Article

Exploring the Affiliation of Corporate Social Responsibility, Innovation Performance, and CEO Gender Diversity: Evidence from the U.S.

Abeer Hassan [1] , Sehrish Atif [1,*] and Jiayi Zhang [2]

[1] School of Business & Creative Industries, University of the West of Scotland, Paisley PA1 2BE, UK; abeer.hassan@uws.ac.uk
[2] Adam Smith Business School, University of Glasgow, Glasgow G12 8QQ, UK; zjoey1129@outlook.com
* Correspondence: sehrish.atif@uws.ac.uk

Abstract: This paper examines the relationship between CSR activities and innovation performance with the moderating effect of CEO gender in the U.S. market. This paper provides evidence about the relationship between CSR and innovation performance from the resources-based views by replacing the common measurements of innovation and R&D expenditures with the number of patents and citations to better measure the innovation quality rather than quantity. The current paper verifies the relationship between CSR and innovation in S&P 500 U.S. listed companies and fills the gaps in the current research on the moderating effect of CEO gender on this relationship. The paper analyzed the panel data for 1204 observations from various databases (Compustat, KLD, U.S. patents by words and Excompustat) from 2014 to 2018. Specifically, the number of patents and citations is set as the measurement of the explanatory variable; innovation performance and CSR scores from KLD are treated as the dependent variable and the proportion of female directors in the top management as the method of moderating indicator. The result in this paper shows a positive correlation between CSR and innovation performance in the U.S. At the same time, the moderating effect of CEO gender has an insignificant impact on this relationship. The findings suggest that the female CEOs do not have a positive relationship with corporate innovation. These results will help companies realize the importance of CSR activities and how to balance gender diversity in their strategies.

Keywords: corporate social responsibility; innovation performance; gender diversity; R&D expenditures

1. Introduction

Since Oliver Sheldon first introduced the concept of Corporate Social Responsibility (CSR) from an academic perspective in 1924, CSR has become an important concept in many academic fields. Even so, compared to other fields in corporate finance, research on CSR is not mature enough. At the early stage, most corporations treat maximizing profits as their primary goal and believe fulfilling CSR is the way to be against because fulfilling CSR may lead companies to spend a large amount of money unreasonably. Bowen (1953) mentions that businessmen's decisions have certain impacts on the corporate stakeholders, such as clients, employees, and suppliers, then directly affect society. Gradually, more and more scholars appeal that corporations should rethink CSR and take it as an obligation to pay back to society while seeking to maximize their profits, such as reduction in energy consumption and pollutant emissions.

As the economy and society continue to evolve, businesses are becoming increasingly cognizant of the value of their sustainable development and the potential competitive advantage it may provide. Notably, innovation performance is a key concern as the main foundation for corporations to improve their financial performance and grab the market (Franko 1989; Dereli 2015). Additionally, corporations with better financial performance are more concerned about innovation and vice versa (Artz et al. 2010). To some extent, this

trend highlights the benefits and importance of innovation performance. Unsurprisingly, innovation is also a crucial dimension for firms' growth; firms with a higher level of innovation usually grow more than non-innovative firms (Colombelli et al. 2013). Therefore, the innovation capability of enterprises occupies a very important strategic position, which drives enterprises to continuously upgrade their innovation capability. However, regardless of the nation or industry, it appears to be a common issue for businesses. Most firms are generally believed to have a low level of innovation, and breakthrough innovations are quite rare compared to incremental ones. Corporate innovation is a high-risk investment activity because it requires significant financial outflows and has no guarantee of future returns, which may explain why companies have fewer intentions to innovate.

Moreover, CSR-compliant businesses can encourage innovation since consumers frequently perceive CSR initiatives as mere adornment and unrelated to corporate strategy (Costa et al. 2015). Most of the literature contends that companies with stronger CSR records are more likely to attract investment because they often have superior brand recognition and consumer loyalty (Khojastehpour and Johns 2014). At the same time, a few scholars have presented a contradicting view on this relationship, arguing that engaging in CSR will divert time and resources away from the firm's capacity for innovation (Bouquet and Deutsch 2007; Mithani 2017). Different conclusions can be drawn under varying situations. Therefore, based on the above discussion, the researchers have mainly selected the U.S. as the base country for the current study, specifically because U.S.-based businesses are becoming abreast of CSR measures. Thus, it is still worth developing how CSR affects innovation performance in the U.S. market.

Another motivation for conducting the current study is to analyze the role of CEOs because they are responsible for setting the corporate strategy that includes innovation and CSR compliance measures. Despite significant progress and evolutions, research on gender diversity in global corporate governance is still in its early stages, and there are not many studies examining how gender diversity affects innovation performance or how the female CEOs' performance is perceived. Therefore, the researchers believed that it would be interesting to investigate the substantial surge in the number of female CEOs in corporate leadership positions and its impact on corporate innovation performance. According to several empirical studies, women tend to make decisions that are more conservative, risk-averse, cautious (Levi et al. 2014), and ecofriendly than men do (Tate and Yang 2015). The female's presence in top management may improve the effectiveness of strategic decisions and the quality of communications from various perspectives (Gul et al. 2011), and they may perform better on CSR (Byron and Post 2016) yet have less innovation and fewer competitive incentives than male executives (Niederle and Vesterlund 2007). At the same time, conclusions about this relationship reached by scholars differ in different constraints, such as countries, firm size (Prabowo and Setiawan 2021), and the nature of ownership (Javaid et al. 2021).

Reviewing previous literature, while most previous research has established a positive relationship between CSR and innovation, conclusions on the relationship between CSR and innovation are still mixed and differ in different countries. Based on the above discussion, this paper aims to study the relationship between corporate social responsibility and corporate innovation performance in the U.S. market. These three aspects generally develop faster in the United States as a developed country than in other countries. These three are at an earlier stage than other corporate finance research fields. Thus, research on these three factors in the U.S. background will take leadership for further studies and guidance for corporations in the world to realize the importance of CSR, innovation, and how to balance CEO gender. Current related literature only concentrates on the impact of CEO gender on either CSR (Grosser and Moon 2017; McGuinness et al. 2017) or corporate Innovation (Marvel et al. 2015; Pecis 2016), and conclusions have not been reached as an agreement as well.

The contribution of this study is very clear, as most of the previous studies solely focus on how CSR affects innovation intentions or activities rather than innovation outcomes.

The current paper will study this link in innovation outputs to fill the identified research gap. Furthermore, this paper also contributes to studying this relationship's movement under the effect of CEO gender, as executives are the implementers and planners of CSR. In sum, it is of theoretical and practical significance to study the relationship between corporate social responsibility, CEO gender, and innovation performance. Notably, it is the key innovation point that setting CEO gender as a moderator variable to examine its effects on this link increases the research values and establishes the foundation for future developments. Hence, a research question has been formulated to evaluate the scope of CSR research, and it provides incremental empirical evidence for relevant social responsibility and corporate innovation literature:

Research Question: What is the relationship between CSR activities and innovation performance? And how does gender diversity have an impact?

In practical terms, the findings of this paper can help companies understand the impact of social responsibility on their innovation capabilities and can help them consider CEO gender diversity and optimize their decision-making. The paper is structured as follows: Section 1 presents the topic's background. Section 2 outlines the theoretical framework and U.S. context of CSR and gender diversity. Section 3 will illustrate the literature review and propose a hypothesis further according to the theories. Then, in Section 4, research methods will be discussed, and the data source, variable description, and regression models will be followed. Section 5 will present the related regression results, and finally, Section 6 will set out the conclusion and discuss this paper's limitations and further research.

2. Literature Review

This section introduces the theoretical background of corporate social responsibility and CEO gender diversity.

2.1. Corporate Social Responsibility

Corporate Social Responsibility (CSR) refers to how a company interacts with society. It encompasses a company's values and how they align with the expectations of the community in which the company operates (Aggarwal and Saxena 2022). McGuinness et al. (2017) averred that the objective of CSR is to ensure that companies operate in a manner that is profitable and socially responsible. By adhering to the principles of CSR, companies can enhance their reputation and contribute to the long-term sustainability of the communities they serve (Hsu 2012). Latapí Agudelo et al. (2019) posit that contemporary business frameworks must adapt and evolve to accommodate the latest tools. However, such adaptations must be undertaken within a comprehensive and holistic framework grounded in social responsibility principles. This involves integrating sustainability, shared value generation, and the notion that companies can redefine their purpose to contribute positively to the world.

Cook et al. (2015) suggested that Corporate Social Responsibility (CSR) initiatives are aligned with a company's values and promote a culture of innovation within the organization. Carroll (2015) emphasized that the focus on environmental preservation has led to the development of eco-friendly product lines and processes. Dyduch and Krasodomska (2017) believe that companies must now consider their ethical, environmental, and social impact to succeed. Society expects them to repair environmental damage, prioritize safety, and prevent further harm. Hoang et al. (2021) advised that community engagement programs should involve partnerships with local startups and innovators, creating an environment that fosters innovation. Kim and Starks (2016) also asserted that promoting diversity and inclusion has resulted in a more diverse workforce, bringing various perspectives that stimulate creative thinking and problem-solving.

Sen and Bhattacharya (2001) defined CSR as the managerial responsibility to take actions that protect and enhance the welfare of society and the organization's interests. Later, Carroll (2015) noted that various interpretations of CSR have emerged over time, ranging from a narrow economic perspective to a comprehensive 'proactive social responsiveness

view'. According to Bahta et al. (2020), this theory suggests that CSR can lead to more efficient resource use, positively impacting corporate financial performance. Meanwhile, Boulouta (2013) highlighted the importance of gender diversity on boards in addressing areas of Corporate Social Performance associated with the female gender role stereotype. Chen et al. (2018) found that female directors are particularly valuable in industries where innovation and creativity are crucial, emphasizing their role in impacting corporate innovation. Therefore, for this study, we have adopted the societal view of CSR, encompassing a company's status and activities regarding its perceived societal obligations. This choice is rooted in the understanding that socially irresponsible actions may lead to higher explicit costs due to a lack of legitimacy and social rejection from interest groups.

2.2. CEO Gender Diversity

Many social sciences studies have shown that there has been a significant shift toward gender equality in the past 50 years, which is often referred to as a "gender revolution" (England et al. 2020). Perryman et al. (2016) have pointed out that to make further progress toward gender equality, significant institutional and cultural changes may be necessary. These changes could include increasing men's involvement in household and caregiving responsibilities, providing governmental support for childcare, and implementing policies that reduce gender discrimination and help both men and women balance their work and family responsibilities (Dutton and Duncan 1987).

However, the research examining women's impact on board directors' social performance suggests that women directors are positively oriented toward some areas of Corporate Social Performance. Furthermore, companies with a similar proportion of male and female executives tend to face less risk and perform better (Perryman et al. 2016). Catalyst (2017) claims that there has been a recent increase in the number of women in top management positions in U.S. corporations. On the contrary, Buchholz (2022) indicated a lower representation of women in leadership positions in the largest companies.

For example, according to Kim and Starks (2016), increasing the representation of women on boards is important, suggesting that more women on boards can help pool expertise and improve board effectiveness through their unique skills and perspectives. Similarly, Gul et al. (2011) suggested that more gender-diverse boards are more likely to fulfil the organization's social mission. Similarly, Hoang et al. (2021) pinpointed that with increased public scrutiny around boards and corporate governance, board composition is expected to affect corporate reputation, especially regarding characteristics such as the diversity of board resources and gender composition.

According to a report by the World Economic Forum (2021), the top three countries on the list are Iceland, Finland, and Norway, while the U.S. ranks 30th out of 149 countries in terms of gender equality, which is an improvement of 23 spots from the previous year. Previously, Loscocco and Robinson (1991) conducted a study investigating the disparities between men and women in the small-business sector of the U.S. The researcher concluded that female-owned businesses are primarily concentrated and have lower average business receipts than male-dominated industries. Likewise, Boulouta (2013) highlighted that the issue of gender is often presented as the problem of women's underperformance in innovation and technology due to the strong association of innovation and technology with masculinity. According to Davidson and Freudenburg (1996), the concept of gender and innovation has only recently gained wider interest among researchers in the management and entrepreneurship fields. England et al. (2020) suggested that one of the reasons for the lack of studies taking a gender perspective on innovation, compared to the increasing number of studies on entrepreneurship and gender, is the apparent invisibility of "people/community" in innovation. While Kim and Starks (2016) stated that research on gender and innovation has not been extensive, there are some influential studies in adherent research areas.

Similarly, in a study conducted by Levi et al. (2014), the researchers examined whether the gender of a director influences the tendency of a CEO to engage in empire-building

and whether it impacts the bid premium paid for target firms. The study found that female directors who are less overconfident tend to make more accurate estimates of merger gains, and their influence on acquisition decisions helps in creating shareholder value. Having female directors on the board positively impacts a company's performance. Similarly, the complexity of the relationship between organizational skills, organizational culture, and gender was conducted by Kouki (2021), who claims that there is no influence of gender balance on the emergence of incentives for innovation.

3. Theoretical Background

This section introduces the theoretical background of corporate social responsibility and CEO gender diversity:

3.1. Resources-Based View

The resources-based view (RBV) is established on these two resources by Barney (1991). It states that resources are a vital factor in firm performance. According to the resources-based view (RBV) theory, a company's success is determined by the internal quantity and quality of resources. Resources that are valuable, rare, and not easily replicated or replaced are considered competitive advantages. Corporate Social Responsibility (CSR) can enhance a corporation's reputation, customer satisfaction, and investor preference. For example, Zhou et al. (2020) have suggested that the RBV theory can be used to understand Corporate Social Responsibility (CSR) and sustainability issues. In their study, they analyzed two important resources of a company, internal employee involvement and external supplier collaboration, to investigate how CSR impacts innovation performance. At the same time, Gallego-Álvarez et al. (2011) suggest that innovation plays a central role in creating value and sustaining competitive advantage.

The current study's researchers believe that committing to innovation can be an effective way to acquire resources and gain customer loyalty. In addition, engaging in CSR activities further enhances these benefits. For instance, according to Battisti et al. (2022), corporate venture capital is a form of open innovation that can influence a company's CSR strategies. Therefore, companies interested in enhancing their CSR outcomes should consider integrating open innovation into their strategies.

This study aims to expand the theoretical principles of the resources-based view (RBV) in a context that relates to the creation of resources through innovation, which enhances economic and financial performance and addresses issues related to the environment and society (specifically gender diversity). Specifically, this study explores the correlation between CSR activities and innovation performance.

3.2. Upper Echelons Theory

Upper Echelons Theory demonstrates that CEO characteristics will be reflected in their corporate strategies, which are premised on the limited rationality of human beings (Hambrick and Mason 1984). The Upper Echelons Theory is a theory that focuses on the demographic characteristics of executives, such as age, educational level, and professional background. These characteristics reflect their values, cognitive ability, communication skills, and psychological traits. According to Naveed et al. (2022), this theory found that the relationship between gender diversity and firm performance varies based on the norms and sociocultural context of the firm. The relationship is positive in the context of greater gender parity and negative in the context of low gender parity.

However, research seldom studies CEO characteristics from a psychological angle, since finding an appropriate method to measure and ensure its accuracy is hard. For example, Issa and Bensalem (2023) conducted a study to explore the relationship between board gender diversity and eco-innovation. The study revealed that the link between eco-innovation and board gender diversity is not solely determined by whether males or females manage a company. Rather, it depends on the gender balance of its corporate board. From an upper echelon perspective, female directors would likely support corporate

strategies prioritizing eco-innovation. Furthermore, according to a study conducted by Liao et al. (2019), which was based on the upper echelons, the data of 688 listed companies in China's manufacturing industry were analyzed to examine the impact of female directors on the firms' environmental innovations and the moderating role of firm ownership. The study concluded that female directors and female independent directors played a significant role in promoting firms' environmental innovations. This finding is consistent with the previous research of Isidro and Sobral (2015) and Hyun et al. (2016), who also found a positive relationship between women on the board and firms' ethical compliance, social compliance, and corporate social responsibility performance.

It has been observed that according to the upper echelon theory, researchers have analyzed the demographic characteristics of CEOs to determine how their traits affect corporate management strategies and performance. Since executives are responsible for making decisions about corporate social responsibility (CSR) activities and innovation research, their unique characteristics, such as gender, may influence their actions. Therefore, this paper argues that a CEO's gender can impact their strategies and actions, which can be reflected in their CSR scores and innovation performance.

4. Hypothesis Development

4.1. Corporate Social Responsibility and Innovation Performance

Innovation is the key factor of business success and contributes to sustainable corporate development in the long term (Damanpour et al. 1989). Some previous studies have demonstrated a relationship between CSR and corporate innovation performance, but the conclusions are mixed. Some scholars pointed out that it is hard to balance CSR and innovation activities and ecological and social contributions since it will distract the firm's innovation ability by analyzing Indian companies (Bouquet and Deutsch 2007; Mithani 2017). Yet, it does not imply that CSR activities will reduce corporate innovation intention. Furthermore, it is not a conclusive conclusion as the impact of CSR activities on innovation is affected by various factors, such as the level of CSR performance and corporate characteristics (Szutowski and Ratajczak 2016).

Nonetheless, most relevant studies support that there is a positive relationship. Wagner (2010) found that CSR performance can positively drive corporate innovation, but family firms harm this relationship. In addition, Tsang et al. (2021) showed that engaging in CSR can enhance firm innovation performance, which can be extended to the global rather than country level and suggested integrating CSR criteria into executive remuneration to strengthen this effect. More importantly, CSR can enhance a firm's intangible value and reshape organizational structures, leading to more innovative activities and external cooperation (Briones Peñalver et al. 2017). Specifically, carrying out CSR can influence employees' behavior, making them aware of innovation as a core factor and thus motivating them to engage in innovation activities (Hartmann 2011).

To date, a large and growing literature has also revealed the advantage of fulfilling CSR, which indirectly implies a positive impact on corporate innovation activities. Firstly, relevant research has reported that fulfilling CSR helps establish brand image and improve corporate reputation. Wang et al. (2021) used structural equation modeling and fuzzy set qualitative comparative analysis to prove that CSR has a significant impact on brand performance and pointed out that CSR is an essential condition for enhancing brand equity. Furthermore, the behavior whereby executives carry out CSR earns a good reputation and loyalty among consumers (Lacey and Kennett-Hensel 2010; Keh and Xie 2009) and may gain support or subsidies from the local government. Investors treat CSR as a form of insurance since it can avoid local social problems and fines by hedging the risk of negative government and community relations (Petersen and Vredenburg 2009). Therefore, corporations fulfilling CSR are more popular among investors.

Moreover, the stock price can also be affected by any positive or negative effects of CSR (Alexander and Buchholz 1978), which investors also consider. Then, these returns from stakeholders provide the necessary funds, lands, and technological talents that support

sustainable corporate development (Wei et al. 2014). Previous research has highlighted the mixed findings in previous studies and the potential influence of contextual factors. Thus, our study aims to contribute to the existing literature by addressing these complexities and providing a more nuanced understanding of the interplay between CSR and innovation performance. Therefore, the current study states the first hypothesis:

H1. *There is a positive relationship between corporate social responsibility and innovation performance, which means that firms will gain better innovation performance with more corporate social responsibility.*

4.2. CSR, CEO Gender, and Innovation Performance

After considering the RBV and upper echelon theory that explain the inconclusive relationship between CSR and innovation performance (Gallego-Álvarez et al. 2011; Liao et al. 2019; Issa and Bensalem 2023), which enhances economic and financial performance and addresses issues related to the environment and society (specifically gender diversity), this researcher therefore planned to explore the correlation between CSR activities and innovation performance. However, previous studies present no literature on the mediating role of the CEO's gender in the relationship between CSR and innovation. However, Kahloul et al. (2022) researched the relationship between Corporate Social Responsibility (CSR) reporting and financial performance and the moderating effect of board gender diversity on that relationship. Hence, the researchers proposed the second hypothesis to explore the moderating role of CEO gender diversity based on the potential existence of intermediate variables that can explain this relationship between CSR and innovative performance to contribute to the existing literature.

4.3. CEO Gender and Corporate Social Responsibility

Males and females seem to have different views on the environment and corporate social responsibility. Many studies have examined this difference and found that females are more concerned about climate change and local environmental problems than men (Davidson and Freudenburg 1996; McCright 2010). In the present literature, there are two main hypotheses behind this conclusion, gender socialization perspectives and social roles perspectives. The former affirms that males and females are taught different values and social expectations at an early age (Chodorow 1978; Gilligan 1982), leading to their different concerns and actions. For instance, boys are expected to be independent, competitive, and rational, so usually, they grow up in a militarized environment, whereas girls are taught to be cooperative, empathetic, and compassionate and are good at connecting with others. The other theory believes that this difference is due to men's and women's different social roles (Greenbaum 1995), leading to their different experiences, interests, and capabilities.

In general, females' greater concern for society and the environment is well grounded in the overall social–cultural environment. In this sense, female directors are more willing to engage in corporate social responsibility (Setó-Pamies 2013) and achieve better performance (Post et al. 2011). Similarly, Kouki (2021), studying the effect of board gender diversity in the U.K. market, finds that female directors on the board can increase the CSR engagement of companies. Additionally, Bear et al. (2010) concluded that the increasing presence of the female board might promote CSR engagements and improve firms' CSR ratings. In developing countries, although CSR is at an early stage and the proportion of female directors is smaller than in the U.S. and European markets, this conclusion still works that Chinese listed corporations usually have a better performance on CSR when they have female CEOs (McGuinness et al. 2017).

4.4. CEO Gender and Innovation Performance

In the past, innovation was seen as male-dominant (Loscocco and Robinson 1991). With the rise of female status and gender diversity promotion, however, there has been growing research on females in innovation and how this affects firms' performance. Cho

et al. (2016) find that CEO characteristics have less impact on corporate innovation than firm-level factors. Females are usually perceived to be more risk-averse and conservative (Palvia et al. 2015). In addition, they are more discreet than men when making decisions, thus rarely engaging in innovation activities (Alsos et al. 2013).

There are opposite views on it as well, showing the differences from the traditional views of gender. The presentation of females at top management can increase the probability of introducing products and innovations for small enterprises (Zastempowski and Cyfert 2021). However, this conclusion is the opposite in developing countries; the Vietnamese used panel data (Hoang et al. 2021). One possible reason is that females in developing countries may have fewer chances to learn high R&D skills, so they lack the capacity to absorb external knowledge, eventually leading to less innovation. Chen et al. (2018), using U.S. companies, found that enterprises with female board representation have greater innovation success, and this effect will be strengthened in innovation-intensive industries or a lower productivity competition. Similarly, Prabowo and Setiawan (2021) point out that companies with female CEOs have a higher probability of engaging in corporate innovation, which varies with firm size. Besides, Javaid et al. (2021) find that CEOs' gender diversity contributes to a higher level of corporate innovation, but it is not applied to state-owned enterprises. Considering the Upper Echelons Theory, corporate strategy decisions, such as the level of CSR engagement and innovation inputs, are all related to CEO characteristics. Therefore, regarding CEO gender, this element plays an important role in the link between CSR and corporate innovation. Controlling for other influencing factors, even if firms fulfill the same level of social responsibility, there may be differences in the role of CSR in promoting or inhibiting innovation, depending on the background characteristics of executives. Based on the discussion above, it can be concluded that female executives can foster CSR engagement. In short, previous research has examined the connection between corporate social responsibility (CSR) and innovation performance. However, there is still a lack of understanding regarding how the gender of the CEO plays a mediating role in this relationship. Thus, the current study aims to fill these gaps by investigating how the CEO's gender might affect the connection between CSR and innovation performance. Therefore, the second hypothesis is as follows:

H2. *CEO gender impacts the link between CSR and innovation performance, and female CEOs can promote it further.*

5. Methodology and Data Collection

This section will consist of three parts: (1) the description and measurement of independent variables, dependent variables, moderate variables, and other controllable variables; (2) sample selection and data source; (3) the regression model of the relationship between CSR and corporate innovation performance and the moderating effects on them.

5.1. Key Variables

This section discusses the measurement of each variable and introduces the regression model in the empirical analysis.

5.1.1. The Dependent Variable

The dependent variable used in the current study is corporate innovation. Most research on corporate innovation focuses on two aspects, innovation inputs and innovation outcomes. In the current studies, there are three main approaches to innovation inputs: the proportion of R&D expenditure to main operating income, the ratio of R&D expenditures to total assets, and the ratio of R&D expenditure to market value. It is easy to find many scholars who believe that the number of R&D expenditures represents how willing companies are to engage in innovation (Del Monte and Papagni 2003). However, R&D investments can only present innovative incentives for firms. It cannot capture all real corporate innovative activities, and measuring the quality of corporate innovation results

is hard since innovation is a high-risk activity with uncertain returns (Wolff 2007). Due to the aim of this paper, innovation outcomes are chosen to measure innovation performance. For innovation outputs, patents, sales for new products, and manufacturing processes are the better methods to measure. Of these, the number of patents can directly show the innovation outcomes. Similarly, the patent backward citation is equally important since each additional citation of a patent by others increases the company's value (Freeman and Soete 2009). On the other hand, the number of citations to a patent indicates how well the patent is recognized in the industry. Therefore, the natural logarithm of several patents and patent citations is chosen as the indicator of the explanatory variable.

5.1.2. The Independent Variable

The independent variable used in the current study is CSR scores. The choice of CSR score measurement is vital since it will influence the conclusion (Boulouta 2013). This paper chooses ESG (environmental, social, and governance) ratings by the KLD database since taking into account the authority and the range of markets, S&P 500, covered by this database. The KLD database creates an MSCI KLD 400 Social index which is a capitalization-weighted index of 400 U.S. securities rating companies with excellent performance on ESG so that it gives guidance to investors. This database sets up more than 80 indicators to measure the level of carrying out CSR from Corporate governance, Diversity, Environment, Community, Employee relations, Products, and other related climate and energy categories. Additionally, each aspect consists of two sections, strengths, and concerns, where strength is on behalf of positive activities, and concerns mean negative activities on ESG. Since this paper aims to examine whether better CSR performance improves corporate innovation, only strength points will be collected. Furthermore, corporate governance, one of these aspects, is excluded in this analysis since governance toward shareholders is argued that it should not be treated as part of CSR and even probably conflicts with it (Friedman 1962). Meanwhile, diversity is not taken in this paper to exclude the endogenous influence of female executives on corporate innovation. Finally, the wide range of indicators is also taken into consideration. Based on this, this paper follows the approach by Brammer et al. (2005), choosing the main three perspectives to measure CSR: Community, Environment, and Employee relations. The CSR scores are equal to the sum of these three strong points.

5.1.3. Controllable Variables

The control variables used in the current study are profitability, debt level, corporate growth rate, cash flows, and firm size.

- Profitability

ROA (Return on assets) as a financial ratio is generally used to measure the profitability of firms. Many prior studies have shown a positive relationship between CSR and a firm's financial performance (Elsayed and Paton 2005; Eifert et al. 2008). Similarly, innovation can also boost firms' profits. Hence, this paper chooses ROA to measure profitability, and the metric is dividing a firm's net income by its total assets. It is important to note that since there is limited permission for the database, the number of net incomes is not collected directly. This paper takes the official database suggestion that uses the sum of income before extraordinary items, extraordinary items, and discontinued items to replace net income.

- Debt Level

This paper chooses total liabilities divided by total assets to measure the leverage. This ratio usually reflects how much a proportion of total assets are financed by borrowing and the extent to protect the interests of creditors in the case of corporate liquidation. Some previous literature has revealed a negative relationship between debt level and innovation (Geelen et al. 2022).

According to the previous approach (Brammer et al. 2005; Hidayat and Leon 2020), this paper adds the debt–assets ratio as the control variable.

- Sales

Prior studies have shown a correlation between innovation performance and corporate sales growth. For instance, Na and Shin (2019) have demonstrated that product innovation can foster sales growth, while a negative relationship exists between new operating technologies and sales growth. Additionally, the growth rate calculated by sales is widely used in various research related to financial performance. This paper also considers growth rate, while due to a lot of missing data, the natural logarithm of each year's sales is chosen rather than the ratio of sales in different periods.

- Cash flows

Operating cash flow is vital for companies to sustain normal operating activities. If a company has a very low cash flow ratio, it implies that this company may have a higher probability of bankruptcy since it does not have enough cash flow to support daily operations when facing unexpected dilemmas (Jones 2017; Akinyomi 2014). The operating-cash-flows-to-total-assets ratio shows how efficiently companies utilize this cash from investors and customers. Therefore, it is generally agreed that investors have a relatively positive attitude toward companies with higher cash flows. This paper chooses the net-operating-cash-flows-to-total-assets ratio as an indicator of controllable variables.

- Firm size

Companies are generally classified by size, and the attention they receive from society and investors usually increases with size (Ullah and Sun 2021). In this way, it is more probable for large companies to win more investments and achieve economies of scale to save more costs and give more rewards back to shareholders. Additionally, many prior studies have shown that firm size will affect innovation performance (Coccia 2001). Prabowo and Setiawan (2021) point out that companies with female CEOs have a higher probability of engaging in corporate innovation, which varies with firm size. Hence, this paper chooses this indicator as a controllable variable following prior literature (Costa et al. 2015; Dyduch and Krasodomska 2017).

Table 1 presents the details about the dependent, independent, and control variables along with their abbreviations and definitions.

Table 1. Research Variables.

Category	Variable Name	Abbreviation	Definition/Measure	References
Dependent variable	Corporate Innovation	Patents	The natural logarithm of one plus the number of patents and citations.	Freeman and Soete 2009; Javaid et al. 2021; Tsang et al. 2021
Independent variable	CSR	CSR	sum up the scores from the KLD report	Brammer et al. 2005; Bear et al. 2010
Moderate variable	female CEOs	Female	equal to 1 if the CEO is female and 0 if the CEO is male, the portion of female CEO in top management	Gul et al. 2011; Boulouta 2013
Controllable variables	Profitability	ROA	Net income/total assets	Javaid et al. 2021; Tsang et al. 2021
	Debt level	Lev	Total debts/total assets	Brammer et al. 2005 Hidayat and Leon 2020; Javaid et al. 2021
	Cashflow	Cash	The natural logarithm of one plus the number of patents and citations.	Tsang et al. 2021
	Sales	Lnsale	Net operating cash flows divided by total assets	Kim et al. 2014 Costa et al. 2015; Javaid et al. 2021
	firm size	Size	The natural logarithm of sales	Costa et al. 2015; Dyduch and Krasodomska 2017 Javaid et al. 2021
Dummy variables	Industry	Industry		
	Year	Year		

5.2. Research Design

Based on the discussion above and to examine the correlation between corporate social responsibility and innovation performance, this paper establishes the following regression model:

- Model 1

Model 1 is developed to examine the correlation between CSR and innovation, which is as follows:

$$Patents = \beta 0 + \beta 1 CSR + \beta 2 Roa + \beta 3 Lev + \beta 4 Cash + \beta 5 Lnsale + \beta 6 size + \beta 7 Industry + \beta 8 Year + \varepsilon$$

where if $\beta 1$ in the regression result is a significantly positive number, it indicates that CSR performance positively impacts corporate innovation performance, which is in line with Hypothesis 1.

- Model 2

Model 2 is developed to test Hypothesis 2. It examines the effect of CEO gender on the relationship between CSR and innovation performance as well as the moderating effect of CEO gender on the correlation, which is as follows:

$$Patents = \beta 0 + \beta 1 CSR + \beta 2 Female + \beta 3 Female * CSR + \beta 4 Roa + \beta 5 Lev + \beta 6 Cash + \beta 7 lnsale + \beta 8 Size + \beta 9 Industry + \beta 10 Year + \varepsilon$$

where if $\beta 1$ in the regression result is a significantly positive number, it indicates that CEO gender positively impacts the correlation between corporate social responsibility and corporate innovation performance, which is in line with Hypothesis 2. Otherwise, Hypothesis 2 fails.

5.3. Data Collection

This paper selects S&P 500 U.S. publicly listed companies from the financial year of 2014 to 2018, considering that the data for CSR are temporarily unavailable from 2019. Data on innovation indicators are collected from U.S. patents by WRDS. The data on CSR are from the MSC ESG KLD STATS database (KLD Research & Analytics Inc., Boston, MA, USA, formally known as the KLD database). Moderate variables, CEO gender, were collected from the ExecuComp for 2014–2018, and other financial variables were obtained from Compustat. We first merged patents with financial variables using company code by Gvkey. While the KLD database lacks this information, we had to merge it with others through CUSIP, so it may miss some observations during this process. Furthermore, there is a significant lack of data on CEO gender. To improve the further validity and rigor of the data, the data were processed by excluding relevant data from the financial sector since financial firms differ from other industries, which easily biases the result. Additionally, the companies with missing data and extreme values were also excluded to avoid biased results. Therefore, the final sample that meets the above criteria in this paper is 1204 observations from 2014 to 2018. Excel and Stata processed all the data.

6. Findings and Discussion

6.1. Descriptive Statistics

Table 2 shows the descriptive result of all variables, Patents, CSR, Size, Cash, Lnsale, ROA, Lev, and CEO gender. In Table 2 below, the total number of observations is 1204. The minimum value of the explanatory variable, patents, is 0, while the maximum is 8.04, demonstrating a wide gap in the level of innovation among companies. The mean value is 0.434, and the standard deviation is 1.269, which means that the overall sample innovation level is low. Companies with high innovation performance are rare, so it will be easier to win a competitive advantage. Then, the dependent variable, CSR, includes 27 strength points, and the maximum in the sample is 18, while some companies even gain 0 points

in these three aspects, community, employee relations, and environment. However, the mean value and the median one both reveal that most companies in our sample are given fewer points under the criteria. This situation is like the current innovation level, while the standard deviation of CSR reaches 4.018, which implies that the CSR performance of firms in the sample is uneven.

Table 2. Descriptive Analysis.

Variable	Obs.	Mean	P50	Std. Dev.	Min	Max
Patents	1204	0.434	0	1.269	0	8.04
CSR	1204	3.655	3	4.018	0	18
Size	1204	9.283	8.942	1.789	4.181	14.78
Cash	1204	0.089	0.087	0.057	−0.359	0.42
Lnsale	1204	8.776	8.661	1.404	4.412	12.807
ROA	1204	0.051	0.049	0.065	−0.437	0.561
Lev	1204	0.672	0.655	0.217	0.088	2.919
Female	1204	0.098	0	0.161	0	1

All numbers were originally in millions from the database for control variables, and then some were processed with a logarithm. From an overall perspective, it is easy to find that their standard deviations are relatively small, meaning there are no obvious differences among companies in these five aspects. According to the mean value, 9.283, and the median, 8.942 firm sizes, it can be deduced that half of the companies in the sample pull up the average since the mean value is bigger than the median. This situation is like that of sales. The minimum value is 4.412, and the maximum value is 12.807. This shows that the difference between them is approximately 2.2 k million, which is also an extreme case. For cash flows and profitability, the minimum values are both negative. The negative cash flows reveal that cash outflows over cash inflows may happen when the company is in an early or rapid growth stage. This is because firms are forced to put cash or profits into operating production to improve corporate growth. However, suppose one company has had negative cash flows for several years. In that case, it will be a dangerous signal to the public that this enterprise is at a loss, and its operating cash inflow cannot cover the related expenses anymore. The negative value of ROA is equal to the negative value of net income, and bankruptcy usually follows. The maximum values of cash flows and ROA are far from the average and combined with the standard deviation and median; these two values are few. The average gearing ratio is at a normal level. However, the maximum leverage value is approximately three, which is very high and extreme, nearly three times its total assets. It is a general agreement that a leverage ratio greater than 1 reflects that this corporation is not in good operation with higher financial risks.

For CEO gender, some companies do not have female CEOs, while in some companies, there are all females in the top management. Surely, this result includes the possibility of incomplete corporate disclosure. Based on the average and median values, many male CEOs still dominate most companies. From Table 3, it is evident that although males occupy top management in most firms, there is an increasing number of female executives.

Table 3. Descriptive (Gender Diversity).

Year	Obs	Mean	Std. Dev.	Min	Max
2014	269	0.086	0.128	0	0.6
2015	254	0.093	0.134	0	0.5
2016	252	0.103	0.174	0	1
2017	196	0.103	0.174	0	1
2018	233	0.109	0.195	0	1
Total	1204	0.098	0.161	0	1

6.2. Correlation Analysis

From Table 4 provided below, it can be seen the correlation between any two variables. Firstly, the most important one is that the core explanatory variables, CSR and patents, have a significant positive relationship, which is consistent with the expected Hypothesis 1. Furthermore, the correlation coefficient of firm size and patents is 0.213 at the significant level of 1%, so it is regarded as there is a linear correlation between these two. Additionally, the control variables, such as firm size, cash, and ROA, are positively correlated with CSR at least at the significant level of 1%, but this correlation is low. However, there may be no relationship between female presentation and patents since the coefficient of the moderating variable, female, and patents is not significant at any level. In contrast, the coefficient of CSR and females is 0.065 at the significant level of 5%, which may imply a positive relationship.

Table 4. Correlation Analysis.

	Patents	CSR	Size	Cash	Lnsale	ROA	Lev	Female
Patents	1							
CSR	0.300 ***	1						
Size	0.213 ***	0.465 ***	1					
Cash	0.055 *	0.108 ***	−0.246 ***	1				
Lnsale	0.259 ***	0.552 ***	0.878 ***	−0.0400	1			
ROA	0.055 *	0.108 ***	0.097 ***	0.632 ***	0.0390	1		
Lev	−0.0110	0.163 ***	0.323 ***	−0.138 ***	0.312 ***	−0.056 *	1	
Female	0.0130	0.065 **	0.083 ***	−0.0200	0.066 **	−0.00200	0.094 ***	1

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Patent is a dependent variable, CSR is an independent variable, female is a moderate variable, and Size, Cash, Lnsale, ROA, and Lev are all control variables. Size represents the natural logarithm of total assets, cash represents net operating cash flows divided by total assets, ROA represents corporate profitability, and leverage represents debt ratio. However, considering that the correlation coefficient matrix only measures the relationship between the bivariate variables and does not exclude the interference of control variables and potential variables (such as time effects and individual effects), the results are only for reference, and further regression analysis is required to determine the exact relationship. In addition, it is important to note that the possibility of collinearity of variables can be preliminarily excluded by determining whether the absolute magnitude of the correlation coefficient between the explanatory variables is greater than 0.9.

6.3. Collinearity Test (Variance Inflation Factor)

To further examine the possibility of collinearity, a multicollinearity test is required. This paper takes the Variance Inflation Factor test (VIF), which refers to the variance ratio

in the presence of multicollinearity between the explanatory variables to the variance in the absence of multicollinearity. Generally, the larger the VIF, the more severe the covariance.

The empirical judgment method shows that: when $0 < VIF < 10$, there is no multicollinearity; when $10 \leq VIF < 100$, there is strong multicollinearity; when $VIF \geq 100$, there is severe multicollinearity. The above Table 5 results from the model's multicollinearity test. The VIF values of all variables are less than 10. Thus, overall, the indicators selected in this paper will not be affected by multicollinearity.

Table 5. Collinearity Test (Variance Inflation Factor).

	VIF	**1/VIF**
Lnsale	5.56	0.18
Size	5.458	0.183
Cash	1.968	0.508
ROA	1.678	0.596
CSR	1.475	0.678
Lev	1.131	0.884
Mean VIF	2.878	

6.4. Multiple Linear Regression Results

To better examine the correlation between CSR and innovation performance and Hypothesis 2, the moderating effect of CEO gender on it, this paper decides to take the Hausman test to check which model is more suitable for this paper.

For panel data, the most important thing is determining which model is suitable for analysis. Generally, three models are probably applied to panel data, the mixed-effect model, fixed-effect model, and random-effect model. Notably, the Hausman test can be used to determine the choice of random-effect model or fixed-effect model, and the F test in the fixed-effect model can determine the choice of fixed-effect model or mixed-effect model. According to the result of the Hausman test in Table 6, the statistic is 46.891, and the *p*-value is 0.00, which is smaller than 0.05, rejecting the original hypothesis. Hence, this paper should choose a fixed-effect model.

Table 6. Hausman Test specification test.

	Coefficient
Chi-square test value	46.891
p-value	0

6.4.1. The Influence of CSR on Innovation Performance

After descriptive statistics and correlation analysis, regression analysis is required to study the relationship between corporate social responsibility and innovation performance. Below is Table 7 for the regression result.

According to Table 7, the coefficient of CSR and patents is 0.082, which is significant at 1%, indicating that CSR positively impacts corporate innovation performance. For every unit increase in CSR performance, innovation performance will increase by 0.082 units, correspondingly. This conclusion is consistent with Hypothesis 1 in this paper.

Table 7. Regression Analysis.

Variables	(1) Patents	(2) Patents	(3) Patents	(4) Patents	(5) Patents	(6) Patents
CSR	0.077 ***	0.080 ***	0.081 ***	0.082 ***	0.081 ***	0.082 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
size		−0.340 ***	−0.384 ***	−0.130	−0.079	−0.097
		(0.10)	(0.08)	(0.18)	(0.18)	(0.17)
cash			−1.316 *	−0.888	−1.394 *	−1.379 *
			(0.70)	(0.60)	(0.72)	(0.74)
lnsale				−0.456 *	−0.557 ***	−0.576 ***
				(0.24)	(0.21)	(0.22)
ROA					1.473 **	1.427 ***
					(0.61)	(0.51)
lev						−0.794 ***
						(0.08)
Constant	−0.242 ***	2.891 ***	3.427 ***	5.045 ***	5.426 ***	6.312 ***
	(0.08)	(0.95)	(0.72)	(0.59)	(0.50)	(0.53)
Observations	1204	1204	1204	1204	1204	1204
R-squared	0.136	0.140	0.141	0.143	0.146	0.150
No. of groups	367	367	367	367	367	367
company	YES	YES	YES	YES	YES	YES
year	YES	YES	YES	YES	YES	YES
F	1276	3863	396.8	562.2	636	42.31

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

For control variables, the coefficient of cash is a negative number, −1.379, at the significance level of 10%; that is, cash flows have a little significant negative impact on innovation performance. In addition, other variables, excluding firm size, are all at the significance of 1%. On the one hand, it proves that this model for Hypothesis 1 is relatively effective. On the other hand, Lnsale, ROA, and leverage ratio significantly affect corporate innovation performance. More specifically, it is more likely for companies with a higher ROA to have a better performance on innovation. Nevertheless, the impact of Lnsale and leverage ratio on innovation moves in opposite directions since they are both negative numbers, −0.576 and −0.794, respectively. For instance, companies with a higher gearing ratio may have worse innovation performance since sometimes too many debts are heavy burdens for the company, so they lack enough energy and assets to support them to carry out high-quality innovation activities (Geelen et al. 2022).

6.4.2. The Moderating Effect of CEO Gender

This part examines the moderating effect of CEO gender on the correlation between CSR and innovation performance. Table 8 below is for this regression result.

According to Tables 5 and 6, the coefficient of interactions, CSR_female, is 0.000, which is not significant at any level. Hence, CEO gender has no significant impact on the relationship between CSR and innovation performance, rejecting Hypothesis 2. As shown in Tables 2 and 3, the proportion of female presentations in top management is generally low, which may lead to the female special viewpoints, charisma, and impacts becoming less visible. In addition, the sample size is small because of incomplete gender data from

the database, which may be the other reason behind the insignificant moderating effects of CEO gender.

Table 8. The Moderation Results.

	(1)	**(2)**	**(3)**
Variables	CSR	Patents	patents
CSR		0.083 ***	0.083 ***
		(0.02)	(0.02)
CSR_female			0.000
			(0.03)
Female	−0.417	0.300 **	0.299 **
	(0.40)	(0.14)	(0.12)
Size	0.543 **	−0.105	−0.105
	(0.27)	(0.16)	(0.16)
Cash	2.269 **	−1.389 *	−1.390 *
	(0.91)	(0.71)	(0.71)
lnsale	0.241	−0.565 ***	−0.565 ***
	(0.61)	(0.21)	(0.22)
ROA	0.376	1.422 ***	1.422 ***
	(1.21)	(0.51)	(0.51)
lev	0.541 ***	−0.812 ***	−0.812 ***
	(0.16)	(0.08)	(0.08)
Constant	−5.054 *	6.274 ***	6.274 ***
	(2.97)	(0.54)	(0.55)
Observations	1204	1204	1204
R-squared	0.0970	0.151	0.151
Number of groups	367	367	367
company	YES	YES	YES
year	YES	YES	YES
F	34.48	47.23	45.15

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6.5. Robustness Test

To confirm the stability of the correlation between CSR and innovation performance, a robustness test is required. This paper takes a new regression model by replacing and changing some variables. Firstly, since the purpose is to measure corporate innovation quality, the method of the dependent variable, innovation performance, will remain the same as before. The independent variable, CSR, will be further algorithmicized, namely LnCSR. For control variables, there are some following changes.

Size = The natural logarithm of the total sales
Cash = Net operating cash flows/total assets
Profitability = Earnings before interest and taxes (EBIT)/total equity
Growth = Sales for this year/sales for last year
Leverage (Lev) = Total liabilities/total assets

The firm size, cash flows, and leverage ratio method are the same as the original regression model. At the same time, this part revises the corporate growth rate measurement

and replaces ROA (net income/total assets) with profitability. Hence, the new regression model follows.

$$Patents = \beta0 + \beta1LnCSR + \beta2Profitability + \beta3Lev + \beta4\ Cash + \beta5Growth + \beta6size + \beta7Industry + \beta8Year + \varepsilon$$

Similarly, the Hausman test is carried out to decide which model is more suitable for this regression model. After the same data procedures, 815 observations are kept. The statistics are 27.8, and the *p*-value is 0.000, which is smaller than 0.05, rejecting the original hypothesis. Therefore, this part chooses a fixed-effect model again. The regression results and VIF test results of this robust test are shown in Table 9.

Table 9. Robustness Test.

Variables	Patent (2)	Patent (3)	VIF
ln CSR	0.151	0.134	1.66
	(0.02)	(0.02)	
size		0.192	1.63
		(0.12)	
cash		−2.113 ***	1.08
		(0.51)	
lev		−1.946 ***	1.08
		(0.23)	
profitability		−0.004 *	1.01
		(0.00)	
growth		−0.157 ***	1.03
		(0.14)	
Constant	0.672	−0.288 ***	
	(0.19)	(1.25)	
Observations	815	815	
R-squared	0.155	0.170	
Number of groups	261	261	
company	YES	YES	
year	YES	YES	
F	420.9	18.56	
Mean VIF			1.25

Standard errors in parentheses *** $p < 0.01$, * $p < 0.1$.

From Table 9, The VIF values of all variables are less than 10, even less than 5. Thus, the variables selected in this part will not be affected by multicollinearity. Furthermore, observing all variables, the research result is relatively stable. More specifically, the correlation between CSR and innovation performance is still expected to be positive at 1%. Meanwhile, the gearing ratio negatively impacts innovation performance, which is consistent with our original results, and the firm size is still irrelevant to innovation. Nevertheless, the relationship between profitability as the replacement of ROA and innovation performance becomes insignificant. The other difference is that cash flows have more significant negative effects on innovation than before. In sum, the results of the robustness tests are generally consistent with the original ones, indicating that the regression results of this paper are stable.

7. Conclusions

This paper examines whether CSR affects corporate innovation performance and the moderating effect of this correlation. Based on the 1204 observations of S&P 500 listed companies in this paper, a positive correlation between CSR and innovation performance was proved, which aligns with the original main hypothesis and supports our recommendations for carrying out corporate social responsibility. In this way, CSR activities can foster innovation performance so that corporations are more likely to create more value and profits since innovation can partially mediate the relationship between CSR and corporate financial performance (Bahta et al. 2020), especially in the high-tech industry (Li and Li 2018). However, the conclusion about the moderating effect of CEO gender in this paper is not as expected. According to this paper's findings, CEO gender has no significant effects as a moderating indicator on the relationship between CSR and innovation performance. Based on previous literature and our original hypothesis, female presentation in top management can improve corporate innovation performance since corporations with more female CEOs are more likely to engage in more CSR activities.

There may be two main reasons, according to our further analysis. Firstly, the available data on CEO gender are incomplete, which leads to a great reduction in the number of observations in this sample, so fewer samples increase the possibility of insignificance. Therefore, this paper suggests that further research can be established with a wider span of time or merge more databases to solve this problem because leadership changes, particularly those related to diversity initiatives, may take time to manifest in innovative outcomes. The effectiveness of CEO gender diversity in influencing innovation may be contingent on the overall diversity climate of the organization and the implementation of specific inclusion policies.

Upon analyzing the moderating factor, it is observed that female CEOs do not exhibit a positive correlation with corporate innovation, which contradicts the results obtained by (Chen et al. 2018; Prabowo and Setiawan 2021; Zastempowski and Cyfert 2021). However, the findings indicate no significant relationship between female executives and CSR activities. Shortly, there may be indications that female executives are drivers of corporate innovation but not necessarily through the lens of CSR. This related hypothesis is expected to be verified in future research. Furthermore, corporate innovation performance varies in different industries (Geelen et al. 2022). Thus, further research can conduct similar examinations in certain industries because the industry in which the company operates plays a significant role. The composition and dynamics of the board and executive team may moderate the influence of CEO gender on innovation. However, in some industries, innovation might be primarily driven by factors other than CEO gender, such as technological advancements, market demands, or competitive pressures.

Apart from those mentioned above, innovation performance measurement can still be improved. In this paper, we choose the number of patents and patent citations to measure the level of corporate innovation. However, Cook et al. (2015) added R&D and acquisition expenditures to measuring innovation since they considered that some companies improve their innovation capability by acquiring others rather than innovating independently. Therefore, further research can try different measurements to examine this relationship and consider more deeply choosing the measurement of innovations since it affects the result. This paper contributes to corporate social responsibility, corporate innovation, and CEO gender. Firstly, we examine the relationship between CSR and innovation performance in the U.S. market under the resources-based views (RBV). Compared to other previous and similar studies, this paper chooses a newer method of the explanatory variable, innovation performance, measuring the number of patents and citations rather than calculating by R&D expenditures. Additionally, this paper adds one of the executive's background characteristics, CEO gender, to verify the effect on this relationship. While there are some studies focused solely on CEO gender and CSR (Grosser and Moon 2017; McGuinness et al. 2017) or CEO gender and innovation (Marvel et al. 2015; Pecis 2016), less research pays attention to studying the relationship between these three. Although the result in this paper

is that there is no significant correlation, we still believe it is worth further studies to work out from different measurements and perspectives. From the view of improving corporate financial performance, this paper has practical significance for corporate strategies on CSR activities and innovation performance, especially for the U.S. market. Firstly, as for corporate social responsibility, this paper proves that corporations can engage in more CSR activities to foster their innovations and gain more profits since there is a positive correlation between CSR and innovation performance.

7.1. Limitations

While contributing valuable insights, the current study is subject to certain limitations. Firstly, the findings are based on an analysis of CSR and innovation in the U.S., and generalizability to other regions may be constrained due to variations in cultural, economic, and regulatory contexts. Additionally, the study acknowledges that CEO gender, although showing an insignificant relationship with innovation performance, does not significantly mediate the link between CSR and innovation. This highlights a limitation in understanding the nuanced interplay between gender diversity and the CSR–innovation relationship. Therefore, future research endeavors are encouraged to explore the following areas to address these limitations.

7.2. Contributions

Overall, the study provides actionable insights for managers and practitioners to enhance CSR initiatives and innovation performance while recognizing the moderating effect of CEO gender diversity such as the following.

7.2.1. Managerial Contributions

The research findings suggest that managers can make better strategic decisions by recognizing the positive impact of CSR activities on innovation performance. Integrating socially responsible practices into corporate strategies can foster organizational innovation. Furthermore, the study highlights the positive relationship between CEO gender diversity and innovation performance. Managers can use this insight to emphasize the importance of gender diversity at the executive level and consider it a strategic imperative for fostering innovation within the company.

7.2.2. Practical Contributions

This study provides valuable insights for practitioners who want to design and implement Corporate Social Responsibility (CSR) programs to enhance innovation performance. Practitioners can develop targeted initiatives by understanding the specific CSR activities associated with innovation. Organizations can use the study's findings to benchmark their CSR activities and identify best practices that align with their innovation goals. Additionally, the study highlights the importance of gender diversity in promoting a workplace culture that values diverse perspectives as a catalyst for innovation. Therefore, organizations can use these findings to advocate for gender diversity at all levels.

References

Aggarwal, Aanchal, and Noopur Saxena. 2022. Examining the relationship between corporate social responsibility, corporate reputation, and brand equity in Indian banking industry. *Journal of Public Affairs* 23: e2838. [CrossRef]

Akinyomi, Odalele John. 2014. Effect of cash management on profitability of Nigerian manufacturing firms. *International Journal of Marketing and Technology* 4: 129–40.

Alexander, Gordon, and Rogene Buchholz. 1978. Corporate Social Responsibility and Stock Market Performance. *Academy of Management Journal* 21: 479–86. [CrossRef]

Alsos, Gry A., E. Ljunggren, and Ulla Hytti. 2013. Gender and Innovation: State of the Art and a Research Agenda. *International Journal of gender and Entrepreneurship* 5: 236–56. [CrossRef]

Artz, Kendall, Patricia Norman, Donald Hatfield, and Laura Cardinal. 2010. A Longitudinal Study of the Impact of R&D, Patents, and Product Innovation on Firm Performance. *Journal of Product Innovation Management* 27: 725–40.

Bahta, Dawid, Jiang Yun, Md. Islam, and Muhammad Ashfaq. 2020. Corporate social responsibility, innovation capability and firm performance: Evidence from SME. *Social Responsibility Journal* 17: 840–60. [CrossRef]

Barney, Jay. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management* 171: 99–120. [CrossRef]

Battisti, Enrico, Niccolò Nirino, Erasmia Leonidou, and Alkis Thrassou. 2022. Corporate venture capital and CSR performance: An extended resource-based view's perspective. *Journal of Business Research* 139: 1058–66. [CrossRef]

Bear, Stephen, Noushi Rahman, and Corrine Post. 2010. The Impact of Board Diversity and Gender Composition on Corporate Social Responsibility and Firm Reputation. *Journal of Business Ethics* 97: 207–21. [CrossRef]

Boulouta, Ioanna. 2013. Hidden Connections: The Link Between Board Gender Diversity and Corporate Social Performance. *Journal of Business Ethics* 113: 185–97. [CrossRef]

Bouquet, Cyril, and Yuval Deutsch. 2007. The Impact of Corporate Social Performance on a Firm's Multinationality. *Journal of Business Ethics* 80: 755–69. [CrossRef]

Bowen, Howard R. 1953. *Social Responsibilities of the Businessman*. Iowa: University of Iowa Press.

Brammer, Stephen, Chris Brooks, and Stephen Pavelin. 2005. Corporate Social Performance and Stock Returns: UK Evidence from Disaggregate Measures. *Financial Management* 35: 97–116. [CrossRef]

Briones Peñalver, Antonio, J. Bernal Conesa, and Carmen de Nieves Nieto. 2017. Analysis of Corporate Social Responsibility in Spanish Agribusiness and Its Influence on Innovation and Performance. *Corporate Social Responsibility and Environmental Management* 25: 182–93. [CrossRef]

Buchholz, Katharina. 2022. *Only 15 Percent of CEOs At Fortune 500 Companies Are Female*. New York: Statista. Available online: https://www.statista.com/chart/13995/female-ceos-in-fortune-500-companies/ (accessed on 8 March 2022).

Byron, Kris, and Corrine Post. 2016. Women on Boards of Directors and Corporate Social Performance: A Meta-Analysis. *Corporate Governance: An International Review* 24: 428–42. [CrossRef]

Carroll, Archie B. 2015. Corporate social responsibility: The centerpiece of competing and complementary frameworks. *Organizational Dynamics* 44: 87–96. [CrossRef]

Catalyst. 2017. *2016 Catalyst Census: Women and Men Board Directors*. New York: Catalyst. Available online: https://www.catalyst.org/research/2016-catalyst-census-women-and-men-board-directors/ (accessed on 22 August 2017).

Chen, Jie, Woon Sau Leung, and Kevin P. Evans. 2018. Female board representation, corporate innovation, and firm performance. *Journal of Empirical Finance* 48: 236–54. [CrossRef]

Cho, Chanho, Joseph Halford, Scott Hsu, and Lilian Ng. 2016. Do managers matter for corporate innovation? *Journal of Corporate Finance* 36: 206–29. [CrossRef]

Chodorow, Nancy J. 1978. *The Reproduction of Mothering*. Berkeley: University of California Press.

Coccia, Mario. 2001. A basic model for evaluating R&D performance: Theory and application in Italy. *R&D Management* 31: 453–64.

Colombelli, Alessandra, Naciba Haned, and Christian Le Bas. 2013. On firm growth and innovation: Some new empirical perspectives using French CIS (1992–2004). *Structural Change and Economic Dynamics* 26: 14–26. [CrossRef]

Cook, Kristen, Andrea Romi, Daniela Sanchez, and Juan M. Sanchez. 2015. The Influence of Corporate Social Responsibility on Investment Efficiency and Innovation. *SSRN Electronic Journal* 46: 494–537. [CrossRef]

Costa, Claudia, Luis Lages, and Paula Hortinha. 2015. The bright and dark side of CSR in export markets: Its impact on innovation and performance. *International Business Review* 24: 749–57. [CrossRef]

Damanpour, Fariborz, Kathryn Szabat, and William Evans. 1989. The relationship between types of innovation and organizational performance. *Journal of Management Studies* 26: 587–601. [CrossRef]

Davidson, Debra J., and Wiluam R. Freudenburg. 1996. Gender and environmental risk concerns. *Environment and Behavior* 28: 302–39. [CrossRef]

Del Monte, Alfredo, and Erasmo Papagni. 2003. R&D and the growth of firms: Empirical analysis of a panel of Italian firms. *Research Policy* 32: 1003–14.

Dereli, Deniz. 2015. Innovation Management in Global Competition and Competitive Advantage. *Procedia—Social and Behavioral Sciences* 195: 1365–70. [CrossRef]

Dutton, Jane, and Robert Duncan. 1987. The influence of the strategic planning process on strategic change. *Strategic Management Journal* 8: 103–16. [CrossRef]

Dyduch, Justyna, and Joanna Krasodomska. 2017. Determinants of Corporate Social Responsibility Disclosure: An Empirical Study of Polish Listed Companies. *Sustainability* 9: 1934. [CrossRef]

Eifert, Benn, Alan Gelb, and Vijaya Ramachandran. 2008. The cost of doing business in Africa: Evidence from enterprise survey data. *World Development* 36: 1531–46. [CrossRef]

Elsayed, Khaled, and David Paton. 2005. The impact of environmental performance on firm performance: Static and dynamic panel data evidence. *Structural Change and Economic Dynamics* 16: 395–412. [CrossRef]

England, Paula, Andrew Levine, and Emma Mishel. 2020. Progress toward gender equality in the United States has slowed or stalled. *Proceedings of the National Academy of Sciences* 117: 6990–97. [CrossRef]

Franko, Lawrence G. 1989. Global corporate competition: Who's winning, who's losing, and the R&D factor as one reason why. *Strategic Management Journal* 10: 449–74.

Freeman, Christopher, and Luc Soete. 2009. Developing science, technology and innovation indicators: What we can learn from the past. *Research Policy* 38: 583–89. [CrossRef]

Friedman, Milton. 1962. *Capitalism and Freedom*. Chicago: University of Chicago Press.

Gallego-Álvarez, Isabel, José-Manuel Prado-Lorenzo, and Isabel M. García-Sánchez. 2011. Corporate social responsibility and innovation: A resource-based theory. *Management Decision* 49: 1709–27. [CrossRef]

Geelen, Thomas, Jakub Hajda, and Erwan Morellec. 2022. Can corporate debt foster innovation and growth? *The Review of Financial Studies* 35: 4152–200. [CrossRef]

Gilligan, Carol. 1982. *In a Different Voice*. Cambridge: Harvard University Press.

Greenbaum, Allan. 1995. Taking stock of two decades of research on the social bases of environmental concern. In *Environmental Sociology: Theory and Practice*. North York: Captus Press, pp. 125–52.

Grosser, Kate, and Jeremy Moon. 2017. CSR and Feminist Organization Studies: Towards an Integrated Theorization for the Analysis of Gender Issues. *Journal of Business Ethics* 155: 321–42. [CrossRef]

Gul, Ferdinand A., Bil Srinidhi, and Anthony Ng. 2011. Does board gender diversity improve the informativeness of stock prices? *Journal of Accounting and Economics* 51: 314–38. [CrossRef]

Hambrick, Donald C., and Phyllis A. Mason. 1984. Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review* 9: 193–206. [CrossRef]

Hartmann, Monika. 2011. Corporate social responsibility in the food sector. *European Review of Agricultural Economics* 38: 297–324. [CrossRef]

Hidayat, Rahmat, and Farah Leon. 2020. Green CSR Moderated by Public Visibility and Innovation Performance at Indonesia Companies. *Journal Management* 24: 1–20.

Hoang, Ngoc, Daehoon Nahm, and Michael Dobbie. 2021. Innovation, gender, and labour productivity: Small and medium enterprises in Vietnam. *World Development* 146: 105619. [CrossRef]

Hsu, Ker-Tah. 2012. The advertising effects of corporate social responsibility on corporate reputation and brand equity: Evidence from the life insurance industry in Taiwan. *Journal of Business Ethics* 109: 189–201. [CrossRef]

Hyun, Eunjung, Daegyu Yang, Hojin Jung, and Kihoon Hong. 2016. Women on boards and corporate social responsibility. *Sustainability* 8: 300. [CrossRef]

Isidro, Helena, and Márcia Sobral. 2015. The effects of women on corporate boards on firm value, financial performance, and ethical and social compliance. *Journal of Business Ethics* 132: 1–19. [CrossRef]

Issa, Ayman, and Nesrine Bensalem. 2023. Are gender-diverse boards eco-innovative? The mediating role of corporate social responsibility strategy. *Corporate Social Responsibility and Environmental Management* 30: 742–54. [CrossRef]

Javaid, Hafiz, Qurat Ain, and Antonio Renzi. 2021. She-E-Os and innovation: Do female CEOs influence firm innovation? *European Journal of Innovation Management* 26: 982–1004. [CrossRef]

Jones, Stewart. 2017. Corporate bankruptcy prediction: A high dimensional analysis. *Review of Accounting Studies* 22: 1366–422. [CrossRef]

Kahloul, Ines, Hicham Sbai, and Jocelyn Grira. 2022. Does Corporate Social Responsibility reporting improve financial performance? The moderating role of board diversity and gender composition. *Quarterly Review of Economics and Finance* 84: 305–14. [CrossRef]

Keh, Hean T., and Yi Xie. 2009. Corporate reputation and customer behavioral intentions: The roles of trust, identification and commitment. *Industrial Marketing Management* 38: 732–42. [CrossRef]

Khojastehpour, Morteza, and Raechel Johns. 2014. The effect of environmental CSR issues on corporate/brand reputation and corporate profitability. *European Business Review* 26: 330–39. [CrossRef]

Kim, Daehyun, and Laura Starks. 2016. Gender Diversity on Corporate Boards: Do Women Contribute Unique Skills? *American Economic Review* 106: 267–71. [CrossRef]

Kim, Yunhee, Christian Brodhag, and Desta Mebratu. 2014. Corporate social responsibility driven innovation. *Innovation: The European Journal of Social Science Research* 27: 175–96. [CrossRef]

Kouki, Ahmed. 2021. Does gender diversity moderate the link between CEO dominance and CSR engagement? A two-step system GMM analysis of UK FTSE 100 companies. *Journal of Sustainable Finance & Investment* 13: 1644–69.

Lacey, Russell, and Pamela A. Kennett-Hensel. 2010. Longitudinal effects of corporate social responsibility on customer relationships. *Journal of Business Ethics* 97: 581–97. [CrossRef]

Latapí Agudelo, Mauricio A., Lára Jóhannsdóttir, and Brynhildur Davídsdóttir. 2019. A literature review of the history and evolution of corporate social responsibility. *International Journal of Corporate Social Responsibility* 4: 1–23.

Levi, Maurice, Kai Li, and Feng Zhang. 2014. Director gender and mergers and acquisitions. *Journal of Corporate Finance* 28: 185–200. [CrossRef]

Li, Bingjun, and Xiaolo Li. 2018. Research on the Relationship between Corporate Social Responsibility and Financial Performance Based on Grey Correlation Analysis: Taking the Smartphone Company as an Example. *Open Journal of Applied Sciences* 8: 431–40. [CrossRef]

Liao, Zhongju, Manting Zhang, and Xiaopeng Wang. 2019. Do female directors influence firms' environmental innovation? The moderating role of ownership type. *Corporate Social Responsibility and Environmental Management* 26: 257–63. [CrossRef]

Loscocco, Karyn, and Joyce Robinson. 1991. Barriers to women's small-business success in the United States. *Gender and Society* 5: 511–32. [CrossRef]

Marvel, Matthew, In Lee, and Marcus Wolfe. 2015. Entrepreneur gender and firm innovation activity: A multilevel perspective. *IEEE Transactions on Engineering Management* 62: 558–67. [CrossRef]

McCright, Aaron M. 2010. The effects of gender on climate change knowledge and concern in the American public. *Population and Environment* 32: 66–87. [CrossRef]

McGuinness, Paul, João Vieito, and Mingzhu Wang. 2017. The role of board gender and foreign ownership in the CSR performance of Chinese listed firms. *Journal of Corporate Finance* 42: 75–99. [CrossRef]

Mithani, Murad. 2017. Innovation and CSR—Do They Go Well Together? *Long Range Planning* 50: 699–711. [CrossRef]

Na, Kyunga, and Kwangsoo Shin. 2019. The gender effect on a firm's innovative activities in the emerging economies. *Sustainability* 11: 1992. [CrossRef]

Naveed, Khwaja, Cosmina L. Voinea, and Nadine Roijakkers. 2022. Board Gender Diversity, Corporate Social Responsibility Disclosure, and Firm's Green Innovation Performance: Evidence from China. *Frontiers in Psychology* 13: 892551. [CrossRef] [PubMed]

Niederle, Muriel, and Lise Vesterlund. 2007. Do Women Shy Away from Competition? Do Men Compete Too Much? *The Quarterly Journal of Economics* 122: 1067–101. [CrossRef]

Palvia, Ajay, Emilia Vahamaa, and Sami Vahamaa. 2015. Are female CEOs and chairwomen more conservative and risk-averse? Evidence from the banking industry during the financial crisis. *Journal of Business Ethics* 131: 577–94. [CrossRef]

Pecis, Lara. 2016. Doing and undoing gender in innovation: Femininities and masculinities in innovation processes. *Human Relations* 69: 2117–40. [CrossRef]

Perryman, Alexa, Guy Fernando, and Arindam Tripathy. 2016. Do gender differences persist? An examination of gender diversity on firm performance, risk, and executive compensation. *Journal of Business Research* 69: 579–86. [CrossRef]

Petersen, Henry, and Harrie Vredenburg. 2009. Morals or Economics? Institutional Investor Preferences for Corporate Social Responsibility. *Journal of Business Ethics* 90: 1–14. [CrossRef]

Post, Corrine, Noushi Rahman, and Emily Rubow. 2011. Green Governance: Boards of Directors' Composition and Environmental Corporate Social Responsibility. *Business & Society* 50: 189–223.

Prabowo, Ronny, and Doddy Setiawan. 2021. Female CEOs and corporate innovation. *International Journal of Social Economics* 48: 709–23. [CrossRef]

Sen, Sankar, and C. B. Bhattacharya. 2001. Does doing good always lead to doing better? Consumer reactions to corporate social responsibility. *Journal of Marketing Research* 38: 225–43. [CrossRef]

Setó-Pamies, Dolors. 2013. The Relationship between Women Directors and Corporate Social Responsibility. *Corporate Social Responsibility and Environmental Management* 22: 334–45. [CrossRef]

Szutowski, Dawid, and Piotr Ratajczak. 2016. The Relation between CSR and Innovation Model Approach. *Journal of Entrepreneurship, Management, and Innovation* 12: 77–94. [CrossRef]

Tate, Geoffrey, and Liu Yang. 2015. Female Leadership and Gender Equity: Evidence from Plant Closure. *SSRN Electronic Journal* 117: 77–97.

Tsang, Albert, Kun Wang, Simeng Liu, and Li Yu. 2021. Integrating corporate social responsibility criteria into executive compensation and firm innovation: International evidence. *Journal of Corporate Finance* 70: 102070. [CrossRef]

Ullah, Subhan, and Di Sun. 2021. Corporate social responsibility corporate innovation: A cross-country study of developing countries. *Corporate Social Responsibility and Environmental Management* 28: 1066–77. [CrossRef]

Wang, Han-Min, Tiffany Yu, and Chih-Yi Hsiao. 2021. The Causal Effect of Corporate Social Responsibility and Corporate Reputation on Brand Equity: A Fuzzy-Set Qualitative. Comparative Analysis. *Journal of Promotion Management* 27: 630–41. [CrossRef]

Wagner, Marcus. 2010. Corporate social performance and innovation with high social benefits: A quantitative analysis. *Journal of Business Ethics* 94: 581–94. [CrossRef]

Wei, Jiuchang, Yuxia Wang, and Weiwei Zhu. 2014. Strategically manipulating social reputation by scheduling corporate social responsibility events. *Journal of Public Affairs* 14: 116–29. [CrossRef]

Wolff, Michael F. 2007. Forget R&D spending—Think innovation. *Research Technology Management* 50: 7–9.

World Economic Forum. 2021. *Global Gender Gap Report 2021*. Geneva: World Economic Forum. Available online: https://www3.weforum.org/docs/WEF_GGGR_2021.pdf (accessed on 30 March 2023).

Zastempowski, Maciej, and Szymon Cyfert. 2021. Impact of entrepreneur's gender on innovation activities. The perspective of small businesses. *PLoS ONE* 16: 0258661. [CrossRef] [PubMed]

Zhou, Haidi, Qiang Wang, and Xiande Zhao. 2020. Corporate social responsibility and innovation: A comparative study. *Industrial Management & Data Systems* 120: 863–82.