significantly impact firm performance, suggesting that H1 and H2 are accepted. These results are consistent with the results of Ullah, Fang [8], Simionescu, Gherghina [95], and Naghavi, Sharif [10], who mentioned in his study that gender diversity and gender CEOs have a positive impact on firm performance. For fixed effects, the coefficient value was positive and significant for female directors and female CEOs for accounting and market-based measures. While CEO duality does not moderate the relationship between stated variables [25], suggesting that H3a and H3b are rejected. The value of the Hausman test was significant showing the random effect is an optional choice for this study. Thus, the study also estimates random effects to investigate state relationships. The random-effect model supports all results of the fixed product. Therefore, the model again presents the gender representation on board and gender CEOs has a significant positive impact on firm performance, while CEO duality does not perform an interaction effect between the stated variables [37,87].

### 5.4. Female Directors and Firm Sustainable Performance with the Moderating Role of CEO Duality

Table 3 present the results of the moderating role of CEO duality in relation between female directors, and female CEOs and firms' sustainable performance. CEO duality defines as a combination of the dual role of CEO, the Chairman of the board, and CEO duties. Tables 4 and 5 indicate the results of accounting and market-based measures for firms' sustainable performance with the interaction effect of a stated variable. The results show that female directors have a significant and positive impact on firm sustainable performance for all measures by decreasing agency conflicts [15,42,96] through diverse experience, educational power, unique expertise, and efficient internal corporate governance mechanism [8,54,73,81,96] decision making process and significant innovation [15]; hence, H1 failed to be rejected. The study introduces the CEO duality moderating variable and the interaction term to investigate the moderating effects of CEO duality. Therefore, H3a proposed that CEO duality moderated the relationship between stated variables. The results indicate negative coefficients with no significance ( $p > 0.05$ ) of the additional interaction term [25]. Therefore, it is proved that CEO duality does not moderate the relationship between female directors and firm sustainable performance. It means these studies support the stewardship theory perspective [21,25] because when CEOs perform as good stewards, they are motivated intrinsically and use full power for the interest and good on behalf of their principals [46,47]. Hence, H3a failed to be accepted. Besides that, CEO duality itself has a significant and negative impact on firms' sustainable performance.

It might be creating agency conflicts between shareholders and managers [38] due to the private interest of the CEO [37] and separation of monitoring and control by the CEO, which leads to a decrease firms' sustainable performance [67]. The hierarchical results are shown in Tables 3–5.

**Table 3.** Gender diversity, female CEO, and firm sustainable performance with the moderating role of CEO duality (OSS measure).

Variables	Female Directors (FD)						Female CEOs (FMC)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Lag	0.412 **	0.002 **	0.214 **	0.412 *	0.012 **	0.123 **	0.362 **	0.051 **	0.020 *	0.421 **	0.060 **	0.051 **
FD	0.013 **	0.013 **	0.032 **	0.003 *	0.016 **	0.021 **						
FD × CEOD				−0.005	−0.023	−0.032						
FMC							0.02 **	0.05 **	0.06 **	0.03 **	0.03 **	0.03 **
FMC × CEOD										−0.012	−0.018	−0.051
BISIZE	0.024 **	0.005 *	0.051 **	0.061 *	0.021 *	0.040 *	0.032 **	0.003 **	0.014 **	0.041 **	0.036 *	0.046 *
BIND	0.036 **	0.006 *	0.036 **	0.002 *	0.032 **	0.003 *	0.014 **	0.004 *	0.006 *	0.013 **	0.005 **	0.002 **
CEOD	−0.013 **	−0.024 **	−0.042 **	−0.07 **	−0.041 **	−0.012 **	−0.042 *	−0.024 **	−0.025 *	−0.021 **	−0.012	−0.043
LEV	−0.021 **	−0.035	−0.036 **	−0.036	−0.036 **	−0.012 **	−0.032 **	−0.104 **	−0.064 **	−0.026 **	−0.162 **	−0.025 *
FS	0.017 **	0.016 *	0.025 **	0.002 *	0.026 *	0.021 **	0.008	0.012 *	0.021 *	0.004	0.005 *	0.031 **
CE	−0.031	−0.024 **	−0.034 **	−0.025 *	−0.084	−0.031 **	−0.015 **	−0.045	−0.041 *	−0.006 *	−0.021 *	0.034 **
TAR	0.004 **	0.023 **	0.032 **	0.033	0.012 **	0.014 *	0.062	0.154	0.025 **	0.014 *	0.014 **	0.083 **
FA	0.008 **	0.026 *	0.412 *	0.002 **	0.052 **	0.192 *	0.004 **	0.015 *	0.215 **	0.006 *	0.002 **	0.015 **
Constant	0.026 **	0.034 **	0.502 **	−0.021 **	0.206 *	0.482 **	0.017 **	0.184 **	0.401 **	0.021 *	0.326 **	0.428 **
Model Sig			0.000			0.000			0.000			0.000
Hausman	0.023			0.014			0.0153			0.0123		
<i>m</i> 2			0.312			0.205			0.332			0.325
Wald Stat		0.002			0.012			0.002			0.001	
Sargan Test			0.214			0.174			0.224			0.215
AR (2)			0.312			0.294			0.332			0.321

Notes: All variables, proxies, and abbreviations are available in the Section 4.3 econometric modeling sections. Here RE, FE and GMM denote the random effect model, fixed effect model and GMM estimation technique. The Hausman test validated that there is no correlation among independent variables and error terms, the null hypothesis of the Wald test is constant variance, the *m*2 is a test for serial correlation for GMM, the Sargen test rejected the null hypothesis with  $p > 0.05$ . The level of significance represents at \*  $p < 0.05$  level, \*\*  $p < 0.01$  level respectively.  $n = 10,143$ .

**Table 4.** Gender diversity and firm performance with the moderating role of CEO duality (accounting-based measures).

Variables	Return on Asset (ROA)						Return on Equity (ROE)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Lag	0.436 **	0.007 **	0.133 **	0.427 *	0.002 **	0.147 **	0.496 **	0.063 **	0.060 *	0.491 **	0.050 **	0.077 **
FD	0.043 **	0.015 **	0.047 **	0.001 **	0.014 **	0.046 **	0.021 **	0.015 **	0.018 **	0.011 **	0.015 **	0.020 **
FD × CEOD				−0.001	−0.019	−0.016				−0.002	−0.028	−0.024
BISIZE	0.014 **	0.004 *	0.026 **	0.061 **	0.003 *	0.016 *	0.002 **	0.007 **	0.025 **	0.002 **	0.005 *	0.025 *

Table 4. Cont.

Variables	Return on Asset (ROA)						Return on Equity (ROE)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
BIND	0.013 **	0.003 *	0.013 *	0.002 *	0.003 **	0.003 *	0.003 **	0.006 *	0.005 *	0.003 **	0.007 **	0.006 **
CEOD	−0.009 *	−0.022 *	−0.021 **	−0.07 **	−0.025 *	−0.017 **	−0.012 *	−0.039 **	−0.049 **	−0.010 **	−0.030	−0.017 **
LEV	−0.038 **	−0.087 **	−0.055 **	−0.038 **	−0.078 **	−0.048 **	−0.045 **	−0.189 **	−0.094 **	−0.045 **	−0.176 **	−0.086 *
FS	0.006	0.013	0.037 **	0.006 *	0.004 *	0.026 **	0.009 **	0.017 *	0.094 *	0.009 **	0.004 *	0.080 **
CE	−0.011 **	−0.034 **	−0.011	−0.031	−0.034	−0.010	−0.030	−0.072 *	−0.027 *	−0.030 *	−0.072 *	0.027 **
TAR	0.010 *	0.026 **	0.033 *	0.011 **	0.020 **	0.035 *	0.064 **	0.231 **	0.091 **	0.064 *	0.222 **	0.098 **
FA	0.003 *	0.020 *	0.462 *	0.003 **	0.040 **	0.462 *	0.005 **	0.060 *	0.135 **	0.005 *	0.001 **	0.016 **
Constant	0.022 **	0.067 **	0.678 **	−0.022 **	0.119 *	0.602 **	0.015 **	0.239 **	0.494 **	0.016 *	0.316 **	0.535 **
Model Sig			0.000			0.000			0.000			0.000
Hausman	0.013			0.034			0.0303			0.0123		
<i>m</i> 2			0.212			0.205			0.213			0.255
Wald Stat		0.000			0.003			0.000			0.002	
Sargan Test			0.264			0.234			0.224			0.201
AR (2)			0.312			0.304			0.321			0.324

Notes: All variables, proxies, and abbreviations are available in Section 4.3 econometric modeling sections. Here RE, FE, and GMM denote the random effect model, fixed effect model and GMM estimation technique. The Hausman test validated that there is no correlation among independent variables and error terms, the null hypothesis of the Wald test is constant variance, the *m*2 is a test for serial correlation for GMM, the Sargen test rejected the null hypothesis with  $p > 0.05$ . The level of significance represents at \*  $p < 0.05$  level, \*\*  $p < 0.01$  level respectively.  $n = 10,143$ .

Table 5. Gender diversity and firm performance with the moderating role of CEO duality (market based measures).

Variables	Tobin's Q						Book to Market Ratio (BMR)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Lag	0.551 **	0.09 **	0.195 **	0.55 **	0.009 **	0.194 **	0.75 **	0.11 **	0.236 **	0.75 **	0.11 **	0.235 **
FD	0.091 **	0.17 **	0.573 **	0.72 **	0.163 **	0.629 **	0.03 **	0.10 **	0.011 **	0.04 **	0.10 **	0.011 **
FD × CEOD				−0.093	−0.270	−0.245				−0.004	−0.010	−0.007
BISZE	0.042 *	0.62 **	0.63 **	0.039 **	0.62 **	0.496 **	0.01 **	0.056 *	0.02 **	0.01 **	0.057 **	0.021 **
BIND	0.017 **	0.073 **	0.094 **	0.020 **	0.069 **	0.065 **	0.05 **	0.007 **	0.03 **	0.05 **	0.007 **	0.029 **
CEOD	−0.447 *	−0.526 *	−0.061 **	−0.578 *	−0.186 *	−0.657 **	−0.024 *	−0.062 *	−0.010 *	−0.019 *	−0.038 *	−0.005 **
Lev	−0.63 **	−0.14 **	−0.163 **	−0.698 *	−0.28 **	−0.635 **	−0.17 **	−0.25 **	−0.34 **	−0.174 *	−0.252 *	−0.35 **
FS	0.105 **	0.57 **	0.549 **	0.095 *	0.85 **	0.11 **	0.024 **	0.68 **	0.48 **	0.025 **	0.694 *	0.48 **
CE	−0.802	−0.064 *	−0.88	−0.78 **	−0.059	−0.75 **	−0.07 **	−0.079	−0.149 *	−0.077 *	−0.079	−0.150
TAR	0.706 **	0.67 *	0.294 **	0.61 **	0.58 **	0.796 **	0.21 *	0.61 **	0.382 **	0.208 **	0.614 **	0.398 *
FA	0.552 **	0.012 *	0.018 *	0.55 **	0.018 **	0.75 *	0.02 **	0.75 **	0.83 **	0.02 **	0.045 *	0.017 **

Table 5. Cont.

Variables	Tobin's Q						Book to Market Ratio (BMR)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Constant	4.279 **	5.276 *	3.63 **	4.23	5.565	6.452	0.496 **	5.051 **	2.98	0.498	5.078	3.196
Model Sig			0.000			0.000			0.000			0.000
Hausman	0.002			0.012			0.003			0.001		
<i>m</i> 2			0.112			0.120			0.114			0.130
Wald Stat		0.000			0.002			0.003			0.000	
Sargan Test			0.321			0.304			0.324			0.311
AR (2)			0.412			0.431			0.411			0.402

Notes: All variables, proxies, and abbreviations are available in Section 4.3 econometric modeling sections. Here RE, FE, and GMM denote the random effect model, fixed effect model, and GMM estimation technique. The Hausman test validated that there is no correlation among independent variables and error terms, the null hypothesis of the Wald test is constant variance, the *m*2 is a test for serial correlation for GMM, the Sargan test rejected the null hypothesis with  $p > 0.05$ . The level of significance represents at \*  $p < 0.05$  level, \*\*  $p < 0.01$  level respectively.  $n = 10,143$ .

### 5.5. Female CEOs and Firm Sustainable Performance with the Moderating Role of CEO Duality

Tables 6 and 7 report the results of female CEOs and firm sustainable performance with moderating effect of CEO duality [67]. The results demonstrate that female executives have a significant and positive impact on firm sustainable performance for all measures due to less leverage and capital expenditure and systematic risk [46] through stewards, communal, and risk-averse behavior [50,52,64] by transformational leadership structure [15] lower level of debt issue, and a higher level of returns announcements [61] and tremendous role in the decision-making process [8,62]. Thus, H2 failed to be rejected. The H3b proposed that CEO duality moderated the relationship among stated variables. Once again, the results show negative coefficients with an insignificant ( $p > 0.05$ ) association of interaction terms. Consequently, it was concluded that CEO duality does not moderate the relationship between female CEOs and firm sustainable performance [25] due to the stewardship theory perspective [47,50,52]. From this, H3b failed to be accepted.

### 5.6. All Control Variables and Firm Sustainable Performance

A study using such corporate governance and firm's level control variables details are as follows. The coefficient of board size is positive and significant with firm sustainable performance measures [55]. It means a large board size could be beneficial as a skilled, educated, and experienced board of directors would improve the firm sustainable performance. Results are consistent with past studies [8,77,97]. The coefficient of board independence is positive and significant for firm sustainable performance measures, meaning that more outside directors can increase the firm sustainable performance [25,62,73]. The financial leverage coefficient value is negative and significant; the high cost of borrowing decreases the firm performance [75,81]. The finding that firm size has a positive and significant coefficient value means that a large firm size is more attractive to potential and foreign investors. It might be possible to enhance the firm's financial position [46,98]. The results of capital expenditure have negative and significant impacts, which means, for the good belief of firm sustainable performance, the female representation avoided the systematic risk and kept a lower level of capital expenditure [63,64]. The firm tangibility ratio shows positive and significant value, meaning that higher representations of gender diversity are more tangible assets than firms without female directors [19,56]. The finding of firm age is positive and significant. It indicates mature and experienced firms have better performance and enhance the firm value [8,81].

**Table 6.** Female CEO and firm sustainable performance with the moderating role of CEO duality (accounting-based measures).

Variables	Return on Asset (ROA)						Return on Equity (ROE)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Lag	0.438 *	0.16 **	0.135 *	0.43 **	0.15 **	0.14 **	0.50 **	0.06 **	0.072 *	0.50 **	0.06 **	0.07 **
FMC	0.03 **	0.07 **	0.03 **	0.05 **	0.03 **	0.04 **	0.08 **	0.007 *	0.01 **	0.13 **	0.02 **	0.03 **
FMC × CEOD				−0.008	−0.010	−0.018				−0.024	−0.013	−0.038
BISZE	0.01 **	0.04 **	0.09 **	0.01 **	0.04 **	0.08 **	0.02 **	0.07 **	0.016 **	0.02 **	0.07 **	0.15 **
BIND	0.02 **	0.03 **	0.003 **	0.002 **	0.04 **	0.06 **	0.04 **	0.006 **	0.05 **	0.03 **	0.007 **	0.05 **
CEOD	−0.011 **	−0.025 *	−0.028 **	−0.04 **	−0.033 *	−0.045 **	−0.016 *	−0.042 *	−0.049 **	−0.003	−0.053 *	−0.084 **
Lev	−0.04 **	−0.08 **	−0.04 **	−0.41 **	−0.08 **	−0.049 *	−0.047 *	−0.18 **	−0.085 *	−0.05 **	−0.183	−0.08 **
FS	0.06 **	0.012	0.037 **	0.06	0.013 **	0.042 **	0.09	0.017 **	0.083 **	0.09	0.018	0.094 **
CE	−0.012 *	−0.036	−0.08 **	−0.013 *	−0.036 *	−0.09 **	−0.032 *	−0.075 *	−0.021 *	−0.33 **	−0.075 *	−0.027 *
TAR	0.008 **	0.022 **	0.035 *	0.088	0.02 **	0.033 *	0.066 **	0.226 **	0.097 **	0.068 **	0.223	0.103 **
FA	0.003 **	0.001 **	0.471	0.002 **	0.016 **	0.476 **	0.05 **	0.021	0.410 **	0.004 **	0.036	0.413 **
Constant	0.018 **	0.046 **	0.322 **	0.016 *	0.033 **	0.295 *	0.022 **	0.217 **	0.015 **	0.027 **	0.199 **	0.087 **
Model Sig			0.000			0.000			0.000			0.000
Hausman	0.021			0.041			0.0015			0.0032		
<i>m</i> 2			0.192			0.186			0.187			0.165
Wald Stat		0.000			0.001			0.000			0.002	
Sargan Test			0.195			0.186			0.168			0.187
AR (2)			0.412			0.403			0.414			0.401

Notes: All variables, proxies, and abbreviations are available in Section 4.3 econometric modeling sections. Here RE, FE, and GMM denote the random effect model, fixed effect model, and GMM estimation technique. The Hausman test validated that there is no correlation among independent variables and error terms, the null hypothesis of the Wald test is constant variance, the *m*2 is a test for serial correlation for GMM, the Sargan test rejected the null hypothesis with  $p > 0.05$ . The level of significance represents at \*  $p < 0.05$  level, \*\*  $p < 0.01$  level respectively.  $n = 10,143$ .

**Table 7.** Female CEO and firm performance with the moderating role of CEO duality (market-based measures).

Variables	Tobin's Q						Book to Market Ratio (BMR)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
Lag	0.53 **	0.012 **	0.209 **	0.548 **	0.015 **	0.217 **	0.754 **	0.108 **	0.243 **	0.753 **	0.108 **	0.242 **
FMC	0.041 **	0.317 **	0.045 **	0.290 **	0.122 **	0.663 **	0.013 **	0.022 **	0.054 **	0.010 **	0.032 **	0.120 **
FMC × CEOD				−1.332	−2.464	−2.409				−0.017	−0.167	−0.170
BISZE	0.016 **	0.647 **	0.12 **	0.022 **	0.584 **	0.263 **	0.001 **	0.046 **	0.050 **	0.013 **	0.048 **	0.059 **
BIND	0.004 **	0.077 **	0.097 **	0.002 **	0.137 **	0.127 **	0.005 **	0.007 **	0.032 **	0.005 **	0.011 **	0.035 **
CEOD	−0.472 *	−0.384 *	−0.385 *	−0.53 **	−0.48 **	−0.79 **	−0.032 *	−0.073 *	−0.021 *	−0.046-	−0.214 *	−0.124 *
Lev	−0.89 **	−0.25 **	−0.64 **	−0.72 **	−0.74 **	−0.062 *	−0.18 **	−0.25 **	−0.32 **	−0.13 **	−0.21 **	−0.29 **

Table 7. Cont.

Variables	Tobin's Q						Book to Market Ratio (BMR)					
	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM	RE	FE	GMM
FS	0.11 **	0.97 **	0.43 **	0.12 **	0.61 **	0.08 **	0.02 **	0.67 **	0.48 **	0.02 **	0.65 **	0.44 **
CE	−0.86 **	−0.92 **	−0.32 **	−0.77 **	−0.90 **	−0.65 **	−0.08 **	−0.09 **	−0.13 **	−0.08 **	−0.089 *	−0.109 *
TAR	0.44 **	0.53 **	0.13 **	0.57 **	0.96 **	0.49 **	0.22 **	0.62 **	0.35 **	0.21 **	0.59 **	0.34 **
FA	0.58 **	0.054 **	0.64 **	0.51 **	0.314 **	0.77 *	0.02 **	0.052 **	0.65 **	0.32 **	0.37 **	0.72 **
Constant	4.61 *	5.279 **	9.35 **	4.355 **	5.783 **	7.050 **	4.514 **	5.248 **	8.71 **	3.51 *	5.015	7.807 **
Model Sig			0.000			0.000			0.000			0.000
Hausman	0.001 *			0.002 *			0.004 *			0.001 *		
<i>m</i> <sup>2</sup>			0.314			0.320			0.332			0.309
Wald Stat		0.004			0.006			0.005			0.007	
Sargan Test			0.124			0.185			0.172			0.152
AR (2)			0.293			0.278			0.281			0.279

Notes: All variables, proxies, and abbreviations are available in Section 4.3 econometric modeling sections. Here RE, FE, and GMM denote the random effect model, fixed effect model, and GMM estimation technique. The Hausman test validated that there is no correlation among independent variables and error terms, the null hypothesis of the Wald test is constant variance, the *m*<sup>2</sup> is a test for serial correlation for GMM, the Sargan test rejected the null hypothesis with  $p > 0.05$ . The level of significance represents at \*  $p < 0.05$  level, \*\*  $p < 0.01$  level respectively.  $n = 10,143$ .

### 5.7. Endogeneity Baseness and Robust Analysis

Generally, if only one variable is used in the whole model, the analysis may have an endogenous issue [37]. So, the optimal statistical technique is applied to deal with the endogeneity problem [81]. This study uses female CEOs and CEO duality as independent and moderator variables that lead to potential endogeneity problems [8,38]. As per existing literature on gender diversity, gender CEOs, and CEO duality with firm sustainable performance, the researchers applied the GMM approach to overcome the endogeneity baseness [37]. Many econometrics tools have been used to examine endogeneity baseness, such as OLS, fixed effect, random effect, and GMM techniques [99]. The GMM model is the best to deal with the endogenous issue in panel data analysis. Besides that, GMM allows for dealing with unobserved heterogeneity, autocorrelation, and heteroscedasticity baseness, consistent with [37,94]. This study applies GMM model techniques; all findings of the GMM approach are shown in Tables 3–7, respectively. Finally, overall all results are illustrated in earlier tables, and all findings are still constant after considering the unobserved heterogeneity, autocorrelation, heteroscedasticity, and endogeneity issues. To investigate the robustness of the findings, the researcher applies several additional tests. The first one is to alternative measures and replaces the accounting-based ROA, ROE with market-based Tobin's Q and MBR measures, then re-estimate the effects. Generally, overall obtained results are similar at a significant level of 5% and 1% in the robustness analysis. The second one is a study using the instrumental approach to investigate the unobserved heterogeneity and endogeneity issues in an earlier relationship [100]. Researchers obtained lagged values of all proxies of the dependent variable as an instrument that is correlated with independent and control variables but not with the error term [87]. Thus, to control the governance factors and firm characteristics, the study re-estimates the effects. All results are reported in Tables 3–7 and suggesting that all results are robust to the presence of unobserved heterogeneity and endogeneity issues.

### 5.8. Hypothesis Testing

Table 8 presents the hypothesis testing of the study. It reports the hypothesis and the status of each hypothesis in terms of its acceptance and rejection, along with the remarks. It shows that the Hypothesis 1 and Hypothesis 2 has been accepted, showing that higher the gender diversity leads to a higher firm sustainable performance and the higher the female CEO's power, the higher the firm sustainable performance. Furthermore, the 3rd hypothesis of the study has been rejected, confirming that CEO duality has no moderated impact on the relationship between female directors, female CEO, and sustainable firm performance in Pakistan.

**Table 8.** Hypothesis testing.

Hypothesis		Remarks
H1: Women on board have a significant positive impact on a firm sustainable performance	Accepted	Higher the gender diversity, the higher the firm sustainable performance
H2: Female CEOs have a significant positive impact on firm sustainable performance	Accepted	Higher the Female CEO's power, the higher the firm sustainable performance
H3a: CEO duality moderates the relationship between female directors on boards and firms' sustainable performance	Rejected	CEO duality cannot influence the female directors and the firm sustainable performance
H3b: CEO duality moderates the relationship between female CEO and firms' sustainable performance	Rejected	CEO duality cannot influence the female CEO and the firm sustainable performance

## 6. Conclusions and Discussion

This study investigates whether female directors on board and female CEOs has an impact on firms' sustainable performance with the moderating role of CEO duality in an emerging economy. To investigate this relationship, this study uses firms' sustainable performance as a dependent variable while gender diversity and female CEO as indepen-

dent variables. The data is collected from the PSX website, annual reports of firms, and State bank balance sheet analysis (BSA). The GMM technique has been used to access the relationship between independent, dependent, and moderating variables. Finding shows the positive and significant association of female directors on board and female CEOs with firm sustainable performance. Therefore, females working on top-level management increases firms' sustainable performance [51]. The results are consistent with past studies and suggest that gender diversity and female leaders have a significant impact on firms' sustainable performance [17,21,101]. The results of the study reveal that higher gender diversity on the corporate board panel enhances firms' sustainable performance. Because they improve corporate governance mechanisms [43], decrease asymmetric information, and improve effective communication systems with potential customers [87]. From an agency theory perspective, the CEO duality itself has a negative and significant association with firms' sustainable performance [66,67], and in alignment with the stewardship theory perspective, it does not moderate the relationship between female directors, female CEOs, and firms' sustainable performance [25,57]. Furthermore, our results show that board independence has a positive impact on sustainable performance, which is consistent with the study of [102]. One possible reason of this positive impact is the fact that more independent directors on boards leads to improving the corporate governance mechanism in a company which ultimately enhances the sustainable firms' performance. This study contributes to financial literature and shows that high representations of gender diversity on corporate boards reduce agency conflicts and enhance monitoring power in corporate governance mechanisms. Firms' performance is a key element for all the stakeholders [97,103,104]. This study also highlights the issue of female CEOs and suggests that females in the top-level management, such as CEOs, are the most important attribute that can enhance the sustainable performance of the firm. Furthermore, the stewardship behavior of CEO are also in favor of corporate governance and firms' sustainable performance. It allows the CEO to run firms with clear leadership. The findings suggest that corporations should consider increasing the number of women on their boards of directors if their participation can improve company performance. Additionally, greater diversity may boost productivity, creativity, and innovation. Governments and market regulators should establish gender quotas for women on boards, similar to what European countries have done. Gender diversity should be increased, with mandatory regulations being a key component. Furthermore, it is important to note that these results are equally important and relevant for emerging and developed economies because, in European countries already quota system has been established. Therefore, in consistent with European countries, other developed and emerging countries government and market regulators should establish gender quotas for women on boards.

## 7. Practical Insights and Future Recommendations

Gender diversity on corporate boards is becoming increasingly important, leading to the development of numerous legislation and policies aimed at encouraging female board nomination and participation around the world. Initiatives to increase the number of female directors on corporate boards are based on the belief that adding more talents, ideas, conversations, and views to corporate boards' decision-making will improve not just social justice, but also governance and company performance.

Our findings offer various managerial takeaways and policy recommendations. The consequences of women's presence on corporate boards have sparked fresh interest during the last decade. Women are generally underrepresented in the boardroom. Female boardroom presence, however, may promote access to a larger pool of human resources, which has substantial ramifications for firms' competition and performance. This raises the important topic of whether women directors boost corporate performance, which has yielded conflicting results in previous empirical studies. The addition of more females to boards of directors improves Pakistani firms' long-term financial success, according to this study. Indeed, the economic justification for gender-balanced boards is as much about

enhancing company performance as it is about supporting women's equality. As a result, boosting female representation in boardrooms will contribute to long-term sustainable transformation in the workplace, responsible governance, and global competitiveness. The results of this study serve as the guidelines for investors, shareholders, and all stakeholders of a firm when selecting a board of governance. Particularly, to mitigate the gender diversity in the firm, the board members should consider the balance between female and male board members to obtain sustainable firms' performance through diversified accumulated human capital. The board of directors recommended adding specific criteria for evaluating gender compensation for new corporate board members. This practical improvement of having gender diversity may act as a catalyst for other stakeholders like employees, customers, and even society.

Finally, the study demonstrates some future recommendations with the known limitations of the study. The study is restricted concerning corporate governance variables; likewise, the study uses the internal level of corporate governance factors, not external level like political influence, market competition, media exposures, etc. New research may consider other factors such as audits, directors' meetings, and remuneration. This study consists of secondary data analysis. New researchers improve our findings by conducting interviews, case studies, and questionnaires to investigate the association of gender diversity with firms' sustainable performance. Furthermore, this study only used the data of the listed companies in Pakistan, while future research can replicate this study in other emerging countries and even in the developed world. In addition, future research should use cross-country samples to analyze and compare the appointment of female representation on boards under the voluntary approach with nations that establish quotas for female presence on boards.

We looked at gender diversity on the board in this research, but there are other sorts of board diversity (e.g., race and age) that can have an impact on sustainable company performance, and whose role can be mitigated by CEO duality, so they are worth looking into. Furthermore, we primarily focus on financial performance indicators; nevertheless, non-financial performance measures (e.g., social performance) are becoming increasingly significant and are thus worth investigating. Even while there is a growing body of literature demonstrating that female directors can influence various board decisions, the impact of CEO duality on such relationships is not well understood and is another area for future research. Finally, this study looks at the impact of board gender diversity on company performance in Pakistan; nevertheless, while looking at board gender diversity and its impact on firms' performance, institutional and cultural systems are critical. To further understand the role of CEO duality in the impact of board gender diversity on the firm, cross-country research is essential.

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