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RESEARCH ARTICLE

Board gender diversity and corporate environmental performance: The moderating effects of resource slack

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ABSTRACT

The board of directors, as the decision-making body of internal environmental governance, has an undeniable impact on corporate environmental performance (CEP). With the continuous improvement of women's status and the increasing emphasis on gender equality in society, the topic of the impact of board gender diversity on CEP has received more attention. The foundation of the study is built around the Resource Base Theory, which explores the impact of board gender diversity on CEP and constructs a research model of slack resources regulating board gender diversity and CEP. The study focuses on industrial enterprises in Guangdong Province, China, and uses the Partial Least Squares (PLS) structural equation model to analyze 478 collected enterprise data. Slack Resources is divided into absorbed slack and unabsorbed slack, and their moderating effects are tested separately. The research findings indicated that female directors have a significant positive impact on CEP, while the unabsorbed slack enhances the positive impact of female directors on CEP; in the same vein, the moderating effect of absorbed slack is not significant. The research findings suggest that it is necessary to determine which types of slack resources and female directors are being considered when discussing the impact of board gender diversity on CEP.

Keywords: CEP; board gender diversity; slack resources; resource base theory; internal environment

1. Introduction

One of the main focuses under the guideline of the Chinese's 14th Five-Year Plan (2021-2025) is enhancing ecological civilization, which resulted in a dramatic change in production and lifestyle which at the same time achieved significant results in energy utilization efficiency, reduction in major pollutant emissions, and significant improvement in the ecological environment[1]. In this context, enterprises must establish sustainable development mechanisms to improve corporate environmental performance (CEP). As an important governing body of modern corporate systems, the board of directors bears primary responsibility for social and environmental issues and the "Triple Bottom Line" [2]. Therefore, it is urgent to explore the favorable conditions driving CEP from the board of directors' perspective to improve the internal driving force of CEP.

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In recent years, in the board of directors of Chinese listed companies, "her power" has shown a consistent growth trend. The 2023 Female Directors of Chinese Listed Companies Report indicates that there is a percentage increase from 10% to 18% of female directors in Chinese listed companies in the recent decade, which indicated an increase of 75%[2]. This translates to an increase in female directors in companies to about 3,947, indicating an increase of 98% out of over 5,055 companies surveyed[2]. The diversity of the board of directors has been greatly improved. To some extent, it has improved the situation where female directors are unable to fully leverage their advantages due to their low proportion, and the influence of female directors on the governance of listed companies is becoming increasingly apparent[2].

Previous studies have shown that in terms of board gender, women exhibit a stronger dedication and commitment when it comes to sustainability in the environment and display a willingness to support responsible environmental practices in the communities of operation[3,4]. In the corporate sector, gender-diverse boards of directors have a higher tendency to receive higher environmental ratings than other companies[5]. Webb (2004)[6] suggested that companies pursuing environmental responsibility have a higher tendency of gender-diverse boards of directors than other companies. Several studies suggest that the availability of females on the board of directors negatively influences disclosure in Environmental, Social, and Governance (ESG). A positive influence on the disclosure of ESG is associated with the absence of a sufficient number of females on the board[7]. The availability of females on the board may serve as a symbol of board diversity in an organization and unable to present a unique perspective in the board's deliberations[8]. It can be seen that there is no consensus on the impact of female directors on corporate environmental performance. Based on this, the study addresses the question of whether gender diversity on the board of directors can improve CEP in enterprises in Guangdong Province. The objective of the study is to determine gender diversity on the board of directors of CEP.

The impact of board gender diversity on CEP may be context-dependent and in line with some studies. The main objective of the study is to increase the knowledge gaps on the impact of diversity in board gender on CEP. The condition considered in this article is resource slack. Resource slack refers to the difference between overall resources and overall required payments[9]. Resource-based theory revealed that slack resources enable senior management to try new strategic choices to fully utilize the potential of team diversity[10]. Therefore, slack resources play an undeniable role in the process of gender diversity in the board of directors affecting CEP. The study introduces the moderating role of slack resources as a variable to empirically study the impact of diversity in gender on the board of directors on CEP.

The study found: Firstly, it revealed a positive and significant correlation between diversity in gender on the board of directors and CEP, suggesting that the more female directors on the board, the more CEP. Secondly, unabsorbed slack enhances the positive correlation between director gender diversity and CEP, while the moderating effect of absorbed slack on both is not significant.

The study has three marginal contributions: (1) Expanded the research on economic consequences of resource-based theory. Combining the resource-based perspective, the study examines the factors influencing board of director gender diversity as well as CEP in an organization, expanding the research scope of resource-based theory; (2) Verified the role played by female directors in CEP and sustainability in environmental development, providing empirical data that support the government to provide gender diversity policies relating to the board of directors. Currently, enterprises are facing a demand from society to engage more female directors on the board, but there is yet to be a consensus on whether such engagement in female directors will lead to the enhancement of good corporate values. Findings from this study confirm that female directors promote CEP, thereby enhancing sustainable and high-quality development of enterprises, providing empirical data support for the government to formulate strong policies in the board of directors' gender diversity. (3)

The introduction of slack resources as a moderating variable and its subdivision into absorbed and unabsorbed slack were empirically tested. The findings revealed a heterogeneity in the moderating effect of different types of redundant resources on board gender diversity and CEP. This enriches existing literature on the context of slack resources and directorization of gender diversity and provides a reference for enterprises to allocate different types of resources reasonably.

The study is divided into the following headings: theoretical analysis and research hypotheses; literature review of some selected related articles; research methodology, which includes variables, models, sample selection, and data sources; and results interpretations, recommendations, and conclusion.

2. Theoretical background and research hypotheses

The study looks at some of the theoretical frameworks related to the article, which include gender diversity as it relates to the board of directors and CEP, resource slack roles in terms of the moderating effect of both the absorbed and unabsorbed slack. With each of these theoretical concepts, a hypothesis is then formulated.

2.1. Gender diversity on the board of directors and CEP

With the development of the economy, women consistently play a vital role in corporate governance. Subsequently, this has resulted in a high number of female directors on the board of directors of various companies. Some countries have established relevant systems or measures to promote the participation of females in the management of companies, and some even have mandatory requirements for female participation. This indicates that enterprises have fully recognized the vital roles of women in development and management. With the increasing number of female managers, the likelihood of female directors participating in decision-making is greater.

From an internal perspective, women tend to consider the interests or needs of relevant stakeholders more. They will increase overall employee salaries, improve office or working conditions for employee safety, and reduce environmental safety hazards. Women are more responsible. Female directors focus more attention on the social image of the enterprise. Female directors have a more sensitive insight into the market. When there are different viewpoints, they will better weigh them and consider the interests of stakeholders more, so they are not just focused on shareholder interests. More often than not, they sacrifice shareholder interests to ensure the interests of stakeholders[11-13] .

A board with more women tends to consider the developmental strategy of the company more on the long-term than on the short-term benefits[14]. Al-Jaifi et al. (2023)[15] studied the influence of board diversity as it relates to environmental performance using the Asia-Pacific region by sampling 14,878 firm-year outcomes to study the characteristics of board diversity. Findings from the study reveal that environmental performance is closely determined by gender diversity on the board and age, which are positively related. In contrast, environmental performance and board diversity tenure are negatively related. In the same vein, Nadeem et al. (2020) [16]answered the question of whether women are eco-friendly by using board diversity and environmental innovation to examine the link. The study used companies listed in the United States of America (USA) and drew a sample of 10,334 firm-year observations. Results reveal that there is a positive and significant influence on environmental performance and board gender diversity. Furthermore, the study discovered the influence is closely associated with less profitable firms and a highly sensitive environment.

Burkhardt, Nguyen, and Pincelot (2020)[17] Agent of change top management female and CEP. Findings reveal that a higher percentage of females in top management positions display excessive environmental performance. Numerous key indicators are also related to the top management female, which includes resource

reduction, eco-friendly products, and environmental performance. Provasi and Harashen (2021) [18]investigate sustainability performance as it relates to gender diversity and corporate performance by observing 40 companies using the FTSE-MIB index for a period of three (3) years from 2016-2018. The methodology adopted yearly regression, Pooled, and differential analysis. Findings indicate a significant impact related to financial performance whenever female participation is involved. The result further reveals a significant correlation between female and corporate sustainability performance. Naveed et al. (2021) [19]examined female diversity on board and corporate social performance in diverse industries, using evidence from China Mainland. The study used Ordinary Least Square (OLS) regression models using Chinese industries from 2009 to 2025. Results indicate a positive impact of gender board diversity in various industries aggregated while putting into consideration firms' ESG risk exposure. Female board diversity can reduce ESG exposure to risk, which increases the CSP and the inclusion of even female directors to the board, either independent directors or executive directors.

In addition, Improving CEP is beneficial for reducing environmental pollution and achieving green and sustainable development of enterprises. Carrying out environmental investment is the main way to improve CEP. However, significant returns may not be achieved within the expected short-term period, which is always possible in the long-term development of the enterprise. According to Post, Rahman, and Rubow (2011)[5], more female directors on the company's board tend to invest significantly in environmental and social responsibility. Compared to men, women can respond more quickly and positively to a company's environmental strategy.

In addition, social role theory suggests that society places more expectations on women, expecting them to consider environmental performance and social responsibility performance more than just economic performance. Because of these expectations, female directors will gain more understanding when choosing environmental strategies. Therefore, they are more inclined to improve CEP[5] (Rahman & Rubow, 2011). Based on the above, the research hypothesis is formulated below:

Hypothesis 1: The higher the female percentage on the board of directors, the higher the level of CEP.

2.2. The regulatory role of resource slack

Hypothesis 1 states that board directors' diversity in gender influences CEP; however, the degree of this impact varies depending on the specific peculiarity of the enterprise, such as slack resources. Different types of organizations have varying degrees of differentiation and flexibility in management due to relaxation [20].

In theory, Singh (1986)[21] was the first person to classify slack resources into unabsorbed slack and adsorbed slack[22]. According to Bowen (2002) [23]and Du, Kim, Foune, and Wang (2022)[24], defined, unabsorbed slack means excessive resources that have no clear purpose or usage or resources uninvested in specific business activities and can be freely disposed of and redeployed. Unabsorbed slack has a high degree of autonomy, and managers can allocate these resources to any purpose[25]. For example, cash and credit lines depend on excess liquid assets[26], while excess time for employees [23]. Absorbing slack indicates additional resources integrated into a company's present processes, related to its specific business, and difficult to use for other purposes [27,28], such as overcapacity[26], excessive professional and technical workers[29] and excess inventory levels[30].

The redeployment ability of both slacks (absorbed and unabsorbed) is different[26]. For idle capacity that has yet to be absorbed, management has greater discretion to redeploy. However, for idle capacity that has been absorbed, due to structural limitations, it is difficult for management to recover the excess capacity that has been absorbed, and the cost and capacity requirements for redeploying these capacities are high. Therefore, managers are unlikely to redeploy existing purposefully absorbed slack (Daniel et al., 2004). Absorption of

resources Slack provides resources and flexibility for enterprises, providing internal buffering to help organize the operation of current workflow as well as maintenance. As a result of the different natures of slack resources and types, then different impacts are expected when studying the impact of board characteristics on CEP[9,20].

2.2.1. The moderating role of unabsorbed slack

In terms of the altruistic behavior of females, empirical evidence suggests that females receive a higher rate of encouragement and praise than males[31]. Subsequently, female directors are in a better position and more concerned about the relationship existing between environmental hazards and people's happiness than male directors[32]. According to Smith and Rogers (2000)[33], situations of uncertainty can influence female directors to exhibit more ethical behavior than their male counterparts. Females on the board of directors also tend to pay more attention to company decision-making and strategy than male directors, considering more interests and stakeholders[12]. So, the assumption is that the higher the proportion of female directors in a company, the significantly more CEP in the company.

The higher the proportion of women on a company's board of directors, the higher the CEP, which increases with the increase of unabsorbed slack. The reasons are as follows: as explained by Liao and Long (2018)[34], cognitive patterns only determine the manager's willingness to engage in environmental innovation, while resources provide organizations with the ability to engage in environmental innovation. Studies have shown that female directors have a higher tendency to protect environmental ethics, which improves the CEP, which requires an excessive investment of human, material, as well as financial resources, than male counterparts[35]. Corresponding freely available resources are needed to ensure that the willingness to protect the environment can be more effectively translated into actual capacity improvement. Unabsorbed slack includes enterprises' tangible and mobile resources, which can be freely and flexibly processed. The existence of unabsorbed slack provides more opportunities and guarantees for environmental investment. Therefore, unabsorbed slack can enhance the significant positive correlation between the proportion of females on the organizational board and CEP. Correspondingly, the below hypothesis is hereby proposed.

Hypothesis 2: The higher the percentage of women on the board of directors, the higher the CEP level. Unabsorbed slack can strengthen this motivation.

2.2.2. The moderating role of absorbed slack

The absorbed slack is related to the excess resources fixed firmly in the enterprise. While unabsorbed slack can't easily be redeployed, if flexibly used, it can improve resource utilization efficiency and contribute to the formation of sustainable core competitiveness of the enterprise. Enterprises with a high proportion of female directors not only have the willingness but also the ability to redeploy absorbed slack to improve environmental performance better:

(1) More boards with female directors are willing to redeploy absorbent sludge. Compared to males, females exhibit an excessive commitment toward environmental sustainability as well as greater environmental support in line with responsible practices even where personal costs need to be increased[3,4]. In terms of leadership qualities, females often pay more attention to stakeholders and orientation in the long term than males, sometimes even sacrificing cost over the short term[36]. According to Diamantopoulos, Schlegelmilch, Sinkovics, and Bohlen (2003)[37], female directors are more attached to the environment and more eager to protect it than males. This means that as long as the redeployment of absorbed slack can help improve CEP, even if the cost is high, they are willing to do so.

(2) According to Singh, Terjesen, and Vinnicombe (2008)[38] and Hillman, Cannella Jr., and Harris (2002)[39], female directors can also redeploy the absorbed slack. Studies have indicated that female directors

possess diverse experiences in communities and service organizations, and these career trajectories may result in female directors adapting to policies that focus on expanding services and communities. Female directors displayed innovative and egalitarian perspectives on corporate strategy [40,12]. Torchia, Calabrò & Huse (2011)[8] discovered that the more female directors on the board of directors in companies with a higher percentage of female directors, the more innovative management strategies, business practices, and personnel planning than in companies with male board directors [8,41].

Therefore, absorbed slack can enhance the positive correlation between the percentage of females on the board of directors and CEP. Correspondingly, the study proposes the below hypothesis:

Hypothesis 3: The higher the percentage of women on the board of directors, the higher the CEP level. Absorbed slack can strengthen this motivation.

In summary, **Figure 1** indicates the model of the study, which is in line with formulated hypotheses:

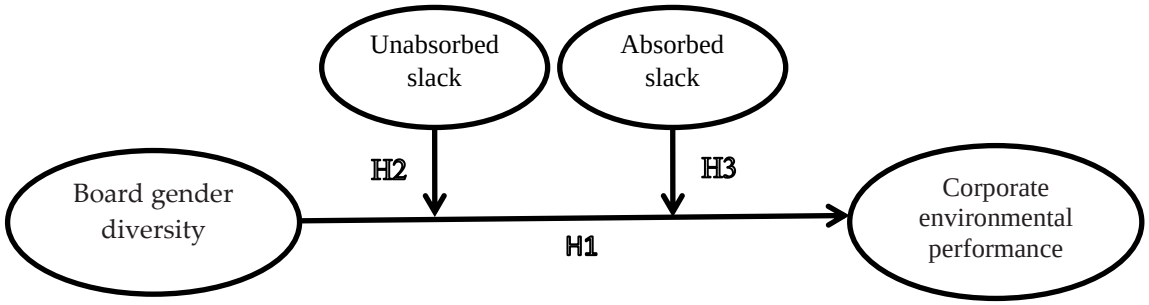


Figure 1. Research model.

3. Research methodology

A questionnaire was also formulated to address the study's objectives and hypotheses. The study selected a primary survey because raw data from the respondents was suitable for the questionnaire. Numerous researchers have used this method to study corporate behavior[42].

3.1. Data collection

Primary data was used to obtain data for the study. Because the enterprise's top managers are the clearest and most familiar with the information to be collected, this questionnaire is directly obtained and collected from the enterprise's top managers using a Simple Random Probability Sampling method through a well-structured questionnaire adopted to address all the objectives of the study.

To improve the reliability of the survey questionnaire, the questionnaire design of this study followed strict steps. Firstly, we conducted a comprehensive literature review to determine the core concepts and corresponding dimensions. Due to the relatively mature concept and measurement items of resource relaxation, this study tried to use existing mature scales as much as possible. In addition, this article has made appropriate modifications to the measurement items of CEP based on the research background. Meanwhile, all scales ensure practicality and consistency in both conceptual and cultural contexts in China.

Secondly, in order to ensure that the measurement items can be clearly understood and avoid answering biases, this study consulted the opinions of middle and senior management personnel and research scholars in the field multiple times during the questionnaire design process. For each question item, it was confirmed whether there were difficult-to-understand terms, whether there were vague questions, whether there was any content that needed to be more convenient to answer, and whether it was in line with corporate practice. On this basis, further modifications were made to ambiguous items, and some items were added or deleted.

Finally, multiple small-scale tests were conducted on the questionnaire, and multiple rounds of modifications were made based on the predicted feedback results to ensure that the description of the questionnaire items can be accurately and clearly understood by the respondents, avoid comprehension bias, and ensure the validity of the questionnaire content, forming the final questionnaire content.

Next, to achieve this, the study used online surveys electronically by adopting Wenxing. Wenxing is an online professional Chinese software questionnaire survey evaluation and voting platform that focuses on giving feedback with reliable and harmonized design in questionnaires, collecting data, creating customized reports, and observing outcomes analysis series of services online. The advantages of Wenxing over traditional survey methods include ease of use, fast outcome, and low cost, as well as the fact that numerous enterprises and researchers widely adopt it. The researcher sent mail to the companies' web links to provide an answer to the questionnaire.

3.2. Study area

The study area is Guangdong Province, China. The province was selected because the first female director initiative for investment institutions and listed companies in China in 2020, the "Xiangmihu Female Directors" initiative, was proposed in Shenzhen, Guangdong Province. Many companies have signed agreements agreeing to the diversity of their board of directors and are willing to accept more women to participate in the board. Moreover, companies in other regions of Guangdong, except Shenzhen, have also agreed to allow women to participate on the board of directors, which gives this study the edge of being the first to start empirical data research from Guangdong Province to provide more evidence support for the impact of gender diversity on the board of directors of enterprises.

To ensure the effectiveness and reliability of data analysis, the first and most important issue is to collect and screen the survey questionnaire[43]. In order to improve the response rate of the questionnaire, we contacted the respondents by phone and sent them sincere gratitude and friendly reminders via SMS. A total of 501 questionnaires were collected. Among them, 23 questionnaires needed to be properly completed or had outliers, which were queued outside of data analysis. A total of 478 questionnaires were effectively collected, accounting for 95.41% of the collected questionnaires, meeting the requirements.

3.3. Data analysis method

Partial Least Squares (PLS) were used to analyze the collected data through the questionnaire distributed online and returned. The method is used to examine models that have variables considered to be latent and facilitates moderation effect analysis[42,44]. PLS analysis is classified into two models. The first one reveals or measures the latent correlation and its indicators. The structural model, on the other hand, represents the correlation between variables differently[45]. The study first evaluates the effectiveness of the variables measured and then examines the structural model.

3.4. Variables measurement

The study's variables are divided into dependent and independent variables. The dependent variable is the CEP, the independent variable is board diversity and resource slack is the moderating variable. Each of the variable measurements is stated below.

3.4.1. CEP

The meaning of CEP is constantly developing, and the scale related to it is also changing. As for how environmental sustainability can be evaluated as a dimension, academics have yet to reach a consensus.

Previous research findings revealed using Likert's five scales provides an appropriate measure for CEP, and the use of multiple scales adopted for the survey[46-51].

Seven items were selected to reflect the CEP: the company can effectively reduce the number of "three wastes" emissions, effectively reduce the consumption of harmful/toxic substances, effectively use energy/resources can reduce environmental accident frequency, comply with environmental regulation, employees, and the public on environmental education, improve enterprise environment image/position of the company. We scored based on standards such as the Environmental Protection Law of the People's Republic of China, the Regulations on the Administration of Pollutant Discharge Permits, and ISO14031. We obtained relevant data using Likert's seven-level scale.

Table 1. The Measurement of CEP.

Item	Measuring index	Resources
CEP	**CEP1:** My company can effectively reduce the emissions of "three wastes".	Sibel and Bulent (2019) Chien（2014） Latan et al., (2018) Judge and Douglas (1998)
	CEP2: My company can effectively reduce the consumption of harmful/toxic substances.	
	CEP3: My company can make efficient use of energy/resources.	
	CEP4: My company can reduce the frequency of environmental accidents.	
	CEP5: My company is in compliance with environmental regulations.	
	CEP6: My company has provided employees with education and training related to environmental protection and safety.	
	CEP7: My company can improve the corporate environmental image.	

3.4.2. Board gender diversity

The study measured Board gender diversity by taking the ratio of female directors to the number of directors in the organization [52].

3.4.3. Resources slack

The researchers divided the ongoing activities as unabsorbed and absorbed resources in line with the degree to which the idle resources absorbed the activities[20]. Unabsorbed idle resources are surplus resources that have yet to be devoted to a specific purpose and can be redeployed for other organizational purposes. Instead, absorbed idle resources are additional resources associated with a particular business that is not to be redeployed for other reasons[27]. Unabsorbed slack includes excess liquid assets such as cash or credit lines[26] and "employees' redundant time" [23]. Absorbed slack includes excess capacity[26]. Excessive professional and technical workers and excessive inventory levels[29,30]. Based on the above content, in order to measure unabsorbed slack and adsorbed slack, this study draws on previous research. According to Wang, Luo, Liu, and Wei (2016)[53] and Tan and Peng (2003)[27], the development of the scale is used to measure the absorption of unabsorbed slack; this scale includes four items as listed in **Table 2**. Absorbed Slack uses the following three measures, as also shown in **Table 2**.

Table2. The measurement of resource slack.

Item	Measuring index	Resources

Unabsorbed Slack (US)	**US1:** My company has enough financial resources to deal with emergent investment demands **US2:** My company's retained earnings are enough to meet market demands **US3:** My company has much potential social relationship to use **US4:** My company can obtain bank loans or other financial funding when need	Wang, Luo, Liu and Wei（2016）
Absorbed Slack（AS）	**AS1:** My company's equipment and technologies are advanced but underused **AS2:** The potential talent resources have not been fully developed **AS3:** My company's current capacity is lower than the designed level	

4. Discussion of results

In this section, we will first evaluate the effectiveness of the measurement model and then examine the structural model to observe the outcomes of the variables in the study empirically.

4.1. Models testing

The reliability results of the model of the study are presented in Table 3 below. The reliability coefficient and composite reliability of latent variables are currently the most commonly used standards to measure the reliability and stability of a model. In general, when the Cronbach's Alpha (CA) coefficient is higher than 0.7[54,55] and the latent variable Composite Reliability (CR) is greater than 0.6[55,56], it indicates that the constructed model has high reliability and is more reliable. Table 3 indicates that the CA coefficients of the variables are all above 0.7, and the range of CR for different measurement values is higher than 0.9.

All the above indicators exceed the recommended threshold, indicating that each latent variable has good internal consistency and reliability, indicating that the model established in this study is very reliable.

Table 3. Assessment of the measurement model.

Variable constructs	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)
AS	0.874	0.921	0.796
CEP	0.918	0.935	0.671
US	0.933	0.949	0.823

Table 3 shows the result of Convergent Validity. The AVE measured the proportion of the latent variable's variability, which is explained by the indicator's variability (the degree to which the indicator explains the latent variable). According to Fornell and Larcker (1981)[57], as a general standard, if the AVE for each measurement is greater than 0.5, it means that more than 50% of the latent variable can sufficiently explain the indicator's variance on average. This also means that the latent variable has a powerful explanatory indicator for its measurement and has sufficient convergence effectiveness. **Table 3** indicates that the AVE of each variable is greater than 0.5, indicating sufficient Convergent validity.

The Discriminant Validity Test outcomes of the scale measurement are indicated in **Table 4**. The measurement adopted the Fornell and Lacker (1981)[57] criterion standard, which requires both variance and specific indicators of the latent variable to exceed any other latent variable. Therefore, the latent variable AVE

should exceed the highest squared correlation of the latent variable and any other variable[57]. **Table 4** shows that the elements in the diagonal of the matrix of AVE square roots also exceed the nondiagonal elements in their corresponding rows and columns, which is in line with the discriminant validity of the study's scale.

Table 4. Discriminant validity of variable constructs.

Latent variables	AS	CEP	US
AS	**0.892**		
CEP	-0.237	**0.819**	
US	-0.221	0.098	**0.907**

Table 5 shows the Discriminant validity of the variable constructs, which is ascertained by correlating the scores of each latent variable with items in the construct to obtain cross-loadings[58]. Cross-loadings are required to be less than factor loadings, which means that higher loading is expected from individual indicators and their specified construct than any other construct, as well as the highest loading in each construct project. Therefore, this indicated that there is sufficient difference between the constructs of the model[58].

From **Table 5**, it can be seen that all projects are greater than 0.7 in their respective structures, ranging from 0.81 to 0.94, and are higher in their respective constructions than in any other constructions. Therefore, it is once again confirmed that these indicators have discriminative validity.

Table 5. Factor loadings and cross loadings.

Item	AS	CEP	US
AS1	**0.887**	-0.216	-0.194
AS2	**0.864**	-0.157	-0.167
AS3	**0.924**	-0.245	-0.222
CEP1	-0.205	**0.817**	0.093
CEP2	-0.204	**0.830**	0.065
CEP3	-0.182	**0.805**	0.069
CEP4	-0.233	**0.816**	0.096
CEP5	-0.172	**0.813**	0.088
CEP6	-0.163	**0.814**	0.070
CEP7	-0.199	0.838	0.084
US1	-0.210	0.113	**0.940**
US2	-0.208	0.104	**0.932**
US3	-0.205	0.035	**0.873**
US4	-0.182	0.057	**0.882**

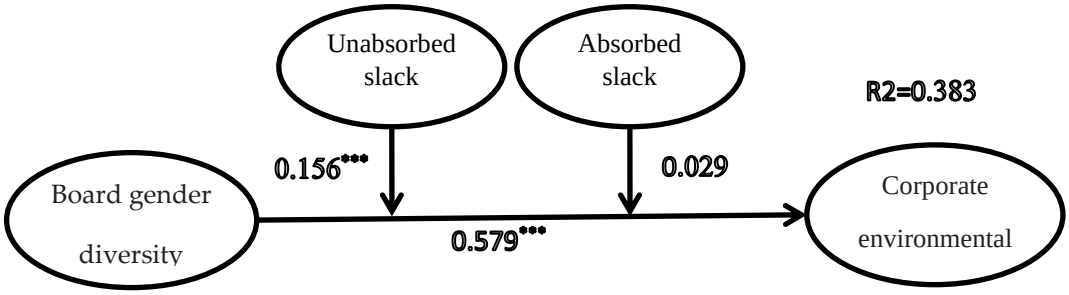
4.2. The structural model

The bootstrapping algorithm of Smart PLS4.0 was used to evaluate the structural equation model. The results of the structural model are shown in **Table 6** and **Figure 2**. **Table 6** shows path coefficients, R^2, and t-values obtained through PLS-SEM.

The first basic criterion for evaluating PLS structural equation models is the coefficient of the determinant (R^2) for endogenous latent variables, which indicates the correlation existing between the explanatory variance and the total variance of the latent variable. It is generally believed that a value ranging around 0.670 is substantial, a value higher than 0.333 is the average, and a value above 0.190 is weaker [58]. Figure 2 shows the results of a structural model with regulatory effects. From Figure 1, it can be seen that the R^2 of CEP is 0.383, which is higher than the average value.

Figure 1 shows the magnitude of the coefficient and the correlation between the latent variables. It is generally believed that the R^2 should exceed 0.100 to explain certain effects in the model[59]. Subsequently, the R^2 should be significant, at least at the 0.050 level of confidence. Based on the above criteria, empirical evidence from the study reveals that the impact of gender diversity is significant and positively correlated with CEP at0.579 and 0.001 respective（β= 0.579, p<0.001), this indicates that the higher the number of female directors on the board, the higher the improvement in CEP. Thus, this means that hypothesis 1 holds.

For the moderating factor (interaction) variable, the interaction between UA and board gender diversity on CEP is positive and significant（β= 0.156, p<0.001). Hypothesis 2 holds, but the interaction between AS and board gender diversity on CEP is positive but not significant（β= 0.029, p<0.388); hypothesis 3 does not hold.



Noted: Path Coefficients

* Significant at p<0.05; ** Significant at p<0.01; *** Significant at p<0.001.

Figure 2. Structural Model Results.

Table 6. Structural model results.

Path coefficients	Original sample	T statistics	P values
Diverse -> CEP	0.579	16.41	0.000
AS x Diverse -> CEP	0.029	0.864	0.388
US x Diverse -> CEP	0.156	3.827	0.000

Source: Research Survey, 2024

5. Conclusion and recommendations

5.1. Conclusion

Based on the resource-based theory, this article explores the relationship between gender diversity in the board of directors, resource slack, and CEP and empirically tests the moderating effect of slack resources on gender diversity in the board of directors and CEP. The following research conclusions are drawn:

Firstly, the study discovered that gender diversity on the board of directors has a positive and significant impact on CEP. This conclusion supports the view of Kyaw, Treepongkaruna, and Jiraporn (2022)[60] that companies with diversified boards are better at committing to and effectively reducing environmental emissions in production and operation processes. This conclusion also conforms to the theory of resource-based view. Based on the resource-based view, the growth of a company mainly depends on whether existing resources can be more effectively utilized[61]. The four characteristics required to build a competitive advantage in organizational resources are valuable, scarce, difficult to imitate, and difficult to replace, forming the basic analytical framework of the resource-based view[62]. In this study, female directors bring divergent perspectives,

styles of leadership styles, and modern methods to the process of decision-making of the company, subsequently improving the ability to meet various stakeholder groups' needs[63,64]. Female directors are highly sensitive and more concerned about the ethical and social issues of the organization[65] and support the implementation of climate change policies, business ethics policies, and health and safety policies[66]. Therefore, compared to male directors, companies with more female directors have more opportunities to implement environmental decisions and strategies, thereby promoting the improvement of CEP.

Secondly, the unabsorbed slack indicated a significant moderating effect on the correlation between board gender diversity and CEP. Through model testing, it was found that the unabsorbed slack has a significant positive moderating effect on the relationship between board gender diversity and CEP. This indicates that although male directors are less likely than female directors to believe that protecting the environment is ethical and necessary, improving CEP requires a significant investment of manpower, material resources, and financial resources[35], and requires the support of material resources. The unabsorbed slack representative of a company has the freedom to dispose of resources. With the unabsorbed slack, the willingness to protect the environment can be more effectively translated into actual capacity improvement. So, suppose female directors represent human resources in supporting environmental strategies. In that case, unabsorbed slack represents material resource security, and unabsorbed slack can enhance the positive relationship between the proportion of women on the board of directors and CEP.

Thirdly, the moderating effect of absorbed slack on the relationship between board gender diversity and CEP is not significant. Our hypothesis has not been supported, and there are two reasons for it. Firstly, compared to female directors who have the willingness to convert the adsorbed slack into resources to enhance CEP, fewer female directors can implement this willingness. Our study only counted the number of women but did not investigate this ability. The second is the lag in effectiveness. As scholars have proposed, effective absorption relaxation recovery may require significant modifications to the systems, processes, and structures to eliminate obsolete or superfluous tasks while elegantly assigning the tasks to reduce rumple to the minimal level[67]. These all require a long time for planning[68]. Our statistics have not been tracked for a long time.

5.2. Practical implications

The study's empirical outcomes have significant policy and practice implications. Firstly, there are no laws and regulations specifically designed to increase the proportion of female directors in mainland China. Our research indicates that female directors have a positive effect on improving CEP, providing empirical data support for the government to formulate gender diversity policies for the board of directors. Secondly, for enterprises, the analysis from the study indicates that, with some conditions, gender diversity among senior leadership significantly improves CEP. This indicates that in optimizing environmental policies and practices, companies' commitment should be prioritized by appointing females to senior positions of leadership. Finally, considering the heterogeneity of the moderating effects of unabsorbed slack and absorbed slack onboard gender diversity and CEP, companies should pay attention to distinguishing types when allocating redundant resources. Based on maintaining the necessary amount of resources for survival and development, it is necessary to avoid excessive absorption of sludge and potential resource stocks and fully leverage the advantages of unabsorbed sludge in the process of improving corporate environmental performance.

5.3. Limitations and future research

Our research has certain limitations, which is also the direction of future research. Firstly, our research is limited to Guangdong Province, China, which may lead to doubts about its universality, and the subsequent regions can gradually expand. Secondly, our study was not designed vertically, and long-term follow-up

studies were not conducted. Furthermore, our data was collected through surveys, and therefore, the possibility of common biases in terms of method and key informants cannot be ruled out. Subsequently, other researchers should use objectivity in collecting data to avert these biases. Finally, the study emphasizes the role of resource slack in board governance and CEP. Still, external factors such as government policies, technological barriers, and the environmental protection departments within the organization need to be taken into account, which can have a profound impact. This is also a part that future research should consider.

Conflict of interest

The authors declare no conflict of interest.

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