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ENVIRONMENTAL, SOCIAL, AND CORPORATE GOVERNANCE AND SUSTAINABILITY

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Editorial: Environmental, social, and corporate governance and sustainability

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Editorial on the Research Topic
Environmental, social, and corporate governance and sustainability

Welcome to this Research Topic of *Frontiers in Psychology* on Environmental, Social, and Corporate Governance (ESG) and Sustainability. After a thorough blind review procedure, we are pleased to announce that 19 articles have been selected for publication in the Research Topic. We believe that all of these articles address important aspects of ESG in this Research Topic according to the background detailed below.

Research Topic background

We are currently witnessing dramatic changes in the business environment (Lee et al., 2015), and there is an increasing need for firms to adequately deal with environmental issues, satisfy social expectations, and design appropriate corporate governance. These changes have also been eye-opening for academic researchers and practitioners in terms of the importance of environmental, social, and corporate governance. Specifically, we assume that the global financial crisis, which initially began in the United States in 2008 before spreading to the global economy, functioned as an opportunity to think about the sustainability of corporate investment and its impacts on societies as the crisis directly triggered alterations around the business ecosystem. In other words, the global financial crisis pushed ESG to the forefront of scholarly attention, thus causing it to become a significant practical agenda, and it would not have emerged as rapidly without the catalyst of the crisis. Before 2008, the concept of ESG was not widely known. Although corporate social responsibility (CSR) already existed, the scope of this notion was much narrower. This was due to the fact that firms tended to consider it as part of their strategies and buried themselves in returns through CSR (Hong et al., 2022).

Based on the situations and backgrounds illustrated above, relevant discussions on ESG are still in their infancy, so it is urgent to answer unanswered questions about ESG. For instance, we do not know exactly which factors promote ESG, how ESG differs from CSR, and how ESG contributes to solving social inequalities, and broadly

speaking, what macroscopic outcomes can be expected by enforcing ESG. The more serious problem is that, although numerous extant studies (e.g., Khan et al., 2015; Park and Ghauri, 2015) have attempted to dig into CSR, it remains unclear whether the empirical results uncovered by these experiments can be applied to ESG. Moreover, to our knowledge, previous studies that have attempted to link and/or bridge ESG and corporate sustainability are sparse.

Built on this premise, our Research Topic attempts to open up relevant research questions and simultaneously fill in these research gaps. We argue that this Research Topic, which includes the following 19 papers, combines theoretical and empirical refinements linking ESG with various economic actors, such as consumers, businesses, and markets, and that the chosen papers significantly expand our current knowledge on ESG.

The nineteen papers included in this Research Topic

The first paper by Shaheen et al. addressed how gender-diverse boards in China influence CSR reporting decisions in politically embedded firms and offered fresh insights showing that the presence of female directors and the participation of executives having political connections are highly related to a company's CSR reporting. In improving CSR reporting and helping Chinese corporations better meet their social and environmental goals, the findings of that study can help policymakers develop policy measures that are specifically targeted at legislation regarding women's quotas and the existence of political connections on corporate boards.

The second paper by Kwak et al. analyzed the sensitivity between fund flow and fund performance among Korean funds. The primary findings of the paper are 3-fold: First, ESG did not affect corporate fund flow. Second, the fund flow–performance interaction had a negative correlation. Third, there was almost no difference between the ESG fund sensitivity asymmetry and the non-ESG fund sensitivity asymmetry.

The third paper by Kim et al. was conducted to answer the question, "can ESG activities have significant effects on performance at the subsidiary level?" According to the results of the empirical analyses, among Korean subsidiaries of multinational corporations, ESG activities positively affected firm performance. As a result of examining the moderating effect of market-oriented organizational culture, it was also found that the positive relationship between ESG activities and performance was weakened.

The fourth paper by Bang et al. examined identifying human resource practices coupled with external CSR activities due to the importance of ESG.

The fifth paper by Kim and Lee investigated the effects of recalling COVID-19 concerns on pro-environmental product consumption. The results indicated that consumers exhibited greater purchase intention toward e-prompt products (vs. non-e-prompt products) when they recall altruistic anxieties associated with COVID-19. Considering ESG also mediated the moderating effects. By introducing the nature of COVID-19 fears as a critical factor, this study made a worthwhile contribution to the literature on pro-environmental behavior.

The sixth paper by Lee and Jeong confirmed that the compatibility and authenticity of social responsibility activities affect a firm's brand trust, thereby improving corporate sustainability management. The results of this study provided strategic implications for the performance of social responsibility activities necessary for the continuous growth of firms and for building brand trust.

The seventh paper by Qing and Jin investigated whether CSR can affect sustainability through the economic and social performance of social enterprises (SEs). It also attempted to verify the moderating role of innovativeness in the relationship between CSR and SE performance. The results suggest that, while CSR can improve sustainability through economic and social performance, innovativeness has no moderating effect on the relationship between CSR and SE performance.

The eighth paper by Bae et al. presented a new theoretical perspective on the relationship between the strength of environmental regulations and foreign direct investment (FDI), which is currently attracting increased scholarly attention. We argue through this new perspective that we should observe the strength of environmental regulations, which has been overlooked by previous literature, and the distance between countries in the FDI relationship. This will make it possible to obtain fresh insights and new ideas regarding the relationship described above.

The ninth paper by Wang and Liu addressed two important research questions: "how may various types of green innovation strategies matter in explaining the variation of firm performance?" and "how may various types of green innovation strategies interact with supply chain risks in illustrating firm performance variation?" Using primary data collected from a sample of 337 firms in China, the study uncovered that the effects of green innovation strategies were statistically significant in elucidating the heterogeneity of firm performance, and their interactions with supply chain risks were also noteworthy and economically important.

The tenth paper by Wang and Teng was motivated to address two major research questions: "what contributes to the development of supply chain management (SCM) capability?" and "how does SCM capability matter in explaining the environmental performance variation of firms operating in large emerging economies?" Using survey data collected from 272 firms in China, the study discovers that specific forms of digital innovation play a positive role in driving the development of SCM capability. The results of the empirical analyses provide further supportive evidence indicating that SCM capability functions as an important role by either partially or fully

mediating the relations between the effect of digital innovation and firm environmental performance.

The eleventh paper by Yang and Yang examined the association between dynamic capabilities (DCs) and corporate performance in ESG management. This empirical study tested this as an alternative method using topic modeling with Word2Vec. The findings imply that DCs can enhance corporate performance under uncertainty and pursue a balanced way of sensing-seizing-recofiguring capabilities through ESG management.

The twelfth paper by Son and Kim attempted to examine the relationship between ESG management and financial performance and the role of socially responsible investment by the National Pension Fund (NPF), Korea's largest institutional investor. Their primary discoveries are that Korean firms with good financial performance actively participate in ESG. NPF has a propensity to invest in firms with high financial and ESG performance.

The thirteenth paper by Lee and Yang investigated the impact of CSR performance feedback on future CSR performance to answer the following research questions: First, how does positive CSR performance feedback affect future CSR performance? Second, how does negative CSR performance influence future CSR performance? By performing generalized least squares (GLS) regression analysis based on Korean company data from 2012 to 2019, their empirical findings document that positive social and historical performance feedback positively affected CSR performance.

The fourteenth paper by Liang et al. explored the role of DCs for ESG strategies as well as sustainable management performance. A research model was established by using DC theory, thereby integrating sustainable management and ESG literature. According to the results of their statistical analyses, both absorptive capability and adaptive capability have considerable effects on sustainable management performance through implementation of the ESG strategy as a mediating factor.

The fifteenth paper by Wu and Kuang began with its anticipation that key subordinate executives would play a role linking superiors and subordinates within the top management team (TMT). Based on their recognition of the heterogeneity of TMT preference, data from Chinese listed firms from 2010 to 2019 were used. Their empirical results exhibited a positive relationship between key sub-level executives' governance and accounting conservatism. They also indicated that CEO overconfidence could positively modulate this relationship.

The sixteenth paper by Li and Qamruzzaman examined the nexus of tourism-driven sustainable human capital development (HCD) in emerging economies from 1984 to 2019. In this process, they observed a statistically substantial and long-lasting favorable correlation between tourism and HCD.

The seventeenth paper by Park and Oh identified the different types of information used by investors to make investment decisions based on the UTAUT (Unified Theory of Acceptance and Use of Technology) model. This paper figures out how ESG information affects the decisions of individual investors regarding investments and the factors that affect such behaviors.

The eighteenth paper by Park et al. used text scraped from Twitter. It polished the data to identify trends in ESG themes and their sentimental value over time. This paper informs us how the general public feels about ESG through sentiment analysis.

The nineteenth paper by Lee et al. addressed that ESG at the host country level significantly impacts the implementation of clean development mechanisms (CDM). Moreover, the results of zero-expansion Poisson regression extended the ESG pillar based on institutional theory and emphasized the importance of sustainable development.

As a final remark, the guest editors would like to thank all the reviewers and all those who submitted papers to this Research Topic. The editor-in-chief of Frontiers in Psychology, Axel Cleeremans, also deserves special gratitude. We are incredibly appreciative of the participants' kindness and efforts, both of which have made this special edition possible.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Assessing the Effect of Board Gender Diversity on CSR Reporting Through Moderating Role of Political Connections in Chinese Listed Firms

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This study departs from existing work on board gender diversity (BGD) and corporate social responsibility (CSR) reporting by analyzing and explaining the mechanism by which gender-diverse boards in politically embedded firms (PEFs) affect firms' CSR reporting choices in a unique institutional setting of Chinese listed firms from 2010 to 2018. The following main results are obtained. First, having female directors and executives with political connections (PCs) on corporate boards improves the CSR reporting of firms. Firms with PCs have a greater possibility to issue CSR reports than their non-connected counterparts. Second, firms that have both gender diversity and PCs on their boards of directors are more likely to engage in CSR reporting. There is an indication that the presence of PCs on boards can strengthen the effect of female directors on firms' CSR reporting. Third, the presence of female directors on corporate boards has a stronger relationship with CSR reporting in PEFs than in non-PEFs. The study concludes that both BGD and PCs on corporate boards positively influence the diffusion of CSR-related practices in the Chinese business environment.

Keywords: board gender diversity, CSR reporting, political connections, China, corporate governance

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INTRODUCTION

Corporate social responsibility (CSR) – previously viewed as a voluntary activity undertaken by businesses to improve social and environmental conditions – has evolved into a strategic issue on the agendas of boards of directors (BODs) and has been planned and discussed at the top management level to fulfill the business' social responsibility (Mackey et al., 2007; Calderón et al., 2020). Despite its global reach, CSR remains contextual both in terms of its corporate and national environments (Moon, 2004), and its importance varies over time and across countries. It has been a well-recognized concept in developed countries for decades, but it is a relatively recent addition to the political and business agendas of emerging countries. China is a unique case in emerging economies in terms of CSR due to its rapid growth, which has resulted in severe damage to the country's environment and society (Lin and Ho, 2011), and the country has long been accused on both national and global scale of being negligent to environmental

and social problems. Since 2004, the Chinese government has introduced and enforced numerous CSR reforms to contribute to sustainable economic development, and Chinese firms have significantly increased their CSR reporting.

China's CSR practices and disclosure are still in developmental stages and Chinese firms are under greater pressure to involve in CSR-related activities and disclosure (McGuinness et al., 2017). The country's approach toward CSR is markedly different from that of other countries. CSR is unique in China in that it is endorsed by the Chinese government as the desired activity as a part of its political agenda (Yin and Zhang, 2012) and Chinese firms engage in strategic CSR activities in response to government pressure. Another feature that distinguishes Chinese firms from their western counterparts is their extensive political connections (PCs), most notably the close ties between the government and the firm's senior management (Tu et al., 2013; Haveman et al., 2017). Even though many firms have transitioned from state-owned enterprises to publicly traded firms, the Chinese government retains control and ownership of these firms as the largest shareholder (Guthrie, 2012). Regulatory pressure from the government may have a significant impact on how politically embedded firms (PEFs) in China behave in terms of CSR. PEFs are the main targets of the Chinese government when it comes to enforcing CSR regulations. Besides, Chinese firms' CSR reporting behavior has been influenced by a variety of factors including firms' listing status, ownership structure, and legislative upgrading of the corporate governance system. In addition, board gender diversity (BGD) is another important factor that has recently been studied in relation to CSR reporting. The key motivational factor behind increasing the gender diversity of board members is to promote CSR activities, and the presence of women on a company's board has a considerable influence on the board's willingness to seriously consider CSR (Bear et al., 2010). The higher the percentage of women on a company's board of directors, the better the company's CSR performance. In many countries, the lack of female directors and increasing global pressure for the nomination of more female directors at the top management level have prompted policymakers and regulators to enact gender quotas, and several countries have implemented female quotas on their corporate boards. China has also extended and reformed its corporate governance laws to meet international institutional requirements; however, such woman board representation quota is minimal in China. Gender diversity on corporate boards is considered as an essential strategic management tool for managing stakeholder expectations, and it has emerged as the most common strategy used by businesses to manage stakeholder expectations, particularly their demand for more transparency as concerns CSR reporting (Sial et al., 2018). Further, in China, PEFs are exposed to greater government pressure and must retain their political legitimacy; therefore, their strategic responses may differ from those of firms without political embeddedness. In this light, it is imperative to inquire about how CSR reporting choices in PEFs are affected by female directors on Chinese corporate boards. Therefore, this study specifically addresses the relationship between BGD and PCs and the strategic CSR choices of Chinese firms. This would enable policymakers to formulate policies measures targeted at the legislation of women quota and existence of PCs on Chinese corporate boards to improve firms' CSR reporting and assist them in achieving their social and environmental objectives more effectively.

We pursue the following main objectives in this study. First, we aim to analyze the extent to which gender-diverse boards in PEFs affect CSR reporting in China. Second, we examine the moderating impact of PCs on the relationship between BGD and firms' choices of CSR reporting and assess the degree to which CSR reporting varies across PEFs and non-PEFs in response to gender diversity on boards.

A diverse body of empirical attempts has been made in recent years to inquire about the role of BGD in firms' CSR reporting (Bear et al., 2010; Fernandez-Feijoo et al., 2014; Adams et al., 2015; Al Fadli et al., 2019). Several studies confirmed that the presence of women on BODs has a significant impact on CSR reporting. For instance, Bear et al. (2010) found a positive correlation between women's representation on BODs and consideration of CSR-related actions. Their findings indicate that gender equality and inclusion of women directors in supervisory boards can play a strategic role in enabling firms to manage sustainable practices and social responsibilities. Fernandez-Feijoo et al. (2014) found that countries with a higher proportion of women on BODs have a higher level of CSR reporting. Some studies pointed out that stakeholders may view gender-diverse boards as an indicator of a higher level of management accountability and social responsibility, and firms with a higher proportion of female directors are likely to engage more in socially responsible actions and disclosure (Adams et al., 2015; Al Fadli et al., 2019). The underlying reason is that women are more concerned about environmental issues, and their values and skills may have a positive influence on firms' CSR reporting behavior (Terjesen et al., 2009; Adams et al., 2015).

In the case of China, there have been few attempts to examine the role of BGD in CSR reporting by Chinese firms. For example, Liao et al. (2016) and McGuinness et al. (2017) discovered that female directors increase firms' willingness to engage in CSR activities. In a recent study, Guping et al. (2020) found that BGD has a positive effect on CSR reporting in Chinese firms. Most of the prior research on BGD has concentrated on the underrepresentation of female directors at various board levels. More particularly, previous studies have examined the influence of BGD and PCs on CSR reporting separately, and little attention has been paid to the extent to which gender-diverse boards in PEFs affect CSR reporting, while the literature on BGD's impact on CSR reporting in the context of China is relatively scarce. This study, therefore, attempts to combine these two lines of research and to assess in a more comprehensive way the uniqueness of CSR reporting behavior of Chinese PEFs having gender diversity in boardrooms.

We investigate the impact of BGD on the CSR reporting decisions made by PEF boards by using an empirical design of Chinese publicly listed firms from 2010 to 2018. The final sample consists of 10,679 firm-year observations. We used fixed-effect regression to explore the above-mentioned

phenomenon. Our analysis yields the following main results. First, we find that BGD in PEFs positively affects the CSR reporting decisions. There is evidence that policymakers should devise policies aimed at increasing women's representation on board and the presence of PCs on Chinese corporate boards to further improve firms' CSR reporting. Second, we document that PCs moderate the relationship between BGD and firms' CSR reporting choices. These findings reveal that, in addition to establishing a female quota, policymakers should consider the political ties of board executives to improve women's role in CSR reporting. Finally, we discover that gender-diverse boards in PEFs are more likely to engage in CSR reporting than non-PEFs boards, implying that PEFs and non-PEFs should be treated differently when it comes to designing CSR strategies.

This study contributes to the existing literature in four ways. First, given the uniqueness of the Chinese business sector, its specific social and political aspects, and the importance of CSR in the Chinese corporate sector, this study attempts to provide empirical evidence on CSR reporting by Chinese firms with BGD, thereby contributing to the body of knowledge confirming the Chinese perspective on CSR disclosure. Second, this study is the first to examine the distinct effect of BGD on CSR reporting decisions made by PEFs and non-PEFs, allowing us to go a step further and present a more fine-tuned picture of the mechanisms underlying the BGD-CSR relationship by examining the previously unexplored moderating effect of PCs on the BGD-firms' CSR reporting link. Third, we contribute to contemporary CSR research by using a longitudinal approach that is uncommon in the greater China region (Yin and Quazi, 2018). Finally, by considering the role of political connectedness as a driver of firms' CSR practices, we complement the strand of literature consisting of non-financial reporting which mostly emphasizes the societal and business causes of corporate social responsibility.

The remainder of the paper is structured as follows: Section Institutional background describes the institutional background, while Section Literature Review, Theoretical Background, and Hypotheses provides a review of literature, discusses theories used to explain a firm's CSR conduct and develops the research hypotheses. The study design and methodology are given in Section Research Method. Sections Empirical Results and Discussion of Results present the findings and discussion of results, respectively. Section Robustness Tests provides robustness tests to check the validity of our findings and finally, and Section Conclusion concludes the paper.

INSTITUTIONAL BACKGROUND

In emerging economies, CSR consideration and implementation, as well as CSR shifts, are a relatively recent phenomenon. China, in particular, is relatively a newcomer to the area of CSR engagement and thus provides an excellent empirical setting for studying firms' CSR-related strategic actions for a variety of reasons. First, China's corporate governance system is still insufficiently developed to ensure adequate legal protection to investors, indicating that minority shareholders are largely exposed to expropriations by majority shareholders (Allen et al., 2005). Following the year 2000, numerous regulations have been introduced in response to investors' demand for transparency and effectiveness in the governance system, including the Code of Corporate Governance (2001) and Disclosure Requirements for Companies (2007). Although China has an official regulator, the China Securities Regulatory Commission (CSRC), the country has been unable to synchronize necessary complementary reforms in areas such as corporate laws, investor protection, and property rights (Ma et al., 2013). To increase the effectiveness and transparency of such imperfect corporate governance systems' decision-making processes, researchers argued strongly for gender diversity on boards, specifically gender equality and the inclusion of women on supervisory boards (Sial et al., 2018). Consequently, many countries including France, Norway, Spain, Italy, Germany, Belgium, Pakistan, and India have enacted quotas for females' representation on corporate boards, while China has yet to do so.

Second, despite its transition from a highly centralized system to a modern market-oriented economy over the last few decades, China's economy has retained a reputation for strong government control (Lee et al., 2014; Xu and Zeng, 2016), and the government is still the largest shareholder and keeps the *de facto* control of these companies, regardless of the privatization of many government entities (Guthrie, 2012). Additionally, the political ties between government and firm's senior management are still popular in China and many firms have government officials as their executives (Ma and Parish, 2006; Tu et al., 2013). These firms are supposed to get many advantages because of their PCs, such as lower taxation, preferential access to debt financing and government projects, and regulatory protection (Faccio, 2010).

China provides a unique institutional setting for examining how PEFs respond to government signals such as the promotion of sustainable business conducts, particularly CSR. The importance of business activities in terms of environmental and social impacts is evident in China's economic development in the post-reform era (See, 2009). Furthermore, the Communist party's statements promoting social responsibility among corporations, citizens, and all kinds of institutions, as well as the Shenzhen and Shanghai stock exchanges issuing guidelines for CSR reporting, demonstrate that the Chinese government views CSR as a desirable action (Geng et al., 2010). Accordingly, we can say that government is the major driving force behind CSR in China. Against the above-mentioned institutional particularities, this study will fill a critical gap in the existing CSR literature by exploring whether PCs in firms with female directors on their boards affect CSR reporting choices, in the context of the world biggest emerging economy China, which is constantly facing rapid social and climate changes with every change posing a new challenge for researchers in the field.

LITERATURE REVIEW, THEORETICAL BACKGROUND, AND HYPOTHESES

CSR Reporting and BGD

A considerable body of literature has been conducted to describe the relationship between CSR and various board attributes

including gender, age, directors' multiple dictatorships, educational background, and nationality. Besides, few studies have explored firms' CSR reporting behavior regarding BGD, and findings have been inconsistent across institutional contexts. For example, some studies evidenced a positive association between BGD and CSR reporting (Galbreath, 2011; Hafsi and Turgut, 2013; Harjoto et al., 2015; Yasser et al., 2017; Guping et al., 2020). In contrast, several studies reported a negative relationship (Zahra and Stanton, 1988; Molz, 1995), while others found no evidence in support of the BGD and CSR relationship (Coffey and Wang, 1998; Stanwick and Stanwick, 1998).

Numerous theories have been developed to explain firms' CSR behavior in terms of both internal and external CSR drivers. Our argument in this paper is based primarily on a synthesis of agency theory (internal driver) and legitimacy theory (external driver), which fits our study context well. According to the CSR perspective of legitimacy theory, CSR contributes to the maintenance of congruence between the objectives of firms and societal objectives. Companies may use a variety of reporting strategies, most notably CSR reporting, to legitimize their activities (Chen et al., 2011; Lanis and Richardson, 2013) and gain social approval from their operating environment. The legitimacy and CSR reporting relationship tends to be stronger in response to a regulation or a policy change influencing the public expectations (Rashid, 2018). Thus, firms may attempt to close the perceived legitimacy gap and use CSR reporting to influence the public perception of its actions and responsibilities. By combining the aforementioned theories, we can gain a better understanding of the extent to which managerial pursuance of personal benefits from CSR activities (agency theory) is enabled or constrained by the external societal context (legitimacy theory).

Apart from other aspects of corporate governance, BGD improves not only the control and monitoring of the firms' decision-making but also enhances their relationships with stakeholders, including the general public (Ellis and Keys, 2015). According to legitimacy theory, the presence of female directors on board motivates firms to use CSR reporting as a strategy for legitimation (Willows and van der Linde, 2016). This is because female' representation in boardrooms brings social and ethical issues into board discussions and improves the board decision-making quality, thereby helping firms to manage sustainable practices and social responsibilities in a strategic manner (Sartawi et al., 2014). In addition, women have a greater tendency to expand firms' CSR initiatives due to better understanding and knowledge of their surroundings than their males (Muttakin et al., 2015). Consequently, firms with gender-diverse boards may enhance their CSR reporting to establish legitimacy through strong corporate governance and greater investor appeal (Chan et al., 2014). From the perspective of agency theory, firms' CSR disclosure is driven by the conflicting incentives of managers, owners, and other stakeholders due to the separation of ownership and control. As it is well-known, BODs are accountable for safeguarding all stakeholders' interests against opportunistic behavior of managers which can be done through various governance mechanisms such as effective monitoring and improving disclosure levels (Barako and Brown, 2008).

For this, the board needs to be effective in its actions which depend on a variety of board attributes, including gender diversity (Bassett et al., 2007). Female directors increase board effectiveness because they come from non-traditional backgrounds, possess vast knowledge, and are more capable of serving multiple boards than males (García-Izquierdo et al., 2018). Also, because of their diverse economic and social backgrounds, female directors place a higher premium on social issues and the welfare of all stakeholders than on the welfare of a single group (Wang and Coffey, 1992). Further, gender diversity on boards is often seen as an indication of increased managerial accountability and social obligation (Al Fadli et al., 2019). Hence, agency disputes can be resolved by having more women on boards of directors which assists firms to better recognize and interact with the environment through disclosure of CSR-related activities, eventually facilitating firm-stakeholders relationships (Beckman and Haunschild, 2002). As a result of the expectation that gender-diverse boards will have a beneficial effect on firms' CSR reporting, we hypothesize the following:

H1: Firms with gender-diverse boards are more likely to engage in CSR reporting.

CSR Reporting and PCs

PEFs are defined as firms with strong government ties, whether through network connections or state ownership. While these firms may benefit from easy access to government resources, they are expected to confront high monitoring and show more adherence to government signals to maintain political legitimacy (Marquis et al., 2011). In a country like China, where the government holds the majority of a firm's shares and CSR reporting is deemed as a desired activity, firms can gain political legitimacy in such an environment by issuing CSR reports in response to government signals, including numerous CSR reporting guidelines issued by the Chinese central government as a strategy to help firms in balancing China's massive economic growth with its environmental and social effects to pursue the idea of "harmonious society" (Wang et al., 2018).

Unlike non-connected peers, PEFs may not have enough motives to issue CSR reports as they have inherent political legitimacy (Marquis and Qian, 2014); however, this argument negates a control-oriented perspective, which claims that government regulatory pressure can significantly shape the PEFs' CSR behavior (Huang and Kung, 2010; Zhao, 2012). This is particularly true in China where targeted firms for implementation of government policies are mostly PEFs (Zeng et al., 2012). As a substantial shareholder and a critical source of legitimacy, the government can directly influence firms' CSR actions. Alternatively, the government can also exert indirect influence on the CSR activities of firms through politically connected board executives. PEFs tend to invest more in CSR initiatives because of the personal incentive of politically connected top managers. Executives with political ties than their peers without political ties have higher motivations to

maintain their personal political legitimacy (Marquis et al., 2011), e.g., acting in compliance with government regulations and policies such as issuing CSR reports can help them to protect their reputation and ensure their political careers (Patten and Trompeter, 2003). These assumptions are also consistent with the findings of Xu and Zeng (2016), who discovered that managers with a reputation for high CSR investment have a higher likelihood of promotion and other political benefits. Because responding appropriately to government signals is a key aspect of gaining legitimacy (Marquis et al., 2011), Chinese firms are continually growing their CSR activities, notably CSR reporting while adhering to government laws.

From an agency-oriented view, this can be explained by proposing that executives may pursue their personal incentives and may act at the cost of owners and other stakeholders in the presence of conflicting interests (Jensen and Meckling, 1976). PCs on corporate boards can help mitigate these conflicts as politically connected executives are likely to obey government policies and instructions on CSR disclosure (Zeng et al., 2012), thus promoting CSR reporting practices and maintaining a balance among all stakeholders' interests.

Furthermore, the government, as the most significant stakeholder in a business in China, sits at the top of the CSR pyramid and endorses CSR as a desirable practice. The government pressure and signals concerning CSR prompt Chinese firms to respond strategically; nevertheless, a firm's strategic response to government signals is likely to be influenced by the extent of government monitoring (Wang et al., 2008). Firms with political ties are usually subject to more stringent oversight by the government and other regulatory institutions than those without such ties (Gu et al., 2013). If these firms fail to meet their social obligations, they will inevitably suffer unfavorable reputational consequences (Wang et al., 2018). As a result, PEFs are more likely to comply with government directives to implement CSR policies than non-PEFs who are not subject to the same level of government scrutiny. Following these arguments, we test the following hypothesis.

H2: PEFs are more likely than non-connected peers to issue CSR reports.

Moderating Effect of PCs

Firms may use CSR reporting as a strategy for legitimizing their activities to gain social approval and sustain their reputation. Female representation on BODs is one of the critical corporate governance characteristics that support this legitimation strategy. Females on board support this strategy due to their numerous advantages over their male counterparts. For example, they have a better understanding of market environments and use a variety of visions to aid problem-solving (Campbell and Mínguez-Vera, 2008). Females are more risk-averse and possess a broader range of preferences (Croson and Gneezy, 2009). Additionally, they tend to follow less aggressive strategies and invest more in social sustainability initiatives than in research and development (Apesteguia et al., 2012), demonstrating a higher level of ethical concerns and pro-social actions behavior to help firms achieve greater social sustainability (Galbreath, 2011). As a result, firms with gender-diverse boards are expected to strengthen their CSR reporting to maintain legitimacy.

Further, the corporate environment in China has been affected by distinct social and political elements. To achieve a harmonious society, various government policies and enforcements actions have created uncertainty for firms and limited their operations (Hillman et al., 2002). To overcome these constraints and uncertainties, Chinese firms tend to build PCs to gain legitimacy and increase their access to resources and information (Hillman, 2005). Board executives with PCs are expected to have a vast knowledge of regulations and policies regarding CSR as (Gu et al., 2013) asserted that firms with politically connected senior managers may have a higher level of awareness and adoption of CSR policies. Accordingly, boards with political ties are more likely to push firms to show their commitment to government initiatives by responding to government pressure and policy signals regarding CSR reporting (Marquis and Qian, 2014). For that, they are expected to positively influence firms' decisions on CSR reporting. It is obvious from the above argumentation that both corporate governance attributes (BGD and PCs) are more concerned about the adoption of CSR activities particularly, issuing CSR reports to gain legitimacy. Also, from an agency theory perspective, women and PCs on boards can help to resolve agency conflicts through CSR disclosure showing care and concern for all stakeholder groups and facilitating relationships with them (Beckman and Haunschild, 2002). Therefore, we expect that PCs on boards may enhance the impact of BGD on firms' CSR reporting. Accordingly, we test the following hypothesis.

H3: PCs on boards moderate the relationship between BGD and CSR reporting such that gender-diverse boards with PCs are more likely to issue CSR reports.

RESEARCH METHOD

Sample and Data

The sample for this study was drawn from Hexun's CSR database over a 9-year time span ranging from 2010 to 2018. We started our sample period in 2010 because Hexun launched the CSR evaluation database of all firms listed on the Shenzhen and Shanghai stock exchanges in the year 2010 (Xiong et al., 2016). Recently, many researchers highlighted the prominence of Hexun in China in guiding the investors' awareness of content and quality of overall CSR reporting activities of listed firms (Li et al., 2013; Xiong et al., 2016). Moreover, according to the user satisfaction and web hit counts, Hexun ranks top in delivering financial information of publicly traded companies by collaborating with the Shanghai Stock Exchange and Thomson Reuters. Data on political connections of board directors and other financial and nonfinancial information were extracted from the China Stock Market and Accounting Research (CSMAR) database, and individual firm annual reports.

We excluded firms belonging to the financial sector because of their unique regulatory characteristics and non-comparability of financial ratios with other industrial sectors. After excluding firms with missing data, the final sample contains 10,679 firm-year observations.

Variables and Measurements

CSR Reporting

We used two measures of CSR reporting to test the study hypotheses. First, we used Hexun CSR rating (CSR score-CSRS) as a proxy for CSR disclosure. CSR rating offered by the Hexun database has been used as a proxy for CSR disclosure in many prior studies (Xiong et al., 2016; Shi et al., 2018b). Hexun's original CSR measure, constructed on stakeholder theory, covers all five critical stakeholder groups in its assessment framework including environment, community, employees, suppliers and customers, and shareholders. Each of these dimensions is further sub-divided into multiple sub-dimensions, which are weighted differently depending on the industries to which the firm belongs. Even though earning profits for shareholders is considered as a basic corporate responsibility, Hexun's CSR measure places greater emphasis on stakeholder interests (Xiong et al., 2016). To align with prior research, we exclude the shareholder dimension from Hexun' original CSR measurement and evaluate CSR on four dimensions (namely environment, community, employees, and supplier & customer) by a total of 19 sub-dimensions (see Xiong et al., 2016, p. 231 for a complete list of Hexun's CSR measuring items). Second, we created a CSR dummy variable (CSRD) as an alternative measure of CSR reporting to confirm the validity of our main results.

Board Gender Diversity

BGD is gauged using four different metrics. We used the Shannon index-SI (Shannon, 1948) as a comprehensive and superior measure of BGD, following the literature (Sial et al., 2018; Ain et al., 2021). In addition, consistent with previous studies (Liu et al., 2014; Trinh et al., 2020), we measured BGD using the Blau index-BI (Blau, 1977), a female director dummy (FDM), and the percentage of female directors (FDBD) for robustness checks. The Shannon index and Blau index (similar to the two widely used measures of diversification in the area of economics and financial studies, i.e., the entropy index and the Herfindahl–Hirschman index, respectively) are the two composite measures of BGD indicating that whether or not the boards are diverse in term of gender and produce the similar results, but the former are larger than the latter (Abad et al., 2017). Because it is a logarithmic matric, the Shannon index is more sensitive to small changes in BGD.

Political Connections

The presence of PCs in a company's board is measured in two ways. First, following (Wang et al., 2008; Chen et al., 2011), a dummy variable (PCD) is used that takes the value of 1 if any of the firm's senior managers, supervisors or directors was or is a member of the Chinese People's Political Consultative Conference (CPPCC), a government official, or a representative of National People's Congress (NPC) and zero otherwise. Second, a continuous variable, the percentage of politically connected directors on the board (PC%), is used to examine the overall degree of political ties on the board.

Control Variables

We added some corporate governance factors and firm-specific factors as control variables. Corporate governance factors which may influence firms' CSR reporting include CEO duality (CEOD), board size (BS), board independence (BID), board age (BA), Big 4, state-owned enterprise (SOE), and board meeting frequency (BMF), while firm-level controls include leverage (LEV), firm size (SZ), return on assets (ROA), firm growth (FG), and free cash flows (FCF). In addition, industry and year dummies are included to control for time and sector effects, respectively. **Table 1** shows the details of variables measurement.

Model Specifications and Estimation Technique

The following multivariate regression models were estimated to test our hypotheses:

$$\begin{aligned} CSRS_{it} = {} & \beta_0 + \beta_1 SI_{it} + \beta_2 PC_{it} + \beta_3 CEOD_{it} + \\ & \beta_4 BS_{it} + \beta_5 BID_{it} + \beta_6 BA_{it} + \beta_7 BMF_{it} + \\ & \beta_8 Big\ 4_{it} + \beta_9 SOE_{it} + \beta_{10} LEV_{it} + \beta_{11} FS_{it} + \\ & \beta_{12} ROA_{it} + \beta_{13} FG_{it} + \beta_{14} FCF_{it} + \beta_{15} Industry + \\ & \beta_{16} Year + \beta_{17} Province + \beta_{18} City + \varepsilon_{it} \end{aligned} \quad (1)$$

$$\begin{aligned} CSRS_{it} = {} & \beta_0 + \beta_1 SI_{it} + \beta_2 PC_{it} + \beta_3 SI_{it} * PC_{it} + \\ & \beta_4 CEOD_{it} + \beta_5 BS_{it} + \beta_6 BID_{it} + \beta_7 BA_{it} + \beta_8 BMF_{it} + \\ & \beta_9 Big\ 4_{it} + \beta_{10} SOE_{it} + \beta_{11} LEV_{it} + \beta_{12} FS_{it} + \beta_{13} ROA_{it} \\ & + \beta_{14} FG_{it} + \beta_{15} FCF_{it} + \beta_{16} Industry + \beta_{17} Year + \\ & \beta_{18} Province + \beta_{19} City + \varepsilon_{it} \end{aligned} \quad (2)$$

where CSRSit reflects the firm's selection of CSR activities during the sampled period. The independent variables SIit and PCit explain the variation in CSR reporting behavior of the firms under consideration, based on the existence of gender diversity and political ties in boards, respectively. The interaction term SI_{it}*PC_{it} describes the effect of political embeddedness on CSR reporting in firms with gender-diverse boards.

To test our hypotheses, a multivariate regression model of panel data, controlling for year and industry fixed effects with firm-level clustered standard errors is used. We also included dummies for provinces and cities because China's institutional arrangements vary significantly across provinces and cities. In the longitudinal or panel dataset, it is common to use a fixed-effect model to control for omitted variables; however, we confirmed the choice between random effects and fixed effects models *via* the Hausman test.

TABLE 1 | Variable measurement.

Variables	Calculations	Variable source
Dependent variables		
CSRS	CSRS is the CSR score computed as the aggregate of four sub-dimensions scores from the Hexun database, namely community, environment, customers and suppliers, and employees.	Xiong et al., 2016; Shi et al., 2018b
CSRD	CSRD is a dummy whose value is 1 if a firm is a CSR report issuer and 0 otherwise.	Cabeza-García et al., 2018; Wang et al., 2018
Independent Variables		
SI & BI	Shannon index (SI) and Blau index (BI) are measured as $\sum_{i=1}^{n} P_i \ln P_i$, and $1-\sum_{i=1}^{n} P_i^2$, where n represents the number of categories (male and female) and P_i indicates the percentage of each category in the board.	Sial et al., 2018; Trinh et al., 2020
FDM	FDM is a dummy variable that is equal to 1 if there is at least one female on the board and 0 otherwise.	Al Fadli et al., 2019; Ain et al., 2021
FDBD	FDBD is the percent of female directors computed as the number of female directors on the board divided by board size.	Hafsi and Turgut, 2013; Yasser et al., 2017; Cabeza-García et al., 2018; Beji et al., 2021
Moderator		
PC	PC is a dummy variable that takes the value of 1 if one of the senior managers, supervisors, or directors of the firm were or are the Chinese People's Political Consultative Conference (CPPCC) member, government official, or representative of the National People's Congress (NPC) and 0 otherwise.	Wang et al., 2008, 2018
PC%	Percentage of politically connected board directors computed as the number of politically connected directors on the board divided by the total number of board directors	Wang et al., 2008; Shi et al., 2018a
Controls		
CEOD	CEOD is a dummy variable equal to 1 If the CEO and Chair of the Board are the same, otherwise 0.	Ma et al., 2013; Yasser et al., 2017; Beji et al., 2021
BS	BS is the board size which indicates the total number of board directors.	Yasser et al., 2017; Sial et al., 2018; Beji et al., 2021
BID	BID is the board independence calculated as the total number of board independent directors divided by board size.	Ma et al., 2013; McGuinness et al., 2017
BA	BA is the board directors' average age.	Yasser et al., 2017; Sial et al., 2018
Big 4	A dummy variable equal to 1 if the company's auditor is an audit firm belonging to "big 4" or its joint venture in China and 0 otherwise.	Sial et al., 2018; Gull et al., 2021
SOE	A dummy variable takes a value of 1 if the firm is state-owned and 0 otherwise.	Ain et al., 2021; Gull et al., 2021
BMF	Board meeting frequency is computed as the number of board directors' meetings each year.	Yasser et al., 2017; Sial et al., 2018
LEV	Leverage is computed as total debts over total assets.	Xu and Zeng, 2016; Al Fadli et al., 2019; Beji et al., 2021
FS	Firm size is calculated by taking the natural logarithm of total assets.	Zhao, 2012; Shi et al., 2018b
ROA	Return on assets is computed as EBIT over total assets.	Ma et al., 2013; Beji et al., 2021
FG	Firm growth is measured as the change in a firm's total assets.	Agrawal and Chatterjee, 2015; Ain et al., 2021
FCF	Free cash flows are calculated as the subtraction of the sum of capital expenditure and working capital from the sum of net profit, noncash expenses, and interest expenses.	Wang et al., 2008; Marquis and Qian, 2014

EMPIRICAL RESULTS

Descriptive Statistics

Table 2 reports the descriptive statistics of our test and control variables. The results indicate that approximately 32.1% of firms in the total sample issue CSR reports and have an average CSR score of 35.1%. According to the Shannon index, there are on average 30.5% female directors on the board. Notably, around 46.5% of sampling firms have at least one of the senior managers, supervisors, or directors with political ties, whereas politically connected directors account for approximately 16.2% of the total number of board directors. Around 59.2% of the total sample firms are state-owned. CEO duality exists in more than 20% of sampled firms. The average board size is 8.72 and the average board member age is around 49.16 years. In addition, sampling firms have approximately 37.2% independence in their boards and board directors on average, and tend to have more than

TABLE 2 | Descriptive statistics.

Variables	Mean	Std. Dev.	Min	Max
CSRS	0.351	0.145	0.154	0.683
CSRD	0.321	0.467	0.000	1.000
SI	0.305	0.179	0.000	0.857
PC	0.465	0.498	0.000	1.000
PC%	0.162	0.075	0.000	0.666
CEOD	0.209	0.406	0.000	1.000
BS	8.725	1.705	4.000	18.000
BID	0.372	0.040	0.182	0.750
BA	49.165	3.880	25.000	88.000
BMF	9.994	4.078	1.000	20.000
Big 4	0.176	0.381	0.000	1.000
SOE	0.592	0.491	0.000	1.000
LEV	0.526	0.166	0.259	0.775
FS	21.783	1.314	7.955	27.381
ROA	0.045	0.147	−0.024	0.229
FG	0.189	0.532	−1.300	3.309
FCF	0.049	0.017	−0.497	0.412

9 meetings each year. The average debt ratio and firm size of sampling firms are 52.6 and 21.78, respectively.

Correlation Analysis

The results of correlations analysis are given in **Table 3**. Overall, results indicate the absence of multicollinearity. The strongest correlation of 47.78% is reported between BID and BS which is well-below the established cut-off of 80% (Gujurati and Porter, 2009). Additionally, the values of all variance inflation factors (VIF) are less than 2 which is well under the maximum limit of 5.3 (Hair et al., 2006). Hence, multicollinearity does not pose any serious threat to our model estimation.

Multivariate Analysis

This section presents the empirical investigation of the impact of gender-diverse and politically connected boards on firms' CSR reporting practices. **Table 4** reports the corresponding results. Model 1 shows the results for the direct effect of BGD on CSR reporting using the Shannon index (SI). Findings indicate that the coefficient of SI ($\beta = 0.031$, $p < 0.05$) in Model 1 is statistically significant and positive. These findings support H1 indicating that firms having gender diversity in boards are more likely to involve in CSR reporting and are in total alignment with studies (Hafsi and Turgut, 2013; Yasser et al., 2017; Guping et al., 2020) which also reported a positive association between firms' CSR reporting and BGD. These results imply that Chinese firms having female directors on boards are likely to disclose more CSR-related information because female directors compared to their male counterparts have different values and concerns regarding disclosure of social responsibility-related practices (Bear et al., 2010). Although female directors have a comparatively low proportion on corporate boards in China; however, their presence can be more effective for firms in managing the public perception of their activities and the legitimation process through enhanced awareness and adoption of CSR reporting.

Further, the coefficient of PCs ($\beta = 0.043$, $p < 0.05$) in Model 1 shows a significant positive association with firms' CSR reporting activity supporting H2 that firms with politically connected boards are more likely to engage in CSR reporting than firms without such connections. These findings are in line with prior research (Marquis and Qian, 2014; Wang et al., 2018), which also confirmed the positive influence of PCs on CSR reporting. These results imply that government regulatory pressures influence the CSR behavior of PEFs in China (Huang and Kung, 2010). This could be because the Chinese government wants PEFs to be pioneers in implementing CSR policies by adhering to government guidelines on the adoption of CSR-related activities (Zeng et al., 2012), thus promoting CSR as the desired activity. Therefore, PEFs are likely to act under government signals and publish CSR reports to gain political legitimacy.

Finally, Model 2 shows the interactive effect of BGD and PCs on the disclosure of CSR activities. The results show that the coefficient of interaction term SI*PC ($\beta = 0.219$, $p < 0.01$) in Model 2 is positive and statistically significant, thereby confirming H3. These findings reveal that politically connected boards enhance the role of BGD in increasing the firm's likelihood of issuing CSR reports. Alternatively, we can assert that gender diversity in boards is more effective in improving CSR reporting in PEFs. This is because both female directors and politically connected executives have greater concern for social matters, particularly the adoption and disclosure of CSR activities, depending upon distinctive gender traits of female directors and politically connected executives' knowledge and a better understanding of CSR-related policies and their incentives in adherence to government signals.

Among control variables, state-owned enterprise status (SOE) and firm growth (FG) have a significant negative association with firms' level of CSR reporting. These findings agree with studies (Sial et al., 2018; Guping et al., 2020). All other control variables including CEO duality (CEOD), board size (BS), board independence (BID), board age (BA), board meeting frequency (BMF), Big 4, leverage (LEV), firm size (FS), return on assets (ROA), and free cash flows (FCF) are significantly positively related to CSR reporting level. These findings are in alignment with studies (Yasser et al., 2017; Al Fadli et al., 2019).

DISCUSSION OF RESULTS

Our research adds to the current body of knowledge by examining how gender diverse, as well as politically linked corporate boards, impact Chinese listed firms' CSR reporting practices. We used China's distinct characteristics to gain a deeper understanding of government signaling and how a company board's attributes specifically gender diversity in boards impact its reaction to signaling. The study's findings reveal that the presence of both female directors and politically connected executives on corporate boards improves the firms' CSR reporting. The results also indicate that PEFs have a higher chance of engaging in CSR reporting than non-PEFs. Furthermore, it has been discovered that having PCs on boards

TABLE 3 | Correlation matrix.

	CSRS	SI	PC	PC%	CEOD	BS	BID	BA
CSRS	1.0000							
SI	0.0261**	1.0000						
PC	0.0211**	0.0067*	1.0000					
PC%	0.0312**	0.0045**	0.2108**	1.0000				
CEOD	0.0383***	0.0344*	0.0088	0.0034	1.0000			
BS	0.0004**	0.0020	0.0277*	0.014**	0.0072*	1.0000		
BID	0.0144*	0.0130*	0.0320*	0.0231*	0.0033	−0.4778*	1.0000	
BA	0.0167*	0.0243*	0.0036*	0.0015*	0.0001	0.0097**	0.0091*	1.0000
BMF	0.0292*	0.0028***	0.0140**	0.0201**	0.0276*	0.0307*	0.0254*	0.0226*
Big 4	0.0519*	0.0039*	0.0008***	0.0012*	0.0370*	0.0151*	0.0049*	−0.0064*
SOE	−0.0282*	0.0425*	−0.0201*	−0.0316**	0.0269*	0.0221*	0.0059	0.0181*
LEV	0.0252*	0.0215*	0.1676*	0.0531*	0.0270*	0.0031	0.0158	0.0009*
FS	0.0329*	0.0054	0.3165*	0.2161*	0.0068	0.2097*	0.0397*	0.0030**
ROA	0.0041*	0.0052	0.0178*	0.0219**	−0.0061	0.0273*	−0.0001	0.0037*
FG	0.0051**	−0.0058**	0.0279*	0.0154*	−0.0011	0.0405*	0.0032	0.0048*
FCF	0.0288**	0.0191*	0.1247*	0.1372*	−0.0007	0.0611*	0.0336*	−0.0111
	BMF	**Big 4**	**SOE**	**LEV**	**FS**	**ROA**	**FG**	**FCF**
BMF	1.0000							
Big 4	0.0144**	1.0000						
SOE	−0.0008**	−0.0323*	1.0000					
LEV	−0.0230*	0.0265*	−0.0048*	1.0000				
FS	0.0189*	−0.0432*	0.0154**	0.2097*	1.0000			
ROA	−0.0126	−0.0026	0.0122*	0.0273*	−0.0400*	1.0000		
FG	0.0000***	0.0014	0.0023	0.0405*	0.1303*	0.0001	1.0000	
FCF	0.0040**	0.0054	−0.0290*	0.0611*	0.4251*	−0.0044	0.1966*	1.0000

*, **, *** *Represent the significance levels at p < 0.1, p < 0.05 and p < 0.01, respectively.*

TABLE 4 | Do gender-diverse boards in Chinese firms with PCs affect CSR reporting?

	Direct Model		Indirect Model	
	Model 1 (CSRS)		Model 2 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
SI	0.031**	0.034		
PC	0.043**	0.021	0.0.023***	0.003
SI*PC			0.219***	0.002
CEOD	0.013***	0.002	0.015**	0.041
BS	0.051**	0.044	0.049*	0.061
BID	0.076*	0.068	0.072*	0.060
BA	0.001*	0.078	0.002*	0.072
BMF	0.002***	0.002	0.003***	0.003
Big 4	0.019***	0.001	0.017***	0.001
SOE	−0.005**	0.031	−0.009**	0.032
LEV	0.018**	0.030	0.016**	0.022
FS	0.031*	0.057	0.027*	0.069
ROA	0.093**	0.021	0.067*	0.091
FG	−0.163**	0.015	−0.198*	0.068
FCF	0.125*	0.091	0.051*	0.078
Constant	0.021***	0.001		
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
R^2 (%)	27.19		28.69	
F	197.76		193.89	
Prob>F	0.000		0.000	

**Represent the significance levels at p<0.1.*
***Represent the significance levels at p<0.05.*
****Represent the significance levels at p<0.01.*

might enhance the influence of BGD on companies' CSR reporting.

From a theoretical standpoint, our results are in alignment with the legitimacy and agency theories' perspectives. From a legitimacy theory perspective, businesses must legitimate their activities for survival and growth in the environment and society in which they operate. Conflicts may arise when firms' goals negate the social and political goals. The CSR perspective of legitimacy theory helps in resolving these conflicts, and firms' approach toward controlling and resolving these conflicts is an attractive research subject. The Chinese government has been actively signaling to businesses that CSR is a legitimate and vital activity. However, in the corporate environment of China, firms may find it difficult to understand and respond to government directions due to underdeveloped institutional infrastructure and lax enforcement of current standards (Marquis et al., 2011). In such scenarios, we believe that responding to government signals and establishing legitimacy with governmental players is critical. The legitimate status is said to be an absolute necessity for easier access to resources and markets, and long-term survival (Brown, 1998). Furthermore, because the Chinese government, as a major stakeholder in many firms, has control over critical resources that shape their competitive environments and positions, firms are strategic in how they manage their interactions with government entities to strengthen their positions (Hillman, 2005). Research has shown that the more the government's influence in a firm's immediate surroundings, the more likely the firm is to participate in political strategies (Bonardi et al., 2005). We found that firms can seek preferred

status (i.e., legitimacy) and associated resources from the government by strategically reporting on their social responsibility which implies that Chinese companies are more inclined to pursue CSR reporting as a political strategy.

Furthermore, to safeguard the interests of stakeholders, corporate boards regulate and monitor the decision-making process in firms (Barako and Brown, 2008). For this, boards must be effective which largely depends on gender quota for females on these boards (Bassett et al., 2007). It is argued that because of their strong relation-building quality, females have a greater ability to engage and respond to multiple stakeholders considering it as social responsibility (Galbreath, 2011). Female directors tend to improve the board's efficiency in terms of environmental policy because they place a greater emphasis on green issues. As per social identification theory and social categorization theory, women directors are more involved in social responsibility initiatives than male directors because they are more concerned about alleged environmental and health risks (Bonardi et al., 2005). The inclusion of female directors on corporate boards increases the use of CSR reporting as a legitimization tool, aiding in the alignment of business and society goals through the mechanism of increasing CSR reporting levels.

Alternatively, the CSR perspective of agency theory can aid in the resolution of interest misalignment in the separation of control and ownership. Female directors on boards guarantee that the firm's goals and the social effect of its operations are met, as well as for settling agency conflicts and legitimizing the firm's actions (Guping et al., 2020). This is because they have a higher level of social concern, a better grasp of the firm's internal and external environment, and the capacity to respond to community-related challenges through CSR disclosure (Beckman and Haunschild, 2002). Voluntary disclosures, such as CSR reporting, help to reduce information asymmetry, allowing the reporting organization to maintain and improve its reputation. As a result, the level of CSR disclosure is an indicator of an efficient and effective board, because it can bring managers', shareholders', and other stakeholders' interests together (Al Fadli et al., 2019).

Our findings also align with the agency-centered perspective of political legitimacy, implying that government-induced CSR policies can be implemented more effectively in the presence of politically connected executives on boards. Since, the government can shape firms' CSR activities in both a direct and indirect manner by using its majority shareholding status and appointing the board executives with PCs, respectively (Wang et al., 2018). Therefore, in addition to government ownership, PCs can be used as a tool for the diffusion of CSR-related practices in China. We observed that indirect government pressure in the form of political embeddedness is a strong predictor of CSR reporting in our developing market environment, i.e., a country where the government owns a significant portion of many firms. The board of directors' membership in government and/or political councils, such as the NPC or CPPCC, affects the company's legitimacy and, as a result, the likelihood of publishing a CSR report. This, we believe, is because such connections expose the firm to additional scrutiny. Even though research has demonstrated that they are crucial for resource access in China (Wang et al., 2018), this may come at the cost of higher government monitoring. Our results also indicate that when the boards are politically embedded, female directors on boards have a higher effect on firms' CSR reporting, highlighting that PCs can add more potential to the role of female directors on board to further promote CSR reporting. The findings that PCs have a moderating effect on the female directors' role in CSR reporting suggest that responding to government signals is not a straightforward process. Firms may experience varying degrees of legitimacy pressure depending on the characteristics of their board executives.

ROBUSTNESS TESTS

In this section, some robustness tests were conducted to check the sensitivity of our main findings from different perspectives including the alternative measurements of dependent and independent, and moderator variables and controlling for possible endogeneity problems.

Alternative Measure of CSR Reporting

Table 5 shows the results for the association between BGD and CSR reporting using CSR dummy (CSRD) as a proxy for a firm's CSR reporting. Findings demonstrate that the coefficients for direct influence of BGD on firms' CSR reporting [SI (β =0.245, $p<0.05$)] in Model 1 along with interaction term [SI*PC (β =0.929, $p<0.01$)] in Model 2 remained significantly positive, showing that our main results, reported in **Table 4**, persist and remained insensitive to the alternative measurement of CSR reporting.

Alternative Measures of BGD

We used Blau index (BI), female director dummy (FDM), and percent female directors (FDBD) as proxies for alternative measurement of BGD. The corresponding results are given in **Table 6** which show that in Models 1, 2, and 3, the coefficients of BI ($\beta=0.131$, $p<0.05$), FDM ($\beta=0.005$, $p<0.01$) and FDBD ($\beta=0.021$, $p<0.01$) are significant and positive. Likewise, in Models 4, 5 and 6, the interaction terms BI*PC ($\beta=0.178$, $p<0.05$), FDM*PC ($\beta=0.032$, $p<0.01$) and FDBD*PC ($\beta=0.049$, $p<0.05$) are also found to have a significant positive effect on CSR reporting. These results confirm the main findings given in **Table 4**. Thus, it is established that our results remain insensitive to alternative measurements of BGD.

Alternative Measure of PC

To check the reliability of our definition of PC, we re-investigated the CSR reporting choices of firms in association with BGD and PC using the percentage of politically connected directors in the board to the total number of board directors (PC%) as an alternative measure of PC. The results, provided in **Table 7**, reveal that the coefficients for both the direct and indirect influence, i.e., SI ($\beta=0.019$, $p<0.05$), PC ($\beta=0.045$, $p<0.05$; $\beta=0.012$, $p<0.01$) and

TABLE 5 | Alternative measure of CSR reporting.

	Direct Model		Indirect Model	
	Model 1 (CSRD)		Model 2 (CSRD)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
SI	0.245**	0.035		
PC	0.078***	0.006	0.298***	0.006
SI*PC			0.929***	0.006
CEOD	0.240***	0.000	0.239***	0.000
BS	0.017**	0.029	0.020**	0.014
BID	0.423*	0.057	0.426**	0.031
BA	0.006*	0.064	0.003**	0.014
BMF	0.039***	0.000	0.032***	0.000
Big 4	0.367***	0.000	0.368***	0.000
SOE	−0.062*	0.072	−0.085**	0.013
LEV	0.307*	0.060	0.303*	0.061
FS	0.034**	0.013	0.027***	0.006
ROA	0.013**	0.018	0.015*	0.051
FG	0.188	0.331	0.187	0.597
FCF	0.179**	0.050	0.202*	0.068
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
Pseudo R^2 (%)	20.82		21.88	
Wald χ^2	137.77		147.99	
Prob> χ^2	0.000		0.000	
Specification test-linktest (Hatsq)	0.463		0.829	
Gof test group (10)	12.05		7.04	
Prob.	0.149		0.532	
% of correction prediction	80.12		80.13	

*Represent the significance levels at $p<0.1$.
**Represent the significance levels at $p<0.05$.
***Represent the significance levels at $p<0.01$.

SI*PC % ($\beta=0.275$, $p<0.01$) in Models 1 and 2, respectively, retain the sign and significance and are consistent with those reported in **Table 4** using PC dummy. Hence, our results continued to be indifferent to alternative PCs' measurement.

Control for Endogeneity

In accounting research, endogeneity is a common problem that could arise due to omitted variables, explanatory variables, and other instantaneous consequences. It is suggested that the relationship between board members and CSR reporting can be simultaneous (Velte, 2017). To resolve the possible endogeneity problem, we re-estimated the main model using the generalized methods of moment (GMM) model. The results of the GMM model presented in **Table 8** show that the *p*- values of the Sargan test, Hansen test, and AR 2 are all insignificant. Additionally, the signs and coefficients are also like those of the main models. Hence, our results are insensitive to the endogeneity problem. Further, to deal with the problem of reverse causality, we used the lagged values of explanatory variables following the literature (Sial et al., 2018; Ain et al., 2021). Accordingly, we used the lagged values of the BGD measure to re-investigate our research hypotheses. The results, reported in **Table 9**, confirm the robustness of the main findings in **Table 4** thus indicating that reverse causality is unlikely.

Finally, we employed the propensity score matching technique (PSM) to address the issue of selective bias. Another possible problem with the validity of our main findings is self-selection bias. This suggests that gender diversified boards have distinct characteristics than non-diversified boards and that it is likely that these characteristics, rather than the presence of female directors on the board, cause firms to engage in CSR reporting. We used PSM and followed the literature (Liu, 2018; Ain et al., 2021) to tackle this problem. First, the logit model was used to predict the likelihood that the firm will appoint female directors, with the same control variables as in the main analysis. For each firm in the treatment group (i.e., firms with female directors), a control group (i.e., firms without female directors) was identified using this procedure. Except for gender diversity, the control group was assumed to have no differentiating characteristics. **Table 10** shows the findings of the PSM, providing additional support for our findings.

CONCLUSION

In conclusion, this study contributes novel insights and presents reliable evidence that the presence of female directors and political connections on the board are positively associated with a firm's CSR reporting by controlling various corporate governance and other firm-related factors. We found that female board directors in China tend to raise awareness of CSR reporting practices and Chinese firms with gender-diverse boards have a greater potential to engage in CSR reporting to fulfill their social responsibility and maintain legitimacy. The underlying reason is that female directors have some unique qualities, such as a stronger emphasis on ethical and social concerns, deeper comprehension of and awareness of their environment, and the capacity to respond appropriately to their environment. Further, PCs on company boards improve CSR reporting, therefore companies with political ties are more likely to provide CSR reports than companies without them. This might be because the government wants these firms to be the first to implement CSR policies. Furthermore, politically connected executives may have personal motivations for being politically connected, such as career progression and reputation. Finally, PCs on corporate boards are found to positively moderate the role of female directors in boosting a firm's CSR reporting, indicating the relevance of PCs in addition to gender diversity in addressing the diffusion of CSR practices in the Chinese corporate environment. We believe that our findings lead to a deeper understanding of the link between gender diversity and CSR reporting, and call for more attention to its impact on CSR.

Practical and Theoretical Implications

Our findings have several practical and theoretical implications. The findings support the notion that female presence and political links improve the board's efficacy. Regarding practical implications, these results are crucial for academia, company boards, policymakers, business partners, and investors of Chinese

TABLE 6 | Alternative measures of BGD.

	Direct Models						Indirect Models					
	Model 1 (CSRS)		Model 2 (CSRS)		Model 3 (CSRS)		Model 4 (CSRS)		Model 5 (CSRS)		Model 6 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***	**Coeff.**	***value of p***	**Coeff.**	***value of p***	**Coeff.**	***value of p***	**Coeff.**	***value of p***
BI	0.131**	0.010										
FDM			0.005***	0.004								
FDBD					0.021***	0.003						
PC	0.046**	0.023	0.003**	0.011	0.002**	0.012	0.021***	0.001	0.005**	0.024	0.007**	0.019
BI*PC							0.178**	0.033				
FDM*PC									0.032***	0.008		
FDBD*PC											0.049**	0.027
CEOD	0.014**	0.049	0.011***	0.002	0.015***	0.001	0.013***	0.003	0.011**	0.023	0.020**	0.029
BS	0.060***	0.003	0.071**	0.037	0.051**	0.048	0.074**	0.026	0.058**	0.021	0.056**	0.019
BID	0.072**	0.032	0.069**	0.029	0.078*	0.056	0.059**	0.017	0.073**	0.015	0.067**	0.021
BA	0.002**	0.024	0.001**	0.014	0.002*	0.083	0.003**	0.019	0.004**	0.011	0.003**	0.011
BMF	0.002**	0.025	0.003***	0.023	0.003***	0.003	0.002**	0.011	0.001*	0.063	0.003**	0.047
Big 4	0.018***	0.001	0.017***	0.000	0.018***	0.001	0.019***	0.000	0.020***	0.007	0.022***	0.005
SOE	−0.007**	0.013	−0.005***	0.007	−0.006**	0.014	−0.006**	0.017	−0.008**	0.019	−0.005**	0.018
LEV	0.021**	0.014	0.019**	0.021	0.018*	0.059	0.017**	0.020	0.019**	0.027	0.017**	0.023
FS	0.001**	0.020	0.001***	0.004	0.004*	0.061	0.002***	0.005	0.003**	0.019	0.003**	0.025
ROA	0.091**	0.034	0.031**	0.040	0.030**	0.017	0.048**	0.019	0.051**	0.021	0.049*	0.069
FG	−0.139*	0.060	−0.081*	0.087	−0.049*	0.071	−0.176*	0.090	−0.201*	0.093	−0.091*	0.091
FCF	0.031*	0.079	0.028**	0.029	0.027**	0.021	0.034*	0.088	0.036**	0.048	0.067*	0.061
Constant	0.056**	0.015	0.051**	0.013	0.039**	0.016	0.053**	0.020	0.061**	0.019	0.049**	0.022
Year & Industry	Yes		Yes		Yes		Yes		Yes		Yes	
Province & City	Yes		Yes		Yes		Yes		Yes		Yes	
N	10,679		10,679		10,679		10,679		10,679		10,679	
R^2 (%)	31.22		32.09		31.97		33.18		33.27		32.92	
F	187.34		203.10		197.56		206.19		199.34		176.90	
Prob>F	0.000		0.000		0.000		0.000		0.000		0.000	

*Represent the significance levels at $p<0.1$.

**Represent the significance levels at $p<0.05$.

***Represent the significance levels at $p<0.01$.

TABLE 7 | Alternative measure of PC.

	Direct Model		Indirect Model	
	Model 1 (CSRS)		Model 2 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
SI	0.019**	0.015		
PC %	0.045**	0.014	0.012***	0.001
SI*PC %			0.275***	0.000
CEOD	0.011***	0.001	0.019**	0.017
BS	0.007**	0.040	0.009*	0.090
BID	0.076*	0.054	0.056*	0.067
BA	0.002*	0.096	0.003*	0.087
BMF	0.001***	0.003	0.002***	0.000
Big 4	0.019***	0.000	0.021***	0.000
SOE	−0.006**	0.022	−0.005**	0.032
LEV	0.013**	0.012	0.017**	0.043
FS	0.031**	0.010	0.041*	0.079
ROA	0.094**	0.063	0.077*	0.081
FG	−0.165**	0.083	−0.173*	0.091
FCF	0.107*	0.061	0.096**	0.049
Constant	0.018**	0.047		
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
R^2 (%)	28.00		30.22	
F	154.27		161.11	
Prob>F	0.000		0.000	

*Represent the significance levels at $p<0.1$.
**Represent the significance levels at $p<0.05$.
***Represent the significance levels at $p<0.01$.

TABLE 8 | GMM regression.

	Direct Model		Indirect Model	
	Model 1 (CSRS)		Model 2 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
L1	0.460***	0.000	0.472***	0.000
SI	0.018***	0.000		
PC	0.004***	0.000	0.09***	0.001
SI*PC			0.058***	0.000
CEOD	0.014***	0.000	0.017***	0.000
BS	0.050***	0.000	0.035**	0.040
BID	0.038*	0.070	0.026**	0.036
BA	0.002***	0.000	0.003***	0.000
BMF	0.007***	0.002	0.006***	0.000
Big 4	0.051*	0.056	0.061***	0.001
SOE	−0.010***	0.001	−0.011***	0.000
LEV	0.016***	0.000	0.016***	0.000
FS	0.003***	0.000	0.004***	0.006
ROA	0.045***	0.000	0.064***	0.000
FG	0.054***	0.000	0.072***	0.003
FCF	0.060**	0.020	0.081*	0.082
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
Wald χ^2	1986.72		1147.99	
Prob> χ^2	0.000		0.000	
Arellano-Bond test for AR(2)	0.210		0.310	
Sargan test	0.187		0.480	
Hansen test	0.517		0.618	

*Represent the significance levels at $p<0.1$.
**Represent the significance levels at $p<0.05$.
***Represent the significance levels at $p<0.01$.

firms to evaluate the impact of board gender diversity and political connections on CSR reporting. First, in the context of academia, investigating this link will contribute to a better understanding of the effects of gender diversity and PCs on CSR reporting. Second, for boards, the study of gender diversity and PCs would benefit in making wiser decisions and improving their companies' performance, particularly in terms of CSR protection. Gender diversity on boards has a significant positive impact since more female directors can improve critical board processes such as analysis and decision making. This favorable influence of females on boards can improve CSR ratings, which can increase company reputation and have a positive impact on institutional investment, stock price, and financial performance of the firm (Bear et al., 2010). This study gives investors an additional tool to use when evaluating potential investments. Because having more women on a board can improve CSR, board changes can send significant signals to investors about a company's potential for better reputation and performance.

The study finds robust evidence that women directors can perform a strategic role in assisting firms in managing sustainable practices and social responsibilities ethically. Given that unethical behavior is more common in emerging economies, the policymakers and regulators are recommended to further improve and legislate gender quotas for women on Chinese corporate boards, as they are in other Asian and European countries, to further improve firms' internal corporate governance mechanism and to aid in the more achievement of social and environmental goals. However, in the current business environment, improving females' board representation is a lengthy process fraught with obstacles including dismissal from informal networks, unfriendly corporate culture, and male stereotyping (Ragins et al., 1998). As a result, policymakers must undertake some professional training to develop skills and create a reasonable competitive environment for females to stimulate their career development.

Further, results support the argument that PCs can be a significant driver of a firm's CSR activities and that PEFs reports differently on CSR than non-PEFs implying that government should implement different policies for PEFs and non-PEFs to exert a stronger influence on their strategic CSR choices. Moreover, the findings show that PCs assist female directors in boosting enterprises' CSR reporting, implying that in addition to establishing women quotas on boards, political ties of board executives should also be encouraged to further promote CSR in China's corporate environment. Finally, investors and business partners interested in improving Chinese firms' corporate social performance should encourage the appointments of senior executives with political ties and appreciate an institutional environment suitable for CSR initiation.

In terms of theoretical implications, our study contributes to agency theory and legitimacy theory by demonstrating that having more female directors and PCs on the board improves the board's performance and firm's legitimacy

TABLE 9 | Reverse causality.

	Direct Model		Indirect Model	
	Model 1 (CSRS)		Model 2 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
SI	0.011**	0.013		
PC	0.055***	0.003	0.051***	0.007
SI*PC			0.017**	0.022
CEOD	0.012***	0.000	0.003**	0.045
BS	0.009**	0.030	0.004*	0.068
BID	0.070*	0.080	0.016*	0.069
BA	0.003*	0.089	0.001*	0.094
BMF	0.001***	0.000	0.003**	0.026
Big 4	0.014***	0.000	0.010**	0.014
SOE	−0.008***	0.003	−0.007**	0.044
LEV	0.012**	0.013	0.004**	0.017
FS	0.002**	0.030	0.003**	0.012
ROA	0.662**	0.047	0.029*	0.097
FG	−0.876**	0.027	0.137*	0.061
FCF	0.123*	0.062	0.150**	0.024
Constant	0.014**	0.044	0.030**	0.035
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
R^2 (%)	32.10		35.19	
F	160.02		164.10	
Prob>F	0.000		0.000	

*Represent the significance levels at $p<0.1$.
**Represent the significance levels at $p<0.05$.
***Represent the significance levels at $p<0.01$.

TABLE 10 | Propensity score matching.

	Direct Model		Indirect Model	
	Model 1 (CSRS)		Model 2 (CSRS)	
Variables	**Coeff.**	***value of p***	**Coeff.**	***value of p***
SI	0.098**	0.015		
PC	0.179***	0.000	0.242***	0.008
SI*PC			0.623***	0.003
CEOD	0.035**	0.023	0.552**	0.036
BS	0.010**	0.019	0.447***	0.007
BID	0.025*	0.092	0.306**	0.037
BA	0.006*	0.069	0.043**	0.031
BMF	0.004**	0.045	0.151**	0.011
Big 4	0.201***	0.008	0.511***	0.001
SOE	−0.052*	0.062	−0.058**	0.031
LEV	0.108***	0.000	0.068*	0.078
FS	0.105***	0.000	0.263***	0.042
ROA	0.020*	0.086	0.069**	0.021
FG	0.595	0.357	0.232	0.793
FCF	0.384**	0.027	0.761***	0.003
Year & Industry	Yes		Yes	
Province & City	Yes		Yes	
N	10,679		10,679	
Pseudo R^2 (%)	23.30		22.88	
F	345.31		324.42	
Prob>F	0.000		0.000	

*Represent the significance levels at $p<0.1$.
**Represent the significance levels at $p<0.05$.
***Represent the significance levels at $p<0.01$.

regarding social responsibility, notably CSR reporting. Agency theory relates board gender diversity with a firm's disclosure of CSR activities and claims that agents disclose such information as a result of the incentives they can gain from such disclosure activities such as reduction in information asymmetry and settlement of agency disputes (Barako and Brown, 2008; Li et al., 2018). The legitimacy theory, on the other hand, link such disclosures to companies' efforts to justify their conduct in front of shareholders and other stakeholders and female directors promote CSR reporting as a legitimization tactic (Chan et al., 2014; Willows and van der Linde, 2016). Our findings lend support to these theories and extend further by presenting the novel evidence of a positive intervening effect of PCs on boardroom gender diversity in terms of a firm's social responsibility reporting. We state that female directors have a stronger influence on board decision making and corporate legitimacy as regards CSR when corporate boards are politically active.

Unlike previous research (Chan et al., 2014; Yasser et al., 2017; Al Fadli et al., 2019; Guping et al., 2020) that has focused solely on the influence of female directors in CSR disclosure, our study provides new insights into how country-specific institutional elements such as political connections influence the governance role of female directors in firm's CSR-related activities and support the recommendations of the world's regulatory authorities on gender diversity in the boardroom. More specifically, we document that gender diversity on the board has the potential to improve China's inadequate governance structure and the board's political links amplify this potential. This will further contribute to a better understanding of the legitimization process for Chinese corporations in terms of CSR reporting, which is highly reliant on the characteristics of board leaders.

Limitations and Future Research

There are some caveats in this study, which may offer useful insights for future research. First, our research is context-specific, focusing solely on Chinese firms that operate in a distinct social, political, and business environment. Therefore, we urge that future research investigate our findings in other settings, such as developed economies or a sample of different emerging economies together, to see if they are generalizable. Second, because of data limitations, we were unable to add other board directors' attributes, such as their educational background and qualification level. As a result, future research may investigate their impact on companies' CSR disclosure practices. Finally, the use of archival data is another drawback in our study, as we are unable to validate how female directors behave in the boardroom when it comes to CSR-related issues. This can be addressed in future research by using primary data such as conducting director surveys and interviews.

DATA AVAILABILITY STATEMENT

The data used in this study are available on request from the corresponding author.

AUTHOR CONTRIBUTIONS

RS and HY contributed to the conceptualization, methodology, investigation and writing - original draft. RS and HB performed the data collection, data curation and formal analysis. RS, MB, and FN participated in the manuscript revision, review, editing and validation. All authors have read and approved the final manuscript.

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A Study on Environmental, Social and Governance Fund Performance and Fund Flow: Evidence From Korea Stock Exchange

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This study analyzed the sensitivity between fund flow and fund performance with Korean funds, whether there would be a difference in the sensitivity between environmental, social and governance (ESG) funds and non-ESG funds, and whether there was a difference in sensitivity according to the type of past fund performance (positive and negative). The main results of the analysis are as follows. First, the analysis of the fund flow–performance correlation of Korean funds revealed that they had a negative (–) correlation and the ESG did not affect fund flow. Analysis of the difference in sensitivity between fund flow and performance volatility revealed that there was a negative (–) correlation regardless of the performance measuring method and ESG. Finally, the comparison of fund flow and performance sensitivity according to the type of past fund performance revealed that despite consistent asymmetry, there was little difference in sensitivity asymmetry between ESG funds and non-ESG funds. The results reveal that, unlike the expectation that investors in Korean ESG funds would focus more on non-financial properties like the purpose of investment than on profit, they attach the same importance to fund performance.

Keywords: ESG fund, fund flow, fund performance, volatility, asymmetry, propensity score matching

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INTRODUCTION

A financial market paradigm change begins with institutional changes. There are many institutional changes currently taking place, one of which is environmental, social and governance (ESG). International interest in ESG investment is increasing as the importance of ESG management is emphasized. Consequently, ESG[1] is the bond market's biggest topic.

Recently, major domestic and foreign companies and financial institutions have increased the importance of the issue of ESG bonds. There have been many discussions about the origin and definition of ESG. More specifically, ESG is a concept that began with the fact that non-financial factors, in which we had little interest, might shake the essence of the issue's subject.

To examine it with stricter criteria, it is defined as bonds issued based on Green Bond Principles (GBP), Social Bond Principles (SBP), and Sustainable Bond Guideline (SBG) announced by the International Capital Market Association (ICMA) and those issued based on The Climate Bond Standards (CBS) announced by the Climate Bond Initiative (CBI).

[1]An ESG fund is issued to raise the fund related to Socially Responsible Investment (SRI) such as Environmental, Social, Governance improvement.

The concept of ESG that had first exhibited an influence on the stock market is spreading fast in the bond market as well, starting in 2020. The most question and concern is "What is the difference between non-ESG bonds and ESG bonds?" The conclusion is the generalization of new bonds. Finally, with global paradigm change, ESG bonds will become common while non-ESG bonds will not be common anymore. Instead of the decrease in credit spread of ESG bonds or becoming excellent bonds, it is possible to see a phenomenon in which credit spread expands as demand for non-ESG bonds decreases.

ESG investment has evolved into an essential element. The size of the ESG bond issues has increased noticeably at home and abroad. In 2015, there were only $80.7 billion in global ESG bonds. In 2020, there were $789.8 billion in ESG bonds. This was almost a 10-fold increase. The weight of responsible funds considering ESG is still lower for bonds than stocks. However, ESG bond numbers are increasing at a significant rate. Responsible investments, which have been limited to stocks, are made actively through bonds. In the ESG bond market, as well as the issue of bonds to raise specific funds (e.g., green bonds), the method of adjusting the weight of the inclusion in the portfolio considering the ESG performance of the issuer draws attention for the same reasons.

When compared to the global ESG market, the Korean ESG bond market is still in an early stage in terms of size, diversity, and investor base. It needs the power to experience growth. And yet, as the National Pension amended the fund management principle in November 2019, it expanded and applied ESG investment to all asset classes. Hence, Korean investors' interest in ESG investment has gradually expanded.

This study is primarily concerned with ESG funds. An analysis of the impacts of the setting of ESG on the monetary flow of the Korean funds will be conducted. ESG and non-ESG funds will be compared to examine the relative difference in the sensitivity between fund flow and fund investment performance. The focus will be placed on the method for measuring the fund performance, as well as the type of fund's past performance. The focus will also be placed on describing the factors with significant positive impacts.

The rest of this article is structured as follows. Section "Literature Review and Hypotheses" summarizes the previous studies of correlations between ESG funds and fund flows. It also presents the empirical hypotheses to be dealt with in this study along with the grounds. Section "Reference Data and Research Methods" describes the characteristics of the samples and the main variables used in the empirical analysis. Section "Result of Empirical Analysis" presents the main results of the empirical analysis, and section "Conclusion" draws a conclusion and provides suggestions.

LITERATURE REVIEW AND HYPOTHESES

It is difficult to clearly define the concept of ESG investment. It is difficult to accurately classify ESG by subject and to examine the history of ESG investment, its definition differs depending on the culture, religion, values, and belief. By the occasion, it is used in various names, such as Socially Responsible Investment (SRI), Responsible Investment (RI), and ethical investment. The SRI forum in the United States and Europe does not clearly define SRI. Consequently, these terms are used in diverse and mixed ways.

The global ESG investment began from an ethical/religious motivation to exclude specific industries (e.g., alcoholic beverages, tobacco, and weapons manufacturing) in the 1920s. In the 1960s–1970s, responsible investments in the public interest became revitalized. As social interest in global warming, human rights issues, and corporate corruption increased, its meaning and concept evolved. Entering the 1970s, South Africa's apartheid policy triggered the SRI of institutional investors. In the 1980s, as large accidents took place (e.g., Exxon Valdez oil spill, and Bhopal gas tragedy), environmental issues have drawn more attention. Since 2000, when the Principles for Responsible Investment were enacted by the UN PRI, there have been international public debates. There has also been a revitalization in ESG investments centered around the Pension and Funds Audit Bureau.

The sales of ESG bonds in South Korea began with the issue of green bonds by the Export–Import Bank in 2013. As the demand for investment in ESG bonds increased in the global financial market (e.g., Europe and United States), which set out for expanding investment assets with responsible investment, Korean paper issuers also set out to expand the base of investors through the issue of ESG bonds. The size of the issue of ESG bonds in Won has increased, thanks to the issue of these bonds by many private companies (e.g., POSCO, Hanwha Energy, and Shinhan Financial Group).

ESG bonds began being issued in Won in May of 2018, much later than the ESG bonds that were first issued in foreign currency in 2013. The Korean Development Bank issued green bonds worth 300 billion Won. Later, Shinhan Bank and Korea Southern Power issued green bonds in Won. And in February of 2019, IBK and Woori Bank issued sustainable bonds in Won. Woori Card issued a social bond in Won for the first time as a financial company specializing in the loan business.

The domestic ESG market centered around green bonds in the earlier stage has recently expanded to social bonds and sustainable bonds. In particular, since sustainable bonds can use the funds raised in eco-friendly investments (green bonds) and investments to solve social problems (social bonds), there is an advantage in terms of versatility. Consequently, the size of the issue has tended to expand. In addition, ESG bonds centering around the bonds in a foreign currency (e.g., U.S. Dollars, Euros, and Swiss Francs) are highly preferred by foreign investors in the global market. In 2018, the Korean Development Bank issued bonds in Won. The number of Won-issued bonds has increased in earnest since 2019.

In this investigation, we will examine the advantages and disadvantages of the investors and issuers of ESG bonds, when compared to non-ESG bonds. The investors have advantages (e.g., investment that improves a public utility, opportunities for investment diversification, and easy risk management), since it is possible to check fund uses. In contrast, the disadvantages include low liquidity and the clear

performance of cumulative returns. Issuers have advantages (e.g., promotion of an image related to social reliability, security of demands for ESG-related investments in response to the social atmosphere). However, when compared to non-ESG bonds, there are also risks (e.g., additional costs for certification in advance, ex-post facto public notification, and confidence slumps according to non-compliance with the issuance principle).

Previous Studies

ESG investments emphasize prioritizing the maximization of the return on investment for customers and beneficiaries as a trustee's duty. The purpose of the investment has been changed from investing in good companies to investing in good companies with bright prospects. The question of whether or not profits can be created in investing in ESG funds continues.

ESG investments aim to increase profitability in priority; however, contributing to social responsibility and capital market fidelity is also a fundamental goal. No conclusions have been drawn concerning whether or not it is possible to achieve non-financial values simultaneously (e.g., ESG values and financial values). Of course, the direction investors want is to consider non-financial values in investments.

There are various opinions in the studies that verified the correlation between ESG investment and financial performance. Bollen (2007) investigated SRI funds, a previous form of ESG funds, and fund flow for the first time and showed that SRI fund flow was more (less) sensitive to positive (negative) time-lag rate of return. The determinants of fund performance and money flow are important topics for fund managers and investors; however, there are differences between non-ESG funds and ESG funds. Chevalier and Ellison (1997) and Sirri and Tufano (1998) noted that the funds with enhanced fund performance had higher money flow; however, there was an asymmetric correlation between fund performance and money flow (Ippolito, 1992; Del Guercio and Tkac, 2002). This asymmetry does not occur in all funds (Del Guercio and Tkac, 2002; James and Karceski, 2006).

According to the result of the survey conducted by Morgan Stanley (2019) (Sustainable Signals), 85% of the institutional investors in asset management companies in the United States responded that non-financial factors were important elements in decision making. Especially, 95% of the millennial generation that would become the mainstream of investment responded that those factors were positive. However, no conclusion has been drawn concerning whether non-financial factors have positive impacts on financial factors. Theoretically, companies in the high ESG class get relatively fewer ESG-related incidents, so the likelihood of exposure to downside risks due to corporate reputation or performance deterioration may decrease. This acts positively on financial performance and returns on investment. On the other hand, the costs that may incur as the investors consider the criteria for ESG investment and decreasing investment opportunities due to the exclusion of items may act negatively on the rate of return.

Friede et al. (2015)[2] analyzed about 2,000 research papers that described the correlations of ESG factors with companies' financial performance and reported that 48% concluded the correlation between ESG and financial performance to be positive; 11%, to be negative; and 23%, to be neutral.

The IMF Global Financial Stability Report Victor Hugo (2019) shows that there is no consistent evidence that ESG funds have a higher or lower rate of return than non-ESG funds and that the limit of investment in ESG funds leads to a decrease in performance (**Figure 1**). In addition, Wee et al. (2020) analyzed the correlation between the ESG level of a fund and the fund performance and reported that there was a higher risk-adjusted return in the funds at a high ESG level than in other funds or no statistically significant difference. This means that the investment strategy that attaches importance to ESG factors and reflects them in investment cannot show any decrease in performance. This suggests that in Korea, ESG funds are likely to be "ESG funds in name only."

In conclusion, there is a lack of ground for judging the performance of ESG investment to be positive or negative. Most countries all over the world have not prepared an environment in which non-financial factors can be measured, and assessment institutions' appraisal methodologies have not been settled. Especially, since in Korea, ESG investment is in its beginning stage, so it is too early to mention its effects.

Hypotheses Development

Investors' choice of funds generally depends on fund performance and risk appetite. In other words, rational investors would compose portfolios based on the past performance of the fund. Thus, rational investors can predict a positive (+) correlation between the past return of the fund and the fund flow (Berk and Green, 2004). In addition, the positive (+) correlation between past performance and fund flow can also be inferred through trading patterns such as a positive feedback strategy (Ippolito, 1992; Gruber, 1996; Sirri and Tufano, 1998; Del Guercio and Tkac, 2002).

[2]ESG and financial performance aggregated evidence from more than 2,000 empirical studies (2015.9).

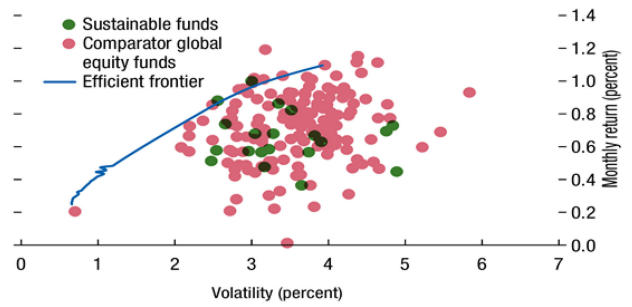

FIGURE 1 | Efficient frontier based on sustainable funds and comparator global equity funds. Source: IMF (Victor Hugo, 2019, p. 10), Global Financial Stability Report.

However, it is expected that ESG fund investors (e.g., corporate social responsibility activities) would be relatively less sensitive to past performance or volatility (Bollen, 2007; Renneboog et al., 2011).

> Hypothesis 1: The fund flow–performance sensitivity would be weaker in ESG funds than in non-ESG funds.

ESG investors decide on investment, actively reflecting non-financial factors such as corporate social responsibility (CSR) activities. Consequently, ESG investors are expected that it would be unlikely that ESG investors decide short-term investment curtailment (withdrawal) even if the financial performance of the fund is poor (Bollen, 2007). Thus, it is assumed that the money flow according to negative investment performance would be less in ESG funds than in non-ESG funds.

> Hypothesis 2: The fund flow-negative fund performance sensitivity would be weaker in ESG funds than in non-ESG funds.

There are conflicting claims on the correlation between fund flow and fund performance volatility. According to Busse's (1999) volatility timing hypothesis, fund managers adjust the market exposure of fund portfolios if the market volatility is expected. Thus, in the funds with low expected performance due to positive feedback trading, there would be a negative (−) correlation between fund performance volatility and fund flow because of fund liquidation or money outflow (Busse, 1999). Meanwhile, noise traders who invest not depending on information become the main cause for letting the market price break away from the fundamental value, and also, because most fund investors are noise traders, their irrational investment behavior (sentiment) may be the main cause for the fluctuation of fund performance (Lee et al., 1991; Black, 1996).

In particular, since positive feedback trading may be accompanied by a short-term volatility increase, the increase in the volatility of the fund performance and fund flow may have a positive (+) correlation.

> Hypothesis 3: The fund flow–performance volatility sensitivity would be weaker in ESG funds than in non-ESG funds.

The disposition effect, an irrational investment behavior, may differ depending on the fund performance for several reasons. First, if a positive fund performance is realized, investors would realize the profits (sell-off) earlier as the fund performance volatility increases. Thus, a negative (−) correlation is expected to exist between the fund flow and the volatility. On the contrary, if a negative fund performance is realized, they would keep holding it as the fund performance volatility increases. Thus, a positive (+) correlation is expected between the fund flow and the volatility. Therefore, the correlation between the fund flow and fund performance volatility will appear asymmetric, according to the type of the fund performance. However, the asymmetric sensitivity of the ESG funds would be weaker than that of the non-ESG funds.

> Hypothesis 4: The fund flow-volatility sensitivity would be asymmetric according to fund performance, and the asymmetry would be weaker in ESG funds than in non-ESG funds.

REFERENCE DATA AND RESEARCH METHODS

Reference Data Set

The reference dataset used in this study includes funds classified as ESG funds in the fund-related materials provided by the Korean Fund Ratings (KFR). This information was matched with non-ESG funds with the fund characteristics most similar to them (Korea Fund Ratings [KFR], 2021). The analysis period was 6 years and 7 months (January 2015 to July 2021). The analysis involved examining the status of Korean funds. As of July 2021, the number of ESG funds was 20 and the number of non-ESG funds was 337. The number of ESG funds used in the analysis was 20 and the number of non-ESG funds matched with them was 52. The descriptive statistics are summarized in **Table 1**.

Of all the funds since 2015, 52 non-ESG funds had similar characteristics to those of the experimental group. The ESG funds were matched to extract them as a control group. The extraction process is presented in **Figure 2**.

Empirical Model

Measurement of Performance Benchmarks

The funds used in the analysis are samples of a minimum of 12 months of performance data. The estimation is made using the average of the 12-month return of the fund for the past 12 months ($Return_{[t-1,t-12]}$), the average of the market-adjusted return ($r_t - r_t^m$), and the average of the CAPM-adjusted return.

$$r_t - r_{f,\ t} = \alpha_1 + \beta_{MKT}\left(r_t^m - r_{f,\ t}\right) + \in_t \quad (1)$$

Where: r_t is the monthly return of the fund; r_t^m is the market-adjusted return during the period; and $r_{f,\ t}$ is the risk-free rate.

Method of Matching Non-Environmental, Social and Corporate Governance Funds With Environmental, Social and Governance Funds

To extract a control group under conditions similar to the experimental group, the propensity score matching methodology, proposed by Rosenbaum and Rubin (1983), was utilized. The propensity score of the variables that may affect business performance was calculated with a Probit Regression for 1:1 matching. The control group had a propensity score closest to that of the experimental group (Nearest Neighbor Matching).

To match the non-ESG funds with similar characteristics to those of the Korean ESG funds, the score is calculated based on the year of the fund, the size of the assets operated, and one CAPM factor. The three non-ESG funds having the smallest difference in the score were selected for the individual ESG fund.

$$Score(a)_{i,\ j} = \frac{\left(AUM_i - AUM_j\right)^2}{\sigma_{AUM}^2} + \frac{\left(\beta_i - AUM_j\right)^2}{\sigma_{AUM}^2} \quad (2)$$

TABLE 1 | Descriptive statistics on reference data set.

Panel A: All funds						
Variable	***N***	**Mean**	**Std. Dev**	**Min**	**Max**	**Median**
AUM (hundred million)	5,582	216.5	422.0	0.0	4799.2	48.7
Flow	5,582	0.396	8.176	−96.399	462.417	0.261
Raw return	5,582	−0.244	4.965	−74.202	97.391	−0.240
MKT-Adj return	5,582	−1.105	7.574	−80.524	95.751	−0.830
CAPM-Adj return	5,582	−0.258	4.966	−74.218	97.376	−0.254
Raw return volatility	4,521	4.269	2.231	1.123	30.224	3.977
MKT-Adj return volatility	4,521	7.359	2.925	1.595	30.333	6.805
CAPM-Adj return volatility	4,521	4.269	2.231	1.123	30.224	3.977
Age	5,582	13.24	4.84	2.00	23.00	15.00
Remuneration Rate (%)	5,582	1.42	0.39	0.21	2.00	1.53
Panel B: (ESG) funds						
Variable	***N***	**Mean**	**Std. Dev**	**Min**	**Max**	**Median**
AUM (hundred million)	1,292	108.7	242.6	0.0	2248.9	35.1
Flow	1,292	0.535	13.786	−14.603	462.417	0.136
Raw return	1,292	−0.104	4.819	−43.323	14.760	0.038
MKT-Adj return	1,292	−1.047	7.412	−43.428	22.755	−0.737
CAPM-Adj return	1,292	−0.117	4.820	−43.332	14.753	−0.054
Raw return volatility	1,019	4.283	1.752	1.497	8.590	4.182
MKT-Adj return volatility	1,019	7.360	2.643	2.085	12.324	6.899
CAPM-Adj return volatility	1,019	4.283	1.752	1.497	8.591	4.181
Age	1,292	12.96	5.33	2.00	21.00	14.00
Remuneration rate (%)	1,292	1.48	0.35	0.67	2.00	1.64
Panel C: Non-ESG funds						
Variable	***N***	**Mean**	**Std. Dev**	**Min**	**Max**	**Median**
AUM (hundred million)	4,290	108.7	242.6	0.0	2248.9	35.1
Flow	4,290	0.535	13.786	−14.603	462.417	0.136
Raw return	4,290	−0.104	4.819	−43.323	14.760	0.038
MKT-Adj return	4,290	−1.047	7.412	−43.428	22.755	−0.737
CAPM-Adj return	4,290	−0.117	4.820	−43.332	14.753	−0.054
Raw return volatility	3,502	4.283	1.752	1.497	8.590	4.182
MKT-Adj return volatility	3,502	7.360	2.643	2.085	12.324	6.899
CAPM-Adj return volatility	3,502	4.283	1.752	1.497	8.591	4.181
Age	4,290	12.96	5.33	2.00	21.00	14.00
Remuneration rate (%)	4,290	1.48	0.35	0.67	2.00	1.64

*In **Table 1**, Asset Under Management (AUM) is fund size; Flow, fund flow; Raw return, the average of returns over the previous 12 months; MKT-Adj return, the average of market-adjusted return over the previous 12 months; CAPM-Adj return, the average of CAPM-adjusted returns over the previous 12 months; Raw return volatility, the volatility of raw returns over the previous 12 months; MKT-Adj return volatility, the volatility of market-adjusted returns over the previous 12 months; CAPM-Adj return volatility, the volatility of CAPM-adjusted returns over the previous 12 months; Age, the history of the fund shown by the number of years; and Remuneration rate.*

Where Asset Under Management (AUM) is the size of the assets operated by the fund at the end of Month t; i refers to the ESG fund; and j refers to the non-ESG fund.

Fund Flows

According to the previous studies, there are various definitions of fund flow and methods for measuring that. In this study, the net change in fund assets is defined as fund flows. The fund flow that reflects money inflow and outflow is calculated using Eq. (3) (Sirri and Tufano, 1998).

$$Flow_{i,\ j} = \frac{AUM_{i,\ t} - AUM_{i,\ t-1}\ (1 + r_{i,\ t})}{\sigma^2_{AUM}} \tag{3}$$

Analysis Model for the Determinants of Fund Flow

A comparison of ESG fund investors with non-ESG fund investors to determine whether or not they had a relatively weaker fund flow–investment performance sensitivity was assumed through the regression equation in Eq. (4).

$$Flow_{i,t} = \gamma_0 + \beta_1 Return_{i,\ [t-1,\ t-12]} + \beta_2 Return_{i,\ [t-1,\ t-12]} \times$$

$$ESG_i + \gamma_1 Controls_{i,\ t-1} + u_{i,\ t} \tag{4}$$

Where, $Flow_{i,t}$ is money flows in Month t of Fund i measured with Eq. (3) above presented; $Return_{i,\ [t-1,\ t-12]}$ is the average of the monthly rate of return of Fund i from $t-1$ month

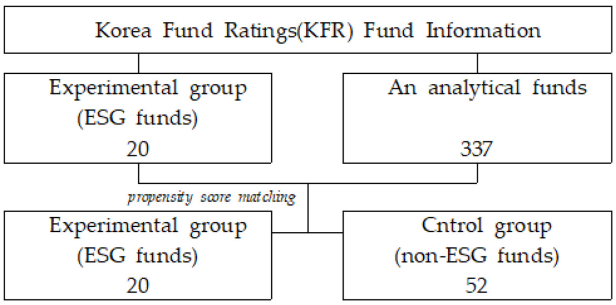

FIGURE 2 | The sampling process.

through $t-12$ months (or that of market-adjusted return or CAPM-adjusted return); dummy variable is indicated as $\begin{cases} if\ ESG\ fund = 1 \\ otherwise = 0 \end{cases}$; and Controls are measured with the fund characteristics, including size, age, fee, volatility of the rate of return, and front-end fee dummy as the major control variables. It was assumed that fund investors decide fund investment, considering other factors, such as the fund size, history, fee structure, fund performance volatility, and seller/operator reputation risk in addition to the past rate of return of the fund.

To analyze whether or not ESG funds are less sensitive to negative returns than non-ESG funds, we conducted the regression in Eq. (5).

$$Flow_{i,t} = \gamma_0 + \left(\beta_1 R^+ + \beta_2 R^-\right) Return_{i,\,[t-1,\,t-12]} + \left(\beta_3 R^+ + \beta_{24} R^-\right)$$

$$Return_{i,\,[t-1,\,t-12]} \times ESG_i + \ \gamma_1 Controls_{i,\,t-1} + u_{i,\,t} \qquad (5)$$

Where: R^+ and R^- are dummy variables having a value of 1 if the monthly rate of return of the fund (or market-adjusted return or CAPM-adjusted return) is a positive (+) value or a negative (−) value, respectively. In Eq. (5), regression coefficients β_1 and β_2 represent the sensitivity of the fund flow to the positive (+) average raw return in comparison with that of the previous year and the sensitivity of the fund flow to the negative (−) average raw return for non-ESG fund, respectively. The regression coefficients β_3 and β_4 represent the sensitivity of the fund flow to the positive (+) average raw return and the sensitivity of the fund flow to the negative (−) average raw return for ESG funds, respectively.

The correlation between the fund performance volatility and fund flow is analyzed in Eq. (6).

$$Flow_{i,t} = \gamma_0 + \beta_1 Vol_{i,\,[t-1,\,t-12]} + \beta_2 Vol_{i,\,[t-1,\,t-12]} \times$$

$$ESG_i + \ \ \gamma_1 Controls_{i,\,t-1} + u_{i,\,t} \qquad (6)$$

Where: $Vol_{i,\,[t-1,\,t-12]}$ represents the standard deviation of the monthly rate of return of Fund i from month $t-1$ through months $t-12$ (or the market-adjusted return or CAPM-adjusted return). Finally, according to the fund's past performance, the difference between the asymmetry of the sensitivity between the fund performance volatility and the fund flow and the asymmetry of the sensitivity between the ESG funds and non-ESG funds is estimated in Eq. (7).

$$Flow_{i,t} = \gamma_0 + \left(\beta_1 R^+ + \beta_2 R^-\right) Vol_{i,\,[t-1,\,t-12]} + u_{i,\,t} \qquad (7)$$

Where regression coefficients β_1 and β_2 represent the fund flow sensitivity to the volatility of the rate of return of non-ESG funds that realized a positive (+) average raw return in comparison with that of the previous year and the fund flow sensitivity to the volatility of the rate of return of the non-ESG funds that realized a negative (−) average raw return, respectively.

RESULTS OF EMPIRICAL ANALYSIS

The empirical analysis yielded several important results. First, the whole fund flow–performance sensitivity was analyzed. This included investigating whether or not ESG fund investors had weaker fund flow–performance sensitivity than non-ESG fund investors. Eq. (4) was used to test this; the results are presented in **Table 2**. Here, Panel A measured the fund performance with the average raw return over the previous 12 months and analyzed the fund flow–performance sensitivity. The entire sample had a negative (−) correlation between fund flow and fund performance. In other words, the lower the fund performance, the more the monetary outflow of the fund. The lower samples were analyzed by dividing the funds into the ESG fund and the non-ESG fund. The results show the same negative (−) sensitivity. In addition, no big difference in the sensitivity existed. Panels B and C examined the sensitivity between the fund flow and fund performance measured with the market-adjusted return and CAPM-adjusted return. This also had a negative (−) correlation, contrary to the results of previous studies showing a positive (+) correlation between fund flow and fund performance.

A regression equation was used to test Hypothesis 1. A dummy variable was added to show whether or not it is an ESG fund. The regression equation included return rate volatility and fund characteristics. The results are presented in **Table 3**. Models (1) and (2) used the raw return. Models (3) and (4) used the Market-Adjusted Return as the fund performance. Models (5) and (6) measured the CAPM-Adjusted Return as the fund performance. There was a significant negative (−) correlation found between the fund flow and the fund performance. However, the ESG fund did not affect the fund flow, unlike what was expected. This result dismisses Hypothesis 1 and is consistent with the results in Wee et al. (2020). In other words, the monetary flow is not affected by whether Korean funds are set up as an ESG or not (Wee et al., 2020).

Fund volatility had significant positive (+) impacts on the dependent variable in Model (2), where fund volatility was measured by the raw return volatility. Model (6) measured fund volatility with the CAPM-adjusted return volatility. It had a significant negative (−) impact in Model (4), which measured it with a market-adjusted return. In other words, the raw return and CAPM-adjusted return result in an increase in fund flow with larger volatility. The market-adjusted return yields an increase in fund flow with smaller volatility. This result suggests that

TABLE 2 | Fund flow–performance sensitivity comparison.

CL.	All funds	ESG funds	Non-ESG funds
Panel A			
Raw return	−0.970*** (−54.42)	−0.963*** (−12.84)	−0.972*** (−129.31)
N	5,582	1,292	4,290
R^2	0.35	0.11	0.80
F	2,961.362	164.827	16,722.197
Panel B			
MKT-Adj return	−0.401*** (−29.86)	−0.371*** (−7.30)	−0.409*** (−45.63)
N	5,582	1,292	4,290
R^2	0.14	0.04	0.33
F	891.529	53.341	2,082.368
Panel C			
CAPM-Adj return	−0.969*** (−54.42)	−0.963*** (−12.84)	−0.972*** (−129.32)
N	5,582	1,292	4,290
R^2	0.35	0.11	0.80
F	2,961.359	164.827	16,722.419

Table 2 *is the result of comparing the fund flow–performance sensitivity. The dependent variable is fund flow, Raw return is the average of returns over the previous 12 months; MKT-Adj return, the market-adjusted returns over the previous 12 months; CAPM-Adj return, CAPM-adjusted return over the previous 12 months. The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

TABLE 3 | Fund flow–fund characteristics sensitivity.

CL.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Raw return	−0.971*** (−48.21)	−0.992*** (−381.82)				
Raw return×ESG	0.007 (0.16)	0.001 (0.16)				
Raw return volatility		0.025*** (3.99)				
MKT-Adj_Return			−0.408*** (−26.90)	−0.428*** (−50.99)		
MKT-Adj_Return×ESG			0.034 (1.06)	0.017 (0.96)		
MKT-Adj return volatility				−0.038** (−2.09)		
CAPM-Adj return					−0.971*** (−48.21)	−0.992*** (−381.80)
CAPM-Adj return×ESG					0.007 (0.16)	0.001 (0.17)
CAPM-Adj return volatility						0.026*** (4.04)
Size		−0.006 (−1.33)		0.004 (0.18)		−0.006 (−1.33)
Age		−0.006* (−1.81)		0.020 (1.27)		−0.006* (−1.85)
Remuneration rate		0.025 (0.63)		−0.054 (−0.28)		0.025 (0.64)
Fee dummy		−0.013 (−0.55)		0.015 (0.12)		−0.013 (−0.56)
N	5,582	4,521	5,582	4,521	5,582	4,521
R^2	0.35	0.98	0.14	0.42	0.35	0.98
F	1,480.435	26,284.837	446.335	467.362	1,480.433	26,281.104

Table 3 *is the result of regression (OLS) analysis on the sensitivity of fund flow–fund characteristics. The dependent variable is fund flow. Raw return is the average of returns over the previous 12 months; MKT-Adj return, the market-adjusted returns over the previous 12 months; CAPM-Adj return, CAPM-adjusted return over the previous 12 months; Raw return volatility, the volatility of raw return over the previous 12 months; MKT-Adj return volatility, the volatility of the market-adjusted returns over the previous 12 months; CAPM-Adj return volatility, the volatility of CAPM-adjusted returns over the previous 12 months; ESG, a dummy that shows whether it is an ESG fund; Size, the natural logarithm of the size of the assets operated by the fund; Age, the age; Remuneration rate, the natural logarithm of a fee; and Fee dummy, the front-end fee dummy. The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

fund flow–performance sensitivity may differ depending on the method used to measure fund performance.

We applied Eq. (5) to test Hypothesis 2. Hypothesis 2 focused on whether or not the sensitivity between the fund flow and fund performance would be asymmetric, according to the type of the fund's past performance (i.e., positive and negative). This asymmetric sensitivity would also be weaker in ESG funds than in non-ESG funds. The results are summarized in **Table 4**. It was determined that a positive fund performance yields a (non)significant positive (+) fund flow–performance sensitivity, while a negative fund performance yields a (non)significant negative (−) fund flow–performance sensitivity. For Korean funds, the interaction between fund flow and fund performance was found to be significantly negative (−), regardless of fund performance, contrary to the expectation.

TABLE 4 | Fund flow–performance sensitivity according to the type of past fund performance.

CL.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Raw return×R^+	−0.964** (−29.05)	−0.991*** (−230.40)				
Raw return×R^-	−0.978*** (−30.26)	−0.993*** (−229.18)				
Raw return×R^+ ×ESG	0.016 (0.25)	−0.021** (−2.01)				
Raw return×R^+ ×ESG	0.000 (0.00)	0.018** (2.00)				
Raw return volatility		0.041*** (4.58)				
MKT-Adj_Return×R^+			−0.323*** (−11.51)	−0.382*** (−23.80)		
MKT-Adj_Return×R^-			−0.471*** (−20.84)	−0.461*** (−35.87)		
MKT-Adj_Return×R^+ ×ESG			0.089* (1.67)	0.158*** (4.44)		
MKT-Adj_Return×R^- ×ESG			0.009 (0.23)	−0.071*** (−2.65)		
MKT-Adj return volatility				−0.114*** (−4.60)		
CAPM-Adj return×R^+					−0.964*** (−29.01)	−0.990*** (−230.10)
CAPM-Adj return×R^-					−0.978*** (−30.30)	−0.993*** (−229.44)
CAPM-Adj return×R^+ ×ESG					0.016 (0.25)	−0.022** (−2.03)
CAPM-Adj return×R^- ×ESG					−0.000 (−0.00)	0.018** (2.03)
CAPM-Adj return volatility						0.041*** (4.64)
Size		−0.006 (−1.37)		0.011 (0.49)		−0.006 (−1.36)
Age		−0.006* (−1.83)		0.021 (1.33)		−0.006* (−1.87)
Remuneration rate		0.026 (0.66)		−0.070 (−0.36)		0.026 (0.66)
Fee dummy		−0.014 (−0.57)		0.016 (0.13)		−0.014 (−0.58)
N	5,582	4,521	5,582	4,521	5,582	4,521
R^2	0.35	0.98	0.14	0.43	0.35	0.98
F	740.011	20,465.331	228.930	373.756	740.011	20,462.784

Table 4 *is the result of regression analysis (OLS) of fund flow–performance sensitivity according to the type of past fund performance. The dependent variable is fund flow. Raw return is the average of returns over the previous 12 months; MKT-Adj return, the market-adjusted returns over the previous 12 months; CAPM-Adj return, CAPM-adjusted return over the previous 12 months; Raw return volatility, the volatility of raw return over the previous 12 months; MKT-Adj return volatility, the volatility of the market-adjusted returns over the previous 12 months; CAPM-Adj return volatility, the volatility of CAPM-adjusted returns over the previous 12 months; ESG, a dummy that shows whether it is an ESG fund; Size, the natural logarithm of the size of the assets operated by the fund; Age, the age; Remuneration rate, the natural logarithm of a fee; and Fee dummy, the front-end fee dummy. The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

In Models (2) and (6), we examined the interactions between raw return and CAPM-adjusted return by including a dummy variable ESG. The results reveal a negative (−) impact on the dependent variable when it had a positive (+) value and a significantly positive (+) impact when it had a negative (−) value. This means that when the fund's past performance is positive, the fund flow sensitivity decreases in the ESG funds. When it is negative, the sensitivity increases. We examined the interaction between the market-adjusted return and the ESG dummy variable in Models (3) and (4). In reverse, when it had a positive (+) value, there was a significantly positive (+) impact on the dependent variable. When it had a negative (−) value, there was a significantly negative (−) impact. Thus, the results are inconsistent.

In summary, the ESG fund shows asymmetric sensitivity between fund flow and fund performance according to the type of the fund's past performance. With a positive fund performance, the ESG fund sensitivity is much higher (Bollen, 2007). In addition, in both cases, there is a difference in the sensitivity between the ESG and non-ESG funds.

Table 5 presents the results of an analysis conducted on the difference in the sensitivity between fund flow and performance volatility between the ESG and non-ESGs funds using Eq. (6) Hypothesis 3. The results reveal that regardless of the method for measuring past performance and whether it is an ESG fund or not, fund performance volatility and fund flow had a negative (−) correlation. Hence, the lower the investors' fund performance volatility, the lower their awareness of the risk becomes, and the higher their expected performance becomes. Thus, they postpone the act of liquidating the fund, and the monetary outflow decreases.

The previous analysis showed a similar result when the interaction variable between performance volatility and the ESG dummy was added to the entire sample. In **Table 6**, to examine the result of the analysis of Models (1), (2), (5), and (6) in the ESG funds, it is noted that there is a negative (−) interaction between performance volatility and fund flow. This is a result following the positive feedback trading according to the financial factors, which is quite different from the ground for the original hypothesis setting. Consequently, Hypothesis 3 was dismissed.

It turned out that, of the variables representing the fund properties, the size variable was found to negatively affect the dependent variable. This means that the smaller the fund size, the lower the fund flow sensitivity becomes.

The result of the Hypothesis 4 test on the difference in volatility according to fund flow sensitivity and the quality of fund performance is summarized in **Table 7**. The analysis revealed that the positive fund's past performance consistently

TABLE 5 | Comparison of the fund flow–performance volatility sensitivity.

CL	All funds		ESG funds		Non-ESG funds	
Panel A						
Raw return volatility	−0.441*** (−12.83)	−0.992*** (−420.22)	−0.730*** (−8.05)	−0.994*** (−96.22)	−0.395*** (−10.61)	−0.992*** (−907.57)
Raw return		0.010* (1.87)		0.065** (2.17)		0.002 (0.79)
N	4,521	4,521	1,019	1,019	3,502	3,502
R^2	0.04	0.98	0.06	0.91	0.03	1.00
F	164.642	91,591.089	64.744	4,956.603	112.577	425,144.247
Panel B						
MKT-Adj return volatility	−0.222*** (−8.38)	−0.422*** (−57.14)	−0.291*** (−4.74)	−0.405*** (−24.83)	−0.207*** (−7.03)	−0.426*** (−51.55)
MKT-Adj_Return		−0.173*** (−8.56)		−0.232*** (−4.78)		−0.160*** (−7.21)
N	4,521	4,521	1,019	1,019	3,502	3,502
R^2	0.02	0.43	0.02	0.39	0.01	0.44
F	70.288	1,693.052	22.448	326.240	49.465	1,372.208
Panel C						
CAPM-Adj return volatility	−0.441*** (−12.83)	−0.992*** (−420.18)	−0.730*** (−8.05)	−0.994*** (−96.21)	−0.395*** (−10.61)	−0.992*** (−907.95)
CAPM-Adj return		0.011** (2.03)		0.066** (2.23)		0.003 (1.10)
N	4,521	4,521	1,019	1,019	3,502	3,502
R^2	0.04	0.98	0.06	0.91	0.03	1.00
F	164.653	91,576.132	64.745	4,955.576	112.584	42,549.066

Table 5 *is the result of comparing fund flow–performance volatility sensitivity. The dependent variable is fund flow. Raw return is the average of returns over the previous 12 months; MKT-Adj return, the market-adjusted returns over the previous 12 months; CAPM-Adj return, CAPM-adjusted return over the previous 12 months; Raw return volatility, the volatility of raw return over the previous 12 months; MKT-Adj return volatility, the volatility of the market-adjusted returns over the previous 12 months; CAPM-Adj return volatility, the volatility of CAPM-adjusted returns over the previous 12 months; The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

TABLE 6 | Fund flow–performance volatility sensitivity.

CL.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Raw return volatility	−0.429*** (−12.32)	−0.451*** (−12.64)				
Raw return volatility×ESG	−0.085** (−2.16)	−0.104*** (−2.60)				
MKT-Adj return volatility			−0.216*** (−8.06)	−0.222*** (−8.14)		
MKT-Adj return volatility×ESG			−0.031 (−1.30)	−0.035 (−1.46)		
CAPM-Adj return volatility					−0.429*** (−12.32)	−0.451*** (−12.64)
CAPM-Adj return volatility×ESG					−0.085** (−2.16)	−0.104*** (−2.60)
Size		−0.080*** (−2.74)		−0.038 (−1.28)		−0.080*** (−2.74)
Age		−0.009 (−0.44)		0.002 (0.07)		−0.009 (−0.44)
Remuneration rate		0.062 (0.25)		−0.052 (−0.21)		0.062 (0.25)
Fee dummy		−0.021 (−0.13)		−0.005 (−0.03)		−0.021 (−0.13)
N	4,521	4,521	4,521	4,521	4,521	4,521
R^2	0.04	0.04	0.02	0.02	0.04	0.04
F	84.721	29.637	35.991	12.289	84.726	29.639

Table 6 *is the result of analyzing fund flow–performance volatility sensitivity. The dependent variable is fund flow. Raw return volatility, the volatility of raw return over the previous 12 months; MKT-Adj return volatility, the volatility of the market-adjusted returns over the previous 12 months; CAPM-Adj return volatility, the volatility of CAPM-adjusted returns over the previous 12 months; ESG, a dummy that shows whether it is an ESG fund; Size, the natural logarithm of the size of the assets operated by the fund; Age, the age; Remuneration Rate, the natural logarithm of a fee; and Fee Dummy, the front-end fee dummy. The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

had a negative (−) impact on the fund flow, while the negative past performance had a positive (+) impact on it in all samples of Panels A–C. Since the expected performance is high when the past performance of a fund is positive, fund flow sensitivity is low. Since the expected performance is low when the fund's past performance is negative, the sensitivity is high. This result partially supports Hypothesis 4. Therefore, the sensitivity between fund flow and performance volatility is asymmetric according to the quality of the fund's performance. However, there is little difference between the ESG fund sensitivity asymmetry and the non-ESG fund sensitivity asymmetry.

CONCLUSION

Rational investors make investments based on risk appetite and the fund's past performance. In other words, they expect a positive (+) correlation between the fund's previous returns and

TABLE 7 | Comparison of fund flow–performance volatility sensitivity according to the type of past fund performance.

CL.	All funds	ESG funds	Non-ESG funds
Panel A			
Raw return volatility×R^+	−0.919*** (−33.42)	−0.938*** (−13.48)	−0.910*** (−30.19)
Raw return volatility×R^-	0.486*** (15.77)	0.543*** (6.50)	0.475*** (14.31)
N	4,521	1,019	3,502
R^2	0.44	0.45	0.44
F	1,779.480	422.831	1,358.093
Panel B			
MKT-Adj return volatility×R^+	−0.531*** (−26.53)	−0.540*** (−11.75)	−0.529*** (−23.76)
MKT-Adj return volatility×R^-	0.371*** (17.20)	0.367*** (7.27)	0.372*** (15.58)
N	4,521	1,019	3,502
R^2	0.47	0.47	0.47
F	2,020.943	449.263	1,570.108
Panel C			
CAPM-Adj return volatility×R^+	−0.918*** (−33.39)	−0.936*** (−13.45)	−0.910*** (−30.17)
CAPM-Adj return volatility×R^-	0.486*** (15.79)	0.545*** (6.52)	0.470*** (14.32)
N	4,521	1,019	3,502
R^2	0.44	0.45	0.44
F	1,778.305	422.448	1,357.286

Table 7 *is the result of comparing the fund flow–performance volatility sensitivity according to the type of past fund performance. The dependent variable is fund flow. Raw return is the average of returns over the previous 12 months; MKT-Adj return, the market-adjusted returns over the previous 12 months; CAPM-Adj return, CAPM-adjusted return over the previous 12 months; is the positive value for the raw return, MKT-Adj return, CAPM-Adj return, respectively, is the negative value for the raw return, MKT-Adj return, CAPM-Adj return, respectively, The content of the table is the regression coefficient value; the figure in parentheses, t-value; and ***, **, and * means that each is significant, respectively, at 1, 5, and 10%.*

the fund flow. However, ESG fund investors reflect upon other non-financial factors (e.g., the purpose of the fund investment, size, age, return volatility, and fee structure), rather than just on the fund's previous returns. Thus, it is expected that ESG fund investors would have weaker fund performance–fund flow sensitivity than non-ESG fund investors.

This study analyzed the sensitivity between Korean fund flow and fund performance. We examined whether there were differences in the sensitivity between ESG funds and non-ESG funds. We also examined the sensitivity according to the type of fund's past performance (i.e., positive and negative). In addition, this study analyzed the correlation between the fund flow–performance volatility to check the fund flow–past performance interaction and asymmetry and the difference in the sensitivity between ESG and non-ESG funds.

The primary results of the empirical analysis are as follows. First, it is noted that there is a negative (−) correlation between Korean fund flow and fund performance. Furthermore, unlike what was expected, in ESG funds, there was no impact on fund flow. This implies that fund flow is more sensitive when Korean funds have a poor return. Whether it is ESG or not does not affect the fund flow. On the other hand, the fund volatility showed different sensitivity according to the method used to measure the fund's performance.

Second, the analysis of the asymmetry between fund flow and performance sensitivity, according to the type of the fund's past performance, revealed that the fund flow–performance interaction had a negative (−) correlation. This was the case regardless of the quality of the fund's performance. This result was not expected. Hence, the interaction between the fund's past performance and the ESG dummy variable yielded asymmetric sensitivity. The sensitivity of the ESG funds was a little higher when the performance was positive. In the meantime, the analysis of the difference in the sensitivity between fund flow and fund performance volatility, measured by dividing the funds into ESG and non-ESG funds, revealed that fund flow and fund performance volatility had a negative (−) correlation, regardless of the method used for measuring fund performance and whether or not it was an ESG fund. Therefore, the lower the investors' fund performance volatility, the lower their risk awareness and the higher their expected performance. As a result, the less the monetary outflow of the fund becomes. The analysis of the entire sample with the interaction variable between the fund performance volatility and the ESG dummy added yielded negative (−) interactions with fund flow. This result shows that investors are more sensitive to the price than to the purpose of the ESG investment.

Finally, the comparison of fund flow–performance volatility sensitivity according to the type of fund's past performance reveals that it is consistently asymmetric, according to the quality of the fund's performance. However, it is noted that there is almost no difference between the ESG fund sensitivity asymmetry and the non-ESG fund sensitivity asymmetry.

The results deviate from the previous expectations that Korean ESG fund investors would focus more on non-financial properties (e.g., the purpose of investment) than on returns. The general investors' choice of ESG fund is to choose nice companies with good performance, instead of simply investing in good companies. Thus, ESG fund sellers and operators should not overlook the fact that ESG fund investors also attach

importance to fund performance. Hence, they should attract investors through developing various ESG fund products that can continue to create and maintain high performance. This means that the screening of the environment, governance, and social responsibility has not been working when investors choose a fund. This proves that there is still a lack of awareness of ESG despite that receives global attention.

ESG fund selling and management companies to develop ESG fund products that can maintain and create a high performance without overlooking the fact that ESG fund investors, of course, attach importance to fund performance as well in the early stages of ESG funds. However, it would be necessary to induce investors to use related screening as a factor supplementing financial performance by making them more interested in social agendas such as the environment (climate change), fair society, shared growth, ethics, and morality. Since the differing effect of capital inflow according to the type of screening is a kind of the clientele effect, it is necessary to develop ESG fund products with a variety of screening.

It would be necessary to examine the relationship between the ESG fund performance and the fund flow once again in the future and check if there is any change if the data are accumulated as ESG funds become more generalized after the awareness of ESG grows further, and investors become more interested in the practical properties of ESG funds.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

DK: conceptualization and investigation. YK: data curation and resources. IK: formal analysis, writing – original draft, and methodology. DK and YK: writing – review and editing. All authors have read and agreed to the published version of the manuscript.

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Key Subordinate Executive Governance, CEO Overconfidence, and Accounting Conservatism: From the Perspective of Sustainable Development

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Key subordinate executives play the role of connecting superiors and subordinates within the top management team (TMT). Based on the heterogeneity of TMT preference, this article takes the data of Chinese A-share listed companies from 2010 to 2019 as a sample to examine whether key subordinate executive governance can affect the short-sighted behavior of CEOs. The empirical result shows that there is a positive relationship between key subordinate executive governance and accounting conservatism, and CEO overconfidence can positively moderate the relationship. The study also shows that there is a significant positive relationship between key subordinate executive governance and accounting conservatism in private enterprises and enterprises with high market competition, that is, the key subordinate executives of these two types of enterprises can better enhance the conservatism under the stimulation of CEO overconfidence. This study contributes to the literature by examining how key subordinate executives affect accounting conservatism and link the prudential attitude of key subordinate executives with the behavioral tendency of CEO overconfidence, which has managerial implications for improving the power balance mechanism of TMT and strengthening the human resource incentive of key subordinate executives.

Keywords: internal governance, TMT, overconfidence, sustainable development, accounting conservatism

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INTRODUCTION

The agency theory states that the operator has different interest appeal and opportunistic behavior tendencies from the owner (Fama and Jensen, 1983). The core of corporate governance aims to solve the agency problem of such interest heterogeneity and form a supervision and restraint mechanism based on investors' interests (Berle and Means, 1932; Armstrong et al., 2010). However, existing research on corporate governance tends to regard the top management team (TMT) as a homogenous subject. In other words, the individual characteristics of the CEO represent the overall characteristics of the TMT to carry out research. The upper echelon theory argues that there are differences in age, tenure, and other demographic characteristics in the TMT (Hambrick and Mason, 1984), which lead to different value orientations among team members. The theory of team production points out that what a team provides is the product of the whole team, not the marginal product of a single member (Alchian and Demsetz, 1972). The heterogeneity of

TMT will affect the decision-making process and results (Nielsen and Nielsen, 2013). Under the joint influence of previous theory, TMT is a collective organization, which not only has interest competition but also needs mutual assistance. Meanwhile, key subordinate executives, as the direct deputies of the CEO, are expected to become the CEO's successor. As a result, there are different career development opportunities between the candidate and incumbent, which lead to varying preferences for company value. The CEO, especially the outgoing CEO, pays more attention to the short-term performance of the company, while key subordinate executives, especially young and promising key subordinate executives, pay more attention to the long-term value of the company (Acharya et al., 2011). Therefore, based on the promising career prospects and ability to restrain team decision-making, key subordinate executive governance is a governance mechanism that check and balance the CEO's short-sighted behavior.

Accounting conservatism is not only an important requirement for the quality of accounting information, but also a key tool for the company's sustainable development. By not overestimating income or underestimating loss, it cautiously confirms an accounting element, alleviates the damage caused by information asymmetry to the investor (Watts, 2003), and maintains the sustainability of performance to support corporate value. The CEO is the direct leader of the company's operation, and the view of hierarchical authority under the Confucian tradition easily gives rise to the overconfidence of the CEO (Jiang et al., 2009), while the psychological characteristics of the CEO often determine the strategic decisions of the company (Chen et al., 2019). Malmendier and Tate (2008) pointed out that an overconfident manager is optimistic about corporate performance. An overconfident CEO, in turn, understates losses and overstates earnings, undermining accounting conservatism. Therefore, this kind of self-serving psychological behavior of the CEO leads the company to pursue short-term performance indicators, which violates the requirements of accounting conservatism and damages the long-term stable development of the company. For key subordinate executives who pay more attention to the long-term value of the company, it is bound to trigger the counterbalance to CEO overconfidence, thus forming the governance mechanism of key subordinate executives to the CEO.

This article has the following research contributions. First, this article improves the measurement of key subordinate executive governance. In the previous literature, the subordinate executive governance was generally measured from the perspective of age and salary (Cheng et al., 2016), it is believed that longer career prospects and contribution ability to the company could reflect the subordinate executive governance. However, these studies fail to consider a more substantive perspective, that is, corporate promotion mechanism and executive restraint mechanism. Based on institutional promotion incentives and practical supervision ability, this article extends the measurement indicators of key subordinate executive governance. Second, this article refines the subject of key subordinate executives. The subordinate executives involved in the previous literature are generally defined as the top four non-CEO executives (Jain et al., 2016). However, these studies overlook the special status of vice president (VP) after CEO. In this article, the key subordinate executives are defined as VPs, which improve the accuracy of the governance mechanism of key subordinate executives. Third, this article expands the governance role of key subordinate executives. Previous literature studies show that subordinate executives have governance effects on stock liquidity, earning management, and corporate social responsibility (Chen and Zhou, 2016; Cheng et al., 2016; Jain et al., 2016). However, it has not been examined how the subordinate executive governance affects accounting conservatism. This article links the cautious mentality of subordinate executives and the overconfident behavior tendency of the CEO to extend the research on the governance role of subordinate executives.

The remainder of this study is organized as follows. Section Literature Review and Hypotheses reviews the related literature and develops hypotheses. Section Research Design introduces sample selection, defines variables, and explains the empirical model. Section Empirical Results reports empirical examination results. Section Discussion offers research conclusions, summarizes contributions, and discusses implications and limitations.

LITERATURE REVIEW AND HYPOTHESES

Key Subordinate Executive Governance

According to the Upper Echelons Theory proposed by Hambrick and Mason (1984), there are demographic differences among members of the TMT, such as age and gender, which also constitute the heterogeneity of the benefit orientation of team members. The heterogeneity determines the existence of cooperation and complementarity as well as restriction and supervision among the internal members of TMT. It requires both wise leadership from the CEO and a strong execution from the subordinate executive. At the same time, the subordinate executives, as potential CEO successors, have longer careers and are more focused on the long-term development of the company than the elder, outgoing CEO. As a result, the CEO is relatively focused on short-sighted interests, while key subordinate executives are relatively focused on far-sighted values. Fama (1980) pointed out that the effectiveness of the separation of ownership and operation right in modern companies lies in the combination of external and internal governance of the TMT, and there is a bidirectional supervision mechanism of top-down and bottom-up in the company. Acharya et al. (2011) proposed the concept of internal governance of the TMT, and regarded the TMT as an aggregate of different career visions and interest appeals. Jain et al. (2016) made it clear that this form of key subordinate executive governance is a bottom-up corporate governance mechanism. Cheng et al. (2016) further pointed out that subordinate executives would exert an influence on the CEO and urge them to restrain the tendency of short-sightedness and make decisions in line with long-term values, which construct the governance role for the CEO through supervision motivation and supervision ability.

The motivation of key subordinate executives to supervise the CEO is derived from the seniority order. As the leader of

the TMT, the CEO is usually more senior and older than the subordinate executive. On the contrary, younger subordinates have a career advancement advantage over the CEO (Baker et al., 1988). Promotion of position is the incentive system under the concept of rank. Based on the psychological contract theory, employees have important expectations for job promotion (Morrison and Robinson, 1997). Possible job promotion in the future will greatly promote key subordinate executives to actively engage in their work and safeguard the interests of the company. Dencker (2009) pointed out that the psychological expectation that job promotion would bring higher returns drove subordinates to increase their work involvement. A good internal promotion mechanism in the company indicates that there are greater opportunities for promotion in the future, which potentially motivates subordinate executives to work hard and pay more attention to the long-term interests of the company. According to the tournament theory, the perceived probability of promotion is positively correlated with the effort invested to win the tournament (Kale et al., 2009). Key subordinate executives are the first echelon in the TMT to achieve generational change. They have a higher probability of being promoted to CEO and bring more incentive intensity than other members of the team. When key subordinate executives perceive higher promotion opportunities, the trophy incentive effect will promote them to improve risk-taking and corporate performance (Kato and Long, 2011; Kini and Williams, 2012). Therefore, key subordinate executives would pay more attention to the long-term interests of the company when there is a promising prospect within the company, i.e., when they have the opportunity to take over as CEO in the future.

Subordinate executives not only have the incentive to supervise the CEO but also have the actual ability to supervise the CEO (Acharya et al., 2011). Hambrick (1994) defined the behavioral integration of the TMT. The decision-making behavior within the team is not a one-way order but a two-way system of sharing and cooperation. On one hand, the CEO's current benefits depend on current cash flow, which is affected by the effort of the subordinate executive. As a result, if the CEO does' not consider the preferences of his subordinate executive when making decisions about how to run the company, his subordinate executive will probably not work hard. It is bound to reduce the company's current cash flow and CEO welfare, which Landier et al. (2009) call "executive constraints." The essence of enterprise operation is team production (Alchian and Demsetz, 1972). TMT needs overall cooperation to achieve the output to the outside world. The realization of executive team creativity is also a process of collective effort and consideration of various opinions (Rong and Wang, 2021). As the direct deputy of the CEO, key subordinate executives play an important role in conveying and executing the orders made by the CEO. The CEO and key subordinate executives are the top two levels in the TMT, and their effective cooperation is essential for the smooth operation of the company. The CEO should not only rely on the information provided by his subordinates, but also consider 'subordinates' interests and preferences when making business decisions. If the CEO's decisions are short-sighted, self-serving, and damaging to the long-term value of the company, key subordinate executives focused on the long-term value of the company will not cooperate in the implementation, thus reducing future cash flow and CEO welfare. As a result, the executive team is built on the decisions of the CEO and the execution of key subordinate executives. This collaboration mechanism gives key subordinate executive selective execution space and regulatory execution strength, forming restrictive governance of CEO's self-interested behavior.

Acharya et al. (2011) pointed out that subordinate executives can make the CEO pay attention to far-sighted interests because they have a longer career horizon. Jain et al. (2016) emphasized the important influence of age on individual behavior and future aspirations, and researchers believed that the age difference between CEO and subordinates is key to the internal governance of TMT. Cheng et al. (2016) believed that the relative horizon adopted by Jain et al. (2016) is not accurate enough, and subordinates' own horizon is more important. Then, the supervisory motivation of key subordinate executives is captured by using their remaining career horizons. However, this literature's age-based measures are only part of the governance motivations. Aggarwal et al. (2017) found that when the CEO is an internal successor, key subordinate executives would pay more attention to the corporate long-term interests. Therefore, subordinates' career prospects depend not only on the horizon before retirement, but also on whether the next CEO is selected from within the subordinates. Indeed, this is also consistent with the implication of Acharya et al. (2011), and it is necessary to pay attention to the internal promotion mechanism to improve the governance of subordinate executives. A good internal promotion environment means more continuous institutional incentives, providing key subordinate executives with another part of the governance motivation.

Moreover, regarding the measurement of supervisory ability, Cheng et al. (2016) believed that compensation reflected their structural power within the enterprise, and then adopted the compensation ratio of subordinate executives to CEO to capture supervisory ability. Chen and Zhou (2016) likewise adopted relative salary. Aggarwal et al. (2017) adopted the number of titles to represent the relative contribution of TMT members. However, Acharya et al. (2011) also pointed out that supervision ability lies in subordinates' right to withdraw their contributions to the company. Therefore, how subordinates have supervision ability depends not only on the proportion of personal contributions made by subordinates, but also on the practical restraint ability imposed by subordinates. Antia et al. (2010) believed that tenure can reflect the company-specific experience and knowledge accumulated by executives. Subordinates are important to the daily operation of enterprises (Aggarwal et al., 2017), so that the experience behind subordinates' tenure can affect the practical implementation of CEO decisions. In addition, Finkelstein (1992) pointed out that board membership means the core member of the company, and is responsible for the final decision of the company's policies. As a result, subordinates who are also directors can influence the core content of the CEO's decisions. Subordinate executives can obtain the important supervisory ability to influence decisions based on their personal qualifications and core identities. Such

substantive constraints mean a more effective check-and-balance mechanism, providing another part of the governance ability of key subordinate executives.

In addition, previous literature studies generally defined key subordinate executives as the top four non-CEO executives (Chen and Zhou, 2016; Cheng et al., 2016; Jain et al., 2016). However, VPs have better promotion opportunities and more direct supervision. In the study of Bognanno (2001), the VP is regarded as an important competitor for the CEO position. Lin et al. (2011) listed VP as the second tier of the senior executive after CEO in the research of Chinese listed companies. Subordinate executives have an important influence on company's decision-making (Hambrick and Mason, 1984). Further, the VP is the immediate subordinate of the CEO and reports to the CEO directly, thus having a more direct influence. Therefore, VPs and other subordinate executives are not homogenous subjects, and their key governance position within the TMT has not been paid attention to by existing research on TMT internal governance.

By reviewing and analyzing the previous literature research, the component variables of key subordinate executive governance include the factors of internal promotion environment and practical constraint ability, and the research subject of key subordinate executives is defined as VP, to carry out follow-up research.

Accounting Conservatism

Basu (1997) defined accounting conservatism as the asymmetric recognition of gains and losses. Accounting conservatism is also the principle of prudence. On one hand, the recognition of income is required to be higher than expenses; on the other hand, assets and income should not be overestimated, while liabilities and expenses should not be underestimated (Basu, 1997). Accounting conservatism also promotes the loss of bad news to be included in earnings faster than expected, and the gain of good news to be included in earnings slower than expected (Guay and Verrecchia, 2018). Based on the agency theory, the CEO manipulates earnings to cope with performance pressure and seize a competitive position (Kasznik and McNichols, 2002; Durana et al., 2021), especially upward earnings management for inflated accounting earnings (Cheng et al., 2016). However, the essential characteristics of accounting conservatism can restrain CEO's short-sighted self-interest psychology. Considering this governance function of accounting conservatism (Ball et al., 2000) and as an important representation of corporate agency problems, many scholars have studied accounting conservatism from the perspective of internal governance. Lafond and Roychowdhury (2008) investigated the impact of management shareholding on accounting conservatism. With the decrease of management shareholding, which runs counter to the interests of shareholders, the serious agency problem increases the demand for accounting conservatism of companies. Cullinan et al. (2012) studied accounting conservatism from the perspective of ownership structure based on Chinese samples. The decline of accounting conservatism reflects the aggravation of agency problems of major shareholders. Sultana (2015) focuses on accounting conservatism from the perspective of the audit committee, which can curb the CEO's opportunistic behavior and restrain the CEO's tendency to exaggerate earnings.

Accounting conservatism includes conditional conservatism (CAC) and unconditional conservatism (UCAC). CAC, based on asymmetrical recognition criteria of gains and losses (Ball and Shivakumar, 2005), is a flexible adjustment made in response to changes in external information, so it is also known as *ex-post* conservatism. Beaver and Ryan (2005) pointed out that non-CAC is *ex-ante* conservatism, a conservatism policy that is decided during the initial confirmation of assets and liabilities, that is, before external news emerges. UCAC is an internal institutional setting independent of changes in the external environment. Qiang (2007) pointed out that the perspectiveness of UCAC enables companies to better deal with the arrival of bad news, identify bad news in advance to reduce litigation costs, promote the expensing of R&D expenditures to avoid future impairment, and achieve smooth and stable impairment ahead of bad news. UCAC is also an important part of accounting slack (Beaver and Ryan, 2005), which accelerates the recognition of expenses and delays the recognition of income, creating institutional redundancy space for the company's financial data. Because UCAC is based on the characteristics of the company's internal system, it is also more consistent with the ideological connotation of long-term institutional supervision over CEO by key subordinate executive governance, so this article focuses on UCAC.

Chen and Zhou (2016) pointed out that younger subordinate executives exert an influence on the CEO to restrain the short-sighted behavior of the CEO and promote the CEO to make more far-sighted decisions. In fact, the psychological characteristics of subordinate executives are consistent with the connotation of accounting conservatism. Improving accounting conservatism means timely identification of losses and reducing the uncertainty of future bad news for the company (Kim and Pevzner, 2010), so as to avoid the adverse consequences of future stock price collapse caused by the accumulation of hidden bad news (Kim and Zhang, 2016). Strengthening the accounting conservatism can enhance the certainty of the future development of the company, which is conducive to the sustainable growth of company value. In addition, Cullinan et al. (2012) found that internal power checks and balances could improve accounting conservatism. Therefore, the checks and balances exerted by subordinate executives are conducive to restraining the short-sighted behaviors of the CEO and further improving corporate accounting conservatism.

To seek a bright prospect of personal career, key subordinate executives pay more attention to the future development interests of the company and promote the improvement of corporate accounting conservatism by curbing the short-sighted self-interest behavior of the CEO. Hu et al. (2020) pointed out that managers' awareness of risk avoidance can enhance accounting conservatism. In other words, the higher the governance degree of key subordinate executives, the more supervisory motivation subordinate executives have, and the more likely they are to restrain CEO's short-term aggressive value through subordinate executives' long-term stable value, thus prompting the whole TMT to follow the concept of sustainable accounting

conservatism. Meanwhile, key subordinate executives, who occupy a unique position in TMT, are responsible for directly executing the CEO's decision, so they have the constraint ability of decision execution, and can check and balance the CEO's short-sighted radical opportunistic behavior. Therefore, key subordinate executives not only have a longer career and a more prudent attitude toward accounting information confirmation, but also have the practical implementation constraints ability, thus restraining the CEO's short-sighted behavior of exaggerating earning. Depending on supervisory motivation and supervisory ability, key subordinate executive governance can accelerate the recognition of expenses and delay the recognition of revenue, thus improving corporate accounting conservatism. Based on the above literature review and theoretical analysis, this article puts forward the following research hypothesis:

Hypothesis 1: Key subordinate executive governance is positively related to accounting conservatism.

The Moderating Role of CEO Overconfidence

Agent theory focuses on the self-interested behavior of the CEO and regards them as a completely rational economic person to carry out uniformly optimal behavior. In fact, bounded rationality is hard to avoid (Simon, 1955), and overconfidence is the most common cognitive bias of managers. In the hubris hypothesis proposed by Roll (1986), it is pointed out that managers' overconfidence will overestimate corporate earnings through the study of managers' overconfidence and acquisitions. As the leader of the enterprise operation, compared with ordinary people or subordinate executives, the CEO tends to be overconfident (Cooper et al., 1988; Nofsinger, 2005). Considering that Chinese enterprises will also be influenced by the hierarchical authority concept of Confucian culture, the over-recognition of self-ability brought by the CEO's high status will further strengthen the overconfidence psychology of the CEO (Jiang et al., 2009). Therefore, under the behavior tendency of CEO overconfidence, enterprises confirm in advance or overestimate earnings and delay confirmation or underestimate losses, which aggravates information asymmetry and damages investors' interests.

As an inherent psychological feature, CEO overconfidence is not easy to be accurately captured. Previous literature mainly measures CEO overconfidence based on stock options, and there are two measurement perspectives. From the perspective of delayed execution, the CEO is optimistic about the future prospects of the enterprise and delays the execution of fully exercisable stock options (Campbell et al., 2011; Reyes et al., 2020). From the perspective of over-holding, the CEO has confidence in their own management ability and holds stock options beyond the optimal level (Kim et al., 2016; Schumacher et al., 2020). There are also some literature studies that measure CEO overconfidence based on media reports, and evaluate CEO self-confidence from the description vocabulary of the CEO in mainstream media (Chen et al., 2015; Schumacher et al., 2020). However, based on China's institutional environment, the stock option incentive system is still underdeveloped, and the media's evaluation of CEO is relatively simple and scarce, which makes it difficult to form an effective measure of CEO overconfidence. The measurement method based on CEO's personal characteristics is relatively more stable and reliable. Therefore, this article uses gender, age, educational background, and CEO duality to measure CEO overconfidence (Chen and Chen, 2021).

Subordinate executives are willing to urge the CEO to act in a more far-sighted way (Acharya et al., 2011), thus promoting accounting conservatism in line with sustainable development. However, the CEO has a strong tendency of overconfident behavior (Nofsinger, 2005). Overconfident people have better-than-average psychological effects than others (Cormier et al., 2016), while overconfident managers tend to view the probability of enterprise success with excessive optimism, resulting in overestimating profits and underestimating losses (Heaton, 2002; Malmendier and Tate, 2008). In addition, to maintain personal welfare and seek career stability, the CEO will not timely disclose bad news, such as losses, but actively disclose good news, such as earnings (Kothari et al., 2009). This is contrary to the requirement of accounting conservatism, which emphasizes neither overestimating gains nor underestimating losses. Therefore, the behavior tendency of CEO overconfidence is detrimental to corporate accounting conservatism. In the face of this behavior tendency, key subordinate executives with longer careers need to strengthen the governance level to ensure corporate sustainable development.

CEO overconfidence is a latent cognitive bias, which is not easily identified by the outside world. The external supervision of the company fails to effectively deal with the problem of management overconfidence (Schrand and Zechman, 2012). As a team partner who works directly with the CEO, key subordinate executives are more likely to detect CEO overconfidence and short-sighted behavior tendency. Specifically, when the CEO gradually shows the behavior tendency of overconfidence, exaggerates the accounting income, and grabs the short-term self-interest, key subordinate executives will also strengthen governance and prudence to seek long-term development. The behavior tendency of CEO overconfidence positively stimulates the motivation of key subordinate executives to conduct governance, thus improving the corporate accounting conservatism level under the team rivalry. Therefore, this article proposes the following research hypothesis:

Hypothesis 2: CEO overconfidence positively moderates the relationship between key subordinate executive governance and accounting conservatism. Other conditions being equal, the greater the CEO overconfidence, the stronger the positive relationship between key subordinate executive governance and accounting conservatism.

RESEARCH DESIGN

Sample Selection

In the context of Chinese institutional culture, the CEO tends to form the personal characteristics of overconfidence. At the same time, the fast-growing Chinese economy has promoted the rapid development of Chinese enterprises. The scale of enterprise

TABLE 1 | Definition of variables.

Variable type	Variable name	Quantitative standard	
Dependent variable	UCAC	Non-operating accruals of the current period divided by total assets of the previous period, multiplied by (−1)	
Independent variable	CGI	Supervision motivation	Internal selection tradition of CEO (more than half of the CEO are selected from within the company)
			Setting up the position of EVP
			Internal selection tradition of chairman (more than half of the chairmen are selected from within the company)
			Subordinates career length (remaining years before the subordinates reach the age of 60)
		Supervision ability	The number of subordinate executives concurrently serving as directors
			The number of subordinate executives' positions
			The tenure time of subordinate executives
			salary ratio between subordinates and CEO
Moderating variable	overconfid	CEO's personal characteristics (gender, age, educational level and CEO duality)	
Control variables	size	Log value of corporate total assets	
	lev	Total liabilities scaled by total assets	
	EPS	Ratio of net profit to its number of shares	
	TBQ	Ratio of a company's market value to its total assets	
	PPE	Fixed assets scaled by total assets	
	balance	Ratio of the shares of the second to tenth largest shareholders to the first largest shareholder	
	indep	Proportion of independent directors on the board	
	HHI	Herfindahl-Hirschman index of product market competition	
	insthold	Shareholding ratio of institutional investors	

has expanded, market competition has intensified, and key subordinate executives have become increasingly important to the CEO. Therefore, there are strong conflicts of interest among TMT members of Chinese listed companies, which provide an institutional environment for further research. Therefore, this article selects the data of Chinese A-share (Shanghai and Shenzhen Stock Exchanges) listed companies from 2010 to 2019 as the initial research sample, and the related data of listed companies are mainly from The CSMAR database. ST and *ST companies were excluded, as were financial industry companies, insolvent companies, and industries with less than 10 companies. Additionally, data missing samples were excluded. To eliminate the effect of extreme values, all the continuous variables at the 1st and 99th percentiles were trimmed.

Variable Definitions and Regression Model

Independent Variable: Key Subordinate Executive Governance

Because the deputy general manager has a unique career development status different from other subordinate executives, this article defines key subordinate executives as the direct deputy of the CEO, namely the VP. And, the governance supervision of key subordinate executives is subdivided into two aspects, namely supervision motivation and supervision ability, so that the key subordinate governance mechanism can be better constructed comprehensively, and specific indicators are defined in **Table 1**.

Supervision Motivation

In the aforementioned studies, supervisory motivation is generally measured by the remaining horizon (Cheng et al., 2016). Based on this, this article also considers the internal selection tradition of the CEO, the internal selection tradition of the chairman, and the position setting of executive vice president (EVP) as measurement standards. In addition, as a successor to the CEO position, the EVP often plays a transitional role between the deputy general manager (VP) and the CEO (Xu, 2012), and the position setting of the EVP can effectively encourage the VP to play the role of bottom-up supervision.

Supervision Ability

Supervision ability is generally measured by the ratio of subordinates' compensation to CEO's compensation (Cheng et al., 2016), the contribution of number of titles is considered (Aggarwal et al., 2017). On one hand, high seniority represents the rich company-specific experience owned by subordinates (Antia et al., 2010), on the other hand, the board of directors empowers directors to make decisions (Finkelstein, 1992). Therefore, key subordinate executives have the practical constraints to influence decision-making based on their personal qualifications and core identity. This article also includes the tenure time of key subordinate executives, the number of key subordinate executives concurrently serving as directors.

After that, the continuous variable indicators of key subordinate executive governance are normalized by min-max, which is convenient for subsequent weighting processing. (1) Under the simple weighting method, all indexes are directly added according to equal weights, and then obtained according to their arithmetic average; (2) Under the principal component analysis, each principal component is weighted according to its own contribution rate of variance, and then added to get it; According to the abovementioned assignment method, the comprehensive indexes CGI (*CGI_comp, CGI_pca*) of key subordinate governance are obtained.

Dependent Variable: UCAC

According to the research of related scholars (Givoly and Hayn, 2000; Zhang and Wang, 2013), in this article, the UCAC ($UCAC_{i,t}$) under the vision of cumulative accruals is defined as follows:

$$UCAC_{i,t} = -NOPACC_{i,t}/TA_{i,t-1} \quad (1)$$

$$NOPACC_{i,t} = Total\ Accruals_{i,t} - Operating\ Accruals_{i,t} \quad (2)$$

$$Total\ Accruals_{i,t} + Net\ Income_{i,t} + Depreciation_{i,t} - Cash\ Flow\ from\ Operations_{i,t} \quad (3)$$

$$Operating\ accruals_{i,t} = \Delta Accounts\ Receivable + \Delta Inventories + \Delta Prepaid\ Expenses - \Delta Accounts\ Payable - \Delta Taxes\ Payable \quad (4)$$

In Equation (1), $UCAC_{i,t}$ represents the UCAC in the current period, $NOPACC_{i,t}$ represents the non-operating accruals in the current period, $TA_{i,t-1}$ represents total assets in the prior period. Equations (2)–(4) define nonoperating accruals, total accruals, and operating accruals, respectively.

Moderating Variable: CEO Overconfidence

Key subordinate governance is a kind of continuous and stable institutional supervision, and the VP and CEO are interdependent and the balanced forces in the TMT. Therefore, based on theoretical analysis and institutional environment, this article adopts the personal characteristics of CEO to measure (Chen and Chen, 2021), namely four indicators including gender, age, educational level, and CEO duality, and takes their arithmetic average as the comprehensive score of overconfidence, the details are as follows: (1) Gender, men are more risky than women, variable equal to 1 if the CEO is male, otherwise it is 0; (2) Age, young people are more radical than old people, age is normalized by min-max, and the variable value is between 0 and 1; (3) Educational level, the higher the education level, the more confident they are, variable equal to 1 if the education level of CEO is a bachelor degree or above, otherwise it is 0; (4) CEO duality, if the CEO is also the chairman, show more confidence in their abilities, variable equal to 1 if the CEO concurrently serves as chairman, otherwise it is 0.

Control Variables

According to relevant research on corporate governance, in this article, company size, Tobin's q value, earnings per share, asset-liability ratio, tangible capital intensity, institutional investor shareholding, equity balance, the proportion of independent directors, market competition are selected as control variables, the specific definitions are shown in **Table 1**. In addition, the article also controls the industry fixed effect and year fixed effect, and further conducts clustering processing for individual and year.

TABLE 2 | Descriptive statistics of main variables.

Variable	Mean	p50	Min	Max	SD
UCAC	0.002	0.002	−0.312	0.337	0.094
CGI_comp	0.451	0.461	0.251	0.593	0.077
CGI_pca	0.498	0.502	0.187	0.768	0.126
overconfid	0.665	0.644	0.294	0.938	0.153
State	0.310	0.000	0.000	1.000	0.463
HHI	0.070	0.017	0.008	0.704	0.120

Regression Model

To test Hypotheses 1 and 2, this article constructed regression models (5)–(6) for empirical test:

$$UCAC_{i,t} = \beta_0 + \beta_1 CGI_{i,t} + \beta_2 size_{i,t} + \beta_3 TBQ_{i,t} + \beta_4 EPS_{i,t} + \beta_5 lev_{i,t} + \beta_6 PPE_{i,t} + \beta_7 insthold_{i,t} + \beta_8 balance_{i,t} + \beta_9 indep_{i,t} + \beta_{10} HHI_{i,t} + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (5)$$

$$UCAC_{i,t} = \beta_0 + \beta_1 CGI_{i,t} * overconfid_{i,t} + \beta_2 size_{i,t} * overconfid_{i,t} + \beta_3 TBQ_{i,t} * overconfid_{i,t} + \beta_4 EPS_{i,t} * overconfid_{i,t} + \beta_5 lev_{i,t} * overconfid_{i,t} + \beta_6 PPE_{i,t} * overconfid_{i,t} + \beta_7 insthold_{i,t} * overconfid_{i,t} + \beta_8 balance_{i,t} * overconfid_{i,t} + \beta_9 indep_{i,t} * overconfid_{i,t} + \beta_{10} HHI_{i,t} * overconfid_{i,t} + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (6)$$

In model (5), $UCAC_{i,t}$ represents the UCAC, $CGI_{i,t}$ represents the governance level of key subordinates, and *CGI_comp* is the main variable in principal regression. Moreover, to enhance the robustness of results, *CGI_comp* is replaced by *CGI_pca* and added into regression. Model (6) based on model (5), focuses on the moderating mechanism of CEO overconfidence (*overconfid*), and analyzes the moderating effect whether the company has high CEO overconfidence.

EMPIRICAL RESULTS

Descriptive Analysis

Descriptive statistics of relevant variables of the regression model were conducted in this article, and the statistical results are shown in **Table 2**. In the sample companies, the median and mean values of key subordinate governance indices whether weighted by the simple weighting method (*CGI_comp*) or principal component analysis method (*CGI_pca*) are at the level of 0.5. It shows that in listed companies, the overall level of key subordinate governance tends to be medium, and the range of maximum and minimum values is relatively concentrated and stable. The *UCAC* of the sample companies was positive or negative, which was consistent with the actual situation of the companies.

Correlation Analysis

Table 3 reports the correlation analysis among the main concern variables. Key subordinate governance is positively correlated with accounting conservatism, and CEO overconfidence is positively correlated with accounting conservatism and key

TABLE 3 | Correlation analysis of main variables.

Variable	UCAC	CGI_comp	CGI_pca	overconfid	state	HHI
UCAC	1.000					
CGI_comp	0.048***	1.000				
CGI_pca	0.059***	0.882***	1.000			
overconfid	0.049***	0.097***	0.132***	1.000		
state	−0.084***	−0.236***	−0.196***	−0.127***	1.000	
HHI	0.014**	−0.055***	−0.024***	−0.019**	0.101***	1.000

****, **, and * refer to significance at 1%, 5%, and 10%, respectively.*

TABLE 4 | Key subordinate executive governance and accounting conservatism.

Variables	Dependent variable:UCAC		Dependent variable:CAC	
CGI_comp	0.028**		−0.155	
	(3.06)		(−1.74)	
CGI_pca		0.016**		−0.110
		(2.42)		(−1.66)
State	−0.007**	−0.007**	0.024	0.024
	(−3.20)	(−3.21)	(1.31)	(1.31)
HHI	−0.013	−0.013	−0.008	−0.006
	(−0.86)	(−0.87)	(−0.04)	(−0.03)
Constant	−0.049	−0.043	5.315***	5.297***
	(−1.19)	(−1.03)	(3.54)	(3.51)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	17,742	17,742	13,991	13,991
Adj R^2	0.181	0.181	0.174	0.174

****, **, and * refer to significance at 1%, 5%, and 10%, respectively.*

subordinate governance. The analysis results are close to the previous assumptions. In addition, this article also conducted a variance inflation factor (VIF) test on key subordinate governance and control variables. The VIF value of the independent variables is lower than 10, and there is no collinearity problem among independent variables.

Hypothesis Testing

Regression Analysis of Key Subordinate Governance and Accounting Conservatism

This article adopts the simple weighting method (*CGI_comp*) and principal component analysis (*CGI_pca*) simultaneously, and the key subordinate governance indexes weighted by the two methods were used as the independent variables. Furthermore, the *UCAC* and *CAC* were used as the dependent variables. The regression results of key subordinate governance and unconditional robustness are shown in columns (1) and (2) of **Table 4**. The regression coefficients are 0.028 and 0.016, respectively, and the significance level reaches 5%. Meanwhile, the sign of the regression coefficients is positive. The regression results show that when controlling for other related variables, there is a positive correlation between the key subordinate governance and the unconditional accounting conservatism. This regression result also supports Hypothesis 1. In addition, a comparative study is also carried out between different accounting conservatism. This article studies the relationship between key subordinate governance and CAC. The C-Score model of Khan and Watts (2009) is adopted to measure CAC. The corresponding model (9) was set for a comparative regression test.

$$\frac{EPS_{i,t}}{P_{i,t-1}} = \beta_0 + \beta_1 D_{i,t} + \beta_2 R_{i,t} + \beta_3 D^* R_{i,t} + \varepsilon_{i,t} \quad (7)$$

$$CAC \equiv \beta_3 = \lambda_0 + \lambda_1 Size_{i,t} + \lambda_2 BM_{i,t} + \lambda_3 lev_{i,t} + \varepsilon_{i,t} \quad (8)$$

$$CAC_{i,t} = \beta_0 + \beta_1 CGI_{i,t} + Controls + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (9)$$

$EPS_{i,t}$ represents earnings per share of the current year, $P_{i,t-1}$ represents the closing price of the stock on 1st May of the reporting year; $R_{i,t}$is the annual stock returns calculated from 1st May of the reporting year to 30th April of the current year. If $R_{i,t} < 0$, D is 1; otherwise, it is 0. $size_{i,t}$ is measured by the natural logarithm of the total market value of the firm; $BM_{i,t}$ is the company's current year's price-to-book ratio; $lev_{i,t}$ is the company's debt to asset ratio for the current year; β_3 is to measure the difference between how much earnings reflect bad news and how much earnings reflect good news, β_3 was defined as CAC. Then CAC ($CAC_{i,t}$) was used as the explained variable, and the regression results were shown in columns (3) and (4) of **Table 4**. It is not statistically significant, but the regression coefficient is negatively correlated, indicating that key subordinate governance may also inhibit CAC. Therefore, UCAC is used to analyze accounting conservatism in subsequent studies.

The Analysis of a Moderating Effect of CEO Overconfidence

As previously analyzed, under the influence of bounded rationality, CEO will show the psychological behavior characteristics of overconfidence, and it is easier to recognize revenue in advance or overestimate earning, thus damaging corporate accounting conservatism. As the CEO shows the behavior tendency that damages the long-term value of the company, the key subordinate executives will also strengthen their supervision ability, and form the effect of counterbalancing the CEO's related behavior tendency within the TMT.

Based on the above measures of overconfidence, companies whose overall overconfidence score is higher than the quartile (75%) of the sample are divided into CEO overconfidence group. Companies less than the quartile of the sample (25%) were classified as non-CEO overconfidence group. The independent variable (*CGI_comp*) is the level of key subordinate governance, and the dependent variable is unconditional accounting conservatism. The moderating mechanism of CEO overconfidence under different property right characters and different industry competition scenarios is further investigated. The regression results are shown in **Table 5**. There is a significant positive correlation between key subordinate governance and unconditional accounting conservatism at the level of 1% in the

TABLE 5 | Moderating effect of CEO overconfidence.

Variables	Dependent variable:UCAC					
	Non-Overconfidence	Overconfidence	Overconfidence			
			State-Owned	Private-Owned	High-HHI	Low-HHI
CGI_comp	0.008	0.047***	0.033	0.049***	0.075***	0.031
	(0.28)	(4.59)	(1.75)	(4.05)	(5.60)	(0.72)
State	−0.006*	−0.007**			−0.006	−0.008
	(−2.16)	(−3.08)			(−0.89)	(−1.21)
HHI	−0.008	−0.026	−0.068	0.000		
	(−0.23)	(−1.27)	(−1.37)	(0.01)		
Constant	−0.033	−0.053	0.027	−0.083	0.011	−0.050
	(−0.97)	(−0.89)	(0.35)	(−1.35)	(0.09)	(−0.62)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes	Yes	Yes
N	3553	6974	2144	4828	1651	1802
Adj R^2	0.206	0.177	0.177	0.181	0.293	0.160

****, **, and * refer to significance at 1%, 5%, and 10%, respectively.*

overconfidence group in column (2), while there is no significant correlation in the non-overconfidence group in column (1).

In China's bureaucratic structure, such as state-owned enterprises, seniority is respected and hierarchy is emphasized (Du et al., 2017), which makes it difficult to play the governance mechanism of key subordinate executives. Therefore, this article further subdivides the CEO overconfidence group into the state- and private-owned group, and the regression results are shown in columns (3) and (4) of **Table 5**. In columns (1) and (2), the state-owned enterprise variable (*state*) is negatively correlated with accounting conservatism. The regression results of column (4) private enterprise group and column (3) state-owned enterprise group show that the key subordinate executives of private enterprise are more likely to restrain the overconfidence of CEO, so as to positively strengthen the accounting conservatism of enterprises.

In addition, external industry competition can strengthen the level of corporate governance. On one hand, Kliestik et al. (2021) believe that the external environment of enterprises will affect the reliability of financial data. On the other hand, the study of Yang and Xu (2020) point out that industry competition and internal governance mechanisms have a synergistic regulatory effect on opportunistic behaviors of management. Schmidt (1997) believes that industry competition can strengthen and motivate managers' operating capacity. Chen et al. (2013) also point out that industry competition has enhanced the motivation of shareholders to supervise the opportunistic behaviors of management. Therefore, the strength of external industry competition plays an important role for key subordinate executives to supervise and restrain the CEO governance mechanism. In this article, the CEO overconfidence group is further divided into high-Herfindahl–Hrschman index (HHI) and low-HHI, respectively, which are higher than the upper quartile and less than the lower quartile. The regression results are shown in columns (5) and (6) of **Table 5**. Only in the highly competitive enterprises listed in column (5), there is a positive correlation between key subordinate governance and accounting conservatism at the significance level of 1%, which further verifies Hypothesis 2.

Robustness Test

As for the relationship between the governance of key subordinate and accounting conservatism, there may be the problem of omitted variables, that is, impact on both explanatory variables and explained variables. To alleviate this endogeneity problem, the Propensity Score Matching (PSM) method was used to test endogeneity. The property right of the treatment group (state-owned enterprises) and the control group (private enterprises) were used as the grouping basis. According to the method of 1:4 nearest neighbor matching, logit regression was used to calculate the propensity matching score, and the control variables selected in the original principal regression were used as the matching criteria for the PSM analysis. **Table 6** shows the results of the two groups according to the matching of control variables, and the SD of the two groups is reduced to <10%, indicating that the difference in enterprise characteristics between the treatment group and the control group is small, basically excluding the influence of other non-observable factors. **Table 7** shows the matched sample regression results, the explained variable is accounting conservatism, column (1) is the matched full sample, columns (2) and (3) are the non-overconfident group and overconfident group divided based on (1), and the matched regression results remain stable and consistent with the previous ordinary least squares (OLS) regression results.

In this article, the two-stage instrumental variable (IV) method is used to estimate the endogeneity of reverse causality. On one hand, the industry median level of key subordinate governance can maintain a certain correlation with the company

TABLE 6 | PSM test: features of samples before and after matching.

Variables	Mean		%bias	*t*-test	
	Treated	Control		*t* value	*p* value
size	22.964	22.977	−1.1	−0.53	0.60
lev	0.52222	0.53269	−5.3	−2.82	0.01
TBQ	1.7463	1.7662	−1.7	−0.98	0.33
EPS	0.10006	0.10313	−1.6	−0.98	0.33
PPE	0.22873	0.2144	9.0	4.40	0.00
insthold	5.6725	5.8677	−3.0	−1.63	0.10
balance	0.64378	0.65969	−2.2	−1.46	0.15
indep	0.37165	0.36763	7.4	4.13	0.00
HHI	0.08799	0.0915	−2.9	−1.31	0.19

TABLE 7 | PSM test: regression results after matching.

Variables	Dependent variable:UCAC		
	Full sample	Non-Overconfidence	Overconfidence
CGI_comp	0.022*	−0.002	0.047***
	(2.06)	(−0.05)	(5.83)
Constant	−0.008	0.019	−0.024
	(−0.22)	(0.63)	(−0.50)
Controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Ind	Yes	Yes	Yes
N	12,014	2,382	4,643
Adj R^2	0.177	0.189	0.176

****, **, and * refer to significance at 1%, 5%, and 10%, respectively.*

level of key subordinate governance, and on the other hand, it is exogenous and relatively unrelated to the error term. Therefore, the industry median level of the key subordinate governance (*comp_med pca_med*) was used as the tool variable. Columns (1) and (2) are *comp_med* as a tool variable, and columns (3) and (4) are *pca_med* as a tool variable. The regression results are shown in **Table 8**. The significance level of key subordinate governance and accounting conservatism is above 10%, which better alleviates the possibility of reverse causality under endogeneity problems. The robustness of the empirical results is further strengthened.

DISCUSSION

Research Conclusion

This article studies the relationship between key subordinate governance and accounting conservatism and examines the moderating mechanism based on CEO overconfidence. The empirical results show that key subordinate governance has a positive effect on accounting conservatism. This article also finds that CEO overconfidence can positively moderate the relationship between key subordinate executive governance and corporate accounting conservatism. In the heterogeneity analysis involving the internal property rights and the external competitive environment of enterprises, the overconfidence

TABLE 8 | IV test: regression results.

Variables	Dependent variable: UCAC			
	Independent variable: CGI_comp		Independent variable: CGI_pca	
	1st-stage	2nd-stage	1st-stage	2nd-stage
CGI_comp		0.259**		
		(2.57)		
CGI_pca				0.098*
				(1.75)
comp_med	0.610***			
	(10.80)			
pca_med			0.663***	
			(14.38)	
Constant	0.352***	−0.196***	0.450***	−0.110***
	(7.34)	(−3.06)	(7.17)	(−2.39)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
N	17,742	17,742	17,742	17,742
Adj R^2	0.164	0.151	0.119	0.170

****, **, and * refer to significance at 1%, 5%, and 10%, respectively.*

moderating mechanism in private enterprises and enterprises with high industry competition is more significant, which can better counterbalance CEO overconfidence and improve accounting conservatism.

Theoretical Contribution

This article has the following research contributions. First, this article improves the measurement of key subordinate executive governance. This article uses the promotion mechanism and practical restraint mechanism. Based on institutional promotion incentive and practical supervision ability, this article optimizes the measurement framework of key subordinate executive governance. Second, this article refines the subject of key subordinate executives. This article emphasizes the special status of VP after CEO. In this article, key subordinate executives are clearly selected as VPs, which improve the accuracy of the governance mechanism of key subordinate executives. Third, this article expands the governance role of key subordinate executives. This article links the prudent attitude of key subordinate governance with the aggressive psychology of CEO overconfidence and discusses the governance path of key subordinate governance to balance CEO overconfidence to ensure accounting conservatism. In addition, considering the governance effect under different property rights and different industry competition environments, the mechanism of key subordinate executive governance on accounting conservatism is better clarified.

Managerial Implications

Based on this study, attaching importance to the governance status of key subordinate executives is conducive to improving

the corporate accounting information quality. This article may provide some managerial implications for the future corporate governance policy reform. First of all, based on the interdependent and mutual restrictive human resources allocation, enterprises should optimize the power balance environment of the TMT, and make the key subordinate executives have more opportunities to display their governance. Second, enterprises should pay attention to the human resources incentives of key subordinate executives, guarantee competitive welfare benefits, create promising promotion mechanism, thus enhancing the governance motivation of key subordinate executives.

Limitations and Future Research

Although the abovementioned research has enriched the research results of corporate governance and accounting conservatism, there are still some deficiencies. Firstly, the analysis of the governance path for the governance of key subordinates is not clear enough in this article, and the scenario construction of how key subordinate executives exert their own supervision ability and reflect their own supervision power needs further consideration. Furthermore, the measurement of overconfidence needs to be improved, and the key subordinate governance role under other related CEO psychological activities is not explored. At last, the theoretical excavation of relevant disciplines is not thorough enough. In the future, it is necessary to continue to explore fields, such as sociology, psychology, and even Confucianism, so as to better identify and analyze the interaction between key subordinate executives and CEO.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

FW designed the research method, collected and analyzed the data, and wrote the manuscript. XK was responsible for the conceptualization of the idea and constructed the fundamental theory. Both authors contributed to this article and approved the submitted version.

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How Does Corporate Social Responsibility Affect Sustainability of Social Enterprises in Korea?

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Social enterprises (SEs) are a new concept, integrating corporate profitability and social purposes. SEs seek to realize sustainable social values, rather than short-term profits. It is therefore important to study the factors that affect the sustainable management of SEs. Corporate social responsibility (CSR) is known to improve corporate image and performance; it can also promote the sustainable development of companies. Innovation has been described as the driving force behind corporate growth and ultimate performance. This study aims to investigate whether CSR can affect sustainability through the economic and social performance of SEs. In addition, it attempts to verify the moderating role of innovativeness in the relationship between CSR and social enterprise (SE) performance. Using survey data from 226 employees of 204 SEs in Korea, we have empirically tested this conceptual framework. The results suggest that, while CSR can improve sustainability through economic and social performance, innovativeness has no moderating effect on the relationship between CSR and SE performance. This study enriches our understanding of the important role played by CSR in driving SE sustainability. It provides new insights into the mechanisms through which SEs can achieve sustainable development. It also contributes to the literature by emphasizing the need for innovation through technical support for SEs.

Keywords: SEs, corporate social responsibility, sustainability, performance, innovativeness, South Korea

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INTRODUCTION

Social enterprises (SEs) are organizations that produce, sell, and promote products and services, while supporting social causes (Steiner and Teasdale, 2019). They fall between non-profit and profit-making enterprises (Kerlin et al., 2021). While the main goal of a traditional business model is to maximize shareholder interests, SEs are different because they help to create jobs and develop local communities, including vulnerable groups, with social problem-solving as a top priority (Cheah et al., 2019). After the International Monetary Fund crisis in the 1990s, various academic opinions emerged in South Korea regarding the effectiveness of government support. Although government support expanded social service-related jobs, they were neither stable nor long-term. In this context, South Korea is introducing SEs to help develop local communities and the national economy by providing high-quality social services, while supporting social and economic values.

Social enterprises that pursue both societal and economic values increase their social influence through corporate social responsibility (CSR). An organization undertakes CSR activities to

advance the sustainable development of society, as a responsible member aiming to maximize profits, which is the basic goal of most commercial enterprises (Javed et al., 2020). To solve social problems, SEs strive to attain enhanced societal and economic performance through job creation, community development, and social-service provision simultaneously (Steiner and Teasdale, 2019). Thus, SEs must realize both economic and social values in order to grow sustainably.

Recently, changes in corporate goals have necessitated the development of new business goals (Moon and Parc, 2019). In particular, although enterprises are striving to make social contributions, social distrust in ethical responsibility or CSR has increased, while trust in—and the reputations of—many businesses have declined. This situation has given rise to the view that enterprises should implement economic revitalization through sustainable growth. In the same context, SEs can help to develop society by fostering social and economic value in the social economy (Richter, 2019). It is thus important to strengthen competitiveness by practicing sustainable management through authentic CSR activities.

Social enterprises should aim to achieve both social and economic performance through strengthened competitiveness (Bhattarai et al., 2019). In addition, SEs, which need to become more competitive by overcoming physical and human resource-related issues, should look for more sustainable growth through CSR. In one interpretation, sustainable growth is taking responsibility for the local community by considering the ethical and moral aspects of a business alongside economic growth. Organizations aligned with this approach develop management activities and goals to achieve better long-term outcomes (Bebbington and Gray, 2001; Moizer and Tracey, 2010).

Although, increasingly, SEs need and show interest in CSR, discussions and studies of improved performance and sustainable growth through CSR remain insufficient (Ketprapakorn and Kantabutra, 2019; Powell et al., 2019). Most research has focused on improving enterprise image through CSR and the effect of corporate economic performance in response to stakeholder needs (Abdulaziz-Alhumaidan and Ahmad, 2019; Zhu et al., 2019; Bahta et al., 2021). It is crucial to explore the effect of CSR on two types of performance: social and economic (Cheah et al., 2019). It is also worth investigating the mediating effect of these two types of performance on the relationship between CSR and sustainability (Powell et al., 2019). Accordingly, the present study discusses the importance of CSR and policy measures on sustainable growth in SEs.

This study analyzes the effects of CSR on performance and sustainability by focusing on SEs. Previous studies (Voss and Voss, 2000; Miles et al., 2014) of social enterprise (SE) performance have categorized their results based on economic and social performance. To ensure sustainable growth among SEs that pursue both profit and public interest, our study reveals the relationship between CSR, performance, and sustainability. In addition, creative ideas and product, process, and management innovations are essential elements of SEs, due to their rapid technological convergence and innovation (Pierce and Delbecq, 1977).

Given the increase in public interest in social responsibility and environmental problems in Korea, the number of SEs is continuously increasing. SEs contribute to the regional economy by creating jobs, solving social problems, and developing local communities. However, these enterprises are highly dependent on government subsidies and lack sustainability, which requires innovation. The present study has therefore focused on improving the sustainability of SEs. Social responsibility, selected as a variable to promote sustainability, affects the performance of SEs. In other words, social responsibility activities can improve a company's performance and ultimately lead to sustainable growth. The present study has analyzed the mediating role of performance in the relationship between CSR and sustainability. In addition, SEs can improve their performance and achieve sustainability through increasing levels of innovative behavior. For this reason, the present study has focused on innovation as a moderating variable.

Therefore, this study aims to investigate whether CSR can affect sustainability through the economic and social performance of SEs. In addition, it attempts to verify the moderating role of innovativeness in the relationship between CSR and SE performance.

This research differs from previous studies. As the CSR of SEs is influenced by performance and sustainable growth, we track and verify the moderating effect of innovation and the mediating effect of performance. Innovation is a moderating variable in the relationship between performance and sustainability. A higher level of innovation will strengthen the effect of performance on sustainability. Finally, this study identifies the CSR levels needed to foster growth in SEs.

LITERATURE REVIEW AND HYPOTHESES

Corporate Social Responsibility

As demand for ethical trading has increased, CSR has become increasingly important. CSR has a positive impact on enterprise performance; it is also an essential factor in sustainable growth, regardless of the type or size of the enterprise in question (Gürlek et al., 2017). SEs that provide jobs and services to socially vulnerable people lead the way in realizing social values through CSR (Cornelius et al., 2008). They prioritize CSR, which ultimately strengthens local-community capability and integration by pursuing high autonomy and continuous profit-making activities. This approach improves the quality of life of local residents, minimizes societal problems and potential issues caused by enterprise activities, and maximizes social contributions to meet the needs of stakeholders and society as a whole (Pomering and Johnson, 2009).

Corporate social responsibility is an organization's responsibility for society, beyond economic, and legal obligations (Carroll, 1991). The organization voluntarily undertakes social roles, solves social and environmental problems, and harmonizes with societal values, norms, and expectations (Sethi, 1975). To satisfy all of the obligations associated with enterprise-management activities, the organization must perform

economically, legally, ethically, and economically in a way that upholds its social responsibilities (Carroll, 1979). In addition, SEs that view CSR as a top priority use it as a survival strategy, contributing to society through social influence (Aras et al., 2010) and using social influence to meet their societal responsibility to provide sustainable growth.

Corporate social responsibility has developed into a new form of management strategy, which generates economic benefits associated with sustainable growth and uses environmental and social responsibilities strategically to create a strong, long-term competitive advantage (McAdam and Leonard, 2003). Recently, as sustainable growth has been incorporated into CSR, researchers have recognized that sustainable growth is an indispensable factor in the survival of SEs (Chen and Kelly, 2015). In other words, CSR is an important strategy, which allows SEs to secure an ongoing competitive advantage (Igwe et al., 2018). In the past, organizations pursued CSR to enhance their business image; now, they aim to account for the needs of various stakeholders while practicing CSR from a strategic and sustainable growth perspective (Hong and Chao, 2018).

Performance

Performance is the achievement and evaluation of organizational outcomes over a certain period of time (Bovaird and Rubienska, 1996). SEs that seek both public interest and profit pursue social goals, involving both social and economic value (Richter, 2019). For such organizations, performance is the degree to which both economic and social values result from management activities carried out over a certain period of time (Bagnoli and Megali, 2011). SE performance incorporates both economic performance (e.g., profits generated through the production and sale of products and services) and social performance, which creates positive values in society, such as job creation, the inclusion of vulnerable groups, environmental conservation, community contributions, and social-service provision (Bhattarai et al., 2019).

Although there is some debate over the measurement index and the best way to measure the performance of SEs, most previous studies have divided the performance of SEs into social and economic performance (Moizer and Tracey, 2010; Miles et al., 2014; Liu et al., 2015; Cheah et al., 2019; Doh, 2020; Pinheiro et al., 2021). Economic performance refers to the generation of profits that enable SEs to operate independently, without government support. Survival and sustainability require both economic performance and profit generation (Leung et al., 2019). Chang and Hong (2000) define economic performance as the level of financial profit creation and economic independence required to manage a company continuously. In other words, the economic performance of a SE is the monetary effect of the sale of its products and services (Bagnoli and Megali, 2011; Doherty et al., 2014).

The social performance of a SE is the result of its contribution, social value, and sense of duty, goals pursued by all SEs (Luke et al., 2013). Although such enterprises must achieve both social and economic performance, they depend on government support (Bae et al., 2018). SE reflects a range of public-interest achievements, including employing vulnerable groups, providing social services, improving the community's quality of life, and facilitating community integration (Brammer et al., 2006). The present study therefore divides SE performance into social and economic performance.

Sustainability

Sustainability, in the corporate or organizational sense, means not just pursuing the goals and activities of an organization, but also achieving and developing them in the long term to achieve better outcomes (Bebbington and Gray, 2001). From an organizational perspective, sustainability is the continual management of activities through the social responsibility of staff members; the consideration of ethical issues, such as social service provisions and environmental problem-solving; and the generation of financial revenue. Sustainability of SE raises the question of whether SEs can achieve their original purpose while maintaining social activities—successfully providing sustainable jobs and expanding social services (Leung et al., 2019).

Arena et al. (2015) have introduced the concept of longevity and a comparative perspective to measure the sustainability of SEs. Compared with other types of businesses, SEs have greater potential in the following areas: future employment, social-service provision, support from government and large corporations, and overall growth and competitiveness. A SE becomes sustainable when it can manage its affairs efficiently without government subsidies, simultaneously pursuing both economic and social goals (Bae and Fiet, 2021). This study evaluates the sustainability of SEs by breaking it down into various aspects, including the continuous expansion of employment and increased sales, continued social-service provision, relations with government agencies, and improved competitiveness.

Innovativeness

Innovation is the creation or invention of new ideas, which are applied to existing processes and operating methods, resulting in new and convergent changes (Hurt et al., 1977; Pierce and Delbecq, 1977; Daft, 1978; Rogers, 1995). Organization staff can use creative approaches to work, enhance competitiveness by applying innovative ideas to products or services, and choose innovation as a strategic plan for sustainable growth. Innovation is an intentional and planned change, which occurs throughout the lifetime of an enterprise, improving performance. As an intangible resource and source of competitive advantage, innovation is essential for enterprise sustainability (Bates and Khasawneh, 2005).

Social enterprises can develop products and services with a low-cost structure by using creative ideas to change and manage organizational components, thereby creating a process that leads to strong social and economic performance. For SEs, it is essential to adapt to rapidly changing environments, manage innovation for sustainable growth, and improve work efficiency. The process of innovation can be divided into management and technology (Damanpour and Evan, 1984; Delmas and Pekovic, 2018; Abbas and Sağsan, 2019). Daft (1978) has categorized the goals of innovation as product and service goals, market and value, and technology. In cases where it is impossible to predict

environmental change, rapid response through flexible, creative, and innovative ideas will help an organization achieve sustainable growth, while improving its performance.

Relationship Between Corporate Social Responsibility and Performance

Mishra and Suar (2010) have analyzed the impact of CSR on enterprise performance in manufacturing enterprises in India; they show that CSR has a positive impact on financial and non-financial performance. In a study of the relationship between CSR and enterprise outcomes, Igwe et al. (2018) have shown that CSR is responsible for profit creation, social contributions, social innovation, and improved social performance. Moon and Parc (2019) have studied the effect of CSR in Korean businesses on shared value creation and management performance, finding that CSR has a positive effect on social and economic value and enterprise performance. Cho and Lee (2019) have verified that CSR has a positive effect on financial and social performance.

Hernández et al. (2020) have analyzed the effects of CSR on enterprise-management performance by categorizing social, environmental, and economic-responsibility activities. Their findings confirm that CSR economic-responsibility activities affect non-financial performance, while economic and social-responsibility activities affect financial performance. Chen and Kelly (2015) have studied the effects of social entrepreneurship on enterprise CSR and social performance, dividing CSR into community, philanthropic, and environmental responsibilities. CSR has a positive influence on social performance, with strategic implications for the sustainable growth of SEs. Based on previous studies, we therefore propose the following hypotheses:

Hypothesis 1: CSR has a positive influence on social performance.

Hypothesis 2: CSR has a positive influence on economic performance.

Relationship Between Performance and Sustainability

Leung et al. (2019) have examined the effects of SE performance on sustainability, showing that the stronger the economic and social performance of a SE, the greater its sustainability. Enterprises can improve their competitiveness and achieve sustainable growth by improving their performance and operations. Both Shabbir and Wisdom (2020) and Canh et al. (2019) have argued that engaging in profit creation alone limits the sustainable development of enterprises, which can achieve sustainable growth—based on balanced development—only by using CSR and environmental conservation activities to continuously increase their value. According to Bhattarai et al. (2019), researchers can divide SE performance into economic and social performance and analyze the factors that enable SEs to provide social services, such as job creation for vulnerable groups and community development. Baek and Cho's (2020) analysis of the impact of internal auditor characteristics on management performance and sustainability management have uncovered a relatively negative perception of enterprise performance and sustainability management. Active efforts are therefore needed to manage activities sustainably. Based on previous studies, we propose the following hypotheses:

Hypothesis 3: Social performance has a positive influence on sustainability.

Hypothesis 4: Economic performance has a positive influence on sustainability.

Mediating Effects of Performance

Corporate social responsibility is a management strategy that strengthens enterprise competitiveness in the long term, generating economic benefits for sustainable growth, and using environmental and social responsibilities strategically to create a competitive advantage (McAdam and Leonard, 2003). CSR improves the lives of local residents by eliminating conflicts and distrust among community stakeholders and increasing local employment and profits, social and economic achievements, and sustainable growth (Hong and Chao, 2018). Enterprises thus use social services, such as CSR, to enhance their performance and to become competitive and sustainable entities. Based on this relationship, we have formulated the following hypotheses:

Hypothesis 5: Social performance has a positive mediating effect on CSR and sustainability.

Hypothesis 6: Economic performance has a positive mediating effect on CSR and sustainability.

Moderating Effects of Innovativeness

In a challenging environment for enterprise survival, enterprises that cannot respond to new opportunities or technological change will inevitably suffer economic losses. To remain profitable, they must embrace innovation (Lee et al., 2020). Innovative organizations outpace less innovative ones in product and service composition. They are highly competitive and sustainable and pursue sustainable management activities that improve their economic and social performance (Cohen and Levinthal, 1990). Therefore, this study proposes the following hypotheses:

Hypothesis 7: Sustainability moderates the relationship between CSR and social performance.

Hypothesis 8: Sustainability moderates the relationship between CSR and economic performance.

RESEARCH METHODOLOGY

Research Model

Figure 1 presents the research model used in this study. The SPSS 25.0 and AMOS 22.0 programs have been used to verify the hypotheses, in accordance with the research model.

Sample and Data Collection

The present study examines the effects of CSR on SE sustainability and the mediating and moderating effects of

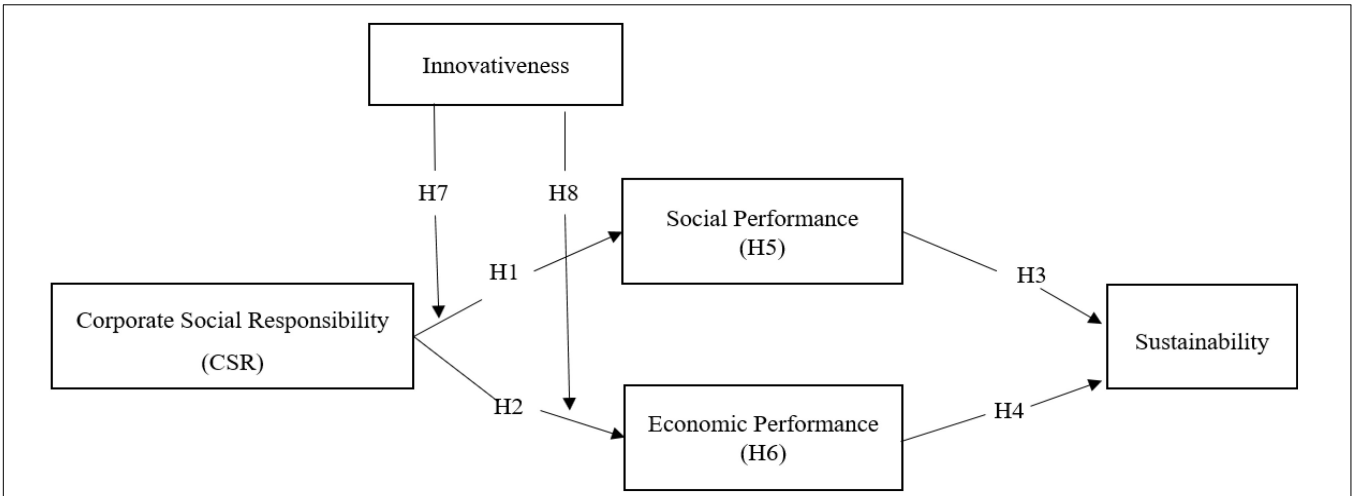

FIGURE 1 | Research model.

performance and innovativeness on this relationship. To provide data, we have surveyed staff members of SEs distributed across Gwangju and Jeonnam provinces in South Korea. In Korea, there is significant public interest in social responsibility, environmental problems, and sustainable development; as a result, SEs are continuously being established. These SEs are linked to employment policies at the national level because they provide beneficial social services for poor people. However, their dependence on excessive information subsidies hinders their sustainable development. The present study therefore focuses on the sustainability of Korean SEs.

Participants gave their informed consent for their data to be used in this research. The survey was conducted in June 1–30, 2021. Overall, 300 questionnaires were distributed and 274 responses were collected; of these, 226 questionnaires were complete and used in this analysis. The demographic characteristics of the participants were as follows: 137 (60.6%) were men and 89 (39.4%) were women. In terms of age, 38 (16.8%) were under 30; 84 (37.2%) were 31–40; 91 (40.3%) were 41–50; and 13 (5.7%) were over 50. Most respondents had a college degree or higher (82.3%) and were organization executives or presidents (77.4%). Of the SEs, 81.9% were mixed (providing jobs, social services, and community contributions). The major revenue sources for most these businesses (85.8%) were sales and services.

As there was a risk of common-method bias (CMB) if the respondents responded in a socially desirable manner (Podsakoff et al., 2003), the following measures were taken to minimize this limitation: the questionnaire content was laid out clearly and concisely, with items arranged differently. To account for CMB, we confirmed the common variance and cumulative variance values through an exploratory factor analysis. The first factor involved the common and cumulative variance, which were 20.404 and 20.404, respectively. There was no problem with the unification method because the first-factor component did not account for more than 50% of the total change in explanatory power (Podsakoff et al., 2003).

Measures

The CSR questionnaire was revised and developed using questions developed by Gürlek et al. (2017), which were assessed using four items. Sample items included "This enterprise practices ethical management," and "This enterprise is actively engaged in social contribution activities."

Based on Pinheiro et al.'s (2021) research on SE performance measurement, four items were used to measure social performance and five to measure economic performance. Social performance was defined as "performance that includes the mission, service spirit, and social contribution that SEs essentially pursue, such as contributions to the stabilization of society," while economic performance was defined as "performance that enterprises essentially pursue, such as continuous sales and operating profit, achieving profit targets, and improving customer satisfaction with products" (Bhattarai et al., 2019; Cheah et al., 2019; Doh, 2020).

Sustainability was divided into five measurement items, based on Leung et al. (2019): continuous employment growth in SEs, social-service provision, relationships with government agencies, improved competitiveness, and increased sales.

Innovativeness was defined as "the speed to accept and spread new ideas, opinions, and products before others," based on Hurt et al. (1977) and Rogers (1995). The measurement tools used were developed by Delmas and Pekovic (2018). All of the items in this study were measured using a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree).

RESULTS

Table 1 shows the results of the exploratory factor analysis. The results were divided into five independent factors. The items associated with each measurement variable were examined in detail: CSR, EP, and INNO included four items each, while SP and SUS included five items. Cronbach's alpha was used to test reliability. The results of the reliability test were as follows:

TABLE 1 | Results of the exploratory factor analysis.

Items	Varimax rotation loadings (n = 226)				
	SP	SUS	EP	CSR	INNO
SP2	0.946	0.142	0.104	0.056	0.099
SP5	0.944	0.137	0.103	0.047	0.147
SP4	0.939	0.131	0.129	0.048	0.104
SP3	0.935	0.159	0.079	0.057	0.152
SP1	0.926	0.123	0.155	0.073	0.043
SUS5	0.124	0.959	0.059	0.000	0.050
SUS1	0.138	0.948	0.066	0.018	0.095
SUS4	0.159	0.947	0.072	−0.019	0.062
SUS3	0.108	0.943	0.084	−0.006	0.098
SUS2	0.142	0.942	0.087	0.013	0.099
EP2	0.136	0.087	0.885	0.143	0.254
EP4	0.158	0.105	0.847	0.106	0.349
EP3	0.120	0.079	0.836	0.114	0.399
EP1	0.167	0.103	0.789	0.121	0.417
CSR2	0.078	0.012	0.128	0.923	0.113
CSR4	0.058	0.008	0.120	0.913	0.131
CSR1	0.007	−0.011	0.022	0.903	0.144
CSR3	0.085	−0.010	0.133	0.838	0.101
INNO2	0.123	0.101	0.350	0.195	0.858
INNO4	0.147	0.132	0.376	0.162	0.840
INNO1	0.156	0.132	0.456	0.136	0.798
INNO3	0.176	0.100	0.405	0.194	0.782
Eigenvalue	4.685	4.678	3.601	3.398	3.373
Percent explained variance	21.294	21.263	16.370	15.447	15.332
KMO = 0.890 (sig = 0.000)					

Loadings on items are shaded dark gray. CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness.

CSR = 0.929, EP = 0.953, SP = 0.980, INNO = 0.961, and SUS = 0.981. All of the values of the Cronbach's alpha coefficient were over 0.7 and the results were confirmed to be highly reliable.

Table 2 shows the results of the confirmatory factor analysis. The model fit showed $X^2(196) = 547.153$, $p < 0.001$, $X^2/df = 2.792$, RMSEA = 0.089, IFI = 0.949, CFI = 0.949, and TLI = 0.940, indicating a satisfactory fit. An RMSEA value under.10 is considered reasonable (MacCallum et al., 1996; Davis et al., 2006). We also checked the convergent validity of the constructs by examining the average variance extraction (AVE) of each construct tested in this study. All of the AVEs were higher than the 0.5 threshold for all constructs (ranging from 0.666 to 0.815), demonstrating convergent validity (Fornell and Larcker, 1981). When the composite reliability (C.R.) values were calculated, CSR = 0.787, EP = 0.881, SP = 0.923, INNO = 0.907, and SUS = 0.924. Since all of the CR values were over 0.70, the measurement tool used in this study was found to be valid. Based on the AVE and CR results, these values were considered significant and acceptable.

Table presents the descriptive statistics. The results of the mean showed that CSR = 0.4.733, EP = 4.920, SP = 4.805, INNO = 5.172, and SUS = 5.000. According to the standard deviation results, CSR = 1.557, EP = 1.412, SP = 1.682, INNO = 1.436, and SUS = 1.170. To verify the discriminant validity between each factor, the square root of AVE was used after a confirmatory factor analysis, based on Fornell and Larcker (1981). Not only was the AVE square root value greater than 0.5, it was also greater than all of the values in the rows and columns, verifying the validity of discrimination among the concepts of composition (**Table 3**).

We conducted a path analysis using the AMOS 22.0 program to test the study hypotheses. **Table 4** presents the results of the path analysis. First, the model fit showed X^2 (62) = 103.641, $p < 0.001$, $X^2/df = 1.672$, RMSEA = 0.055, IFI = 0.989, CFI = 0.989, and TLI = 0.986. According to the results of the path analysis (CSR → EP→ SUS), CSR had a positive influence on EP (estimate = 0.258, $p < 0.001$). In addition, EP had a positive influence on SUS (estimate = 0.293, $p < 0.001$). The indirect effect had an estimated value of 0.069. According to the bootstrap results, the lower and upper bounds were 0.034 and 0.124, respectively. Therefore, the mediating effect of EP was significant.

Next, the model fit showed $X^2(71) = 117.560$, $p < 0.001$, $X^2/df = 1.656$, RMSEA = 0.054, IFI = 0.990, CFI = 0.990, and TLI = 0.987. According to the results of the path analysis (CSR →SP→ SUS; see **Table 5**), CSR had a positive influence on SP (estimate = 0.218, $p < 0.1$). In addition, SP had a positive influence on SUS (estimate = 0.288, $p < 0.001$). The indirect effect had an estimated value of 0.037. According to the bootstrap results, the lower and upper bounds were 0.010 and 0.080, respectively. Therefore, the mediating effect of SP was significant.

We used Baron and Kenny's (1986) moderating effect verification method with SPSS. Hypothesis 7 states that INNO positively moderates the relationship between CSR and EP. To test the moderating effect of EP, we conducted a multiple regression analysis using the SPSS 18. **Table 6** presents the moderating effects of INNO on CSR and EP. Model 1 shows that CSR positively influenced EP (β = 0.286, $p < 0.001$). Model 2 shows that INNO had a positive influence on EP (β = 0.756, $p < 0.001$). The moderating effect of INNO was β = −0.114, $p < 0.001$. However, INNO had a negative moderating effect. Therefore, Hypothesis 7 was rejected.

Hypothesis 8 states that INNO positively moderates the relationship between CSR and SP. **Table 7** shows the moderating effects of INNO on CSR and SP. Model 1 shows that CSR positively influences SP (β = 0.146, $p < 0.05$). Model 2 shows that INNO has a positive influence on SP (β = 0.318, $p < 0.001$). Finally, the moderating effect of INNO was β = −0.066, $p > 0.1$. However, INNO had an insignificant moderating effect. Therefore, Hypothesis 8 was rejected.

DISCUSSION AND CONCLUSION

Given global awareness of social issues, businesses are pursuing sustainable growth and higher performance through activities related to CSR. CSR is vital to the sustainable growth of SEs. SEs that rely heavily on government subsidies can achieve sustainable growth through better economic and social performance by

TABLE 2 | Results of the reliability and validity testing.

Variable		SE	CR	*P*	Standardized factor loadings	AVE	CR
CSR	CSR4				0.787	0.666	0.787
	CSR3	0.089	12.752	***	0.710		
	CSR2	0.062	20.267	***	0.927		
	CSR1	0.075	16.469	***	0.826		
EP	EP1				0.844	0.752	0.881
	EP2	0.063	17.564	***	0.836		
	EP3	0.055	22.091	***	0.923		
	EP4	0.06	18.912	***	0.864		
SP	SP1	0.063	18.906	***	0.856	0.797	0.923
	SP2				0.828		
	SP3	0.05	23.715	***	0.936		
	SP4	0.045	24.602	***	0.882		
	SP5	0.047	25.217	***	0.956		
SUS	SUS1				0.816	0.806	0.924
	SUS2	0.047	24.778	***	0.892		
	SUS3	0.061	20.606	***	0.898		
	SUS4	0.047	25.167	***	0.910		
	SUS5	0.059	23.166	***	0.966		
INNO	INNO4				0.904	0.815	0.907
	INNO3	0.048	19.386	***	0.873		
	INNO2	0.037	26.246	***	0.901		
	INNO1	0.047	22.358	***	0.932		
Model fit					$X^2(196) = 547.153$, $p < 0.001$, $X^2/df = 2.792$, RMSEA = 0.089, IFI = 0.949, CFI = 0.949, TLI = 0.940		

*N = 226. CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05.*

TABLE 3 | Descriptive statistics, reliability, and correlation analysis.

	Mean	SD	1	2	3	4	5
1	4.733	1.557	(0.929)				
2	5.172	1.436	0.350***	(0.961)			
3	4.920	1.412	0.286***	0.763***	(0.953)		
4	4.805	1.682	0.146*	0.330***	0.322***	(0.980)	
5	5.000	1.710	0.029	0.248***	0.220**	0.295***	(0.981)

*N = 226; 1 = CSR; 2 = INNO; 3 = EP; 4 = SP; 5 = SUS; CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05. The diagonal () is the square root of the AVE of each variable.*

TABLE 4 | Path analysis (CSR → EP→ SUS).

Path			Estimate	SE	CR	*p*
CSR	→	EP	0.258	0.058	4.418	***
EP	→	SUS	0.293	0.086	3.386	***
Mediating effect			**Indirect effect**	**Lower bounds**	**Upper bounds**	
SCR → EP→ SUS			0.069	0.034	0.124	
Model fit			$X^2(62) = 103.641$, $p < 0.001$ $X^2/df = 1.672$, RMSEA = 0.055, IFI = 0.989, CFI = 0.989, TLI = 0.986			

*N = 226; CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05.*

creatively managing innovations to adapt to a rapidly changing environment. This study investigates the effect of CSR on sustainability in SEs, the mediating effect of performance, and the moderating effect of innovation on this relationship. The results of this study suggest that economic and social performance mediate the effect of CSR on the sustainability

TABLE 5 | Path analysis (CSR → SP→ SUS).

Path			Estimate	SE	CR	*P*
CSR	→	SP	0.218	0.121	1.805	0.071
SP	→	SUS	0.288	0.064	4.526	***
Mediating effect			**Indirect effect**	**Lower bounds**	**Upper bounds**	
SCR → SP→ SUS			0.037	0.010	0.080	
Model fit			$X^2(71) = 117.560$, $p < 0.001$, $X^2/df = 1.656$, RMSEA = 0.054, IFI = 0.990, CFI = 0.990, TLI = 0.987			

*N = 226. CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05.*

TABLE 6 | Moderating effect of INNO between CSR and EP.

	Dependent: EP						
	Model 1		Model 2		Model 3		VIF
	β	*T*	β	*t*	β	*t*	
CSR (A)	0.286***	4.467	0.022	0.472	0.025	0.548	1.140
INNO (B)			0.756***	16.380	0.723***	15.275	1.229
Interaction (A X B)					−0.114*	−2.567	1.084
R^2 (Adjusted R^2)	0.082 (0.078)		0.583 (0.583)		0.595 (0.595)		
△ R^2 (△Adjusted R^2)			0.501 (0.505)		0.012 (0.012)		
F	19.951***		156.035***		108.826***		

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

*N = 226. CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05.*

TABLE 7 | Moderating effect of INNO between CSR and SP.

	Dependent: SP						
	Model 1		Model 2		Model 3		VIF
	β	*t*	β	*t*	β	*t*	
CSR (A)	0.146*	2.213	0.035	0.521	0.037	0.549	1.140
INNO (B)			0.318***	4.715	0.299***	4.271	1.229
Interaction (A X B)					−0.066	−0.999	1.084
R^2 (Adjusted R^2)	0.021 (0.017)		0.110 (0.102)		0.114 (0.102)		
△ R^2 (△Adjusted R^2)			0.089 (0.085)		0.004 (0.000)		
F	4.898*		13.798***		9.531***		

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

*N = 226. CSR, corporate social responsibility; EP, economic performance; SP, social performance; SUS, sustainability; INNO, innovativeness ***p < 0.001, **p < 0.01, *p < 0.05.*

of SEs. However, innovation had no moderating effect on the relationship between CSR and performance. This suggests that SEs are less willing to embrace new changes or to attempt creative technological innovations. In the future, it will be necessary to help SEs recognize the importance of innovation through technical support. The present study emphasizes the positive advantages of CSR on SE, highlighting the role of performance, which ultimately strengthens the effect of CSR on sustainable development. Despite its limitations, this research provides invaluable insights that can help SEs understand the mechanisms that increase sustainability through CSR activities.

Although many studies have examined the effects of CSR activities on corporate image (Abdulaziz-Alhumaidan and Ahmad, 2019; Zhu et al., 2019), relatively few have explored the way in which CSR affects corporate sustainability through performance. The present study makes a meaningful contribution by empirically verifying sustainability through SE performance. CSR plays a crucial role in enhancing corporate performance (Hernández et al., 2020). Companies can achieve sustainability through performance (Bhattarai et al., 2019; Canh et al., 2019). In previous studies, CSR has been explained as a factor that strongly influences corporate performance

(Igwe et al., 2018; Cho and Lee, 2019; Moon and Parc, 2019) and can be used as a powerful variable to improve corporate competitiveness. It is therefore clear that competitiveness ultimately enables sustainability. Digital innovation is rapidly changing the management environment of SEs. In this context, the present study makes an important theoretical contribution, arguing that innovation can improve SE performance. Although this study shows that innovation does not have a moderating effect on improving SE performance, it is essential to make innovative changes in SEs in the future.

Against this backdrop, our empirical analysis of the impact of CSR on sustainability in SEs has identified the mediating effect of performance and the moderating effect of innovativeness. The findings and implications can be summarized as follows. First, CSR on SE has been shown to improve economic and social performance. By pursuing social and economic values that improve the quality of life of community members, SEs can improve their business performance and the community environment. This suggests that CSR is a key responsibility of SEs, which can improve their corporate image and competitiveness through CS activities, thus strengthening their economic and social performance.

Second, the economic and social performance of SEs can lead to improved sustainability. SEs can achieve sustainable growth only when they also achieve good economic and social performance through business activities and social services. They can gain a competitive advantage by employing efficient management strategies, providing creative and innovative social services, improving performance, and ultimately achieving sustainable growth. Through sustainable growth, SEs can offer employment and social services to vulnerable people, achieve stable profit growth, and secure their own competitiveness.

Third, SE performance mediates the relationship between CSR and sustainability. In other words, improved performance is critical to improving the sustainability of SEs, and CSR can achieve that. For SEs to achieve sustainable growth, they must strengthen their economic and social performance by increasing revenue from products and services, based on strong competitiveness, and doing more to develop communities.

Fourth, innovation does not have a moderating effect on CSR of SE and performance in this study. Since SEs seek social goals that provide employment and social services to marginalized people, they tend to be unaware of creative and innovative operational methods that encourage change. However, given the dynamic and unpredictable nature of the business environment, SEs must actively cooperate with their local communities and improve cooperative ties with community stakeholders through innovation to strengthen their business performance and enable sustainable growth. To this end, diverse educational programs must be offered to members of SEs to help them recognize the importance of innovation.

Fifth, SEs needs to achieve goals in the long term. They should make the continual management through the CSR, such as social service provisions, environmental problem solving, and the generation of financial revenue. Also, SEs can achieve their original purpose through providing sustainable jobs and social services.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of Gachon University. The participants provided written informed consent before taking part in the study.

AUTHOR CONTRIBUTIONS

CQ performed data collection and analysis. SJ contributed to drafting, review, and editing. Both authors contributed to the study conception and design.

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Does Tourism Induce Sustainable Human Capital Development in BRICS Through the Channel of Capital Formation and Financial Development? Evidence From Augmented ARDL With Structural Break and Fourier-TY Causality

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The motivation of the study is to explore the nexus tourism-led sustainable human capital development (HCD) in Brazil, Russia, India, China, and South Africa (BRICS) for the period 1984–2019. The study applied several econometrical techniques for exposing the empirical association between tourism and HCD, such as the conventional and structural break unit root test, the combined cointegration test, long-run and short-run coefficients detected through implementing the Augmented Autoregressive Distributed Lagged (AARDL), and directional causality by following Toda-Yamamoto with Fourier function. The unit-roots test established variables are integrated in mixed order, wherein variables are stationary at a level or after the first difference. The estimated test statistics from the combined cointegration test and AARDL confirmed the long-run association between tourism, gross capital formation, financial development, and HCD. Tourism revealed a positive and statistically significant tie with HCD in the long run. Moreover, the joint effects of interactive terms TOR*GCF and TOR*FD (TOR, GCF, and FD denoting tourism development, gross capital formation, and financial development, respectively) established a positive and statistically significant relationship with HCD. In addition, the causality test revealed the feedback hypothesis available between tourism and HCD in all sample countries except India. In conclusion, the role of tourism development is critically important for sustainable HCD in BRICS. Therefore, in case of a policymaking concern, it is inevitable to address the tourism issues with care for capitalizing on the benefits for tourism development.

Keywords: tourism, human capital development, financial development, gross capital formation AARDL, BRICS

INTRODUCTION

Economic development and poverty alleviation need a significant investment in human capital. This is because human capital accumulation boosts labor productivity, enables technological innovation, raises capital returns, and makes growth more sustainable, all of which contribute to poverty alleviation and ensure sustainable development (Gibescu, 2010). Thus, human capital accumulation is seen as a critical production element in the economy's overall production function at the macro level. From a microeconomic standpoint, education boosts one's employment seeking ability and increases their earning capability (Xia et al., 2021). Thus, human capital is defined at the micro-level as the component of education that adds to an individual's labor productivity and profits while also serving as a critical component of company output (Haltiwanger et al., 1999). In other words, human capital refers to people's capacity and efficiency in transforming raw resources and capital into products and services, and the agreement is that these talents may be acquired *via* education (Bhagavatula et al., 2010). Thus, human capital development (HCD) is critical for growth on its terms, not only for its instrumental usefulness.

Considering the existing literature focusing on HCD, it is apparent that two vines of evidence were available: the role of HCD in various macro aspects and the critical determinants of HCD in the economy. From the growth contributory perspective, human capital has been placed in the apex position among the other macro fundamentals for economic growth (Gebrehiwot, 2014; Matthew et al., 2018; Qamruzzaman et al., 2020), financial development (Nik et al., 2013; Khan et al., 2020), poverty alleviation (Becker, 1994; Adekoya, 2018), income inequality (Lee and Lee, 2018; Scheyvens et al., 2021), and environmental sustainability (Ma et al., 2017; Ahmad et al., 2021), among others. According to existing literature, HCD is one of the key determinants of economic resource optimization and sustainable development (Trostel et al., 2002), which is because human capital accumulation is attributed to economic growth. Over the past decades, researchers, academicians, and policymakers have invested time and money in exploring the micro-macro factors that have been playing a critical role in HCD, and they have also been able to derive a few factors such as level of education (Son, 2010), inequality (Londoño and Bank, 1996; Quang Dao, 2008), trade openness, foreign direct investment (FDI) (Ardichvili et al., 2012), financial development, remittances, institutional quality, and economic growth (Adelakun, 2011). It is apparent that the economic growth attributes have linkage with HCD, which is investigated in the literature. However, the nexus tourism-led HCD has yet to investigate in empirical studies extensively. Thus, the intended purpose of this study is to explore fresh insight concerning the nexus between tourism-led HCDs in selected Brazil, Russia, India, China, and South Africa (BRICS) countries. It is firmly believed that study findings enhance the conceptual understating of exploring the role of tourism development for human capital accumulation and open an avenue for the policy strategic rethinking process in tourism development. The novelty of the study is as follows:

First, tourism-led economic development (Muslija et al., 2017; Aratuo et al., 2019; Pan and Dossou, 2020), financial development (Ohlan, 2017), capital flows, FDI, and environment (Mishra et al., 2019; Dogru et al., 2020) have been extensively investigated, but the role on HCD still remains untouched. For the first time, the role of tourism receipts has been investigated for HCD in BRICS nations with our best knowledge. We firmly believe that the study findings will open an avenue for the strategic decision-making process in the case of tourism development and expedite the present state of HCD in BRICS.

Second, the role of gross capital formation has been investigated and we have assessed the impacts on various macro-fundamental. However, with our best knowledge for the first time, the direct impact of gross capital formation on HCD has been investigated with the study and has tried to establish a bridge for fulfilling the existing research gap.

Third, the study has incorporated the interactive terms for evaluating the indirect effects of tourism on HCD through the channel of gross capital accumulation and financial development. According to existing literature, tourism positively influences gross capital formation (Po and Huang, 2008; Hüseyni et al., 2017) and financial development (Kumar, 2014; Shahbaz et al., 2019), especially in the long run. The interactive term explained the joint effects on target variables. Therefore, the finding of interactive terms on HCD can augment the capital accumulation through skills development in the population.

According to the combined cointegration test and Augmented Autoregressive Distributed Lagged (AARDL) estimation, the findings of this study established a long-run association between tourism, gross capital formation, financial development, and HCD in sample countries' estimation. Referring to the long-run association, especially from tourism, gross capital formation, and financial development with HCD, the study documented positive and statistically significant links between explanatory variables that tourism, gross capital formation, and financial development have with HCD in both the long-run and short-run. Furthermore, directional causality with Fourier-Toda-Yamamoto (TY) revealed the feedback hypothesis that bidirectional causality runs between tourism and HCD [TOR$\leftarrow\rightarrow$HCD], suggesting the importance of both factors in their respective development.

The remaining structure of the manuscript is as follows: Section Literature Review deals with the literature review and conceptual development for the study. Data and econometrical tools are displayed in Section Methodology and Data of the Study. Empirical model estimation and interpretation are reported in Section Estimation and Interpretation. Discussion of the study findings are reported in Section Discussion and the conclusion is available in Section Conclusion.

LITERATURE REVIEW

Since the advent of the growth model offered by Solow (1956), education has been seen as a significant driver of economic development. Even though education did not explicitly include in his development theory, the critical position of technology in his model gave momentum for the emphasis

on education since a well-educated populace was required for technological innovation after all. Nelson and Phelps (1966) made the connection explicit in what they called "investment in humans," wherein economy demands a skilled workforce for application and use of new technology, and education facilities enable the population to enrich their knowledge and skills, thereby boosting total factor productivity that drives economic expansion. According to new growth theories, such as those proposed by Lucas (1988), Romer (1990), and Mankiw et al. (1992), human capital accumulation through knowledge and skills development augment economic growth by improving labor productivity, promoting technological innovation and adaptation, and lowering fertility (Scheyvens et al., 2021).

Human capital is essential to economic development and poverty alleviation (Becker, 1995; Olopade et al., 2019). From a macroeconomic standpoint, human capital accumulation enhances economic productivity, enables technical breakthroughs, raises returns on capital, and makes growth more sustainable, which aids in poverty alleviation. Thus, human capital is a critical component of the macroeconomic production function. Micro-economically, education increases one's chances of finding work and increases earning potential. Thus, human capital is defined, at the microeconomic level, as the component of education that increases an individual's labor productivity and earnings while simultaneously serving as a vital component of business production. Human capital, in other words, refers to people's ability and efficiency in turning raw materials and capital into goods and services, and it is commonly believed that these qualities may be gained *via* the educational system. On the other hand, HCD is critical for development not just for its instrumental value but also for its intrinsic significance as a development target in and of itself.

Capital accumulation results in technological advancement in an economy, enhancing the advantages of large-scale manufacturing and increasing economic specialization (Ongo and Vukenkeng, 2014). Additionally, when capital development results in the efficient exploitation of natural resources and the construction of diverse businesses, income levels rise, allowing for the satisfaction of people's varied desires. As a result, it enhances residents' economic wellbeing and serves as a barometer of economic progress (Jena and Sethi, 2021). Furthermore, domestic capital accumulation enables a nation to achieve self-sufficiency and alleviates the weight of foreign debt. Inadequate domestic capital availability encourages nations to borrow money from another country for an extended period; it severely burdens future generations. As a result, the tax burden grows, and money leaves the economy through debt repayments. This indicates that only capital production results in independence from foreign help, a reduction in the weight of foreign debt, and self-sufficiency for the nation, which eventually accelerates the economy.

Capital formation has induced domestic aggregated output by promoting domestic trade liberalization, FDI inflows, and skills human resources development. Akobeng (2017) documented that gross capital formation in the economy assists in reducing the poverty level by allowing excess earning with grabbing investment opportunities, which eventually increase the speed of HCD. Gibescu (2010) advocated that gross capital formation plays a critical role in supplying the factors of production in the economy and in expediting economic growth toward sustainable development. The human element plays a role in economic development by increasing macroeconomic work volume and the quality of labor productivity, which is a synthetic expression of that work volume.

The study of Schumpeter (1911) opened the discussion on the role of financial markets in the economy with evidence that the finance-growth nexus is vital for economic sustainability. Several economists believe that financial markets are vital to economic growth because of the efficient financial intermediation, hence economic performance (Shaw, 1973; McKinnon, 1979; Levine, 1997), among others. Aziz and Duenwald (2002) outlined three ways financial development might affect economic growth. A well-developed financial market improves the efficiency of capital. Second, it enhances credit availability in the economy, and third, it lowers capital costs. It promotes effective financial intermediation between lenders and borrowers. Following then, an expanding body of literature began concentrating on people's living standards and wellbeing with the progress of financial development in the economy. Ranis (2004) found a link between HCD and rapid economic growth in his research. According to Sehrawat and Giri (2017), the financial sector and HCD are critical components of economic growth. The development of the financial industry in the absence of adequate human capital results in poor economic growth.

The studies conducted by De Gregorio (1996), Outreville (1999), Evans et al. (2002), and Papagni (2006) pioneered the study of the relationship between human capital and financial growth. Financial factors have a vital impact in boosting human capital in Pakistan. Broad money supplies have a significant impact on human development. However, a poor link between market capitalization and human capital was discovered. Similarly, Sethi et al. (2019) discovered that a higher rate of financial sector expansion and a big market size boost HCD in South Asia. Nik et al. (2013), on the other hand, investigated the link between human capital and financial growth in Iran. Because of the financial flows, they discovered an inverse link between both variables. The research investigated how inefficient banking channels, such as insufficient resource allocation, inadequate facilities, and so on, negatively impact human development.

Similarly, Hakeem and Oluitan (2012) discovered a detrimental impact of financial development on human capital in South Africa owing to their inefficient banking systems. On the other hand, some research found no substantial association between financial development and HCD (Hatemi and Shamsuddin, 2016). According to the existing nexus, human capital alongside financial growth revealed inconclusive evidence, suggesting the role of HCD in various economic structure, governmental practices, and institutional quality. HCD may help finance develop by closing knowledge gaps and rising demand for various financial products Hatemi and Shamsuddin (2016). Financial development is seen as vital as human capital contributing to economic progress. Arif and Khan (2019) have performed and studied for gauging the role of financial development on human capital accumulation in Pakistan for the

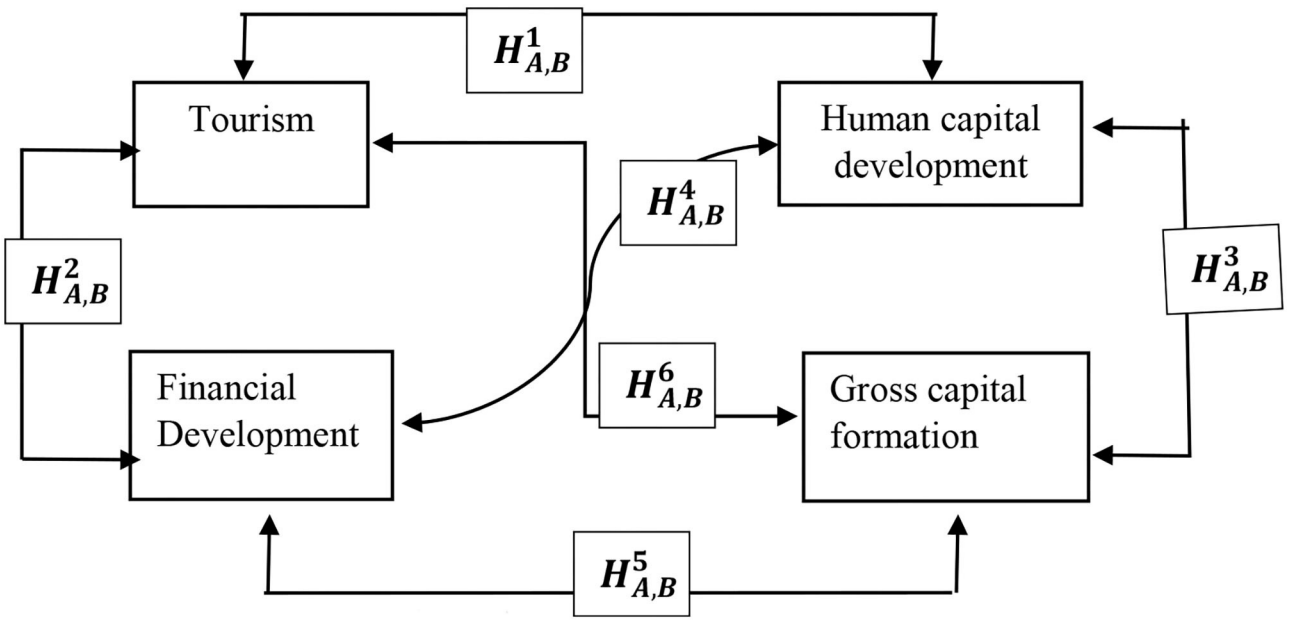

FIGURE 1 | Conceptual model and hypothesis of the study.

period 1991–2016. Study findings documented that the financial institution's growth augmented HCD by releasing the effects of liquidity constraints and boosting technical skills development among the population. Another study conducted by Hakeem and Oluitan (2012) in South Africa study revealed that capital support with an efficient financial system allows both physical and HCD in the economy in the long run. Sehrawat and Giri (2017) underline that, when physical capital is paired with deficient human capital, economic development may be low. Only when finance is permitted to "do what finance can do" is physical capital anticipated to contribute to human capital. As a result, efficiency is boosted by redistributing buying power from low-return customers to high-return ones. Additionally, finance is anticipated to combat poverty by boosting income and, in the long term, through improving health and education (Yang et al., 2021). This is because investment in skill development and services and physical infrastructure that promote health and lifespan is critical.

Conceptual and Hypotheses Model for Hypothesis Testing

Existing literature has revealed growing evidence, focusing on two-directional studies. First, a group of researchers have investigated the role of HCD on fundamental macro growth, such as economic growth, trade openness, remittances, financial development, and others. Second, similar to this study, assessing the key determinants of HCD in the economy and revealing several factors have been the focus. The motivation of the current study is to gauge the role of tourism development in the process of human capital accumulation in BRICS. It is evident in literature that skilled human resource availability promotes tourism across the world, but when the economy is talking about HCD, the role of tourism has yet to be revealed in extensive empirical investigation. Furthermore, this study also intended to look into the joint effects of tourism and capital formation and tourism and FDI on HCD. The motivation for joint effects was also studied when it comes to empirical estimation for exploring the indirect effects of gross capital formation and FDI since researchers have documented that tourism boosts the gross capital formation and FDI. Considering the study's motivation, we propose the following conceptual model (**Figure 1**) for understanding and hypothesis development.

The following hypothesis is to be tested in evaluating the directional causalities.

$H^1_{A,B}$: Tourism development Granger causes HCD and vice versa

$H^2_{A,B}$: Financial development Granger causes tourism development and vice versa

$H^3_{A,B}$: Gross capital formation Granger causes HCD and vice versa

$H^4_{A,B}$: Financial development Granger causes HCD and vice versa

$H^5_{A,B}$: Financial development Granger causes gross capital formation and vice versa

$H^6_{A,B}$: Tourism development Granger causes gross capital formation and vice versa.

METHODOLOGY AND DATA OF THE STUDY

Model Specification

The motivation of the study is to gauge the role of tourism on HCD in BRICS for the period 1980–2019 through the channel of capital formation and financial development. In

TABLE 1 | Variable definition and data sources.

Variables	Notation	Definition	Sources
Tourism	*Tor*	Tourism receipt as % of GDP	WDI
Human capital development	*HCD*	Human capital index, based on years of schooling and returns to education.	Penn World Table version 10.0., 2021
Capital formation	*GCF*	Gross capital formation as a % of GDP	WDI
Financial development	*FD*	Financial development index	IMF
Money supply	*MS*	Broad money as a % of GDP	WDI
Foreign Direct Investment	*FDI*	FDI inflows as a % of GDP	WDI

TABLE 2 | The definition of null hypotheses for all three tests.

Cointegration test	Null hypothesis	Alternative hypothesis
F-bound test	$\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$	Any, $u_1, u_2, u_3, u_4 \neq 0$
A *t*-test on lagged dependent variable	$\gamma_1 = 0$	$\gamma_1 \neq 0$
F-test on the lagged independent variable	$\gamma_2 = \gamma_3 = \gamma_4 = 0$	Any,break $u_2, u_3, u_4 \neq 0$

investigating the nexus tourism-led HCD, BRICS has been chosen because tourism is an important area of cooperation among these countries. Cooperation in tourism increases people-to-people exchanges among the BRICS countries, leading to friendship fraternity and a better understanding of each other's culture and heritage. Furthermore, in recognizing the potential of tourism to contribute toward sustainable and socio-economic development, the 2013 BRICS eThekwini Declaration and Action Plan mentioned tourism as one of the new areas of cooperation to be explored by the BRICS countries. This was also reiterated in the Xiamen Declaration in 2017.

Taking into account the empirical nexus, the generalized model is as follows:

$$\text{HCD}|\ \text{tourism},\ \text{financial development},\ \text{capital formation} \quad (1)$$

$$\text{HCD}|\text{TOR},\ \text{FD},\ \text{GCF},\ \text{TOR}^{*}\text{FD},\ \text{GCF}^{*}\text{TOR} \quad (2)$$

Equation (1) deals with the direct effects running from explanatory variables to dependent variables in the equation, but the interactive term incorporation in Equation (2) confirms to reveals both direct and indirect effects of tourism on HCD. The variables delimitation and data sources are displayed in **Table 1**.

Variable Definitions and Descriptive Statistics

Human Capital Development

HCD is the process of enhancing human potential to achieve a healthy and knowledgeable life, a good quality of living, and the capacity to prosper (Becker and Gerhart, 1996). As previously said, HCD comprises the growth of human capability. The human development index (HDI) is a commonly used metric for assessing HCD. It is divided into three dimensions: education, health, and level of life.

Tourism

The term "tourism development" refers to a growth in the number of visitors visiting a nation over time. Increased tourist receipts are connected with tourism development. Tourism receipts are the sum of all expenditures made by visitors who visit a nation during a specific period:

Gross Capital Formation

Nwanna (1986) defined capital formation as the accumulation of both physical and intangible assets, such as plants, equipment, and machines, as well as intangible assets, such as high levels of education, health, and scientific knowledge. According to Kuznets (1955), domestic capital creation comprises additions to domestic structures, equipment, inventories, and additional capital expenditures. Capital accumulation is sometimes linked with earnings or savings, particularly tangible capital goods. Capital creation necessitates that a society or a nation devotes a portion of its existing economic activity to producing capital goods, such as tools and instruments, machinery and transportation infrastructure, and plant and equipment. In other words, it is the allocation of a portion of society's existing available resources to build the stock of capital goods to facilitate future increases in consumable output. Capital formation/accumulation is equivalent to investing in essence.

Financial Development

Financial development is an independent variable seen as a critical economic component. It is defined as the growth of the country's financial markets. A well-functioning financial system benefits the economy by enabling effective intermediation.

Foreign Direct Investment

The amount of FDI inflows is positively related to a country's economic development (Alfaro et al., 2004; Ajayi, 2006; Zhu et al., 2016; Ferdousi and Qamruzzaman, 2017). The need for skilled workers and qualified professionals to manage technical, managerial, and professional jobs has grown as FDI inflows have increased. The development of human capital is thus critical for sustainable social and economic development. FDI flows into emerging nations, and transition economies continue to grow at a breakneck pace. The primary reason for such nations receiving a disproportionate amount of FDI is their substantial investment in knowledge, which resulted in developing a trained labor force capable of embracing technical breakthroughs (Qamruzzaman et al., 2021). FDI is seen favorably by developing nations as a source of finance. Inadequate skills and training adversely affect FDI, reducing capital inflows to the host nation. Countries having

a greater human capital pool attract a greater amount of FDI. The study of Gökmenoglu et al. (2018) advocated that FDI inflows accelerate the poverty allocation process by increasing the skilled workforce in the economy. Furthermore, Iamsiraroj and Ulubaşoglu (2015) documented that FDI inflows augmented HCD by increasing secondary school enrolment in the economy. In a nutshell, the literature suggested that FDI inflow has a positive effect on HCD across the world, which motivated us to incorporate FDI as a control variable in empirical estimation (Qamruzzaman et al., 2021).

Money Supply

In the empirical literature, the role of money supply in the economy has been investigated and documented, such as money supply led inflation, capital accumulation, both physical and human (Olanipekum and Akeju, 2013), economic growth (Doorasamy and Wilfred, 2020), and remittances (Kim, 2019). The study of Cover (1992) investigated the asymmetric effects of output level in the economy. The study documented that positive shocks in money supply increase output level, whereas adverse effects revealed negative shocks in the money supply. In the study of Ezeaku et al. (2018), it was postulated that money supply plays a deterministic role in industrial output acceleration through direct and indirect channels, that is, the optimal level of money supply control inflation and accelerate domestic trade expansion of financial development.

The motivation of the study is to investigate the role of tourism and gross capital formation on HCD in BRICS for the period 1980–2019. By taking into account the variables mentioned above, the following generalized Equation (1) is to be implemented to explore each variable's elasticity

$$HCD_t = \alpha_0 + \beta_1 TOR_t + \beta_2 GCF_t + \beta_3 FD_t + \beta_4 X_t^* \varepsilon_t \ldots, \quad (3)$$

with interactive term for joint effects

$$\begin{aligned} HCD_t = \; & \alpha_0 + \gamma_1 TOR_t + \gamma_2 GCF_t + \gamma_3 FD_t + \gamma_4 (FD_t * TOR)_t \\ & + \gamma_5 (GCF_t * TOR)_t + \gamma_6 X_t^* \varepsilon_t + \varepsilon_t \ldots, \end{aligned} \quad (4)$$

where HCD stands for human capital development, TOR for tourism development, GCF denotes gross capital formation, FD for financial developmen (FD*TOR) and (TOR*GCF) are interactive terms, and X denotes control variables that are FDI and money supply in the economy. E is the error term, and subscript t is the period. All the data were transformed into a natural log before empirical estimation.

Estimation Strategy

Unit Root Test

In empirical model estimation considering time series data, the properties of the variable assessments are critically essential for selecting the appropriate strategies for evaluating the nexus between dependent and explanatory variables (Meng et al., 2021). The study applied several unit root tests for evaluating the variable's stationarity properties, such as the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979), the Philipps-Perron (P-P) test (Phillips and Perron, 1988), the Dickey-Fuller Generalized Least Square (DF-GLS) test (Elliott et al., 1996), the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (Kwiatkowski et al., 1992), and the Zivor-Andrews (Z-A) test (Zivot and Andrews, 2002) for one structural break in the research unit.

The ADF test has investigated the stationary properties with a lagged difference form of target variable so that serial correlation can be addressed. The following system function is to be considered.

$$\Delta Y = \gamma_0 + \gamma_1 Y_{t-1} + y2^t + \sum_{i=1}^{w} \alpha_i \Delta Y_{t-1} + \mu_t, \quad (5)$$

Elliott et al. (1996) extended the ADF test and used the DF-GLS test, performed based on ordinary least square (OLS). The stationary test through DF-GLS allows linear trend in assessment, which is as follows:

$$\Delta y_t^d = \alpha y_{t-1}^d + \sum_{i=1}^{p} \vartheta_j \Delta y_{t-i}^d + \sigma_t, \quad (6)$$

where y_t^d stands for de-trend data and σ_t stands for the white noise error term.

Kwiatkowski et al. (1992) familiarized the unit root test with the null hypothesis of stationary by implementing the following time series mode:

$$y_t = \beta_0 + \beta_1 t + \gamma_t + \epsilon_t \quad (7)$$

$$\gamma_t = \gamma_{t-1} + \theta_t, \quad (8)$$

where β_0 and β_1 explain the deterministic term in a constant form and a linear trend in Equation (7), whereas γ_t stands for the random walk factors in the estimation. Kwiatkowski et al. (1992) proposed the following Lagrange multiplier (LM) test statistics for stationary tests.

$$LM = \frac{1}{T^2} \frac{\sum_{t-1}^{T} M_t^2}{\widehat{\delta^2}},$$

where $M_T = \sum_{i=1}^{t} e_i$ stands for residuals from OLS estimation and δ^2 is the variance estimator, which may remove nuisance parameters from the asymptotic distribution of the LM statistics under the null hypothesis.

Bayer and Hacked Combined Cointegration Test

In investigating the long-run association in empirical assessment, the conventional cointegration was extensively used prior to the inception of the novel combined cointegration test. In some instances, the conclusion reached with different cointegration tests revealed inconclusive decisions. Therefore, the so-called Bayer-Hanck test was newly proposed by Bayer and Hanck (2013) by ensuring the power of cointegration test, with the unique aspect of generating a joint test-statistic for the null hypothesis of no cointegration based on Engle and Granger, Johansen, Peter Boswijk, and Banerjee tests. Since this new approach allows us to combine various individual cointegration

test results to provide a more conclusive finding, it is also applied in this study to check the presence of a cointegrating relationship between tourism, gross capital formation, foreign direct investment, financial development, money supply, and HCD in BRICS nations.

The study implemented the cointegration test by following the framework proposed by Bayer and Hanck (2013), commonly known as the combined cointegration test. The proposed cointegration test consists of four conventional tests of cointegration familiarized by Engle and Granger (1987), Johansen (1991), Peter Boswijk (1994), and Banerjee et al. (1998), and with the null hypothesis of the no cointegration test, and the following Fishers' equation is considered in deriving the test statistics for detecting long-run association.

$$\begin{aligned} EG-JOH &= -2[LN\,(PEG)+LN\,(PJOH)] \\ EG-JOH &- BO-BD = -2[LN\,(PEG)-\ln(PJPH) \\ &+ \ln(PBO)+\ln(PBDM\,)], \end{aligned}$$

where PBDM, PBO, PJOH, and PEG stand for the significance levels of Engle and Granger (1987), Johansen (1991), Boswijk (1995), and Banerjee et al. (1998), respectively.

Augmented ARDL

In recent times, by investigating long-run association in empirical studies, the framework proposed by Pesaran known as ARDL was extensively applied to see (Qamruzzaman and Jianguo, 2018; Qamruzzaman et al., 2020; Qamruzzaman and Karim, 2020a,b). ARDL estimation possesses certain benefits over traditional cointegration tests, those are, (1) efficient estimation regardless of the study's sample size (Ghatak and Siddiki, 2001), (2) capability of handling mixed-order variable integration, and selecting appropriate lagged specifications for model stability and efficiency (Pesaran et al., 2001), and (3) unbiased estimation for both long-run and short-run elasticity (Banerjee et al., 1993) (see **Table 2**).

Following Pesaran et al. (2001), the Equations (3) and (4) transformed into a generalized ADRL model for investigating the role of tourism on HCD through the channel of capital formation and financial development.

$$\begin{aligned} \Delta lnHCD_t &= \alpha_0+\sum_{i=1}^{n}\mu_1\Delta lnHCD_{t-i}+\sum_{i=0}^{n}\mu_2\Delta lnTOR_{t-i} \\ &+ \sum_{i=0}^{n}\mu_3\Delta lnCF_{t-i}+\sum_{i=0}^{n}\mu_4\Delta lnFD_t \\ &+ \sum_{i=0}^{n}\mu_5\Delta lnGCF_{t-i}+\sum_{i=0}^{n}\mu_6\Delta lnX_{t-i} \\ &+ \gamma_1 lnTOR_{t-1}+\gamma_2 lnCF_{t-1} \\ &+ \gamma_3 lnFD_{t-1}+\gamma_4 lnX_{t-1}+\omega_{1t} \end{aligned} \quad (9)$$

$$\begin{aligned} \Delta lnHCD_t &= \alpha_0+\sum_{i=1}^{n}\mu_1\Delta lnHCD_{t-i}+\sum_{i=0}^{n}\mu_2\Delta lnTOR_{t-i} \\ &+ \sum_{i=0}^{n}\mu_3\Delta lnCF_{t-i}+\sum_{i=0}^{n}\mu_6\Delta lnFD_t \\ &+ \sum_{i=0}^{n}\mu_7\Delta lnCF*TOR_{t-i}+\sum_{i=0}^{n}\mu_7\Delta lnFD*TOR_{t-i} \\ &+ \gamma_1 lnTOR_{t-1}+\gamma_2 lnCF_{t-1}+\gamma_3 lnFD_{t-1} \\ &+ \gamma_4 lnFD*TOR_{t-1}+\gamma_5 lnCF*TOR_{t-1}+\omega_{1t} \end{aligned} \quad (10)$$

where Δ indicates differencing of variables, while is the error term (white noise), and (t-1) is for the lagged period. Based on linear ARDL, the long-run coefficient were available from γ_1 to γ_5 and short-run coefficients were obtained from $\mu_1$to μ_5 from each empirical model estimation. Long-run association between variables were tested following the F-test (Pesaran et al., 2001) and the lagged level of the dependent variable following the *t*-test, as suggested by and the lagged levels of the independent variable(s) following another additional F-test as suggested by McNown et al. (2018).

The study implemented the following equation with error correction terms to capture the short-run dynamics.

$$\begin{aligned} \Delta lnHCD_t &= \alpha_2+\sum_{i=1}^{n}\beta_1\Delta lnHCD_{t-i}+\sum_{i=0}^{n}\beta_2\Delta lnTOR_{t-i} \\ &+ \sum_{i=0}^{n}\beta_3\Delta lnR_{t-i}+\sum_{i=0}^{n}\beta_6\Delta lnFDI_t \\ &+ \sum_{i=0}^{n}\beta_7\Delta lnGCF_{t-i}+\rho ECT_{t-1}+\omega_{1t} \end{aligned} \quad (11)$$

$$\begin{aligned} \Delta lnHCD_t &= \alpha_2+\sum_{i=1}^{n}\beta_1\Delta lnHCD_{t-i}+\sum_{i=0}^{n}\beta_2\Delta lnTOR_{t-i} \\ &+ \sum_{i=0}^{n}\beta_3\Delta lnGCF_{t-i}+\sum_{i=0}^{n}\beta_4\Delta lnFD_t \\ &+ \sum_{i=0}^{n}\beta_5\Delta lnX_{t-i}+\sum_{i=0}^{n}\beta_6\Delta lnTOR*GCF_{t-i} \\ &+ \sum_{i=0}^{n}\beta_7\Delta lnTOR*FD_{t-i}+\rho ECT_{t-1}+\omega_{1t} \end{aligned} \quad (12)$$

Researchers used the Granger (1969) causality test to look into causal relationships between macroeconomic variables. However, structural discontinuities in the series are ignored by the Granger test and many other causality tests in the literature, including those by TY (Toda and Yamamoto, 1995). Enders and Jones (2016) demonstrated that incapacity to account for structural breaks leads to misspecification issues in the vector autoregression (VAR) model. As a result, deviations toward the erroneous rejection of the true null hypothesis arise. The Fourier-TY causality tests were developed by Nazlioglu et al.

(2016) to compensate for this omission with the extension of the trigonometric term, and the VAR model can be reproduced in the following ways:

$$y_t = \alpha(t) + \beta_1 y_{t-1} + \ldots + \beta_{p+d} y_{t-(p+d)} + \varepsilon_t \quad (13)$$

where $\alpha(t)$ explain the possible structural changes in the dependent variable (y), β_1 stands for the coefficients, and ε_t stands for the white noise error term in the equation. The above Equation (13) can be transformed with Fourier functions for capturing the unknown structural changes in the following manner.

$$y_t = \alpha(t) + \beta_1 y_{t-1} + \ldots + \beta_{p+d} y_{t-(p+d)} + \vartheta_1 \sin\frac{2k\pi t}{T} + \vartheta_2 \cos\frac{2k\pi t}{T} + \varepsilon_t \quad (14)$$

where k refers to the frequency, t denotes time trend, T shows the number of observations, and %_ and %_ measures the amplitude and displacement of the frequency. The null hypothesis for Fourier–TY test is no causality between variables ($H_0: \beta_1 = \beta_2 \ldots\ldots\ldots\ldots\ldots \beta_P = 0$).

ESTIMATION AND INTERPRETATION

Unit Root Test

Detection of variable properties is one of the critical strategic decisions for appropriate selection of econometrical model; thus, we begin by implementing the test of stationery, the unit root test. The study implemented both conventional unit root test following Dickey and Fuller (1979), Phillips and Perron (1988), unit root following Kwiatkowski et al. (1992) and Elliott et al. (1996), as well as unit root test following Ng and Perron (2001) and unknown structural break unit root test following (Zivot and Andrews, 2002). The conventional unit root test displayed in **Table 3** reveals that few variables are stationary at a level, but all the variables become stationary after the first difference; it was suggested that few variables can be used directly into the empirical estimation without derivation, but according to stationary test, some variables need to be derived with differential for empirical assessment. However, neither variables were exposed to stationary after the second difference. The conclusion is valid for all counties in the study samples.

The unit root test results with an unknown structural break are displayed in **Table 4**. According to test statistics, all the variables are stationary after first difference with one structural, particularly HCD, exposed stationary each with break year (optimal lag) for Brazil 2001(2), Russia 2014(1), India 2008(1), China 1999(1), and South Africa 2009(1).

The following study moved to detect the long-run association in the empirical equation before implementing the target model by implementing the novel test of cointegration familiarized by Bayer and Hanck (2013). The result of the cointegration test is displayed in **Table 5**. It was found that all the test statistics of model [1] to [5] were higher than the offered critical value at a 5% level of significance, suggesting the long-run association available between HCD, TOR, GCF, FD, MS, and FDI in BRICS nations. Considering the novel cointegration test results, it is postulated that all the selected independent variables are critically important in ensuring sustainable HCD because the long-run association explained co-effects running between dependent and independent variables. Thus, any variations in any variables can be caused in either manner.

Empirical Model Estimation With Equation (1)

Next, we moved to gauge the long-run association between remittances, financial development, cash flows, and HCD by performing the Equation (9). The long-run association under the augmented ARDL framework is displayed in **Table 6**. The study documented that the test statistics of $F_{overall,}$ $t_{DV,}$ and F_{IDV} are statistically significant at a 1% significance, suggesting the long-run cointegration between research units. The conclusion of long-run association in the empirical model is valid for all sample countries' estimations. Once the cointegration has been detected, the study evaluates the long-run and short-run magnfititutes of explanatory variables on HCD in BRICS nations.

The empirical estimation results of the long-run and short-run coefficients are displayed in **Table 7**, with Panel A for long-run coefficients, panel B for short-run coefficients, and the residual diagnostic test for panel C. Referring to tourism effects on HCD, the study documented positive and statistically significant association in Brazil (a coefficient of 0.1728), in Russia (a coefficient of 0.1257), in India (a coefficient of 0.1713), in China (a coefficient of 0.1903), and in South Africa (a coefficient of 0.1751%). More precisely, a 10% growth in tourism development in terms of tourism receipts can result in augmenting the progress of the human capital accumulation process in BRICS nations by 1.728% in Brazil, 1.257% in Russia, 1.711% in India, 1.903% in China, and 1.751% in South Africa. The study findings suggest that continual inflows of tourism income in the economy can boost the speed of HCD and support sustainable economic growth. Our findings align with existing literature such as Ngoma and Ismail (2013). The short-run assessment has revealed a similar association line to the long-run assessment, that is positive and statistically significant. In the short run, a 10% growth in remittance receipts increases HCD by 1.02% in Brazil, by 0.93% in Russia, by 0.9365% in India, by 0.88% in China, and by 0.48% in South Africa. However, the short-run elasticities are less prominent compared with the long-run horizon.

The role of capital adequacy in capital formation in the economy boosts the present state of human capital accumulation, suggesting the positive and statistically significant association between capital formation and HCD in BRICS nations. In particular, a 10% growth in domestic capital formation in BRICS can increase the process of human capital accumulation by 0.911% in Brazil, 0.979% in Russia, 1.457% in India, 1.109% in China, and 1.556% in South Africa. While referring to short-run coefficients, the positive effects are from gross capital formation to HCD. However, the magnfititutes are more evident in the long-run compared with the short-run. Precisely, a 10% innovation in gross capital formation in the short-run accelerates the HCD process by 0.153% in Brazil, 0.104% in India, 0.125% in China,

TABLE 3 | Results of conventional unit root test.

	At level				After first difference			
	ADF	**GF-DLS**	**PP**	**KPSS**	**ADF**	**GF-DLS**	**PP**	**KPSS**
				Panel-A: for brazil				
HCD	−0.461	−1.757	−0.027	0.9280	−7.346	−4.181	−4.199	0.1570
TOR	−1.671	−0.239	−1.871	0.7600	−4.554	−3.588	−4.297	0.0770
CF	−0.908	−1.717	−0.165	0.9510	−6.919	−2.502	−4.053	0.1240
FD	−1.287	−0.85	−1.314	0.8070	−5.764	−2.394	−4.166	0.1310
MS	−2.145	−1.821	−1.538	0.8600	−5.077	−2.385	−4.535	0.1060
FDI	−2.337	−1.455	−0.505	0.7060	−4.019	−4.896	−4.769	0.1510
				Panel-B: for Russia				
HCD	−1.866	−1.468	−2.714	0.7950	−7.98	−3.915	−3.235	0.1840
TOR	−2.617	−2.217	−1.319	0.6890	−4.666	−3.696	−5.123	0.1810
CF	−1.121	−1.237	−0.249	0.8610	−6.973	−4.532	−3.525	0.1120
FD	−0.32	−0.325	−2.505	0.8360	−5.074	−4.495	−4.467	0.0960
MS	−1.201	−1.063	−2.496	0.7780	−7.85	−3.277	−5.348	0.1450
FDI	−0.347	−2.429	−1.753	0.7170	−7.243	−2.133	−3.103	0.0990
				Panel-C: India				
HCD	−2.751	−2.119	−0.215	0.7700	−4.591	−2.996	−5.876	0.0990
TOR	−0.152	−2.776	−1.73	0.9180	−4.544	−2.748	−3.783	0.1610
CF	−1.82	−0.451	−1.958	0.9070	−4.841	−3.193	−3.411	0.1310
FD	−1.003	−2.121	−2.887	0.9380	−6.69	−4.619	−3.614	0.1360
MS	−1.545	−0.56	−2.867	0.7820	−6.879	−2.05	−3.248	0.0750
FDI	−1.138	−2.943	−1.323	0.7730	−4.669	−2.166	−5.629	0.1280
				Panel-D: for China				
HCD	−2.15	−1.304	−2.235	0.7090	−6.079	−4.955	−3.516	0.1000
TOR	−2.35	−1.38	−2.965	0.8930	−5.204	−2.945	−4.732	0.1210
CF	−0.318	−0.428	−2.542	0.9070	−5.653	−4.251	−5.231	0.1470
FD	−0.463	−1.715	−1.42	0.9800	−5.124	−2.184	−5.295	0.1530
MS	−2.582	−2.629	−1.339	0.7490	−5.027	−2.08	−5.246	0.0890
FDI	−0.161	−1.336	−2.311	0.7820	−7.891	−3.36	−5.498	0.1030
				Panel-E: for South Arica				
HCD	−0.477	−1.232	−1.033	0.8830	−5.815	−3.893	−4.063	0.0890
TOR	−1.841	−2.83	−1.656	0.7290	−4.854	−3.71	−5.595	0.1430
CF	−1.122	−0.031	−0.57	0.9690	−4.781	−3.296	−5.696	0.1590
FD	−0.629	−1.799	−0.164	0.7930	−6.916	−2.411	−3.947	0.1710
MS	−2.974	−1.474	−0.98	0.9700	−6.856	−2.435	−3.816	0.1080
FDI	−2.915	−0.487	−0.311	0.7990	−6.492	−4.544	−3.606	0.1660

and 0.129% in South Africa, whereas negative linkage was revealed in Russia with a coefficient of −0.683%.

For nexus between financial development and HCD, the study established a positive and statistically significant association in the long run (short run) in Brazil with a coefficient of 0.1378 (0.0233), in Russia with a coefficient of 0.096 (0.0162), in India with a coefficient of 0.1427 (0.0058), in China with a coefficient of 0.1681 (0.097), and in South Africa with a coefficient of 0.0913 (0.0288). Long-run magnfititutes of financial development are evident in comparison to the short-run assessment. More precisely, a 10% further development in the financial system can accelerate the growth of human capital accumulation in the economy by 1.378% in Brazil, 0.96% in Russia, 1.427% in India, 1.681% in China, and 0.913% in South Africa.

The coefficient of error correction established negative and statistically significant at a 1% level of significance, suggesting that long-run convergence toward the equilibrium position. More precisely, due to explanatory variables shock in the short-run, the disequilibrium state can be rectified at a speed of 14.4% per period in Brazil, 12.12% per period in Russia, 15.84% per period in India, 36.2% per period in China, and 11.64% per period in South Africa. Furthermore, the study has implemented several residual diagnostic tests for confirming the model's internal consistency, robustness in estimation, and efficiency in managing residual (see Panel-C). Referring to residual diagnostic test statistics, it was revealed that empirical models are free from serial correlation, and normally distributed residuals have no issue for heteroskadacity.

TABLE 4 | Results of unit root test with an unknown structural break.

	Test statistics	Break point	lag		Test statistics	Break point	lag
			Panel-A: for Brazil				
HCD	−2.379	2015	1	ΔHCD	−5.044	2001	2
TOR	−2.55	2011	2	ΔTOR	−6.048	2010	1
CF	−2.713	2000	1	ΔCF	−5.086	2004	2
FD	−3.107	2013	1	ΔFD	−8.174	1997	3
MS	−2.328	2015	3	ΔMS	−5.551	2007	2
FDI	−1.902	2011	2	ΔFDI	−6.735	2000	2
			Panel-B: for Russia				
HCD	−3.151	1998	2	ΔHCD	−5.698	2014	1
cTOR	−2.36	2011	2	ΔTOR	−8.78	2002	2
CF	−1.96	2005	2	ΔCF	−7.621	1998	2
FD	−2.944	2008	2	ΔFD	−7.581	2005	2
MS	−2.334	2014	3	ΔMS	−8.029	2016	3
FDI	−2.227	2002	3	ΔFDI	−8.155	1999	3
			Panel-C: for India				
HCD	−2.805	1999	3	ΔHCD	−8.776	2008	1
TOR	−2.688	2007	3	ΔTOR	−8.598	2017	3
CF	−2.544	2012	3	ΔCF	−5.841	2012	1
FD	−2.473	2002	2	ΔFD	−7.578	2018	2
MS	−2.797	2010	3	ΔMS	−7.696	2006	2
FDI	−2.747	2010	3	ΔFDI	−7.506	1998	1
			Panel-D: China				
HCD	−2.171	2003	2	ΔHCD	−7.783	1999	1
TOR	−2.627	2009	3	ΔTOR	−6.896	2014	1
CF	−2.752	2013	2	ΔCF	−7.868	2008	2
FD	−2.9	2005	2	ΔFD	−7.403	1998	3
MS	−2.436	2016	2	ΔMS	−7.038	1998	3
F	−2.813	2005	3	ΔFDI	−9.098	2002	1
			Panel-E: for South Africa				
HCD	−2.291	2005	1	ΔHCD	−6.531	2009	1
TOR	−2.89	2000	2	ΔTOR	−6.303	2017	1
CF	−2.716	2012	3	ΔCF	−6.968	2002	3
FD	−3.01	2014	1	ΔFD	−8.695	2005	3
MS	−2.093	2018	3	ΔMS	−7.917	2010	2
FDI	−2.792	2009	1	ΔFDI	−6.794	2007	3

Next, we gauge the long-run cointegration between remittances, financial development, cash flows, and HCD by performing Equation (10) with the interactive term: TOR*FDD, TOR*GCF for indirect effects of tourism through the channel of financial development and capital formation in the economy. The long-run association under the augmented ARDL framework is dispalyed in **Table 8**. The study documented that the test statistics of $F_{overall,}$ $t_{DV,}$ and F_{IDV} are statistically significant at a 1% significance, suggesting the long-run cointegration between research units. The conclusion of long-run association in the empirical model is valid for all sample countries' estimations. Once the cointegration has been detected, the study evaluates the long-run and short-run magnfititutes of explanatory variables on HCD in BRICS nations.

The results of long-run and short-run coefficients empirical estimation with interactive term is displayed in **Table 9**, with Panel A for long-run coefficients, Panel B for short-run coefficients, and Panel C for residual diagnostic test. Referring to tourism effects on HCD, the study documented positive and statistically significant association in Brazil (a coefficient of 0.0741), Russia (a coefficient of 0.0911), India (a coefficient of 0. 0694), China (a coefficient of 0.158), and South Africa (a coefficient of 0.1,227). More precisely, a 10% growth in tourism development in terms of tourism receipts can result in augmenting the progress of the human capital accumulation process in BRICS nations by 0.741% in Brazil, 0.911% in Russia, 0.694% in India, 1.58% in China, and 1.227% in South Africa. Study findings suggest that continual inflows of tourism

TABLE 5 | Results of Bayer–Hacked combined counteraction test.

Model		EG-JOH	EG-JOH-BO-BDM
HCD|TOR		10.996	23.42
HCD|TOR	Brazil	10.996	23.42
	Russia	11.554	24.129
	India	13.125	27.341
	China	10.897	24.209
	South Africa	13.609	23.682
HCD|TOR, GCF	Brazil	11.021	27.541
	Russia	11.101	23.904
	India	12.31	25.94
	China	12.319	24.313
	South Africa	13.56	27.121
HCD|TOR, GCF, FD	Brazil	13.089	26.482
	Russia	14.109	24.61
	India	11.782	23.629
	China	11.587	27.275
	South Africa	13.405	25.047
HCD|TOR, GCF, FD, MB	Brazil	13.301	26.958
	Russia	10.892	23.127
	India	11.997	23.802
	China	13.299	26.436
	South Africa	12.321	26.269
HCD|TOR, GCF, FD, MB, FDI	Brazil	11.047	26.144
	Russia	12.718	24.879
	India	13.437	22.568
	China	12.91	27.272
	South Africa	14.239	23.831

income in the economy can boost the speed of HCD and support sustainable economic growth. The short-run assessment has revealed a mixed level of association, that is, positive and negative linkage with HCD, and all the coefficients are statistically. In particular, a 10% growth in remittance receipts in the short run results in increasing the HCD by 0.648% in India and 0.21% in South Africa, whereas tourism adversely causes HCD by 0.664% in Brazil, 0.945 in Russia, and 0.513% in China.

Regarding the role of capital adequacy in human capital formation in the economy, the study has documented the positive tie with HCD in BRICS nations: Brazil (a coefficient of 0.1248), Russia (a coefficient of 0.1525), India (a coefficient of 0.0579), China (a coefficient of 0.0994), and South Africa (a coefficient of 0.1317). In particular, a 10% growth in domestic capital formation in BRICS can increase human capital accumulation by 1.248% in Brazil, 1.525% in Russia, 0.579% in India, 0.994% in China, and 1.317% in South Africa. Regarding short-run coefficients, the adverse effects run from gross capital formation to HCD in Brazil (a coefficient of −0.0243), Russia (a coefficient of −0.0689), India (a coefficient of −0.0426), and South Africa (a coefficient of −0.0086), whereas a positive and statistically significant connection was revealed in China (a coefficient of 0.126).

Referring to the association between financial development and HCD in BRICS nations, the study findings documented a positive and statistically significant tie between the measurement of financial development and HCD in the long run and mixed-effects revealed in the short run. In the long run, a 10% growth in the financial system can trigger the present state of HCD by 1.139% in Brazil, 1.646% in Russia, 1.357%, 1.231% in China, and 0.684% in South Africa. On the other hand, financial development in the short-run revealed positive and statistically significant association in China (a coefficient of 0.0425) and South Africa (a coefficient of 00728), whereas a negative and statistically significant association was found in Brazil (a coefficient of −0.0267), Russia (a coefficient −0.0562), and India (a coefficient −0.064). So, it is assumed that financial development has critical importance for sustainable HCD; thus, BRICS nations have to establish uniformity between financial policy formulation and HCD strategies in the economy.

Referring to the coefficients of interactive terms, that is, the indirect effects of tourism on HCD through the channel of financial development (TOR*FD) and capital formation (GCF*TOR), the study documented a positive and statistically significant connection between TOR*CF (TOR*FD) with HCD in the long run in Brazil with a coefficient of 0.051 (0.0938), in Russia with a coefficient of 0.0488 (0.0762), in India with a coefficient of 0.1796 (0.0527), in China with a coefficient of 0.0677 (0.0746), and in South Africa with a coefficient of 0.0248 (0.0297). For the short-run assessment, the study documented a mixed nature of association, that is, both positive and negative linkage were revealed, but the coefficients' elasticity is petty insignificant.

The speed of long-run disequilibrium correction due to short-run shocks is measured by the coefficient of the error correction term and has to be negative and statistically significant. More precisely, due to explanatory variables shock in the short run, the disequilibrium state can be rectified at a speed of 10.43% per period in Brazil, 8.94% per period in Russia, 15.98% per period in India, 17.47% per period in China, and 45.9% in South Africa. Furthermore, the study has implemented several residual diagnostic tests to confirm the model's internal consistency, robustness in estimation, and efficiency in managing residual (see panel-C). Referring to residual diagnostic test statistics, it is revealed that empirical models are free from serial correlation, and normally distributed residuals have no issue for heteroskadacity.

Next, the directional association in the empirical equation has been derived by implementing the novel TY causality test with the Fourier function familiarized by Enders and Jones (2016). The results of the causality test are displayed in **Table 10**. The study documented several directional causalities among the research units. However, considering the target association of tourism and HCD, the study documented feedback hypothesis that is bidirectional causality [TOR←→HCD] in all sample countries except India. The feedback hypothesis between tourism and HCD explained the complementary association between them; precisely, strategic decisions for tourism or HCD can be

TABLE 6 | Augmented Autoregressive Distributed Lagged (AARDL) cointegration test.

Empirical model	Test statistics	Brazil	Russia	India	China	South Africa
HCD|*TOR, FD, GCF, MS, FDI*	$F_{overall}$	10.229***	9.847***	9.818***	8.811***	9.848***
	t_{DV}	−7.771***	−7.83***	−8.117***	−8.207***	−6.586***
	F_{IDV}	4.254***	4.883***	6.57***	4.321***	5.961***
Critical value : K = 5	1%		5%		10%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Pesaran et al. (2001)	5.095	6.77	3.673	5.002	3.087	4.277
Narayan (2005)	−3.96	−5.13	−3.41	−4.52	−3.13	−4.21
Sam et al. (2019)	3.58	5.91	2.46	4.18	2.00	3.47

****denote 1% level of significant.*

TABLE 7 | Results of long-run and short-coefficient with AARDL.

	Brazil	Russia	India	China	South Africa
Panel-A: Long-run coefficients					
TOR	0.1728 (0.0461) [3.7487]	0.1257 (0.0832) [1.5113]	0.1713 (0.0536) [3.1967]	0.1903 (0.0826) [2.3041]	0.1751 (0.018) [9.6871]
CF	0.0911 (0.057) [1.5955]	0.0979 (0.0231) [−4.1201]	0.1457 (0.0391) [3.7209]	0.1109 (0.0398) [2.7836]	0.1556 (0.0742) [2.0959]
FDB	0.1378 (0.0526) [2.6194]	0.0960 (0.3946) [2.4332]	0.1427 (0.096) [1.4855]	0.1681 (0.037) [4.5395]	0.0913 (0.0643) [1.4203]
FDI	0.248 (0.0117) [21.1156]	0.012 (0.0108) [1.1109]	0.1158 (0.0455) [2.5459]	0.0559 (0.0061) [9.0641]	−0.1814 (0.0594) [−3.0516]
MS	0.1305 (0.0847) [1.5402]	0.0751 (0.1653) [0.4541]	−0.0884 (0.0526) [−1.6813]	0.107 (0.0563) [1.8989]	0.1283 (0.0943) [1.3605]
DMU	−0.0742 (0.0368) [−2.0166]	−0.0088 (0.0066) [−1.3346]	0.0151 (0.0096) [1.5754]	0.2024 (0.0744) [2.7203]	−0.1673 (0.0443) [−3.7726]
C	2.1897 (0.9027) [2.4254]	2.638 (1.3638) [1.9343]	−0.4741 (0.091) [−5.2063]	−0.0974 (0.0203) [−4.7809]	−0.134 (0.0846) [−1.584]
Panel-B: Short-run coefficients					
TOR	0.102 (0.039) [2.6096]	0.093 (0.041) [2.2496]	0.0936 (0.0139) [6.7009]	0.088 (0.0494) [1.7806]	0.048 (0.0168) [2.8514]
CF	0.0153 (0.0037) [4.1717]	−0.0683 (0.0109) [−6.2523]	0.0104 (0.0012) [8.2747]	0.0125 (0.0055) [2.2558]	0.0129 (0.0019) [6.4671]
FD	0.0233 (0.0031) [3.7173]	0.0162 (0.0386) [0.4201]	0.058 (0.0091) [5.9959]	0.097 (0.0502) [1.9329]	0.0288 (0.0027) [10.3156]
FDI	0.0029 (0.001) [2.6839]	−0.0388 (0.0445) [−0.8708]	−0.0023 (0.0008) [−2.9291]	0.0792 (0.0085) [9.2646]	0.0144 (0.0018) [7.6939]
MS	0.0023 (0.0011) [2.141]	−0.0338 (0.001) [−32.3444]	−0.0079 (0.001) [−7.3314]	0.013 (0.0049) [2.6585]	−0.0059 (0.0013) [−4.5807]
DMU	−0.0033 (0.0012) [−2.7379]	0.0168 (0.0029) [5.7899]	−0.0824 (0.0055) [−14.914]	0.145 (0.0098) [14.8047]	−0.0841 (0.0068) [−12.2037]
CointEq (−1)*	−0.144 (0.003) [−44.4307]	−0.1212 (0.0045) [−26.8451]	−0.1584 (0.0102) [−15.5056]	−0.362 (0.0219) [−16.487]	−0.1164 (0.0109) [−10.6784]
Panel-C: Residual diagnostic test					
	0.5107	0.6826	0.528	0.4888	0.7222
	0.5492	0.5895	0.6382	0.412	0.4782
	0.6035	0.7945	0.4266	0.5925	0.5337
	0.5447	0.7586	0.4241	0.7635	0.4235

attributed to either side. Thus, it is suggested for the policy-making concern that, when formulating the macro policies focusing on tourism and human capital accumulation in BRICS nations, that both aspects receiving full attention needs to be ensured.

DISCUSSION

Referring to tourism effects on HCD, the study established a positive and statistically significant association between them, suggesting the booster role of tourism receipts in the process

TABLE 8 | AARDL cointegration with the interactive term.

Empirical model		Test statistics	Brazil	Russia	India	China	South Africa
HCD|*TOR, FD, GCF, MS, FDI, TOR*GCR, TOR*FD*		$F_{overall}$	11.131****	8.816***	9.913***	9.529***	9.806***
		t_{DV}	−8.112***	−7.673***	−8.313***	−7.812***	−8.406***
		F_{IDV}	6.38***	8.47***	7.76***	8.91***	8.53***
Critical value : K = 7	1%		5%		10%		
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
Pesaran et al. (2001)	4.459	6.206	3.251	4.64	2.729	3.985	
Narayan (2005)	−3.96	−5.49	−3.41	−4.85	−3.13	−4.53	
Sam et al. (2019)	3.58	5.91	2.46	4.18	2.00	3.47	

****,**, * denotes the level of insignificant at a 1%, 5% and 10%, respectively.*

TABLE 9 | Model estimation with an interactive term for indirect effects.

	Brazil	Russia	India	China	South Africa
			Panel-A: Long-run coefficients		
TOR	0.0741 (0.0271) [2.7341]	0.0911 (0.0196) [4.5863]	0.0694 (0.6077) [0.1142]	0.158 (0.0864) [1.8271]	0.1227 (0.1556) [0.7886]
CF	0.1248 (0.0136) [9.1286]	0.1525 (0.0776) [1.9642]	0.0579 (0.0026) [22.0228]	0.0994 (0.0756) [1.3156]	0.1317 (0.0813) [1.6199]
FD	0.1139 (0.063) [2.2209]	0.1646 (0.0691) [2.3813]	0.1357 (0.0202) [6.4451]	0.1231 (0.0184) [6.682]	0.0684 (0.0387) [1.7665]
FDI	0.0433 (0.013) [3.3262]	0.0561 (0.0185) [3.0248]	0.0167 (0.0073) [2.2637]	0.018 (0.0088) [2.043]	0.0877 (0.0502) [1.7455]
MS	−0.1409 (0.0815) [−1.7291]	0.1022 (0.0856) [1.1934]	−0.0955 (0.0399) [−2.3939]	0.0412 (0.0209) [1.9653]	−0.0414 (0.0066) [−6.1994]
TRCF	0.051 (0.0219) [2.3265]	0.0488 (0.0176) [2.7646]	0.1796 (0.0273) [6.5733]	0.0677 (0.012) [−5.613]	0.0248 (0.0039) [6.2342]
TRFD	0.0938 (0.0265) [3.5319]	0.0762 (0.0254) [−3.0003]	0.0527 (0.0157) [−3.3608]	0.0746 (0.0357) [2.0911]	0.0297 (0.8911) [0.0333]
C	−13.6698 (1.9671) [−6.9491]	9.0478 (0.3777) [23.9545]	2.0235 (0.5047) [4.0093]	−2.2622 (0.9963) [−2.2704]	3.7674 (71.5122) [0.0526]
			Panel-B: Short–run coefficients		
TOR	−0.0664 (0.0395) [−1.6828]	−0.0894 (0.0296) [−3.0196]	0.0648 (0.0124) [5.1923]	−0.0513 (0.0076) [−6.7187]	0.021 (0.0031) [6.7042]
CF	−0.0243 (0.006) [−4.0584]	−0.0689 (0.0198) [−3.4802]	−0.0426 (0.0139) [−3.0573]	0.126 (0.056) [2.2485]	−0.0086 (0.0038) [−2.2331]
FD	−0.0267 (0.0093) [−2.8722]	−0.0562 (0.0175) [−3.2021]	−0.064 (0.0303) [−2.1126]	0.0425 (0.0193) [2.1973]	0.0728 (0.0125) [5.7919]
FDI	0.1905 (0.6997) [0.2722]	−0.0783 (0.0157) [−4.9594]	−0.037 (0.0081) [−4.5343]	−0.0651 (0.0221) [−2.9455]	−0.0453 (0.0184) [−2.462]
MS	0.0003 (0.001) [0.394]	−0.0848 (0.0494) [−1.7156]	0.0014 (0.0311) [0.0469]	0.046 (0.0181) [2.5305]	−0.0175 (0.003) [−5.6623]
TRCF	0.0094 (0.0009) [9.4318]	0.0687 (0.023) [2.9808]	−0.0197 (0.0106) [−1.8618]	−0.0658 (0.0174) [−3.7661]	−0.0171 (0.0239) [−0.7156]
TRFD	0.0092 (0.0024) [3.7312]	0.0135 (0.007) [1.9195]	0.0308 (0.0091) [3.3792]	−0.0544 (0.0167) [−3.2486]	0.1308 (0.023) [5.6741]
CointEq (−1)	−0.1043 (0.0213) [−4.8901]	−0.0894 (0.028) [−3.1929]	−0.1598 (0.0264) [−6.0545]	−0.1747 (0.0244) [−7.1552]	−0.459 (0.0017) [59.6272]
			Panel-C: Residual diagnostic test		
	0.7995	0.6846	0.5773	0.8423	0.7953
	0.4815	0.4471	0.4281	0.6063	0.5408
	0.442	0.7738	0.5316	0.4298	0.6524
	0.8431	0.4009	0.4589	0.4431	0.471

TABLE 10 | Toda–Yamamoto Fourier causality test.

	Brazil		Russia		India		China		South Africa	
TOR ↛ HCD	8.09 [0.032]	√	16.474 [0.004]	√	5.493 [0.022]	√	14.627 [0.005]	√	10.075 [0.0002]	√
GCF ↛ HCD	14.676 [0.030]	√	13.739 [0.027]	√	12.163 [0.011]	√	1.39 [0.665]	√	8.149 [0.047]	√
FD ↛ HCD	15.258 [0.039]	√	1.744 [0.138]		0.274 [0.756]		2.31 [0.391]	√	1.013 [0.740]	
FDI ↛ HCD	0.916 [0.621]		6.924 [0.027]	√	11.786 [0.004]	√	1.826 [0.187]	√	4.078 [0.0490]	√
GCF ↛ HCD	9.512 [0.011]	√	14.233 [0.005]	√	6.632 [0.017]	√	3.624 [0.065]	√	0.637 [0.907]	
HCD ↛ TOR	7.947 [0.006]	√	4.624 [0.018]	√	0.555 [0.935]		14.651 [0.014]	√	0.031 [0.784]	√
HCD ↛ GCF	6.583 [0.044]	√	11.518 [0.009]	√	13.522 [0.008]	√	11.212 [0.005]	√	8.295 [0.0341]	√
HCD ↛ FD	0.569 [0.747]		10.887 [0.004]	√	13.55 [0.073]	√	15.083 [0.007]	√	0.148 [0.451]	√
HCD ↛ GCF	10.874 [0.002]	√	2.899 [0.278]		0.719 [0.844]		8.107 [0.037]	√	15.299 [0.064]	√
HCD ↛ FDI	12.488 [0.071]	√	8.008 [0.032]	√	7.322 [0.007]	√	13.93 [0.005]	√	2.333 [0.266]	

The values in [ ] explain the Bootstrap p-value associated with w-statistics. √ indicates causalities.

of human capital accumulation, both in the long run and the short run. The positive and statistically significant linkage was confirmed in both models without the interactive term and with the interactive term. Our findings align with existing literature such as Ngoma and Ismail (2013) and Pu et al. (2021). Tourism development has the potential to boost human capital in many ways. First, it employs individuals employed in the industry and those who provide services to foreign visitors throughout their presence (Sinclair and Stabler, 2002; Jordan et al., 2016; Folarin et al., 2017). They could afford to obtain the necessities of life *via* their job, allowing them to live a respectable existence and extending their life expectancy. Second, tourism development generates cash for the government and provides extra financing for the government to subsidize health and educational services, making them affordable to a broad segment of the population and providing educational and health facilities. Moreover, our present study contradicts the study finding documented by KoŽić (2019) that revealed that tourism development subsidized the present state of HCD by reducing school enrolment in Croatia.

The nexus between financial development and human capital accumulation established a positive tie between them, suggesting that the development in the financial system played a positive role in contributing to human capital accumulation in BRICS. Our study findings are supported by the existing literature of Hakeem and Oluitan (2012) and Arif and Khan (2019). The financial industry's growth increases the efficiency of lending and the intermediation between lenders and borrowers. Improved financial market conditions also encourage labor division and innovation, boosting efficiency, competitiveness, and, eventually, innovating. Financial development, in theory, is just as important as HCD, and both contribute considerably to the economic progress. When physical capital is paired with inadequate human capital, economic development may be slow. Physical capital contributes to human capital only when finance is permitted to "perform what finance can do," boosting efficiency by redistributing buying power from low-return consumers to high-return users. Finance combats poverty by raising income, and over time, finance alleviates poverty through improving health and education. This is accomplished *via* investment in skill development and services and physical infrastructure that promote health and longevity. Human and physical capital drive economic development endogenously and are critical components of economic growth (Sibel et al., 2015). While both are necessary for long-run development, physical capital accumulation occurs first, and human capital buildup occurs later (Laktionova et al., 2021).

Gross capital formation revealed a positive and statistically significant association with HCD in BRICS nations, suggesting that capital adequacy induces human development in the economy. Capital accumulation is comparable or necessary to a nation's physical capital stock being increased by investment in social and economic infrastructure. Gross fixed capital accumulation comprises gross domestic private investment and gross domestic public investment and result in the production of physical items (plants, equipment, and machinery, for example) and/or intangible assets (such as a high quality and level of education, health, scientific tradition, and research) in a nation. The study of Onyinye et al. (2017) argued that capital development might result in increased output and job prospects. He also emphasized that capital creation results in technological advancement, enabling large-scale production economies to be realized, enhancing specialization, or supplying machinery, tools, and equipment for the rising labor force. Moreover, capital production aided in eliminating market defects *via* the creation of economic and social overhead capital, breaking the vicious loop of poverty on both the demand and supply sides (Shuaib and Ndidi, 2015). Bakare (2011) advocated that capital formation affects a country's economic prosperity and contributes to satisfying the needs of an expanding population in a growing economy. It results in the appropriate exploitation of natural resources and the formation of diverse enterprises, increasing levels of growth and satisfying the diverse desires of the populace, and, eventually, results in increasing the population's standard of living and economic well-being, hence boosting human capital accumulation.

CONCLUSION

The motivation of the study is to gauge the role of tourism development on sustainable HCD in BRICS for the period

1984-2019. The study applied both conventional and unknown structural break unit root tests, the novel Bayer and Hanck (2013) combined cointegration test, the augmented ARDL test, offered by Sam et al. (2019), and directional causality by performing the causality test with Fourier function, familiarized by Nazlioglu et al. (2016). The key findings of the study are as follows:

First, the stationarity test with conventional and unknown structural break unit root tests revealed that all the variables were stationary either level or after the first difference but not after the second difference. Findings suggest that variables are integrated in mixed order, preferable for autoregressive distributed lagged implementation.

Second, the study implemented the novel combined cointegrated test offered by Bayer and Hanck (2013); the test statistics of all five models for BRICS are higher than the critical value offered at a 5% level of significance. Study findings suggest the long-run cointegration between tourism, financial development, gross capital formation, and HCD.

Third, empirical assessment with AARDL revealed long-run cointegration between tourism, gross capital formation, financial developer, and HCD in BRICS nations. In the long run, the coefficients of tourism, gross capital formation, and financial development are positive and statistically significant at a 1% level of significance, suggesting the contributory role toward sustainable HCD in BRICS. Furthermore, in the short run, the magnfititutes of tourism, gross capital formation, and financial development to HCD are positive and statistically significant but insignificant compared with long-run coefficients. The coefficient of joint effect, that is, the interactive terms are positive and statistically significant, implying the indirect effects of tourism through financial development and gross capital formation on HCD, especially in the long run.

Fourth, the directional causality with Fourier-TY, following Nazlioglu et al. (2016), documented the feedback hypothesis, that is, bidirectional causality running between tourism and HCD in all sample nations except in India.

Considering all the information revealed with the empirical assessment, we ended with the concluding remarks for further actions in developing and achieving sustainable HCD in BRICS nations. For maintaining sustainable HCD with the assistance of tourism, it is evident that policymakers have to put extra effort into boosting the progress of tourism development because the findings of the interactive term reveal the positive connection to HCD. HCD, according to literature, ensure a skilled workforce in the economy, that is, the transformation of the population into resources with the inclusion of technology and conceptualization development. Precisely, the population having both technical know-how and formal education, that is, population enrolment in schooling, can boost accumulating skilled human resources in the society. Furthermore, tourism inflows increase earning opportunities in the economy and support increasing present living standards. Thus, the capacity to avail education can be an alternative through which tourism can play a role in sustainable economic development in BRICS. Additionally, higher education plays a role in educational tourism, recognizing that "educational tours are an interesting site of study, first, because they are explicitly about learning, and second, because they provide an opportunity for universities to reach beyond their walls and directly teach members of the broader community." It is asserted that universities can play a pivotal role in teaching ethics outside of the context of academic education by providing moral education that supplements professional skills and by using the entire world as a stage for pedagogy and that it is possible to increase the links between the university and the community by using mixed strategies, such as practical and experiential learning at a local level, and by exposing students to real life.

In other words, government policies for promoting tourism can increase financial activities in the financial system, suggesting that financial development and eventually financial progress allow HCD by offering opportunities, skills, and technological exposure in the economy. Financial inclusion helps tourist businesses and entrepreneurs to acquire institutional financing and bolster the resources necessary for tourism operations. Inextricably linked to innovation, access to financing contributes to economic development *via* increased productivity. Bank-based financial inclusion significantly enhances financial inclusion and contributes to faster economic development *via* inclusive growth in developing nations where bank-based financial systems are prevalent. Furthermore, financial inclusion through microfinance models lowers the cost of financial intermediation for borrowers, resulting in quicker economic growth. Tourism helps reduce poverty in developing nations, especially in the least developed countries, when people and small- and medium-sized enterprises (SMEs) active in the tourism industry have established access to financing in BRICS. Tourism development has revealed the sources of capital flows in the economy because the money flows from tourism receipts increase the capital adequacy in the economy and allow the population to earn extra by garbing the income scope available in the economy, which eventually promotes the prospects of human rights capital in the long run.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

JL: introduction, methodology, and first draft preparation. MQ: introduction, methodology, empirical model estimation, and final preparation. Both authors contributed to the article and approved the submitted version.

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Human Resource Practices for Corporate Social Responsibility: Evidence From Korean Firms

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Human resource management (HRM) in managing environmental, social, governance (ESG), or corporate social responsibility (CSR) initiatives has been recently raised. Yet, little attention has been paid to integrating CSR and HRM. Our primary goal was to identify how and whether certain HR practices are critical for developing employee capability to operate in firms with active CSR initiatives. We first examine the impact of external CSR activities on firm-level work outcomes. Moreover, we attempt to identify a choice of particular HR practices that could be aligned with external CSR activities. We then empirically examine how each HR practice interacts with external CSR activities that influence employee retention and labor productivity. Using three longitudinal datasets conducted by the government-sponsored research institution over 154 publicly traded Korean firms for five waves of survey years, the results show that external CSR has a limited impact on employee retention and labor productivity. However, when external CSR activities are combined with a specific set of HR practices, including person-organization fit-based selection, performance-based pay, extensive investment of training and development, and employee suggestion program, the impact of external CSR on employee work outcomes is more substantial. The results indicate that external CSR and a particular set of HR practices as internal CSR can be complementary and generate a positive interaction on creating sustainable human capabilities.

Keywords: corporate social responsibility, external and internal CSR, person-organization fit, pay-for-performance, training and development, employee voice, labor productivity, employee retention

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INTRODUCTION

There is a rapidly growing interest in how organizations benefit or harm social welfare. Corporate strategies or actions in this area are often referred to as environmental, social, governance (ESG), or corporate social responsibility (CSR). ESG represents how firms and investors integrate environmental, social, and governance concerns into their business models (Gillan et al., 2021). CSR has traditionally referred to corporate activities as more socially responsible and a better corporate citizen (Aguinis, 2011). One difference between the two terms is that ESG explicitly includes governance, and CSR indirectly includes governance issues related to environmental and social considerations. Therefore, ESG tends to be a broader term than CSR (Gillan et al., 2021). Vast literature attempts to find how CSR as corporate activity could impact a firm's

financial performance (Wang et al., 2016). However, prior research on CSR effects on firm performance has been characterized by conflicting or mixed findings at best (Margolis and Walsh, 2003; Ducassy, 2013; Wang et al., 2016). For instance, an empirical review of 127 studies by Margolis and Walsh (2003) suggested a positive relationship between CSR and firm performance through gaining market recognition. Similarly, Ducassy (2013) showed that 68% of the papers supported the positive link between CSR and financial performance, and 6% confirmed the negativity toward CSR and firm performance. Such mixed or conflicting empirical results may indicate that organizations differ in managing CSR strategies' consequences.

Some studies attempt to clarify the relationship by emphasizing responses from specific stakeholders and CSR domains to solve such mixed results. For instance, studies have indicated the importance of employees' responses from CSR activities because employees constitute important internal stakeholders who are central actors of CSR implementation, which can determine the effects of CSR on firm performance (Aguinis and Glavas, 2012; Farooq et al., 2017; Shen and Zhang, 2019). Moreover, emerging studies suggested employees may differentiate CSR initiatives based on various stakeholder groups instead of considering it as a unidimensional concept. Therefore, we divide CSR domains into external and internal CSR, followed by Farooq et al. (2017) and Deng et al. (2020). Specifically, external CSR is referred to as stewardship, including volunteerism and corporate philanthropy directed external stakeholders such as customers, business partners, and local communities. Internal CSR generally focuses on policies and practices of a firm that are related to the wellbeing of employees, their lives, and productivity (Farooq et al., 2017). It is predicted that external and internal CSR have a different impact on employees since the former has no direct gains on employees (Royle, 2005; Deng et al., 2020) while the latter is directed toward employees. Therefore, it is worth exploring how employees would respond to external CSR.

Following this research stream, this paper aims to investigate the impact of external CSR on work outcomes such as labor productivity and employee retention. Building on social identity theory, external CSR can promote positive employee attitudes and behaviors (Tyler and Blader, 2003; Valentine and Fleischman, 2008; Farooq et al., 2017; Deng et al., 2020). For example, studies have presented evidence supporting external CSR efforts improve perceived organizational prestige and higher self-esteem, positively related to employees' job satisfaction, loyalty, and work engagement (Zhu et al., 2014; Deng et al., 2020). Therefore, it is expected that higher labor productivity could reflect all these positive attitudes and behaviors caused by external CSR activities.

Moreover, we argue that these external CSR and a specific set of HR practices as internal CSR can be complementary and positively affect sustainable human capabilities such as labor productivity and employee retention. HRM can be internal CSR itself that represents organizational actions to satisfy employees' expectations, actively improve and fulfill organizational justice such as improving employee reward satisfaction, and ensuring work safety and the growth of employees (Greenwood, 2002; Crane et al., 2019). Building on the internal fit approach from strategic human resource management (SHRM) literature, we contend that employees respond differently to external CSR at different HR practices. Lastly, we attempt to identify the particular HRM practices to interact with external CSR within a firm and examine whether these practices can promote the effectiveness of external CSR initiatives.

This study contributes to the literature in two significant aspects: First, we extend our understanding of CSR-HRM link literature. Specifically, HRM has been treated separately from CSR as a cause or consequence of CSR (Aust et al., 2020). However, this study emphasizes the potential role of HR as internal CSR and the interaction between HR and external CSR. Building on the social exchange theory, employees are internal stakeholders of a firm that can be influenced by the actions such as HR practices. It is the norm of reciprocity between the employees and employer through the implementation of HR practices that focus on the wellbeing of employees (Low et al., 2017). Moreover, our study contributes sustainable HRM literature that still lacks much empirical attention to identifying the particular HRM practices (Macke and Genari, 2019; Aust et al., 2020). The study aims to empirically identify how and whether specific HR practices are critical for developing employee capability to operate in firms with active CSR initiatives.

THEORETICAL BACKGROUND AND HYPOTHESES

External CSR and Work Outcomes

As previous organizational psychology research suggested, we first revisit the relationship between external CSR and employee attitudes. Scholars have argued that external CSR can affect employees' attitudes and behaviors by enhancing their organizational pride (Farooq et al., 2017; Deng et al., 2020). Based on social identity theory, it is expected that the employees tend to identify with an organization through comparison and association with other organizations to achieve self-worth improvement (Tyler and Blader, 2003). Specifically, employees can perceive more external CSR as a representation of the healthy image and reputation of the firm, which can be used to predict improvement of employees' self-worth (Tyler and Blader, 2003; Farooq et al., 2017). Then, employees can earn a high level of organizational pride by comparing with external CSR of other firms (Valentine and Fleischman, 2008; Farooq et al., 2017). Such organizational pride can meet social identity needs, retaining employee engagement (Hogg and Turner, 1987). Empirical evidence suggests that external CSR can affect employees' attitudes and behaviors through acquiring employees' self-esteem promotion and organizational identification. For example, Jones and Kramar (2010) found that CSR can affect employees' pride and identification with their organization, influencing organizational commitment and employee satisfaction. In addition, Rupp et al. (2018) found that work engagement is positively associated with CSR since employees are likely to be prouder of the firm. Studies have

also presented that employees tend to increase a high level of self-worth evaluation and their attachment to the organization when a firm has a healthy reputation outside the organization (Peterson, 2004). These studies explain employee work engagement, enhancing positive attitudes and behaviors.

Furthermore, firms with high external CSR are expected to gain higher financial benefits. Deng et al. (2020) argue that external CSR initiatives are considered effective ways to manage relationships with other critical external stakeholders such as customers, government, and investors. Therefore, a firm's investment in external CSR may reap the cost from receiving resources and support from the government, investors, and customers (Barnett and Salomon, 2006; Deng and Xu, 2017). Thus, employee work engagement outcomes, including employee retention and labor productivity, could be expected to present organizational pride, self-esteem promotion, and employee expectation from gaining financial benefits from external CSR.

To summarize, we extend prior research to revisit the relationship between external CSR and employee outcomes reflected by a reduced turnover and improved labor productivity to examine whether an organization can enjoy benefits from employees' perceived external CSR. Put differently, the supposed positive association between external CSR and employee work outcomes, including labor productivity and employee retention, may indicate a form of strategic investment that positively affects firms' economic outcomes and the creation of a "sustainable competitive advantage" (Su et al., 2016). This argument leads to the following hypotheses.

H1a: The external CSR activity is negatively related to employee turnover.

H1b: The external CSR activity is positively related to employee productivity.

External CSR, HR Practices, and Work Outcomes

We further explore the possibility that the effect of external CSR on employee work outcomes may be contingent on HR practices as internal CSR in organizations. Emerging studies explore the possibility of interaction between external and internal CSR. For instance, Story and Castanheira (2019) showed that the interaction between internal CSR and external CSR increased employees' organizational citizenship behavior. In addition, Deng et al. (2020) confirmed an S-shaped curve relationship between external CSR and labor productivity. Firms with higher internal CSR have a positive moderating effect in the S-shaped curve relationship. A study of the luxury business industry by Sipilä et al. (2021) found that external CSR activities negatively affect a company's financial performance and customer loyalty. Internal CSR alleviated the negative relationship between external CSR and customer loyalty. Empirical studies in the hotel industry in Korea found that employee perception of internal CSR was more strongly related to pro-social behavior than external CSR perception. This positive relationship was more pronounced when external CSR perception was lower (Hur et al., 2020).

We argue that certain HR practices are highly related to internal CSR that can be better matched with external CSR activities, leading to higher employee work outcomes. Internal CSR and certain HR practices have in common that can influence the attitudes and behaviors of employees through the principle of reciprocity from social exchange theory (Luo and Zheng, 2013). The principle is defined as the human need and tendency to give something back when something is received. This need is more substantial when the gift is given without expecting a return (Slack et al., 2015). The reciprocity is particularly applicable to specific HR practices because they lead to some firms acting to support employee wellbeing and sustainability. Therefore, employees may feel obliged to pay these investments back by putting more effort or work engagement to reciprocate to firms (Slack et al., 2015; Aju and Beddewela, 2020). For instance, based on reciprocity, employees work harder or better to reward the organization by enhancing commitment and trust when employees receive fair wages (Luo and Zheng, 2013).

In this vein, certain HR practices as internal CSR can serve as a proxy for mutual support and trust, fulfilling employees' work engagement (Tyler and Blader, 2003; Rupp, 2011; George et al., 2020). Thus, we contend that particular HR practices primarily take on ESG's social aspect (S) and can be managed as internal CSR, creating positive synergies with external CSR. Part of the reason may be that mutual trust or reciprocity, combined with organization pride through external CSR, can create positive interaction on work engagement (Rupp, 2011; De Kock, 2021). Furthermore, anecdotal evidence suggested that when HRM and CSR managers agree on a mutual role in responsibility, the organization will act faster (Guerci and Pedrini, 2014). In addition, it seems probable that employees can perceive the firm's effort to external CSR as mere construction of corporate images. This perception is highly likely when organizations lack internal CSR. Specifically, when employees feel that such internal CSR is insufficient, employees are likely to perceive external CSR activities negatively. It is consistent with recent studies arguing that firms exclusively focus on external CSR, and the outcome may be harmful due to employee cynicism (Low et al., 2017).

Furthermore, we argue that the internal fit perspective can explain the interaction between external CSR and HR practices. The perspective suggests that organizations need to seek efficient human resource practices, being dependent on the other strategic actions such as external CSR actions to obtain a "fit" or "internal consistency" between practices (Delery and Roumpi, 2017; Wright and Ulrich, 2017). The nature of the relationship that presents internal fit is complementary or synergistic between practices by mutually supplying each other's lack that generates better performance than when each practice works in isolation (Wright and Ulrich, 2017). In addition, SHRM literature also views the particular "bundles" of HR practices that could make to organizational performance (Delery and Doty, 1996; Macky and Boxall, 2007). Specifically, these bundles consist of HR practices consistent with each other, such as selective recruiting,

employee development, performance managing pay system, and employee involvement (Wright et al., 2003; Boxall and Macky, 2009; Wright and Ulrich, 2017). Following Wright et al. (2003), we divided multiple HR practices into four major functional areas in HRM: hiring, training, compensation, and employee participation. Then, we attempt to identify a particular HR practice from each functional HR area well aligned with CSR initiatives, aiming to create capabilities required for positive work outcomes.

Person-Organization Fit-Based Selection

The dominant approach in hiring employees in practice has been the person-job fit (P-J fit), referred to as selecting employees based on their knowledge, skills, abilities, and experience that a job is required (Kristof-Brown et al., 2005). However, recent studies have argued that the person-organization fit (P-O fit) approach has been gained much attention and has become an essential criterion for employee selection. P-O fit-based selection suggests that employees tend to be attracted and selected to an organization that shares similar values and goals as the organization (Coldwell et al., 2008). In addition, prior studies have confirmed that P-O fit-based selection positively impacts employee socialization, job attitude, employee behavior, and actual retention (Kristof, 1996). Later, several scholars, including Hoffman and Woehr (2006), suggested that the relative importance of these two types of fits depends on the context of the job task and the organizational purpose. We posit that P-O fit-based selection is better matched with external CSR activities, leading to higher employee work outcomes for the following reasons.

First, P-O fit-based selection in firms with a high-level external CSR is more likely to consider CSR values of individual employees during the selection process. Therefore, it may increase the chance of hiring employees who have a more favorable attitude toward CSR, promoting the effectiveness of the firm's external CSR activities. For example, Hur and Kim (2017) suggested that the employees identify with a company that implements CSR initiatives, particularly when their values are aligned with the firm's CSR initiatives. Second, selection based on P-O fit can improve communication and encourage helping behaviors by having similarities in values and attitudes (Kristof, 1996). According to the similarity-attraction theory, similar attributes between employees can create closer relationships (Moreland, 1985). Therefore, a higher level of similarity between organizational members based on P-O fit selection and attitude reduces role ambiguity and conflict levels, promoting cooperation and communication (Meglino et al., 1989). Such cooperation and lateral communication are mainly related to reciprocity and social exchange when organizations make more significant efforts when devising and implementing external CSR activities.

Similarly, Evans and Davis (2005) also revealed that selection based on P-O fit positively impacts group shared mental models. This approach can influence positive organizational support, consideration, and social responsibility among employees required in most CSR firms. Additionally, Kim et al. (2010) have suggested the importance of value-fit in CSR firms, implying that congruence between employee personality and characteristics of CSR activities may create the employee perception of organizations as a responsible organization perceived as organization pride.

To summarize, P-O fit-based selection combined with employee pride through external CSR efforts are consistent and signify employee work engagement. As proposed above, P-O fit selection can benefit from screening out potential employees who are less favorable or less matched toward the firm's external CSR efforts, thereby increasing the success of external CSR initiatives. In addition, value-fit achieved by P-O fit selection facilitates communication and a strong sense of organizational support, reinforcing employee perception of organizational pride (Lee et al., 2012). Finally, P-O fit-based employee selection is more beneficial in firms with more external CSR initiatives, indicating positive employee work outcomes. Thus, we formulate the following hypotheses.

H2a: The negative relationship between external CSR activity and the turnover rate is stronger when the selection is based on person-organization fit.

H2b: The positive relationship between external CSR activity and productivity is stronger when the selection is based on person-organization fit.

Performance-Based Compensation

Pay-for-performance is the most direct and visible signal to employees about how firms satisfy employee expectations and increase employees' perception of organizational justice (Rynes and Gerhart, 2000). We argue that performance-based pay and external CSR can be complementary, creating a positive synergy on employee performance. First, performance-based compensation as an incentive alignment mechanism ties employee compensation directly to the firm's strategic actions, including external CSR. It can enhance employees' external CSR cognition and motivate employees to take more external CSR-oriented activities. Anecdotal evidence suggests that employees' actions toward external CSR activities such as *pro bono*, voluntary work, green behavior, donations to nonprofit organizations, and community involvement are more recognized during the performance evaluation and reward design (Gelade and Ivery, 2003; Orlitzky et al., 2006). In addition, pay-for-performance, particularly collaborative rewards based on collective performance such as profit-sharing, affects employees' perception of mutual support and communication. It is because collaborative pay-for-performance can increase cooperation and coordination among members (Harrison et al., 2002), prevent social loafing (Pearsall et al., 2010), and share information among members (Chen and Kanfer, 2006). These employee attitudes and behaviors raised by collaborative pay-for-performance can create employees' perception of CSR-favorable climate in an organization well matched with external CSR actions (Harrison et al., 2002).

Furthermore, recent studies argue that firms that need external CSR programs should promote short-term financial performance by implementing employee performance-improving systems. Therefore, the organizations taking external CSR initiatives are more likely to adopt performance-based pay because it motivates employees to work harder and better through monetary incentives to improve their short-term financial performance. For example, Jones and Kramar (2010) conducted a qualitative study for Australian companies. They found that the degree to which a firm is involved in CSR for external stakeholders was positively associated with adopting a pay-for-performance. In sum, performance-based pay combined with external CSR is complementary, creating positive interaction through increased employees' awareness and motivation of external CSR activities.

Consequently, the alignment will create a CSR-favorable climate and improve the short-term financial performance. Thus, a performance-based pay system combined with CSR can promote employee work outcomes. It leads to the following hypotheses.

H3a: The negative relationship between external CSR activity and the turnover rate is stronger when firms use a pay-for-performance system.

H3b: The positive relationship between external CSR activity and the productivity rate is stronger when firms use a pay-for-performance system.

Extensive Investment in Training and Development

Employee training and development enhance employee skills and behaviors and the motivation to apply those skills and behaviors at work (Pfeffer and Veiga, 1999). Studies show that the advancement of employees' skills and behavior is a critical part of internal CSR and employee training and development opportunity is a service provision by organizations (Low et al., 2017). A firm's continued growth depends on meeting the needs of employees through employee development and establishing a positive social exchange relationship, thereby creating a perception of employee obligation (Ferreira and de Oliveira, 2014). Then, employee obligation can influence employees to benefit the firm through better quality of work or extra-role behaviors. In addition, this investment in employee training and development can also affect the employee perception of being valued or self-worth improvement (Kuvaas and Dysvik, 2009), thereby increasing organization pride. Thus, it is expected that extensive investment in employee training and development, an essential part of internal CSR, may enhance employee obligation, self-worth improvement, and commitment to organizations as responsible organizations. Furthermore, the above process may evoke more external CSR activities because a high level of obligation and mutual trust caused by a significant investment in employee development can increase employees' tendencies to help others, including customers.

Moreover, recent studies suggest that employee training and external CSR are tightly coupled through CSR training by infusing the firm's CSR values directly to employees (Ellis, 2009). For example, Ellis (2009) emphasized that CSR training can enhance employees' awareness of CSR and improve their engagement in external CSR activities. Similarly, Obrad and Gherheş (2018) also classified environmental and social activities within organizations that present social responsibility toward the firm's stakeholders. A majority of these activities were professional development workshops and training programs.

Overall, significant investment in employee training and development is expected to provide more potential benefits to organizations that pursue a more active external CSR activity. Compared to those who do not, firms with relatively significant investments in CSR activities tend to have higher mutual trust, commitment to organizations, willingness to help other external stakeholders, and CSR awareness. Employee training and development combined with external CSR activities can positively impact employee work outcomes. The argument leads to the following hypotheses:

H4a: The negative relationship between external CSR activity and employee turnover is stronger with the investment in employee training and development.

H4b: The positive relationship between external CSR activity and employee productivity is stronger with the investment in employee training and development.

Employee Voice

In practice, employee voice is represented by openness to considerations such as grievance procedures, suggestion systems, counseling services, employee management councils, survey feedback, non-management task forces, question and answer programs, and ombudsman services (Spencer, 1986). In addition, several studies have insisted that employees positively perceive employee voice because it sends the signal to employees that their inputs are valued and they are valued members of the firm (Morrison and Milliken, 2000; Milliken et al., 2015). In contrast, the lack of concern for employees' ideas or suggestions could translate into an employee perception that the firm is not using procedural justice, thereby generating negative behavioral consequences such as frustration, stress, low self-control, self-efficacy, and quitting (Cohen-Charash and Spector, 2001).

We contend that employee voice influences firm's external CSR activities and is influenced by external CSR. It appears that employee voice, being a direct feedback communication, may promote employees' awareness of a firm's efforts to invest in external CSR and influence how they view their firm's CSR activities. For instance, Kirat (2015) found that a firm's relationships with external stakeholders may depend on its efforts to communicate with employees. Additionally, Rupp et al. (2006) noted that employees are less likely to internalize a firm's CSR into their daily operation fully when employees are less committed to developing and implementing CSR efforts

through employee participation or voice. Similarly, Young and Thyil (2014) also show that firms displaying congruence between communication and CSR activities can encourage connectivity, allowing employee participation and engagement. In addition, a recent study maintains that employees as vulnerable stakeholders are less capable of exercising a direct influence on firms (Civera and Freeman, 2019). Therefore, the employee voice function may be a mechanism that can help confirm that the external CSR activities are aligned with the ethical or fair treatment of employees. This employee voice can be legitimately handled by the representative function such as employee councils or labor unions. Indeed, the promotion of open interaction between employees and their representatives and the participation of employee representatives in the firm's decision-making process has been identified as pivotal parts of firms with active CSR efforts (Diaz-Carrion et al., 2019; Yu et al., 2021). Thus, the hypothesis is given as follows:

H5a: The negative relationship between external CSR activity and the turnover rate is stronger when firms use a suggestion system.

H5b: The positive relationship between external CSR activity and employee productivity is stronger firms use a suggestion system.

RESEARCH METHOD

Sample and Data

The study sample was constructed from three publicly available datasets in Korea. We used the five waves of CSR survey of 2010, 2012, 2014, 2016, and 2018, all of which were conducted by the Korea Economic Justice Institute (KEJI), and the HR data from the Human Capital Corporate Panel (HCCP), government-sponsored national employer survey in Korea. Financial data from the Korea Information Services (KIS) from 2010 to 2019 were also obtained. First, the KEJI index provides CSR scores for approximately 200 publicly traded firms in Korea. KEJI has published 200 CSR firms every 2 years and evaluated CSR scores in terms of seven components of CSR activities: environmental conservation community service, organizational integrity, justice, customer satisfaction, employee satisfaction, and economic development (Lee et al., 2017). Both quantitative and qualitative approach assesses each component. The quantitative methods use a wide range of archival sources, including firm annual reports; reports from the Fair Trade Commission in Korea, the newspaper article about illegal corporate activities; the Korea Employment Agency for the Disabled and the Korea Investors Service; and certifications from the Korean Agency for Technology and Standards and the Ministry of Environment (Lee et al., 2017). The qualitative method is conducted from a survey designed by professional researchers and representatives of civic groups.

Second, HCCP is employee-employer panel surveys to acquire HRM information, including the firm's availability of the particular HR practices. The survey respondents were largely HRM and business strategy managers, each of whom responded to the items related to their specialization. Over 450 Korean publicly traded firms participated in the survey, and a panel investigation was conducted at biennial intervals. HCCP consists primarily of a corporate-wide survey (Enterprise Survey) and a survey of employees (Workers Survey), divided into a head office survey and a site survey. Since this study was analyzed at the firm level, we used data obtained from the corporate-wide survey. We used these five waves of panel dataset to acquire HR-related information but used all financial data from 2010 to 2018 from the KIS value. The five waves of survey years from the KEJI dataset included 180 firms. After excluding 22 companies with neither financial information nor HR variables, our usable sample was 154 firms that completed the survey.

Measures and Analyses

Dependent Variable

We used two employee work outcome indicators as dependent variables. First, we measured employee productivity (or labor productivity) as the net sales per employee obtained from firms' financial statements. We can collect firms' financial reports and calculate their productivity using the KIS-value dataset. Through cost reduction and asset utilization, corporate financial performance improves profitability and asset return. The rate of return on invested capital is essential such as operating income, sales, and total profit. Although various financial indicators exist, sales and operating profit benefit from directly gauging the market's reaction as a quantitative indicator of the profitability of businesses (Lee et al., 2017). We measure productivity as sales divided by the number of employees in the given year. Secondly, the firm-level turnover rate was measured by the voluntary turnover divided by the number of total employees in the year from the HCCP dataset.

External CSR

External CSR score is obtained from the KEJI index, published in 2010, 2012, 2014, 2016, and 2018. As noted above, total CSR activity was measured to elicit the seven items of the KEJI index listed below: organizational integrity, justice, community service, customer satisfaction, environmental conservation, employee satisfaction, and economic development. We exclude employee satisfaction from the CSR Index directed at internal company members. The combined values of the remaining items except the employee satisfaction are considered CSR for external stakeholders.

HR Practices

P-O fit selection (POF) variable was measured based on the choice of survey questions in HCCP. The question requires HR managers to choose from 14 responses on what they consider necessary in the recruitment process. We used the measurement tool implemented by Cable and Judge (1996). If the firm had a selection program that pursues

person-organization fit, one and the other were coded 0. In the present study, the questionnaire presenting recruitment based on person-organization fit has been included in survey questions of HCCP since 2016, not from the beginning year of the sample. Therefore, the number of observations from the sample about recruitment in this study to test hypotheses 2a and 2b is smaller than other samples.

The pay-for-performance was measured by a pay-for-performance plan from the HCCP dataset used. If a firm had a pay-for-performance or merit-pay system, it was coded 1; otherwise 0. Moreover, we measured *the extent of investment in employee training and development* by the total money spent on training and development programs obtained from the firm's financial report from the KIS dataset. Finally, a *suggestion system* in the firm captures the measure of employee voice. Dundon and Gollan (2007) examined the 18 case studies, explored the purpose and meanings of employee voice, and suggested two motives for establishing employee voice systems: to eliminate employee dissatisfaction; to capture suggestions to improve organizational performance. Therefore, the types of content voiced through the formal suggestion system ranged from dissatisfaction to suggestions for improvement and participation in decision making. Information on the *suggestion system* was obtained from the HCCP dataset. If a firm adopted the suggestion system, it was coded 1; otherwise 0.

Control Variables

Several variables are included to account for some variation in the dependent or independent variables. We included *firm size, firm age, industry fixed effect*, and *firm financial performance*. These variables are organizational characteristics that are closely related to or may influence a firm's HR practices and CSR activities (Evans and Davis, 2005). Firm size was measured as the natural log of total employees. Firm age is the number of years from the founding year to the given period. Financial performance at the past year (t-1), such as ROA(t-1), is controlled due to its influence on the firm's CSR strategies or HR policies (Lee et al., 2017).

In this study, we conducted panel data analyses. Panel data provide information on individual firm behavior across individual firms (i) and over time (t). The panel data we used are unbalanced since firms are not observed in all periods. Selecting the appropriate empirical model in panel data analysis is important to ensure the correct estimation. The STATA (18.0 version) was used in this study to validate assumptions based on the variables above. There are two models used to analyze panel data: fixed-effect model and random effect model. We used the Hausman test method to determine which model was more appropriate. As a result of the Hausman test, the fixed-effect model is more appropriate than the random effect model. Its value (prob>chi^2 = 0.0002) is not within the significance level (1, 5%) and is rejected. Fixed effects regression was used to test all of our hypotheses. In addition, we conducted the Shapiro–Wilk normality test, indicating the normal distribution of data. The following is the empirical specification model used in this study.

$$\ln(\text{Productivity}_{i,t+1}) = \beta_1 \text{ external CSR }_{it} + \beta_2 \text{ HR Practice}_{it} + \beta_3 (\text{external CSR} * \text{HR practice})_{it} + \beta_4 (\text{Controls})_{it} + \varepsilon_{it}$$

RESULTS

Table 1 presents the descriptive statistics and correlations for variables used in the study.

Tables 2, **3** present the results of the panel regression analyses. **Table 2** shows the effect of the explanatory variables on the firm-level turnover rate. First, external CSR is negatively associated with the turnover rate ($\beta = -1.95$, $p < 0.05$) shown in column 2 of **Table 2**, but the negative relationship between external CSR and the firm-level turnover rate is not always statistically significant across different empirical models presented in **Table 2**. Specifically, the coefficients of external CSR are not statistically significant or marginally significant when the specific HR practices are added in the regression models shown in column 3, column 7, and column 9 of **Table 2**. It indicates a potential interactive relationship between external CSR and HR practices. Thus, we do not have much evidence that external CSR impacts the turnover rate.

In contrast, the results find the strong positive effect of external CSR on firm-level labor productivity ($\beta = 4.39$, $p < 0.001$) shown in column 2 of **Table 3**. Moreover, this positive relationship remains robust across different empirical specifications in predicting labor productivity, even when included in individual HR practices. Therefore, external CSR does not directly impact the turnover rate, but it confirms the positive association between external CSR and labor productivity. The results indicate limited evidence supporting that external CSR is positively related to employee work outcomes.

Hypotheses 2, 3, 4, and 5 predict the interaction effects of external CSR and individual HR practice on employee work outcomes. First, we examined the interaction between P-O fit-based selection and external CSR. As shown in column 4 of **Table 2**, the coefficient of the cross-product interaction term is negative and statistically significant ($\beta = -2.15$, $p < 0.05$), indicating external CSR combined with P-O fit selection can decrease turnover rate, supporting Hypothesis 2a. However, it is worth noting that the effect of P-O fit selection on turnover is positive but combined with external CSR, the interaction term becomes negative, and the marginal effect of POF on turnover rate becomes negative ($\beta = -2.15 + 2.11 = -0.04$, $p < 0.05$). Additionally, external CSR itself does not significantly affect the firm-level turnover rate. Still, its impact is increased when accompanied by the firm's utilization of P-O fit-based selection. Thus, the results support the interactive relationship between P-O fit-based selection and external CSR in decreasing turnover rate. In contrast, we do not find evidence supporting the interaction between external CSR and POF on productivity shown in column 4 of **Table 3**. Thus, limited evidence supports the potential alignment between P-O fit-based selection and external CSR.

TABLE 1 | Descriptive statistics and correlations.

S. No.	Variables	Mean	SE	1	2	3	4	5	6	7	8	9
1.	External CSR	49.35	6.90									
2.	Employee productivity	815,426	1,183,162.	0.08***								
3.	Turnover rate	5.11	14.26	−0.002**	−0.081***							
4.	POF	0.36	0.48	0.1	−0.008	−0.081						
5.	Pay-for-performance	0.47	0.50	−0.050	0.098***	−0.044	0.233**					
6.	Expense of training and development *	506.44	1013.15	0.058	0.045***	−0.037	−0.049	0.201***				
7.	Suggestion system	0.82	0.38	−0.095	0.053*	−0.010*	0.241	0.082*	0.007			
8.	Firm size	1570.20	2986.13	0.056	0.091***	−0.102***	−0.014	0.032**	0.053***	0.034		
9.	Firm age	51.18	17.34	−0.080*	−0.027**	−0.024	−0.010	−0.073**	−0.130***	−0.021***	−0.099***	
10.	ROA	2.76	28.64	0.014	0.048***	−0.646***	−0.011	−0.044	0.037†	−0.012	0.046***	0.023

*Performance-based pay (existence 1; nonexistence 0), suggestion system (existence 1; nonexistence 0), and *unit: Thousand won. †p<0.10. *p<0.05; **p<0.01; ***p<0.001.*

Moreover, Hypothesis 3a and 3b posit the interactive effect of pay-for-performance and external CSR activities. As presented in column 6 of **Table 2**, the interaction term of external CSR and pay-for-performance on turnover rate was negative and statistically significant ($\beta = -0.18$, $p < 0.05$), indicating external CSR activities combined with pay-for-performance practices can decrease firm-level employee turnover, supporting Hypothesis 3a. However, the interaction term of external CSR and pay-for-performance on productivity is positive but statistically insignificant presented in column 6 of **Table 3**, suggesting no strong evidence that supports the complementary relationship between external CSR and pay-for-performance in influencing productivity.

The potential interactive relationship between external CSR and investment in training and development was supported as proposed by Hypothesis 4a and 4b, suggesting a good fit between investment in training and development and external CSR. The regression coefficients of the interaction term of external CSR and investment in training and development on turnover rate were marginally negative ($\beta = -1.37$, $p < 0.10$), and the interaction term of external CSR and investment in training and development on training and development productivity is significantly positive ($\beta = 4.05$, $p < 0.001$) as presented in column 8 of **Table 2**, **3**. The results suggest that the higher investment in training and development, the more positive the external CSR will have on the employee outcomes. Finally, as with Hypotheses 4a and 4b, Hypothesis 5a and 5b were strongly supported. The regression coefficient of the interaction between external CSR and suggestion system on turnover rate was negative and significant ($\beta = -0.55$, $p < 0.05$). In addition, the interaction term of external CSR and employee voice has a positive impact on productivity. ($\beta = 3.30$, $p < 0.001$). It indicates that the complementary effect of employee voice and external CSR significantly impacts the turnover decrease and labor productivity.

DISCUSSION

Our first purpose in this study was to examine the impact of external CSR activities on firm-level work outcomes. Hypothesis 1a and 1b predicted the negative effect of external CSR on firm-level employee turnover and the positive effect on labor productivity. Based on the panel data of 154 publicly traded Korean firms obtained from the separate archival sources on CSR activities, HR practices, and financial data for five waves of survey years, we found limited evidence of the significant impact of external CSR on work outcomes. The results show that external CSR does not significantly impact the turnover rate when the specific HR practice is added. It seems probable that the HR effect on employee retention partially absorbed the CSR effect, and the interaction term of the two variables was positive and significant, suggesting the two complementarily interacted with each other. Still, it supports the positive relationship between external CSR and labor productivity, implying that firm can partially benefit from employees' perceived external CSR. The result is consistent

TABLE 2 | Results of regression analysis of the CSR, HR practices, and Turnover rate.

Variables	Dependent variable: firm-level turnover rate									
	1	2	3	4	5	6	7	8	9	10
Firm size (log)	−9.20***	−9.33***	−2.80**	−2.83**	−8.88***	−8.82***	−9.38***	−9.35***	−7.02***	−7.02***
Firm age (log)	−0.07	−0.13	−2.38*	−2.38*	−0.08	−0.08	−0.55	−0.57	−0.78	−0.77
ROA (log)	−2.31*	−2.29*	−1.34	−1.36	−2.29*	−2.28*	−2.27*	−2.24*	−2.51*	−2.51*
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
External CSR		−1.95*	−0.5	−0.08	−1.71†	−1.15	−1.63	−1.12*	−1.78†	−0.97
POF			1.03	2.11*						
Individual performance-based pay					1.31	−0.36*				
The expense of training and development(log)							−1.76†	−1.13		
Suggestion system									−1.57	−0.77
External CSR* POF				−2.15*						
External CSR* Performance-based pay						−0.18*				
External CSR* Expense of T&D								−1.37†		
External CSR* suggestion system										−0.55*
R^2	0.22	0.23	0.17	0.17	0.22	0.22	0.23	0.24	0.21	0.21
Number of observation	372	372	119	119	365	365	356	356	296	296

*Coefficient is non-standardized β. All variables were changed to logged variables for reducing the degree of distortion. †p<0.10; *p<0.05; **p<0.01; ***p<0.001.*

TABLE 3 | Results of regression analysis of the CSR, HR practices, and productivity.

Variables	Dependent variable: labor productivity									
	1	2	3	4	5	6	7	8	9	10
Firm size (log)	3.61***	3.73***	2.19*	2.23*	4.73***	4.76***	2.89**	2.49*	3.28**	3.54***
Firm age (log)	2.93**	3.25***	1.5	1.54	2.91**	2.93**	3.81***	3.85***	2.76**	2.54*
ROA (log)	3.43**	3.41**	0.08	0.11	2.71**	2.70**	3.32**	3.22**	2.84**	2.85**
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
External CSR		4.39***	3.89***	3.85***	3.55***	2.28*	4.41***	5.17***	3.89***	4.17***
POF			0.3	−0.72						
Individual performance-based pay					2.89	0.9**				
The expense of training and development (log)							4.11***	5.63***		
Suggestion system									1.97*	3.55***
External CSR* POF				−0.08						
External CSR* performance-based pay						0.5				
External CSR* Expense of T&D								4.05***		
External CSR* suggestion system										3.30**
R^2	0.07	0.1	0.08	0.09	0.12	0.12	0.13	0.15	0.11	0.13
Number of observation	627	627	141	141	519	519	607	607	423	423

*Coefficient is nonstandardized β. All variables were changed to logged variables for reducing the degree of distortion. *p<0.05, **p<0.01; ***p<0.001.*

with recent findings by Deng et al. (2020), suggesting that building on social identity theory, external CSR had a positive economic gain through the increased labor productivity due to the enhancement of employees' self-esteem from the firm's external CSR activities. However, our findings indicate that the effect of external CSR on employee retention diminishes as we include some HR practices, implying the potential interaction between external CSR and HRM.

Our primary goal was to identify how and whether specific HR practices are critical for developing employee capability to operate in firms with active CSR initiatives. Following sustainable HRM literature, recent studies have attempted to identify socially responsible HR practices such as CSR training and reward based on employee volunteering (Shen and Benson, 2016; Clarke and Boersma, 2017). However, these practices are somewhat peripheral and do not represent the overall function of HR. In addition, it is challenging to generalize through empirical analysis because these are used only by a few organizations. Thus, we identified the particular HR practices *a priori* from four primary HR functions: P-O fit-based selection, performance-based compensation, extensive investment in training and development, and suggestion system. We also predict the synergistic effect between the particular HR practice and external CSR.

First, our findings indicate weak evidence supporting the potential interaction between P-O fit-based selection and external CSR predicted by Hypotheses 2a and 2b. It suggests that P-O fit-based selection is more beneficial in firms with high external

CSR activities. The result is consistent with recent empirical evidence indicating that the perceived value-fit may explain why some applicants are attracted to organizations that engage in CSR (Shen and Benson, 2016; Shen and Zhang, 2019). However, limited evidence shows the potential fit between external CSR and pay-for-performance, supposed by Hypotheses 3a and 3b. The results imply that performance-based pay as a retention tactic can positively interact with external CSR by becoming aware of CSR activities and motivating CSR efforts through organization pride to retain employees. However, our results indicate that the interaction has no impact on labor productivity. It is partly because pay-for-performance in firms with external CSR efforts may not necessarily provide employees with incentives to work harder and better. The results are partially consistent with prior studies, indicating that the extent to which a firm is involved in CSR activities was significantly related to implementing a pay-for-performance system to retain employees (Jung and Kim, 2016).

Moreover, our results predicted by Hypotheses 4a and 4b indicate strong evidence of the positive synergistic effect of external CSR and the amount of money spent on employee training and development. In addition, the findings indicate that extensive investment in training and development in firms with a high level of external CSR may create a high level of mutual trust, commitment to organizations, and employees' CSR awareness which can positively influence productivity and employee retention. Finally, the positive interaction between external CSR and suggestion system predicted by Hypotheses 5a and 5b was strongly supported. The results suggest that firms presenting consistency between open communication from voice mechanism and CSR activities can encourage connectivity and work engagement, consistent with Young and Thyil (2014).

Based on these results, this study makes the following contribution. First, the findings extend our understanding of sustainable HRM by identifying how and whether specific HR practices are critical for developing the employee capability required to operate in firms with active external CSR initiatives. Our view is consistent with prior studies positing that external CSR is viewed as an independent function in its own right (Shen and Benson, 2016). Our evidence suggests that specific HR practices take on the social (S) aspect of ESG through managing as one part of the internal CSR. Then, particular HR practices can emerge and facilitate the full exploitation of synergies between internal and external CSR efforts. Finally, our findings indicate that building on the social identity theory and social exchange, reciprocity combined with organization pride will positively influence employee retention and performance.

Moreover, this study highlights the impact of CSR activities on firm-level employee performance from a strategic perspective. Prior studies mainly focused on the impacts of overall CSR on employee attitudes and behaviors such as organizational commitment (Orlitzky and Swanson, 2008; Jones et al., 2017), organization identification, and extra-role helping behavior (Shen and Benson, 2016). Thus, our study attempts to link CSR activities and HRM into financial or bottom-line results by utilizing firm-level retention and labor productivity variables from the macro HR perspective.

Furthermore, our findings contribute to our understanding of managing CSR initiatives and human resources in practice. Our results empirically provide evidence that P-O fit-based selection, performance-based pay, extensive investment of training and development, and suggestion system align well with external CSR activities, promoting the effectiveness of CSR initiatives. Therefore, firms need to recognize the importance of managing HR practices internally to integrate them into CSR strategies. A set of mutually complementary HR practices can be used to promote the success of CSR activities in organizations.

CONCLUSION

In conclusion, this research contributes essential insight to the CSR-HR literature from the SHRM perspective. Specifically, we recognized that the implementation of well-matched HR practices is consistent with core values embedded in the external CSR activities. In addition, employees' perception of social identity and social exchange plays a critical role in affecting CSR-HR interaction. Therefore, the findings can help organizations make strategic HR management which can signify the CSR-HR interaction.

Limitation and Future Research

This study is not without any limitation that suggests further study needs. First, this research used the dichotomous measure that indicated the existence of a formal HR practice. Therefore, it did not assess the level of usage of "pay for performance" practices and employee suggestion programs. Secondly, this study did not directly test the underlying process through which employees' social identity and the perception of reciprocity can affect the interaction between external CSR and HR practices in promoting work outcomes. Some refinements can be made in future research by utilizing case studies and employee perception surveys to illustrate a more understanding of the relationship. For example, a multi-level approach may help relate CSR initiatives and HRM to employee responses.

Second, it is also worth noting whether our focus on Korean firms can limit the generalizability of the findings. CSR activities have become a common practice and are viewed as an essential device where management directs firms through changing environments worldwide (Crane et al., 2019). However, geographical context may matter as there is a great deal of variation in the regulatory environment regarding CSR. Thus, further research is necessary to verify that our findings are generalizable to other countries. Moreover, our empirical evidence does not indicate a reverse-causal relationship that posits more successful firms are more likely to use CSR activities and developed HR practices. However, our study calls for a further study investigating the long-term effect of CSR and its interaction with HR practices on organizational performance.

Finally, this study suggested that the HR practices such as selection considering person-organization fit, performance-based pay, extensive investment for training and development, and suggestion system must be aligned to external CSR. However, with the excepted practices mentioned above, future avenues

of research may examine the effect of other HR practices, such as job design, employee socialization, performance evaluation, and working environment that can consider the full range of HR practices. However, this study is limited by using four practices due to data availability. Such limitation may leave room for future research that will explore a configuration of HR bundle or HR system that promotes the success of CSR initiatives.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

J-YA and S-RB contributed to the conceptualization, methodology, investigation, and writing—original draft. M-CC and J-YA participated in the manuscript revision, review, editing, and validation. All authors performed the data collection, data curation, and formal analysis and have read and approved the final manuscript.

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Integration of ESG Information Into Individual Investors' Corporate Investment Decisions: Utilizing the UTAUT Framework

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Environmental, Social, and Governance (ESG) criteria are now considered significant, global non-financial evaluating factors of corporate value. However, no attention is given to what influences the integration of ESG information by individual investors in their investment decisions. This study first identifies different types of information investors use to make investment decisions. Risks identified in information integration in investment decision making is reviewed. Next, the Unified Theory of Acceptance and Use of Technology (UTAUT) model is used to identify individual investors' investment tendencies and the factors affecting integration of ESG information into investment decisions. Each of four categories for UTAUT innovation adoption factors (performance expectancy, effort expectancy, social influences, and facilitating conditions) are discussed in relation to how they affect individual investors' integration of ESG information. Standardization of ESG reporting and evaluation frameworks would reduce efforts to adopt ESG information and could build a strong foundation for facilitating ESG information integration. Corporates' efforts to further communicate their ESG management through their investor relations and active governmental well as non-governmental organizations' participation are recommended.

Keywords: UTAUT, ESG criteria, investment decisions, individual investors, ESG information integration

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INTRODUCTION

Investors use various strategies to gain quality information when making investment decisions. Investors traditionally make decisions based solely on financial performance, but they now have more goals than simple financial gain. Also, they are using more than just financial information (such as ESG information) to make investment decisions (Sultana et al., 2018). With regard to the investment using ESG information, Sustainable and responsible investment (SRI) is an investment approach that "integrates ESG factors in the research, analysis, and selection process of securities within an investment portfolio in order to better capture long-term financial returns for investors, and to benefit society by influencing the behavior of companies" (Eurosif, 2021). Investors can influence corporate CSR behaviors and management (Park and Ghauri, 2015). Therefore, positive

social and environmental outcomes as well as long-term financial gains necessitate integration of ESG information by investors.

To attract individual investors, companies need to expose themselves to individual investors more since they tend to invest in familiar companies (Barber and Odean, 2013), and companies need to present their data a format easily accessible and digestible. While three are issues regarding standardization and comparability exists, policy makers and regulators try to improve corporate ESG disclosures and the standardized rating agencies' reports. For example, the Investor Advisory Committee (IAC) under the SEC operates to ensure availability and usability of data for individual investors. Also, there is an increasing number of nations mandate that companies disclose their ESG management practices.

Despite the growing desire of individual investors' for ESG investment, research on ESG information integration by individual investors is insufficient. In addition, even for active involvement in SRI, it is necessary to investigate the factors that influence individual investors to integrate ESG information. Therefore, the objective of this paper is to explore individual investors' intentions to integrate ESG management information and the ways they actually integrate it into their investment decisions. By doing so, this study contributes to the literature in two ways. First of all, previous studies on ESG information integration were mainly focused on institutional investors, but this study focuses on individual investors. Thus, it contributes to expanding the understanding of factors that encourage ESG information integration into the investment decisions of individual investors and closes the gap in research that intensively studied institutional investors. Second, this study meets the current demand for understanding ESG information integration. This study analyzes ESG information integration by individual investors by utilizing a traditional method, a risk management perspective, and the UTAUT innovation adoption model. In previous studies, the UTAUT model was mainly used for technical knowledge or information, but it is designed for use with any type of innovation in various disciplines. Thus, this study contributes to expanding theoretical discussion of the UTAUT model.

The organization of this paper is as follows. "Information that Individual Investors Use" discusses the variety of information that individual investors use when making investment decisions. "Discussion of ESG Information Integration Using Risk Management View" brings the risk management view into investment decision making to identify the risks posed by ESG information integration. In "Discussion of the UTAUT for Integration of ESG Information in Investment Decisions", factors influencing individual investors' integration intentions are identified by using the UTAUT model. Lastly, the paper presents the conclusions from, and the contributions, implications, and limitations of, this research.

INFORMATION THAT INDIVIDUAL INVESTORS USE

Information enables investors to manage risks associated with investment decisions (Heukelom, 2007). Investment decision making is a continuous effort to reduce the level of uncertainty/risk, and acquisition of good information and proper analysis of information can help the process (Danarti et al., 2020). Individual investors' presence in the stock market is increasing. Individual investors account for roughly 25% of stock market activities due to the market volatility created by COVID 19, which is up from 10% of stock market activities in 2009 (Winck, 2022). Due to the increasing importance of individual investors in financial markets, we investigate and discuss the variety of information that individual investors integrate into their investment decisions. **Table 1** shows the types of information integrated by investors for their investment decisions, as presented in previous studies.

One of the critical pieces of information affecting individual investment decisions is publicly available information affecting stock prices; thus, information regarding product safety and quality, corporate ethics, employee relations, community engagement, and organizational environmental activities are in high demand by investors (Chandra and Kumar, 2012). A corporate announcement is useful public information helping individual investors to make the right investment decisions efficiently and at the right time (Pradhan and Kasilingam, 2015).

Financial information driven by various analyses is utilized to determine investment risks and to find investment opportunities (Nur Ozkan-Gunay and Ozkan, 2007). Investors use financial ratios to avoid default risks and maximize financial leverage, to balance long- and short-term investments, to ensure debt coverage stability, etc. To enhance the predictive power of forecasting, it is necessary to explore other non-financial factors (Lin et al., 2011; Harford and Uysal, 2014). Also, non-financial macroeconomic indicators have been found to correlate with investment returns when data from a number of countries are analyzed (Ang and Piazzesi, 2003; Mahmood and Mohd Dinniah, 2007; Pramod Kumar and Puja, 2012). Many investment decision studies have dealt with non-financial information, such as political environments (Herbst and Slinkman, 1984), geopolitical risks (Kim, 2011), consistency in economic policies (Jang and Park, 2019), and legal issues (Dincer, 2007; Jomini, 2011). ESG criteria are the most actively researched non-financial factors to consider (along with financial information) in assessing the investment attractiveness of a company (Velte, 2019; Lee et al., 2020). Information on the ESG criteria themselves includes corporate ESG management disclosure, rating agencies' ESG ratings, news regarding corporate ESG activities, and more.

ESG investing is stimulating mainstream interest from individual investors for two reasons. First, ESG investing actively promotes ethical investment practices; second, ESG investments are considered a means to improving the performance of managed portfolios, and a way to increase returns and reduce portfolio risk (Broadstock et al., 2021).

DISCUSSION OF ESG INFORMATION INTEGRATION USING RISK MANAGEMENT VIEW

Due to the lack of research regarding what causes resistance in individual investors to ESG information integration, a review

TABLE 1 | Information integrated by investors into investment decisions.

Study	The source of information	Objective	Key findings
Obamuyi, 2013	Past performance of the company's stock, expected stock splits/capital increases/bonuses, dividend policies, expected corporate earnings, and get-rich-quick schemes	Determine the main factors influencing investment decisions of investors	Past performance of the company's stock, expected stock splits/capital increases/bonuses, dividend policies, expected corporate earnings, and get-rich-quick schemes are the most influencing factors on investment decisions in Nigeria. The investment climate and the market environment can be made friendly and conducive to attracting investors by creatively developing programs and policies that impact investors' decisions in order to maximize the value of firms and to enhance the wealth of investors
Pradhan and Kasilingam, 2015	Five corporate actions such as dividend announcement, bonus announcement, right issue, buy back and stock split issue	Find out the most influential corporate actions on investment decisions of individual investors	Dividends have the highest influence on investment decisions, and stock splits have the lowest influence. Demographic factors significantly influence the announcement-based investment decision. This encourages investors to hold shares for a long period and is more relevant to the market than other announcements
Hafenstein and Bassen, 2016	Sustainable information (ESG)	Identify the factors affecting the use of ESG information and investment decisions in corporations	Investment decisions are influenced by individual sustainability orientation, and non-professional investors could not distinguish between various aspects of sustainability (that is, ESG criteria). Thus, companies need to inform investors about sustainable practices
Amel-Zadeh and Serafeim, 2018	ESG information	Investigate the reasons for the use of ESG information by investors	The main reason investors consider ESG information when making investment decisions is because they think it is important for investment performance. ESG information is considered to mainly provide information on risks, but it is difficult to use ESG information due to a lack of reporting standards
Uslu Divanoglu and Bagci, 2018	Situations of individual & social, the level of basic knowledge and general factors	Identify the factors influenced by individual investors, and the factors influencing decisions when making investment decisions	Situations of individuals and society, the levels of basic knowledge, and other general factors influence bank investment decisions
Sultana et al., 2018	ESG issues	Investigate the impact on investment decision making of individual stock market investors' preferences for ESG issues and their investment purposes	ESG issues affect investment decisions and are the purpose of investment
In et al., 2019	ESG data	Investigate how to evaluate the quality of ESG data to facilitate its usage by investors and its integration in investment decision making	The quality of ESG data is ultimately determined by the investment decisions in which such data are used
Jang and Park, 2019	Domestic and global factors, such as the global recession and geographical risks	Investigate the determinants of global investors' investments in Korean treasury bonds	Investors with short-term investments are more sensitive to domestic and global factors. Investors with long-term investments are more sensitive to international factors, such as a global recessions and geo-political risks
Khemir et al., 2019	ESG information	Investigate whether investors use ESG information to choose investments in the Tunisian capital market	ESG information influences investment decisions in Tunisia, and governance and social information have more influence than environmental information. Thus, corporations should pay more attention to ESG information disclosure practices
Lee et al., 2020	ESG information	Investigate the differences in performance and risk between high and low ESG investment portfolios	ESG integration helps avoid risks arising from ESG investment. Portfolios with high ESG ratings continuously lower the risks along with providing excellent performance, compared to portfolios with low ESG ratings
Ullah et al., 2021	Corporate CSR strategy	Investigate the effect on investors' investment decisions from the concept of corporate social responsibility (CSR)	Corporate CSR strategy plays a critical role in forming investor investment behavior
Prajapati et al., 2021	ESG and credit ratings	Find out the main drivers and factors that influence individual investors' investment decisions in green bonds	ESG ratings and green bond issuers' credit ratings are the main factors influencing individual investment decisions

TABLE 2 | Information integration issues using the risk management perspective.

Study	Theoretical lense	Information management focus	Type of investors related	Key finding
Jain et al., 2015	Prospect theory, behavioral theory	Information gathering/ processing difficulty	Individual investors	Uncertainty creates bias in individual investors due to the unpredictability
Dong et al., 2016	Price informativeness	Information processing cost	All investors	Information processing costs reduce firm-specific acquisition costs
Pennington and Kelton, 2016	Information processing theory	Information processing cost	All investors	Individual investors use different stopping rules when collecting the information necessary for decision making
Danarti et al., 2020	Prospect theory, risk-taking bias, loss-aversion	Information gathering/ processing difficulty	Individual investors	Uncertainty brings in heuristics to minimize the effort in making investment decisions, introducing bias
Blankespoor, 2019	Mosaic theory, disclosure theory	Information processing cost/ information standardization	All investors	Using Extensible Business Reporting Language brings more disclosures
Blankespoor et al., 2019	Information awareness and acquisition costs	Information processing cost	Individual investors	Information awareness and acquisition costs deter individual investors from using accounting information
Alaaraj and Bakri, 2020	Financial literacy	Information gathering/ processing difficulty	All, but applies more for individual investors	Financial literacy (knowledge and awareness) influences investment decision making
Griffin et al., 2020	Impossibility of informationally efficient market	Information processing cost	All investors	Including disclosures of environment information increases information processing costs for analysts, making it harder for investors to include many firms with ESG management in the portfolios
Huang et al., 2021	Impossibility of informationally efficient market	Information processing cost/ information standardization	All investors	Extensible Business Reporting Language reduces information processing costs
Yi et al., 2021	Information asymmetry	Information processing cost/ information standardization	All investors	Comparability of financial statements reduces information asymmetry and makes companies issuing an IPO more attractive for acquisitions and joint ventures
Chen et al., 2022	Information processing cost	Information processing cost	All investors	Low information-acquisition costs for financial analysts increase information production, improve forecast accuracy, and result in better recommendations
Kim and Gamble, 2022	Risk and uncertainty	Information gathering/ processing difficulty	All investors	Under uncertainty, information acquisition becomes harder for investors with low analytical abilities, resulting in higher reward estimations

of recent literature on information integration in investment decision making was conducted (**Table 2**). The review provides the issues in integration of information. According to Chavas (2004), there are three main sources of risk: (1) when the causes of events are difficult to control or measure precisely; (2) when decision makers lack the ability to process information regarding investment outcomes from the given options; and (3) when the necessary information is too costly to obtain or process. Since the first source cannot be easily controlled or identified, risks are being managed by lowering information processing costs and increasing the quality information acquisition. Each of the studies in **Table 2** is categorized in terms of types of information risks.

In accordance with the Chavas's risk management view, integration of ESG information by individual investors is also related to quality information and information processing costs. Lack of comparability in the reported corporate ESG activities and corporate greenwashing of ESG performance make it harder to collect, analyze, and compare ESG information (Amel-Zadeh and Serafeim, 2018). The divergence in ESG ratings introduces uncertainty in decision making (Berg et al., 2019). Lack of standardization in ESG disclosures and in reporting frameworks and measurements was mentioned by Amel-Zadeh and Serafeim (2018) as the main problem for ESG information integration. Individual investors' lack of skills in acquiring and processing ESG information adds to the information processing costs. While there are differences, individual investors lack financial literacy (Alaaraj and Bakri, 2020) and incur high costs from information awareness and acquisition (Blankespoor et al., 2019).

ESG information integration is a new trend for investment decisions nowadays. Innovation is defined as the development (generation) and/or adoption of new ideas or behaviors (Damanpour and Schneider, 2009). Therefore, integration of ESG information in order to make investment decisions can be considered an innovation. Successful ESG integration in investment decisions needs a new perspective outside traditional risk management. Therefore, the following section presents an innovation adoption perspective to explore the various factors affecting investors' integration of ESG information. There are

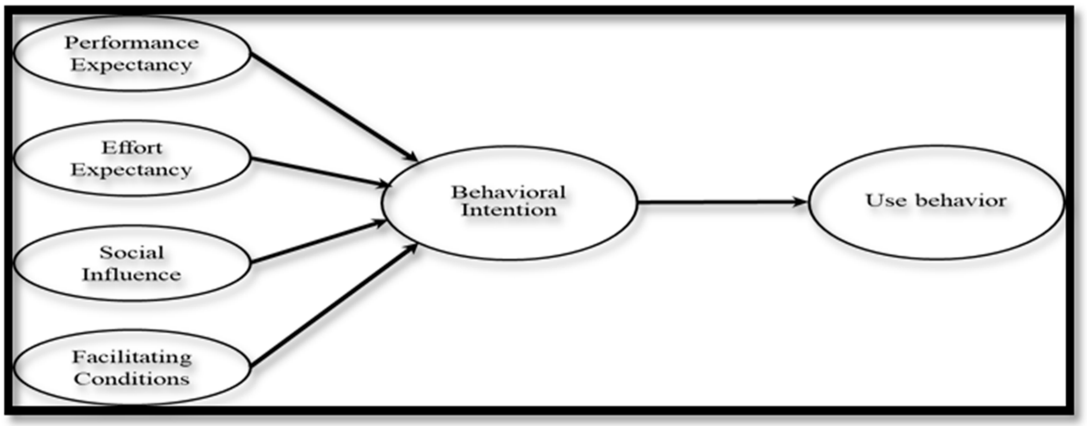

FIGURE 1 | The UTAUT model (Venkatesh et al., 2003).

multiple innovation adoption and integration models (Compeau and Higgins, 1995), but the UTAUT model is the most comprehensive and tested model (Venkatesh et al., 2003). The UTAUT model has been used in previous research related to investment integration/adoption (Gunawan and Novendra, 2017; Francisco and Swanson, 2018; Sun et al., 2019; Gupta et al., 2020; Christensen et al., 2021).

DISCUSSION OF THE UTAUT FOR INTEGRATION OF ESG INFORMATION IN INVESTMENT DECISIONS

UTAUT was developed incorporating eight different acceptance models under four main theoretical backgrounds, and it is used to understand the intentions for and use of innovation. The comprehensive model has been tested vigorously and strongly backed by multiple theories, and thus, this study adopts it to explore various aspects of investors' integration of non-financial information into their decision making (Venkatesh et al., 2003). The UTAUT proposed four categories: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003, see **Figure 1**). The current paper adopts these categories to explain ESG information integration, which is defined as individual investors "explicit inclusion … of ESG risks and opportunities into traditional financial analysis and investment decisions based on a systematic process and appropriate research sources" (Eurosif, 2014).

One of the main goals of SRI through ESG information integration is long-term returns for investors (Eurosif, 2021). Performance expectancy, the first component of the UTAUT model to explain ESG information integration by individual investors, is based on the potential users' belief that the adoption of innovation or innovative behavior is expected to bring better performance. Information on how firms manage their ESG issues is valuable in predicting the firms' long-term sustainability. Investors adopt different kinds of strategies using ESG information, and they always seek good performance indicators for future corporate sustainability. ESG investment is largely motivated by the promise of positive performance (Plagge and Grim, 2020). Therefore, information regarding positive corporate ESG performance should become important corporate ESG information that will positively influence individual investors' integration of it into their investment decisions. A number of studies in the literature have suggested that companies with good ESG practices have a higher return on investment. Friede et al. (2015) conducted a study on ESG/SRI factors and found a significant positive relationship between ESG performance and financial performance. Abate et al. (2021) shows that fund portfolio composed with high ESG-rating securities performed better that low ESG-compliant counterparts.

The second component comprising the UTAUT model is effort expectancy, the ease of integrating ESG information in making investment decisions (Venkatesh et al., 2003). The expectancy is related to how much potential users of ESG information think the entire process will be easy, flexible, and understandable. Eccles et al. (2014) discussed investors' lack of required knowledge or training to use ESG information to do the job. Disclosure processing costs (Blankespoor et al., 2020) should negatively influence effort expectancy. According to Kempeneer et al. (2021), rating agents provide too divergent ratings to rely on. Therefore, individual investors are likely to have a negative effort expectancy regarding ESG integration due to their limited resources in processing disclosures as well as the divergence in corporate ESG disclosures and ESG ratings. Negative effort expectancy will deter individual investors from integrating ESG information into their investment decisions.

Thirdly, social influence in the context of ESG information integration is defined as the level of perception potential investors have regarding how others believe they should use ESG information (Venkatesh et al., 2003). The biggest social influence

seems to be the current business environment, which urges businesses to adopt socially responsible ways, and to promote all the stakeholders' values. The places they live, their work, their cultures, and the surroundings in their living environments give individual investors information advantages increasing the chance of making positive performances (Ivkovic and Weisbenner, 2005; Massa and Simonov, 2006). Individual investors form investment-related knowledge and opinions from their physical environment and their online and offline communities. Because of their close communities, the investment community members (Haritha and Uchil, 2020) and individual investors often demonstrate herd behaviors (Olsen, 2008). They also rely heavily on information from financial online communities (Lerman, 2020). Research by Ammann and Schaub (2020) showed that postings from online communities affect individual investors' decision making significantly—more so for investors who are smaller and less financially literate. Therefore, efforts on SRI involvement should be made in local investment communities where individual investors rely their investment-related information and form their investment ideas.

As the last factor influencing individual investor's ESG information integration, facilitating conditions refers to the belief of individual investors have about the existence of legal, technical, and organizational infrastructures enabling integration and the actual existence of the conditions enabling facilitation. The most important facilitating condition for ESG information integration is legislation on ESG disclosure. Many companies in countries such as those in the EU and in South Korea need to report their ESG disclosures in the near future, and many other nations are expected to adopt such laws (Park and Jang, 2021). The domicile of the investor show integration of ESG information differently (Eurosif, 2014). The issue of ESG reporting and rating standardization is the most cited facilitating condition to be tackled (Eccles et al., 2017).

Discussing each of the four factors of ESG information integration reveals individual investors' general as well as unique ESG investment tendencies. Promoting ESG information integration by individual investors gives a chance to better the quality of ESG disclosures, resulting in positive corporate performance (Raghunathan, 1999). Individual investors would integrate ESG information for their decision making only when they expect positive profitability and a low level of effort in processing the information. Individual investors' participation in ESG investment will require their understanding of ESG management, which can be strengthened with investor relations. Utilizing corporate investor relations will enable individual investors to better integrate ESG information, and it will make them socially conscious investors in the long run. Most importantly, better facilitating conditions under proper laws and regulations, and standardization of the ESG frameworks and metrics are also required for ESG investment by individuals.

CONCLUSION

This study identified the factors affecting individual investors' integration of ESG information into their investment decisions. In this research, (1) we point out the importance of utilizing ESG information for investment decisions; (2) we identify the existing information integration problems for individual investors; (3) we extend the applicability of the existing UTAUT model in order to explain ESG information integration; and (4) we further promote strengthening corporate ESG management *via* individual investors' adoption of ESG information.

While there is a great deal of academic attention given to understanding the adoption of ESG information by institutional investors (Eccles et al., 2017; Park and Jang, 2021), the existing research lacks an understanding of what encourages individual investors to integrate ESG information. Individual investors might not look resourceful as individuals, but their influence on financial market can be significant. Thus, this study contributes to our understanding of the factors that encourage ESG information to be integrated into investment decisions by individual investors, and it closes a gap in investor research that has been largely ignored. Additionally, this study contributes to expanding the generalizability of the UTAUT model by examining the ESG information integration by individual investors (a new research field).

The risk management perspective and the UTAUT model bring multiple factors enabling integration and potentially reducing integration barriers. Therefore, from a managerial perspective, companies can increase the quality of information and lower information processing costs for individual investors by providing quality ESG disclosures, inviting them to their IR meetings for in-depth Q&Rs, avoiding greenwashing, and following industry disclosure practices to increase comparability in their reports. Also, this study offers hints to finance-seeking companies on how to attract investment. First is to emphasize on positive corporate ESG performance to increase the expectations of individual investors. Second is to create comprehensible and comparable ESG reports for individual investors with limited resources. Third is utilizing social communities to attract potential investors. And finally, they can strive to standardize ESG reporting, evaluation frameworks, and ESG metrics. While there is no official standard provided for individual companies, there are standards used more frequently by industry. Merging these steps into industry practice will at least enable comparability within each industry. Also, the network externality each industry builds could influence what becomes standard. To sum up, ESG management is no longer a matter of choice, but an innovative process for investors' investment decisions. Therefore, companies need to disclose not only their financial information but also non-financial corporate information such as ESG criteria. In other words, companies should learn to align their strategic purpose with social values and must efficiently allocate resources to meet the aim of sustaining ESG management.

This paper contributes significantly to current knowledge on ESG information integration by individual investors and provides practical implications for management. It can be expected that more such results can be obtained by applying different models and looking at ESG integration from a different perspective. The most apparent limitation of this research is

the scope. It is aimed at encouraging individual investors' integration of ESG information, and subsequent studies will need to examine the differences in ESG integration between institutional and individual investors.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

SP conceived the idea for the manuscript. All authors contributed to the writing and development of the manuscript and have read and agreed to the published version of the manuscript.

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Digital Innovation and Firm Environmental Performance: The Mediating Role of Supply Chain Management Capabilities

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Given the omnipresence and profoundness of the ongoing pandemic from the Coronavirus disease 2019, its potential spread can be minimized through social distancing. However, this practice causes increasing difficulties and undesirability of traditional transactions or interactions. Accordingly, various manufacturing firms around the world have become more committed not only to accelerating the development of digital technologies, but also to integrating them with existing processes. In this study, we address an important issue of how manufacturing firms can adapt to the ever-changing volatility and unpredictable global business environment, and achieve sustainable growth by developing a strong supply chain management capability. Two specific interrelated research questions are considered: (1) How do supply chain management capabilities contribute to firm environmental performance; and (2) What are the sources of such capabilities? In so doing, we integrate various forms of digital innovation into a supply chain management capability logic to explore their antecedents and consequences. By using survey data from 272 manufacturing firms in China, we examine the relationship between three key forms of digital innovation (i.e., product, platform, and service) and firm environmental performance. Results show that digital product, platform, and service innovations all have positive contributions to supply chain management capability. In turn, supply chain management capabilities have a partial mediating effect between digital product innovation and firm environmental performance, but a full mediating effect between digital platform and service innovations and firm environmental performance.

Keywords: sustainable growth, digital innovation, supply chain management capability, firm environmental performance, manufacturing industry

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INTRODUCTION

Since the beginning of the 21st century, the rapid development of digital technology has accelerated the reorganization of the supply chain. At present, the digital economy has become the most dynamic and emerging economic and social development, leading future business trends. Considering these developments, major countries in the world have encouraged firms to carry out digital innovation as their main thrust and is regarded as the main kinetic energy to lead their own

growth. To comply with the national call and economic environment changes, firms must actively participate and improve in digital innovation, enhance their competitiveness, seize opportunities for future economic development, and gain competitive advantages for performance improvement. Especially in the context of the pandemic from the Coronavirus disease 2019 (COVID-19), face-to-face contact is avoided. Thus, digital platforms are used as important means for major firms to maintain interaction in supply chain nodes. The gap between firms that are leading and lagging in technology has further widened. Digital innovation is used to stabilize risks and turn crises into opportunities, thereby becoming the consensus of all industries. In the post-pandemic era, an industry reshuffle is inevitable. Firms with successful digital innovations are expected to take advantage of the situation and expand in the international market, whereas those who encounter failure would probably withdraw from such arena. Based on its importance, digital innovation has gained the extensive attention of academic circles. In the dimension of digital product innovation, firms recombine digital and physical components to produce new products, use digital resources to produce new artifacts, and apply digital technology to add new attributes and functions to existing non-digital products, thus creating new use values (Nambisan et al., 2017). In the dimension of digital platform innovation, firms use digital tools such as process, project, and information management programs to improve their operational efficiency (Boland et al., 2007). The innovation of digital platform helps firms with the following: improving the existing processes and functions; meeting dynamic business requirements; reducing the time, costs, and resources needed for development and deployment; and identifying digital opportunities to cope with the changes in the internal and external environments (Sedera et al., 2016). In the dimension of digital service innovation, firms use digital technology to communicate with customers in real time, provide timely feedback, and solve customer problems to provide them with completely different solutions and improve their engagement in company efforts (Kim et al., 2021). Thus, with the continuous integration of digital technology into the product, service, and business process transformations, digital innovation can be subdivided into digital product, platform, and service innovations.

With the influence of digital innovation, firms can shorten the R&D cycle, save resources, and realize value creation (von Briel et al., 2018), reduce the time to market of products (Fichman et al., 2014), and use digital technology on a large number of simulation experiments, thereby eliminating the need to repeatedly develop abrasives and saving resources (Vaccaro et al., 2011). In terms of relevant research, finding the shortcomings is not difficult. First, existing research mainly comprises case studies whereas quantitative analyses are relatively few. Second, as digital innovation is a complex concept that covers various levels such as products, platforms, and services, their refinement into these three dimensions is necessary. Finally, although digital innovation provides various benefits, no research has focused on the relationship among digital innovation, supply chain management capability, and firm environmental performance.

The considerable development of global economic integration leads to the increasing commonality of multinational operations. Take the manufacturing industry as an example; for the finished products received by consumers, the product design, raw materials, production, and assembly of components may come from different countries. Before products enter the consumer market, its manufacturing is carried out by a considerable number of firms. Given the different geographical locations, production levels, and management capabilities of these firms, fluctuations in market demand and lack of effective supply chain management may easily lead to the "bullwhip effect". This scenario magnifies a demand variation in the supply chain, severely affecting their entire value output. In the digital era, firms use digital technology to reduce product development cycles, inventory levels, and delivery time. In addition, through digital innovation, firms provide customized products and services. The pressures of pre-sales, after-sales, and operation costs are maintained in balance to meet the increasing digital demand of consumers and operate to benefit every node in the chain. When companies carry out digital innovations, the constant upgrading of their products is driven by technology. The shortened product life cycle has led to increased fluctuations in product demand. In addition, digital innovation has caused an unprecedented level of requirements for supply chain management capabilities. On the supply side, firms capture demand from new users or even meet potential ones through digital innovation, which puts supply chain management capabilities to the test. Improving supply chain management capabilities enables the relevant firms to share information, resources, benefits, and risks. In addition, all stakeholders, such as sellers, buyers, and consumers, can be integrated into a networked chain structure with the aim to maximize the overall benefits (Castorena et al., 2014). A company's supply chain management capabilities mainly include information exchange, coordination and operation, integration of activities, and responsiveness. Specifically, compared with competitors, companies in a supply chain can: exchange information more freely and with better quality; coordinate their operations more efficiently and with less costs; better anticipate demand and plan for the future; and respond faster and more effectively to changing customer and supplier demands (Wu et al., 2006). In the post-pandemic era from COVID-19, only by improving their supply chain management capabilities and rapidly mobilizing digital resources to respond quickly to the crisis can firms become stronger and more resilient. With the spread of COVID-19, increased consumer awareness of environmental protection, global warming, and environmental pollution that increases the risk of virus transmission, companies are deeply reflecting on their past production and management methods to determine how they can innovate to win in the unpredictable post-pandemic era. The relationship between digital innovation, supply chain management, and firm environmental performance is not yet clearly understood by the industry and academia. In response to such situation, this study sets one of the research objectives to determine whether digital product, platform, and service innovations can effectively support firms to improve their supply chain management capabilities. The aim is to

systematically understand the impact paths and mechanisms these three innovation dimensions on the firm environmental performance. Empirical analysis is then used to verify the mediation role of supply chain management capabilities in the above relationship. Findings can lay the foundation for subsequent research on digital innovation, to help more firms understand the relationship between digital innovation, supply chain management capabilities, and environmental performance. Apart from filling the research gap in this field, this study can provide a reference for government departments and firms to make effective digitalization and environmental protection decisions.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Resource-based theory holds that the core competitive advantage of firms is specific resources, which include tangible and intangible ones that can be used in production. Tangible resources are the source of enterprise capabilities. This theory has narrow and broad definitions of resources: the former only regards tangible resources as the key elements of firms whereas the latter considers both tangible and intangible resources (Barney, 2012). According to this theory, an enterprise that has scarce, unrepeatable, lasting, and irreplaceable resources can gain a competitive advantage. The coordination of these resources can improve the enterprise performance and competitiveness (Hart and Dowell, 2011). Digital innovation is an operable resource for firms to gain competitive advantage. In addition, improving the supply chain management ability can optimize enterprise resources (Halldorsson et al., 2007), such as supply chain risk management and learning. Inter-enterprise relationships are also regarded as a type of resource, which emphasizes its importance in mobilizing and integrating the strengths of external partners, and thus bringing the unique advantages of relationships. Referring to the resource-based theory, this study proposes the following theoretical model in **Figure 1** and its digital innovation in three dimensions: digital product, platform, and service innovations as independent variables. The mediating variable is supply chain management capability while the dependent variable is firm environmental performance. First, this study discusses the various influences of digital product, platform, and service innovations on the firm environmental performance. Second, as a mediating variable, the role of supply chain management capability is systematically analyzed between the three innovation dimensions and firm environmental performance.

Digital Product Innovation and Supply Chain Management Capability

Digital product innovation aims to use digital technology to improve existing products, develop new ones, and provide new solutions (Khin and Ho, 2020; Wang, 2021). Enterprise digital technology is regarded as an operational resource and its integration can present different functions (Fichman et al., 2014). Manufacturing firms use digital technology to drive innovation and integrate resources to expand product functions. Digital technology not only enables data to be stored, accessed, and processed, but also feeds back to product development and design to improve environmental performance. Thus, the changing trends of customer demand through data analysis can be effectively predicted to realize accurate product development (Hashem et al., 2015). The application of digital technology in the supply chain can help monitor product manufacturing, predict customer demand, help firms make accurate supply plans, adjust the production schedule as needed, better control the inventory level, reduce inventory and transportation costs, and improve the efficiency of supply chain management (Kwon et al., 2014). Thus, the digital product innovation of firms can have a positive role in improving supply chain management capability. On this basis, the following hypothesis is proposed:

> *Hypothesis 1(H1)*: A firm's digital product innovation is positively associated with the development of the firm's supply chain management capability.

Digital Platform Innovation and Supply Chain Management Capability

Digital platforms are external programs based on software, which comprises an extensible code base. Companies and users share information resources on the applications they build (Ghazawneh and Henfridsson, 2015). Digital platforms are widely used in mobile technology, cloud computing, memory technology, and social media, enabling revolutionary changes to the economy and society (Hofmann and Woods, 2010). Firms use digital platforms to build an ecosystem for manufacturers and suppliers, break the boundaries of traditional firms informatization, and reduce the coordination and transaction costs among partners (Harris et al., 2012). By establishing a digital platform with its partners, manufacturing firms share information resources, monitor every node at any time, and improve the entire supply chain (Maroofi et al., 2017). Thus, the digital platform innovation of firms can help improve supply chain management ability. On this basis, the following hypothesis is proposed:

> *Hypothesis 2(H2)*: A firm's digital platform innovation is positively associated with the development of the firm's supply chain management capability.

Digital Service Innovation and Supply Chain Management Ability

Digital service innovation aims to illustrate the technological features (Kohtamäki et al., 2019) and can enhance the communication between firms and customers, thereby exerting a positive effect on consumer satisfaction (Khin and Ho, 2020). Digital technology is used in customer-oriented innovation to solve customer problems, technology-oriented innovation to launch new services, and collaboration-oriented innovation to improve the customer relationship and experience, as well as allow their participation in firms operation (Kim et al., 2021). Using digital technology, firms can collect and analyze customer data in real time, delve deep into the potential demands of customers, and increase their awareness of customer needs

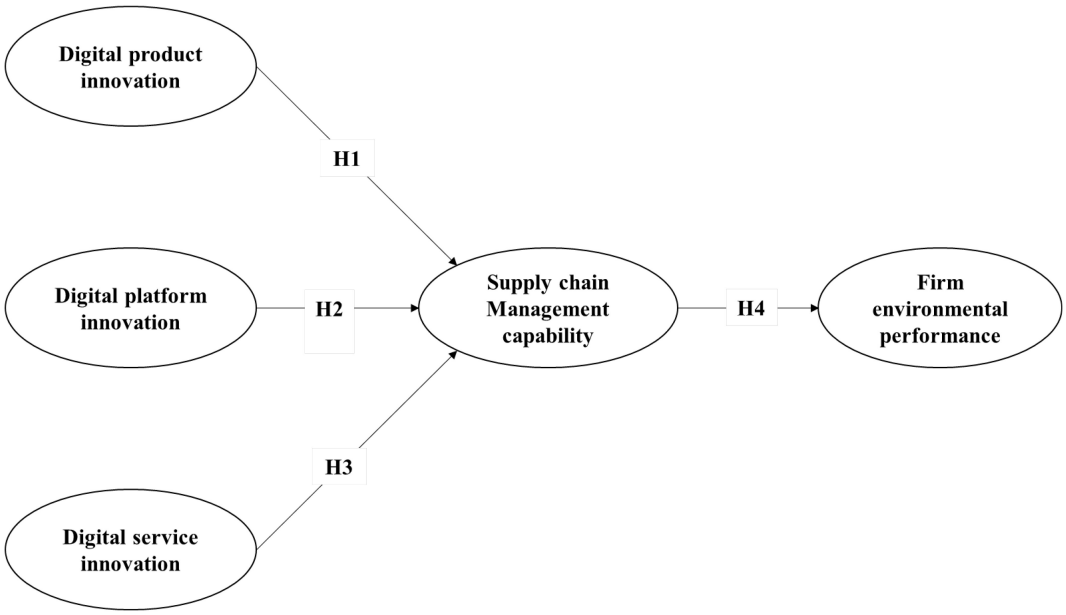

FIGURE 1 | Research model.

(Nambisan et al., 2017). Digital technology integrates the resources in the field of service innovation, expands the scope of business, and improves the efficiency of supply chain (Parry et al., 2016). Thus, the digital service innovation of firms plays a positive role in improving supply chain management ability. On this basis, the following hypothesis is proposed:

> *Hypothesis 3(H3)*: A firm's digital service innovation is positively associated with the development of the firm's supply chain management capability.

Supply Chain Management Capability and Firm Environmental Performance

The purpose of supply chain management is to maximize the value of products and services by fully mobilizing all of its resources and anticipating customer demand in a timely and accurate manner through information sharing and strategic collaboration (Autry and Griffis, 2008). Supply chain management is a set of coordinated operations from procurement to production all the way to delivery to the consumer. The effectiveness of this process helps companies make informed decisions and minimize the costs of information delays or poor flow (Maroofi et al., 2017). Supply chain management has seven dimensions, namely, strategic supplier partnerships, information sharing level, information quality, customer service management, internal lean practices, delays, and total quality management. Among these dimensions, information sharing and quality have the largest impacts on business performance (Al-Shboul et al., 2017). The sharing of information resources allows the exchange of knowledge among related firms while that of risks allows manufacturing firms to significantly improve their performance (Liu et al., 2013). Supply chain management capabilities have a positive impact on firms performance (Podsakoff et al., 2003). As an important part of firm performance is environmental, which refers to the effectiveness of environmental protection and pollution control in business activities, and the ability to reduce harmful emissions through the supply chain (Dubey et al., 2015). This aspect is mainly expressed in the reduced emissions of hazardous substances, gases, wastewater, and solid wastes; saved energy consumption; and improved environmental awareness (Chien, 2014). The ability of companies to enhance collaboration with suppliers and customers (Siagian and Tarigan, 2021) and manage their suppliers in the supply chain can significantly improve their environmental performance (Dubey et al., 2015). As such, the improvement of supply chain management capabilities can positively contribute to the firm environmental performance. On this basis, the following hypothesis is proposed:

> *Hypothesis 4(H4)*: A firm's supply chain management capability is positively associated with the firm's environmental performance.

METHODOLOGY

Sampling and Data Collection

To empirically examine our hypotheses, we collected data from a sample of firms in China's manufacturing sector. We believe China provides an appropriate research context to examine the effect of a firm's digital innovation on the firm's supply chain management capability, which, in turn, contributes to its environmental performance. China, the world's second largest economy, has become one of the world's most innovative economies and most important global innovation leaders by

TABLE 1 | Results of reliability and validity assessments of the constructs.

Construct and indicators	Cronbach's alpha	SFL	CR	AVE
Digital product innovation (DTI)	0.908		0.908	0.553
DTI1		0.714		
DTI 2		0.763		
DTI3		0.796		
DTI4		0.774		
DTI5		0.710		
DTI6		0.711		
DTI7		0.761		
DTI8		0.714		
Digital platform innovation (DMI)	0.928		0.929	0.591
DMI1		0.746		
DMI2		0.770		
DMI3		0.740		
DMI4		0.750		
DMI5		0.743		
DMI6		0.774		
DMI7		0.819		
DMI8		0.781		
DMI 9		0.793		
Digital service innovation (DSI)	0.913		0.914	0.541
DSI1		0.759		
DSI2		0.743		
DSI3		0.751		
DSI4		0.723		
DSI5		0.718		
DSI6		0.728		
DSI7		0.665		
DSI8		0.802		
DSI9		0.724		
SCM capability	0.976		0.976	0.686
SCM1		0.798		
SCM2		0.854		
SCM3		0.838		
SCM4		0.825		
SCM5		0.835		
SCM6		0.828		
SCM7		0.796		
SCM8		0.800		
SCM9		0.821		
SCM10		0.813		
SCM11		0.829		
SCM12		0.804		
SCM13		0.835		
SCM14		0.832		
SCM15		0.875		
SCM16		0.819		
SCM17		0.834		
SCM18		0.851		
SCM19		0.842		
Environmental performance (EP)	0.931		0.932	0.696
EP1		0.786		
EP2		0.839		
EP3		0.849		
EP4		0.830		
EP5		0.857		
EP6		0.844		

N = 272. Model Summary: χ2/df = 1.67, p < 0.001, CFI = 0.928, TLI = 0.925, IFI = 0.929, RMSEA = 0.050. AVE = average variance extracted, SFL = standardized factor loading, CR = composite reliability, SCM = supply chain management.

undergoing rapid digital transformation. According to the 2021 Global Innovation Index (GII) released by the World Intellectual property Organization (WIPO), China was knocking on the GII top 10's door by ranking 12th among more than 130 economies in the 2021 GII list. In fact, China was the only middle-income economy among the world's top 30 most innovative economies. It has been argued that the ongoing innovative design and use of digital technologies in transforming and advancing China's manufacturing capabilities and developing new business models has been one of the important forces driving its innovation and economic growth (Li et al., 2022). A recent survey report released by global consultancy Accenture shows that many Chinese firms are accelerating their digital transformation to develop sustainable competitive advantages and achieve sustainable growth through the innovative use of new digital technologies such as cloud computing and big data. For example, it was reported that the Digital Transformation Champions accounting for 16% of the surveyed firms generated more than half of their revenues from new businesses over the past three years. More importantly, the report further found that Chinese firms which had digital advantages achieve revenue growth 3.7 times than that of other peers in 2020.

To collect survey data used for the study, we carefully developed the survey instrument by using a double-translation procedure to translate the English survey instrument to Chinese. In doing so, we first developed an English-language version of the questionnaire by conducting extensive literature review and incorporating feedback from four academics. Then, two independent bilingual translation helped us translated it into Chinese. Finally, two different independent bilingual translators back translated the Chinese-language version of the questionnaire into English again to ensure conceptual translation equivalence and accuracy. Prior research (Hoskisson et al., 2000) has suggested the potential challenges faced in collecting useful and sufficient primary data from firms in China and argued for the particular importance of building trust and a good *guanxi* (relationship/personal tie) to obtain high-quality responses in the Chinese market. Therefore, we hired a renowned research institute in the Chinese local market to help us conduct the survey procedures and administer the surveys. Through such survey procedures, we received a total of 281 questionnaires. After eliminating 9 incomplete responses, we received a total of 227 completed and usable questionnaires and utilized them in our final data analysis.

TABLE 2 | Descriptive statistics and correlations.

Variable	Mean	STD	1	2	3	5	4	6	7	8
1. Firm size	3.282	1.431	1.000							
2. Industry category	0.608	0.489	0.362**	1.000						
3. Ownership structure	0.620	0.486	−0.162**	−0.052	1.000					
4. Digital product innovation	6.107	0.987	0.080	0.011	−0.024	**0.744**				
5. Digital platform innovation	6.239	0.950	0.099	0.033	−0.028	0.651**	**0.769**			
6. Digital service innovation	6.217	1.028	0.181**	0.134*	−0.036	0.438**	0.486**	**0.736**		
7. Supply chain management capability	2.011	1.137	−0.064	0.009	0.077	−0.615**	−0.392**	−0.386**	**0.828**	
8. Environmental performance	5.993	1.122	0.141**	0.122*	−0.032	0.605**	0.612**	0.543**	−0.546**	**0.834**

*N = 272. *p < 0.05, **p < 0.01. Figures reported in bold on the diagonal are the square root of the average variance extracted for the constructs.*

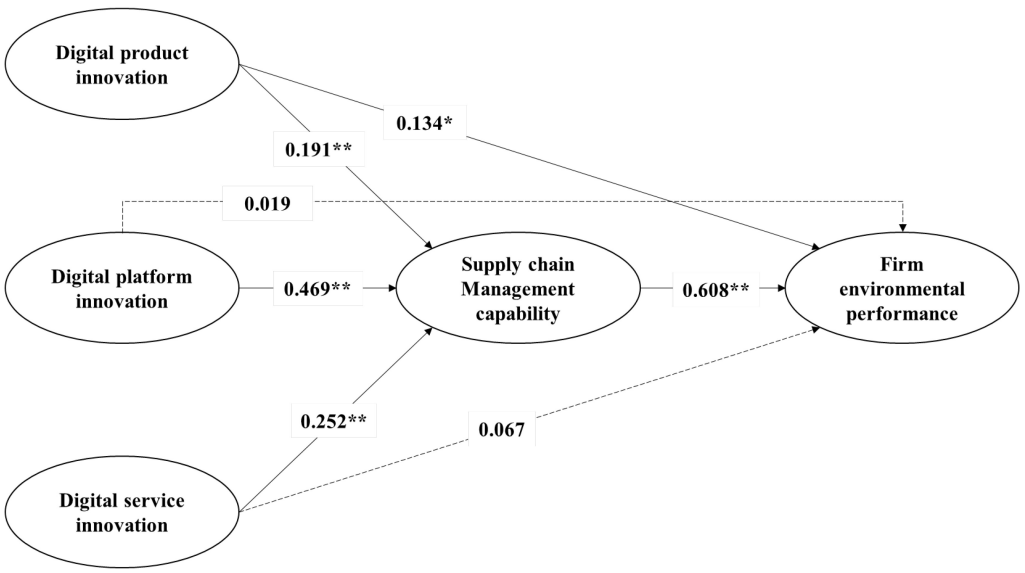

FIGURE 2 | Estimated results of the hypothesis tests using a structural equation modeling. Note: Model summary: χ^2/df = 1.67, $p < 0.001$, CFI = 0.928, TLI = 0.925, IFI = 0.929, RMSEA = 0.050. Non-significant paths are shown by a dotted line. *$p < 0.05$ and **$p < 0.01$.

As non-response bias is likely to occur in our sample of firms and thus may influence the interpretation of our empirical results, we assessed the possible presence of non-response bias by comparing the differences between the responding firms and non-responding firms as well as the early-responding firms and late-responding firms, and the results of the comparison revealed that there were no statistically significant differences between these groups in terms of key firm characteristics (e.g., firm size). In addition, like all survey research, our data may also suffer from serious common method variance (CMV). However, we believe that CMV was less likely to occur in our study due to the following reasons. First, we carefully developed the survey questionnaire by keeping it relatively short. Meanwhile, we designed the questionnaire by placing the dependent and independent variables into several subsections with different response format. To reduce the potential concern stemming from social desirability bias, we ensured the respondents that there were no right or wrong answers to the questions included in the questionnaire and that they should answer the survey question from the current perspective of a group of managers rather than from their own. We further encouraged the respondents to participate in the survey by ensuring both the anonymity and confidentiality of their responses in the cover letter accompanying the questionnaire and promising to offer them a summary and evaluation of the findings upon completion of the study, if requested. Nevertheless, we checked for the presence of potential CMV in our data by following Podsakoff et al.'s (2003) recommendation and performing Harman's one-factor analysis. More specifically, we performed exploratory factor analysis by entering all multiple-item scales into non-rated factor analysis and the results of the one-factor analysis demonstrated that there was no general factor which is apparent in the unrotated factor structure and accounts for a majority of the variance. This finding suggests that our data and results are less likely to suffer from serious CMV problem.

Variables and Measurement

Unless noted otherwise, we measured all the dependent and independent variables using multiple-item, seven-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (7).

In this study, to capture a firm's environmental performance, we asked the firm to assess its overall environmental performance

and measured the variable using six items derived from prior research (e.g., Dragomir, 2018; Gölgeci et al., 2019; Weidner et al., 2021; Zhang et al., 2021). Following prior studies (e.g., Khin and Ho, 2020; Wang, 2021), we asked a firm to evaluate its product innovation efforts by adopting digital technologies and measured the firm's such digital product innovation using eight items derived from prior literature. To measure a firm's digital platform innovation, we used nine times which were adopted from prior research (e.g., Sedera et al., 2016). Similarly, following prior research (e.g., Woo et al., 2021), we adopted nine items to measure a firm's digital service innovation. To measure a firm's supply chain management capability, we carefully reviewed the related literature and adopted a nineteen-item scale to measure the firm's supply chain management capability (Wu et al., 2006; Peng et al., 2016).

In addition, to control for alternative explanations for the results, we included several variables in the analysis: firm size, industry type, and ownership structure. We measured firm size the annual sales of a firm (Qian et al., 2010; Zhao and Murrell, 2016). To control for the industry effect, we created a dummy variable equal to 1 if the firm is primarily operating in the industrial markets (Takata, 2016). To measure the effect of a firm's ownership structure, we created a dummy variable equal to 1 if the firm is privately owned (Houston et al., 2011; He et al., 2013).

ANALYSES AND RESULTS

Measure Reliability and Validity Assessment

In this study, we used a structural equation modeling (SEM) approach to test the proposed model (**Figure 1**). Before testing the proposed model and research hypotheses, we first assessed the reliability and validity of the constructs. We summarize the results of the reliability and validity assessment in **Table 1**. To assess the measure reliability, we used Cronbach's alpha which has been considered a widely used measure of reliability (Nunnally, 1978). As shown in **Table 1**, the alpha values of all scales, ranging from 0.908 to 0.976, are greater than 0.70, demonstrating an adequate level of reliability for the measures of constructs used in this study (Nunnally, 1978). To assess the convergent and discriminant validity of the measures, we created a measurement model by conducting confirmative factor analysis (CFA). The fit indexes of the CFA analysis show that the overall model offers satisfactory fit to the data [$\chi 2/df = 1.67$, $p < 0.001$; comparative fit index (CFI) = 0.928; Tucker Lewis Index (TLI) = 0.925; incremental fit index (IFI) = 0.929; root mean square error of approximation (RMSEA) = 0.050]. To further check the reliabilities for the constructs, we calculated the composite reliability of each construct and the results shown in **Table 1** demonstrated that all the composite reliabilities, ranging from 0.908 to 0.976, are above the 0.70 benchmark, again exhibiting strong internal reliability for our measures. Further, the factor loadings of all indicators are highly statistically significant with values greater than the 0.70 benchmark. In addition, we also calculated the average variance extracted (AVE) statistics, which, ranging from 0.541 to 0.696, are all above the recommended threshold of 0.50. These results provide adequate convergent validity (Fornell and Larcker, 1981). Following Fornell and Larcker (1981), we assessed discriminant validity of the measures by checking whether the square root of AVE of each construct is larger than the correlation between the construct and all possible pairs of other constructs in the model. As shown in **Table 2**, the results confirmed that the square root of AVE value of each construct is much larger than its correlation coefficients with the other constructs, providing strong evidence for adequate discriminant validity of the measures. Overall, the assessment of the measurement reliability and validity indicates that each construct and their respective indicators exhibit an adequate level of reliability and validity in the context of this study.

Hypotheses Testing

Following the measurement model assessment, we empirically examine the hypotheses by performing structural equation modeling. We present the results of SEM analysis in **Figure 2**. We assessed the overall structural model fit and all indexes of model fit demonstrate that the sample data fit the hypothesized structural model reasonably [$\chi 2/df = 1.67$, $p < 0.001$; comparative fit index (CFI) = 0.928; Tucker Lewis Index (TLI) = 0.925; incremental fit index (IFI) = 0.929; root mean square error of approximation (RMSEA) = 0.050]. Overall, the results presented in **Figure 2** indicate that the constructs are largely related in the theoretically predicted manner. More specifically, the results show a significant positive relationship between all the three digital innovation variables, i.e., digital product innovation (ß = 0.191, $p < 0.01$), digital platform innovation (ß = 0.469, $p < 0.01$), digital service innovation (ß = 0.252, $p < 0.01$), and the development of supply chain management capability. Therefore, these results indicate that a firm's digital product innovation, digital platform innovation, and digital service innovation, as hypothesized, are key determinants of the development of the firm's supply chain management capability. These results thus provide strong support for Hypotheses 1, 2, and 3.

Furthermore, we tested Hypothesis 4 by examining the possible role of a firm's supply chain management capability in predicting the firm's sustainable environmental performance. As reported in **Figure 2**, the path coefficient between the supply chain management capability and environmental performance is positive and statistically significant (ß = 0.608, $p < 0.01$). This result indicates that a firm which has a stronger supply chain management capacity is expected to achieve a better environmental performance. On the basis of this empirical evidence, Hypothesis 4 is also strongly supported.

Supplementary Analysis

We examine the possible mediating effect of supply chain management capability in the relationships between the three digital innovation variables and firm environmental performance. Although exploring this possible mediating effect goes beyond the scope of this study, we empirically investigate such possibilities as a supplementary analysis. Following Zhao et al. (2010), we use empirical tests to verify the potential mediating effect of supply chain management capability by

determining their significance. Consistent with our expectations, the results shown in **Figure 2** provide strong evidence that a firm's supply chain management capability fully mediates the relationship between its digital platform innovation and its environmental performance. In this relationship, the coefficient of the indirect effect is positive and statistically significant (ab: ß = 0.285, $p < 0.01$) but that of the direct effect is not statistically significant (c: ß = 0.019, n.s.). Similarly, the results also suggest that a firm's digital service innovation has a positive and statistically significant indirect effect on the firm's environmental performance, which is fully mediated by the firm's supply chain management capability. In this relationship, the coefficient of the indirect effect is positive and statistically significant (ab: ß = 0.153, $p < 0.05$) but the direct effect is not statistically significant (c: ß = 0.067, n.s.). Overall, the results in **Figure 2** provide evidence of full meditating effects of supply chain management capability in the relationships of digital platform and service innovations with environmental performance (Zhao et al., 2010). In terms of the effect of digital product innovation on environmental performance, the results reveal that not only is the direct effect positive and statistically significant (c: ß = 0.134, $p < 0.05$), but also the indirect effect is positive and statistically significant (ab: ß = 0.116, $p < 0.01$). These results imply a presence of complementary or partial mediating effect of supply chain management capability in the relationship of digital product innovation with environmental performance (Zhao et al., 2010). In the following section, we discuss these results and their implications.

DISCUSSION AND CONCLUSION

The COVID-19 pandemic has accelerated the importance of digital platforms as a means for firms to maintain interaction in their supply chains. Thus, digital innovation has become a strategic firm choice, and the gap between firms that are leading and lagging in technology has further widened in terms of competitiveness. To help firms grasp the development initiative in the post-pandemic era, we need a clear understanding of the relationship among digital innovation, supply chain management capabilities, and firm environmental performance. By using the resource-based theory, this study divides the digital innovation strategy into digital product, platform, and service innovations, and discusses their various influences on supply chain management capabilities. Using unique survey data collected on a sample of manufacturing firms in China, we provide and discuss the following findings. First, supply chain management capabilities have a partial mediating effect between digital product innovation and environmental performance. Companies can use digital technology to innovate their products to achieve a double effect, namely, improve their supply chain management capabilities, which can also directly improve their environmental performance. Companies that cannot build digital platforms or provide digital services can instead prioritize the implementation of digital product innovations according to their own situation. Moreover, supply chain management capabilities have a full mediating effect between digital platform innovation and environmental performance. Among the three major digital innovations, that of platforms has the greatest impact on supply chain management capabilities, that is, a positive impact that is not directly related to environmental performance. Digital platform innovation can only indirectly improve environmental performance through supply chain management capabilities, which firms are thus recommended to enhance when building digital platforms. Finally, supply chain management capabilities have a full mediating effect between digital service innovation and environmental performance. In other words, digital service innovation can indirectly but not directly improve firm environmental performance by enhancing supply chain management capabilities. These empirical findings provide theoretical basis for firms to implement strategies in the post-pandemic era and help them determine how to implement digital innovation to improve supply chain management capabilities and firm environmental performance. In this study, digital product, platform, and service innovations are set as independent variables, with supply chain management capability as a mediating variable and firm environmental performance as a dependent variable. A survey of 272 firms reveals the relationship among the three dimensions of digital innovations, supply chain management capability, and firm environmental performance. A comprehensive model is developed and designed to provide useful reference for firms to implement digital innovation strategy in the post-pandemic era, promote and improve firms supply chain management, and provide effective solutions for maximizing firm environmental performance.

Through empirical analysis, our study contributes to the literature in the following ways.

First, previous literature emphasized that digital product innovation can create new use value for customers (Nambisan et al., 2017). The present study finds that digital product innovation has a clear promoting effect on supply chain management ability. Thus, firms can use digital technology to add new attributes and functions to existing products. In addition, digital technology can be applied to development, design, and marketing links to enable faster and more effective responses to the ever-changing needs of customers and suppliers, as well as to allocate according to demand, and better control the inventory to rapidly improve the supply chain management capability.

Second, previous literature emphasized that digital platform innovation can help improve the operational efficiency of firms (Boland et al., 2007), breaking the boundaries of traditional informatization and reducing the coordination and transaction costs among partners (Harris et al., 2012). Moreover, the dynamic business requirements can be fulfilled with reduced time, costs, and resources for firms development and deployment (Sedera et al., 2016). Consistent with previous literature, this study proves that digital platform innovation has a positive effect on supply chain management capability. Firms are suggested to actively use digital tools such as process, project, and information management programs to strengthen the contact with suppliers and customers, and thus fulfill their changing needs. Build digital platforms with partners and customers, share information resources, and improve their abilities in activity integration,

information exchange, and coordination response in the supply chain such that all partners can maximize their interests.

Third, in previous literature, the innovation of digital services enhances the communication between firms and customers (Khin and Ho, 2020) to improve the latter's participation (Kim et al., 2021). The present study finds that digital service innovation has a positive effect on firms supply chain management capability. Firms are encouraged to actively use digital technology to carry out service innovation when solving customer and partner problems, provide real-time communication and quick feedback of digital services for cooperation activities, improve the coordination response and information exchange ability in supply chain management, and work together with suppliers to plan future demand.

Lastly, in general, supply chain management capabilities have a positive effect on firm performance (Podsakoff et al., 2003; Hsu et al., 2009), of which environmental performance is important. This study extends previous findings to verify that improving supply chain management capabilities can significantly improve firm environmental performance. The results demonstrate a partial mediating effect of supply chain management capability in the relationship between digital product innovation and firm environmental performance. Therefore, a firm may choose to prioritize the implementation of digital product innovation if they have no sufficient digital platform or service innovation. Furthermore, the results also show that supply chain management capability has a full mediating effect in the relationship between digital platform innovation and firm environmental performance. More importantly, among the three types of digital innovation, digital platform innovation has the greatest impact on supply chain management capabilities, indicating its important positive influence on the development of supply chain management capabilities but no significant direct effect on firm environmental performance. Given this indirect effect, firms can rather focus on developing and enhancing their supply chain management capabilities when attempting digital platform innovation. Moreover, the results suggest that supply chain management capability also fully mediates the effect of digital service innovation on firm environmental performance. In other words, digital service innovation can only exert an indirect effect by enhancing the supply chain management capabilities but not directly improve environmental performance. Overall, building on resource-based theory, this study offers important contributions to relevant literature by delving deeper into the mediating effect of supply chain management in the relationships between specific types of firm digital innovation and environmental performance, and providing empirical evidence for one of the three mechanisms. Therefore, we hope that this study can enrich the literature on resource-based theory and provide meaningful, practical guidelines for managing supply chains and digital innovation strategies.

Limitations and Future Research Directions

Similar to any research, this study faces certain limitations. First, given the influence of time, energy, and economy, we only investigate Chinese firms. The varying digital innovations and supply chain management capabilities in various countries and firms necessitates the further expansion of this research methodology to greatly improve its universality. Second, compared with that for individual users, the use of survey for firm users is difficult and yields a low feedback rate. During the survey, many firms are reluctant to disclose sensitive information, such as their financial performance. Thus, the firm environmental performance can only be studied through scales. In the future, various channels can be used to obtain relevant information and maximize the research persuasiveness by comparing second-hand and original firm data. Third, in this study, we only consider the mediating role of supply chain management capability in the relationship of digital innovation and firm environmental performance. However, we believe that the contribution of digital innovation to environmental performance may be mediated or even moderated by other organizational and environmental factors. Therefore, future research is encouraged to explore these factors, such as digital technology capabilities, leadership, and supply chain risks, that may mediate or moderate the relationship between digital innovation and environmental performance. We hope an extension of this study can provide more new and useful insights about how to further benefit from implementing digital innovation strategies. Finally, more valuable suggestions can be provided for the implementation of firms' digital innovation strategies. Fourth, regarding supply chain management capabilities, this study focuses on core upstream and downstream firms because of the possible involvement of different partners at various levels, which increases its complexity. Another direction of improvement in future research is to examine more specific issues at different upstream and downstream stages. Finally, while the results of our study provide evidence for full or partial mediating roles of supply chain management capability in the relationships between specific types of digital innovation and environmental performance, several important issues remain. For example, what are the plausible mechanisms that firms can use to better transform their digital innovations into performance? Additional studies thus need to further unpack the specific mechanisms underlying different mediating effects of supply chain management and other firm-specific capabilities. Such research attempts are of significant theoretical and practical importance to more deeply understand the role of digital innovations on firm performance.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

Both authors listed have made substantial, direct, and intellectual contributions to the work, and approved it for publication.

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How Do Green Innovation Strategies Contribute to Firm Performance Under Supply Chain Risk? Evidence From China's Manufacturing Sector

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With environmental issues increasingly becoming prominent in today's business world, firms may need to pay extra attention to developing their environmental strategies and capabilities in response to environmental concerns and achieving sustainable growth. While a broad consensus exists on the value of green innovation, current empirical research on how different types of green innovation strategies may account for the international performance of a firm remains scant. Addressing this gap is important because determining how to better manage a firm's green innovation strategies nowadays has become increasingly important for firms hoping to achieve and maintain their sustainable performance advantages. This study aims to bridge this gap by systematically examining how various types of green innovation strategies (i.e., green product, green process, and green service innovations) can be beneficial to firms in an emerging market economy. This study also examined the important role that potential risks of supply chain play in shaping the relationships between various types of green innovation strategies and firm performance. This study proposes that the effective management of supply chain risks may be important to the successful implementation of green innovation strategies because green innovation has increasingly become a collaborative effort. This study empirically tested the hypotheses by gathering survey data from a sample of 337 firms in China's manufacturing industries. Results demonstrate that the green innovation strategies of firms are positively related to their firm performance. Additionally, the potential risks faced by the firms in efficiently and effectively managing their supply chain significantly moderate the impact of green product innovation and green process innovation strategies on their firm performance. This study not only offers useful theoretical implications for the green innovation strategy research and for better and effective supply chain risk management. It also provides important practical guidelines and managerial actions that practicing managers can implement to accelerate their green innovation strategy, assess the effect of supply chain risks, and thus improve firm performance in the post-pandemic era.

Keywords: sustainability, green innovation, green product innovation, green process innovation, green service innovation, firm performance, supply chain risk

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INTRODUCTION

Sustainable development is an important topic in the twenty-first century, and green innovation is an important driving factor to achieve sustainable development. With sustainable development and continuous popularization of the concept of green environmental protection, green innovation has become an important direction of firm development. Faced with growing environmental problems, many countries have established environmental regulations to regulate and reduce pollution and damage to the environment in production and service processes. With the continuous growth of their environmental awareness, consumers are placing increasing value on the green attributes of a product (Mu et al., 2021). Green innovation is essential for the sustainable development of a firm and the satisfaction of consumers. Green innovation includes hardware and software innovation. It is achieved by adopting eco-friendly materials, developing energy-saving technologies, and reducing processes (Schiederig et al., 2012). Specifically, green innovation can be divided into three parts: green product innovation, green process innovation, and green service innovation.

Green product innovation includes innovations in product design to reduce environmental impacts during production, use, and disposal at the end of the product's life (Arfi et al., 2018). It focuses on the use and recycling of eco-friendly materials to reduce material waste and energy in the production process (Khan et al., 2021). Compared with traditional product innovation, green product innovation is an innovation undertaken by companies to meet environmental changes and customer expectations by reducing excessive consumption of raw materials and energy to avoid risks to consumer health and safety (Chen et al., 2017). This innovation focuses on environmental issues, emphasizes corporate environmental responsibility, and places importance on the use and disposal of products, including energy conservation, pollution prevention, waste recovery, toxicity reduction, and environmental design (Chen et al., 2006; Tariq et al., 2017). Green product innovation meets the needs of consumers for environmental protection, helps firms develop new markets, makes copying of products difficult for other firms, and maintains product competitiveness. Successful green product innovation not only can improve resource utilization efficiency but also enable firms to obtain a competitive advantage (Dangelico and Pujari, 2010; Chang, 2016; Andersén, 2021).

Green process innovation has been widely recognized by governments, scientific research organizations, and social groups (Dugoua and Dumas, 2021). As one of the most basic elements of green innovation and a necessary explicit requirement for implementing green product innovation, green process innovation emphasizes the innovation of production process by using the approaches such as the introduction of advanced green process, green production equipment, and green recycling methods to minimize environmental load (Ma et al., 2017). Compared with traditional innovations, green process innovations play an irreplaceable role in improving environmental quality to reduce environmental pollution and energy and raw material consumption (Guo et al., 2020). This innovation incorporates the environmental needs of stakeholders into production design by reducing the cost of producing goods and aligning products with environmental regulations (Hart and Dowell, 2011). It applies the concept of green to the entire process of product innovation by increasing resource utilization, efficiently promoting green production design, and positively promoting corporate financial performance (Xie et al., 2019). Accordingly, businesses can reduce their environmental and operating costs while indirectly improving their economic performance (Ma et al., 2021). Green process innovation has a positive effect on the reputation, image, and economic performance of a firm (Lee and Min, 2015). It can help develop green products, enlarge product size, improve product quality, raise the reputation of the firm, increase its market share, and realize sustainable development (Xie et al., 2019).

Green service innovation includes elements such as green invention, environmental service portfolio, environmental service delivery, and environmental service design (Chen et al., 2015). Distinct from other service innovations, green service innovation focuses on environmental social responsibility and customer experience (Vakulenko et al., 2019). It is a unique service that rivals will not easily replicate by primarily considering the environmental impact of services provided by companies (Lin and Chen, 2017). In the course of green service innovation, the company repackages new products and services according to environmental concerns, promises environmentally friendly sales practices and after-sales services, and actively helps companies achieve their sustainable development goals (Chen et al., 2015). Companies gain the upper hand by promoting green service innovation activities, such as green services, green design, and clean production (Chuang and Huang, 2015). They can also increase entry barriers to rivals through green service innovation (Chang, 2018).

Based on the above analysis, green product innovation, green process innovation, and green service innovation are the inevitable trends of future development. They can bring many benefits to firms, but challenges and opportunities coexist. Some scholars believe that firms need to invest considerable resources and equipment and a certain amount of funds for waste treatment to implement green innovation. Energy conservation and emission reduction through a green treatment process will increase production cost. The cost of producing green products is significantly higher than that of producing similar non-green products, the profit space is largely reduced, and the competitiveness of product price is not high, all of which will have a negative impact on and cause difficulty in improving the firm's market performance (Palmer et al., 1995; Ambec and Lanoie, 2008; Bray et al., 2011; Wong et al., 2012; Olson, 2013). A look at previous research on the impact of green innovation on firm performance reveals that academia has different views on whether green innovation strategy can have a positive impact on firm performance. Apart from using different empirical settings and research samples, another important plausible explanation for the conflicting findings is that these prior studies tend to view green innovation as a whole and thus do not demarcate specific types of green innovation (e.g., green product innovation, green process innovation, and green service

innovation). With the increasingly prominent contradiction between environmental protection and economic development, more and more firms hope to break through the bottleneck and improve their performance through green innovation. In this regard, we recognize the urgency of adding to our understanding of important green innovation issues by demarcating specific types of green innovation, and more importantly, by identifying and exploring how specific types of green innovation contribute to firm performance. At this time, research on which types of green innovation firms improve their performance is extremely important. To fill the gap in previous research, this study takes the exploration of and analysis on the impact of green innovation on firm performance as the main research themes. First, green innovation is divided into three parts, namely, green product innovation, green process innovation, and green service innovation. Additionally, empirical analysis is used to verify green product innovation. By investigating the different effects of green process innovation and green service innovation on firm performance, we hope to lay the foundation for follow-up green innovation research, deepen and expand the research scope of green innovation and firm performance, help firms deepen their understanding of green innovation strategy, and provide another theoretical basis for firms to implement green innovation strategies.

Under the current background of global economic integration and globalization of environmental issues, a continuing effort has been made by firms to improve their performance by implementing green innovation. In this situation, considerable attention has been increasingly given to the issue of supply chain risks. For example, the question of whether upstream firms can guarantee the adequate supply of important equipment needed to treat wastewater, gaseous wastes, and other types of wastes becomes a genuinely big issue. Therefore, this paper presents a resolution to the debate, by investigating whether and how supply chain environmental conditions such as risks moderate the specific type of green innovation and firm performance. With deepening globalization, future competition will no longer be between firms but between supply chains instead. In the process of global firms adapting to environmental changes and adopting green innovation strategies, the upstream and downstream firms in the supply chain are closely related. Mistakes in any part of the chain may cause considerable losses to the whole supply chain. If the upstream side cannot supply in time, it will lead to the interruption of downstream transportation and in turn, the whole supply chain. Hence, supply chain risk cannot be ignored (Cao and Zhang, 2011). Supply chain risk is the risk that some uncertain factors or emergencies have a negative impact on one or more supply chain links, resulting in the reduction of supply chain efficiency and even the interruption of the supply chain. Its uncertainty is reflected in the inability of firms to accurately judge when, where, in what form, and to what extent the risk will cause losses to upstream and downstream firms (Heckmann et al., 2015). Any risk factor affecting the delivery of products from suppliers to end users can be defined as supply chain risk (Peck, 2006). Supply chain risk generally includes demand interruption and supply interruption. Demand interruption refers to the reduction of market demand because of emergencies. Supply interruption refers to the supplier's failure to achieve supply within the commitment period (Shen and Li, 2017). The sudden pandemic has slowly become long term, and mankind has paid a huge economic and social price. Supply chain risks such as border blockade, sea and air transportation interruption, and logistics obstruction emerged one after another, and firms are forced to deal with them. An increasing number of suppliers are unable to supply goods according to their contract, and the uncertainty of supply and demand has increased. During the pandemic, global trade protectionism increased, some countries strengthened the protection of their firms and markets, the global internationalization process slowed down, market uncertainty and complexity increased, and more and more risk factors appeared in the supply chain. Owing to the close relationship between upstream and downstream firms in the supply chain, if the upstream cannot supply in time, it will lead to the interruption of downstream transportation. Errors in any link of the supply chain will cause considerable losses to each firm, and each firm in the supply chain is not alone (Cao and Zhang, 2011). In view of the fact that firms need to fully control supply chain risks in the process of green innovation practice, the present study takes understanding and grasping the moderating role of supply chain risks as the second research purpose. From the perspective of supply chain risks, this study explores and analyzes the moderating role of supply chain risks between green innovation and firm performance to help firms avoid supply chain risks in the process of green innovation while providing effective solutions for firms to maximize their performance.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

The theory of circular economy was first mentioned by British environmental economists David Pearce and Kerry Turner in the book, "Natural Resources and Environmental Economics" (Pearce and Turner, 1990). In the face of existing environmental problems and resource shortage, this theory states that the relationship between economy and the environment is circular (Li and Liu, 2010). The most important principles of a circular economy are reduction, reuse, and recycle. Reduction means minimizing the input of primary energy and raw materials by improving production efficiency. Reuse means recommending the use of by-products and waste of one company as resources for other companies or industries to maximize product utilization. Recycling encourages the processing of recyclable materials into new products to reduce the consumption of raw materials. Given the different levels, the three principles have different functions and degrees of importance in the economy. Among them, reducing resources is the leading principle in the circular economy system (Su et al., 2013).

Figure 1 illustrates the research model inspired from the theory of circular economy and proposed in this study. As shown in **Figure 1**, this study divides green innovation into green product innovation, green process innovation, and green service innovation. Hypotheses 1–3 propose that green product innovation, green process innovation, and green service

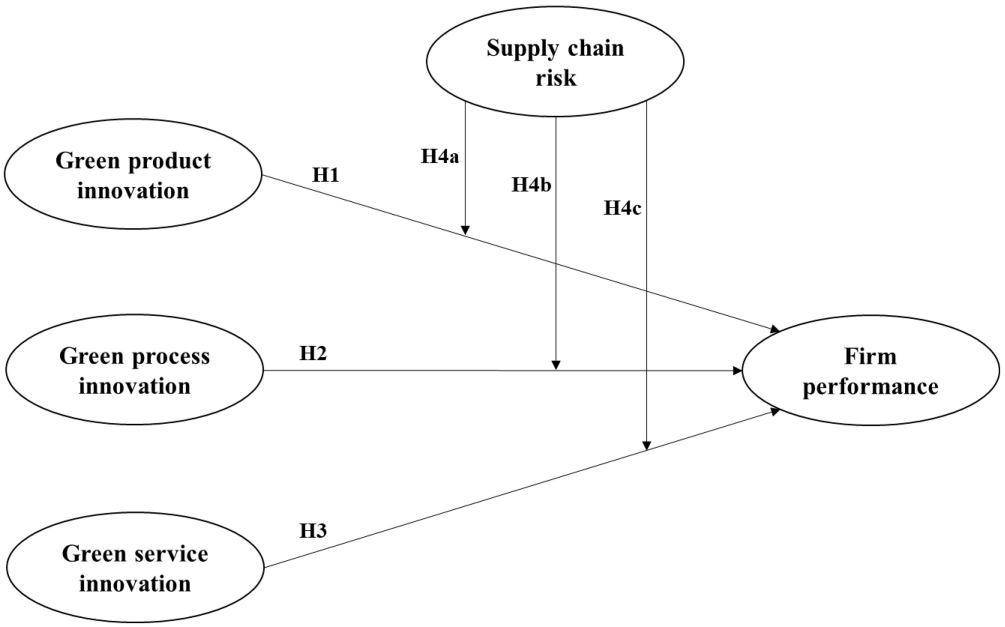

FIGURE 1 | Conceptual model.

innovation, respectively, have different positive promoting effects on firm performance. At the same time, in view of the changes in the international situation and based on the original circular economy theory, taking the global supply chain risk as a moderating variable, Hypotheses 4a–4c assume that supply chain risk negatively moderates the contribution of green product innovation, green process innovation, and green service innovation to firm performance, respectively.

Green Product Innovation and Firm Performance

According to previous literature research, green product innovation reduces the negative impact of firms on the environment and improves the profitability of the firms by reducing waste and costs (Singh et al., 2020). Green product innovation also plays a positive role in promoting the establishment of corporate image (Weng et al., 2015). With the continuous improvement of consumers' awareness and demand for environmental protection, firms are providing more environmentally friendly products than their competitors, which help the former develop new markets and gain competitive advantages (Chen et al., 2006). The implementation of green product innovation by firms enhances the possibility of implementing differentiation strategies and helps improve consumers' perceived value of products (Porter, 1991). In view of the benefits of green product innovation, its implementation is anticipated to have a positive impact on firm performance in the market competition. On this basis, this study proposes the following relationship:

Hypothesis 1: A firm's level of green product innovation is positively associated with the firm's performance.

Green Process Innovation and Firm Performance

From the perspective of innovation economics, green process innovation can improve the economic performance of firms by optimizing the factor allocation efficiency of firms, including reducing production and operation costs, expanding production, increasing market share, obtaining green technology patent license, and other benefits (Wang et al., 2021). Green process innovation plays a positive role in improving resource utilization and reducing input and waste treatment costs (Wei and Sun, 2021). Given the increasingly serious problem of global environmental degradation, governments of various countries have formulated and issued a series of environmental protection policies to restrict the production of pollutant discharge firms. The pressure on a firm to practice green process innovation is increasing. As an important part of green innovation, green process innovation can significantly reduce pollution in the manufacturing process and meet the green needs of the government and consumers (Dai and Zhang, 2017). With the continuous enhancement of consumers' awareness of environmental protection, they not only like to buy energy-saving and environmental protection products but also want to know whether a green process is used in the production process of the products. Environmental protection products through green process innovation can be highly praised by consumers (Liu et al., 2012). To sum up, firms may improve their performance if they implement green process innovation in market competition. On this basis, this study proposes the following relationship:

Hypothesis 2: A firm's level of green process innovation is positively associated with the firm's performance.

Green Service Innovation and Firm Performance

In green firms, customer demand is the key to whether firms can improve performance, and it can be fully met by providing green service innovation (Yu et al., 2017). Green service innovation focuses on environmental issues and can create unique services that cannot be easily copied by competitors (Chen et al., 2016). Such innovation provided by firms not only reduces the negative impact on the environment but also helps firms integrate with the international market and better meet the environmental requirements of the international community (Lin and Chen, 2018). Green service innovation is a process to attract customers by improving the environmental protection of products and services, thus providing customers with green experience and helping firms improve their market share (Yu et al., 2017). It can add value to products and services as well as improve the competitiveness and creativity of firms to help them gain competitive advantage (Lin and Chen, 2017). Overall, providing green service innovation may contribute to firm performance. On this basis, this study proposes the following relationship:

> *Hypothesis 3*: A firm's level of green service innovation is positively associated with the firm's performance.

Moderating Effect of Supply Chain Risk

Generally, inaccuracy in predicting market demand will lead to excess inventory and increase in storage costs. Drastic changes in the international environment will lead to fluctuations in raw material prices and increase in procurement costs. Natural and man-made disasters will affect production and interrupt the supply chain. Firms are said to be deep in the supply chain, and any uncertain factors and negative events may affect their performance (Kuo and Lin, 2018). The firm supply chain itself is fragile. Affected by factors such as firm outsourcing, the emergence of the global market, increasing dependence on suppliers and customers, and the rapid development of information technology, supply chain risks are increasing in the process of implementing an innovation strategy (Kuo and Lin, 2018). Once supply chain risks reach the degree of interruption, the downstream supply will be unstable and unable to respond to the needs of customers immediately, and the firm performance will suffer losses (Sheffi, 2001; Hendayani et al., 2021). As the biggest uncertainty in the sustainable development of firms, environmental problems have a huge impact on firm performance. If firms cannot control the supply chain risks well, these risks may have a negative impact on firm performance (Singh, 2020). Firms have promoted green product innovation, green process innovation, and green service innovation to stabilize firm performance and thus prevent the uncertainty of environmental problems and reduce the supply chain risks caused by environmental problems. To reduce the negative impact on the environment, green product innovation uses decomposable materials for product packaging, designs environmentally friendly packaging for products, establishes the environmental image of the firm, and reduces the supply chain risk caused by the uncertainty of environmental problems (Chen et al., 2006). Green process innovation means that firms improve the product process environment; reduce pollutants or harmful substances in the production process; prevent firms from polluting the soil, water quality, noise, and air in the production process; and recycle waste, wastewater, and resources (Chen et al., 2006; Xie et al., 2019). Green service innovation means that firms provide green services for customers on the basis of environmental concerns and social responsibility, make environmental protection commitments for environmental problems, provide environmental protection sales methods and after-sales services, and actively strive to practice environmental protection practices (Chen et al., 2015). Green innovation strategy applies the green concept to the whole process of product innovation, which can improve resource utilization efficiency, effectively promote the production and design of green products, improve product quality and firm popularity, increase market share, achieve sustainable development, and positively promote firm performance (Lee and Min, 2015; Xie et al., 2019). When firms use the green innovation strategy to expand overseas, opportunities and challenges coexist; moreover, they may encounter political, social, environmental, supplier, and customer supply chain risks (Brusset and Teller, 2017). Owing to different environmental regulation standards in various countries, governments, suppliers, and customers have different views on environmental issues (d'Astous and Legendre, 2009; Wu and Ma, 2016). The degree of supply chain risk encountered by each firm is also different. Thus, the following are expected: the greater the supply chain risk, the more obstacles for firms to practice green innovation; and the lower the supply chain risk, the smoother the path of firm green innovation and the higher the firm performance. Taken together, this line of reasoning suggests that, in most circumstances, supply chain risks weaken the contribution of green innovation to firm performance. Thus, any given firm experiencing greater supply chain risks is more likely to achieve worse performance than the firm experiencing less supply chain risks by implementing green product innovation, green process innovation, and green service innovation on firm performance. On this basis, we propose the following relationships:

> *Hypothesis 4a*: The level of supply chain risk negatively moderates the relationship between green product innovation and the firm's performance, such that the higher the degree of supply chain risk, the lower the contribution of green production innovation to firm performance.

> *Hypothesis 4b*: The level of supply chain risk negatively moderates the relationship between green process innovation and the firm's performance, such that the higher the degree of supply chain risk, the lower the contribution of green process innovation to firm performance.

> *Hypothesis 4c*: The level of supply chain risk negatively moderates the relationship between green service innovation and the firm's performance, such that the higher the degree of supply chain risk, the lower the contribution of green service innovation to firm performance.

METHODOLOGY

Sampling and Data Collection

We test our hypotheses using survey data collected from a sample of firms in China's manufacturing sector. China provides an appropriate research setting to empirically explore how the type of green innovation may determine firm performance and how supply chain risk may moderate the contribution of the type of green innovation to firm performance. With the quick innovation-driven transformation, China has been making active efforts to boost innovation in manufacturing by speeding up and upgrading the green technological innovation, particularly the greening of its manufacturing system to enhance global competitiveness and achieve a more sustainable high-quality development in the long run. Accordingly, many Chinese firms are actively seeking innovation in products, services, business models, and core technologies by further ramping up their efforts in core technologies to foster green and sustainable development. According to the 2021 China manufacturing innovation survey report on large- and medium-sized manufacturing firms released by Deloitte Consulting, more than 30% of the surveyed Chinese manufacturing firms have been engaged in various innovation activities such as product, service, or technological innovation; meanwhile, 9% of the firms have been seeking more green-oriented innovation (Deloitte Consulting, 2021). The report also indicated that Chinese firms generally experience many persisting significant challenges in boosting green and sustainable innovation. Furthermore, as China has announced that its carbon emissions will be expected to peak its carbon emission before 2030 and achieve carbon neutrality before 2060, the Chinese government has been introducing a series of supporting policies and incentives to encourage and facilitate Chinese firms to deploy innovative technologies that will speed up their green transformation.

We followed a careful process to develop the questionnaire for the study. We first developed an English version of the questionnaire and then translated it into Chinese by two independent bilingual translators. To ensure conceptual equivalence and accuracy, the Chinese version of the questionnaire was back-translated into English by two additional independent bilingual professional translators. Prior research has pointed for the difficulties of collecting sufficient primary data from Chinese firms and emphasized the particular importance of developing a good relationship and trust with the sampling firms to increase high-quality responses (Hoskisson et al., 2000). Therefore, we conducted the survey procedures with the help of a renowned research company in the Chinese local market. We received a total of 353 questionnaires. After excluding 16 incomplete responses, we received a total of 337 completed and usable questionnaires that are utilized for the final data analysis. Responding firms operating primarily in industrial markets accounted for 62%. The participating firms with annual sales less than 5 million RMB accounted for 31.5 and 20.5% of the participating firms ranged in size from 5 million RMB to 10 million RMB in annual sales. Regarding ownership structure, nearly 63% of the responding firms were privately owned enterprises.

To check for the presence of non-response bias in the survey data that may influence our statistical results, we compared the differences between the responding firms and non-responding

TABLE 1 | Results of reliability and validity assessments of the constructs.

Construct and indicators	FL
Green product innovation **(Cronbach's alpha = 0.913, *CR* = 0.917, AVE = 0.736)**	
Modifications of product design not to use toxic compounds within the production process.	0.861
Product design reformations aimed to improve energy efficiency during usage.	0.887
Product packaging with decomposable materials for lower disposal environmental impact.	0.889
Improving and designing environmentally friendly packaging for existing and new products.	0.790
Green process innovation **(Cronbach's alpha = 0.937, *CR* = 0.937, AVE = 0.651)**	
The environmental improvement of products reduces pollutants or hazardous materials within the production process.	0.755
The environmental improvement of the product has reduced soil, water quality, noise, and air pollution within the production process.	0.743
The environmental enhancement of the product leads to the recycling of waste, water, and materials within the production process.	0.801
The environmental enhancement of the product leads to a reduction in energy use within the production process.	0.828
The environmental contribution of the product leads to reduced soil, water quality, noise, and air pollution within the production process.	0.846
The environmental contribution of the product leads to improved recyclability within the production process.	0.822
Upgraded existing production equipment and processes	0.838
Increased investment in R&D of environmental protection technology	0.816
Green service innovation **(Cronbach's alpha = 0.947, *CR* = 0.947, AVE = 0.781)**	
The firm repackages existing products/services on the basis of its concern for the environment.	0.891
The firm frequently extends products/services on the basis of its concern for the environment	0.894
The firm creates and establishes new lines of products/services on the basis of its concern for the environment.	0.904
The firm offers new practices in new product/service development on the basis of its environmental concerns.	0.859
The firm proposes new practices in the promotion of new products/services related to environmental reputation.	0.869
Supply chain risk **(Cronbach's alpha = 0.957, *CR* = 0.957, AVE = 0.789)**	
Your supply chain is affected by external social risks.	0.801
Your supply chain is affected by risks related to your suppliers.	0.913
Your supply chain is affected by risks related to your customers.	0.924
Your supply chain is affected by external economic risks.	0.905
Your supply chain is affected by external environmental risks.	0.908
Your supply chain is affected by external political risks.	0.871
Firm performance **(Cronbach's alpha = 0.934, *CR* = 0.936, AVE = 0.745)**	
Profitability	0.769
Net profit margin	0.864
Profitability growth	0.907
Sales performance	0.855
Overall firm performance	0.912

N = 337. AVE, average variance extracted; CR, composite reliability; FL, factor loading.
Model Summary: $\chi^2(340) = 710.914$, $p < 0.001$, CFI = 0.959, TLI = 0.954, IFI = 0.959, RMSEA = 0.057.

firms as well as the early- and late-responding firms, and the results of such comparison demonstrated that these groups did not differ statistically in terms of key firm characteristics (e.g., firm size). We also checked for the presence of potential common method variance (CMV) in our data. Following Podsakoff et al. (2003), we assessed the potential CMV concern in our data by performing Harman's one-factor analysis. Accordingly, we performed exploratory factor analysis by running non-rotated factor analysis with all multiple-item variables entered. The results of the one-factor analysis indicate that no general factor is apparent in the unrotated factor structure and accounts for a majority of the variance, thereby suggesting that CMV is less likely to be a significant concern in our data.

Variables and Measurement

Unless noted otherwise, we measured all the dependent, independent, and moderating variables in the study using multiple-item, seven-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (7).

The dependent variable, firm performance, represents the degree of self-reported performance. Following prior research (e.g., Katsikeas et al., 2006; Schilke, 2014; Park and Xiao, 2020), we measured firm performance by asking the firms to assess their profitability, net profit margin, profitability growth, sales performance, and overall firm performance compared with those of their industry rivals. To measure a firm's green product innovation, we used four items derived from prior related research (e.g., Chen et al., 2006; Lin et al., 2013; Xie et al., 2019). On the basis of the work of Xie et al. (2019) and Wang et al. (2021), we measured green process innovation using eight items. To measure green service innovation, we used five items derived from prior literature (e.g., Chen and Tsou, 2006; Chen et al., 2015). Following prior research (e.g., Brusset and Teller, 2017), we measured the degree of supply chain risks using six items.

To rule out alternative explanations for our results, we also incorporated several control variables into the analysis: firm size, industry type, and ownership structure. We included firm size measured as a firm's annual sales (Qian et al., 2010; Zhao and Murrell, 2016). We controlled for the industry effect using a dummy variable, which was equal to 1 if the firm's product domain was industrial (Takata, 2016). To control for the effect of ownership structure, we developed a dummy variable which was equal to 1 if the firm is privately owned (Houston et al., 2011; He et al., 2013).

ANALYSES AND RESULTS

Measure Reliability and Validity Assessment

Before empirically testing the hypotheses, we first assessed the reliability and validity of the constructs. **Table 1** presents the results of the reliability and validity assessment, which summarizes the construct reliabilities, factor loadings, and the average variances extracted (AVEs). As we used the established scales to measure the variables in this study, all measures exhibit strong reliability and validity. As shown in **Table 1**, all the Cronbach's alpha values, ranging from 0.913 to 0.957, are greater than 0.90, exceeding the 0.70 benchmark. Therefore, our constructs exhibit strong internal reliability (Nunnally, 1978). In addition, we assessed the construct validity using confirmatory factor analysis (CFA). The fit indexes of the CFA analysis show that the overall model offers satisfactory fit to the data [$\chi^2/df = 2.09$, $p < 0.001$; comparative fit index (CFI) = 0.959; Tucker Lewis Index (TLI) = 0.954; incremental fit index (IFI) = 0.959; root mean square error of approximation (RMSEA) = 0.057]. The factor loadings of all constructs are highly significant with values greater than 0.70. The composite reliability of all constructs, ranging from 0.917 to 0.957, exceeds the 0.70 benchmark and all AVE values, ranging from 0.651 to 0.789, are greater than 0.50. These results provide adequate reliability and convergent validity (Fornell and Larcker, 1981). Following Fornell and Larcker (1981), we assessed discriminant validity of the measures by comparing the square root of AVE of each construct and correlation between the construct and all possible pairs of constructs in the model. As shown in **Table 2**, the results confirmed that the square root of AVE of each construct is much higher than its correlation with the other constructs, providing an adequate discriminant validity of the measures. Overall, the constructs and their respective indicators exhibit strong reliability and validity in the context of this study.

Hypothesis Testing

Following the measure reliability and validity assessment, we empirically test the theoretical model and the hypotheses.

TABLE 2 | Descriptive statistics and correlations.

Variable	Mean	*SD*	1	2	3	4	5	6	7	8
1. Firm size	3.282	1.431	1.000							
2. Industry category	0.608	0.489	0.362**	1.000						
3. Ownership structure	0.620	0.486	−0.162**	−0.052	1.000					
4. Green product innovation	6.107	0.987	0.080	0.011	−0.024	***0.858***				
5. Green process innovation	6.239	0.950	0.099	0.033	−0.028	0.651**	***0.807***			
6. Green service innovation	6.217	1.028	0.181**	0.134*	−0.036	0.438**	0.486**	***0.884***		
7. Supply chain risk	2.011	1.137	−0.064	0.009	0.077	−0.615**	−0.392**	−0.386**	***0.888***	
8. Firm performance	5.993	1.122	0.141**	0.122*	−0.032	0.605**	0.612**	0.543**	−0.546**	***0.863***

*N = 337. Figures in italicized bold denote the square root of the AVE of each study construct. *p < 0.05, **p < 0.01.*

Table 2 reports means, standard deviations, and correlations for each of the measures. Considering that no correlation is above the recommended level of 0.70 (Tabachnick and Fidell, 1996), multicollinearity is less likely to occur and threaten the interpretability of our results. Nonetheless, we checked for the potential presence of multicollinearity by examining the variance inflation factors (VIF) of each individual predictor in our regression model. The VIF values for all our individual predictors were all well below 10 (with the maximum being 4.02), suggesting that multicollinearity is less likely to be a problem in our analysis (Neter et al., 1996). To further mitigate multicollinearity concerns, we mean-centered all independent and moderating variables when running all interaction models (Aiken and West, 1991).

To test our hypotheses, we employed moderated hierarchical regression analysis. **Table 3** presents the results of the moderated hierarchical regression analysis in which the changes in R-squared (ΔR^2) at each step and standardized coefficients are reported. Model 1 included all control and independent variables. Models 2, 3, and 4 tested the interaction terms by introducing them individually. As shown in Model 1 of **Table 3**, the coefficients for the green product innovation ($\beta = 0.159$, $p < 0.001$), green process innovation ($\beta = 0.302$, $p < 0.001$), and green service innovation ($\beta = 0.218$, $p < 0.001$), were all positive and statistically significant. Therefore, Hypotheses 1, 2, and 3, which predicted a positive relationship between type of green innovation (i.e., green product innovation, green process innovation, and green service innovation) and firm performance, were all supported. Hypotheses 4a, 4b, and 4c proposed a negative moderating effect for supply chain risk on the relationship between type of green innovation and firm performance. The coefficient for the interaction term between green product innovation and supply chain risk in Model 2 (GTISCU) was negative and significant ($\beta = -0.172$, $p < 0.001$). It provides evidence that the relationship between green product innovation and firm performance is negatively moderated by supply chain risk, thereby supporting Hypothesis 4a. Similarly, as shown in Model 3 of **Table 3**, the results indicate the negative and also statistically significant interaction effect of green process innovation and supply chain risk ($\beta = -0.130$, $p < 0.01$). Accordingly, Hypothesis 4b was also supported. Conversely, the coefficient for the interaction term between green service innovation and firm performance (GEISCU) in Model 4 was negative but statistically insignificant ($\beta = -0.014$, n.s.). Therefore, Hypothesis 4c was not supported. In the following section, we discuss these results and their implications.

TABLE 3 | Results of hierarchical regression analysis.

Variable	Model 1	Model 2	Model 3	Model 4
Firm size (annual sales)	0.018	0.028	0.028	0.018
Industry dummy	0.077	0.076	0.074	0.077
Ownership structure	0.014	0.027	0.027	0.014
Green product innovation (GTI)	0.159**	0.204***	0.152**	0.158**
Green process innovation (GSI)	0.302***	0.302***	0.337***	0.305***
Green service innovation (GEI)	0.218***	0.210***	0.228***	0.221***
Supply chain risk (SCR)	−0.247***	−0.288***	−0.259***	−0.248***
GTI SCR		−0.172***		
GSI SCR			−0.130**	
GEI SCR				−0.014
F statistics	56.447***	54.224***	52.300***	49.277***
R^2	0.546	0.569	0.561	0.546
ΔR^2		0.024***	0.015**	0.000

*N = 337. **p < 0.01, ***p < 0.001.*

DISCUSSION AND CONCLUSION

Discussion and Implications for Theory and Practice

In this study, we theorized and empirically investigated the effect of various types of green innovation strategies on the firm performance of manufacturing firms in one of the world's largest emerging economies (i.e., China). We have outlined the gains from green innovation and the context required for firms to leverage these gains. When environmental problems become serious enough to threaten human survival, the necessity and urgency of firms' green innovation are further highlighted. Implementing green innovation has become a strategic choice for firms to grasp the development initiative in the post-pandemic era. This study is based on the circular economy in view of the international situation that multiple uncertainties of global supply chain risks have brought testing firms' green innovation. Green innovation strategy is subdivided into green product innovation, green process innovation, and green service innovation. This study examines the different effects of these innovations on firm performance, thereby laying a theoretical foundation for firms to implement green innovation strategy in the post-pandemic era and help firms figure out how to implement green innovation to improve firm performance. At the same time, this study takes supply chain risk as a moderating variable and develops a comprehensive model to provide a useful reference for firms to avoid supply chain risk and accelerate green innovation strategy in the post-pandemic era. This study is expected to provide effective solutions for firms to implement green innovation strategy and improve firm performance.

By theorizing and offering empirical evidence of the importance of green innovation and supply chain risks, this study contributes to the literature in the following ways. First, green product innovation can significantly promote the performance of firms. Previous literature emphasized that green product innovation can help firms obtain market competitiveness (Chen et al., 2006). The current study extends this idea on the basis of the original literature. Given the positive impact of green product innovation on firm performance, firms should avoid using compounds that pollute the environment in product design. Designing environmentally friendly packaging for products is necessary.

Second, this study provides evidence that green process innovation has a positive effect on firm performance. Previous literature emphasized that green process innovation can solve the environmental problems in the process of production and

consumption and improve the sustainability of production (Wang et al., 2021). This study further deepens and extends the previous research results. Given that green process innovation has a positive impact on firm performance, firms are suggested to avoid the use of harmful substances in the process of generating products; reduce the pollution of soil, water quality, air, and other environmental factors caused by the production of goods; adopt advanced environmental protection technology; and introduce pollution control equipment to make wastewater and waste materials recyclable to maximize energy efficiency. Through these green process innovation measures, firm performance will be largely improved.

Third, this study finds that green service innovation can significantly promote firm performance. This result is consistent with previous research results. In previous literature, green service innovation can make copying and gaining a competitive advantage difficult for competitors (Lin and Chen, 2017). It can also effectively help firms achieve sustainable development goals (Chen et al., 2015). The present study suggests that firms should pay attention to environmental issues. With the view to solving environmental problems, firms must redefine their existing products and services, provide environmental protection services for customers, and advocate the use of environmental protection sales methods and after-sales services, all of which will directly promote firm performance.

Fourth, for the moderating effect of supply chain risk, this study finds that supply chain risk plays a negative moderating role between green product innovation and firm performance. In the supply chain where firms generate products and deliver them to consumers, production networks such as raw material supply, parts manufacturing, labor supply, and logistics are closely linked. Mistakes in any link will bring challenges and risks to the main participants in the supply chain. In particular, implementing green product innovation by firms will inevitably require the production of products with environmentally friendly materials. Firms need to bear the risks brought by the replacement of raw materials (Cao and Zhang, 2011). According to the results of this research, when implementing the green innovation strategy, firms must pay close attention to the political, social, and environmental risk factors of each firm in the supply chain. They should also prepare response plans according to the changes in the situation, give full play to the positive role of green product innovation, and support the steady rise of firm performance.

Furthermore, this study finds that supply chain risk plays a negative moderating role between green process innovation and firm performance. For green process innovation, firms need to introduce environmental protection production machinery and equipment and replace suppliers. If the replaced machinery and equipment are from abroad, firms may need to bear transportation and political risks (Sheffi, 2001; Hendayani et al., 2021). In view of this possible scenario, firms should fully consider the cost burden triggered by replacing the machinery, equipment, and suppliers when carrying out green process innovation to avoid supply chain risk as much as possible. Finally, this study finds that supply chain risk does not play an obvious negative moderating role between green service innovation and firm performance. A plausible explanation for the insignificant moderating effect of supply chain risk on the relationship between green service innovation and firm performance is that green service innovation usually focuses on the service field which is performed by using environmentally friendly packing service and after-sales services. Such green service innovations are generally carried out by the firms themselves. In addition, other supply-chain related firms may be less likely to bring significant effects on the internal service innovation activities of such firms. In other words, the green service innovation of firms to improve performance will not be negatively affected by supply chain risk. Therefore, firms can prioritize the implementation of green service innovation according to their own situation. After the firm is strong enough to bear the risks brought by the supply chain, they can consider trying green product innovation and green process innovation, actively promote service measures related to environmental problems, and conquer consumers with green services.

Limitations and Future Research Directions

Similar to all studies, this study is not without limitations. First, as our sample primarily comprised the small- and medium-sized firms in the Chinese economy, generating our findings to very large firms may be difficult. Thus, an important avenue for fruitful research is to incorporate large Chinese firms. Second, the sample of our study was limited to Chinese firms, and our focus on firms in China may raise some concerns on the generalizability of our findings. As competitive and institutional environments are heterogeneous and more importantly, cultures and policies may also vary significantly across emerging economies (Hoskisson et al., 2000), firms in these economies may not only have very different motivations and capability to pursue green innovation but also experience different degrees of supply chain risks. Therefore, future research is encouraged to replicate and extend our research focusing on China by employing comparative analysis and examining the role of green innovation and supply chain risks across emerging economies. Third, considering the complexity of the international situation and investigation, this study incorporated only a moderating variable of supply chain risk into the model. Future research can also examine the role of other internal organizational characteristics and external environmental variables in moderating or mediating the contribution of different types of green innovation to firm performance.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation

and institutional requirements. Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

Both authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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How Can We Increase Pro-environmental Behavior During COVID-19 Pandemic? Focusing on the Altruistic (vs. Egoistic) Concerns

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Would the life-threatening pandemic impact pro-environmental behavior? This study demonstrates the effects of coronavirus disease 2019 (COVID-19) on pro-environmental product consumption. Two experimental studies manipulated individuals' COVID-19 concerns and the presence/absence of pro-environmental prompts. In study 1, we found that consumers indicated lower purchase intention for a product with the environmental prompts when recalling COVID-19 concerns compared to normal situations. In study 2, we disentangled egoistic COVID-19 concerns (e.g., concerns about disadvantages to individuals' work and finances) from altruistic COVID-19 concerns (e.g., concerns about damage to the country's economy) and investigated the effects of both these concerns on pro-environmental product consumption. The results of study 2 revealed that consumers reported an increased purchase intention toward the e-prompt products, which manipulated altruistic COVID-19 concerns. However, the presence/absence of e-prompt products did not affect consumers' purchase intentions when recalling egoistic COVID-19 concerns. Concerns regarding environmental, social, and corporate governance (ESG) issues mediated the interaction effect between the type of COVID-19 concerns and the presence/absence of e-prompts for the products.

Keywords: concern for ESG, egoistic COVID-19 concerns, altruistic COVID-19 concerns, pro-environmental behavior, environmental prompts, moderated mediation effect

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INTRODUCTION

Pro-Environmental behavior is fundamental for individuals and societies to maintain sustainable lives. Therefore, it is important to understand how pro-environmental behavior develops during a catastrophe and determine the factors that advance the deeds. The ongoing coronavirus disease 2019 (COVID-19) pandemic is the world's most significant global disaster affecting individuals and nations worldwide (Word Health Organization, 2020). Since altruistic behavior benefits extend not only to society as a whole, but also to individuals who offer help as a form of relieving individuals' stress (Raposa et al., 2016) and mitigating physical pain (Wang et al., 2020); it is meaningful to broaden our understanding of individuals' pro-environmental behavior during this ongoing worldwide pandemic.

Extant literature supports the idea that crises such as COVID-19 can either elevate or lower prosocial behavior. For example, the empirical literature has demonstrated that behaviors directed toward others increase in difficult times, such as natural disasters (Rodriguez et al., 2006) and war

(Bauer et al., 2016). In addition, when people are confronted with common challenges, cooperation increases, which is called the "common enemy effect" (Ostrom et al., 1999). On the other hand, other studies have suggested that crises prompt selfish and antisocial behavior because of a lack of resources and an increased competition (Dietz, 2003; Hsiang et al., 2013). Regardless of the effect, both the accounts show a shift in prosocial conduct during a crisis, either an increase or a decrease.

Despite the importance of prosocial behavior and its relationship with social crises such as COVID-19 pandemic, only a few studies have directly explored the potential relationship between the crisis and individual behavior on environmental responsibility (Tchetchik et al., 2021). For example, Urban and Braun Kohlová (2020) insisted that there is no statistically significant association between COVID-19 crisis and pro-environmental attitudes. More specifically, Lucarelli et al. (2020) suggested that individuals who are more aware of the relationship between COVID-19 and climate change have shown more instances of pro-environmental behavior. To provide a better understanding of the link between COVID-19 pandemic and pro-environmental behavior, we conducted two empirical studies that manipulated the individual COVID-19 concerns (Rojas-Méndez, 2021) and the presence/absence of pro-environmental prompts (Moussaoui et al., 2020) and examined the effects of both the factors on consumer behavior. We expected that individuals who were concerned about public issues evoked by the pandemic would be aware of corporate environmental, social, and governance (ESG) issues as well, leading to an increased purchase intention toward products with the pro-environmental prompts. Before delving deeper into this study, we will go over some key aspects of the existing literature on the concept of the environmental prompts and COVID-19 concerns and their potential effects on consumer behavior.

LITERATURE REVIEW AND HYPOTHESES

Environmental Prompt

Two approaches were adopted in previous literature to account for pro-environmental behavior: personal and situational. The personal approach attempts to identify individual characteristics, including environmental attitudes, demographic factors, and personality constructs. The situational approach attempts to identify environmental aspects that enhance pro-environmental behaviors, including prompting, rewards, and commitment (Schultz et al., 1995). Prior study has investigated personal and situational variables separately as well as interactions between these variables.

Extant study focusing on the situational approach has suggested that prompts or reminders of when to execute the desired action is an important situational factor that effectively fosters pro-environmental behaviors (Moussaoui et al., 2020). For example, a meta-analysis of 44 articles on prompts has reported that the moderate-to-high effect of environmental prompts enhances pro-environmental actions, including public energy conservation and public recycling (Osbaldiston and Schott, 2012). In addition, environmental prompts increase community stair usage across various commuter settings (Dolan et al., 2006). Likewise, prompts perform best for simple and repeated actions, particularly when prompts are presented explicitly in the context where the user should act (Schultz, 2014). This manner of prompt is described as a point-of-decision prompt in that it appears at the precise moment and location when the user must decide whether or not to conduct the behavior. Prompts are useful when people simply forget to behave or are distracted by other stimuli. In these cases, prompts can serve as reminders of pro-environmental behavior. Therefore, it would be useful to investigate the effects of prompts in a certain situational context such as overwhelming crises where people are distracted and easily forget to do good deeds for others.

In this study, we have focused on the ongoing COVID-19 pandemic and investigated the interaction between the individual pandemic concerns and the presence of prompts to evoke pro-environmental behaviors. To the best of our knowledge, few empirical studies have directly examined the link between COVID-19 pandemic and prompts on pro-environmental behaviors. Although a large body of extant literature has tested the effects of prompts on individual environmental attitudes or behavioral changes (Wiese et al., 2004; Kurz et al., 2005), relatively little study has investigated them in the context of COVID-19 pandemic. Since COVID-19 outbreak has altered individual and collective behavior changes (Ramkissoon, 2020), it is worth noting that this study provides a deeper understanding of ways to promote pro-environmental actions in the midst of COVID-19 pandemic.

Coronavirus Disease 2019 Concerns (Altruistic vs. Egoistic)

Worry is described as a bothersome mind where the state of an issue in a certain domain of life departs from its desired state (Boehnke et al., 1998). Worriers continue to worry despite the fact that it is a nasty experience characterized by a flow of negative images and thoughts, unpleasant emotions, and a loss of mental control (Mathews, 1990). Worry includes daily concerns as well as severe and extended problems that may be linked to an anxiety disorder diagnosis (Borkovec et al., 2004). Previous literature has suggested the concept of intolerance uncertainty in relation to concern (Freeston et al., 1994; Boehnke et al., 1998). Individuals who worry strive to exercise some control over the circumstances they confront in life in the hope of preventing or diminishing future negative consequences. Therefore, worry and the ability to tolerate uncertainty are negatively correlated (Ladouceur et al., 2000).

Coronavirus disease 2019 crisis can cause people to feel stressed and worried, not only as a threat to survival, but also because of the restrictions in social activities and disruption to social networks, such as social distancing, quarantine, and work closures (Limcaoco et al., 2020). Worry is known to be one of the most common responses to the outbreak of COVID-19 crisis and recent articles have investigated the antecedents or consequences of individuals' concerns in this difficult time

(Zysberg and Zisberg, 2020). For example, recent studies have demonstrated that higher social status, larger family size, a greater sense of community, and little knowledge of the pandemic have lowered concerns as buffers during COVID-19 pandemic (Meltzer et al., 2021; Rojas-Méndez, 2021). Zhou and Guo (2021) has revealed the outcome of different types of concerns evoked by COVID-19 pandemic by demonstrating that economic concerns and safety concerns do not predict the death rate during COVID-19 pandemic, whereas health concerns result in a decrease in fatality in COVID-19 crisis.

As an unmanageable crisis that poses a threat to human safety and existence, we assume that concerns related to COVID-19 may influence pro-environmental attitude and behavior. Environmental protection has been described by some scholars as a "luxury good" that is appealing when the situation is normal and well-off but being ignored during times of difficulties (Abou-Chadi and Kayser, 2017). For example, economic crises such as the Great Recession of 2008 have a detrimental impact on individuals' willingness to pay for climate change prevention (Ivlevs, 2019). Similarly, unemployment rates have negative impacts on individuals prioritizing environmental preservation (Kenny, 2020). Therefore, we expect that evoked concerns during the difficult times would lead to decreased attention to others and environment.

Hypothesis 1: People will show less purchase intention toward products with environmental prompt (e-prompt) when recalling COVID-19 concerns compared to the normal situation.

Furthermore, we considered the altruistic and egoistic values in determining individuals' concerns evoked by the pandemic (Yadav, 2016). Extant literature has demonstrated that altruistic values (concern for others) and egoistic values (concern for the self) are the two fundamental motives to behave in a virtuous way (Schwartz, 1992). The term "altruistic" refers to a condition in which individuals behave on behalf of others without any personal gain (Schwartz, 1977). On the other hand, the term "egoistic" refers to acting on one's own behalf or alleviating one's own pain and damage (Stern et al., 1993). Based on past literature, we have termed altruistic COVID-19 concerns as concern for others, such as concerns about impairment of the national economy or national health, whereas we have described egoistic COVID-19 concerns as concern for self during the pandemic, including concerns about the disadvantages of individual health or financial loss (Prakash et al., 2019; Rojas-Méndez, 2021).

We expect that the types of COVID-19 concerns would influence pro-environmental behaviors differently. Altruistic values or concerns are critical in molding consumer behavior toward the environment (Heberlein, 1972). Individuals with altruistic concerns behave for the welfare of others without seeking personal benefit (Yadav, 2016). On the other hand, egoistic values or concerns motivate individuals to perform in their own interest (De Groot et al., 2013). Individuals with self-centered considerations swiftly displace their behavior depending on the gains and expenses (Diekmann and Preisendörfer, 2003). Therefore, egoistic values do not lead to pro-environmental behavior without guaranteed advantages. As stated earlier, extant literature has demonstrated the inconsistent findings whether COVID-19 enhances or reduces prosocial behaviors including the environmental domain. We assume that these mixed findings may result from the different types of COVID-19 concerns. Previous literature has measured COVID-19 concerns without distinction of content [Amato et al., 2021; "Currently, how concerned are you about coronavirus/COVID-19?"]. By suggesting the different impacts of types of COVID-19 concerns on consumer behavior, this study tried to reconcile the previous inconsistent findings. We expect COVID-19 concerns for others and communities to lead to an increased pro-environmental behavior, whereas COVID-19 concerns for the self would not change consumer behavior toward the environment. Therefore, we hypothesize the following:

Hypothesis 2: People will show greater purchase intention toward the e-prompt products (vs. without the e-prompt products) when recalling altruistic COVID-19 concerns. The presence/absence of e-prompts does not affect purchase intention when recalling egoistic COVID-19 concerns.

Environmental, Social, and Corporate Governance

The growing number of firms implementing sustainability plans and disclosing ESG data has promoted fundamental shifts in business models and management theory (Xie et al., 2019). The aim of traditional shareholder-oriented management is to maximize shareholder advantages and improve financial performance (Friedman, 1970). Sustainable management, on the other hand, focuses on minimizing externalities and optimizing social values regarding ESG issues considering all the shareholders, communities, consumers, and other related organizations. Recent reports have demonstrated the role of ESG performance and confirmed its accumulative importance during COVID-19 pandemic (Broadstock et al., 2021). Emerging evidence supports the notion that sustainability firms have fewer downside risks and are more robust during times of crisis (Hoepner et al., 2019; Jacobsen et al., 2019). Therefore, it is fundamental to investigate ways to increase ESG concerns among consumers during COVID-19 period.

Prior literature has demonstrated that altruistic motives and values are essential in shaping individual behaviors toward the environment and the welfare of communities (Prakash et al., 2019). Specifically, Romani et al. (2013) showed that individuals with altruistic values behave more favorably toward companies practicing sustainable values. Similarly, we expected that consumers with concerns about the national economy or health during the pandemic, considered an altruistic value, will lead to greater ESG concerns. Finally, an increased ESG concerns will lead to greater purchase intention toward the e-prompt products, as consumers with greater awareness of corporate social responsibility (CSR) are more likely to purchase socially responsible products (Pomering and Dolnicar, 2009; Tian et al., 2011). In addition, Kang et al.'s (2012) study directly supports our assumption that people with greater degrees of environmental concern indicate an increased willingness to pay premiums for

hotels' green initiatives. This positive link between environmental concern and willingness to pay for green products has been found in other contexts, such as ecolabeled appliances and furniture (2012) and environment-friendly food products (Shin et al., 2019). Thus, it is plausible that ESG concern, an extended concept of environmental concern, will have a positive effect on consumers' green consumption. On the other hand, egoistic COVID-19 concerns will not influence individuals' ESG concerns and purchase intention toward environmental products because self-centered values lead individuals to behave in their own interest (Yadav, 2016). Yeh et al. (2014) reported that egoism is one of the significant obstacles to promote CSR implementation. Therefore, this study proposes the following hypotheses and visualizes the study model (see **Figure 1**):

> **Hypothesis 3:** Concerns about environmental, social, and corporate governance (ESG) will mediate the interaction effect between the type of COVID-19 concerns and the presence/absence of e-prompt products.

STUDY 1: COVID-19 CONCERNS AND PRO-ENVIRONMENTAL PRODUCTS

Both the study 1 and study 2 were conducted in accordance with the ethical standards of the Institutional Review Board of Seoul Women's University, Seoul, South Korea (IRB 2021A-43). Study 1 was designed to determine the effects of COVID-19 on pro-environmental product consumption. Consistent with H1, we predict that people would indicate lower purchase intention toward pro-environmental products than normal products when recalling COVID-19 concerns.

Materials and Methods

Participants, Design, and Procedure

A total of 117 participants from the US (77 women; M_{age} = 30.97, SD = 10.57) were recruited *via* the Prolific Academic online panel service,[1] see detailed demographic information in **Table 1**. We chose the sample size based on the G*Power program (Faul et al., 2007). For this study, based on the input parameters (effect size f = 0.40, α error probability = 0.05, power = 0.80, and number of groups = 2), choosing a total sample size of 52 was recommended (Faul et al., 2007). The participants were each randomly assigned to one of the two conditions as either recalling or not recalling COVID-19 concerns. In the condition of recalling COVID-19 concerns, participants were guided in the instruction to write down sentences including the phrases (e.g., concerns for the country's economy, the safety of my family) (Rojas-Méndez, 2021). For the normal condition, participants were guided to write what they did for today. There was no time or length limit, but they were instructed to write down at least five sentences in both the conditions. After completing the writing task, participants responded to two 7-point scales to provide their purchase intention toward a notebook with e-prompt (Yan et al., 2021): "How inclined would you be to purchase this notebook?" and "How willing would you be to purchase this notebook?" (1 = not at all and 7 = very much). The e-prompt for the notebook was presented with the label of "recycled." Thus, a notebook with the label "recycled" is considered to be a product with an e-prompt and a notebook without the label "recycled" is considered to be a product without an e-prompt. Further, both the types of notebooks were presented at the same price of $ 3 by following the study of Yan et al. (2021). Scores on these two items of purchase intention were averaged to form a composite purchase intention scale (α = 0.92). Then, participants responded to two 7-point scales of manipulation check questions to find out they perceived the writing task as we intended: "The previous writing task was related to the concerns of COVID-19" and "The previous writing task *was not* related to the concerns of COVID-19" (1 = not at all and 7 = very much). Finally, the questions to collect demographic information were asked and a debriefing session was followed after the survey was completed.

[1] www.prolific.ac

Results

Manipulation Checks

A one-way ANOVA on the manipulation check for recalling/not recalling COVID-19 concerns indicated that participants who were involved in the writing task to include phrases of COVID-19 concerns marked higher scores on the first manipulation check question than those who were guided to write down what they did for today [$M_{\text{COVID}-19\text{ condition}}$ = 6.54 vs. $M_{\text{normal condition}}$ = 1.54; $F_{(1,115)}$ = 628.85, $p < 0.001$]. The same ANOVA for the second manipulation check question showed the reversed results compared to the first manipulation check question. Participants who were involved in the writing task instructed to include phrases related to COVID-19 concerns marked lower scores on the second manipulation check question than those who were guided to write down their daily life of that day [$M_{\text{COVID}-19\text{ condition}}$ = 1.60 vs. $M_{\text{normal condition}}$ = 6.46; $F_{(1,115)}$ = 437.51, $p < .001$]. Thus, we can confirm that participants perceived the writing task in the way we intended.

Purchase Intention

A one-way ANOVA on purchase intention revealed that the main effect of recalling/not recalling COVID-19 concerns was significant [$M_{\text{COVID}-19\text{ condition}}$ = 4.86 vs. $M_{\text{normal condition}}$ = 5.40; $F_{(1,115)}$ = 3.62, p = 0.06] (see **Figure 2**).

Discussion

As we predicted, participants show less purchase intention toward pro-environmental products when recalling COVID-19 concerns than the condition of not recalling COVID-19 concerns. However, while reviewing the experiences, we found that the concerns for COVID-19 were mixed with altruistic and egoistic COVID-19 concerns—the portions of egoistic COVID-19 concerns were much higher than altruistic ones (78%, 49 out of 63 participants). For example, the examples of egoistic concerns are as follows: "I am worried that I will not be able to get a job with good enough pay to support myself," "When the outbreak first happened, there was a toilet paper shortage and I was worried about not getting the supplies I needed," and "I concern about not being able to make ends meet because rent prices are drastically

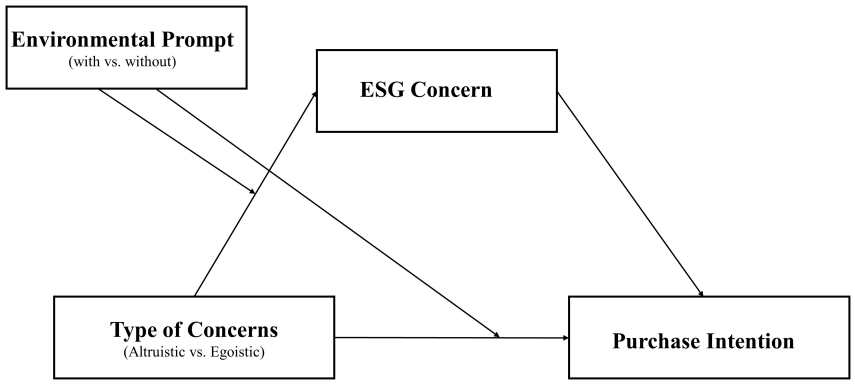

FIGURE 1 | Conceptual framework.

increasing and my income is not." On the other hand, altruistic concerns focus more on concerns for others: "I have also been worried that I could contribute to spreading the virus to others in my community who are vulnerable," "I am concerned about the country's economy because the ongoing pandemic is holding back businesses," and "Antivaxxers are contributing to the spread of the virus and jeopardizing overall public health." Thus, in study 2, we disentangled COVID-19 concerns from altruistic to egoistic and manipulated two different types of COVID-19 concerns in order to take a closer look at the consumer behavior on the basis of each type of concern.

TABLE 1 | Sample demographic for study 1.

	Study 1	
Variables	**Frequency (*N*)**	**Percent (%)**
Gender		
Male	40	34.19
Female	77	65.81
Age		
≤20s	60	51.28
30s	35	29.91
≥40s	22	18.80
Education degree		
Less than high school	1	0.86
High school	9	7.69
Some college	34	29.06
2-years college	12	10.26
4-years college	39	33.33
Master's degree	16	13.68
Professional degree	3	2.56
Doctoral degree	3	2.56
Yearly income (unit: 000 USD)		
≤29	55	47.01
30–49	17	14.53
50–89	28	23.93
≥90 and above	17	14.53
Employment status		
Employed full-time	48	41.03
Employed part-time	15	12.82
Unemployed/looking for work	25	21.37
Student	18	15.38
Homemaker	10	8.55
Retired	1	0.85
Total	117	100

STUDY 2: ALTRUISTIC AND EGOISTIC CONCERNS OF COVID-19 AND PRO-ENVIRONMENTAL PRODUCTS

Study 2 was designed to determine the effects of two types of COVID-19 concerns on pro-environmental product consumption. We predicted that people would show different attitudes toward pro-environmental products depending on the different types of COVID-19 concerns. We also predicted that people would show greater purchase intention toward the e-prompt products (vs. without the e-prompt products) when recalling altruistic COVID-19 concerns and the presence or absence of e-prompts would not affect purchase intention when recalling egoistic COVID-19 concerns, consistent with H2. Further, study 2 was designed to determine the underlying mechanism to explain the effects observed in H2. We predicted that concerns for ESG would mediate the interaction effect between the type of COVID-19 concerns and with/without the e-prompt products.

Materials and Methods

Participants, Design, and Procedure

A total of 100 participants from the US (73 women; M_{age} = 30.83, *SD* = 11.48) were recruited *via* the Prolific Academic online panel service, see detailed demographic information in **Table 2**. Based on the input parameters (effect size f = 0.40, α error probability = 0.05, power = 0.80, and number of groups = 4), a total sample size of 76 was recommended (Faul et al., 2007). Participants were randomly assigned to one of four conditions in a 2 (types of COVID-19 concerns: altruistic vs. egoistic) × 2

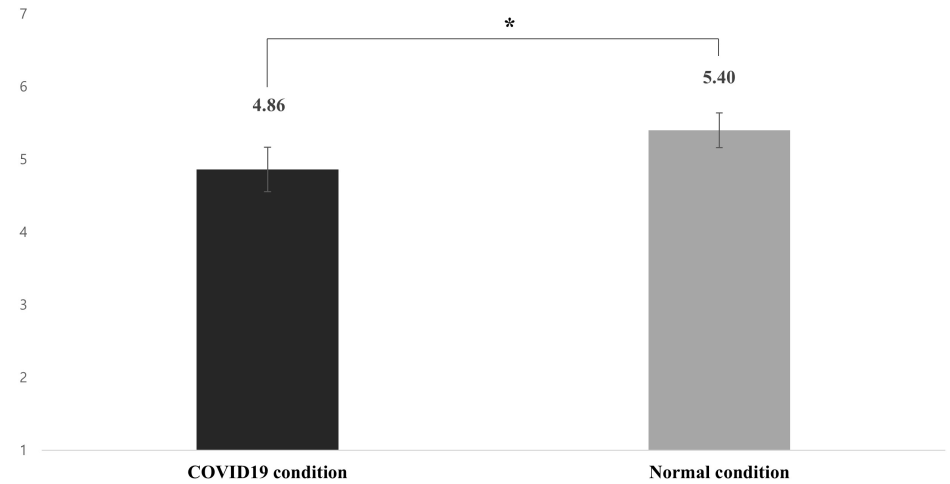

FIGURE 2 | Effects of recalling coronavirus disease 2019 (COVID-19) on purchase intention for pro-environmental product (study 1). Error bars show the 95% CIs around the means. *$p < 0.1$.

(products: with e-prompt vs. without e-prompt). In the condition of recalling COVID-19 concerns related to the altruistic issues, participants were guided to write down sentences including the phrases (e.g., worry for the world's economy, overall public health, and the safety of the people in the world) in the instruction (Rojas-Méndez, 2021). For COVID-19 concerns related to the egoistic issues, participants were guided to write down sentences including the phrases (e.g., my job or income, my personal health, and safety of myself or my family) in the instruction (Rojas-Méndez, 2021). There was no time or length limit, but they were instructed to write down at least five sentences in both the conditions. After completing the writing task, participants responded to three 7-point scales to provide their attitude toward the products with/without the e-prompt products (1 = very negative, 7 = very positive; 1 = very bad, 7 = very good; and 1 = unfavorable, 7 = favorable) (Batra and Ahtola, 1991; Folkes and Kamins, 1999). Scores on these three items were averaged to form a composite attitude scale ($\alpha = 0.90$). The e-prompt for the notebook was presented with the label of a "recycled" exactly the same as in study 1. Further, participants responded to the same two 7-point scales utilized in study 1 to provide their purchase intention (Yan et al., 2021). Scores on these two items were averaged to form a composite purchase intention scale ($\alpha = 0.92$). In addition, the participants answered a 7-point scale to provide their perceived concerns for ESG: "During COVID-19 pandemic, I had more chances to think about those topics: environmental, social, and corporate governance and sustainability" (1 = not at all and 7 = very much) [adapted from Kang et al. (2012)]. Then, participants responded to two 7-point scales of manipulation check questions to find out they perceived the writing task as we intended: "The previous writing task was related to the *self-concerns* of COVID-19" and "The previous writing task was related to the *social concerns* of COVID-19" (1 = not at all and 7 = very much). The manipulation checks for the product with/without e-prompt were followed. The participants responded to three 7-point scales to provide their perception regarding the notebook presented in the experiment: "The notebook is an environmental-friendly product," "The notebook is a green product," and "The notebook is beneficial to the environment" (1 = not at all and 7 = very much). Scores on these three items were averaged to form a composite manipulation check scale for the product with/without e-prompt ($\alpha = 0.88$). Finally, the questions to collect demographic information were asked and a debriefing session was followed after the survey was completed.

Results

Manipulation Checks

A 2 × 2 ANOVA on the manipulation check for recalling COVID-19 concerns indicated that participants who were involved in the writing task of *self-concerns* of COVID-19 marked higher scores on the first manipulation check question than those who were guided to write down sentences including phrases of *social concerns* of COVID-19 [$M_{\text{altruistic concerns}} = 1.80$ vs. $M_{\text{egoistic concerns}} = 6.47$; $F_{(1,96)} = 295.724$, $p < 0.001$]. The same ANOVA for the second manipulation check question showed the reversed results compared to the first manipulation check question. Participants who were involved in the writing task of *social concerns* of COVID-19 marked higher scores on the second manipulation check question than those who were guided to write down *self-concerns* of COVID-19 [$M_{\text{altruistic concerns}} = 6.45$ vs. $M_{\text{egoistic concerns}} = 3.24$; $F_{(1,96)} = 72.056$, $p < 0.001$]. Thus, we can confirm that participants perceived the writing task in the way we intended. In addition, a 2 × 2 ANOVA on the manipulation check for the product with/without e-prompt showed that participants who were involved in the condition with e-prompt showed higher scores on the manipulation check scale for the product without e-prompt [$M_{\text{with e-prompt}} = 5.88$ vs. $M_{\text{without e-prompt}} = 3.41$; $F_{(1,96)} = 83.998$, $p < 0.001$].

TABLE 2 | Sample demographic for study 2.

	Study 2	
Variables	**Frequency (*N*)**	**Percent (%)**
Gender		
Male	27	27.00
Female	73	73.00
Age		
≤20s	58	58.00
30s	26	26.00
≥40s	16	16.00
Education degree		
High school	6	6.00
Some college	26	26.00
2-years college	7	7.00
4-years college	46	46.00
Master's degree	10	10.0
Professional degree	5	5.00
Yearly income (unit: 000 USD)		
≤29	41	41.00
30–49	20	20.00
50–89	29	29.00
≥90 and above	10	10.00
Employment status		
Employed full-time	51	51.00
Employed part-time	13	13.00
Unemployed/looking for work	11	11.00
Student	17	17.00
Homemaker	5	5.00
Retired	3	3.00
Total	100	100

Consumer Attitude

A 2 × 2 ANOVA on the consumer attitude indicated that the main effects of the product with/without e-prompt was significant [$M_{\text{with e-prompt}} = 5.54$ vs. $M_{\text{without e-prompt}} = 4.97$; $F_{(1,96)} = 5.296$, $p = 0.024$] and types of COVID-19 concerns were not significant [$M_{\text{altruistic concerns}} = 5.15$ vs. $M_{\text{egoistic concerns}} = 5.40$; $F_{(1,96)} = 1.092$, $p = 0.299$]. More importantly, the two-way interaction was significant [$F_{(1,96)} = 3.753$, $p = 0.056$]. Planned contrast indicated that consumer attitude toward the e-prompt products was significantly higher than without the e-prompt products when participants recalled social concerns of COVID-19 [$M_{\text{with e-prompt}} = 5.65$ vs. $M_{\text{without e-prompt}} = 4.63$; $t_{(96)} = 2.981$, $p = 0.004$]. However, consumer attitude did not vary depending on self-concerns of COVID-19 [$M_{\text{with e-prompt}} = 5.44$ vs. $M_{\text{without e-prompt}} = 5.35$; $t_{(96)} = 0.259$, $p = 0.796$].

Purchase Intention

A 2 × 2 ANOVA on the purchase intention revealed that the both main effects of the product with/without e-prompt and types of COVID-19 concerns were not significant [$M_{\text{with e-prompt}} = 5.02$ vs. $M_{\text{without e-prompt}} = 4.54$; $F_{(1,96)} = 1.875$, $p = 0.174$; $M_{\text{altruistic concerns}} = 4.57$ vs. $M_{\text{egoistic concerns}} = 5.02$; $F_{(1,96)} = 2.011$, $p = 0.159$]. More critically, the two-way interaction was significant [$F_{(1,96)} = 3.936$, $p = 0.050$]. Planned contrast indicated that purchase intention toward the e-prompt products was significantly higher than without the e-prompt products when participants recalled social concerns of COVID-19 [$M_{\text{with e-prompt}} = 5.12$ vs. $M_{\text{without e-prompt}} = 4.00$; $t_{(96)} = 2.358$, $p = 0.020$]. However, purchase intention toward the e-prompt products did not vary depending on when participants recalled self-concerns of COVID-19 ($M_{\text{with e-prompt}} = 4.93$ vs. $M_{\text{without e-prompt}} = 5.14$; $t_{(96)} = -0.437$, $p = 0.663$) (see **Figure 3**).

Mediation Analysis

To test whether perceived concerns for ESG mediate the interaction effect between the type of COVID-19 concerns and the presence/absence of e-prompt products, we employed a bootstrapping analysis using the PROCESS version 3.0 macro (model 8) with 5,000 resamples (Hayes, 2017). The model uses the types of COVID-19 concerns as the independent variable (1 = egoistic concern and 0 = altruistic concern), the presence/absence of e-prompt products as moderator (1 = with the e-prompt products and 0 = without the e-prompt products), concerns for ESG as the proposed mediator, and purchase intention as the dependent variable. The overall mediation effect of concerns for ESG was found to be significant [90% CI = (−0.8412, −0.0305)]. In addition, the conditional indirect effect of the types of COVID-19 concerns on purchase intention was only significant with the e-prompt products condition [90% CI = (−0.6113, −0.1022)], but not without the e-prompt products condition [90% CI = (−0.2075, 0.3335)].

Discussion

The results of study 1 were replicated in study 2. Consistent with H2, we confirmed that participants evaluated products with e-prompts more positively (vs. without the e-prompt products) when recalling altruistic COVID-19 concerns. The presence/absence of e-prompts did not affect purchase intention when recalling egoistic COVID-19 concerns. Furthermore, supporting H3, we corroborated that concerns for ESG mediated the moderating effect of with/without the e-prompt products on the asymmetrical pattern in purchase intention between the two types of COVID-19 concerns.

GENERAL DISCUSSION

This study explored the effects of COVID-19 on pro-environmental product consumption. Two experimental studies manipulated individuals' COVID-19 concerns and the presence/absence of pro-environmental prompts. We found that consumers indicated lower purchase intention for the pro-environmental products when recalling COVID-19 concerns compared to normal situations (study 1). Further, by disentangling egoistic COVID-19 concerns (e.g., concerns about disadvantages to individuals' work and finances) from altruistic COVID-19 concerns (e.g., concerns about damage to the country's economy), we investigated the effects of both COVID-19 concerns on pro-environmental product consumption. We found that consumers reported an increased

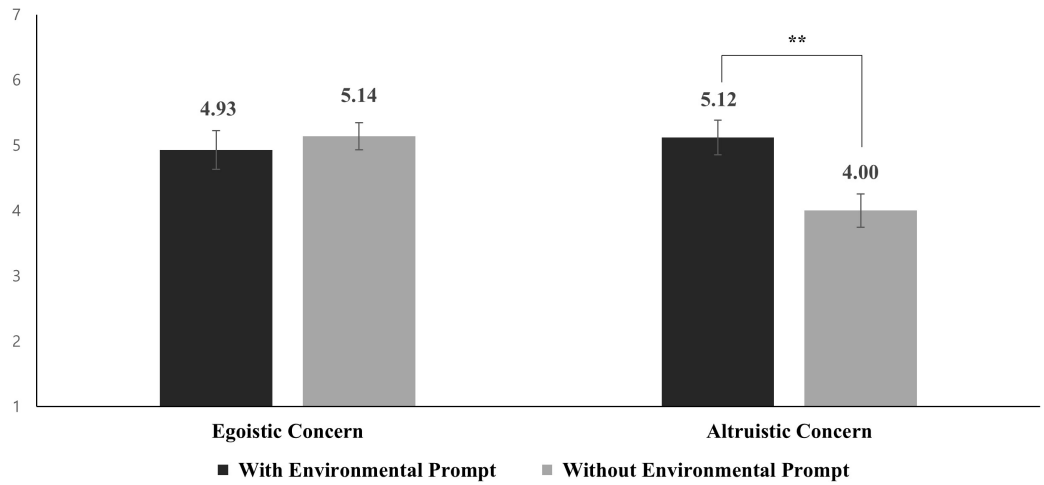

FIGURE 3 | Effects of type of concerns and with/without environmental prompt product on purchase intention (study 2). Error bars show the 95% CIs around the means. $^{**}p < 0.05$.

purchase intention toward products with the e-prompt products when manipulating altruistic COVID-19 concerns. However, the presence/absence of the e-prompt products did not affect consumers' purchase intentions when recalling egoistic COVID-19 concerns (study 2). The concern for ESG issues mediated the interaction effect between the type of COVID-19 concerns and the presence/absence of the e-prompt products.

Although prosocial behaviors are fundamental for a sustainable society, little study has been conducted to directly determine which factors of COVID-19 accelerate or inhibit prosocial behaviors. Thus, in this study, we conducted pioneering study on pro-environmental behavior as a part of prosocial behavior by investigating when and why consumers show an increased or decreased pro-environmental behavior by applying consumers' psychological factors, which appear to be most vulnerable to social crises such as COVID-19 pandemic era. What we learned from this study is that consumers' concerns regarding COVID-19 include not only egoistic concerns, but also altruistic concerns and manipulating the specific type of COVID-19 concerns is possible. Finally, among the concerns, only altruistic COVID-19 concerns significantly amplified consumers' pro-environmental behavior and the underlying mechanism to explain this phenomenon was found to increase ESG concerns. People who were manipulated with altruistic concerns (vs. egoistic concerns) showed an increased concern for ESG issues, which finally accounted for an increased purchase intention for pro-environmental products. Thus, characteristics of COVID-19 concerns should be focused on, depending on which sector the marketers belong to. Further, the first proposed ESG concern is meaningful as a novel concept, but the authors admit that it has not been defined clearly. Thus, we expect further study to expand this study.

Specifically, the study results provide several theoretical contributions. First, we empirically found that people have different types of concerns regarding COVID-19 pandemic (Limcaoco et al., 2020): not only egoistic concerns focusing on maximizing one's outcomes, but also altruistic concerns reflecting issues for the welfare of others. Depending on the type of concerns they are manipulated with, consumers show an increased or decreased pro-environmental product consumption. Thus, this finding theoretically expends prosocial behavior literature that suggests that the nature of COVID-19 concern is a critical factor in accelerating or inhibiting consumers' prosocial behavior. Second, the results demonstrate the concern for ESG issues as a psychological mechanism to understand why the two types of COVID-19 concern affect prosocial behavior differently. They also show that people who are manipulated with altruistic concerns (vs. egoistic concerns) show an increased concerns for ESG issues, which finally account for an increased purchase intention for pro-environmental products.

The results of this study suggest practical implications for marketers in the field. Among the types of concerns regarding COVID-19 pandemic, this study proves that manipulating specific types of concerns is possible. In addition, different effects on pro-environmental behavior were observed depending on the type of COVID-19 concerns. Thus, during the process of communicating with consumers, marketers can emphasize marketing messages that can take advantage of persuading consumers more effectively. For example, in the field of prosocial marketing contexts or public institutions, marketers can highlight the altruistic issues related to COVID-19 pandemic, which may help to increase consumers' prosocial intentions. As we observed in this study, being manipulated with altruistic concerns (vs. egoistic concerns), evokes increased concern for ESG issues, which finally account for an increased purchase intention for pro-environmental products. On the other hand, it would be useful for marketers, belonging to private companies, to

emphasize consumers' egoistic concerns focusing on maximizing one's outcomes when persuading consumers in the general consumer goods sector. In addition, even in COVID-19 catastrophe, we found that one of the situational factors of the environmental prompt works as an effective way to communicate pro-environmental behaviors to consumers. In other words, consumers can differentiate pro-environmental products from the existence of e-prompts. Thus, marketers in the field could consistently utilize e-prompts when delivering the message to consumers that they provide products or services that are environment-friendly, even in COVID-19 pandemic situation.

Despite its substantial theoretical and field contributions, this study has several limitations. First, it used a single item as an exploratory attempt to measure ESG concerns. The ESG concern item directly assesses individuals' concerns about ESG issues based on the definition (Corporate Finance Institute, 2022). However, future study based on a more comprehensive measurement to assess ESG concerns would provide us with more defined and definitive conclusions. Second, this study classified COVID-19 concerns into two types: altruistic and egoistic. Although they are two principle drives to behave in the desired way (Schwartz, 1992), future study can use more detailed classifications of COVID-19 concerns, including economic, safety, and health concerns, as Rojas-Méndez (2021) has suggested. Third, we employed the 2 × 2 between-subject design and, therefore, we cannot draw conclusions about causal relationships between variables including egoistic COVID-19 concerns that lead to altruistic COVID-19 concerns and vice versa. To address this issue, longitudinal studies using a variety of designs, such as the experience sampling method or the daily diary method, are needed in future study. Fourth, regarding the design of the studies, we tested two conditions of COVID-19 concern (vs. no-concern) in study 1, while in study 2, we only tested two types of concerns, altruistic vs. egoistic, rather than including no-concern condition. We understand including the no-concern condition in study 2 would have been helpful to extend the idea of study 1. Thus, to give better insights for readers with a holistic point of view, we will include the no-concern condition in the design of the experiment in further studies. Last, to capture individuals' pro-environmental behaviors, we measured the attitudes and purchase intentions of the e-prompt product. Future study can broaden the applicability of the findings by investigating environment-friendly behaviors in a variety of domains, such as measuring intention to participate in the pro-environmental campaign or willingness to invest time and money in pro-environmental behavior.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Seoul Women's University. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Both authors jointly designed the experiments, undertook data collection, analyzed, and wrote up this manuscript.

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Assessing the Effect of Dynamic Capabilities on the ESG Reporting and Corporate Performance Relationship With Topic Modeling: Evidence From Global Companies

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The primary purpose of this study is to examine the relationship between the dynamic capabilities (DCs) embedded in ESG management, which are being pursued by global companies, and corporate performance amid increasing uncertainty. Furthermore, the secondary purpose is to examine the function of environmental uncertainty moderating the DCs-performance relationship. Concerning the analysis tool, this study employs topic modeling with Word2Vec embedding that analyzes unstructured data. This was employed as an alternative method beyond the limitations of the traditional approach, i.e., survey or interview. A DCs dictionary was constructed by redesigning the 12 detailed dimensions of Teece's DCs into 10 dimensions, and then time series scores of individual global companies were extracted by applying this dictionary to the sustainability reports of 97 companies. Sustainability reports of 153 companies among Fortune Global 500 companies announced in 2020 were originally collected, but in the process of collecting additional financial data about these companies from OSIRIS, a total of only 97 companies was selected in the end due to omission of data. A fixed effect panel analysis was conducted, and the main findings are as follows: First, the DCs embedded in ESG management have a positive or negative direct effect on corporate performance. In particular, a statistically significant relationship was not observed in the innovation (technology) oriented capabilities, whereas a statistically significant positive relationship was observed in the customer (market) oriented capabilities. Second, uncertainty moderates the relationship between DCs and corporate performance positively or negatively. Interestingly, the moderating effect of uncertainty only appears in the function of the sensing and reconfiguring capabilities. From this, it can be seen that the function of DCs, which is embedded in the ESG management of global companies, is limited due to the imbalance between the sensing-seizing-reconfiguring capabilities. These findings imply that, despite the positive function of DCs embedded in ESG management, costs and benefits occur at the same time, and DCs can improve performance only

if there is an organizational adaptation strategy suitable for uncertainty. Accordingly, business managers need to recognize the importance of pursuing sensing-seizing-reconfiguring capabilities in a balanced way to improve corporate performance through ESG management under uncertainty.

Keywords: dynamic capabilities, ESG reporting, topic modeling, organizational adaptation, uncertainty, corporate performance, Word2Vec embeddings

INTRODUCTION

After the era of emphasizing Corporate Social Responsibility (CSR) and Creating Shared Value (CSV), global companies are currently confronting a new topic of ESG (Environment, Social, Governance) management. As technological and market changes accelerated, the concept of values demanded by society from companies diversified, expanding the scope of corporate citizenship, and now it has begun to emphasize socially responsible investment to investors (including companies). In line with changes in the corporate business environment, global companies today publish annual sustainability reports, attempt to shift the paradigm for ESG management beyond the concepts of CSR and CSV, and form a new strategic architecture to secure competitive advantages. An increasing number of companies are publishing sustainability reports for the purpose of sharing their socially responsible management performance with stakeholders. This is because it is an integrated information disclosure tool and at the same time can highlight the image of communicating with society. Therefore, it is worth noting whether this new strategic architecture can secure competitive advantages beyond the scope of CSR or CSV.

From a traditional Resource-based View (RBV), ownership-specific competitive advantages associated with firm-specific attributes are emphasized as performance determinants. The logic that resources determine performance makes companies focus on strategies that retain sustainable competitive advantages. The problem is that the sustainability of competitive advantages is likely to be threatened by market dynamism. Market dynamism frequently changes the value of key factors for competitive advantages, shortens the period of maintaining a company's sustainable competitive advantages over time, and creates companies that recover again after losing their competitive advantages (Wiggins and Ruefli, 2002). Thus, under uncertainty, companies tend to develop temporary competitive advantages over sustainable competitive advantages, and these temporary competitive advantages are linked like a chain, allowing them to maintain high performance over a long period of time (Wiggins and Ruefli, 2002).

Research, on the other hand, from the Dynamic Capability View (DCV) denies the relationship that resources determine performance, and explains that dynamic abilities mediate or moderate the relationship between resources and performance. Wu (2006), analyzing 244 Taiwanese IT companies, argues that resources such as special know-how, financial capital, sales management capability, reputation, and partnership experience do not directly affect corporate performance, but improve performance in areas such as innovation speed, market response speed, production efficiency and flexibility, and R&D capability through dynamic capabilities (DCs).

Current research on the DCs that are emphasized as companies' alternative strategic assets in an era of uncertainty examines the DCs' effects in certain partnership modes such as strategic alliances and joint ventures (Cohen and Levinthal, 1990; Doz and Hamel, 1998; Madhok and Osegowitsch, 2000), their relationships with competitive advantages such as product quality, process flexibility, and low cost (cost effectiveness; O'ReillyIII, and Tushman, 2008; Li and Liu, 2014; Vanpoucke et al., 2014; Kuo and Tsou, 2017; Yu et al., 2017), their influence on corporate performance (Helfat, 1997), their relationships with environmental dynamism (Li and Liu, 2014), and their functions to create new competitive advantages (Helfat, 1997). It is noteworthy that all of them are based on static approaches. Previous studies on the moderating and mediating effect of DCs on the competitive advantages-corporate performance relationship (Wu, 2006; Jiao et al., 2019) also explore the interaction between firm-specific advantages and DCs, but since they also employ static approaches, they are not free from critique either (Collis, 1994; Winter, 2003; Schilke, 2014).

Unlike environmental determinism, which describes the appearance of organizations responding to changes in the business environment, organizational adaptation to environmental uncertainty shows constructivism consisting of interactions between companies and the challenges to the business environment. From the perspective of organizational adaptation to environmental uncertainty, it is difficult to fully understand DCs of current significance embedded in ESG management strategies using traditional static approaches, so a new alternative analysis tool is needed.

This study, therefore, aims to empirically examine the direct effect of DCs on the ESG reporting and corporate performance relationship and the moderating effect of uncertainty on the DCs-performance relationship by opening a black box of DCs, which are evaluated as one of the influential theoretical lenses in the academy of strategic management (Kim and Heo, 2016). It is also intended to empirically examine how companies respond to and proactively approach new technologies and market changes. Concerning a specific research methodology for these research purposes, based on Teece's (2007) dynamic capability concept, a dynamic capability dictionary has been constructed using topic modeling with Word2Vec embedding, and applied to the empirical analysis of a company's strategic architecture for an ESG management.

The remainder of this study is organized as follows. The above Introduction presented the main research questions addressed by this study. Next, the Literature Review and Hypotheses

section not only explains the theoretical concepts and analysis tools used in this study, but also presents the hypotheses that this article intends to review. The next section, Research Methodology describes model specification, such as the research model, variables, and measures. Empirical Results summarizes the analysis results, and the Discussion section describes the theoretical and managerial implications derived from the analysis results. Finally, the Conclusion presents the methodological limitations of this study and future research themes that were not addressed in this study.

LITERATURE REVIEW AND HYPOTHESES

ESG

The ideological roots of the ESG concept stemmed from the concept of "social capital" presented by James S. Coleman, 1988 as a new concept for value measurement against Milton Friedman's theory that corporate evaluation in the 1960s and 1970s should be based on net profit. Since then, in a book by Elkington and Fennell (1998), social, environmental, and economic factors have been emphasized as the determinants of the corporate stock value. Putnam's (1993) concept of social capital consisting of moral obligations and norms, social values (especially trust) and social networks (especially voluntary associations) also forms another root of ESG values.

An official interest in ESG began in 2000 when the European International Organization Global Reporting Initiative (GRI) presented guidelines for the preparation of sustainability reports for companies, presenting standards including more than 150 indicators covering the ESG sector. Thereafter, the ESG concept was used in the 2003 UN Environmental Planning Finance Initiative, and the ESG concept was officially used in the 2005 UN Global Compact. In addition, the Financial Stability Committee, established in 2017 with the delegation of the G20 and the central bank, recommended disclosure of financial information on climate change. Through this series of formal procedures, companies are obligated to identify climate change-related risks and opportunities, reflect them in risk management systems and strategies, quantify the expected financial impact, and post them.

Comparing the concept to CSR (Carroll, 1999; Lin et al., 2022), which emphasizes corporate citizenship based on philanthropic responsibility as a social member, CSV has since embodied CSR into corporate management and formed a strategic architecture that creates shared value between companies and society (Kramer and Porter, 2011). The LVMH's Mécénat initiative to sponsor the restoration of a World Heritage Site, Marriott Hotel's project to support the poor, and Toyota's forest protection activities are understood as CSR categories. Meanwhile, the Matsushita Electric's investment in developing non-Freon refrigerators, the development of no margin meningitis vaccines by Glaxo Smith Kline, and UPS's safe driving training for teenagers are classified into CSV categories.

ESG management refers to challenging environmental impact (E), social impact (S; workers' health and safety, and diversity), and governance (G; corporate ethics, shareholders' rights, and executive compensation policies) by using non-financial factors such as energy and materials. This is the case in which SK Hynix in Korea was the first among the world's memory semiconductor companies to issue a US$1 billion bond for eco-friendly business investment under the strategic architecture of focusing on the development of a new state-of-the-art wastewater treatment plant, water recycling system, and low-power SSD. Another example of ESG management is that in 2016, Danish startup 'Too Good To Go' operated a restaurant closing discount platform that sells leftover food at buffet restaurants at a certain time. The case of Patagonia, an outdoor brand where 60% of the jackets on sale are made of recycled materials, is also a good example of ESG management.

Dynamic Capabilities

Despite the existence of conceptual differences between researchers (Williamson, 1999; Priem and Butler, 2001), DC is largely classified into two competing viewpoints such as the RBV and the Capability-based View (CBV). In the former, DC is conceptualized as a routine or process that integrates and reorganizes resources or resource bases (Eisenhardt, 1989; Eisenhardt and Martin, 2000), or as a pattern of collective activity (Zollo and Winter, 2002) that creates or modifies operational routines from a broad RBV that recognizes DC as another type of resource as the ability to create resources.

In the case of CBV, DC is also recognized as the ability to create resources, similar to RBV, and it is conceptualized as the ability to integrate, build, and reconfigure capacities or routines created by resources (Teece and Pisano, 1994; Teece et al., 1997; Teece, 2007). Alternatively, it also may refer to the ability to change the company's routine, activity, and the process itself which results in changing the resource base (Collis, 1994). Therefore, DC is a parent concept of the black box that challenges the routines, activities, and processes in which resource conversion occurs.

In this study, according to the conceptualization of Teece (2007), DC is defined as sensing-seizing-reconfiguring capacities. Sensing capabilities refer to analytical systems and individual capabilities to learn, detect, filter, shape, and measure technological and market opportunities. Seizing capabilities refer to corporate structure, procedures, design, and incentives to occupy technology and market opportunities. Reconfiguring capabilities refer to the corporate ability to continuously (re)align firm-specific tangible and intangible assets and operating modes in line with market changes. The absorptive capacity to evaluate and acquire external information or knowledge (Cohen and Levinthal, 1990) is in line with the seizing capabilities, while the combinative capability to realize technology or market opportunities with outcomes (Kogut and Zander, 1992) by combining and utilizing existing knowledge is similar to the reconfiguring capabilities. In addition, the learning ability to improve existing operational capabilities with new knowledge, and the coordination ability to coordinate or deploy resources and activities (Pavlou and El Sawy, 2011; Nieves and Haller, 2014; Vanpoucke et al., 2014) also compose Teece's (2007) DC in a great detail.

DC consists of sensing-seizing-reconfiguring capabilities, and each capability is further subdivided into four activities,

respectively (Teece, 2007). First of all, sensing capabilities consist of four detailed activity areas: (1) internal R&D and selection processes of new technologies, (2) monitoring processes of external science and technology development, (3) monitoring processes of innovation within the supply chain and target market segments, and (4) observation processes of changes in customer needs. Seizing capabilities consist of four detailed activities: business model design, selecting corporate boundaries, selecting investment decision protocols, and building organizational loyalty and commitment (organizational efficiency management). Finally, reconfiguring capabilities consist of four detailed activities: decentralization, co-specialization, governance, and knowledge management (Teece, 2007). Today, companies publish sustainability reports responding to the uncertainty caused by the market needs that emphasize ESG management, and display their DCs to sense changes in the business environment, to seize new market opportunities by changing business models, and to reconfigure resources and capabilities.

Hypotheses Development

Strategic Postures of Dynamic Capabilities to Achieve Corporate Sustainability

Sensing

In the study of Teece (2007), sensing consists of a process to direct internal R&D and select new technologies, a process to tap developments in exogenous science and technology, a process to tap supplier and complementor innovation, and a process to identify target market segments, changing customer needs, and customer innovation. The four sessions of sensing activity (capability) can be classified into two subsectors: the Analyzing capability to analyze the environment of external innovation, internal innovation, and R&D activities to learn market opportunities; and the identifying capability to recognize market segments, ecosystems and industrial trends, and changing customer needs. The former can be summarized as innovation (technology) orientation, and the latter can be summarized as customer (market) orientation. In the same vein, Ordanini and Parasuraman (2011) classified DCs into customer-oriented DCs and innovation-oriented DCs.

Technology orientation is achieved by coordinating the structure, system, and resources of a company in line with technological changes and using this technology as an organizational competency. Customer orientation refers to the alignment of organizational resources to create an excellent customer value. The problem is that if a company adopts only innovation orientation for technological change and overlooks customer orientation factors, it cannot meet consumer needs (Ordanini and Parasuraman, 2011). It is necessary to create joint value with customers and innovate products and services by combining customer orientation and utilizing corporate resources (Lusch et al., 2007). Using only new knowledge and resources to pursue innovation cannot guarantee consumer satisfaction. Therefore, based on changes in organizational systems and strategies that have shifted to meet technological changes, companies should adjust their organizational capabilities and innovation capabilities to suit customer needs to actively cope with environmental changes. And all innovation activities can create positive customer perception and consumer demand only when they are based on customer-oriented DCs. Customer-oriented companies can develop and maintain close relationships with customers and get quick feedback from customers (Shapiro, 1988; Fundin and Bergman, 2003). If a company does not actively lead customer orientation, competitors will preempt consumers' unmet demand (Paladino, 2007). In response to the aforementioned reasoning, the following hypotheses are assumed:

> *Hypothesis 1: Analyzing capability of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*

> *Hypothesis 2: Identifying capability of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*

Seizing

According to Teece's (2007) argument, as the market and technology change, the capability to seize the newly emerging market opportunities results in a company's competitive advantages. A company's seizing capability requires the relevant corporate structure and procedures, business model design and incentive systems (Teece, 2007). A company's seizing activity for market opportunities begins with the development and investment for commercialization, and redesigning of their business model. Based on fundamental strategies (Porter and Kramer, 1985), such as cost leadership or differentiation, a business model design that reflects organizational architecture for productivity and efficiency and customer architecture for target customers should be executed (Teece, 2007).

In the newly designed business model, the timing of resource commitment, commercialization strategies, and investment priorities to seize market opportunities are defined (Teece, 2007), and enterprise boundaries are set according to technological changes. Enterprise boundaries should proceed so that the benefits of innovation can be greater than those of imitation, and should be able to establish a cospecialization strategy to prevent the occurrence of cannibalization in which new products erode old product marketing (Teece, 2007).

As such, business model design and enterprise boundaries resetting according to technological and market changes are bound to require reorganization of the organizational decision-making protocols. Companies attempting to establish new strategies in response to environmental uncertainty should choose effective decision-making protocols so as to avoid decision-making errors that do not take into account strategic inflection points which often determine a company's survival and prosperity (Teece, 2007).

Global companies' seizing activities (capabilities) in response to uncertainty also require changes in organizational culture. Companies' active organizational adaptation to environmental changes requires efficient communication and leadership based on entrepreneurship, which consists of proactiveness, innovation, risk-taking, and agility (Drucker, 1985; Covin and Slevin, 1991;

Kao, 1993; Gartner et al., 1994; Wooldridge and Jennings, 1994; Lumpkin and Dess, 1996; Davis and Harveston, 1998) and an effective communication system (Pincus, 1986; Ford and Ford, 1995). The sharing of corporate vision is also important (Robbins and Duncan, 1988; Kotter, 1990; Evans and Doz, 1999; Teece, 2007). Corporate shared vision is often considered in line with leadership (Finkelstein et al., 1996; Conger and Kanungo, 1998; Wang et al., 2011). This sequence of organizational culture and system transformation can properly develop a business environment, and in turn, it plays an important role in developing a successful organization and developing trust and commitment within the organization (Kotler and Keller, 2006). Here, "commitment" refers to the job commitment and organizational commitment that constitute organizational efficiency, which is said to play a role in triggering the improvement of innovation and financial performance (Campbell, 1977; Hall, 2002).

In terms of organizational efficiency, the DCs to build company's competitive advantages are expected to have a positive correlation with corporate performance. In addition, the positive correlation between loyalty and commitment building and corporate performance has the potential to improve the reconfiguration and deployment of organizational resources. Therefore, the positive DCs to seize market opportunities due to technological and market changes, the efficient communication structure, and the possession of an innovative organizational culture are key sources of corporate competitive advantages. To sum up, regarding the detailed seizing activities (capabilities) of DCs the following hypotheses are assumed:

> *Hypothesis 3: Delineating business model of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*
>
> *Hypothesis 4: Selecting enterprise boundaries of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*
>
> *Hypothesis 5: Selecting decision-making protocols of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*
>
> *Hypothesis 6: Building loyalty and the commitment of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.*

Reconfiguring

From the DC perspective, theorists stress that the key to sustainable profitability is the ability to recombine and reconstruct assets and organizational structures as companies grow and markets and technologies change (Schilke, 2014; Girod and Whittington, 2017). Companies must continuously align and realign internal tangible and intangible assets to suit environmental changes for sustainable growth (Teece, 2007). The continuous alignment and realignment muse be associated with decentralization and cospecialization (Teece, 2007). In addition, changes in the organizational structure are also required, and thus governance should be changed to lower costs derived from the agency problem. Also, organizational learning skills should be cultivated for efficient knowledge transfer and know-how integration (Teece, 2007).

Intellectual assets within the organization should be integrated so that they can adapt to technological changes and further lead technology development, and insufficient intellectual assets should be absorbed through open innovation. Open innovation refers to innovation in which knowledge resources such as valuable ideas, know-how, and physical technology are commercialized from within or outside the company (Chesbrough, 2006). Therefore, it is necessary to resolve innovation resistance within the company. This type of resistance may lead to destructive knowledge creation through knowledge transfer and knowledge sharing associated with integrated mechanisms. Meanwhile, it is also necessary to strengthen organizational learning of technology and knowledge resources outside the company. During this process, companies need to boldly promote either open innovation through strategic alliances, or joint ventures for organizational growth while they coordinate, reconfigure, and recombine technologies and assets (Teece, 2007).

Regarding open innovation, one thing to note is the strategic fit. In response to changes in technology and customer needs, companies need to invest in short-term product development and long-term research activities, i.e., exploitation and exploration (March, 1991), and look for co-specialization between new and old products (Teece, 2007). Considering the learning race that may occur, even between companies, it is also necessary to carefully consider differences in knowledge level and content/knowledge specialization.

Corporate strategy transformation according to environmental changes, on the other hand, requires an organizational redesign. In order to attract modern talent, the incentive system should be strengthened. In addition, to establish an effective management of open innovation and to protect intellectual assets, potential conflicts in joint R&D activities should be resolved, eliminating costs from the agency problem. Such governance improvement capabilities prevent rent-seeking activities between partners in advance and enable knowledge transfer and knowledge sharing to proceed in a proper way.

Companies should be able to achieve effective knowledge transfer not only inside the company but also outside (other companies or overseas subsidiaries) in the process of reorganizing knowledge management due to environmental changes. Effective knowledge transfer creates knowledge sharing, a major process of knowledge management activities (Kogut and Zander, 1992), and this knowledge transfer and knowledge sharing are fundamental means for members of the organization to contribute to knowledge application, innovation, and ultimately competitive advantages (Jackson et al., 2006).

According to the current business environment elements emphasizing ESG management, global companies improve sustainable R&D and knowledge management capabilities through the reconfiguring capabilities of DCs as a special resource embodied within the company (Eisenhardt and Martin, 2000; Makadok, 2001). They also align heterogeneous organizational resources to environmental changes, and establish corporate governance to begin and improve cospecialization,

resulting in better performance. Considering the positive function of reconfiguring activities, this study assumes the following series of hypotheses:

Hypothesis 7: Cospecialization of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.

Hypothesis 8: Governance of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.

Hypothesis 9: Knowledge management of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.

Hypothesis 10: Decentralization of dynamic capabilities will have a positive influence on corporate performance in seeking an ESG strategy.

The Moderating Effects of Uncertainty on the Dynamic Capabilities-Performance Relationship

The business environment is an important factor for companies to consider in the process of acquiring necessary resources and establishing strategies to achieve competitive advantages (Achrol et al., 1983). Therefore, changes in the business environment are management resources that companies must continuously monitor. Environmental uncertainty as a management resource imposes opportunities or threats on individual companies. Certain companies get market opportunities from technological and market changes, while certain companies face threats. So far among the previous studies, there is no consensus about the effect of environmental uncertainty on corporate performance.

As technological changes accelerate and customer needs diversify, companies' strategic goals face continuous challenges. Technological changes lead to costs by imposing restrictions on the use of scarce resources and capabilities of companies. However, looking at the company's response strategy, as uncertainty increases, companies try to strengthen their internal capabilities, access high-quality information for innovation, and solve problems through a strategic move to expand networks that actively utilize external resources (Uzzi, 1997; Koka and Prescott, 2002).

It is still difficult today to conclude that major conglomerates are making strategic moves in ESG management. Even the function of firm size, which controls the positive relationship between ESG management and corporate performance, does not show consistency. In addition, understanding of the relationship between ESG management and corporate performance is also divided into negative and positive viewpoints. Nevertheless, as can be seen in many corporate cases, the organizational adaptation shown by global companies in response to the increase in uncertainty brought about by environmental dynamism of the importance of ESG management leads us in part to expect uncertainty to have a positive effect on corporate performance.

In summary, unlike the negative view that increasing uncertainty due to changes in the business environment imposes constraints on companies, it can act as an incentive to increase internal capabilities and shift the paradigm of competitive advantages to realize corporate problem solving and improve performance. In this study, from a neutral standpoint on the role of environmental uncertainty, we intend to examine the relationship in which environmental uncertainty moderates the DCs of global companies embedded in ESG management strategies. Specifically, the positive and negative functions of uncertainty are expected to be inconsistent when interacting with the detailed sub-activities (capabilities) of DCs, and differ depending on the sensing-seizing-reconfiguring capabilities. This is because when individual companies pursue organizational adaptation strategies based on ESG management in response to environmental uncertainty, they show an imbalanced pattern of implementation between sensing-seizing-reconfiguring capabilities. Accordingly, the following hypotheses are assumed:

Hypothesis 11: Environmental Uncertainty will moderate the Dynamic Capabilities-Corporate Performance Relationship.

RESEARCH METHODOLOGY

Text Mining: Unsupervised Learning of Latent Dirichlet Allocation

Supervised learning is a method of learning data using data with correct answers, and unsupervised learning is a method of predicting results for new data by clustering data without correct answers among similar attributes. A classification model or regression analysis belong to the former, while clustering analysis is a good example of the latter. Text Mining, which derives meaning from a large amount of text data, is also one of the unsupervised learning methods. Text is not structured data such as general numerical data, but unstructured data. The relationship or mode, i.e., pattern, between and among data is embedded in the unstructured text. Text mining is a machine learning technique that examines connections between various diverse sources of information and derives relationships or patterns, beyond the benefits provided by a simple content analysis.

Topic modeling is one of the main methodologies constituting text mining techniques. Topic modeling infers story topics by finding clues contained in the context and grouping words with similar meanings (clustering). In this process, stochastic techniques are used to discover hidden semantic structures, and the work is divided into several stages. The first step is to collect text data from relevant data (all forms of text such as reports, newspaper articles, broadcasting news, and social media). Subsequently, the second step extracts the most frequently used and key words from the preprocessed data. The most frequently used words are identified by arranging the words in the order of high word frequency throughout the total document. Key words are extracted using various weighting methods such as Okapi BM25 and Term Frequency-Inverted Document Frequency (TF-IDF). In particular, the TF-IDF weighting scheme identifies how important words are within a particular document and then sorts

them using the figures from them to consider the highest-valued words as key words (Santhanakumar and Columbus, 2015; Dai, 2018; Qaiser and Ali, 2018).

The next third step can create and analyze a semantic network that can identify the relationship between each word based on the extracted word. It is a method of linking words that appear together for each article and expressing them as an adjacency matrix. Thereafter, related topics are created and analyzed through the topic modeling package. Topic modeling is one of the research methods used in text mining, and is a process of finding topics in a set of documents. In detail, there are Latent Semantic Indexing (LSI), Deerwester et al. (1990), pLSA (Probabilistic Latent Semantic Analysis; Hofmann, 1999), and LDA (Latent Dirichlet Allocation; Blei et al., 2003), and among them, this study employs the LDA method.

This is because the LDA method is recent enough to complement the shortcomings of the earlier methods (Blei, 2012). The LDA scheme assumes that documents consist of a mixture of topics, and topics form a dirichlet distribution, which is one of continuous probability distributions, not a binomial distribution. The sum of the topic words is 1, which is the same as all of the topic element values (Blei et al., 2003). LDA is an unsupervised learning algorithm that generates topics by estimating the topic distribution of each document and the word distribution within each topic, representing the probability distribution in which documents and words are assigned to the topic. Subsequently, in step 4, the generated topic network is analyzed. It is a method of numerically presenting the structure by modeling the relationship between topics as a node and a link. Through this, words related to a specific topic and topics being discussed can be identified, and the correlation between and among topics can be analyzed.

Building Lexical Dictionary of Dynamic Capabilities Employing Word2Vec Embedding

It is possible to form a word dictionary through similar contextual analysis by employing specialized words with semantic similarities. In particular, technologies such as Word2Vec using machine learning are able to construct vector space in a similar context for text corpus of natural language. By using cosine similarity function, a distance between vectors close to each other in this vector space has the property of revealing words that are semantically similar or related to a given word. That is, when the machine learning method is used, each word is expressed as a correlation between similar meanings and other words. This unstructured text analysis has been revised to improve the rigor of the correlation between and among words (Mikolov et al., 2013).

After the introduction of Word2Vec by Mikolov et al. (2013), in order to discover the characteristic vocabulary of the professional dictionary, it is numerically determined whether words are semantically related in the dictionary. In this study, an algorithm was designed to construct a given word dictionary. Using this algorithm, from this corpus, it is possible to extract characteristic vocabularies for domains and build more complex lexical structures, which taxonomy employs. The corpus we explored for building DCs dictionary comes from a paper by Teece (2007) and contains the following text: 507 words were extracted based on centrality and linkage in the sensing dictionary, and 138 keywords were finally extracted. As a result of a heuristic review of 587 words, 137 keywords were extracted for the seizing dictionary, and 134 keywords were extracted for the final reconfiguring dictionary. In the case of seizing, four keywords [loyal, culture, affordability, regeneration (s)] were added through the heuristic approach and eight keywords such as fitness, fit, value, knowledge, know-how, open, and embraced were added for reconfiguring dictionary as shown in **Table 1**.

Word2Vec Word Embedding to Vector

In this study, Word2Vec (word embedding to vector) is used as a method of measuring the networking similarity between words developed by Google in 2013. This method has a stochastic language model using a single-layer artificial neural network technique (Mikolov et al., 2013). Stochastic Language Model learns context through words and expresses the meaning of words.

Word2Vec is applied to the vector space model of the query document with centrality and similarity value. The vector space representation of the words provides a projection of words from the documents with similar meanings. It is a learning algorithm based on the distributional hypothesis of linguistics (Harris, 1954; Sahlgren, 2008; Le and Mikolov, 2014) that words with the same meaning often appear in similar contexts. As learning progresses, words with similar meanings have similar vector positions. It is taught in a way that maximizes the probability of a word that can be inferred from a specific context, and after learning, similar words have similar vector positions. The similarity also increases. In the end, the similarity between words is measured to be higher as they are closer in context.

Model Specification

Sample and Data Collection

The method of collecting previous reports to calculate the quantitative index value of DCs is as follows. Companies selected as the Fortune Global 500 in 2020 provide ESG reports as PDF files in the corporate filings archives, and anyone can access and download files. In this study, data for a panel model over 10 years

TABLE 1 | Extract key words for each DC dictionary.

Dynamic capability	1st Step Number of Extract key word centrality cut off	2nd Step Heuristic	After Heuristic additional key word
Sensing	507 words	Decreased to 138 words	Not applicable
Seizing	587 words	Decreased to 137 words	Loyalty, culture, appropriability, revenue
Reconfiguring	565 words	Decreased to 134 words	Fitness, fit, value, knowledge, transfer, know-how, open, embraced

was collected by securing annual ESG reports from a total of 153 companies from 2011 to 2020. In order to analyze the collected ESG management reports, data conversion was performed to analyze unstructured data by converting PDF files into TXT files. Next, the score for each activity is obtained by performing a similarity analysis between the codebook and the sustainability management reports that have been pre-built DCs.

Financial data is secondary data that shows major financial attributes collected from the OSIRIS database. OSIRIS databases provide useful information such as firm-specific variables, financial profitability, activity, stability, growth, and market performance. Finally, the data configuration for a total of 97 companies was completed since the data value for financial variables to be put into the research model was omitted or not secured. The major industrial sector consists of manufacturing and service companies such as agriculture, mining, science and technology, construction, wholesale and retail, transportation and warehouses, bio, chemistry, engineering, health, IT, and automobile.

Variables and Measures

The variables put into the empirical analysis of this study are variables related to designed DCs score, environmental uncertainty, and financial performance. The score of DCs represents the activity level of the dynamic capacities inherent in the ESG reporting. If the score is high, it can be said that the corresponding activity is actively progressing. Conversely, if the score of competency activity is low, *vice versa*. The research method used in other studies through literature review was used as a starting point, and in particular, the variable measurement is presented in **Table 2**.

In this study, the quantitative score of DCs is a measure of sensing, seizing, and reconfiguring, adopting Teece's (2007) definition. Teece (2007) classified DCs into 12 major activities of clusters. Embedding the words constituting the four activities such as analyzing internal R&D, tapping external R&D, tapping supplier and complementor innovation, and identifying customer needs, which are components of Teece's (2007) sensing of DCs, converges to two clusters of analysis and identifying. In a similar research line, Rudolph (2017) developed a codebook of DCs based on corporate performance analysis. Rudolph (2017) presented the measurement of the sensing capability by simplifying them into market-oriented and technology-oriented characteristics because it is very ambiguous to distinguish among four subcategories. Therefore, in this study, we follow Rudolph's (2017) classification in defining DCs according to 10 detailed capabilities. Sensing can be explained by the ability to analyze and identify, and seizing represents activities that (re)design business models, select decision-making protocols, build loyalty and commitment, and define enterprise boundaries. Finally, reconfiguring is presented with a focus on appropriate knowledge management, governance, cospecialization and decentralization capabilities.

The measurement of uncertainty is as follows by referring to the theoretical model that integrates the moderating effects of environmental dynamism on sustainability and DCs. Existing researchers calculated uncertainty for changes in profitability and volatility of a certain indicator, and presented it as value representing the frequency of fluctuations in specific areas, such as product demand. Therefore, this study employs the measurement of environmental uncertainty that presents the results calculated through standard deviation in the variation rate of profit margin.

As a proxy of a dependent variable, this study employs the two measurements of financial performance to evaluate the effect of DCs on the spread of corporate performance. In particular, ROA (Return on Assets), a short-term financial performance, which is the core of profitability indicators measures economic performance as a ratio of net profit to total assets. Another proxy of financial performance is Tobin's Q, a long-term market value, which is used as a representative market performance indicator. In the case of Tobin's Q, various calculation methods are used to measure investors' perception.

Tobin's Q is a measure of a firm's market performance and is defined as the ratio of market value divided by the firm's asset replacement cost (Tobin, 1969). However, since it is difficult to objectively measure the market value of asset replacement cost and liabilities, Equation (1) was used to measure the value by dividing the average market capitalization by the total assets as shown below (Li and Wang, 2019).

$$TBQ = \frac{market\ capitalization}{total\ assets} \quad (1)$$

It is explained that R&D investment, one of the main activities in DCs, contributes to improving the corporate performance. This study aims to evaluate the performance improvement effect of R&D intensity by examining R&D investment in proportion to a company's assets, rather than evaluating a company's R&D capability with the traditionally used simple R&D investment amount (Reynard, 1979; García-Manjón and Romero-Merino, 2012). Using R&D intensity, it is possible to examine in detail whether a company is spending R&D expenses in line with its size. Therefore, as the R&D capability for this research model, R&D intensity calculated as R&D expenditure compared to operating profit was adopted.

The main factors that determine corporate performance include PER (Price to Earnings Ratio), current ratio, debt ratio, firm size, and firm age. These financial factors are generally input as control variables in a research model that uses corporate performance as a dependent variable, and the influence of predictor variables is considered. The PER, which is considered as a control variable, is an index that judges the enterprise value in the market from a short-term perspective. The evaluation of productivity, a financial performance indicator, through sales per employee was also considered in this study. The current ratio was calculated as current assets compared to current liabilities to measure a company's ability to pay its debts. The debt ratio is calculated as the debt-to-asset ratio to measure a company's risk.

Firm size is measured by the number of employees or total assets are used as proxies. In this study, total assets were replaced with natural logarithms to control the firm size. When the number of employees was employed as a proxy for firm size, the multicollinearity problem occurred, and thus total assets substituted with natural logarithms were adopted as the final

TABLE 2 | Variables and measures.

Variables	Acronyms	Measures
ROA	ROA	Return on asset = Net profit before taxes/total assets
Tobin's Q	TBQ	Ratio of a company's market value to total assets
Analyzing	ANL	External and internal innovation/open innovation focused/External and internal R&D
Identifying	IDN	Market segments/changing customer needs/valuating ecosystem and industry trends/sense opportunities and threats
Enterprise boundaries	EBR	Arranging alliances to upgrade/deciding outsourcing and insourcing/controlling bottleneck assets/assessing legal and natural protection through an appropriability regime
BM design	BMD	Selecting technology/feature and product/service architecture/(Re-)Designing revenue structures/(Re-)Designing cost structures/Designing mechanisms to capture value/Designing partnerships
Decision-making protocols	DMP	Recognizing inflexion points/avoiding and mitigating decision errors/avoiding anticannibalization tendencies/encouraging creative thinking and action/encouraging removal of no value-adding assets and activities/learning from mistakes
Loyalty and commitment	LYC	Demonstrating leadership/communicating effectively/recognizing non-economic factors, value and culture
Cospecialization	COS	Managing strategic fit so that asset combinations are value-enhancing
Governance	GOV	Achieving incentive alignment/minimizing agency issues/checking strategic malfeasance/blocking rent dissipation
Knowledge management	KNW	Learning/transferring knowledge/integrating know-how/achieving know-how
Decentralization	DEC	Developing integration/coordination and reconfiguration skills/adopting loosely coupled structures/embracing open innovation
Uncertainty	UNC	A rate of change in sales profit and the standard deviation of the analysis is calculated as an environmental volatility value
R&D intensity	RND	R&D intensity = R&D expenditure/operating revenue (%)
Price Earnings Ratio	PER	Market value per share/earnings per share
Revenue per employee	RPE	Productivity = operating revenue/no. of employee (logarithm)
Current ratio	CR	Current assets/current liabilities (%)
Debt ratio	DB	Total liabilities/total assets (%)
Firm size	FS	Total assets (logarithm)
Firm age	Number of years since first date of incorporation	

proxy of firm size. Given that high-tech industries specialize in intangible assets, when total assets are adopted as a proxy for firm size, measurement errors may occur. In contrast to this, there will be less error in asset measurement, so consistency can be maintained since the general manufacturing and service companies targeted in this study have a greater proportion of tangible assets to intangible assets. The firm age was calculated by taking the natural logarithm of the number of years of business activity since the establishment of the company. Ultimately, in order to control the impact of industry on corporate financial performance, it was analyzed by treating it as a dummy variable.

Research Model

In this section, we will explain the model description for the empirical analysis and the characteristics of the key variable data used in the model. Since the collected panel data are cross-sectional containing time series data and characteristics of each company, the predictive power of a panel model analysis is higher than that of multiple regression analysis (Baltagi et al., 2005; Hsiao, 2007). In other words, the panel data has a high model fit because it can reflect the dynamic relationship as well as the characteristics of multiple objects because the object is repeatedly observed over time (Baltagi et al., 2005; Hsiao, 2007). In an empirical analysis, the researcher must select a model suitable for his or her research framework between fixed-effect and random-effect models.

In the process of securing ESG continuous data, a lot of data preprocessing is required. In general, it is rare for all data to be uniformly distributed. In most cases, the data is imbalanced due to missing items or missing values at a specific point in time. In this study, global 500 companies were investigated, and 10 years of balanced panel data of 93 companies was finally obtained. In order to analyze these fixed panel data, a fixed-effect panel model should be adopted (Baltagi et al., 2005; Baum, 2006). Therefore, this study established a final research model that examines the relationship between a company's DCs and its financial performance through a fixed-effect panel model.

In this study, the financial performance of a company was divided into two types. One is a research model with corporate performance (ROA) as a dependent variable, and the other is a regression model with long-term corporate value (Tobin's Q) as a dependent variable. DCs, the main variable in this research model, are independent variables that can examine the strategic characteristics of a company. Control variables that affect the dependent variable include uncertainty, R&D intensity, PER, potential growth, liquidity, debt ratio, firm size, and firm age.

Also, the interaction term between DCs and uncertainty variables was examined. The equation for performing the hypothesis test in this study is as follows.

$$\begin{aligned} y_{i,t} &= \alpha + \beta_1 ANL_{i,t} + \beta_2 IDN_{i,t} + \beta_3 EBR_{i,t} + \beta_4 BMD_{i,t} \\ &+ \beta_5 DMP_{i,t} + \beta_6 LYC_{i,t} + \beta_7 COS_{i,t} + \beta_8 GOV_{i,t} \\ &+ \beta_9 KNW_{i,t} + \beta_{10} DEC_{i,t} + \beta_{11} RND_{i,t} + \beta_{12} PER_{i,t} \\ &+ \beta_{13} RPE_{i,t} + \beta_{14} CR_{i,t} + \beta_{15} DB_{i,t} + \beta_{16} FS_{i,t} \\ &+ \beta_{17} AG_{i,t} + \varepsilon_{i,t} \quad (2) \end{aligned}$$

$$\begin{aligned} y_{i,t} &= \alpha + \beta_K DCs_{i,tK} + \beta_{11} UNC_{i,t} + \beta_{12} RND_{i,t} + \beta_{13} PER_{i,t} \\ &+ \beta_{14} RPE_{i,t} + \beta_{15} CR_{i,t} + \beta_{16} DB_{i,t} + \beta_{17} FS_{i,t} \\ &+ \beta_{18} AG_{i,t} + \varepsilon_{i,t} \quad (3) \end{aligned}$$

$$\begin{aligned} y_{i,t} &= \alpha + \beta_K DCs_{i,tK} + \beta_{11} UNC_{i,t} + \beta_K DCs^*_{i,tK} UNC_{i,tK} \\ &+ \beta_{22} RND_{i,t} + \beta_{23} PER_{i,t} + \beta_{24} RPE_{i,t} + \beta_{25} CR_{i,t} \\ &+ \beta_{26} DB_{i,t} + \beta_{27} FS_{i,t} + \beta_{28} AG_{i,t} + \varepsilon_{i,t} \quad (4) \end{aligned}$$

where, DC refers to dynamic capabilities, RND refers to R&D intensity, PER refers to price to earnings ratio, RPE refers to revenue per employee, CR refers to current ratio, DB refers to debt ratio, FS refers to firm size, AG refers to firm age, UNC refers to uncertainty, ε is an error term, and i indicates an entity, t indicates time, and k indicates 1,. . .,10.

The first step equation (Equation 2) reveals the correlation between DCs and corporate performance. The second step equation (Equation 3) adds uncertainty to the first step equation. In the final model (Equation 4), a fixed-effect panel analysis is performed by inputting firm specific attributes including the interaction terms of DCs and uncertainty and financial items to analyze the moderating effect.

EMPIRICAL RESULTS

Descriptive Analysis

Table 3 shows the descriptive statistics of DCs and major variables used in the research model. In descriptive statistics, the mean, standard deviation, maximum, and minimum values are presented as the basis for data normality. As a method to determine whether each variable follows a multivariate normal distribution, the standards of skewness and kurtosis are reviewed from Curran et al. (1996). In general, when skewness is more than ± 2 and kurtosis is not more than ± 7, it is judged that it does not affect the estimation. In this study, kurtosis and skewness did not exceed the reference values, so there was no problem with normality. Also, to verify the reliability of the scale shown by each indicator, we looked at the Cronbach alpha value. The Cronbach alpha value of all scales was 0.6 or higher, indicating a value satisfactory for reliability (Cronbach, 1951; Sijtsma, 2009; Kiliç, 2016).

Correlation Analysis

In this study, the Pearson correlation analysis of variables was performed, and the results are shown in **Table 4**. Variables with correlation coefficients greater than 0.5 among various variables in DCs are: in the analysis of the sensing group, the correlation between analysis and identifying was 0.562, the correlation between enterprise boundaries and loyalty and commitment in the seizing group was 0.598, and the correlation between cospecialization and decentralization in the reconfiguring group was 0.591. All cases showed a rather high correlation coefficient, but it was confirmed to be smaller than the general cut-off value of 0.7.

In addition, the Variance Inflation Factors (VIF) value was estimated for an additional multicollinearity test before the research model estimation was performed, and the average VIF value of all variables was less than 3.3. Therefore, it was concluded that the research model of this study is not affected by the multicollinearity problem (Diamantopoulos and Siguaw, 2006; Petter et al., 2007; Cenfetelli and Bassellier, 2009). In this study, the Hausman Test, a representative test that judges which model is more reliable among the fixed-effect model and the random-effect model (Hausman, 1978). As a result of Hausman Test conducted on the final models (Model 16 and Model 32) in **Tables 5** and **6,** respectively, the *P*-value was all 0.00001. That is, since $P < 0.05$, it can be judged that the fixed effect model is a reliable model.

Hypotheses Testing

Table 5 shows the results of regression analysis using ROA as the dependent variable, and **Table 6** shows the estimation results of the research model using Tobin's Q as the dependent variable. In the empirical analysis of this study, some results were consistent with the theories and hypotheses, but in a specific model, the opposite results were also found. We should pay attention to two areas in the results of this empirical analysis: (1) the relationship between DCs and financial performance shown in the ESG reporting and (2) the moderating effect of environmental uncertainty on the DCs-performance relationship.

Among the sub-activities of DCs, the identifying capability (hypothesis 2) and the decentralization capability (hypothesis 10) showed a significant positive relationship in the regression model using corporate performance (ROA) and corporate value (Tobin's Q) as dependent variables. Also, in part, it was found that the loyalty and commitment capability (hypothesis 6) and the governance capability (hypothesis 8) had no effect on ROA.

Looking at the statistical results, Hypothesis 2 was supported as the identifying capability had a significant positive effect on both ROA (beta = 4.183 in Model 16) and Tobin's Q (beta = 0.518 in Model 32). Looking at research model 32 using Tobin's Q as a dependent variable, the decentralization capability was found to be positively linked with corporate performance, supporting hypothesis 10 (beta = 1.394). Also, in Model 15 using ROA as a dependent variable, it was found that the loyalty and commitment capability (beta = 2.563) and the governance capability had a

TABLE 3 | Descriptive statistics and measures of skewness, kurtosis test for variables.

Variables	Mean	P50	Min	Max	S.D.	Kurtosis	Skewness
ROA	12.082	10.385	0.190	47.910	7.882	6.006	1.400
TBQ	0.905	0.612	0.010	5.100	0.929	6.891	1.807
ANL	0.145	0.097	0.004	0.855	0.141	6.082	1.635
IDN	0.148	0.107	0.004	0.828	0.134	5.241	1.410
EBR	0.170	0.143	0.004	0.880	0.143	5.241	1.410
BMD	0.169	0.141	0.004	0.888	0.140	6.043	1.505
DMP	0.148	0.108	0.003	0.835	0.137	6.853	1.664
LYC	0.165	0.135	0.004	0.931	0.133	6.063	1.349
COS	0.167	0.140	0.003	0.844	0.134	4.889	1.169
GOV	0.182	0.159	0.003	0.764	0.135	4.161	1.022
KNW	0.155	0.135	0.003	0.817	0.121	5.293	1.137
DEC	0.174	0.149	0.004	0.845	0.136	4.758	1.172
UNC	0.14	0.06	0.00	2.62	0.25	6.604	1.400
RND	5.08	2.75	0.01	44.13	6.51	6.242	1.913
PER	26.07	15.13	0.30	770.52	63.14	6.650	1.884
RPE	1879	618	86	27993	3552	6.572	1.816
CR	1.322	1.210	0.170	5.530	0.647	4.833	1.748
DB	68.02	69.39	27.71	114.23	15.51	2.645	0.056
FS	17.30	17.83	9.14	22.32	2.57	3.846	-1.077
AG	44.22	30.00	2.00	155.00	35.60	3.582	1.154

ROA, return on assets; TBQ, Tobin's Q; ANL, analyzing; IDN, identifying; EBR, enterprise boundaries; BMD, business model design; DMP, decision-making protocols; LYC, loyalty and commitment; COS, cospecialization; GOV, governance; KNW, knowledge management; DEC, decentralization; UNC, uncertainty; RND, R&D intensity; PER, price earnings ratio; RPE, revenue per employee; CR, current ratio; DB, debt ratio; FS, firm size; AG, firm age.

non-significant positive relationship with financial performance, so Hypothesis 6 and Hypothesis 8 were not supported.

The results of the analyzing of the direct effects of DCs on corporate performance, meanwhile, are as follows: the capabilities of enterprise boundaries (hypothesis 3), decision-making protocols (hypothesis 5), cospecialization (hypothesis 7), and knowledge management (hypothesis 9) were shown to have a significant negative relationship with corporate performance (ROA or Tobin's Q).

Statistical results show that the selecting enterprise boundaries capability has a significant negative relationship for the two dependent variables with ROA (beta = −3.964 in Model 16) and Tobin's Q (beta = −0.494 in Model 32). Looking at research model 32 using Tobin's Q as a dependent variable, it was found that the cospecialization capability (beta = -0.702) and the knowledge management capability (beta = −1.021) had a significant negative correlation with corporate performance. In Model 16 using ROA as a dependent variable, the decision-making protocols capability (beta = −3.730) had a significant negative effect on financial performance.

This study presents the empirical analysis results by subdividing the dimensions of sensing, seizing, and reconfiguring, which are the three major components of Teece's (2007) DCs. Capabilities that directly and significantly positively correlated corporate performance were the identifying and the decentralization capabilities. In addition, it was found that the loyalty and commitment and the governance capabilities have a positive effect on ROA when environmental uncertainty plays the role of a moderator. On the other hand, the results suggest that the enterprise boundaries, the decision-making protocols, the cospecialization, and the knowledge management capabilities have a negative relationship with financial performance. The analysis and the business model design capabilities, which are the main variables of the hypotheses not supported in this study, show the following characteristics: looking at the values of the correlation coefficients from Models 1 to 16 that use ROA as a dependent variable, it is possible to find that the direction is irregular. For example, in Model 1, the correlation coefficient value is negative, but in Model 3, on the contrary, it appears positive, indicating an inconsistency of results.

Regarding Hypothesis 11, the various relationships of DCs with corporate performance under uncertainty found in this study are as follows. First, the direct effect of the identifying capability showed a generally positive relationship in the research model in which corporate performance (ROA) and corporate value (Tobin's Q) were dependent variables. However, the result was changed to a negative relationship through interaction with environmental uncertainty on the dependent variable ROA (beta = −21.969 in Model 16).

Second, the direct effect of the knowledge management capability showed a negative relationship in the research model in which the corporate value (Tobin's Q) was a dependent variable. However, in the interaction with environmental uncertainty, the result was reversed to a positive relationship (beta = 3.671 in Model 32). Finally, the direct effect of the decentralization capability showed a positive relationship in the research model in which the corporate value (Tobin's Q) was the dependent variable. However, the result was reversed to a negative

TABLE 4 | Bivariate correlations matrix.

	VIF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ROA	1.103	1																			
TBQ	1.121	0.187	1																		
ANL	1.739	−0.001	0.018	1																	
IDN	1.874	0.070	−0.019	0.562	1																
EBR	2.063	0.019	0.039	0.237	0.464	1															
BMD	1.651	0.007	−0.031	0.115	0.165	0.419	1														
DMP	1.661	0.042	0.063	0.166	0.180	0.582	0.448	1													
LYC	1.827	0.000	−0.022	0.220	0.234	0.598	0.412	0.438	1												
COS	2.479	0.056	−0.067	0.194	0.145	0.143	0.294	0.230	0.270	1											
GOV	2.677	0.044	0.023	0.249	0.295	0.227	0.459	0.139	0.180	0.558	1										
KNW	2.406	−0.021	−0.039	0.152	0.292	0.242	0.242	0.183	0.106	0.511	0.582	1									
DEC	2.692	0.066	−0.023	0.197	0.205	0.255	0.298	0.270	0.267	0.591	0.526	0.543	1								
UNC	1.093	−0.121	−0.076	−0.046	−0.007	−0.052	−0.019	−0.054	−0.028	−0.010	−0.054	−0.062	−0.052	1							
RND	1.124	0.045	0.127	−0.088	−0.022	0.088	0.001	0.094	−0.032	−0.060	−0.122	−0.052	−0.077	−0.048	1						
PER	1.110	−0.036	0.172	−0.044	−0.057	−0.042	−0.102	−0.036	−0.040	−0.045	0.013	−0.051	−0.069	0.008	0.048	1					
RPE	1.161	−0.097	−0.159	−0.051	0.006	0.000	0.040	0.058	0.008	−0.044	−0.114	−0.051	−0.070	0.153	0.010	−0.021	1				
CR	1.138	0.131	0.074	0.020	0.044	0.031	−0.037	0.017	0.036	0.046	0.035	0.017	0.001	−0.133	−0.090	−0.007	0.000	1			
DB	1.226	−0.067	0.147	0.005	0.088	0.019	−0.005	−0.051	−0.043	0.047	0.044	0.056	0.046	0.042	0.095	0.137	−0.141	−0.250	1		
FS	1.213	−0.023	−0.229	−0.053	−0.006	0.002	0.048	0.075	−0.001	−0.032	−0.101	−0.013	−0.015	−0.105	−0.035	−0.153	0.117	0.018	−0.202	1	
AG	1.097	−0.072	0.013	−0.006	0.013	−0.036	0.011	−0.003	−0.022	0.031	0.050	0.061	0.059	−0.004	−0.154	0.042	−0.115	0.046	−0.118	−0.113	1

ROA, return on assets; TBQ, Tobin's Q; ANL, analyzing; IDN, identifying; EBR, enterprise boundaries; BMD, business model design; DMP, decision-making protocols; LYC, loyalty and commitment; COS, cospecialization; GOV, governance; KNW, knowledge management; DEC, decentralization; UNC, uncertainty; RND, R&D intensity; PER, price earnings ratio; RPE, revenue per employee; CR, current ratio; DB, debt ratio; FS, firm size; AG, firm age.

TABLE 5 | Fixed effect panel model estimation of the impact of DCV and environmental uncertainty on ROA.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
ANL	−0.040	−0.091	0.550	0.058	−0.023	−0.049	−0.095	−0.094	−0.075	−0.176	−0.140	−0.290	−1.008	−0.065	−0.030	−1.082
	(1.540)	(1.542)	(1.808)	(1.543)	(1.547)	(1.541)	(1.546)	(1.553)	(1.552)	(1.544)	(1.555)	(1.552)	(2.036)	(1.558)	(1.559)	(2.110)
IDN	2.528*	2.447*	2.389	3.461**	2.402	2.340	2.448*	2.448*	2.445*	2.403	2.468*	2.471*	4.153**	2.342	2.193	4.183**
	(1.460)	(1.464)	(1.468)	(1.594)	(1.467)	(1.466)	(1.466)	(1.466)	(1.466)	(1.465)	(1.468)	(1.464)	(1.812)	(1.471)	(1.475)	(1.867)
EBR	−2.820*	−2.848*	−2.802*	−2.792*	−2.318	−2.608*	−2.844*	−2.849*	−2.852*	−2.826*	−2.852*	−2.884*	−2.843*	−2.946	−2.935*	−3.964**
	(1.538)	(1.539)	(1.541)	(1.537)	(1.769)	(1.549)	(1.544)	(1.541)	(1.541)	(1.539)	(1.540)	(1.539)	(1.539)	(1.889)	(1.541)	(1.973)
BMD	−0.032	−0.111	−0.082	−0.107	−0.108	0.918	−0.114	−0.112	−0.103	−0.126	−0.136	−0.169	−0.156	1.199	0.077	1.373
	(1.302)	(1.306)	(1.307)	(1.304)	(1.307)	(1.528)	(1.309)	(1.310)	(1.309)	(1.306)	(1.310)	(1.307)	(1.306)	(1.724)	(1.312)	(1.775)
DMP	−3.082*	−3.035*	−3.000*	−2.872*	−3.010*	−3.112*	−2.998	−3.033*	−3.044*	−2.952*	−2.994*	−2.883*	−2.839*	−3.270*	−3.006*	−3.730*
	(1.667)	(1.668)	(1.670)	(1.669)	(1.670)	(1.668)	(1.861)	(1.672)	(1.672)	(1.670)	(1.677)	(1.674)	(1.670)	(1.923)	(1.677)	(1.945)
LYC	2.363	2.426	2.385	2.277	2.362	2.286	2.429	2.438	2.422	2.435	2.444	2.563*	2.264	2.238	2.563*	2.234
	(1.539)	(1.541)	(1.544)	(1.542)	(1.546)	(1.544)	(1.544)	(1.696)	(1.544)	(1.541)	(1.544)	(1.546)	(1.543)	(1.744)	(1.552)	(1.765)
COS	−2.890	−2.870	−2.959	−2.962	−2.881	−2.981	−2.874	−2.871	−2.932	−2.985	−2.876	−3.050	−2.855	−2.983	−4.644**	−4.233*
	(1.859)	(1.860)	(1.865)	(1.858)	(1.861)	(1.861)	(1.864)	(1.864)	(1.955)	(1.862)	(1.862)	(1.867)	(1.863)	(1.869)	(2.169)	(2.200)
GOV	1.975	2.018	2.070	1.875	2.057	2.162	2.020	2.021	1.998	3.242	2.093	2.344	1.698	2.155	4.172*	3.887
	(1.952)	(1.954)	(1.956)	(1.953)	(1.956)	(1.955)	(1.956)	(1.962)	(1.965)	(2.251)	(1.976)	(1.976)	(1.966)	(1.969)	(2.514)	(2.590)
KNW	−2.146	−2.193	−2.187	−1.981	−2.171	−2.212	−2.191	−2.192	−2.216	−2.121	−1.986	−2.145	−1.870	−2.247	−4.201*	−4.238*
	(2.048)	(2.049)	(2.050)	(2.050)	(2.051)	(2.048)	(2.052)	(2.053)	(2.063)	(2.050)	(2.199)	(2.049)	(2.056)	(2.057)	(2.544)	(2.558)
DEC	2.744	2.790	2.719	2.703	2.766	2.782	2.793	2.790	2.794	2.747	2.778	3.606*	2.781	2.791	5.001*	5.068*
	(2.017)	(2.019)	(2.022)	(2.016)	(2.020)	(2.017)	(2.021)	(2.021)	(2.021)	(2.019)	(2.021)	(2.151)	(2.019)	(2.027)	(2.556)	(2.632)
UNC		−0.559	−0.181	0.325	−0.027	0.660	−0.525	−0.546	−0.712	0.876	−0.244	0.836	0.157	0.415	0.168	1.128
		(0.695)	(0.891)	(0.887)	(1.118)	(1.172)	(1.029)	(1.111)	(1.638)	(1.485)	(1.391)	(1.450)	(0.912)	(1.529)	(1.686)	(2.010)
UNC × ANL			−5.566										10.014			11.129
			(8.180)										(12.466)			(13.127)
UNC × IDN				−11.463									−18.108*			−21.969*
				(7.168)									(10.947)			(11.832)
UNC × EBR					−3.715									2.737		8.960
					(6.105)									(9.254)		(10.476)
UNC × BMD						−8.460								−10.656		−10.577
						(6.544)								(9.097)		(9.820)
UNC × DMP							−0.322							0.979		6.906
							(7.109)							(8.881)		(9.471)
UNC × LYC								−0.078						0.368		0.432
								(4.883)						(5.962)		(6.505)

(Continued)

TABLE 5 | (Continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
UNC × COS									0.712						13.114	8.074
									(6.915)						(11.175)	(12.125)
UNC × GOV										−6.962					−13.353	−13.548
										(6.368)					(11.239)	(12.301)
UNC × KNW											−1.792				16.108	20.036
											(6.839)				(14.370)	(14.638)
UNC × DEC												−7.356			−19.100	−19.972
												(6.710)			(13.441)	(14.731)
RND	−0.671***	−0.674***	−0.673***	−0.675***	−0.674***	−0.674***	−0.674***	−0.674***	−0.675***	−0.667***	−0.674***	−0.671***	−0.679***	−0.675***	−0.667***	−0.672***
	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.084)	(0.084)
PER	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***	−0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
RPE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CR	−0.275	−0.263	−0.258	−0.253	−0.254	−0.247	−0.262	−0.263	−0.262	−0.261	−0.262	−0.256	−0.256	−0.250	−0.240	−0.241
	(0.267)	(0.267)	(0.268)	(0.267)	(0.268)	(0.267)	(0.268)	(0.268)	(0.268)	(0.267)	(0.268)	(0.267)	(0.267)	(0.268)	(0.267)	(0.268)
DB	−0.040	−0.038	−0.037	−0.039	−0.037	−0.037	−0.038	−0.038	−0.037	−0.039	−0.038	−0.039	−0.040	−0.037	−0.037	−0.041
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
FS	0.660	0.677	0.655	0.677	0.698	0.655	0.676	0.677	0.671	0.785	0.695	0.740	0.717	0.641	0.765	0.777
	(0.488)	(0.488)	(0.490)	(0.488)	(0.490)	(0.488)	(0.490)	(0.491)	(0.493)	(0.498)	(0.494)	(0.492)	(0.490)	(0.496)	(0.499)	(0.508)
AG	−0.181***	−0.182***	−0.180***	−0.178***	−0.183***	−0.183***	−0.182***	−0.182***	−0.181***	−0.195***	−0.184***	−0.191***	−0.180***	−0.182***	−0.192***	−0.191***
	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.066)	(0.065)	(0.065)	(0.065)	(0.065)	(0.066)	(0.066)
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
_cons	11.818	11.498	11.680	11.290	11.107	11.716	11.507	11.509	11.571	10.129	11.264	10.693	10.842	11.980	10.238	10.283
	(7.560)	(7.574)	(7.582)	(7.563)	(7.606)	(7.570)	(7.584)	(7.611)	(7.615)	(7.675)	(7.633)	(7.608)	(7.586)	(7.676)	(7.679)	(7.789)
N	580	580	580	580	580	580	580	580	580	580	580	580	580	580	580	580
R^2	0.244	0.245	0.246	0.249	0.246	0.248	0.245	0.245	0.245	0.247	0.245	0.247	0.250	0.248	0.253	0.260
F	13.400	13.200	13.150	13.190	13.170	13.100	13.120	13.130	13.130	13.060	13.130	13.020	13.190	12.980	12.950	12.830
Hausman (Prob > χ^2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****, **, and * refer to significance at 1%, 5%, and 10%, respectively. ROA, return on assets; TBQ, Tobin's Q; ANL, analyzing; IDN, identifying; EBR, enterprise boundaries; BMD, business model design; DMP, decision-making protocols; LYC, loyalty and commitment; COS, cospecialization; GOV, governance; KNW, Knowledge management; DEC, decentralization; UNC, uncertainty; RND, R&D intensity; PER, price earnings ratio; RPE, revenue per employee; CR, current ratio; DB, debt ratio; FS, firm size; AG, firm age.*

TABLE 6 | Fixed effect panel model estimation of the impact of DCV and environmental uncertainty on Tobin's Q.

	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28	Model 29	Model 30	Model 31	Model 32
ANL	−0.127	−0.130	0.098	−0.105	−0.123	−0.129	−0.132	−0.122	−0.122	−0.131	−0.118	−0.151	−0.016	−0.118	−0.127	0.056
	(0.187)	(0.188)	(0.219)	(0.187)	(0.188)	(0.188)	(0.188)	(0.189)	(0.189)	(0.188)	(0.189)	(0.189)	(0.247)	(0.190)	(0.189)	(0.256)
IDN	0.455**	0.449**	0.429**	0.616***	0.445**	0.448**	0.450**	0.448**	0.448**	0.449**	0.444**	0.452**	0.558**	0.447**	0.417**	0.518**
	(0.178)	(0.178)	(0.178)	(0.193)	(0.179)	(0.179)	(0.178)	(0.178)	(0.178)	(0.178)	(0.179)	(0.178)	(0.220)	(0.179)	(0.179)	(0.226)
EBR	−0.474**	−0.476**	−0.460**	−0.467**	−0.425**	−0.474**	−0.474**	−0.474**	−0.478**	−0.476**	−0.475**	−0.480**	−0.463**	−0.419*	−0.494***	−0.494**
	(0.187)	(0.187)	(0.187)	(0.187)	(0.215)	(0.189)	(0.188)	(0.188)	(0.187)	(0.187)	(0.187)	(0.187)	(0.187)	(0.230)	(0.187)	(0.239)
BMD	0.046	0.041	0.051	0.042	0.041	0.052	0.040	0.045	0.045	0.041	0.047	0.035	0.046	0.015	0.068	0.057
	(0.158)	(0.159)	(0.158)	(0.158)	(0.159)	(0.186)	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.210)	(0.159)	(0.215)
DMP	0.025	0.028	0.040	0.055	0.030	0.027	0.047	0.024	0.024	0.029	0.018	0.044	0.052	0.054	0.026	−0.074
	(0.203)	(0.203)	(0.202)	(0.203)	(0.203)	(0.203)	(0.226)	(0.203)	(0.203)	(0.203)	(0.204)	(0.204)	(0.203)	(0.234)	(0.203)	(0.235)
LYC	0.118	0.122	0.108	0.098	0.116	0.121	0.124	0.091	0.121	0.123	0.118	0.137	0.099	0.088	0.160	0.077
	(0.187)	(0.188)	(0.187)	(0.187)	(0.188)	(0.188)	(0.188)	(0.206)	(0.188)	(0.188)	(0.188)	(0.188)	(0.187)	(0.212)	(0.188)	(0.214)
COS	−0.504**	−0.503**	−0.534**	−0.518**	−0.504**	−0.504**	−0.505**	−0.499**	−0.532**	−0.505**	−0.502**	−0.522**	−0.527**	−0.500**	−0.692***	−0.702***
	(0.226)	(0.226)	(0.226)	(0.226)	(0.226)	(0.227)	(0.227)	(0.227)	(0.238)	(0.227)	(0.226)	(0.227)	(0.226)	(0.228)	(0.263)	(0.266)
GOV	−0.044	−0.042	−0.023	−0.065	−0.038	−0.040	−0.041	−0.049	−0.051	−0.020	−0.060	−0.006	−0.050	−0.048	0.022	−0.023
	(0.237)	(0.238)	(0.237)	(0.237)	(0.238)	(0.238)	(0.238)	(0.239)	(0.239)	(0.274)	(0.240)	(0.240)	(0.239)	(0.240)	(0.305)	(0.314)
KNW	−0.606**	−0.609**	−0.607**	−0.574**	−0.607**	−0.609**	−0.608**	−0.613**	−0.620**	−0.608**	−0.660**	−0.604**	−0.584**	−0.608**	−1.017***	−1.021***
	(0.249)	(0.249)	(0.249)	(0.249)	(0.250)	(0.250)	(0.250)	(0.250)	(0.251)	(0.250)	(0.268)	(0.249)	(0.250)	(0.251)	(0.309)	(0.310)
DEC	0.850***	0.853***	0.828***	0.839***	0.851***	0.853***	0.854***	0.854***	0.855***	0.852***	0.856***	0.941***	0.832***	0.853***	1.345***	1.394***
	(0.245)	(0.246)	(0.245)	(0.245)	(0.246)	(0.246)	(0.246)	(0.246)	(0.246)	(0.246)	(0.246)	(0.262)	(0.245)	(0.247)	(0.310)	(0.319)
UNC		−0.036	0.098	0.109	0.015	−0.024	−0.019	−0.075	−0.108	−0.012	−0.114	0.114	0.123	−0.029	−0.022	0.011
		(0.085)	(0.108)	(0.108)	(0.136)	(0.143)	(0.125)	(0.135)	(0.199)	(0.181)	(0.169)	(0.176)	(0.111)	(0.186)	(0.205)	(0.243)
UNC × ANL			−1.977**										−0.835			−1.328
			(0.992)										(1.514)			(1.590)
UNC × IDN				−1.882**									−1.328			−1.296
				(0.870)									(1.330)			(1.433)
UNC × EBR					−0.361									−0.406		−0.038
					(0.743)									(1.128)		(1.269)
UNC × BMD						−0.087								0.233		0.273
						(0.798)								(1.109)		(1.189)
UNC × DMP							−0.167							−0.219		1.131
							(0.865)							(1.082)		(1.147)

(Continued)

TABLE 6 | (Continued)

	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28	Model 29	Model 30	Model 31	Model 32
UNC × LYC								0.217						0.228		0.444
								(0.594)						(0.726)		(0.788)
UNC × COS									0.334						1.063	0.960
									(0.841)						(1.356)	(1.469)
UNC × GOV										−0.120					−0.310	−0.049
										(0.776)					(1.364)	(1.490)
UNC × KNW											0.438				3.500**	3.671**
											(0.832)				(1.744)	(1.773)
UNC × DEC												−0.794			−4.191**	−4.917***
												(0.817)			(1.631)	(1.784)
RND	−0.036***	−0.036***	−0.035***	−0.036***	−0.036***	−0.036***	−0.036***	−0.036***	−0.036***	−0.036***	−0.036***	−0.035***	−0.036***	−0.036***	−0.036***	−0.036***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
PER	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RPE	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CR	−0.043	−0.042	−0.040	−0.040	−0.041	−0.042	−0.042	−0.042	−0.042	−0.042	−0.042	−0.041	−0.040	−0.041	−0.038	−0.037
	(0.032)	(0.033)	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.032)	(0.033)	(0.032)	(0.032)
DB	−0.009**	−0.009**	−0.008**	−0.009**	−0.009**	−0.009**	−0.009**	−0.009**	−0.008**	−0.009**	−0.009**	−0.009**	−0.009**	−0.009**	−0.008**	−0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
FS	−0.230***	−0.229***	−0.237***	−0.229***	−0.227***	−0.229***	−0.230***	−0.227***	−0.232***	−0.227***	−0.234***	−0.222***	−0.233***	−0.225***	−0.234***	−0.228***
	(0.059)	(0.059)	(0.059)	(0.059)	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)	(0.061)	(0.060)	(0.060)	(0.060)	(0.060)	(0.061)	(0.062)
AG	0.044***	0.044***	0.045***	0.045***	0.044***	0.044***	0.044***	0.044***	0.044***	0.044***	0.045***	0.043***	0.045***	0.044***	0.044***	0.044***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
_cons	3.746***	3.725***	3.790***	3.691***	3.687***	3.727***	3.730***	3.695***	3.760***	3.702***	3.782***	3.638***	3.728***	3.652***	3.772***	3.670***
	(0.919)	(0.921)	(0.919)	(0.918)	(0.925)	(0.922)	(0.922)	(0.926)	(0.926)	(0.935)	(0.928)	(0.926)	(0.921)	(0.935)	(0.931)	(0.943)
N	580	580	580	580	580	580	580	580	580	580	580	580	580	580	580	580
R^2	0.141	0.141	0.148	0.149	0.142	0.141	0.141	0.141	0.141	0.141	0.142	0.143	0.150	0.142	0.155	0.166
F	28.140	27.650	27.450	27.800	27.590	27.500	27.540	27.490	27.610	27.480	27.520	27.590	27.420	27.250	27.660	27.380
Hausman (Prob > χ^2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****, **, and * refer to significance at 1%, 5%, and 10%, respectively. ROA, return on assets; TBQ, Tobin's Q; ANL, analyzing; IDN, identifying; EBR, enterprise boundaries; BMD, business model design; DMP, decision-making protocols; LYC, loyalty and commitment; COS, cospecialization; GOV, governance; KNW, knowledge management; DEC, decentralization; UNC, uncertainty; RND, R&D intensity; PER, price earnings ratio; RPE, revenue per employee; CR, current ratio; DB, debt ratio; FS, firm size; AG, firm age.*

relationship due to the interaction effect with environmental uncertainty (beta = −4.917 in Model 32).

Robustness Test

The results of the empirical analysis should secure consistency through a robustness test. In this study, three methods were adopted for the robustness test: inputting control variables sequentially, replacing different proxies for the same variable, and verifying first-order autocorrelation of the error term. First, by introducing sequential control variables, we tried to avoid methodological distortion that may occur when simultaneously inputting control variables. As a result of the test, there was a slight difference between the statistical significance and the regression coefficient, but the positive or negative direction indicating the relationship to the dependent variable did not change. Second, alternative proxies for the same variables were adopted to examine the consistency of the analysis results, and other proxies for growth, productivity, and activity were substituted. As a result of the test, there was no significant change in the direction of the regression coefficient and the statistical significance. Finally, the Bhargava test (Bhargava et al., 1982) and the Baltagi–Wu test (Baltagi and Wu, 1999) were performed to determine whether there was a first-order autocorrelation of the error term. Each test statistic showed a value close to the threshold of 2, for the 5% significance level, so the null hypothesis, i.e., there is no autocorrelation of the first-order error term was not rejected. Therefore, it could be finally determined that there was no first-order autocorrelation of the error term.

DISCUSSION

Theoretical Implications

Our results suggest extensions to the present literature in two key areas: (1) methodology and (2) organizational adaptation. First, we discovered the possibility of alternative analysis tools using algorithms that went beyond the fundamental limitations of the properties of questionnaire data and financial data. In this study, the panel model was processed by constructing a dictionary and developing algorithms, extracting time series scores, and using them in an empirical analysis, rather than analyzing existing survey or financial data. The data obtained from the survey is "cognitive" data of respondents (Groves et al., 2009), accompanied by response error according to adaptive response behavior (Baumgartner and Steenkamp, 2001; Drolet and Morrison, 2001), and the common method bias (Podsakoff, 2003; Conway and Lance, 2010), which occurs when measuring independent and dependent variables simultaneously. In addition, previous studies contain unresolved problems such as questionnaire order according to context effect (Schuman et al., 1981), problems of symbolism and expression of questions (Fee, 1981), and a non-response problem in which information was not obtained from part of the sample (Hedderley and Wakeling, 1995; Dufour et al., 2001; Groves, 2006). In addition, financial data represents short-term figures and is not free from endogenous problems with performance indicators. On the other hand, DC data extracted from unstructured text through algorithms is primary data that directly analyzes the contents of a company's ESG management strategy. Therefore, it can be said that the rigor of the data value is relatively high. Moreover, it can be said that this study contributes to academic and methodological advancement in the field in the sense that time series data capable of panel model analysis was extracted.

Measurement of ESG management, which is a non-financial performance, is essentially difficult to quantitatively evaluate, making it a proxy variable as an indicator evaluated by external entities such as the internationally validated MSCI ESG index (total of 7 stages including AAA, AA, A, BBB, BB, B, CCC), Europe's FTSE4Good index, and latecomer, DJSI index. In the case of Korea, the ESG grades of the Korea Corporate Governance Service (A+, A, B+, B, below B, C, D, etc.), which are calculated on a yearly basis, are used as an authoritative data. These indices take the form of ranking-order variables that assign value according to the evaluation results, so it is necessary to convert them into scores. The problem is that all of them address incompleteness when time series data are needed because this data is not continuous.

Secondly, we explored how DCs interact with environmental uncertainty in causing changes in performance levels. Wu's (2010) study examined the effects of integrating, learning, and reconfiguring capabilities on individual competitive advantages such as market response speed, production efficiency, product quality, and innovation speed, but rather, detailed consideration of the process of DCs interacting with uncertainty is rare. In this study, DCs were divided into 10 detailed activities (Teece, 2007) and the process of their interacting with uncertainty was examined. Unlike static approaches shown by previous studies on DCs, this study tells us about the importance of the sequence and fit of sensing-seizing-reconfiguring of corporate strategies, and it presents important empirical insights into the dynamic process in which the structural relationship between DCs, competitive advantages, and corporate performance is moderated by uncertainty.

Only 5 out of 10 constructive capabilities of DCs were found to have a statistically significant positive or negative effect on corporate performance. This is partially inconsistent with previous studies (Wu, 2006; Vanpoucke et al., 2014; Kuo and Tsou, 2017; Jiao et al., 2019) that discovered the positive effect of DCs on corporate performance or competitive advantages in general. According to the results of this study the process in which DCs affect a company's strategic choices and core competitive advantages is not automatic (Ambrosini and Bowman, 2009). In the process of organizational adaptation to ESG management, unlike a previous study (Helfat, 1997) that showed DCs have a positive effect on corporate performance, no automation was found. Rather, there are subordinate activities (capabilities) that do not directly affect corporate performance. In addition, it can be observed that the subordinate activities (capabilities) of DCs with positive or negative direct effects on corporate performance were moderated, such as the disappearance of the direct effect or the change in the direction of the correlation coefficient due to the moderating function of uncertainty. Therefore, it is attractive for strategic management researchers to open the

black box using an advanced research model based on DCs moderated by uncertainty.

Third, the existence of uncertainty reminds us that ownership-specific advantages that constitute corporate heterogeneity gradually accumulate and have temporary properties. In the academy of strategic management, it is understood that a company is a bundle of technology and knowledge, and its process of accumulating competitive advantages is gradual rather than radical. Typically, Teece et al. (1997) understand that the essential elements of competitive advantages are accumulated through a gradual path dependence mechanism. In the same vein, Prahalad and Hamel (1994) and Hamel and Prahalad (1994) describe the basis of a company's core competencies as an evolutionary outcome of its corporate experience.

Gradually accumulated competitive advantages are established as "sustainable competitive advantages" by meeting VRIN (Value, Rareness, Imitability, Non-substitutable) conditions (Barney, 1991). Interestingly, however, Wiggins and Ruefli (2002) revealed that only a few companies have sustainable competitive advantages. Rather, competitive advantage, which is valuable in seizing market opportunities and avoiding threats in a business environment with high uncertainty, should be continuously transformed in accordance with technological and market changes, rather than having sustainability as an attribute. Wiggins and Ruefli (2002) also revealed that over time, the period for companies to maintain their competitive advantages becomes shorter. In the same context, the core competencies presented from the static RBV do not create sustainable competitive advantages in a contemporary era with high environmental uncertainty. On the other hand, DCs do not simply strengthen corporate competitive advantages, but induce them to improve corporate performance by converting them to suit environmental changes.

Managerial Implications

In addition to the implications for theoretical development in the fields of international business and strategic management, the results of this study provide the following managerial implications for corporate managers. First, it is necessary to discover the source of competitiveness both inside and outside the company as part of the fundamental response strategy to be taken by companies in the era of rising uncertainty. Corporate competitive advantages can be defined using a variety of concepts, including product quality, differentiation ability, cost leadership, flexible process, established customer service, innovation speed, market response speed, production efficiency, cost efficiency, and product line width and depth (Morrison and Roth, 1993; Antonio et al., 2007; Kristal et al., 2010; Wu, 2010). DCs are necessary factors to secure and maintain these competitive advantages (Teece, 2007; Kuo et al., 2017), and to strengthen competitive advantages in response to environmental changes by integrating corporate resources and improving asset utilization (O'ReillyIII, and Tushman, 2008; Li and Liu, 2014; Kuo et al., 2017).

The problem is that the more dynamic industries experience market changes, i.e., changes in consumer needs due to rapid technological changes, the more difficult it is to survive in the market with only the company's internal technology and knowledge base. Developing new products in line with changes in the business environment requires complementary capabilities of external companies based on internal technologies and knowledge capabilities. As a result, open innovation through strategic alliances or joint ventures is emerging as an attractive option.

Second, it is necessary to maintain strategic value through knowledge-based reconfiguration. In a situation where the contemporary business environment is rapidly changing, it is difficult to maintain a knowledge base as a sustainable competitive advantage (Ambrosini and Bowman, 2009). Under uncertainty, companies must continue to reconfigure to meet detected technology and market changes in order to keep their knowledge base up to date and maintain its strategic value (Leonard-Barton, 1992; Wohlgemuth and Wenzel, 2016).

In this process, it is very important to maintain the fit of sensing-seizing-reconfiguring capabilities. From the fact that the number of firms that recovered after losing their competitive advantages has increased, Wiggins and Ruefli (2002) concluded that successful firms do not retain long-term competitive advantages, but rather create chains of temporary competitive advantages. In the same vein, D'Aveni and Gunther (1994) also stress the importance of realizing a temporary chain of competitive advantages in the era of hyper competition, where the durations of corporate competitive advantages have been shortening. This chain of competitive advantages cannot be realized simply by strengthening DCs. Rather, it is important to strategically appropriate the structural relationship between sensing-seizing-reconfiguring capabilities that constitute DCs so that they can seize opportunities according to market changes. The disconnection between sensing-seizing-reconfiguring capabilities hinders DCs from becoming sustainable competitive advantage resources.

Third, it is necessary to be wary of the strategic failures of DCs caused by the disproportionate pursuit of sensing-seizing-reconfiguring capabilities in ESG management. Unlike CSR activities that emphasize corporate citizenship, ESG is a concept of sustainable investment linked to investor indicators consisting of three specific factors: environment, society, and governance. The emphasis on ESG management has begun to take hold in Korea more by private investors rather than in the public sector. Representatively, Goldman Sachs and JP Morgan, along with BlackRock, the world's largest asset management company, have expressed their intention to exercise their voting rights against companies that are passive in publicizing their statements of ESG management. In particular, the financial sector responds faster than other industries. There is a consensus that ESG management has a positive effect on the corporate value of financial institutions (Carroll and Einwiller, 2014; Goloshchapova et al., 2019), and it drives a corporation's financial performance (Friede et al., 2015; Mozaffar et al., 2017; Henisz et al., 2019). On the other hand, there is also a conflicting view that it is not easy to drive financial performance because of the nature of ESG management, which involves many responsibilities resulting in costs (Robert and George, 2013).

According to the results of this study, the DCs embedded in ESG management have a higher sensitivity to market

performance than financial performance. The sensitivity of sensing-seizing-reconfiguring is observed in both financial and market performance, but the interaction effect with uncertainty is much more sensitive to market performance. In addition, while the direct effect of sensing-seizing-reconfiguring capabilities have both positive and negative effects, in the case of financial performance, sensing-seizing-reconfiguring capabilities do not have a significant effect due to the moderating effect of uncertainty. On the other hand, in the case of market performance, sensing-seizing-reconfiguring capabilities negatively or positively affect performance based on the moderator, i.e., uncertainty. However, since a significant influence is observed only in the sensing and reconfiguring activities, imbalanced pursuit between the sensing-seizing-reconfiguring capabilities is observed in the case of market performance.

Given these differences in the effects of DCs embedded in ESG management on financial and market performance, it is possible to conclude that the results of the strategic move to ESG management are closer to failure than success in terms of corporate organizational adaptation to environmental uncertainty. As a result, companies should successfully pursue business model transformation to seize market opportunities in the process of sensing market changes in terms of socially responsible investment value and reconfiguring resources and capabilities, rather than establishing a vision and mission from a traditional CSR perspective.

Limitations and Future Research

Although acknowledging its academic and practical contribution to the academy of strategic management by presenting an alternative analysis tool to increase the objectivity of analysis and opening a black box of DCs embedded in ESG management, this study does not provide us with a full understanding of DCs. Our understanding of DCs can only become more complete when encompassing several future research topics. First, it is necessary to consider the curvilinear effect, not the linear effect of uncertainty. In this study, positive and negative functions were considered, omitting the curvilinear relationship between DCs and uncertainty. Second, further research is needed to examine the interaction effect with uncertainty in specific value chain activities in each of the three areas of DCs, i.e., sensing-seizing-reconfiguring. Third, in future studies, selected companies should belong to a meaningful industry because that industry will be carrying out significant activities which need consideration in the field of DCs. Thirdly, it is also necessary to compare the theoretical and practical meanings of different conceptualizations of DCs presented by Teece (2007); Eisenhardt and Martin (2000), and Zollo and Winter (2002), which are well known for their definition of DCS. Finally, in order to extend the generalizability of this study for the theorizing of DCs, comparative research needs to be done across various industries.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

BY designed the research method, collected and analyzed the data, and wrote the manuscript. OY was responsible for the conceptualization of the idea and constructed the fundamental theory. Both authors contributed to this article and approved the submitted version.

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The Effect of Corporate Social Responsibility Compatibility and Authenticity on Brand Trust and Corporate Sustainability Management: For Korean Cosmetics Companies

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The purpose of this study is to examine whether corporate social responsibility (CSR) activities perceived by consumers affect brand trust and corporate sustainability management (CSM). In other words, this study tried to examine whether the compatibility and authenticity of CSR influences brand trust, thereby affecting CSM including economic viability, environmental soundness, and social responsibility. To measure this, an empirical analysis was conducted on 479 consumers who had experience purchasing products from cosmetic companies that are carrying out CSR. As a result of the analysis, it was found that the compatibility and authenticity of CSR have a positive effect on brand trust. Also, it was found that brand trust had a positive effect on social responsibility among the sub-concepts of CSM, but did not affect economic viability and environmental soundness. The results of this study are expected to provide strategic implications for social responsibility performance and brand trust building necessary for cosmetics companies to grow continuously.

Keywords: corporate social responsibility, brand trust, corporate sustainability management, Korean cosmetics company, Korean cosmetics market

INTRODUCTION

As companies' influence on society increases, corporate social responsibility (CSR) has become an essential factor that companies must choose to realize sustainable management. CSR is a process of fulfilling economic and environmental responsibilities required by society to realize human values as well as maximize profits (Clark, 2000). CSR can have a direct effect on the formation of positive attitudes toward companies and products by consumers, thereby enhancing customer loyalty and business performance (Sen et al., 2006). Therefore, it is necessary for companies to consider CSR as a key means to enable corporate sustainability management and to strengthen strategic approaches using it (Konrad et al., 2006).

As sustainable development for mankind and social awareness become more important, corporate sustainability is emerging as an important issue (Lloret, 2016). In addition, as problems

such as global economic crisis, social conflict, climate change and environmental pollution continued, "sustainability" became the most fundamental goal in corporate management (Benessia and Funtowicz, 2015). Unilever (2017) reported that the sustainable market is worth about 3,200 trillion won, of which 125 trillion won is a potential market that has not yet been developed. Accordingly, as a part of sustainable management, companies have come up with various strategies to increase social interest in eco-friendliness.

Corporate Sustainability Management (CSM) refers to management activities that do not harm current and future generations and secure corporate economic outcomes as well as striving for ethical, environmental, and socially sustainable development (Benessia and Funtowicz, 2015). CSM is based on environmental responsibilities, including producing eco-friendly products and participating in environmental movements, and social responsibilities, including creating jobs and improving human resources with the profits generated by the company (Elkington, 1997). These activities yield ethical management, innovative management, social responsibility management, environmental management, and creative management within the company. Outside the company, they enhance consumers' knowledge or perceived value of the company and positively affect trust, corporate image, and customer loyalty, thereby strengthening a company's competitive edge (Forehand and Grier, 2003; Luo and Bhattacharya, 2006).

Amid the changing business environment, companies are carrying out CSR that create economic and social values for sustainable growth (Matten and Moon, 2008). However, CSR was perceived by consumers as an activity for business to generate profits, resulting in negative attitudes of consumers (Webb and Mohr, 1998). Therefore, the compatibility and authenticity of CSR that can attract consumers' participation and interest is important (Becker-Olsen and Hill, 2006). These concepts have an important effect on consumers' assessment of CSR as well as attitudes toward companies (Sen et al., 2006).

Corporate social responsibility compatibility refers to the degree to which consumers recognize whether there is a correlation between a company's characteristics, such as brand image and products, and CSR (Gupta and Pirsch, 2006). Should there be a high compatibility between the company's features and CSR, consumers can establish trust in the company, ultimately forming commitment and loyalty between the company and the consumer (Becker-Olsen and Hill, 2006; Koschate-Fischer et al., 2012). In addition, high compatibility creates a positive corporate and brand image (O'Connor and Meister, 2008).

Corporate social responsibility authenticity means that a company carries it out with pure intentions (Price et al., 1995). Even if the company and CSR are compatible, the company cannot achieve any outcome should consumers recognize CSR as profit-seeking, hypocritical activities (Price et al., 1995). Sincere CSR with authenticity results in favorable responses from consumers and has a positive effect on consumers' trust in and attitude toward the company, as well as their purchase intention (Alhouti et al., 2016). Therefore, should consumers feel that CSR is authentic, they will positively evaluate corporate activities and recognize them as ethical companies, establishing trust in the company and brand (Sen and Bhattacharya, 2001; Becker-Olsen and Hill, 2006).

Brand trust refers to the belief that a brand will fulfill consumers' best interests for goals or values shared by the consumers (Chaudhuri and Holbrook, 2001). Since brand trust affects the relationship between consumers and the brand, it is one of the factors that promote the continuous growth of a company (Erdem and Swait, 2004; Sichtmann, 2007). Therefore, companies must build brand trust in order to form a positive relationship with consumers. In other words, should a company carry out compatible and genuine CSR activities, it can establish a successful relationship with consumers, thereby raising brand trust.

This study aims to examine whether the CSR of cosmetics companies perceived by consumers affect brand trust and CSM. In other words, this study aims to examine whether the compatibility and authenticity of CSR affects brand trust, and whether the aforementioned brand trust affects CSM, which is comprised of economic viability, environmental soundness, and social responsibility. Cosmetics companies were selected as the subject in this study because they used chemical stock and plastic containers in the past, and as these materials have become one of the main causes of environmental destruction, cosmetics companies have started to invest in and research sustainable development, including eco-friendly packaging, reduction of waste and carbon emissions, and research on alternative substances, to protect the natural environment (Bom et al., 2020). For example, The Body Shop, a Korean cosmetics company, promotes anti-animal testing, promoting self-respect, protecting human rights, supporting fair trade, and protecting the global environment as sustainable management. Amore Pacific also promotes a sustainable lifestyle, grows together with economic and social communities, and contributes to a circular economy for future generations (Lassk, 2019). The outcome of this study is expected to provide strategic implications for establishing the CSR and brand trust necessary for the continuous growth of cosmetics companies.

THEORETICAL BACKGROUND

Corporate Social Responsibility Compatibility and Authenticity

Corporate social responsibility (hereinafter referred to as CSR), a term first used by Bowen in the 1950s, refers to pure supporting activities that do not have commercial purposes and it is the duty of entrepreneurs to make policies and decisions that fit the purpose and value of society and are considered desirable (Bowen, 1953). Since then, studies on CSR have presented ethical as well as social aspects and defined social responsibility more broadly and comprehensively. Carroll (1983) stated that CSR includes economic, legal, ethical, and benevolent expectations that society has for a company. In other words, CSR fulfills the economic and environmental responsibilities required by society by prioritizing profit maximization along with human value realization (Clark, 2000). CSR is carried out in various ways, including research on its purpose and research on factors that

affect performance (Joyner and Payne, 2002). Recently, studies have been conducted to find out whether CSR has a direct effect on consumers' attitude and behaviors toward companies (Backhaus et al., 2002). CSR establishes a positive image of a company, and as it increases consumer loyalty by inducing a caring reputation, CSR promotes the improvement of corporate financial performance (Doh et al., 2010).

Compatibility and authenticity play an important role in consumer behavior and attitudes and have the greatest influence on CSR (Beckman et al., 2009). CSR compatibility refers to the degree to which consumers recognize whether there is a correlation between a company's characteristics, such as brand image and products, and CSR (Gupta and Pirsch, 2006). CSR tailored to the characteristics of a company can enhance the effectiveness of CSR by making it easier for consumers to understand the company and its products and quickly recognize and accept CSR (Sen et al., 2006). In other words, the higher the CSR compatibility, the more positive attitudes and trust consumers have toward corporate reputation and image (O'Connor and Meister, 2008). In this way, CSR compatibility is an important factor in determining the effectiveness of CSR (Becker-Olsen and Hill, 2006).

Corporate social responsibility authenticity refers to the degree to which a company is carrying out CSR with pure intentions (Price et al., 1995). Consumers may suspect that companies engage in CSR as a means of pursing profits or overcoming crises (Beckman et al., 2009). In other words, the effectiveness of CSR may vary depending on how consumers perceive the authenticity of CSR (Forehand and Grier, 2003). When consumers infer that a company carries out CSR to pursue economic outcomes, they realize authenticity is low. When consumers infer that a company carries out CSR out of pure acceptance of social needs, they may consider that the company is authentic and think highly of the company (Becker-Olsen and Hill, 2006). Therefore, CSR authenticity is an important factor influencing the outcome of CSR, and companies must carry out authentic CSR activities (Becker-Olsen and Hill, 2006; Beckman et al., 2009; Alhouti et al., 2016). Compatibility and authenticity, which are elements for evaluation of CSR, are seen as essential factors in achieving a competitive edge (Gilmore and Pine, 2007).

Brand Trust

Brand trust refers to consumers' belief that the brand will fulfill the best interests for the consumers in order to achieve the goals or values shared by the company and consumers, and such trust will have a positive effect on consumers' decision-making processes (Doney and Cannon, 1997; Chaudhuri and Holbrook, 2001). Moreover, brand trust is achieved from the relationship between the consumer and the brand and established after the consumer experiences a specific brand (Del Vecchio, 2000). Therefore, brand trust is an important factor in promoting a company's long-term growth as it affects the relationship between consumers and a company (Erdem and Swait, 2004; Sichtmann, 2007).

According to previous studies on brand trust, Morgan and Hunt (1994) argued that the establishment of a successful relationship between a brand and consumers would bring a positive effect on consumer loyalty and commitment to the brand. Doney and Cannon (1997) stated that trust between the consumers and brand plays an important role in situations in which a consumer has to make a purchasing decision before experiencing a specific brand. Lafferty and Goldsmith (1999) argued that CSR can create a positive corporate image and raise brand trust. In other words, the establishment of brand trust promotes customers' positive words and purchase intentions, thereby promoting the company's long-term performance (Kotler and Armstrong, 2013). Brand trust is a motivational factor promoting consumer consumption and plays an important role in building a positive relationship between a brand and consumers (Gwinner et al., 1998). Therefore, brand trust is a future behavior subscale expected of consumers in a competitive marking environment and an essential factor that companies must manage for long-term performance (Vogel et al., 2008).

Corporate Sustainability Management

The concept of sustainability began to form as it was suggested that human growth would reach its limit due to environmental pollution and resource depletion caused by economic development. Sustainable development was first proposed by the 1987 Brundtland Report from the World Commission on Environment and Development (WCED) (Carroll and Shabana, 2010). Sustainable development satisfies the needs and desires of the present generation while presenting eco-friendly development without hindering the ability of subsequent generations to meet their needs (WCED, 1987). Such sustainable development and management activities that fulfill corporate social responsibility can be referred to as CSM. In other words, CSM includes environmental and ethical responsibilities as well as economic, social, and legal responsibilities required by society (Schaltegger and Hörisch, 2017). Therefore, rather than pursuing profit, economic responsibility, and legal responsibility, CSM accompanies economic, social, environmental, and ethical management, serving as a positive role in the community, country, and world society beyond internal and external stakeholders (Elkington, 1997). Although CSM is perceived as a similar meaning to CSR, there is a clear difference. While CSM focuses on the continuous development and growth of companies, CSR focuses on issues for social development (Van Marrewijk and Werre, 2003).

Triple Bottom Line (TBL) is the most common term used in CSM. TBL presented by Elkington (1997) refers to a situation in which companies are economically viable and environmentally sound and strive to sustain CSR. It consists of economic viability, environmental soundness, and social responsibility (Craig and Rogers, 2008). Among the factors of TBL, economic viability is essential to secure, maintain, and efficiently distribute benefits with the stakeholders in the long run (Amalric and Hauser, 2005). Environmental soundness refers to the management of the environment within the boundaries of the law, production of eco-friendly products to enhance corporate reputation, and participation in environmental movements and campaigns to raise the standard of life for all members of society (Elkington, 1997). Social responsibility, essential for companies to practice

sustainable management, refers to the act of returning a portion of the profits produced by a company to society. Not only that, it includes job creation and the improvement of human resource related infrastructure (Becker-Olsen and Hill, 2006). Social responsibility is the effort of a company to create new social capital to achieve social goals. Social capital is a concept that a company builds trust with its stakeholders. In order for companies to be sustainable, social capital must be promoted (Becker-Olsen and Hill, 2006). In other words, all activities regarding management must maintain and manage social systems and ecosystems by harmonizing with economic, environmental, and social responsibilities, and TBL is a practical tool for practicing sustainable management and is being utilized in corporate management by means of basic and universal methods (Carroll and Shabana, 2010).

According to studies on CSM, King and Lenox (2001) reported that practicing sustainable management has a positive impact on the values and financial outcome of a company. Moreover, Craig and Rogers (2008) summarized the concept of CSM and reported on the relationship between long-term economic viability and environmental, social, and economic performance. Porter and Kramer (2011) argued that a company can gain its competitive edge by securing more valuable resources than its competitors and practicing CSR; therefore, it can facilitate CSM.

RESEARCH METHOD

Research Model

When consumers perceive that CSR is authentic and suitable for the company's products, they feel trust in the company's brand (Becker-Olsen and Hill, 2006; Sen et al., 2006). In other words, consumers can perceive a company as ethical if its CSR compatibility and authenticity are high, thereby establishing brand trust and satisfaction (Becker-Olsen and Hill, 2006; Alhouti et al., 2016). In addition, consumer trust in the brand improves the company's sustainability management because it makes consumers trust the company and continue to purchase the product (Hon and Grunig, 1999). Therefore, this study proposed a research model as shown in **Figure 1** to determine whether CSR compatibility and authenticity affect brand trust, and brand trust affects CSM, which includes economic viability, environmental soundness, and social responsibility.

Hypotheses

Corporate Social Responsibility and Brand Trust

Consumers "awareness of CSR can have an important impact on consumers" attitudes to the brand. In particular, it is important whether the CSR fits well with the company's product and whether the CSR is genuine (Beckman et al., 2009). CSR compatibility refers to the degree to which consumers recognize whether there is an association between a company's characteristics, such as brand image and products, and CSR (Gupta and Pirsch, 2006). CSR that is highly compatible with corporate brands can result in positive consumer attitudes (Forehand and Grier, 2003). According to Rifon et al. (2004), if CSR and corporate characteristics are highly compatible, consumers establish trust in the company, hence, it can secure a positive corporate image. Becker-Olsen and Hill (2006) argued that a high CSR compatibility yields a strong association between the company and CSR, and as a result, consumers positively evaluate the brand.

Corporate social responsibility authenticity refers to the degree to which a company is carrying out CSR with pure intentions (Price et al., 1995). Brown and Dacin (1997) stated that authentic CSR has a positive effect on consumers' positive attitudes toward the products and services. Schallehn et al. (2014) argued that consumers positively evaluate corporate activities and perceive the company as ethical when they consider CSR as a sincere act, thereby establishing trust in the company and brand. On that account, the following hypotheses were established.

H1: CSR compatibility will have a positive effect on brand trust.

H2: CSR authenticity will have a positive effect on brand trust.

Brand Trust and Corporate Sustainability Management

Brand trust refers to the belief that a brand will fulfill the consumers' best interests for the goals or values shared by the consumers (Chaudhuri and Holbrook, 2001). Since brand trust affects the relationship between a company and consumers, it is an important factor in maintaining and strengthening long-term transactions between them, thereby inducing sustainable growth of the company (Erdem and Swait, 2004; Sichtmann, 2007).

When consumers perceive that the trade of products or services is honest and fair and establish trust, they will be fonder of the brand, forming a long-term relationship (Ganesan, 1994; Garbarino and Johnson, 1999). According to Ganesan (1994), when consumers establish trust by observing and anticipating a company, the quality of mutual relationship improves, and the relationship can be prolonged. Erdem and Swait (2004) argued that brand trust is built in the faith that the brand will fulfill its promise in the long run, and consequently, consumers will more likely choose the brand while maintaining a long-term relationship (Doney and Cannon, 1997; Chaudhuri and Holbrook, 2001). Therefore, the following hypotheses were established.

H3: Brand trust will have a positive effect on CSM.

H3-1: Brand trust will have a positive effect on economic viability.

H3-2: Brand trust will have a positive effect on environmental soundness.

H3-3: Brand trust will have a positive effect on social responsibility.

Measurement of Variables

The variables used in this study were modified and supplemented from the questionnaires verified in previous studies to suit the purpose of this study. All measurement items were evaluated on a Five-Point Likert scale with "Strongly disagree" as 1 point, "Neutral" as 3 points, and "Strongly agree" as 5 points (See **Appendix**).

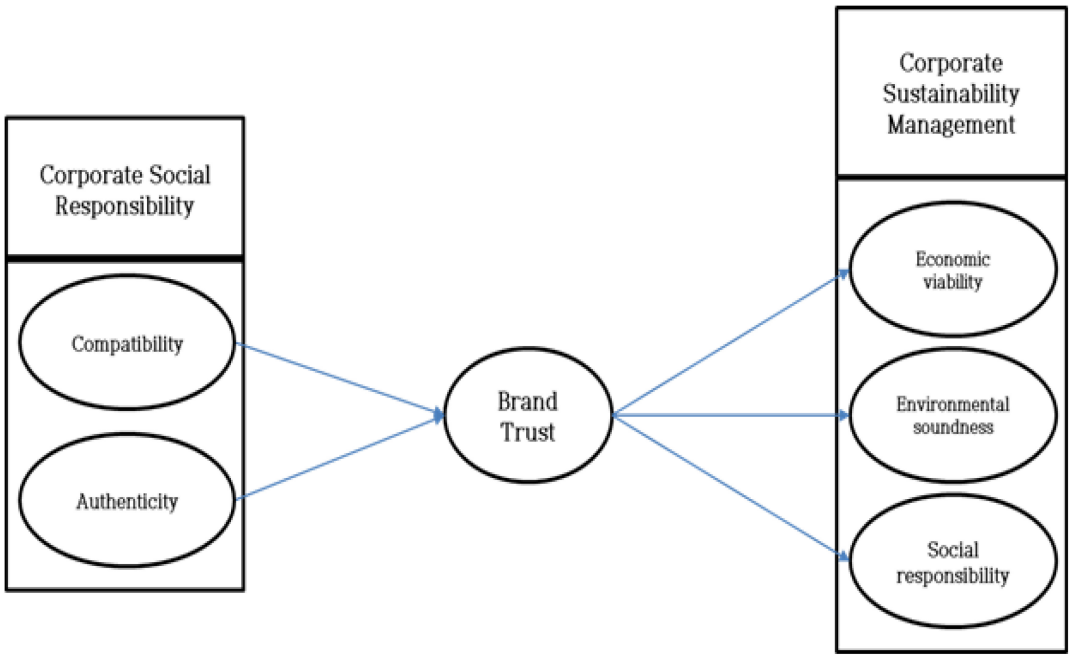

FIGURE 1 | Research model.

This study defines CSR compatibility as the degree to which consumers recognize whether there is an association between a company's characteristics, such as brand image and products, and CSR. To measure this factor, a total of three items were used based on the studies of Becker-Olsen and Hill (2006) and O'Connor and Meister (2008). CSR authenticity is defined as the extent to which consumers perceive that a company is carrying out CSR with pure intentions, and to measure this, a total of three items were established based on a study by Alhouti et al. (2016).

Brand trust is defined as the belief that a brand will fulfill the consumers' best interests for the goals or values shared by the consumers, and to measure this, a total of five questions were used based on the studies of Keller and Aaker (1992) and Mayer et al. (1995).

Corporate sustainability management is defined as the degree to which consumers perceive that a company is engaged in management activities not only for its economic outcome, but also for continuous economic and social developments. Moreover, three sub-concepts – economic viability, environmental soundness, and social responsibility – were established based on Elkington's (1997) concept of Triple Bottom Line. Economic viability is defined as the degree to which a company engages in management activities to secure economic profits and maintain them in the long run. A total of four questions were composed by referring to a study done by Amalric and Hauser (2005). Environmental soundness is defined as the degree to which a company manages the environment and produces eco-friendly products to increase the standard of lives of all members of society, and a total of four questions were composed by referring to a study done by Chen et al. (2006). Social responsibility is defined as the degree of management activities that return a portion of the profits to society, and four questions were composed based on a study by Kotler and Lee (2005).

Research Data and Analysis Method

The questionnaire consisted of three questions on CSR compatibility, three on authenticity, five on brand trust, and 12 on CSM. A preliminary questionnaire was conducted on 20 adult men and women who have used products from Amore Pacific and The Body Shop, which both carry out CSR. After that, the survey contents were revised and supplemented. Conducted on adult men and women who have used products from Amore Pacific and The Body Shop, this questionnaire was conducted for almost 3 months from March 4 to May 30, 2021. A total of 500 copies of the questionnaire were distributed, of which a total of 479 copies were used for empirical analysis, excluding 21 copies with insincere responses. These pieces of data were empirically analyzed *via* SPSS WINDOW 21.0 and AMOS 19.0 statistical analysis programs.

In this research, we conducted structural equation model analysis instead of regression analysis which had been used. Because structural equation model that confirms structural relation among multiple variables is more suitable than regression analysis that is limited to research casual relations among multiple valuables. Also, regression analysis can analyze using error of variable's multiple factor scale value, on the other hand, if measurement error occurs, structural equation model analysis's fit of model go down. Therefore, structural equation model analysis is more suitable than regression analysis to examine exactly relationship with multiple variables.

EMPIRICAL ANALYSIS

Demographic Characteristics of Respondents

The total effective sample of this study is 479 people, and the demographic characteristics of the respondents are shown in **Table 1**.

Reliability and Validity

In this study, confirmatory factor analysis was performed to examine reliability and validity. First, reliability verification was analyzed using Cronbach's α, an index that confirms the internal consistency of measurement items. As a result of the analysis, Cronbach's α of the measurement items was higher than the standard value of 0.6, so it was judged that the reliability of the measurement items of this study was secured (Anderson and Gerbing, 1988). The reliability results are shown in **Table 2**.

Second, we tried to examine the validity of the variables in this study, especially the convergent validity and discriminant validity. Convergence validity can be judged when the construct reliability (CR) value is 0.7 or higher and the average variance extracted (AVE) value is 0.5 or higher. And discriminant validity can be checked when the AVE values of the variables in this study are greater than the squared values of the correlation coefficients (Hair et al., 2005). According to the analysis result (refer to **Table 3**), both CR and AVE values of the variables were above the standard values, so it can be judged that the variable items have convergence validity. Among the variables, brand trust (0.514) with the smallest AVE value was larger than the squared value (0.190) of compatibility and authenticity (0.436) with the largest correlation value, indicating that there is no problem with discriminant validity (refer to **Tables 3**, **4**).

As a result of examining the fit indices of the measurement model according to the confirmatory factor analysis (refer to **Table 3**), it was confirmed that various suitability indices were higher than the standard value (χ^2 = 132.384, df = 136, p = 0.000, GFI = 0.913, CFI = 0.927, NFI = 0.924, RMR = 0.064, RMSEA = 0.059). The results of the confirmatory factor analysis are shown in **Table 3**.

TABLE 1 | Demographic characteristics of respondents.

	Content	Number of respondents	%
Gender	Male	225	47.0
	Female	254	53.0
Age	Under 25	77	16.1
	26–30	79	16.5
	31–35	144	30.1
	36–40	98	20.5
	Over 41	81	16.9
Marriage	Single	291	60.8
	Married	188	39.2
Education	High School Graduate	58	12.1
	Junior College Graduate	117	24.4
	University Graduate	220	45.9
	Graduate School	84	17.5
Job	Student	34	7.1
	Housewife	65	13.5
	White Collar	137	28.5
	Official	128	26.6
	Specialized work	73	15.2
	Others	42	8.7
Where to buy cosmetics	Online	114	23.8
	Department store	125	26.1
	Duty free shop	84	17.5
	Specialty store	118	24.6
	Others	38	7.9
Average monthly cosmetic usage amount	Less than 50,000 Won	65	13.6
	50,000–100,000 Won	125	26.1
	100,000–200,000 Won	154	32.2
	200,000–300,000 Won	104	21.7
	300,000 Won or more	31	6.5
Average monthly income	Less than 1 million won	27	5.6
	1–2 Million won	61	12.7
	2–3 Million won	105	21.9
	3–4 Million won	157	32.8
	4–5 Million won	91	19.0
	5 Million won or more	38	7.9
Total		479	100

Correlation Analysis

Correlation analysis was performed to confirm the problem of multi-collinearity between variables. The correlation between most variables was statistically significant at 0.01. Among the correlations between variables, the relationship between suitability and authenticity showed the highest value at the significance level of 0.01–0.436, but the correlation between other variables was 0.5 or less. Therefore, it was judged that there was no problem of multi-collinearity among the variables in this study (Hair et al., 2005). The results of the correlation analysis are shown in **Table 4**.

Hypothesis Test

The hypothesis was verified by confirming the significance of the path coefficient of the structural equation model. The suitability of this research model was examined prior to hypothesis testing, and as a result, it can be judged that the research model is suitable for hypothesis testing (χ^2 = 135.173, df = 132, p = 0.000, GFI = 0.917, CFI = 0.928, NFI = 0.926, RFI = 0.938,

TABLE 2 | Reliability analysis.

Construct		Number of first items	Number of final items	Cronbach's α
CSR	Compatibility	3	3	0.928
	Authenticity	3	3	0.887
	Brand trust	5	5	0.858
CSM	Economic viability	4	4	0.875
	Environmental soundness	4	4	0.856
	Social responsibility	4	4	0.924

TABLE 3 | Confirmation factor analysis.

	Construct	Factor	Standard estimate	*t*-Value	CR	AVE
CSR	Compatibility	CP1	0.844	–	0.876	0.526
		CP2	0.785	10.288		
		CP3	0.754	10.242		
	Authenticity	AT1	0.856	–	0.885	0.549
		AT2	0.853	10.935		
		AT3	0.797	10.386		
	Brand trust	BT1	0.847	–	0.816	0.514
		BT2	0.804	10.513		
		BT3	0.820	10.642		
		BT4	0.796	10.292		
		BT5	0.784	10.287		
CSM	Economic viability	EV1	0.842	–	0.913	0.611
		EV2	0.811	10.522		
		EV3	0.793	10.290		
		EV4	0.780	10.283		
	Environmental soundness	ES1	0.824	–	0.894	0.563
		ES2	0.803	10.512		
		ES3	0.790	10.289		
		ES4	0.742	10.225		
	Social responsibility	SR1	0.823	–	0.915	0.613
		SR2	0.815	10.524		
		SR3	0.814	10.523		
		SR4	0.785	10.288		

χ^2 = 132.384, df = 136, p = 0.000, GFI = 0.913, CFI = 0.927, NFI = 0.924, RMR = 0.064, RMSEA = 0.059.

TABLE 4 | Correlation analysis.

	CP	AT	BT	EV	ES	SR
CP	1					
AT	0.436**	1				
BT	0.223**	0.189**	1			
EV	0.308**	0.398**	0.211**	1		
ES	0.304**	0.369**	0.188**	0.307**	1	
SR	0.193**	0.301**	0.296**	0.230**	0.238**	1
Average	3.7124	3.4398	3.4497	3.5269	3.7471	3.5688
Standard Deviation	0.6708	0.7831	0.6892	0.6789	0.6833	0.6793

***p < 0.01.*

IFI = 0.909, TLI = 0.912). Hypothesis testing can generally be judged according to the criterion of *t*-value according to the significance level ($p < 0.05$: *t*-value 1.96–2.58, $p < 0.01$: *t*-value over 2.58). The hypothesis test results are shown in **Table 5**.

CONCLUSION AND DISCUSSION

The purpose of this study was to determine whether the CSR compatibility and authenticity of cosmetics companies affect CSM, which consists of economic viability, environmental soundness, and social responsibility, through brand trust. The results of the empirical analysis confirmed that the compatibility and authenticity of CSR did have a positive effect on brand trust. Additionally, brand trust was confirmed to have a positive effect on social responsibility, but not on economic viability and environmental soundness. The specifics and implications of the results of this study are as follows.

First of all, it was confirmed that CSR compatibility and authenticity of cosmetics companies have a positive effect on brand trust. This outcome indicates that consumers are very interested in the nature of CR, compatibility with corporate culture, and business purpose, and that compatibility and authenticity, which are the motivations for CSR, are significant in building brand trust. No matter how good-natured CSR is, if it does not match the company's characteristics, consumer trust will inevitably fall. Therefore, it is important to determine whether the type of CSR carried out by cosmetics companies is related to the company and plan the CSR strategies and directions. In other words, it is crucial to find issues that can represent the core competence of cosmetics companies rather than social issues, such as environmental problems and support for the poor. In addition, it is important to find the targets for CSR, which match the company's image, and clearly display the company's characteristics, drawing responses from consumers. Furthermore, cosmetics companies need a strategy that provides consumers the perception that their CSR is authentic by prioritizing the social good over individual economic benefits. Therefore, the company has to actively provide information, such as outcome and ripple effect of CSR, using corporate advertisements and communication tools so that consumers can establish trust in the company as well as the brand.

Second, brand trust was confirmed to have a positive effect on the social responsibility of CSM. This outcome shows that consumers' trust in the brand is an important factor in establishing social responsibility, a sub-factor of CSM. On the other hand, brand trust did not affect economic viability and environmental soundness, which are also both sub-factors of sustainable management. According to the result, it can also be assumed that consumers think that a company's investment in product development, quality improvement, R&D investment, and service efforts is not because consumers trust the brand, but because it is logical. In addition, if a company releases a product using a trusted brand, it is more likely to succeed than otherwise,

TABLE 5 | Hypothesis test.

	Hypothesis	Path coefficient	Standardized path coefficient	*t*-Value	*p*-Value	Result
H1-1	Compatibility → Brand trust	0.191	0.202	4.495	0.000	Accept
H1-2	Authenticity → Brand trust	0.279	0.244	5.490	0.000	Accept
H2-1	Brand trust → Economic viability	0.011	0.055	0.318	0.751	Reject
H2-2	Brand trust → Environmental soundness	0.006	0.007	0.159	0.874	Reject
H2-3	Brand trust → Social responsibility	0.154	0.175	3.893	0.000	Accept

and thus consumers might think that the company does not strive for eco-friendliness or improvements in the lives of local residents. For that reason, companies need to put in their efforts in further strengthening brand trust in order to improve CSM, which fulfills the responsibilities and obligations as members of society, as well as corporate image.

The outcomes of this study present theoretical implications that can be applied to the rapidly changing business environment. Through this study, it became clear that establishing compatible and authentic CSR as well as brand trust is essential for sustainable development. On that account, this study is significant as it confirmed that CSR activities suitable for a company do not solely spend money. Instead, they strengthen corporate and brand trust and enable a company to engage in sustainable management that helps humans and the environment.

Unlike previous studies, this study drew results on strategic planning and operation of CSM from the perspective of consumers. In other words, although CSR was mostly used as an outcome variable based on strategy, this study contributed to the development of previous studies related to CSR and CSM by deducing the results that consumer perceived CSR enhances brand trust and brand trust improves CSM. In addition, although cosmetic companies actively engage in CSR for sustainable management, research on this has been insufficient. Accordingly, this study suggested the strategic and policy direction for cosmetic companies to pursue sustainable management by examining the relationship between CSR, brand trust, and CSM.

Although this study focused on presenting significant results and implications, there are problems that need to be dealt with in the future. The limitations of this study are as follows. First, since this study targets cosmetics companies, the results cannot be applied to other companies in various industries. Hence, future studies must examine compatibility and authenticity of CSR and the factors of brand trust in various industries. Second, since this study used questionnaires reported by individuals, common method bias may have occurred in conformity with individual characteristics. Thus, the quality of research method must be improved by incorporating qualitative methods such as observation and indepth interviews. Lastly, this study only looked into the main and mediated effects. Therefore, different moderating variables that can be used for various multiple group analyses have to be considered and reapplied to this research model.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

G-YJ contributed to the derivation of ideas, practical analysis, and wrote conclusions and recommendations of the thesis. S-HL contributed to the theoretical background and hypothesis setting and data collection. Both authors contributed to the article and approved the submitted version.

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APPENDIX

APPENDIX TABLE 1 | Measurement item.

Construct		Measurement Item	Number	Measure	References
CSR	Compatibility	CSR is highly relevant to a company's business CSR is highly associated with corporate image CSR is highly relevant to target customers	3	Five-Point Likert scale	Becker-Olsen and Hill, 2006; O'Connor and Meister, 2008
	Authenticity	CSR has sincerity that it is for the public good CSR contributes society CSR truly care for social abbreviations	3	Five-Point Likert scale	Alhouti et al., 2016
Brand trust		Corporation has professional skills Corporation has the ability to develop products that meet the needs of consumers Corporation is striving for mutual benefit with consumers Corporation is trying to provide consumers with the right information Corporation is striving to accept consumer requirements correctly	5	Five-Point Likert scale	Keller and Aaker, 1992; Mayer et al., 1995
CSM	Economic viability	Corporation is striving to improve the quality of the product Corporation is working to improve sales Corporation is striving to improve profits Corporation is striving to develop core technologies to create future values	4	Five-Point Likert scale	Amalric and Hauser, 2005
	Environmental soundness	Corporation is working to improve the environment Corporation is working to protect the environment Corporation is striving to develop eco-friendly products Corporation is working hard to ensure that their products are recycled	4	Five-Point Likert scale	Chen et al., 2006
	Social responsibility	Corporation is striving to contribute to social development Corporation is actively engaged in donation activities Corporation contributes to stabilizing society Corporation is making efforts to create jobs and develop local communities	4	Five-Point Likert scale	Kotler and Lee, 2005

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Revisiting the Relationship Between the Strength of Environmental Regulation and Foreign Direct Investment

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Interest in sustainability is increasing, and research on ESG management continues. The first issue to be discussed in the present situation is the environment. The study between the environment and internationalization was conducted around two conflicting arguments. First, the pollution haven hypothesis states that multinational corporations move to countries with looser regulations depending on environmental regulation. Next is the Porter Hypothesis, which argues that well-designed environmental regulations offset the cost of compliance and ultimately help firms gain a competitive advantage through innovation that enhances performance. However, the two arguments have not yet reached a consensus conclusion. In addition, studies on the national level and studies considering the distance between countries, an important factor in international management, are lacking. This manuscript aims to revisit the relationship between the strength of environmental regulation and foreign direct investment (FDI) in the context of increasing environmental concerns. Differences between countries are an important field of international management, but research on environmental regulations is lacking. The purpose of this study is to examine the relationship between existing environmental regulations and FDI and to discuss how the distance between countries can affect existing theories.

Keywords: FDI, environmental regulation, country distance, ESG, pollution haven hypothesis, porter hypothesis, sustainability

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INTRODUCTION

An important motive for firms has always been to generate profits and maximize shareholder value. However, as the environmental and social issues emerge, the focus of governments, institutions, investors, and firms is shifting toward more 'socially responsible' behaviors of firms along with maximizing profits. This concern has garnered much attention as a way of assessing the non-financial performance of companies, such as environmental, social, and governance (ESG) issues and ethical considerations. Currently, ESG management has become an important issue. According to Morgan (2020), economic policymakers and investment decision-makers should make a wake-up call to sustainability management. The US SIF Foundation Report

found that portfolio investors consider ESG factors at a 42% higher rate than in 2018, and ESG investments are one for all assets invested in the United States. 1/3 (US SIF, 2020).

The pressure on sustainability management, which started with CSR, that firms are receiving continues. The pressure on the firm is divided into moral and strategic obligations. Moral obligations have a role in resolving social problems because a company has obligations to shareholders and external stakeholders (Freeman, 1984; Carroll, 1991; Wood, 1991), and strategic obligations can improve corporate competitiveness through sustainable management (Porter and Van der Linde, 1995; Russo and Fouts, 1997; Porter and Kramer, 2011). Studies dealing with these two obligations have received significant attention at the firm level, but studies at the country level are still lacking. Considering the growing interest in ESG worldwide and the agreement on the Sustainable Development Goals (SDGs), national-level research is necessary.

In an increasing interest in ESG management, the priority area to be discussed is the environment. Concerns about the future have led to actions demanding a better environment (Sharfman et al., 2004). The greatest challenge of the 21st century is balancing environmental degradation with economic growth (Alola, 2019). Countries made efforts to achieve the two goals of high-quality economic development and an eco-friendly ecosystem, and foreign direct investment (FDI) was emphasized to achieve the goals. Research on FDI and the environment was conducted centered around the study of the effect of the strength of environmental regulations and two theories located at both extremes. The pollution haven hypothesis (PHH) explains that countries make environmental regulations looser to attract FDI. Depending on the degree of environmental regulation, multinational corporations with pollution-intensive industries move to countries with looser regulations. Contrary to the PHH theory, the Porter Hypothesis (1991) suggests that well-designed environmental regulations offset the cost of compliance, leading to innovations that improve corporate performance (Porter and Van der Linde, 1995). It is explained that it mediates the development and adoption of green innovation to help secure a competitive advantage that affects corporate performance (Xing et al., 2019).

However, many existing studies dealing with the two theories have been discussed at the corporate level. To the best of our knowledge, few studies have addressed the inter-country distance between investment and host countries dealing with environmental regulation and FDI (Bu and Wagner, 2016). "Distance" has been used as a metaphor for differences between countries in international management (Shenkar, 2012). Research in international management mentions "distance" as a major factor impacting foreign direct investments and location choices (Beckerman, 1956; Johanson and Wiedersheim-Paul, 1975; Zaheer, 1995; Shenkar, 2001; Blomkvist and Drogendijk, 2013). Several recent IB (International Business) studies have been conducted on the relationship between country distance and FDI (Evans et al., 2000; Sousa and Bradley, 2006; Brewewer, 2007; Child et al., 2009). In other words, the purpose of this study is to examine the relationship between existing environmental regulations and FDI and to discuss how country distance can affect existing theories.

BACKGROUND AND LITERATURE REVIEW

The debate over environmental regulations and FDI attraction has been the focus of various theories (Santos and Forte, 2021). The first is that multinationals tend to invest in countries with less stringent environmental regulations because cost considerations are important when choosing a host country. This phenomenon is called the Pollution Haven Hypothesis (PHH). Therefore, they are easily attracted to developing countries where environmental regulations are perceived to be less stringent in investment location decisions (Cole et al., 2017). The second theory is the pollution halo effect. For example, if a technologically advanced multinational corporation decides to invest in an area that is less technologically advanced, it is positive if the latter helps reduce pollution, but if the company decides to move to a less regulated area and the pollution in that area is negative if it contributes to an increase in level (Cole et al., 2017). A third theory could lead to an effect known as "race to the bottom" (RTB) in which host countries seek to ease local environmental regulations to attract FDI (Cole et al., 2017). The fourth theory is the environmental Kuznets curve (EKC), which hypothesizes the relationship between economic development and the environment. The impact of FDI on the promotion of industrialization will be examined. The main content is that incomes will also increase because of economic development and wealthier population groups will demand agencies to enforce environmental regulations and ensure better quality for the environment, thus leading to reduced pollution (Zugravu-Soilita, 2017). Finally, a fifth theory is the Porter hypothesis-based mechanism in environmental regulation theory is that well-designed environmental regulations stimulate innovation that offsets regulatory compliance costs and ultimately improves firm financial performance (Porter and Van der Linde, 1995).

Although there is such extensive literature on the subject, RTB is an extension of the PHH theory, and environmental regulation is not central to the pollution halo effect. EKC focuses on the dynamics that change according to the time and the condition of the host country. In conclusion, the theories that the host country's environmental regulation focuses on are the PHH and the Porter hypothesis. This study was conducted with a focus on literature research on PHH and the Porter hypothesis.

Psychological research tends to favor familiar situations over unfamiliar situations (Powell and Ansic, 1997). International management conducted a study on the concept of distance between countries that implicitly captures these insights. And the importance of the street is represented by the sentence "International management is the management of the distance" (Zaheer et al., 2012). This article suggests that differences between home countries and host countries can create uncertainties between countries and influence their decisions in the internationalization process (Child et al., 2009). The distance between countries was defined and used in various concepts.

In this study, the distance between countries is focused on the four characteristics proposed by Ghemawat (2001) and enables a comprehensive view of the relationship between environmental regulations and FDI.

POLLUTION HAVEN HYPOTHESIS AND PORTER'S HYPOTHESIS

The pollution haven hypothesis (PHH) has been debated for decades between internationalization and environmental pollution. It is argued that trade and capital movement liberalization contribute to the transfer of polluting industries from countries with relatively strict environmental regulations to countries with less stringent regulations (Hille, 2018). For this reason, stringent regulation of environmental standards leads to new equipment requirements, landfill rules, restrictions on specific inputs and outputs, and additional production costs due to the need to find alternative methods for waste disposal. This is because investment is shifted to countries with relatively less stringent regulations (Rezza, 2015). PHH focuses on the cost-effectiveness of environmental regulations considered by enterprises. The difference in production costs is a sufficient stimulus for enterprises to relocate to production facilities. Assuming that increased production costs are sufficient reasons for firms to move, firms are usually associated with replacing certain production lines, using different equipment, or finding new methods. The primary argument of PHH is that pollution is a factor of production, and in countries with low pollution costs, producers should use the pollutant intensively (Bu and Wagner, 2016). In conclusion, PHH is a representative theory showing a negative relationship between environmental regulation and FDI, and PHH becomes a leading theory of race to the bottom.

In the face of a race to the bottom from countries with weak environmental regulations, the conditions under which firms decide to attract investment respond to differences in environmental regulations (Erdogan, 2014). Previous studies assume that all firms in the industry are equally affected by the structures of environmental regulations, and the host country's government is under tremendous pressure to be environmentally flexible (Madsen, 2009). When attracting FDI, the host country takes a strategic position through legislation and faces a dilemma. Two situations can be assumed. First, choosing public welfare as a priority will compete with a race to the top. Still, the inflow of investment in the polluting industry decreases (Erdogan, 2014), and the withdrawal of investments can hurt the national economy. In the opposite case, if the decision to attract FDI by reducing environmental regulations related to the polluting industry, multinational companies will be relocated to looser-regulated countries and accept long-term environmental destruction in exchange for short-term economic benefits while inducing a transition (Madsen, 2009).

Regarding the relationship between environmental regulation and internationalization, many studies examined, at the environmental level, the contents of environmental regulation policies and their effect on globalization *via* internationalization. Country-level (Kahouli and Omri, 2017; Mulatu, 2017; Zugravu-Soilita, 2017), industry-level (Cole and Elliott, 2005), and firm-level research (Javorcik and Wei, 2003; Dam and Scholtens, 2012) were variously studied. A study covering China's economic revival and environmental pollution relationship went ahead (Bu et al., 2013; Cai et al., 2018; Cheng et al., 2018).

Various empirical studies have been conducted to confirm PHH in internationalization. Mulatu (2017) checked the PHH through the relationship between environmental regulations and FDI in 64 investment-inducing countries for 4 years to investigate the possibility of UK-based multinational companies entering a country with loose environmental regulations. It was confirmed that multinational companies belonging to polluting industries tend to invest in countries with loose environmental regulations. Naughton (2014) analyzed the effect of home country environmental regulation on FDI, deviating from the focus of host country environmental regulation intensity, and concluded a correlation between FDI and strict environmental regulation.

Studies to identify PHH show mixed results (Cole and Elliott, 2005; Dietzenbacher and Mukhopadhyay, 2007; Tang, 2015; Zugravu-Soilita, 2017). Dietzenbacher and Mukhopadhyay (2007) showed that PHH is the result of the Heckscher-Ohlin theory through input-output analysis, and in India, the opposite was shown. However, depending on the characteristics of imported products, the PHH theory was contradictory (Cave and Blomquist, 2008).

Economic evidence from empirical studies have suggested that environmental regulation and financial performance are closely linked (Ambec et al., 2013). However, it remains controversial whether environmental regulations are an efficient mechanism to achieve sustainability and improve financial performance (López-Gamero et al., 2010; Testa et al., 2011). PHH has been recognized as a negative mechanism for firm performance and the environment regarding environmental regulations and firm performance. However, PHH shows contradictory results. Contrary to PHH theory, the Porter hypothesis-based mechanism in environmental regulation theory is that well-designed environmental regulations stimulate innovation that offsets regulatory compliance costs and ultimately improves firm financial performance (Porter and Van der Linde, 1995). To this end, the government designs and implements the "right type" of policies. Shifting environmental concerns into a competitive advantage requires establishing the correct type of regulation, which leads to processes that reduce pollution and costs or improve quality (Porter, 1991). In particular, the 'right type of regulation' is a tool that leads to new technological solutions and innovations, which in turn improves the allocation of resources.

Previous studies related to the Porter hypothesis have studied the positive relationship between corporate innovation and environmental regulation. Companies responded to the increasing intensity of environmental regulations through innovation, showing a positive relationship between environmental regulations and innovation (Lanjouw and Mody, 1996; Popp, 2006). Frondel et al. (2007) used OECD data and observed that strict environmental regulations tend to positively affect cost savings, general management systems, and specific environmental management

tools have a positive effect on clean production. Horbach et al. (2013) argued the importance of regulation as a driver of eco-innovation compared to other innovations in German and French firms in a two-country comparison. Also, studies related to the Porter hypothesis were conducted on the relationship between internationalization performance and environmental regulations. Among polluting industries, specific industries are determined by the host country's loose environmental regulations, but do not affect all industries (Xing and Kolstad, 2002).

Furthermore, countries with environmental stringency below a certain level are less attractive for investment (Kalamova and Johnstone, 2012). As environmental regulations become more assertive, it does not necessarily show negative consequences for FDI inflow (Waldkirch and Gopinath, 2008; Costantini and Mazzanti, 2012). Waldkirch and Gopinath (2008) found that less pollution-intensive industries invest more FDI in Mexico, suggesting that environmental regulations that enforce emission reductions may not necessarily harm FDI inflows. Costantini and Mazzanti (2012) showed that energy tax positively affects high-tech and low-medium-tech exports of 14 EU exporting countries and that environmental policies induce innovative performance mechanisms. Furthermore, environmental regulations can strengthen a country's comparative advantage in exports (Costantini and Crespi, 2008; Groba, 2014).

FDI can promote both races to the bottom and the top (Madsen, 2009). In the former case, firms operating in a specific country will increase their costs due to increased environmental regulations. Firms will import or relocate production plants or pollution-intensive products to foreign countries with less stringent regulations (Jaffe et al., 1995). In other words, loose environmental regulations can be a location advantage. Global competitive pressures can motivate multinationals to choose countries with relatively loose environmental regulations (Dasgupta et al., 2002). As a result, foreign investment decisions are expected to be made in countries with lax environmental standards (Kalamova and Johnstone, 2012). In the latter case, environmental regulation induces innovation, which positively affects productivity and increases profitability (Porter and Van der Linde, 1995). Multinational corporations can have high clean technology and high-quality environmental management systems due to stricter environmental regulations than the host country (Zarsky, 1999). The social and environmental responsibilities that multinational corporations receive lead to demands for corporate strategy. As a result, multinational companies in developed countries are expected to make more significant green investments than companies in developing countries, and eco-innovation is likely to occur larger than in SMEs (Blomström and Kokko, 1998; Eskeland and Harrison, 2003). Therefore, it is very likely that MNEs will develop specific environmental technology and management standards and then apply them to foreign facilities, making it relatively easy to transfer knowledge from home to foreign countries and vice versa (Dasgupta et al., 2002). In conclusion, FDI transfers innovation from an investment country to a host country and ultimately enables additional innovation (Lanjouw and Mody, 1996).

COUNTRY DISTANCE

According to Hymer (1960), the liability of foreignness is likely to prevail over foreign firms because domestic firms have the general advantage of obtaining better information about their countries, such as economy, language, law, and politics. In addition, the cost of obtaining information for foreign firms may be high, and it is a barrier to the international operation cause of discrimination by the government, consumers, and suppliers. Liability of foreignness refers to additional costs incurred when a firm operates a business abroad. Specifically, they consist of spatial distance, inexperience in the host countries' environment, discrimination in investment host countries, and expenses imposed by the host countries' environment (Zaheer, 1995).

The liability of foreignness stems from differences between countries. And differences between countries were used as a metaphor for "distance" in international management (Shenkar, 2012). Country distance is one of the most widely studied and controversial concepts related to distance in international management and marketing (Shenkar, 2001). In general, distance can be measured by an individual, a team, an organization, a country, a language group, an ethnic group, or the distance between two entities. Distance has a metaphorical meaning that refers to group differences between countries beyond simply geographic and physical (Zaheer et al., 2012). Commonalities between countries (signs of similarity) close the distance, and differences (signs of dissimilarity) make countries farther apart. That is, the commonalities of the home country and the potential host country favor entry (Williams and Grégoire, 2015).

Country distance has been described in various ways. First, psychic distance is the sum of factors that impede the flow of information between firms and markets (Johanson and Wiedersheim-Paul, 1975). Cultural differences and uncertainties degree caused by various factors that hinder the learning and operation of overseas markets (O'Grady and Lane, 1996). Since then, psychic distance has been extended to various factors that make the distance longer. Various factors identified four dimensions of Cultural, Administrative, Geographic, and Economic (CAGE) (Ghemawat, 2001), the dominant religion, business language, form of government, economic development (Boyacigiller, 1990), language, business practice, political and legal systems, education, economic development, marketing, infrastructure, and industrial structures (Evans et al., 2000).

Although FDI suggests that FDI is the preferred entry mode because it allows firms to transfer knowledge and other assets without relinquishing ownership or management, it can lead to problems and conflicts related to the liability of foreignness (Johanson and Vahlne, 2009; Berry et al., 2010). Country distances have been highlighted in various fields, including FDI-related internationalization outcomes, entry methods, market selection, internationalization processes, antecedents, determinants, coping measures, and activities in other areas (Ciszewska-Mlinarič and Trąpczyński, 2016). Blomkvist and Drogendijk (2013) found that country distance is influenced by some psychic distance stimuli, including the integrative composition of distance and differences in culture, religion, democracy, and language. Distant country distances

increase the cost of tailoring goods and services to local tastes and preferences (Miller and Eden, 2006) and the difficulty in overcoming discrimination and litigation (Hennart et al., 2002; Mezias, 2002). It has much more significant difficulties in establishing and maintaining business relationships in the host country (Slangen et al., 2011), which can negatively affect performance and influence overseas expansion decisions (Hennart et al., 2002; Flores and Aguilera, 2007). As the distance increases, it is more difficult for MNCs to acquire market knowledge, making them less competitive than the host country (Zaheer, 1995).

In this study, the distance between countries is focused on the four characteristics proposed by Ghemawat, 2001:cultural, administrative, geographic, and economic distance. First, culture is one of the most frequently cited and empirically tested factors contributing to country distance (Sousa and Bradley, 2006). Cultural distance refers to a cultural country that creates uncertainty and increases costs by limiting the flow of information and knowledge between countries and finding a negative relationship between entry into foreign markets (Berry et al., 2010).

Second, various government policies are an essential source of administrative distance (Ghemawat, 2001). The presence of corruption in the target country, a high barrier to foreign market entry (Weitzel and Berns, 2006), leads to an increase in administrative distance between countries. Countries with weak institutional systems and corruption are more likely to prefer FDI from countries with close administrative distance (Hotchkiss, 1998). Since administrative distance incurs high coordination costs, it is reasonable to assume that administrative distance will increase barriers to entry. Various studies have shown administrative factors such as language (Johanson and Vahlne, 1977), religion (Ghemawat, 2001), or legal system (Berry et al., 2010) have a strong influence on corporate strategic decisions and emphasize differences in political (Henisz, 2000) and trade relationships (Fratianni and Oh, 2009). Most studies on the effect of administrative distance on foreign market entry show a negative relationship (Berry et al., 2010; Guler and Guillén, 2010).

Third, various studies in the field of international management frequently use geographic distance to study the international activities of firms (Bevan and Estrin, 2004). Unlike the previous abstract concept, the geographic distance as a physical concept generally suffers from difficulties in business operation as the distance between two countries increases. Since it is associated with an increase in transportation and communication costs, the cost of dispatching foreign workers, and the costs associated with overcoming cultural, linguistic, and regulatory differences (Ghemawat, 2001; Berry et al., 2010).

Finally, a country's economic development has traditionally been viewed as a reflection of the country's market potential (Evans and Mavondo, 2002). However, Mitra and Golder (2002) found that the extensive economic distance between the home country and the host country prevented entry into foreign markets because consumers in countries with similar per capita GDP had similar consumption patterns and similar marketing strategies. In previous studies, the concept of economic distance represents important factors such as differences in customer preferences, differences in purchasing power, and differences in transportation and communication infrastructure. Firms are more likely to succeed by entering a country with an economic environment like their home country because, first, firms can more easily transfer their existing business models to countries with economic characteristics like their home country (Malhotra et al., 2009). Second, by entering a country that is economically like the home market, a firm can build an economy of scale, scope, and experience through the transfer of technology and knowledge from the home market to the host country's market. International experience can also be enhanced by operating in similar countries and expanding to more economically distant countries (Malhotra et al., 2009).

DISCUSSION

Summary

When globalization is accelerating, there is constant debate about sustainability management research. Among them, the environment is one of the pillars of ESG management and it has become an important issue. The pressure on sustainability management, which started with CSR, that firms are receiving continues. The pressure on the firm is divided into moral and strategic obligations. Moral obligations have a role in resolving social problems because a company has obligations to shareholders and external stakeholders (Carroll, 1991; Freeman, 1984; Wood, 1991), and strategic obligations can improve corporate competitiveness through sustainable management (Porter and Van der Linde, 1995; Russo and Fouts, 1997; Porter and Kramer, 2011). Studies dealing with these two obligations have received significant attention at the firm level, but studies at the country level are still lacking. Considering the growing interest in ESG worldwide and the agreement on the Sustainable Development Goals (SDGs), national-level research is necessary. Studies dealing with the relationship between environmental regulations and globalization performance in the environmental aspect have been approached in several ways, including various countries, entry methods, and corporate performance, but an agreed conclusion is still lacking. To the best of our knowledge, few studies have addressed the inter-country distance between investment and host countries in studies dealing with environmental regulation and FDI (Bu and Wagner, 2016). In other words, the purpose of this study is to examine the relationship between existing environmental regulations and FDI and to discuss how country distance can affect existing theories.

We propose the importance of country distance in the study of the relationship between environmental regulation and FDI. The reason is that PHH assumes that strong regulation leads to higher costs. However, starting with the Kyoto Protocol in 1997, the types and power of various pan-national regulations such as the Paris Agreement in 2015 are increasing. If the regulations are the same, the aspect that needs to be carefully considered in the entry conditions of countries is the distance between countries, which needs to be re-examined. The next important assumption in the Porter hypothesis is 'well-designed regulation.' The distance between countries has the potential as

a proxy for a well-designed and regulated variable in the host country. A well-designed regulation is that if you are considering the host country with high environmental regulations, your investment decision will depend on how far/close that country is. The increased commonalities discussed earlier makes it easier to adapt to regulations. In other words, a well-designed regulatory perspective can be thought of as the relative effect of distances between countries.

This manuscript suggested examining the effect of current environmental regulations, which concentrate on the environment, on FDI, and the effect of the relationship between environmental regulations and the country distance on FDI.

Environmental Regulation as National Competitiveness

Competitiveness equates to the ability to achieve specific outcomes, such as high living standards and economic growth, or focuses on achieving specific economic outcomes, such as job creation, exports or FDI, low wages, and stable unit labor costs. It is defined in several ways, including specific regional conditions, such as a "competitive" exchange rate to support a balanced budget or current account surplus (Delgado et al., 2012). For example, countries like Sweden show a high quality of life, and countries like China show competitiveness in driving growth through low labor costs. A new aspect of competitiveness is innovation. For example, improved products and processes arising from regulatory R&D and innovation (Testa et al., 2011), corporate reputation, and green credentials are also competitive (Poelhekke and Van der Ploeg, 2015). While previous studies have found that environmental regulation promotes innovation, the most significant conflict is the effect of environmental regulation on competitiveness (Cohen and Tubb, 2018). Early research found that environmental regulation harmed productivity (Palmer et al., 1995), but it might be reasonably assumed that environmental regulation had a positive effect on productivity (Berman and Bui, 2001; Lanoie et al., 2008).

From the perspective of national competitiveness, if environmental regulations are extensive in terms of cost, environmental competitiveness is low. However, according to Porter's hypothesis, environmental competitiveness is high. This paper shows that strict environmental regulations might have a positive relationship with FDI is contrary to the cost perspective of previous studies. Conflicting results require discussion of other aspects of environmental regulation. In addition to implementing innovation to comply with environmental regulations, countries with strict environmental regulations are likely to have high environmental technology levels, and companies with high environmental technology are likely to have standards that are difficult to match with other companies, duplication, and application of conformity assessment procedures. There is a possibility of various restrictions such as transparency in-laws and technical regulations. Companies will enter countries with high environmental regulations to take a preemptive response. Strict environmental regulations provide an opportunity to raise an ethical reputation, which can be a new asset. This paper proposes the possibility of environmental regulation as a factor of national competitiveness through previous discussions.

AUTHOR CONTRIBUTIONS

MB and NL conceived of the presented idea. MB wrote the first draft of the manuscript. YW critically revised the manuscript. All authors discussed the results and contributed to the final manuscript, and approved the final version of the manuscript.

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Environment, Social, and Governance Performance and Financial Performance With National Pension Fund Investment: Evidence From Korea

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This study attempts to examine the relationship between environment, social, and governance (ESG) management and financial performance and the role of socially responsible investment in the National Pension Fund (NPF), Korea's largest institutional investor. This study tries to provide evidence for the slack resource hypothesis by verifying whether companies with higher financial performance make more efforts to improve ESG performance. In addition, we tried to validate whether NPF is expanding its investments in corporations with high economic performance and high ESG performance. Based on our analysis, Korean companies with good financial performance actively participate in ESG. When we compared the performance between 2019 and 2020, companies with high ESG performance increased regardless of financial performance level, whereas companies with high financial performance and low ESG performance decreased. This represents that the perception and attitude of Korean companies toward ESG management are evolving. NPF has a high investment ratio for firms having a high ratio in both financial and ESG performance. NPF further invested in companies with high ESG performance, even if the financial performance is not decent. This study provides evidence that Korean companies' interest in ESG management as well as the behavior of socially responsible investment of NPF are rising.

Keywords: ESG, stewardship code, national pension fund, social performance, carbon emission reduction

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INTRODUCTION

Sustainable management is a long debating issue in business research and is currently understood in three pillars of environment, social, and governance (ESG). ESG is a movement that underscores to maximize corporate financial performance (CFP) and non-financial values including "green practices," "social and ethical values," and "improvement of corporate governance" simultaneously.

There have been many attempts to create social values from corporate management even before ESG management was introduced (Bowen, 1953; Friedman, 1970; Carroll, 1991; Kaplan and Norton, 1992; Preston and O'Bannon, 1997; Waddock and Graves, 1997). The international

community tried to enhance social value by suggesting "ISO 26000," "the Paris climate agreement," "RE100," and "the EU carbon border tax." As corporate social responsibility (CSR) becomes important, the role of a corporate citizen to fulfill economic, legal, ethical, and philanthropic responsibilities has also been emphasized (Carroll, 1991).

At present, ESG management becomes more critical than the concept of CSR and encompasses not only social (S) area but also environmental (E) and governance (G) aspects. A company can obtain support from various stakeholders including shareholders and the market by adopting ESG management. The concept of ESG is broader than CSR, and ESG faces stronger regulations. Apple, for example, declared its plan to achieve 100% carbon neutralization in its supply chains and products by 2030, and BlackRock, the world's largest asset manager from the United States, announced that it would not invest in companies with the sales from thermal power production such as coal (BlackRock, 2020). Additionally, ExxonMobil, the largest US energy company, was excluded from the Dow Jones industrial average.

In Korea, the interest in ESG management is also growing. ESG management is strongly required in Korean companies, especially those operating in global value chains. Within the global value chain, companies must respond to ESG-related requirements in international business environments. The Korean government has started the carbon emission trading market and RE100. Korea Stock Exchange and Financial Transactions Commission have provided ESG-related information such as ESG index, ESG statistics, and domestic/foreign guidelines in the ESG portals (Korea Exchange, 2021; esg.krx.co.kr) since December 2021.

There have been numerous studies to examine how ESG affects CFP. Many studies investigated the relationship between CSR and CFP. Academic papers reporting a positive relationship seem to be dominant (Friede et al., 2015; Sohn, 2016), yet some papers also show a negative relationship (Brammer et al., 2006; Hoepner and McMillan, 2009; Christophe and Viviani, 2015). Slack resource hypothesis can offer the supporting logic for the positive relationship. The relationship between CSR and CFP needs to be further investigated.

Environment, social, and governance requires firms to move from shareholder orientation to stakeholder capitalism and to create social values through various efforts such as reducing greenhouse gas emission, tackling global warming in environmental issues, decreasing racial, or gender discrimination, preventing labor exploitation in social issues, and solving accounting fraud and managerial moral hazard in governance issues. At this point, an inquiry arises to us—what is the aim of ESG? ESG management does not replace shareholder orientation with stakeholder capitalism. The core value pursued by ESG is to maximize not only the financial worth of a company but also the social value made by it. ESG management is consistent with the stakeholder theory of Freeman (1984) and the BSC philosophy of Kaplan and Norton (1992), the slack resource hypothesis of Preston and O'Bannon (1997) and Waddock and Graves (1997). In stakeholder theory and BSC philosophy, it is argued that the enhancement of non-financial performance measures will lead to an increase in economic performance. In the slack resource hypothesis, firms with higher financial performance have more available resources, and they can conduct ESG management more actively to create more social values. The aim of ESG, therefore, should establish the concept of the coexistence of shareholder orientation and stakeholder capitalism. There are many studies that investigated the causal relationship between CSP and CFP, but the question to examine whether social performance is decent in companies with excellent CFP or *vice versa* remains largely unexplored. This study, from the viewpoint of the slack resource hypothesis, aims to investigate if Korean companies with high financial performance tend to show high social performance measured by ESG standards.

In contrast, the role of institutional investors in socially responsible investment becomes significant as the interest in ESG rises. The stewardship code is a part of the UK company law and is a voluntary guideline to actively encourage institutional investors to exercise their voting rights. Korean National Pension Fund (NPF) also began to operate the fund based on socially responsible criteria through the revision of the National Pension Act in January 2015. The legal basis for the fund investment is newly prepared by considering ESG factors.[1] NPF is the world's third-largest pension fund with a reserve of KWD 930 trillion (US$84.5 billion) as of 2021. NPF is investing 5% or more shareholding in over 300 companies in the Korean stock market in 2021 (National Pension Fund, 2021). After adopting the stewardship code, NPF exercised shareholder rights actively and considered ESG factors in its investment decision.

As the role of institutional investors in the financial market becomes more important, studies have been conducted that the activism of institutional investors can provide benefits to shareholders (Gillan and Starks, 2000, 2007; Becht et al., 2008; Buchanan et al., 2012; Farooqi et al., 2017; Brav et al., 2018; Routledge, 2020). A general argument in this field is that the activism of institutional investors can provide benefits to shareholders (Becht et al., 2008; Buchanan et al., 2012; Brav et al., 2018). However, there is also opposite evidence to the contrary (Gillan and Starks, 2007; Farooqi et al., 2017; Routledge, 2020). In Korea, NPF declared its investment direction with regard to corporate ESG activities. But there has been less attention to examine whether NPF is strengthening its activism of institutional investors since they adopted the National Pension Fund Responsible Investment Promotion Plan in 2019. This study intends to investigate if NPF, which adopted stewardship code, invests more in corporations with higher social performance measured by ESG standards and whether this NPF's

[1]A provision for responsible investment was added in the fund management guidelines in 2016. NPS laid the groundwork for exercising shareholder rights by enacting and revising the Principles on Trusteeship Responsibility (Stewardship Code) and related guidelines in 2018, and NPF has tried to raise the shareholder value of investment companies through the adoption of the Stewardship Code. NPF adopted National Pension Fund Responsible Investment Promotion Plan in 2019 and added "sustainability" in addition to "profitability," "stability," "publicity," "liquidity," and "operational independence." Since then, NPF decided to consider not only financial components but also environmental (E), social (S), and governance (G) factors.

behavior in ESG investment can show how socially responsible investment is applied in Korea.

The remainder of the study is structured as follows. In the "Theory and Hypotheses" section, we reviewed the literature relevant to our study and developed our hypotheses. The "Methodology" section describes the sample and data. The "Empirical Results" section depicts the research design and explains the results, and the "Conclusion" section offers discussion and conclusion.

THEORY AND HYPOTHESES

Environment, Social, and Governance Performance and Financial Performance

The aim of ESG management is to remove the dark side caused by achieving the economic prosperity of the current human society and make the human community sustainable for a long time. ESG management performs this function in the pillars of ESG in addition to maximizing a company's financial performance. There have been attempts to create social value related to ESG even before the ESG concept was introduced. CSR was first mentioned by Bowen (1953) when he defined it as "the duty of entrepreneurs to formulate desirable policies, make decisions, and pursue actions in light of the values and objectives pursued by our society." Since then, Friedman (1970) and Carroll (1979) tried to define it, and especially Carroll (1991) emphasized the role of a corporate citizen by dividing CSR into four areas, namely, economic responsibility, legal responsibility, ethical responsibility, and philanthropic responsibility.

The international community has recently proposed the Paris climate agreement, RE100, and EU carbon border tax. Global companies started green management to reduce the carbon emission amount and investment institutions such as Blackrock stressed responsible investment.

Recently, ESG-related information disclosure standards were enacted by the Sustainability Accounting Standards Board (SASB) in the United States and the Sustainability Standards Board (SSB) from International Financial Reporting Standards (IFRS) Foundation. Korea followed these trends, and Korea Stock Exchange made it mandatory for listed companies with total assets of over KWD 2 trillion won (US$1.8 billion) to disclose their governance structure in 2019. Additionally, the Ministry of Trade, Industry, and Energy established the K-ESG guidelines in 2021. The Financial Transactions Commission and Korea Stock Exchange provide ESG-related information, such as ESG grades of listed companies, ESG investment product statistics, as well as domestic and foreign guidelines from the ESG portal (esg.krx.co.kr) since December 2021. Along with the efforts of the Korean government, listed companies in Korea are expanding ESG management.

Numerous studies were conducted to examine how the corporate efforts in the areas of ESG affect CFP. The recent papers investigated the relationship between ESG management and CFP. For example, Friede et al. (2015) performed a meta-analysis of 2,200 prior studies about the relationship between ESG and CFP and reported that 48% of the overall sample concluded positive results in the relationship. Sohn (2016) also reported that the relationship between financial characteristics and economic performance of companies that perform CSR in Korean society is positive. However, other studies reported negative, neutral, or mixed relationships (Vance, 1975; Aupperle et al., 1985; Griffin and Mahon, 1997; Wright and Ferris, 1997; Rowley and Berman, 2000; van Beurden and Gössling, 2008; Hoepner and McMillan, 2009; Christophe and Viviani, 2015; Friede et al., 2015; Kwak et al., 2022). Multiple early outcomes about how CSR affects CFP proved a negative relationship (Vance, 1975; Wright and Ferris, 1997). As an early argument, Friedman (1970) asserted that the maximization of shareholders' profit is the only social responsibility of the corporates. Friede et al. (2015) also reported that 11% of the sample showed the impact of ESG on CFP to be negative, 23% to be neutral, and 18% to be mixed. Kwak et al. (2022) analyzed the sensitivity between fund flow and the performance of Korean funds and whether there would be a difference in the sensitivity between ESG funds and non-ESG funds. The analysis revealed that they had a negative (-) correlation, and the ESG did not influence fund flow. They concluded that investors in Korean ESG funds focused more on non-financial properties rather than on profit. It is recognized that results from the past studies are mixed, and further analysis is still needed.

The most debated question is whether active ESG management of a firm improves its financial performance, or companies with high financial outcomes tend to actively carry out ESG management. There are two opposing arguments for the discussion of the relationship between financial performance and ESG performance. One argument from neoliberalism economists including Friedman (1970) is based on the agency theory. They argued that the management should not engage in actions that undermine shareholder value because the efforts to improve social performance make companies spend corporate resources and undermine short-term corporate value. The other argument, however, is that socially responsible behavior may have a positive effect on corporate financial performance (Friede et al., 2015). This is based on the stakeholder theory started by Freeman (1984) and the slack resource hypothesis asserted by Preston and O'Bannon (1997) and Waddock and Graves (1997). In this dispute, a company with good financial performance is able to increase its activities to enhance social value because it has more available resources.

The ESG management is consistent with the stakeholder theory of Freeman (1984) and the BSC philosophy of Kaplan and Norton (1992), the slack resource hypothesis of Preston and O'Bannon (1997) and Waddock and Graves (1997). So, the core value pursued by ESG should emerge maximizing not only the financial performance of a company but also the social value contrived by it. There have been countless studies to investigate the causal relationship between CSP and CFP, but the question to answer whether social performance is decent in companies with excellent CFP or *vice versa* remains mainly uncharted.

This study, therefore, aimed to examine whether companies with high financial performance make more efforts to improve social performance measured by ESG standards than those with

lower financial performance. This assumption is based on the slack resource hypothesis. The first hypothesis is as follows:

Hypothesis 1: *Korean company with good financial performance has respectable ESG performance.*

Environment, Social, and Governance-Related Investment of National Pension Fund

The stewardship code was established by the UK Financial Reporting Council in 2010 based on The UK Corporate Governance Code and the ISC Code as part of the UK's efforts to overcome the financial crisis that occurred in 2008. It is not to regulate companies to improve corporate governance but rather to focus on socially responsible behaviors of institutional investors. The reason is that the financial crisis occurred because institutional investors did not make appropriate investments in firms.

In Korea, NPF was established in 1986 with the vision of contributing to a stable and happy life for people through sustainable pension and welfare services. It also adopted the stewardship code in 2016 to play an important role in corporate governance as an institutional investor. Specifically, NPF prepared a legal basis for accountable investment so that ESG factors are considered for an investment decision. The fund is operated based on the revised National Pension Act in 2015, and the principles of responsible investment were added to the fund management guidelines in 2016. NPF revised Principles on Trusteeship Responsibility (Stewardship Code), which includes the guidelines to exercise shareholder rights, and prepared implementation plans for fiduciary responsibility activities in 2019. NPF added sustainability to the five fund management principles (i.e., profitability, stability, publicity, liquidity, and operational independence) of the NPF's management guidelines by launching a plan to promote responsible investment in 2019. These efforts have become the basis for NPF and responsible investment, and the exercise of shareholder rights can be continuously promoted (National Pension Fund, 2019).

As the role of institutional investors in the financial market becomes more important, the role of institutional investors in corporate governance is becoming significant from the passive role (Gillan and Starks, 2000). Many prior studies tried to investigate the effective governance role of institutional investors. The general argument is that institutional investor activism can provide benefits to shareholders (Becht et al., 2008; Buchanan et al., 2012; Brav et al., 2018), but there is also opposite evidence (Gillan and Starks, 2007; Farooqi et al., 2017; Routledge, 2020). For example, Mehrani et al. (2017) divided institutional investors into active institutional investors and passive institutional investors, and they reported that active institutional investors had a positive effect on earning quality, but passive institutional investors did not. Routledge (2020) also stated that when internal corporate governance does not properly play its role, responsible investment by institutional investors can serve as an effective external governance structure. However, Gillan and Starks (2007) insisted that institutional investor activism lowers corporate value by hindering managers from pursuing long-term goals. Farooqi et al. (2017) also classified institutional investors into active and passive ones, and after analyzing the effect on corporate credit grade, they reported that the more the passive institutional investors, the higher the corporate credit score.

Some Korean literature analyzed NPF as an institutional investor. Kim et al. (2015) investigated the accounting characteristics of companies in which NPF acquired over 5% of shareholding from 2010 to 2013. It was shown that companies in which NPF acquired a large number of shares had higher performance in profitability [ROA and return on equity (ROE)] and growth (net profit growth rate). NPF prefers stocks with a high price-earning ratio (PER). This is evidence supporting that NPF invests more in companies with excellent profitability, growth potential, and stock price return. Meanwhile, Kim and An (2018) studied the relationship between the percentage of shareholding of NPF and CSR activities. They found that there was a positive relationship between the ownership ratio of NPF and CSR activities. Firms in which NPF holds over 5% shares for 3 years are more progressive in CSR activities. This may be evidence that NPF is playing a successful monitoring role as an institutional investor.

Unlike CSR, ESG is stressed by investors. Investors utilize a company's ESG scores for their investment decision.[2] To achieve ESG-related investment, institutional investors should reduce a negative externality caused by market imperfections and management activities. Institutional investors must enhance profitability in the long-term perspective. It is necessary to reduce market imperfections and an externality from management activities (Richardson, 2007). In Korea, NPF declared its investment strategy with regard to the ESG activities of firms. However, less attention has been paid to examine if NPF is strengthening its activism of institutional investors ever since they adopted National Pension Fund Responsible Investment Promotion Plan in 2019. This study, therefore, tries to examine whether NPF, which has implemented the stewardship code to protect the wealth of the investors in the fund, invests in companies with higher social performance and higher financial performance. Additionally, this study aims to provide evidence on how socially responsible investment has prevailed in Korea. The second hypothesis is as follows:

Hypothesis 2: *A company with higher financial and ESG performance will have a larger percentage of shareholding by Korean NPF.*

METHODOLOGY

Data Collection

The variables in this study are financial performance, ESG management index, and ownership rate of NPF. Financial

[2]According to the result of the survey conducted by Morgan Stanley (2019), most asset managers (79%) surveyed were putting financial considerations at the fore front of their sustainable investing strategies. Additionally, 82% suggested that strong ESG practices can lead to higher profitability, and those companies with such practices may be better in the long-term investments.

performance represents the economic position in a specific period of a company from financial statements. Although various existing indicators show financial performance, this study selects the ROE as a proxy,[3] which shows how much profit the invested equity capital has generated. ESG management index refers to the degree to which a company performs desirable activities in terms of ESG. There are diverse ESG indices both domestically and globally that measure the level of ESG management, and all these indices have pros and cons. This study uses the ESG score published by Korea Corporate Governance Service (KCGS). KCGS evaluates ESG management by seven grades (i.e., S, A+, A, B+, B, C, and D). NPF discloses the ownership rate of the invested firm. This study utilizes the percentage of shareholding revealed by NPF.

Sample Selection

We obtained ESG data from the KCGS's ESG index for 2019 and 2020. NPF adopted the stewardship code in 2018. It began to exercise shareholder rights for the purpose of preventing agency problems by large shareholders. In 2019, NPF adopted a plan to promote responsible investment, and since then, NPF considers ESG factors for the investment decision to play the governance role as the Korea's largest institutional investor. The purpose of this study was to inspect the relationship among financial performance, ESG performance, and ownership rate of NPF for Korean companies for the period 2019 and 2020. This analysis is valuable because ESG investment started to be emphasized during the study period of this research in Korea. Financial data of the companies were attracted from Fn-guide, and the ownership rate of NPF was collected from NPF disclosure on its website. The sample was collected as shown in **Table 1**.

We collected ESG data for 1,968 companies from the KCGS's ESG index reported for 2019 and 2020. Fifty-five companies were excluded because some scores were omitted. Eleven companies were removed because they had the impairment of the capital or did not have the financial performance data in Fn-guide. The final sample was 902 firms in 2019 and 945 firms in 2020. The total number of the sample is 1,847 company years. The industries in our sample are presented in **Table 2**, which is based on the Korean standard industry classification used on Korea Stock Exchange.

Panel (A) shows the distribution of the sample by industry. The manufacturing industry accounted for 60.2%, which is the highest proportion, followed by the service industry, distribution industry, and information and communication industry. In panel (B), among the manufacturing industries, the portion of the subindustries is presented. Chemicals (226, 20.3%), electrical and electronic (156, 14.0%), pharmaceuticals (137, 12.3%), machinery (115, 10.3%), and transportation equipment (112, 10.1%) account for relatively high portions. The distribution of the sample according to the ESG grades by each year for 1,847 samples is shown in **Table 3**.

Panel (A) shows the distribution of the ESG index. In 2019, 253 companies with B + or higher grades were 28.1%, and 649 (71.9%) companies have B or lower grades. In 2020, 349 (36.9%) and 597 (63.1%) were classified respectively. Panel (B) presents the individual scores of ESG for companies with an ESG index of B + or higher. Interestingly, some companies with an ESG index of B + or higher have low scores in each area of ESG. Especially, the scores in E are relatively low. In 2019, 103 (40.7%) from 253 companies did not obtain high scores in E, and in 2020, 106 (30.4%) from 349 companies are in the same case. In Korea, the Green New Deal policy was only introduced in 2020 and during the years 2019 and 2020, and Korean firms' performance in E was relatively poor compared with their performance in S or G.

EMPIRICAL RESULTS

Results of Hypothesis 1

In hypothesis 1, we examined whether Korean companies with high financial performance have high ESG performance at the same time. The criteria for judging high or low ROE was referred to Fiegenbaum (1990) and Min and Kim (2019). The two groups were classified based on the median ROE. If the ROE was above the 60th percentile, it was classified as a company with good financial performance, and if it fell below the 40th percentile, it was classified as a company with bad financial performance. ESG performance was grouped based on the ESG index developed by KCGS. If the index is above or equal to B+, the company was considered to have decent ESG performance. We could create a 2 × 2 matrix based on ROE and ESG index as shown in **Figure 1**.

To test hypothesis 1, we used the chi-square test and difference test of population ratio. Independence verification was tested

[3] In this study, we selected ROE as a proxy of financial performance because ROE can show management efficiency of capital as it measures owner's equity only excluding debt. We, of course, could choose ROA instead of ROE. In that case, we should consider that the weighted average cost of capital may be lowered due to the tax reduction effect, and thus, the enterprise value may increase. We also should acknowledge that rise in the debt-to-equity ratio may advance the risk of bankruptcy and diminish the corporate value. In addition, above all, society cannot require companies to implement ESG activities using debt. Therefore, we suggested that ROE is a more suitable indicator to exam the effects of ESG activities on CFP.

TABLE 1 | Sample selection.

	2019		2020		Total
	Remove	*N*	Remove	*N*	*N*
1. ESG grade of KCGS from ESG portal	–	963	–	1,005	1,968
2. Companies without ESG sub-grades	55	908	55	950	1,858
3. Companies not included in Fn-guide, and companies in capital impairment	6	902	5	945	1,847
4. Total		902		945	1,847

TABLE 2 | Distribution of sample by industry.

(A) Distribution in the entire sample

Industry	*N*	%
Agriculture, fishing, mining	10	0.5
Manufacturing	1,112	60.2
Distribution	136	7.4
Construction	59	3.2
Transportation, warehousing	50	2.7
Information and communication	131	7.1
Financial insurance	121	6.6
Service	228	12.3
Total	1,847	100.0

(B) Distribution in manufacturing industry

Industry	*N*	%
Food and beverage	83	7.5
Textile and clothing	47	4.2
Paper and wood	40	3.6
Chemistry	226	20.3
Pharmaceuticals	137	12.3
Non-metallic minerals	52	4.7
Steel metal	96	8.6
Machinery	115	10.3
Electrical and electronic	156	14.0
Medical	18	1.6
Transportation equipment	112	10.1
Other manufacturing	30	2.7
Total	1,112	100.0

TABLE 3 | Environment, social, and governance (ESG) performance.

(A) Distribution by ESG grade

2019	**S**	**A +**	**A**	**B +**	**B**	**C**	**D**	**Total**
	0	14	92	147	319	303	27	902
		253 (28.1%)				649 (71.9%)		
2020	**S**	**A +**	**A**	**B +**	**B**	**C**	**D**	**Total**
	0	14	179	156	280	296	20	945
		349 (36.9%)				597 (63.1%)		

(B) E, S, G distribution for samples with ESG grade B + or higher

2019	**E**				**S**				**G**			
	E > B +	**B**	**C**	**D**	**S > B +**	**B**	**C**	**D**	**G > B +**	**B**	**C**	**D**
	150	73	22	8	226	27	0	0	230	23	0	0
	59.3%		40.7%		89.3%		10.7%		90.9%		9.1%	
	253 (100.0%)				253 (100.0%)				253 (100.0%)			
2020	**E**				**S**				**G**			
	E > B +	**B**	**C**	**D**	**S > B +**	**B**	**C**	**D**	**G > B +**	**B**	**C**	**D**
	243	79	22	5	328	20	0	1	334	15	0	0
	69.6%		30.4%		94.0%		6.0%		95.7%		4.3%	
	349 (100.0%)				349 (100.0%)				349 (100.0%)			

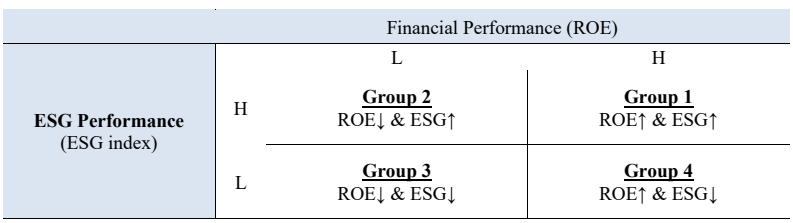

FIGURE 1 | Group classification by financial performance [return on equity (ROE)] and environment, social, and governance (ESG) performance.

to examine the significance of the difference in the frequency of high and low ESG performances and high and low financial performances (ROE). Then, if the group 1 (G1) has a higher frequency than the group 2 (G2), the result of the difference test of population ratio is statistically significant (G1 > G2), or the group 4 (G4) has a lower frequency than the group 3 (G3), and it is statistically significant (G4 < G3), it is supported that a firm with good financial performance actively conducts ESG management.

The results of the chi-square test and the difference test of population ratio for all industries in this study are presented in **Table 4**.

Panel (A) shows the distribution of the ROE level for all industries. For the 2019 sample, the median of ROE_{19} is 4.35, companies above the 60th percentile ($ROE_{19} \geq 5.83$) were classified as having decent financial performance, and companies below the 40th percentile ($ROE_{19} \leq 2.23$) were classified as having poor financial performance. Notably, 181 from 902 companies were eliminated and 721 companies remained. Among them, 352 (48.8%) firms have good financial performance, and 369 (51.2%) firms have bad financial performance. From the sample of the year 2020, 385 companies (50.8%) were grouped as having respectable financial performance and 373 companies (49.2%) having unsatisfactory financial performance. In total, 737 (49.8%) companies with good financial performance and 742 (50.2%) companies with bad financial performance were included in the year-pooled data of this study. With a sample of 1,479 firm-year, we tested hypothesis 1.

The results of the chi-square test for the four groups are presented in panel (B). Among 737 companies with decent financial performance, 271 companies with good ESG performance and 466 companies with bad ESG performance exist. Among 742 companies with poor financial performance, 184 companies with good ESG performance and 558 companies with bad ESG performance were found. From the chi-square test for the four groups above, the statistics of Pearson chi-square was 24.884, and the *p*-value was 0.01, which means that the null hypothesis is rejected. There is a statistically significant difference between the high and low levels of financial performance (ROE) and ESG performance. Panel (C) shows the result of the difference test of parent ratios for distribution of a 2 × 2 matrix produced by financial performance and ESG performance. Among the 455 companies with good ESG performance, companies with good financial performance (G1) were 271 (18.3%), and companies with bad financial performance (G2) were 184 (12.4%). Additionally, it was statistically significant with a *Z*-value of 4.078 and a *p*-value of 0.01. Among 1,024 companies with bad ESG performance, companies with bad financial performance (G3) were 558 (37.7%), companies with good financial performance (G4) were 466 (31.5%), and the difference is also statistically significant.

In summary, the frequency of companies with respectable financial performance (ROE) and ESG performance is greater than those with indecent ROE and good ESG (G1 > G2). The frequency of companies with good ROE but with bad ESG was smaller than those with bad ROE and bad ESG (G4 < G3). We conclude that hypothesis 1 in our study is supported. To control the differences by industries, we analyzed it again for the

TABLE 4 | Chi-square test and difference of population ratio test for all industries.

(A) Sample distribution by ROE level

	60th Percentile	40th Percentile	Total	Median (ROE_{19} = 4.35)		Total
2019	$ROE_{19} \geq 5.83$	$ROE_{19} \leq 2.23$		$ROE_{19} \geq 4.35$	$ROE_{19} < 4.35$	
	352 (48.8%)	369 (51.2%)	721	442 (49.0%)	460 (51.0%)	902
	60th Percentile	40th Percentile	Total	Median (ROE_{20} = 4.08)		Total
2020	$ROE_{20} \geq 6.03$	$ROE_{20} \leq 2.39$		$ROE_{20} \geq 4.08$	$ROE_{20} < 4.08$	
	385 (50.8%)	373 (49.2%)	758	480 (50.6%)	465 (49.4%)	948
Year Pooled	Good FP	Bad FP	Total			1,847
	737 (49.8%)	742 (50.2%)	1,479			

(B) Chi-square test for four groups made by ROE and ESG index

Classification	Bad FP ($ROE_{19} \leq 2.23$, $ROE_{20} \leq 2.39$)	Good FP ($ROE_{19} \geq 5.83$, $ROE_{20} \geq 6.03$)	Total
Good EP(ESG ≥ B +)	G2 184 (12.4%)	G1 271 (18.3%)	455 (30.8%)
Bad EP(ESG ≤ B)	G3 558 (37.7%)	G4 466 (31.5%)	1,024 (69.2%)
Total	742 (50.2%)	737 (49.8%)	1,479 (100.0%)
Chi-square test	Degree	Pearson Chi-Square	*p*-value
	1	24.884	0.01

(C) Financial performance by ESG performance (ESG) - difference of population ratio test

Good EP (ESG ≥ B +)		**Bad EP (ESG ≤ B)**	
Good FP	**Bad FP**	**Good FP**	**Bad FP**
G1	G2	G4	G3
271 (18.3%)	184 (12.4%)	466 (31.5%)	558 (37.7%)
Difference of population ratio test (H_0: p_1-p_2 = 0)		Difference of population ratio test (H_0: p_1-p_2 = 0)	
Z = 4.078		*Z* = 2.875	
Two-tail test *p*-value < 0.01		Two-tail test *p*-value < 0.01	

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓, FP, financial performance; SP, ESG performance.

TABLE 5 | Chi-square test and difference of population ratio test for the manufacturing industry.

(A) Sample distribution by ROE level

	60th Percentile	40th Percentile	Total	Median (ROE_{19} = 3.28)		Total
2019	$ROE_{19} \geq 5.10$	$ROE_{19} \leq 1.77$		$ROE_{19} \geq 3.28$	$ROE_{19} < 3.28$	
	207 (48.1%)	223 (51.9%)	430	262 (48.5%)	278 (51.5%)	540
	60th Percentile	40th Percentile	Total	Median (ROE_{20} = 3.64)		Total
2020	$ROE_{20} \geq 5.13$	$ROE_{20} \leq 2.04$		$ROE_{20} \geq 3.64$	$ROE_{20} < 3.64$	
	237 (51.4%)	224 (48.6%)	461	293 (51.2%)	279 (48.8%)	572
Year Pooled	Good FP	Bad FP	Total			1,112
	444 (49.8%)	447 (50.2%)	891			

(B) Chi-square test for four groups made by ROE and ESG index

Classification	Bad FP $ROE_{19} \leq 1.77$, $ROE_{20} \leq 2.04$	Good FP $ROE_{19} \geq 5.10$, $ROE_{20} \geq 5.13$	Total
Good SP (ESG ≥ B +)	G2 105 (11.8%)	G1 144 (16.2%)	249 (27.9%)
Bad SP (ESG ≤ B)	G3 342 (38.4%)	G4 300 (33.7%)	642 (72.1%)
Total	444 (49.8%)	447 (50.2%)	891 (100.0%)
Chi-square test	Degree 1	Pearson Chi-Square 8.846	*p*-value 0.01

(C) Financial performance by ESG performance - difference of population ratio test

Good SP (ESG ≥ B +)		**Bad SP (ESG ≤ B)**	
Good FP	**Bad FP**	**Good FP**	**Bad FP**
G1	G2	G4	G3
144 (16.2%)	105 (11.8%)	300 (33.7%)	342 (38.4%)
Difference of population ratio test (H_0: p_1-p_2 = 0)		Difference of population ratio test (H_0: p_1-p_2 = 0)	
Z = 2.471		Z = 1.657	
Two-tail test p-value < 0.01		Two-tail test p-value < 0.05	

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓, FP, financial performance; EP, ESG performance.

only manufacturing industry, which accounted for 60.2% of the sample.[4] The result is shown in **Table 5**.

The distribution of the ROE level in the manufacturing industry is presented in panel (A). Two groups were made by the criteria of above the 60th percentile of ROE and below the 40th percentile. Notably, 444 companies (49.8%) have good financial performance, and 447 companies have poor financial performance. Of 1,112 companies, 221 were removed, and the remaining 891 companies were tested.

The results of the chi-square test for four groups are given in panel (B). From the chi-square test, the statistic of Pearson chi-square was 8.846, and the *p*-value was 0.01, so the null hypothesis was rejected. This represents that there is a difference between the high and low levels of financial performance (ROE) and social performance (ESG). The difference test of parent ratios for the distribution of financial performance and ESG performance is summarized in panel (C). Among the 249 companies with good ESG performance, companies with good financial performance (G1) are 144 (16.2%), and companies with bad financial performance (G2) are 105 (11.8%). The difference is statistically significant with a *Z*-value of 2.471 and a *p*-value of 0.01. Among 649 companies with bad ESG performance, the number of companies with bad financial performance (G3) is 342 (38.4%), companies with good financial performance (G4) are 300 (33.7%), and the difference is also statistically significant. The analysis of the manufacturing industry showed that ESG management is active in companies with excellent financial performance like the results from all industries.

Then, we tested the relationship between financial performance and the performance in each area of ESG, E, S, and G the using chi-square test and difference test of population ratio. The results for the difference in the population ratio are summarized in **Table 6**.

Panel (A) shows the result of the analysis for all industries, and Panel (B) shows the result for the only manufacturing industry. First, the analysis for the performance in E among ESG is shown in panel (A)-1 and panel (B)-1, respectively. As a result, G1 has a greater frequency than G2, and G4 has a lower frequency than G3. Then, the analysis of the performance in social and governance areas is found in panels (A)-2 and (B)-2 and in panels (A)-3 and (B)-3. All results are similar to those from the previous analysis, where the total ESG score is considered.

[4]In addition, this study solely analyzed the manufacturing industry which has large samples. We, unfortunately, could not analyze our hypotheses for other industries due to their small sample size. It will be a future research opportunity.

TABLE 6 | Difference of population ratio test for ESG and financial performance.

(A) All industries				**(B) Manufacturing industry**			
(A)-1 ESG (E)				**(B)-1 ESG (E)**			
ESG(E) Good (ESG ≥ B +)		**ESG(E) Bad (ESG ≤ B)**		**ESG(E) Good (ESG ≥ B +)**		**ESG(E) Bad (ESG ≤ B)**	
Good FP	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**
G1	G2	G4	G3	G1	G2	G4	G3
185 (12.5%)	134 (18.1%)	552 (37.3%)	608 (41.1%)	111 (12.5%)	91 (10.2%)	333 (37.4%)	356 (40.0%)
Z = 2.855		Z = 1.645		Z = 1.407		Z = 0.876	
Two-tail, p-value < 0.01		Two-tail, p-value < 0.05		Two-tail, p-value < 0.10		Two-tail, p-value < 0.10	
(A)-2 ESG (S)				**(B)-2 ESG (S)**			
ESG(S) Good (ESG ≥ B +)		**ESG(S) Bad (ESG ≤ B)**		**ESG(S) Good (ESG ≥ B +)**		**ESG(S) Bad (ESG ≤ B)**	
Good FP	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**
G1	G2	G4	G3	G1	G2	G4	G3
344 (23.3%)	231 (15.6%)	393 (26.6%)	511 (34.6%)	176 (19.8%)	122 (13.7%)	268 (30.1%)	325 (36.5%)
Z = 4.712		Z = 3.924		Z = 3.128		Z = 2.341	
Two-tail, p-value < 0.01		Two-tail, p-value < 0.01		Two-tail, p-value < 0.01		Two-tail, p-value < 0.01	
(A)-3 ESG (G)				**(B)-3 ESG (G)**			
ESG(G) Good (ESG ≥ B +)		**ESG(G) Bad (ESG ≤ B)**		**ESG(G) Good (ESG ≥ B +)**		**ESG(G) Bad (ESG ≤ B)**	
Good FP	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**	**Good FP**	**Bad FP**
G1	G2	G4	G3	G1	G2	G4	G3
409 (27.7%)	335 (22.7%)	328 (22.2%)	407 (27.5%)	231 (23.9%)	189 (21.2%)	213 (23.9%)	258 (29.0%)
Z = 2.712		Z = 2.913		Z = 2.049		Z = 2.073	
Two-tail, p-value < 0.01		Two-tail, p-value < 0.01		Two-tail, p-value < 0.01		Two-tail, p-value < 0.05	

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓, FP, financial performance; EP, ESG performance.

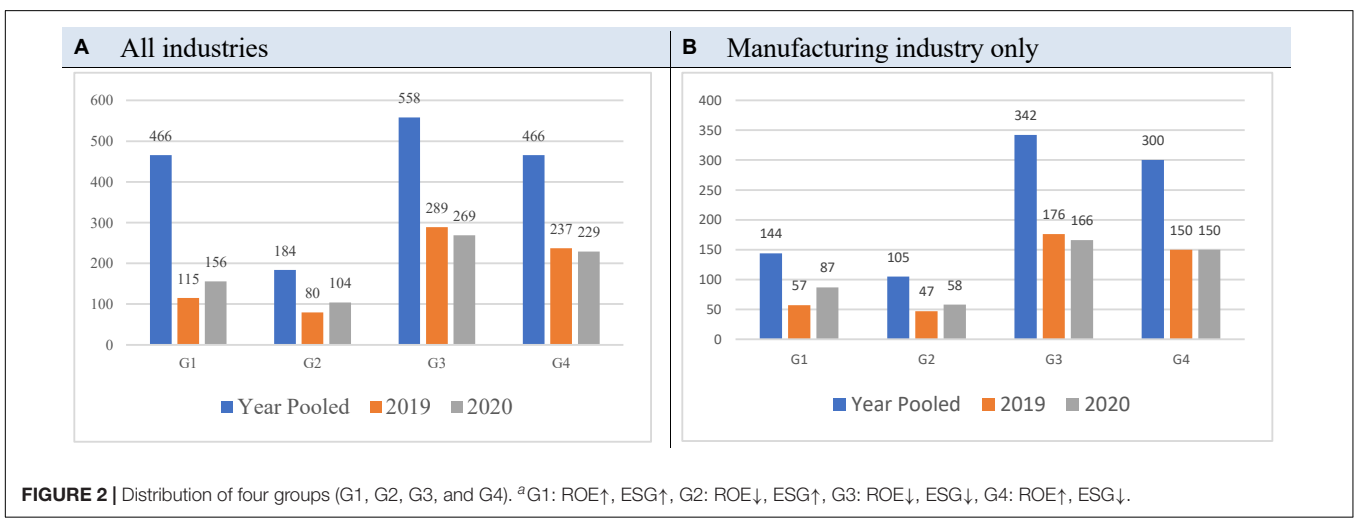

FIGURE 2 | Distribution of four groups (G1, G2, G3, and G4). [a]G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓.

Additionally, the chi-square test and the difference test of population ratio are performed for the years 2019 and 2020 each. This analysis can compare the result of hypothesis 1 for two different years. This is in **Figure 2**.

Panel (A) shows the result of the analysis for all industries. The outcome of the analysis for each of the 2 years is the same as the results from 2 years in total. In each of the 2 years, companies with good financial performance also show decent ESG performance (G1 > G2, G4 < G3). A finding is that when comparing the trends from 2019 to 2020, G1 and G2 are increasing, and G4 and G3 are decreasing. Panel (B) shows the result of the analysis for the only manufacturing industry. The result is the same as that for entire industries. From the analysis, even if ESG management in Korea is in its early stage, the interest in ESG management and the corresponding corporate actions are improving.

Results of Hypothesis 2

In hypothesis 2, we tested whether a company with high financial and ESG performance will have a larger percentage of shareholding by NPF. We compared the shareholding rates of NPF in four groups created by high and low levels of financial performance (ROE) and ESG performance. Analysis of variance (ANOVA) and *post hoc* analysis were performed to test hypothesis 2. The output from the analysis for entire industries is found in **Table 7**.

Panel (A) shows the ANOVA results, with G1 having the highest average of 6.10, followed by G2 (= 4.65), G4 (= 2.55), and G3 (= 1.16). However, the Levene statistic was 121.88, and the *p*-value was 0.01, indicating heteroscedasticity among groups. Therefore, Dunnett T3 analysis was added to solve the heteroscedasticity problem and validate the differences among groups, and the result is presented in panel (B) and shows that G1 had a larger shareholding rate of NPF than G2, G3, and G4, and the difference was also significant at the 1% level. G2 had a larger percentage of shareholding of NPF than G3 and G4. G4 shows a larger rate than G3. The results of the ANOVA and the *post hoc* analysis for the manufacturing industry are found in **Table 8**.

From the examination, NPF has a larger shareholding rate in G1 than in G2, G3, and G4. This is similar to the results for entire industries. We also found the same result when comparing G2 with G3 and G4 and G3 with G4. ANOVA and *post hoc* analysis are performed for three areas of ESG, and the result is in **Table 9**.

Panel (A) is created by analyzing all industries, and Panel (B) is the result of analyzing the only manufacturing industry. First, the level of social performance was considered in E

TABLE 7 | ANOVA and *post hoc* analysis for all industries.

(A) ANOVA, independent variable = percentage of NPF

Classification	*N* (= 1,479)	Mean	*SD*		SS	Degree	MS	*F*-value	*p*-value
G1	271	6.10	4.48	WG	5051.63	3	1683.87		
G2	184	4.65	4.24					151.64	0.01
G3	558	1.16	2.26	BG	16381.84	1475	11.11		
G4	466	2.55	3.20						

Levene static = 121.88 *p*-value = 0.01

(B) *Post hoc* table

	G(I)	G(J)	MD(I-J)	*p*-value
Dunnett T3	1	2	1.44	0.01
		3	4.92	0.01
		4	3.55	0.01
	2	3	3.48	0.01
		4	2.09	0.01
	3	4	−1.39	0.01

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓.

TABLE 8 | ANOVA and *post hoc* analysis for the manufacturing industry.

(A) ANOVA, dependent variable = percentage of NPF

Classification	*N* (= 891)	Mean	*SD*		SS	Degree	MS	*F*-value	*p*-value
G1	144	6.09	4.43	BG	2925.63	3	975.21		
G2	105	4.31	4.31					96.60	0.01
G3	342	1.00	1.98	WG	8954.01	887	10.10		
G4	300	2.49	3.09						

Levene static = 92.889, *p*-value = 0.01.

(B) *Post hoc* table

	G(I)	G(J)	MD(I-J)	*p*-value
Dunnett T3	1	2	1.78	0.01
		3	5.09	0.01
		4	3.60	0.01
	2	3	3.31	0.01
		4	1.82	0.01
	3	4	−1.49	0.01

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓.

TABLE 9 | ANOVA and *post hoc* analysis for ESG and financial performance.

(A) All industries

(A)-1 ESG (E)

	N (= 1,479)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	1.80	0.01
G1	185	6.86				3	5.50	0.01
G2	134	5.06	148.53	0.01		4	4.02	0.01
G3	608	1.36						
G4	552	2.84			2	3	3.70	0.01
						4	2.22	0.01
					3	4	−1.48	0.01

(A)-2 ESG (S)

	N (= 1,479)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	1.48	0.01
G1	344	5.54				3	4.43	0.01
G2	231	4.06	128.81	0.01		4	3.16	0.01
G3	511	1.11						
G4	393	2.38			2	3	2.95	0.01
						4	1.68	0.01
					3	4	−1.27	0.01

(A)-3 ESG (G)

	N (= 1,479)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	1.89	0.01
G1	409	5.03				3	3.92	0.01
G2	335	3.14	88.48	0.01		4	2.65	0.01
G3	407	1.11						
G4	328	2.38			2	3	2.03	0.01
						4	0.76	0.05
					3	4	−1.27	0.01

(B) Manufacturing industry only

(B)-1 ESG (E)

	N (= 891)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	2.00	0.01
G1	111	6.41				3	5.30	0.01
G2	91	4.41	87.06	0.01		4	3.67	0.01
G3	356	1.11						
G4	333	2.74			2	3	3.30	0.01
						4	1.67	0.01
					3	4	−1.63	0.01

(B)-2 ESG (S)

	N (= 891)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	1.73	0.01
G1	176	5.66				3	4.69	0.01
G2	122	3.93	88.60	0.01		4	3.32	0.01
G3	325	0.97						
G4	268	2.34			2	3	2.96	0.01
						4	1.59	0.01
					3	4	−1.37	0.01

(B)-3 ESG (G)

	N (= 891)	Mean	*F*	*p*	G(I)	G(J)	I-J	*p*
					1	2	1.88	0.01
G1	231	4.72				3	3.72	0.01
G2	189	2.84	49.34	0.01		4	2.21	0.01
G3	258	1.00						
G4	213	2.51			2	3	1.84	0.01
						4	0.33	0.92
					3	4	−1.51	0.01

1. G1: ROE↑, ESG↑, G2: ROE↓, ESG↑, G3: ROE↓, ESG↓, G4: ROE↑, ESG↓.

only, and the results are in Panel (A)-1 and Panel (B)-1. G1 has a larger percentage of shareholding of NPF than other groups (G2, G3, and G4). G2 had a larger percentage of shareholding of NPF than G3 and G4, and G4 also shows a larger ratio than G3. However, in the analysis of the only manufacturing industry when G is considered for social performance, there is no statistical significance between G2 and G4.

As a result, the analysis for hypothesis 2 is summarized as follows. First, G1 has a larger percentage of shareholding by NPF than other groups (G1 > G2, G1 > G3, G1 > G4), and NPF is seen to invest more in companies with respectable financial and ESG performance. Second, G2 has a larger percentage of shareholding by NPF than G3. If the financial performance is low, NPF tends to invest more in companies with decent ESG performance. Third, G4 has a larger percentage of shareholding by NPF than G3. NPF seems to invest more in companies with favorable financial performance if ESG activity is insufficient. Fourth, G2 has a higher percentage of shareholding by NPF than G4, and NPF invests more in companies with satisfactory ESG performance rather than in those with good financial performance. This may be the evidence that Korean NPF stresses ESG performance more than financial performance for its investment decision, but more studies are required in the future.

Interestingly, G is considered as social performance, and there is no difference in NPF investment between high financially performing firms and low financially performing firms. When E or S is considered, the result is different. Even if financial performance is not entirely satisfactory, NPF invests more in companies with exceptional social performance in E or S. NPF may not consider governance factors as seriously as environmental or social components.

CONCLUSION

This study investigated the relationship between financial performance and ESG performance, along with the shareholding ratio of NPF for listed companies in Korea. From the analysis of hypothesis 1, it is found that companies with favorable financial

performance are more active in ESG management. From the comparison between the years 2019 and 2020, G1 and G2 with decent ESG performance are increasing, and G4 and G3 with low ESG performance are decreasing. This shows that even if ESG management in Korea is in its early stage, social interest and corporate participation are improving.

In hypothesis 2, NPF has more shareholding in companies with decent financial performance and ESG performance. NPF is shown to invest more in companies with respectable ESG performance rather than in those with good financial performance. This is consistent with the fact that pension funds in the world are interested in ESG management in addition to financial output and that sustainability management becomes important to attract investment from outside institutions. For NPF, the fiduciary responsibility for the Korean people is critical, and stable profitability should be kept in the fund operation. NPF cannot pursue public interests such as ESG at the expense of stability and profitability of the fund as a pension fund for all Korean people. The basic purpose of NPF is to create a firm revenue from the investment to guarantee Korean people's old-age income.

Even if financial performance is not superb, NPF invested more in companies with respectable performance in E or S areas but not in G. Corporate governance is still a critical issue in Korean companies, especially for Korean chaebol firms. The dispute about governance reform in Korea became active after the currency crisis in 1997. Approximately 20 years have passed since the crisis, but the agency difficulties caused by the owner-managers of Korean chaebol firms should be studied further. There has been much dispute about E issues such as climate change since Korean Green New Deal was announced in July 2020, and most discussions about ESG management are in the area of carbon emission reduction. Corporate governance reform in Korea remains for future research.

This study attempted to investigate the relationship between ESG management and financial performance and the role of socially responsible investment in NPF. Additionally, we discovered another evidence to hitherto discussion for the slack resource hypothesis that companies with good social performance can have decent financial performance and confirmed that NPF is starting to strengthen its activism of institutional investors. The main contribution of this study is to show that interest in ESG management is increasing, and the investment considering ESG is also expanding in Korea.

This research has the following limitations.

First, from the analysis of hypothesis 1, companies with good financial performance have decent ESG performance. However, this does not represent a causal relationship between the two variables. We cannot argue that improvement in ESG performance leads to better financial performance or *vice versa*. Even if social performance has improved through ESG management, there may be a time lag in order to lead to the increase in the financial performance since financial performance improvement comes from complex interactions of various factors such as macroeconomic/microeconomic E and internal/external circumstances of the company. It would be helpful to consider a time series research method to solve this limitation. The study period is from 2019 to 2020 when Korean NPF just began to take interest in ESG investment. Given the brief period of research and the early stage of ESG management in Korea, it is hard to design a time-series method for our analysis. Moreover, the year 2020 was a very unusual economic circumstance due to the COVID-19 pandemic, and the results of this study might be affected by the event. However, we could not control the epidemic by designing separate experiments before and after the pandemic due to the inherent limitation of the research duration of this study. In the future examination, we can extend the study term, analyze the causal relationship between financial performance and ESG performance, and explore moderating effects of shareholding of NPF in the relationship between CSP and CFP. Second, from the analysis of hypothesis 2, we found that NPF has performed the role of institutional investor activism by enlarging its investment in companies with respectable social performance rather than those with good financial performance. However, it was not clear from our analysis whether the institutional activism of Korean NPF is only a temporary trend in the early ESG stage or will it continue. Third, it is found that NPF did not make an investment in companies with favorable financial and G performance. It may be a sign to require further investigation of the weak Korean governance structure in Korean chaebols.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

JK: research design, hypotheses development, and theory building. SS: data analysis and hypotheses development. Both authors contributed to the article and approved the submitted version.

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Does Environmental, Social, and Governance Drive the Sustainability of Multinational Corporation's Subsidiaries? Evidence From Korea

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We examined the relations between environmental, social, and governance (ESG) activities and the performance of subsidiaries of multinational corporations (MNCs). We further investigated the moderating effect of market-oriented organizational culture on the relationship between ESG and performance. Employing generalized least square regression analysis using survey data, we show that ESG activities of MNC subsidiaries are positively associated with financial and non-financial performance. These results suggest that ESG improves the financial and non-financial performance of subsidiaries. The test for the moderating effect of the market-oriented organizational culture shows that it weakens the positive relationship between ESG activities and financial performance. This could be due to the incongruous nature of the short-term focus of a market-oriented organizational culture versus the long-term orientation of the sustainability of ESG activities.

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Keywords: ESG, sustainability, MNC, subsidiary, market-oriented organizational culture, moderating effect

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INTRODUCTION

This study examines the relationship between environmental, social, and governance (ESG) activities and the performance of subsidiaries of multinational corporations (MNCs). Furthermore, we investigate the moderating effect of market-oriented organizational culture on the relationship between ESG and performance. The growing global campaign for ESG makes it increasingly necessary to understand better the factors that hamper or facilitate its practice across firms. Firms' interest in ESG is not just voluntary. It is also primarily driven by an increase in the number of investors that sought after ESG-based assets and the pressure from civic groups and international organizations.

Environmental, social, and governance could also provide a cushion for firms during times of economic downturn. Gilllan et al. (2021) posit that high ESG firms show performance resilience during an economic crisis by harnessing value through financial figures and non-financial avenues.

In particular, after the 2008 global financial crisis, reflection on neoliberalism, shareholder capitalism, and resistance to deepening economic inequality acted as critical environmental factors. Therefore, in the context of "the double power principle," the market forces contributed directly

and indirectly to the proliferation of interest in ESG. Discussed as an alternative to the recovery to a moral economy and shareholder-first principle, ESG focuses on sustainability as a core value by linking economic and social values.

The concept of sustainability was first discussed at the World Commission on Environment and Development (WCED) in 1987. WCED, in its 1987 report entitled "Our common future," defined sustainable development as development that meets the needs of the present without sacrificing the ability of future generations to meet their own needs. Durand et al. (2019) define sustainability as the possibility of meeting immediate short-term needs while meeting the requirements for securing the future. Consequently, companies are now publishing sustainability reports according to the guidelines of the 2016 Global Report Initiative (GRI). Since the term ESG was first introduced in the UN Environment Program Financial Initiative in 2003, the UN Principles for Responsible Investment were presented in 2006, focusing on ESG indicators.

As a result, MNCs have strengthened their social, ethical, and environmental responsibilities in the global market. Carroll (2004) predicts that the pressure on firms to protect the environment, promote social responsibility, and practice transparent management will increase because corporate social responsibility (CSR) activities have become a global mainstay. Therefore, it is crucial and time-relevant to investigate whether the headquarters of an MNC and its subsidiaries are fulfilling their responsibilities as global market leaders (Luo, 2006). In this context, this study empirically analyzes the relationship between ESG and the performance of subsidiaries of MNCs located in Korea.

The resource-based theory could explain how a subsidiary of an MNC generates financial performance through ESG activities. Subsidiaries strategically and preemptively conduct ESG activities from a long-term perspective to solve local problems and gain a sustainable competitive advantage. The external factors that cause subsidiaries to engage in ESG activities can be examined from stakeholder theory and institutional duality. The resource-based theory focuses on the internal factors of a company to build a competitive advantage. In contrast, the stakeholder theory and institutional duality are related to the company's external factors. As with the general discussion of ESG, subsidiaries of MNCs conduct ESG activities to meet the expectations and needs of local stakeholders, which can positively impact business performance in the long run. Institutional duality can explain the ESG activities carried out in reconciling the different interests to meet the local needs that the subsidiaries face with the strategic guideline of the global standard established at the headquarters level.

This study conducted an empirical analysis of data collected through a questionnaire survey on subsidiaries of MNCs located in Korea from December 1, 2021, to February 28, 2022. Respondents to the survey were male (50.7%) and female (49.3%). The average age of the respondents was 39.53, and the average tenure was 8.5 years. Before sending the survey questionnaire to the respondents *via* email, a phone call was made first to solicit their interest and ensure participation and completion rate.

The main results and implications of this study are as follows. First, the MNCs' ESG activities are positively associated with the financial and non-financial performance of subsidiaries of MNCs. Second, a firm's market-oriented organizational culture weakens the positive relationship between ESG and performance. Lastly, we find that market-oriented organizational culture did not play a moderating role in the relationship between ESG and non-financial performance.

The contributions of this study are as follows. First, to the best of our knowledge, this study is the first to analyze the relationship between ESG and performance for subsidiaries of MNCs using survey data. Second, this study divides non-financial and financial performance to examine various aspects of business performance. Third, we investigated the moderating effect of market-oriented organizational culture on the relationship between ESG and the performance of subsidiaries of MNCs.

The rest of this study is organized as follows. The following part explains the theoretical background of how ESG can affect organizational performance from the perspective of MNCs. Then, we propose hypotheses on the relationship between variables. Next, we introduce the data and analysis methods used in this study and present the empirical results. Finally, we discuss the conclusions and practical implications.

THEORETICAL BACKGROUND

Environmental, Social, and Governance

Firms implement ESG policies and diligently enforce its practice when they desire to achieve sustainable management. ESG consists of environmental, social responsibility, and transparent management (Friede et al., 2015). ESG management can be seen as slightly different from CSR. It focuses on firms that show resilience during times of crisis by demonstrating sustainability and reflecting value from the financial figures and non-financial factors (Gilllan et al., 2021).

Despite the aforementioned differences, it would be false-hearted to deny that interest in ESG management originated from prior research on CSR. Instead, ESG can be viewed as a concept developed from CSR rather than a completely different concept from CSR. In other words, it is reasonable to view ESG as a concept, with some additions or adjustments, that supplements CSR. In practice, it is recognized as an essential toolbox that helps firms attain sustainability. Previous studies on sustainability management use ESG and CSR similarly in research models can be seen as supporting the supplementing-relationship argument. McWilliams and Siegel (2001) define CSR activities as corporate activities aimed at creating a better society beyond meeting the requirements set by laws and regulations. Eccles et al. (2014) assert that it is those activities that firms undertake which determine their future performance through consideration of the environment, society, and governance.

Friede et al. (2015) examine existing studies on CSR from the viewpoint of emphasizing each element of the **e**nvironment (E), **s**ocial responsibility (S), and transparent management through a **g**overnance system (G). A closer examination of CSR studies shows that the focus is on the environment and social responsibility. In conclusion, the ultimate goal of ESG, like CSR, is to pursue sustainable growth from a long-term perspective and

to have a positive impact on social benefits. However, ESG is different from CSR in that ESG is based on the triple bottom line (TBL) to evaluate the level of sustainable management from an investor's point of view. Therefore, we can argue that the three clear concepts of ESG emphasized in the study of Eccles et al. (2014) can be correctly implemented only when the part corresponding to G is reflected in the research model (Friede et al., 2015).

Environmental, Social, and Governance in Multinational Corporation Perspective

We need to look at the research on ESG of MNCs based on the following three theoretical contents. First, overseas subsidiaries of MNCs have to survive by solving local problems from a resource-based point of view and carrying out activities to gain a competitive advantage in the local market. In this process, local subsidiaries face the challenge of overcoming resource limitations as outsiders who do not have sufficient external justification (Zaheer and Mosakowski, 1997; Kostova and Zaheer, 1999). MNCs can implement environmental, social responsibility, and ethical management activities to secure assets to solve the problem of liability of foreignness that the subsidiaries have to pay to acquire information or the problem of external legitimacy lacking in the subsidiaries (Zaheer, 1995; Nachum, 2003). In addition, subsidiaries entering the growth phase pursue opportunities and engage in value-enhancing activities that continuously strengthen the company's competitiveness. Thus it is imperative that the subsidiaries of MNCs actively engage in activities related to the local environment, social responsibility, and ethical management (Meyer, 2017).

Second, subsidiaries of MNCs will conduct ESG management to meet the expectations and needs of local stakeholders from the point of view of CSR. MNCs entering developing countries, including emerging markets, can lay the groundwork for sustainable growth with their subsidiaries and related stakeholders by simultaneously meeting environmental, social, and local economic needs (Jamali et al., 2011). When an MNC operates in a host country with a lower level of economic development than its home country, activities that address local stakeholders' economic, environmental, and social needs are the social responsibility implicitly required of subsidiaries (Hart and Christensen, 2002). The degree of responsibility differs based on the host country. Suppose the level of development is lower than that of the home country. There may be environmental specificities inherent in social problems, such as a decrease in education level, unemployment, and poverty.

Conversely, if the economic level of the host country is higher than that of the home country, the overseas subsidiary needs to demonstrate ESG activities that comply with global standards. Since MNCs must operate in different business environments between countries, their subsidiaries cannot help but be under the influence of local stakeholders. Therefore, the sensitivity to environmental, social responsibility, and ethical management activities experienced by subsidiaries in the local market will be high. Consequently, it is essential to carry out ESG activities for subsidiaries of MNCs in developing countries. It enables innovation at the level of the corporate value chain and provides answers to sustainability management (London and Hart, 2004).

Finally, subsidiaries of MNCs conduct ESG management from the perspective of institutional duality. Overseas subsidiaries have to reconcile their various interests in conducting global management. As a preemptive measure, they can be under pressure to promote and engage in ESG activities locally. Environmental and social responsibility activities directed by the head office have to take into account the strategic choice of the parent company, internal processes, and stakeholder groups while also taking into account the impact of regulations and norms at various levels in the host country (Zhao et al., 2014). This also has to do with how much autonomy a subsidiary has from its headquarters. When reviewed comprehensively, the institutional duality of MNCs can be said to be an issue that is caused by the characteristics of subsidiaries internally as well as in various external environments. In other words, MNCs inevitably face various institutional factors when managing their ESG activities, ranging from local optimization or global market-leading standardization to host country-centric or host-country-centric issues. Therefore, some of the ESG activities at the headquarters level of MNCs are transferred to overseas subsidiaries. However, some ESG activities are initiated at the local subsidiary level.

HYPOTHESIS DEVELOPMENT

Environmental, Social, and Governance, Performance, and Sustainability

Recently, some studies (Dyllick and Hockerts, 2002; Springett, 2003) highlighted the concept of sustainability that satisfies the needs of shareholders and stakeholders without compromising the company's capabilities. Sustainability is a management activity that enhances the organization's value by promoting communication with the company and stakeholders. Sustainability management can also be ideal for a company that seeks to maximize shareholder value by increasing corporate profits in alignment with the expanding stakeholders' specific interests (Edmans, 2021). From this perspective, our study uses subsidiaries' financial and non-financial performance as a proxy for sustainability. Research on sustainability generally analyzes the impact of ESG activities on performance, consisting of financial and non-financial performance, represented by shareholder value (Waddock and Graves, 1997; Margolis and Walsh, 2003; Orlitzky et al., 2003; Edmans, 2011).

The results of studies analyzing the effects of ESG on performance do not converge in one direction. There are mixed results. The findings vary from no significant relationship between two variables to a positive association or negative relationship. Some report a U-shaped or inverse U-shaped relationship (Teoh et al., 1999; Wright and Ferris, 1997; McWilliams and Siegel, 2000; Arora and Dharwadkar, 2011). Nonetheless, most studies report that corporate ESG activities positively affect firm performance (Waddock and Graves, 1997; Barnett, 2007; Wang and Qian, 2011; Aguinis and Glavas, 2012).

Waddock and Graves (1997) argued that non-financial performance could positively affect financial performance, such as stock price or profit margin, leading to a sustainable virtuous cycle. Also, research results showed that such a virtuous cycle of performance is observed better in MNCs that conduct business as subsidiaries in other countries. They have more free resources and stronger stakeholder influence than smaller corporations (Barnett, 2007).

Environmental, Social, and Governance and Financial Performance

If most studies had shown that CSR activities hurt corporate performance, it would have been for the campaign for CSR to gain any traction. Most empirical findings support CSR's value-enhancing arguments, translating to a positive effect on firm performance. Carroll (1979) classified the beneficiaries of economic and philanthropic responsibilities tied to CSR activities into shareholders and stakeholders, respectively, and argued that CSR could positively affect financial performance. In addition, several studies have concluded that CSR has a positive effect on corporate performance (Waddock and Graves, 1997; Orlitzky et al., 2003; Barnett, 2007; Wang and Qian, 2011; Aguinis and Glavas, 2012; Cho and Tsang, 2020).

Environmental, social, and governance, which has a more active meaning than CSR, is highly likely to positively affect firm performance (Friede et al., 2015). ESG activities of subsidiaries meet the expectations of local stakeholders by meeting the economic and social needs of the local country, which can give the impression that the company is active in the localization (Jamali, 2007). Local stakeholders impressed and satisfied by the subsidiary's ESG activities will be more willing to provide more valuable resources that contribute to the growth and success of the subsidiary's business (Peng and Luo, 2000). Subsidiaries that are more active in ESG engagements with local stakeholders could reduce operating costs and even save money when acquiring the necessary resources needed for their business (McWilliams and Siegel, 2011). In addition, resources provided by local stakeholders increase the ability of subsidiaries to adapt to local conditions and become a driving force for performance improvement (Wang et al., 2008). Therefore, we can expect that the ESG management of subsidiaries will positively affect financial performance. Based on the above discussion, we propose the following hypotheses.

> **Hypothesis 1:** The ESG activities of a subsidiary of MNCs can lead to higher financial performance.

Environmental, Social, and Governance and Non-financial Performance

As discussed above, the subsidiaries of MNCs can conduct ESG activities to create and sustain a competitive advantage in the local market based on the resource-based theory. The competitiveness of these companies is closely related to financial performance and non-financial performance. If a subsidiary concentrates too much on financial profits, its core business may suffer long-term, declining productivity. Expansion into a new market unrelated to an existing business may destroy social value, which corresponds to non-financial performance, and endanger the growth of the local community and the survival of the company (Moeller et al., 2005). However, suppose a subsidiary implements a strategy that considers the environment, consumers, employees, financial supporters, suppliers, regulators, and the community. In that case, it can create social value with strong externalities (Jensen, 2002). Jamali (2010) argued that the activities of a subsidiary of MNCs paying attention to the education and safety issues of the local community and providing public infrastructure create social value. The actions of such subsidiaries can improve the corporate image (Tully and Winer, 2014). Therefore, subsidiaries conducting business in the local market may induce various externalities related to social responsibility (Jamali, 2008).

Drawing from the arguments, we posit that the local subsidiaries' management of its ESG will positively affect non-financial performance, which is a social value, including the image of the subsidiary perceived by local stakeholders. Based on the above discussion, we establish the following hypothesis.

> **Hypothesis 2:** The ESG activities of a subsidiary of MNCs can lead to higher non-financial performance.

The Moderating Effect of Market-Oriented Organizational Culture

Each organization has its unique cultural characteristics. The extant research on organizational culture has focused on categorizing organizational culture, identifying common characteristics and culture-determining factors, explaining the characteristics of culture, and revealing organizational effectiveness (Denison and Mishra, 1995; Cameron and Quinn, 2011). Previous studies have also identified organizational cultures by classifying them based on organizational characteristics (Ketchen, Jr, Thomas and Snow, 1993). As part of this classification, Cameron and Quinn (2011) developed Quinn's theoretical model published in 1988 to define organizational culture types as flexibility and discretion, stability and control, inward orientation, and integration. Organizational culture was classified based on four factors: (internal focus and integration) and external focus and differentiation. Our study examines the moderating effect of market-oriented organizational culture, which has elements of stability and control, external orientation, and discrimination in the relationship between ESG and performance. According to Cameron and Quinn (2011), organizational culture can be classified into clan, adhocracy, hierarchy, and market cultures. As such, there are various organizational cultures, but among them, the market-oriented organizational culture is selected as a moderating variable because our study is conducted on subsidiaries of MNCs. A market-oriented organizational culture based on competition may not be strategically aligned with ESG management focused on long-term sustainability in that it is oriented toward short-term performance.

A market-oriented organizational culture can be a type of organizational culture that emphasizes productivity in achieving organizational goals and performing tasks. Organizations with market-oriented culture value efficiency and reward for

performance, from planning to achieving goals (Zammuto and Krakower, 1991). In particular, subsidiaries are highly likely to espouse the characteristics of a market-oriented organizational culture. They are organizations designed to produce tangible results from a local, short-term perspective from birth in corporate culture, goals, corporate structure, and decision-making (Hewett et al., 2003). This market-oriented organizational culture induces short-term performance-oriented activeness among members of the organization.

Subsidiaries' market-oriented organizational culture fosters an atmosphere where subsidiaries focus on short-term outcomes rather than processes. Therefore, ESG is more likely to be perceived as a cost or unavoidable procedure rather than an immediate benefit to a subsidiary competing fiercely in the local market. However, ESG management focuses on long-term performance rather than short-term performance. Thus, ESG contrasts with the immediate results of a market-oriented organizational culture. This suggests that the subsidiary's market-oriented organizational culture can become an obstacle to ESG management activities' path to positive and tangible results. The strategic fit perspective argues that a company can improve its performance by enhancing the fit between its strategies and the particular environments where it operates (Katsikeas et al., 2006). Improving the fit between its strategic type and a firm's characteristics is desirable because it produces a better performance (Miles and Snow, 1984; Porter, 1996; Zajac et al., 2000). Based on the above discussion, the following hypotheses were established.

Hypothesis 3: The market-oriented organizational culture of MNCs' subsidiaries weakens the positive relationship between ESG and financial performance.

Hypothesis 4: The market-oriented organizational culture of MNCs' subsidiaries weakens the positive relationship between ESG and non-financial performance.

RESEARCH DESIGN

Figure 1 illustrates the research model in our study.

We test the following Equation (1) to examine our hypotheses.

$$\begin{aligned} PERFORMANCE_{i.t} &= \alpha_0 + \alpha_1 SUBSIDIARY'S\_ESG_{i,t} \\ &+ \alpha_2 MARKET - ORIENTED\_ORG\_CULTURE_{i,t} \\ &+ \alpha_3 SUBSIDIARY'S\_ESGXMARKET - ORIENTED\_ORG\_ \\ &\quad CULTURE_{i,t} + \alpha_4 SALES_{i,t} + \alpha_5 PARENT\_EQUITY\_ \\ &\quad SHARE_{,t} + \alpha_6 SUBSIDIARY\_AGE_{,t} + \alpha_7 HQ\_GLOBAL\_ \\ &\quad ORIENTATION_{i,t} + \alpha_8 LOCAL\_RESPONSIVENESS_{i,t} \\ &+ \alpha_9 SUBSIDIARY'S\_LEVEL\_OF\_LOCALIZATION_{i,t} \\ &+ \alpha_{10} SUBSIDIARY\_AUTONOMY_{i,t} \\ &+ \alpha_{11} INDUSTRY_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Variables	Description
Dependent variables	
PERFORMANCE	
FINANCIAL_ PERFORMANCE	= Mean value of the survey data of sales growth rate, market share, and operating profit
NON-FINANCIAL_ PERFORMANCE	= Mean value of the survey data of customer satisfaction, employee satisfaction, and reputation and image
Independent variables	
SUBSIDIARY'S_ ESG	= Environmental, social, and governance (ESG) of multinational corporation's subsidiary, the mean value of environmental, social, and governance (Detailed items of ESG are shown in **Appendix Table A1**)
MARKET-ORIENTED_ORG_ CULTURE	= Subsidiary firm's market-oriented organizational culture is measured by the extent to which (1) subsidiary is performance-oriented, (2) subsidiary's leader is performance-oriented, (3) subsidiary values the progress of performance more than relationship, (4) subsidiary pursuit the mission accomplished ultimately, (5) subsidiary values the maximization of performance under a given circumstance, and (6) subsidiary values the competition with main competitors
SALES	= Natural logarithm of sales revenue for the fiscal year
PARENT EQUITY_ SHARE	= Parent firm's equity share, a dummy variable taking 1 if the subsidiary's type of foreign direct investment (FDI) is a greenfield investment and 0 if the subsidiary's type of FDI is a brownfield investment
SUBSIDIARY_ AGE	= Subsidiary firm's age
HQ_ GLOBAL_ ORIENTATION	= Headquarter firm's global orientation measured by the extent to which our MNE-HQ concentrates on developing standardized products by considering the world market as a single unit, and our MNE-HQ provides the same advertisement, product, and design for targeting the transnational global market.
LOCAL_ RESPONSIVENESS	= Subsidiary firm's local responsiveness is measured by the extent to which our MNE-HQ guides foreign subsidiaries to compete in their own markets, and our MNE-HQ corresponds to the needs of local markets.
SUBSIDIARY'S_ LEVEL_ OF_ LOCALIZATION	= Subsidiary firm's level of localization measured by the extent to which the (1) product or service provided by the subsidiary, (2) research and development or marketing of subsidiary, (3) organization structure or operation of the subsidiary, (4) HR control (employing, development, etc.) of the subsidiary in the local market takes great importance of local trait than of head office's standard procedure.
SUBSIDIARY_ AUTONOMY	= Subsidiary firm's autonomy measured by the extent to which subsidiary's decision making for (1) developing or introducing a new product in the local market, (2) expanding or reducing manufacturing facilities in the local market, (3) establishing or executing of budget in the local market, and (4) administrators (employment, expatriate, promotion) in the local market.
INDUSTRY	= Industry dummy taking 1 if the firms belong to the Manufacturing, 0 otherwise.

Data

We obtained data through a survey from December 1, 2021, to February 28, 2022. The firms listed in the directory of foreign-invested enterprises operating in Korea compiled by the Investment Notification Statistics Center (INSC) of

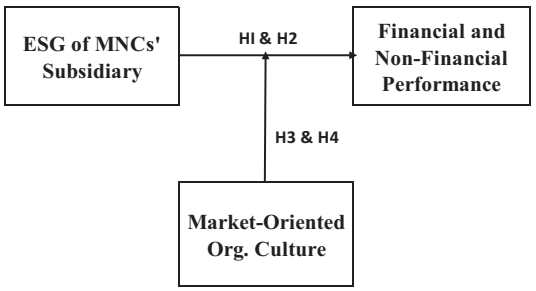

FIGURE 1 | Research design.

Korea were used as the sample of our model. INSC's dataset provides the contact information of the subsidiaries of MNCs that have entered Korea. We focused on MNC subsidiaries in Korea, investigating their ESG and firm performance. South Korea has recorded substantial growth in the past few decades, supported by the rapid international investment from MNCs. As the economy of Korea entered an advanced level, the management of MNC subsidiaries in Korea has increasingly become a critical topic of interest. Previously, the MNC subsidiaries in Korea, with limited information regarding their investment purpose, were excluded from the subsidiaries in Korea listed in INSC's dataset. Secondly, subsidiaries operating for less than 5 years were excluded from the dataset to capture the long-term performance of MNC subsidiaries. Finally, subsidiary units with definite contact information were selected.

Structured questionnaire items were prepared as the primary data source. The respondents were employees having general work experiences at the subsidiary level since this research aimed to investigate the relationship between ESG and the performance of MNC subsidiaries located in Korea. Participants, targeted employees of MNC subsidiaries, were required to complete our questionnaire concerning their business activities and other key variables such as ESG and their company backgrounds. Before sending the questionnaire, items for the survey were developed in accordance with an inclusive literature review and consultation with researchers. Initially, questionnaires were responded to from the initial calls and follow-up e-mailing. After excluding data that had missing points and were not suitable for this research, the final data were collected.

Variable Measurements

A survey instrument was developed to capture the four building blocks: ESG, financial performance, non-financial performance, and market-oriented organizational culture of MNC subsidiaries. Seven-point Likert-type scales were used for all measures, ranging from 1 = "strongly disagree" to 7 = "strongly agree."

Environmental, Social, and Governance of the Subsidiary

Environmental, social, and governance were utilized as antecedents of financial and non-financial performance in this research. Specifically, we used the ESG measure developed by Zhou and Wang (2020). ESG was measured comprehensively by asking respondents to rate each of the items.

Financial Performance of Subsidiary

The financial performance was measured by aggregating items to embrace the long-term performance of a foreign subsidiary in the host country in different dimensions regarding their competitors in the market. Owing to the scarce reliable profitability data at the level of subsidiaries, a multi-dimensional construct that includes aspects such as profitability, productivity, and market share relative to peer organization which comes from a well-designed multi-item questionnaire, is thought to be suitable (Meyer et al., 2020).

Non-financial Performance of Subsidiary

As this research focused on the non-financial performance of subsidiaries and financial performance, the respondents were asked to answer questions of items regarding non-financial performance. The non-financial performance measures the satisfaction of customers and employees, and reputation links to the stakeholder interests.

Market-Oriented Organizational Culture

The market-oriented organizational culture was developed by Cameron and Quinn (2011). Their definition of market-oriented organizational culture includes the performance-oriented culture of the organization. The respondents were asked to answer questions concerning items as this research concentrated on the culture can affect the relationship between a subsidiary's ESG and performance. These items include the organization's overall environment in terms of specific results and the underlying culture that drives organizational success.

Control Variables

Studies drawing on stakeholder and institutional perspectives have not accounted for the fact that firms are heterogeneous, with different resources and capabilities (Barney, 1991). However, this heterogeneity in firm attributes may influence the subsidiary performances. Consequently, we include subsidiary-level, MNC-level, and local market-level control variables to control their effects on subsidiary performance. For subsidiary-level control variables, we included previous performance, subsidiary autonomy, subsidiary age, and the industry of the subsidiary. The autonomy of the subsidiary measure was developed by O'Donnell (2000). Also, the industry of the subsidiary is proxied as dummies: 1 if the subsidiary is operating in the manufacturing industry and 0 otherwise. For the MNC-level control variables, we controlled for a parent equity share in the subsidiary and international strategies of the head office, HQ global orientation, and local responsiveness. Specifically, we used the HQ global orientation measure developed by Bartlett and Ghoshal (2002) and local responsiveness developed by Yang and Rivers (2009). Parent equity share was measured as dummies: 1 if the subsidiary's type of foreign direct investment (FDI) is a greenfield investment, and 0 if the subsidiary's

type of FDI is a brownfield investment. For the local market-level control variables, we controlled for the subsidiary's level of localization. Lastly, we used these control variables of ESG influence to measure their effect on the performance of subsidiaries.

Validity and Reliability

The validity and reliability of measures were estimated. Content validity was ensured when developing the survey instrument through relevant literature reviews and in-depth interviews with employees of MNE subsidiaries. In addition, the discriminant validity, unidimensionality, and reliability were measured by factor analysis. The reliability of all constructs exceeded 0.70 in Cronbach's alpha (Hinton et al., 2004). As a result, it was concluded that all measures exhibited an appropriate level of discriminant validity and unidimensionality.

Most of the variables, including independent and dependent variables in the research model, were measured by the answers of the same informants who completed the same questionnaire, which may bring on common method bias (Podsakoff et al., 2003). We conduct Harman's single factor test employing principal component analysis to control common method bias and check for construct validity. This single factor explained the variation, which is less than the 50% threshold in latent constructs overall. Consequently, we conclude that the effect of the common method bias is hardly problematic in this study.

Regression Method

This study used a regression model by adopting the generalized least squares (GLSs) procedure. GLS involves transforming the original variables into the converted variables which satisfy the OLS assumptions (Kmenta, 1971). The GLS procedure partitions error variance into three components – random error in space, random error in time, and random error not unique to space or time – and uses this information to draw efficient and unbiased parameter estimates (Sayrs, 1989). Furthermore, GLS assumes that the intercept is acquired from a normal distribution and is statistically independent of the explanatory variables in the model. GLS is used to capture the precise relationship between the variables considering both time and space by minimizing the error between variables. The STATA program's xt family of commands was used to perform the analysis for this research.

We first explored which effect would be appropriate for our research between fixed effect and random effect using dummy variables of country-level when we analyzed the research model using the GLS procedure. We discarded the fixed-effects approach not only because some of our independent variables were remarkably stable over space for our countries but also because we lost a significant number of observations. In the case where the fixed-effects approach is not appropriate, a random-effects method can be used wherein the fixed effects are uncorrelated with the other independent variables (Cannella et al., 2008). A Hausman test (Hausman and Taylor, 1981) revealed no significant correlations between our independent variables and the country-level fixed effects. Another Hausman test is recommended if the preferred random effect p-value is greater than 5%, validating our choice of random-effects models in testing our hypotheses (Schaffer and Stillman, 2006).

EMPIRICAL RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 shows the characteristics distribution of the sample subsidiaries of MNCs. We can find the number of employees (more than 100–42.8%), CEO's nationality (headquarters' country 40.6% and Korea 50.7%), Industry classification (manufacturing 59.4%), types of investment (single investment 60.1%), types of business operation (manufacturing and sales 31.2%), and year of entry (after 2000 63%).

Table 2 reports the descriptive statistics. The mean value of *FINANCIAL_PERFORMANCE*, *NON-FINANCIAL_PERFORMANCE*, and *SUBSIDIARY'S_ESG* is 4.59, 4.63, and 4.50, respectively, implying that the performance and ESG are above average. *MARKET-ORIENTED_ORG_CULTURE*

TABLE 1 | Characteristics' distribution of the sample subsidiaries of MNCs.

		Persons	%
Total respondent		138	100.0
Number of employees	Less than 30	50	36.2
	Between 31 and 99	26	18.8
	More than 100	59	42.8
	No answer	3	2.2
CEO's nationality	Headquarters' country	56	40.6
	Korea	70	50.7
	Other countries	12	8.7
Industry	Manufacturing	82	59.4
	Service	56	40.6
Types of investment	Single investment	83	60.1
	Joint investment	33	23.9
	Merge of local firms	11	8.0
	Others	11	8.0
Types of business operation	Manufacturing	20	14.5
	Sales	37	26.8
	Manufacturing and sales	43	31.2
	Service	38	27.5
Year of entry	Before 1999	51	37.0
	After 2000	87	63.0
Sales revenue of subsidiary firm in 2021	Less than U$45 million	77	55.8
	More than U$45 million	53	38.4
	No answer	8	5.8
Headquarters' share of investment to subsidiary	Less than 100%	32	23.2
	100%	85	61.6
	No answer	21	15.2
Location of headquarter	North America	31	22.5
	Asia and Oceania	60	43.5
	Europe	47	34.1

TABLE 2 | Descriptive statistics.

Variable	*N*	Mean	p50	SD	p25	p75
FINANCIAL_PERFORMANCE	105	4.59	4.33	1.14	4.00	5.33
NON-FINANCIAL_PERFORMANCE	105	4.63	4.67	0.98	4.00	5.33
SUBSIDIARY'S_ESG	105	4.50	4.51	1.02	3.96	5.17
°*Environmental*	105	4.52	4.50	1.24	4.00	5.25
°*Social*	105	4.79	4.80	1.12	4.00	5.40
°*Governance*	105	4.18	4.25	1.34	3.38	5.00
MARKET-ORIENTED_ORG_CULTURE	105	4.93	5.00	0.84	4.33	5.67
SALES	105	5.78	5.66	1.91	4.47	7.23
PARENT EQUITY_SHARE	105	0.38	0.00	0.49	0.00	1.00
SUBSIDIARY_AGE	105	20.86	19.00	12.05	12.00	26.00
HQ_GLOBAL_ORIENTATION	105	4.85	5.00	1.32	4.00	6.00
LOCAL_RESPONSIVENESS	105	4.84	5.00	1.12	4.00	5.50
SUBSIDIARY'S_LEVEL_OF_LOCALIZATION	105	4.77	4.75	1.08	4.00	5.50
SUBSIDIARY_AUTONOMY	105	4.09	4.00	1.15	3.29	4.86
INDUSTRY	105	0.35	0.00	0.48	0.00	1.00

is 4.93, which is much higher than average. The mean value of *SUBSIDIARY_AGE* is 20.86. **Table 3** shows the Pearson correlation matrix. The correlation coefficients of the independent variables are less than 0.53, suggesting that there are no material problems of multicollinearity. *SUBSIDIARY'S_ESG* is significantly and positively correlated with *FINANCIAL_PERFORMANCE* (0.414, $p < 0.01$) and *NON-FINANCIAL_PERFORMANCE* (0.530, $p < 0.01$).

In addition, each value of the variance inflation factor (VIF) was calculated. The VIFs ranged between 1.08 and 1.76 with an average of 1.46, suggesting no material problems of multicollinearity in the analysis (Chatterjee and Hadi, 2013). The result reported in **Table 3** implies that the relationships among key variables—subsidiary's ESG and financial performance and subsidiary's ESG and non-financial performance—are precisely in line with the directions of the hypotheses established. Also, **Tables 4**, **5** report the regression results. In **Tables 4**, **5**, the subsidiary's ESG performance is the independent variable, and financial and non-financial performance are the dependent variables. We will examine each model in turn as we consider the hypotheses.

Regression Analyses

Table 4 provides the test results for Hypothesis 1 and 2. Model 1 of **Table 4** is a baseline model that includes only control variables such as previous performance, parent equity share, subsidiary age, HQ global orientation, local responsiveness, subsidiary's level of localization, subsidiary autonomy, and industry. First, we included ESG separately in the estimation model. Model 2 reveals the positive effect of subsidiary's ESG on the financial performance ($b = 0.233$, $p < 0.05$), where Model 4 shows the positive effect of subsidiary's ESG on the non-financial performance ($b = 0.350$, $p < 0.001$). These results provide strong evidence to support Hypothesis 1 and 2 simultaneously. The ESG of MNC subsidiaries operating in Korea positively influences financial performance and non-financial performance. Additionally, we conclude that the regression models have reasonable explanatory power since the R^2 is greater than 0.29.

The results in **Table 5** show the moderating effect of market-oriented organizational culture on the relationship between a subsidiary's ESG and performance. Specifically, Model 1 and

TABLE 3 | Correlation matrix ($n = 105$).

	1	2	3	4	5	6	7	8	9	10	11
1. FINANCIAL_PERFORMANCE	1										
2. NON-FINANCIAL_PERFORMANCE	0.687***										
3. SUBSIDIARY'S_ESG	0.414***	0.530***									
4. MARKET-ORIENTED_ORGANIZATIONAL_CULTURE	0.308**	0.461***	0.482***								
5. SALES	0.279**	0.241*	0.450***	0.238*							
6. PARENT_EQUITY_ SHARE	−0.088	0.004	−0.066	−0.039	−0.160						
7. SUBSIDIARY_AGE	0.023	−0.007	0.115	−0.107	0.429***	−0.086					
8. HQ GLOBAL_ORIENTATION	0.351***	0.466***	0.235*	0.366***	0.108	0.024	0.025				
9. LOCAL_RESPONSIVENESS	0.429***	0.504***	0.419***	0.446***	0.217*	−0.018	0.046	0.436***			
10. SUBSIDIARY'S_LEVEL_OF_ LOCALIZATION	0.172†	0.181†	0.261**	0.182†	0.176†	0.125	−0.018	0.031	0.394***		
11. SUBSIDIARY_AUTONOMY	0.216*	0.177†	0.205*	0.225*	0.122	0.144	0.035	0.058	0.347***	0.530***	
12. INDUSTRY	0.071	−0.012	−0.061	0.002	−0.205*	0.037	−257**	−0.089	−0.063	−0.140	−0.069

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

FINANCIAL_PERFORMANCE = mean value of the survey data of comprehensive performance, sales growth rate, market share ratio, and operating profit; NON-FINANCIAL_PERFORMANCE = mean value of the survey data of customer satisfaction, employee satisfaction, and reputation and image; SUBSIDIARY'S_ESG = environmental, social, and governance (ESG) of multinational corporation's subsidiary, the mean value of environmental, social, and governance; MARKET-ORIENTED_ORG_CULTURE = subsidiary firm's market-oriented organizational culture; SALES = natural logarithm of sales revenue for the fiscal year: PARENT EQUITY_SHARE = parent firm's equity share; SUBSIDIARY_AGE = subsidiary firm's age; HQ_GLOBAL_ORIENTATION = headquarters' global orientation; LOCAL_RESPONSIVENESS = subsidiary firm's local responsiveness; SUBSIDIARY'S_LEVEL_OF_LOCALIZATION = subsidiary firm's level of localization; SUBSIDIARY_AUTONOMY = subsidiary firm's autonomy; and INDUSTRY = industry dummy taking 1 if the firms belong to the Manufacturing, 0 otherwise.

TABLE 4 | The effects of subsidiary's ESG on financial and non-financial performance.

Independent variables	Dependent variable			
	FINANCIAL_PERFORMANCE		*NON-FINANCIAL_PERFORMANCE*	
	Model 1	**Model 2**	**Model 3**	**Model 4**
SUBSIDIARY'S_ESG		0.233* (0.115)		0.350*** (0.089)
SALES	0.137* (0.060)	0.087 (0.064)	0.096* (0.049)	0.022 (0.049)
PARENT_EQUITY_SHARE	−0.180 (0.208)	−0.171 (0.205)	0.040 (0.170)	0.054 (0.159)
SUBSIDIARY_AGE	−0.005 (0.009)	−0.004 (0.009)	−0.008 (0.008)	−0.006 (0.007)
HQ_GLOBAL_ORIENTATION	0.195* (0.085)	0.181* (0.084)	0.229** (0.069)	0.207** (0.065)
LOCAL_RESPONSIVENESS	0.261* (0.111)	0.205† (0.112)	0.288** (0.090)	0.204* (0.087)
SUBSIDIARY'S_LEVEL_OF_LOCALIZATION	−0.003 (0.114)	−0.021 (0.113)	0.001 (0.093)	−0.025 (0.087)
SUBSIDIARY_AUTONOMY	0.106 (0.103)	0.102 (0.102)	0.016 (0.084)	0.009 (0.079)
INDUSTRY	0.354 (0.216)	0.333 (0.212)	0.104 (0.176)	0.072 (0.164)
INTERCEPT	1.238† (0.659)	0.899 (0.671)	1.608** (0.538)	1.098* (0.518)
Wald Chi-Square	39.38***	44.70***	53.64***	77.08***
R^2	0.29	0.32	0.36	0.45
Number of samples	105	105	105	105

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
FINANCIAL_PERFORMANCE = mean value of the survey data of comprehensive performance, sales growth rate, market share ratio, and operating profit; NON-FINANCIAL_PERFORMANCE = mean value of the survey data of customer satisfaction, employee satisfaction, and reputation and image; SUBSIDIARY'S_ESG = Environmental, Social, and Governance (ESG) of Multinational corporation's subsidiary, the mean value of environmental, social, and governance; SALES = natural logarithm of sales revenue for the fiscal year: PARENT EQUITY_SHARE = parent firm's equity share; SUBSIDIARY_AGE = subsidiary firm's age; HQ_GLOBAL_ORIENTATION = headquarters' global orientation; LOCAL_RESPONSIVENESS = subsidiary firm's local responsiveness; SUBSIDIARY'S_LEVEL_OF_LOCALIZATION = subsidiary firm's level of localization; SUBSIDIARY_AUTONOMY = subsidiary firm's autonomy; and INDUSTRY = industry dummy taking 1 if the firms belong to the Manufacturing, 0 otherwise.

TABLE 5 | The moderate effect of market-oriented organizational culture.

Independent variables	Dependent variable			
	FINANCIAL_PERFORMANCE		*NON-FINANCIAL_PERFORMANCE*	
	Model 1	**Model 2**	**Model 3**	**Model 4**
SUBSIDIARY'S_ESG	0.233* (0.115)	1.474* (0.594)	0.350*** (0.089)	0.321 (0.467)
MARKET-ORIENTED_ORG_CULTURE		1.075† (0.549)		0.123 (0.432)
SUBSIDIARY'S_ESG×MARKET-ORIENTED_ORG_CULTURE		−0.239* (0.113)		−0.001 (0.089)
SALES	0.087 (0.064)	0.065 (0.064)	0.022 (0.049)	0.016 (0.051)
PARENT_EQUITY_SHARE	−0.171 (0.205)	−0.125 (0.204)	0.054 (0.159)	0.059 (0.160)
SUBSIDIARY_AGE	−0.004 (0.009)	−0.005 (0.009)	−0.006 (0.007)	−0.004 (0.007)
HQ_GLOBAL_ORIENTATION	0.181* (0.084)	0.164† (0.085)	0.207** (0.065)	0.192** (0.067)
LOCAL_RESPONSIVENESS	0.205† (0.112)	0.205† (0.113)	0.204* (0.087)	0.185* (0.089)
SUBSIDIARY'S_LEVEL_OF_LOCALIZATION	−0.021 (0.113)	−0.030 (0.111)	−0.025 (0.087)	−0.020 (0.088)
SUBSIDIARY_AUTONOMY	0.102 (0.102)	0.112 (0.101)	0.009 (0.079)	0.001 (0.079)
INDUSTRY	0.333 (0.212)	0.286 (0.211)	0.072 (0.164)	0.067 (0.166)
INTERCEPT	0.899 (0.671)	−4.354† (2.641)	1.098* (0.518)	0.804 (2.078)
Wald Chi-Square	44.70***	50.48***	77.08***	77.55***
R^2	0.32	0.35	0.45	0.45
Number of samples	105	105	105	105

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
MARKET-ORIENTED_ORG_CULTURE = subsidiary firm's market-oriented organizational culture.

Model 3 of **Table 5** are baseline models consisting of only control variables, including ESG influencing financial and non-financial performance. Then, we entered the interaction term between ESG and market-oriented organizational culture in the estimation model. Model 2 reveals that this interaction term is negative and significant ($b = -0.239$, $p < 0.05$), suggesting that the relationship between a subsidiary's ESG and financial performance is weakened when subsidiaries in

Korea have a market-oriented organizational culture. Thus, Hypothesis 3 is supported. On the other hand, the interaction term between ESG and market-oriented organizational culture is insignificant in Model 4. Therefore, Hypothesis 4 is not supported.

DISCUSSION AND CONCLUSION

This study analyzed how much ESG management performed by a Korean subsidiary of MNCs contributes to the subsidiaries' performance. In addition, we examined how market-oriented organizational culture moderates the relationship between ESG activities and performance. The relationship between ESG and performance was considered an extension of existing CSR research theories, including institutional duality theory and resource-based theory. Moreover, the moderating effect of market-oriented organizational culture on the relationship was designed as a research model. Data were collected by surveying Korean subsidiaries of MNCs, and hypotheses were verified through regression analyses.

The analyses results are summarized as follows. First, ESG management has a significantly positive relationship with financial and non-financial performance. These results are consistent with prior studies (Waddock and Graves, 1997; Godfrey et al., 2009) that corporate activities related to social responsibility positively affect business performance.

Also, we find that the market-oriented organizational culture of Korean subsidiaries of MNCs had a significantly negative effect on the relationship between ESG and financial performance.

The theoretical implications of this study are as follows. First, our study provides empirical evidence that the ESG activities of subsidiaries of MNCs have a positive effect on firm performance. Why can ESG activities of overseas subsidiaries have a positive effect on business performance? We can explain the reason through the resource-based theory and the stakeholder theory. Second, the empirical results of the moderating effect of market-oriented organizational culture can be explained through institutional duality along with strategic fit. Since the institutional duality of MNCs broadens the spectrum of strategic choices, certain strategies chosen by subsidiaries may not be a good fit for each other. In conclusion, the results of our empirical analysis suggest that a market-oriented organizational culture and ESG management do not present a strategic fit in the Korean market.

The following practical implications can be drawn from the results of this study. First, ESG management of Korean subsidiaries of MNCs is a driving force that can overcome the liability of foreignness and improve the subsidiaries' financial and non-financial performance. Therefore, MNCs should strategically initiate and implement ESG activities for the subsidiary that are intentionally tailored to meet the needs of its immediate business environment, thereby directly enhancing the subsidiary's performance and overall value.

Second, subsidiaries' market-oriented organizational culture fosters an environment where subsidiaries focus on short-term performance. Consequently, ESG is more likely to be perceived as a cost or an unavoidable procedure rather than an immediate benefit to a subsidiary in fierce competition. Because ESG focuses on long-term rather than short-term performance, it contrasts with the short-term performance orientation driven by a market-oriented organizational culture. This suggests that the subsidiaries' market-oriented organizational culture can become an obstacle to ESG activities' path to positive and tangible outcomes. Establishing an organizational culture is critical to the success of the firm. Thus, it is necessary to pay more attention to the fact that ESG management, which emphasizes procedures, is the driving force leading to performance.

Although this study draws meaningful conclusions through empirical analysis of subsidiaries of MNCs in Korea on the relationship between ESG management and the performance of MNCs, our study has the following limitations. First, we made efforts to categorize and conceptualize the activities of ESG management of Korean subsidiaries of MNCs. However, there are difficulties in systematizing them to gain consensus due to the nature of the concept of ESG management.

In addition, since we attempted to verify a hypothesis through survey data of overseas subsidiaries, the homogeneity of the survey respondents was not secured, so there is a possibility that the respondents responded in a situation where they did not fully understand the concept and type of ESG management. Moreover, it is possible that the respondents are not directly involved with the ESG-related department or responded based on insufficient information about the parent company and strategic direction from the subsidiary's perspective.

Despite these limitations, this study differentiated it from existing studies and conducted an empirical analysis of the ESG activities and performance of subsidiaries of MNCs through a questionnaire survey. Through this, we confirmed previous studies' results that subsidiaries' ESG has a positive effect on financial and non-financial performance. In addition, we find that a market-oriented corporate culture, which emphasizes short-term performance, weakens the positive association between ESG and firm performance. This could be due to the long-term orientation of ESG activities. Therefore, the results of this study are significant in that it provides valuable information that practitioners can refer to in their work when pursuing business strategies that maximize a firm long-term value.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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APPENDIX

TABLE A1 | Detailed items of ESG.

SUBSIDIARY'S_ESG: environmental	The degree of (1) environmental protection training and education, (2) investment in environmental protection, (3) energy consumption water consumption, and (4) R&D and application of environmental protection technology equipment
SUBSIDIARY'S_ESG: social	The degree of (1) gender equality in the subsidiary, (2) employees participating in trade unions, (3) protection of employees' personal privacy and guarantee of paid vacation days per year, (4) support for education, local governments, and NGOs, and (5) support for employee volunteer systems and employee volunteer activities
SUBSIDIARY'S_ESG: governance	The degree of (1) CSR planning or annual planning, (2) social responsibility organization system, (3) stakeholder identification, (4) stakeholder expectations and corporate response measures, (5) whether to issue a social responsibility report, (6) whether a CSR column exists on the official website, (7) social responsibility activities that involve senior leaders, and (8) social responsibility activities that involve employees

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The Impact of Corporate Social Responsibility Performance Feedback on Corporate Social Responsibility Performance

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This study empirically analyzes how corporate social responsibility (CSR) performance feedback impacts CSR performance, focusing on the performance feedback perspective of behavioral theory of the firm (BTOF). By performing generalized least squares (GLS) regression analysis based on Korean company data from 2012 to 2019, we presented evidence that positive social and historical performance feedback had a positive effect on CSR performance. Our results provide evidence that firms with higher social and historical CSR performance than CSR aspiration may have higher CSR performance than those that do not.

Keywords: performance feedback, aspiration, corporate social performance, behavioral theory of the firm (BTOF), CSR

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INTRODUCTION

Corporate social responsibility (CSR) can be defined as a firm's core strategy for voluntarily reflecting social and environmental concerns in the operation of the business to interact with various stakeholders (Wang et al., 2018, p. 68). CSR has attracted scholarly attention, and CSR has increased gradually owing to the growing, recent perception that sustainability is crucial for a firm's long-term growth and survival (Bahta et al., 2021). Many researchers and managers are prioritizing CSR to create a sustainable competitive advantage (Lee and Lee, 2019; Kim and Kim, 2020; Matten and Moon, 2020). However, the degree and pattern of CSR activities performed by firms vary greatly among firms, and CSR performance due to CSR activities also vary greatly from firm to firm. Therefore, many scholars have attempted to identify corporate decisions to participate in CSR activities and determinants of CSR performance (Kim and Kim, 2020; Yuan et al., 2020; Ben-Amar et al., 2021). The previous studies have stressed that firms participate in CSR activities to increase stakeholder value based on the stakeholder theory, arguing that firm CSR performance is eventually related to the financial firm performance (Hillman and Keim, 2001; Kim et al., 2019). Conversely, based on the trade-off theory, other scholars emphasize that CSR activities negatively affect financial performance as they force firms to spend unnecessary money and eventually worsen profitability (McWilliams and Siegel, 2001; Moore, 2001; López et al., 2007).

Meanwhile, many scholars in the field of organizational theory and strategic management have used the performance feedback perspective based on the behavioral theory of the firm (hereafter, BTOF), which has been presented as a major theoretical basis for explaining corporate performance (Cyert and March, 1963). From the BTOF aspect, the difference between a firm's actual performance and aspiration level of performance, that is, attainment discrepancy, affects firm strategy or behavior (Cyert and March, 1963). Attainment discrepancy is crucial in the performance feedback

model of the BTOF. Moreover, the performance feedback model is considered to evaluate one's performance based on the level of performance that firms aspire to Cyert and March (1963) and Alessandri and Pattit (2014). Essentially, based on the actual firm performance compared and evaluated based on the performance of the aspiration level, the CEO determines the effectiveness of the current firm strategy (Audia and Greve, 2006; Lu and Wong, 2019). Applying these discussions to the CSR context, the strategic behaviors that firms can choose may vary depending on whether CSR performance is high or low compared to aspiration level. However, previous studies that have sufficiently discussed this are scarce. Additionally, the difference between CSR aspiration level and actual CSR performance, that is, the effect of attainment discrepancy on CSR performance, remains unclear.

As Nason et al. (2018) highlighted the discussion on social performance feedback compared to financial performance feedback is lacking and attempts to examine how a firm's strategic behavior changes according to corporate non-financial social performance feedback have been relatively insufficient. Few studies have attempted to apply the performance feedback perspective of BTOF to the CSR context (Arora and Dharwadkar, 2011). For example, Arora and Dharwadkar (2011) found that attainment discrepancy moderates the relationship between corporate governance and CSR based on the BTOF perspective. However, in the study of Arora and Dharwadkar (2011), since attainment discrepancy was measured based on the financial performance, there is a big difference from our study that measures attainment discrepancy based on the CSR performance. Additionally, Xu and Zeng (2020) are similar to this study in that it investigates the relationship between CSR's attainment discrepancy and CSR performance, not financial performance. However, their study considers only the social corporate social performance (CSP) aspiration level, while ours study includes both social and historical CSP aspiration levels.

To fill this research gap, this study investigates the impact of CSR performance feedback on future CSR performance. We present the following research questions. First, how does positive CSR performance feedback (positive attainment discrepancy wherein CSR performance exceeds CSR aspiration levels) affect future CSR performance? Second, how does negative CSR performance feedback (negative attainment discrepancy in which CSR performance is below CSR aspiration levels) affect future CSR performance?

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Performance Feedback and Corporate Social Responsibility Performance

One of the main theories explaining firm CSR performance is the perspective of performance feedback of BTOF. In the BTOF perspective, organizations form levels of aspiration for their goals and choose courses of their actions that can help them to achieve that level of aspiration (Cyert and March, 1963; Kotiloglu et al., 2020). The BTOF emphasizes organizational processes such as performance evaluation, search, and decision-making (Cyert and March, 1963; Greve, 2003). Considering performance feedback from the BTOF, as organizations are considered a goal-directed system (Chen and Miller, 2007) using simple decision-making rules to change their activities, the firm will evaluate their performance based on aspiration levels and respond differently depending on whether performance is higher or lower (Cyert and March, 1963; Greve, 2003). According to the perspective of performance feedback, aspiration levels are the reference point for evaluating the organizational performance (Kotiloglu et al., 2020). In other words, the aspiration level becomes the criterion for decision makers to judge satisfaction and dissatisfaction with their strategic results (Simon, 1955). By evaluating one's performance using aspiration level as a reference point, organizations that recognize its success or failure can change the direction and scope of organizational search to enhance performance (Greve, 2003). Aspiration level can be divided into the historical and social aspiration levels. The former is formed through past experience organizational experience and latter through comparison with the reference group (Cyert and March, 1963; Greve, 1998). Historical aspiration (HA) level considers the organization's past experience as a major reference point, mainly by comparing current performance with the organization's past performance (Greve, 2003). Conversely, the social aspiration level is determined by comparing the performance of the reference group with that of the firm. Studies have emphasized that both historical and social aspiration level should be considered (Bromiley, 1991; Greve, 1998). Hence, this study considers both historical and social aspiration levels. The decision maker determines the type of search, such as problemistic or slack search, through the process of comparing aspiration level and one's performance. If firm performance does not reach the aspiration level, this signals the decision maker that a problem has occurred in the current organization and prompts a problemistic search that makes efforts to compensate for the current performance that falls short of expectations. In this problemistic search process, decision makers make decisions to take more risks and actively solve problems. Conversely, if a firm's performance exceeds its aspiration level, decision makers feel no need to change because they see the current situation as profitable and tend to maintain or wait and monitor the current situation (Cyert and March, 1963). When a firm's performance exceeds its aspiration level, it conducts slack search even if it conducts search, and firms hope that the current situation will be maintained (Cyert and March, 1963; Greve, 2003). We attempt to apply this discussion to the CSR context in this study. In this study, CSR performance feedback was considered a major antecedent factor in CSR performance as decision makers can make different decisions related to CSR depending on whether a firm's CSR performance is high (positive) or low (negative) compare with their CRS aspiration level.

Research Hypotheses

In this study, the difference in the CSR performance compared to the CSR aspiration level of a firm (positive or negative attainment discrepancy) influences the firm's strategy or behaviors related to

CSR according to the BTOF's performance feedback perspective. Particularly, when a firm's CSR performance is low compared to CSR aspiration level (negative CSR performance feedback), firm decision-makers may recognize low CSR performance as an important problem and conduct problemistic search to improve it (Zhong and Ren, 2021). Here, CSR aspiration level can be divided into historical and social CSR aspiration level. Decision makers with bounded rationality can make appropriate decisions by comparing past and present CSR performance. Hence, this CSR aspiration level can consider the historical CSR aspiration level. Additionally, decision makers with bounded rationality can make CSR-related decisions by comparing the CSR performance of their reference groups with their CSR performance. Hence, the CSR aspiration level simultaneously becomes the social CSR aspiration level. Many previous studies emphasize that negative performance feedback generates the problemistic search (Cyert and March, 1963). The problemistic search can be considered a solution for firms having lower performance relative to aspiration level (Iyer and Miller, 2008; Posen et al., 2018; Choi J. et al., 2019). In addition, performance below the aspiration level tends to cause firms to solve problems faced by encouraging more innovative activities (Lu and Wong, 2019). If the CSR performance is low as compared to the CSR aspiration levels, firms may be threatened with legitimacy for CSR, and the need to secure legitimate CSR for sustainable growth and survival increases (DiMaggio and Powell, 1983; Du and Vieira, 2012). Receiving negative performance feedback may reduce external stakeholders' trust in the corporate decision makers. Additionally, receiving negative feedback can further strengthen external pressure requiring stakeholders to achieve their goals, limiting management autonomy (Arora and Dharwadkar, 2011). Therefore, receiving negative CSR performance feedback may motivate firms to spend more CSR costs to minimize the negative impact and restore legitimacy and trust from stakeholders. In the end, the negative CSR performance feedback could have a positive effect on CSR performance (Park, 2007; Kim et al., 2015; Xu and Zeng, 2020). Hence, the following hypothesis was derived.

> *H1*: Negative CSR performance feedback (in that as CSR performance falls below CSR aspiration level) is positively related to CSR performance.

Conversely, according to the performance feedback perspective of BTOF, when a firm's financial performance exceeds aspiration level, decision-makers feel no need to change because they see the current situation as profits (Lu and Fang, 2013). As firms have already achieved their high level of financial performance they aspire to, decision-makers are unaware of the need for additional search to take additional risks and further enhance financial performance (Audia et al., 2000). Managers do not perceive their financial performance as a problem if their financial performance exceeds their aspiration level. Hence, even if they conduct a search, they will attempt to maintain the current situation by mainly conducting a slack search. These conservative tendencies of decision-makers have been confirmed in many previous studies. For example, Greve (1998) emphasized that as a result of conducting an empirical analysis on the US radio industry, if firm performance is higher than the aspiration level, the probability of strategic change becomes exceedingly lower. Basically, when financial performance is generally higher than the aspiration level, firms will tend to maintain the phenomenon without making additional efforts to improve financial performance (Lucas et al., 2018). However, considering that CSR requires fulfilling a non-financial aspect of a firm, a slightly different discussion is possible in the CSR context. CSR needs to consider a wide range of stakeholders who have relationships with firms as it goes beyond the general responsibility that firms must legally comply with and includes ethical and moral responsibilities. When firm CSR performance is high compared to the CSR aspiration level, stakeholders related to the firm can show trust in firm decision makers. This provides decision makers with more discretion over resource allocation (Arora and Dharwadkar, 2011). If firm decision makers are satisfied with the current situation and reduce the budget or expenditure required for CSR activities, stakeholders may doubt the authenticity of the activities. As CSR is related to the perceptions of various stakeholders, including consumers, even if CSR performance is higher than CSR aspiration levels, firm decision makers can have a positive impact on CSR performance by continuously spending CSR costs to ensure legitimacy without reducing CSR commitment. This argument can also be confirmed in the previous empirical studies. Xu and Zeng (2020) conducted empirical analysis on Japanese companies in anticipation of a negative impact on philanthropic/environmental expenditure if they performed higher than the level of philanthropic/environmental aspirations of firms. However, owing to empirical analysis, and contrary to the authors' expectations, empirical analysis results were presented wherein positive attainment discrepancy in corporate philanthropic/environmental performance had positive effect on philanthropic/environmental expenditure, respectively. Additionally, when a slack search is performed compared to a problematic search, slack resources will likely be formed because of the additional room for resource utilization. Firms with abundant organizational slack resources can enable more experimentation and organizational change than those that do not (March, 1981). If a firm receives positive CSR performance feedback, it can secure authenticity and legitimacy for CSR activities from stakeholders, including consumers, and can perform more experimental and active CSR activities to strengthen their positive corporate image. Therefore, positive CSR performance feedback could have a positive effect on CSR performance. We propose the following hypothesis:

> *H2*: Positive CSR performance feedback (in that as CSR performance rises above CSR aspiration level) is positively related to CSR performance.

RESEARCH METHODS

Sample and Data

In this study, we matched the Korea Economic Justice Research Institute (KEJI) index and firm-level information to those firms

selected in the top 200 selected by the KEJI (Oh et al., 2019). Data were collected from archival data sources such as KIS-Value, TS2000, DART as an electronic disclosure system, and KEJI for KEJI index. Our initial sample was obtained from KEJI for 2012 to 2019 and merged these firms with financial data using KIS-Value and TS2000. Our final dataset comprises 1091 observations for 8 years of publicly listed firms on Korea Stock Exchange (KSE) from 2012 to 2019. We employed a 1-year lagged structure between dependent and independent variables and control variables to avoid any reverse causality (Oh et al., 2019).

Variables and Measurement

Dependent Variable

CSR performance was measured in various ways in previous studies, using scores announced by specific organizations (Jung and Kim, 2016; Jeong et al., 2018) or the donation amount or donation ratios (Choi Y. K. et al., 2019; Wang et al., 2021). Following earlier studies (Jung and Kim, 2016; Chang et al., 2017; Jeong et al., 2018; Oh et al., 2019), as the proxy for the social corporate responsibility performance for this study, we used the KEJI index, which is announced annually. The KEJI index is one of the representative CSR performance indicators used in Korean studies (Oh et al., 2019) and is similar to the index such as Kinder, Lydenberg which evaluate the CSR index of S&P 500 (Jung and Kim, 2016).

Since 1991, the KEJI has developed its own evaluation model. CSR performance is quantitatively calculated using accounting information data for KOSPI-listed companies. KEJI has evaluated various aspects and characteristics for selecting the 200 largest companies in Korea (Jung and Kim, 2016). The KEJI index consists of six criteria with a total score of 100 points: soundness (25 points), fairness (20 points), contribution to social service (15 points), consumer protection satisfaction (15 points), environmental protection satisfaction (10 points), and employee satisfaction (15 points). Until 2011, contribution to economic development was included in the KEJI index. However, in 2012, the corresponding item was removed from the index. This study measured the CSR performance as the dependent variable by using the total score of KEJI (Jung and Kim, 2016; Jeong et al., 2018; Oh et al., 2019).

Independent Variables

Corporate social responsibility performance feedback: We analyzed CSR performance feedback using CSR performance instead of corporate financial performance to measure corporate CSR performance feedback (Xu and Zeng, 2020; Wang et al., 2021). The amount of donation was widely used to proxy CSR performance in earlier studies (Choi Y. K. et al., 2019; Wang et al., 2021), we used each firm's donation amount to measure CSR performance aspiration. In this study, performance feedback was classified into two types, HA level and social aspiration level. Both effects were analyzed accordingly (Manzaneque et al., 2020).

Social aspiration (SA) was measured as the average donation expenditure of firms in the same industry except for the focal firm based on two-digit level of the KSIC codes (Greve, 2003; Manzaneque et al., 2020; Xu and Zeng, 2020; Ye et al., 2021). Following previous studies (Manzaneque et al., 2020; Ye et al., 2021), HA was measured by the difference between a firm's CSR performance and past aspiration level and is measured as each firm's amount of donation in year t-1.

Based on the previous research on the performance feedback formulas (Xu and Zeng, 2020), we measured the positive CSR performance feedback and negative CSR performance feedback for both social and historical CSR performance feedback.

$$\text{Positive CSR Performance Feedback}_i = \text{CSR Performance}_i - \text{Aspiration}_i \text{ if CSR Performance}_i > \text{Aspiration}_i$$
$$= 0 \quad \text{if CSR Performance}_i \leq \text{Aspiration}_i$$

$$\text{Negative CSR Performance Feedback}_i = \text{Aspiration}_i - \text{CSR Performance}_i \text{ if CSR Performance}_i < \text{Aspiration}_i$$
$$= 0 \quad \text{if CSR Performance}_i \geq \text{Aspiration}_i$$

; where i = focal firm

Control Variables

We controlled for firm- and industry-level factors that could affect a CSR. Generally, large-size firms receive most of the social attention, increasing stakeholder pressure, and imposing high expectations for socially responsible behavior (Xu and Zeng, 2020). Therefore, in this study, firm size was included as a control variable, and firm size was measured as a log value of total sales (Attig et al., 2016; Chang et al., 2017; Xu and Zeng, 2020).

The previous studies have reported that firm age has a positive or negative relationship with corporate CSR performance (Chang et al., 2017). Hence, to control for the age of the firm, we included firm age as the control variable by measuring the number of years since the firm establishment (Xu and Zeng, 2020).

The previous studies argued that firm financial status has great influence on the CSR performance (Chang et al., 2017). Therefore, return on asset (ROA), a representative measure of firm financial performance, was included as a control variable (Xu and Zeng, 2020). ROA was measured by dividing net income by total assets (Chang et al., 2017; Jeong et al., 2018).

Slack influences the search behavior of the behavioral theory of the firm (Greve, 2003; Chen, 2008). To control for the effect of potential slack on CSR performance of financial position, the debt-to-equity ratio of the firm was controlled (Chen, 2008).

Tobin's Q was included as a proxy for corporate value (Jeong et al., 2018; Wang et al., 2021), and Tobin's Q is a representative proxy for market value, reflecting the firm's future profits (Cho et al., 2019). Tobin's Q was calculated as follows.

$$\text{Tobin}'\text{s Q} = [(\text{Stock market price per common share} \times \text{Number of common shares}) + (\text{Book value of total debt})]/\text{Book value of total asset}$$

Since the degree of the internationalization of the firm acts as a pressure to improve corporate CSR (Attig et al., 2016; Xu and Zeng, 2020), the degree of internationalization of a firm was included as a control variable. Hence, we measured the level of internationalization by the ratio of foreign to total sales (FSTS), the most representative indicator of the degree of the internationalization (Attig et al., 2016).

In this study, the industry rivalry, the industry annual sales growth rate and the industry dummy were included in the analysis to control for industry differences owing to the different characteristics of each industry (Chen, 2008). To control for the rivalry within an industry, the degree of competition within the industry was measured by a number of firms in each industry according to previous studies (Lee et al., 2009; Ye et al., 2021). The industry dummy was controlled by making each industry a dummy variable based on the three-digit level (middle-level) of the KSIC code.

Statistical Analysis

Since data for this study are panel data, and both cross-sectional and time series analysis are required. Additionally, because of potential heteroskedasticity and serial correlation problem in panel data, generalized least squares (GLS) regression analysis is suitable for this study (Lee et al., 2009; Wang et al., 2021). The Hausman Test was conducted to select an accurate analysis method. The analysis shows that the random-effect model was considered a more efficient estimating equation than fixed-effect model. Thus, we ran random-effects GLS regression to test our hypotheses.

RESULTS

Table 1 shows the descriptive statistics and correlation coefficients of our study. To test for multicollinearity, we calculated the variance inflation factor (VIF) (Oh et al., 2019). The result shows that the VIF value was less than 2 in all models, indicating that there is no multicollinearity problem (Chatterjee et al., 2000).

Table 2 shows the results of random effect GLS analysis performed for testing the hypothesis which anticipates the effect of performance feedback on CSR performance. Before examining the hypothesis test results, among the control variables, the variables confirmed to have a statistically significant influence on the CSR performance were firm size, slack, Tobin's Q, industry sales growth, and industry rivalry.

According to Model 1 in **Table 2**, firm size had a positive impact on CSR performance ($p \leq 0.001$). This implies that large-size firms receive most of the social attention, which, in turn, increases stakeholder pressure. Therefore, those firms are highly expected to exhibit socially responsible behavior (Choi et al., 2018; Xu and Zeng, 2020). The corporate value measured as Tobin's Q was found to be a positive effect on the CSR performance ($p \leq 0.05$). This may attributable to visibility and can be explained as similar to the logic of the effect of the firm size on the CRS performance.

Conversely, firm slack resource was found to have a negative (-) impact on CSR performance ($p \leq 0.01$). As we measured the slack resource as a debt ratio, a high debt ratio may represent the perception of resource which, in turn, may discourage firms to invest in CSR towing to resource constraints. This result remains consistent with that of Attig et al. (2016), wherein the negative relationship between slack and CSR performance and potential slack calculated as the ratio of total debt to total equity was demonstrated to represent that situation, as the more debt the firm has, the less money they can borrow. Also, the control variables for industry, among industry sales growth had a positive (+) effect on the CSR performance ($p \leq 0.01$). This result shows that the higher industry sales growth means firms in this industry participate more in CSR.

Hypothesis 1 predicted that negative CSR performance feedback in that CSR performance falling below CSR aspiration level is positively related to CSR performance. Hypothesis 2 predicted that positive CSR performance feedback in that as CSR performance rises above the CSR aspiration level is positively related to CSR performance. Our results in Model 2 of **Table 2** showed that both positive social performance and historical performance feedbacks were confirmed to have a statistically significant positive effect on the CSR performance ($p \leq 0.01$ and $p \leq 0.01$, respectively). However, both negative historical and social performance

TABLE 1 | Descriptive statistics and correlations.

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1	64.252	2.310	1												
2	25.992	1.776	0.2056	1											
3	38.051	19.743	−0.0548	−0.0273	1										
4	0.015	0.154	0.0379	0.1325	−0.0187	1									
5	0.971	6.658	−0.094	0.0369	0.0101	−0.0258	1								
6	1.332	1.123	0.1535	−0.1183	−0.1024	−0.0071	−0.0093	1							
7	21.904	29.034	−0.0231	0.0694	−0.0284	−0.0133	−0.0065	−0.0442	1						
8	4.486	19.982	0.0852	−0.0811	−0.0573	0.0206	−0.0031	0.0587	−0.0598	1					
9	4.416	1.063	0.1105	−0.2476	0.0482	−0.0085	−0.0353	0.1014	0.1329	−0.0601	1				
10	1.337	48.215	0.0173	−0.0136	0.0186	0.0029	0.0004	−0.0069	0.0054	−0.0071	0.0079	1			
11	149.882	10677.67	0.0212	−0.0061	−0.0133	0.0036	−0.001	−0.0092	−0.0099	−0.0054	−0.0119	0.0831	1		
12	238.156	3344.20	0.0562	0.003	−0.0226	0.0026	−0.0016	−0.0199	−0.0078	−0.0169	−0.0463	−0.0022	−0.0011	1	
13	135175.5	3448960	0.0897	0.0926	0.0007	0.0161	−0.0008	0.0014	−0.0159	0.0065	−0.006	−0.001	−0.0006	0.0079	1

1. KEJI score, 2. firm size, 3. firm age, 4. roa, 5. slack, 6. Tobin's Q, 7. fsts, 8. industry sales growth, 9. industry rivalry, 10. negative social CSR performance feedback, 11. negative historical social CSR performance feedback, 12. positive social CSR performance feedback, 13. positive historical social CSR performance feedback.

TABLE 2 | Random effects GLS model (full sample).

Variables	Model 1	Model 2
Firm size	0.3929***	0.3788***
	(0.0579)	(0.0584)
Firm age	−0.0080	−0.0078†
	(0.0045)	(0.0045)
ROA	−0.3290	−0.3647
	(0.7129)	(0.7076)
Slack	−0.3057**	−0.3106**
	(0.1147)	(0.1146)
Tobin's Q	0.2224*	0.2245*
	(0.1125)	(0.1122)
FSTS	−0.0014	−0.0013
	(0.0031)	(0.0031)
Industry sales growth	0.0107**	0.0113**
	(0.0038)	(0.0038)
Industry rivalry	−0.2141	11.5930*
	(1.4428)	(4.8859)
Negative social CSR performance feedback		0.0010
		(0.0022)
Negative historical CSR performance feedback		0.0001
		(0.0002)
Positive social CSR performance feedback		0.0000**
		(0.0000)
Positive historical CSR performance feedback		0.0000**
		(0.0000)
Industry dummy	Included	Included
Intercept	52.2423***	36.2426***
	(2.3807)	(7.5132)
R-sq	0.191	0.205
Wald χ^2	171.25***	191.21***
N	1,091	1,091

*Robust standard errors are in parentheses; †p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001. Industry dummy variables are included, but not reported to save space.*

TABLE 3 | Random effects GLS model (manufacturing industry).

Variables	Model 1	Model 2
Firm size	0.4483***	0.4338***
	(0.0648)	(0.0654)
Firm age	−0.0101*	−0.0100*
	(0.0049)	(0.0049)
ROA	−0.1356	−0.1739
	(0.7167)	(0.7114)
Slack	−0.1917	−0.2003
	(0.1255)	(0.1253)
Tobin's Q	0.2464†	0.2440†
	(0.1291)	(0.1286)
FSTS	−0.0013	−0.0012
	(0.0034)	(0.0034)
Industry sales growth	0.0108**	0.0116**
	(0.0041)	(0.0041)
Industry rivalry	−0.5260	−0.5180
	(0.9893)	(0.9837)
Negative social CSR performance feedback		0.0011
		(0.0021)
Negative historical CSR performance feedback		0.0001
		(0.0001)
Positive social CSR performance feedback		0.0000**
		(0.0000)
Positive historical CSR performance feedback		0.0000*
		(0.0000)
Industry dummy	Included	Included
Intercept	54.5995***	54.9580***
	(4.35131)	(4.3352)
R-sq	0.1844	0.1993
Wald χ^2	128.61***	147.13***
N	907	907

*Robust standard errors are in parentheses; †p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001. Industry dummy variables are included, but not reported to save space.*

feedback are not statistically significant to CSR performance. Therefore, Hypothesis 1 was not supported, and Hypothesis 2 was supported.

Additional Analysis

We performed additional analysis to confirm our empirical results. The sample of this study includes both manufacturing and non-manufacturing industries because 200 companies with excellent CSR activities selected by the Economic Justice Research Institute were targeted. Considering the claims of previous studies that manufacturing is a core industry in Korea and the influence of CSR in manufacturing is stronger in manufacturing (Chung et al., 2018), an additional analysis was conducted only on manufacturing to confirm the result of the entire sample.

Table 3 shows the results of testing the hypothesis by classifying samples of firms in the manufacturing industry. The results of analyzing only firms in the manufacturing industry showed that both the positive social performance feedback and the historical performance feedback had a positive (+) effect on the CSR performance ($p \leq 0.01$ and $p \leq 0.05$, respectively).

DISCUSSION AND CONCLUSION

Considering the growing social interest in CSR, this study contributes to CSR literature by analyzing the CSR determinants from the BTOF perspective. Based on the perspective of the BTOF and RBV, this study empirically analyzed the CSR performance feedback on CSR performance. To test the hypotheses, we performed GLS regression analysis based on 2012–2019 Korean company data. We found that positive social and historical performance feedback had a positive effect on CSR performance. Our results showed that positive social and historical performance feedback have positive impact on the CSR performance. These results imply that the difference in CSR performance compared to a firm's CSR aspiration level (positive or negative attainment discrepancy) influences the firm's strategy or behavior related to CSR according to the

performance feedback perspective of BTOF. Especially, if a firm receives positive CSR performance feedback, they increase their efforts in CSR activities to secure authenticity and legitimacy for CSR activities from stakeholders. This includes consumers and can perform more experimental and active CSR activities to strengthen their positive corporate image (Jeong et al., 2018; Vogler and Eisenegger, 2021).

This study provides the following theoretical and empirical contributions to CSR and BTOF research fields. First, this study contributes to CSR literature by applying BTOF discussions to the CSR context by theorizing the performance feedback as the significant determinants to CSR performance and empirically testing the relationship between two variables. Specifically, this study showed that the strategic behaviors that firms choose may vary depending on whether CSR performance is high or low compared to aspiration level. Additionally, we examined both the historical and social aspirations of CSR performance feedback on CSR performance. By doing so, this research empirically confirms both the historical and social aspirations of CSR attainment on CSR performance.

Second, our study expands BTOF literature by examining the CSR aspiration of both historical and social aspiration level and its performance implication. According to a recent study, it is argued that it is not advisable to use a combination of the two variables because historical aspirations and social aspirations are fundamentally different in terms of their characteristics and influence (Deb et al., 2019). The previous studies have not sufficiently addressed the effect of the CSR performance feedback and the difference between CSR aspiration level and actual CSR performance. Thus, we answer a recent call for more research examining the CSR performance feedback research. As Nason et al. (2018) highlighted the discussion on the social performance feedback compared to financial performance feedback is considerably lacking. Attempts to examine how a firm's strategic behavior changes according to corporate non-financial social performance feedback have been relatively insufficient so far.

Despite the above-mentioned contributions, this study has several limitations as follows. First, as this study examined CSR aspiration level on the CSR performance of Korean firms, generalization in interpreting the results may be difficult. Therefore, future research should investigate whether this study's results can be generalized to countries other than Korea. Particularly, as the degree of social interest by country in corporate CSR—along with the pressure received by firms—may vary, future research should examine the relationship between CSR aspiration based on the BTOF on CSR performance using a more diverse sample of countries. Second, the sample of this study is 200 companies with excellent CSR activities selected by the Economic Justice Research Institute. We used the sample that matched the KEJI index and firm-level information to those firms selected in the top 200 selected by KEJI, there may be a problem of a sample selection bias (Oh et al., 2019). Third, CSR activities are related to the use of significant resources. The type of slack resource is highly likely to affect CSR results from the BTOF perspective (Greve, 2003). Although this study could not consider the moderating role of these slack resources, analyzing the moderating role of various types of slack resources on this research context in future studies will be promising. Fourth, corporate reputation can be considered the strategic assets held by firms that are a source of a sustainable competitive advantage (Wernerfelt, 1984; Barney, 1991; Roberts and Dowling, 2002; Eberl and Schwaiger, 2005), which, in turn, may have impact on CSR performance. Therefore, future research should examine the impact of corporate reputation on CSR performance. Finally, this study could not consider the impact of corporate governance as a control variable. Hence, we recommend exploring corporate governance as a control variable in future research.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

J-EL and YY contributed to conception and design of the study, and wrote the first draft of the manuscript. YY organized the database, performed the statistical analysis, and wrote "Research Methods" and "Discussion and Conclusion" sections of the manuscript. J-EL wrote "Introduction" and "Theoretical Background and Hypothesis Development" sections of the manuscript. Both authors contributed to manuscript revision, read, and approved the submitted version.

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Dynamic Capabilities and an ESG Strategy for Sustainable Management Performance

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This research explores the dynamic capabilities required for firms to implement environmental, social, and governance (ESG) strategies, and investigates sustainable management performance that can be created based on them. By using dynamic capabilities theory, we integrate sustainable management and the ESG literature to suggest a research model and identify the factors that act as the catalysts achieving sustainability. The data used for the analysis were collected from 78 firms listed on the Korea Exchange (KRX) with assets totaling more than 2 trillion Korean won. In this study, the partial least squares structural equation model (PLS-SEM) is applied. We found that absorptive capability and adaptive capability significantly affect sustainable management performance through implementation of the ESG strategy as a mediating variable. In particular, a firm's implementation of an ESG strategy is a significant determinant that impacts sustainable management performance. We also believe our model contributes to the current knowledge by filling several research gaps, and our findings offer valuable and practical implications not only for achieving sustainable growth but also for creation of competitive advantage.

Keywords: dynamic capabilities, absorptive capability, adaptive capability, ESG strategy, sustainable management performance

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INTRODUCTION

We often witness the rise and fall of firms due to various environmental changes (technological evolution, pandemics, etc.). In other words, firms that appropriately respond to changes in the business environment get an opportunity to maintain their business activities or prosper, while those that fail to adapt can lose their competitive advantage and face expulsion from the market. In particular, the COVID-19 pandemic further increases uncertainties in the business environment, triggering innovations for firms to survive. In this situation, firms seek solutions by establishing and implementing various strategies, such as changing business models or restructuring to enhance their sustainability in order to survive.

Discussions have steadily taken place in academia on ways to increase corporate sustainability. This stream of research assumes the resource heterogeneity and stability of the strategic resources over time. Some researchers, including Barney (1991), argued that the relationship between a firm's resources and sustained competitive advantage is possible if the resources are valuable, rare, inimitable, non-sustainable, and organized (Pisano, 1994; Grant, 1996; Eisenhardt and

Martin, 2000; Bhandari et al., 2020). The resource-based view (RBV) focuses on the internal strengths and weaknesses of the firm, as opposed to the external environmental model of competitive advantage, which emphasizes on opportunities and threats (Bhandari et al., 2022). On the other hand, climate science enthusiasts and environmental economists have emphasized that firms need to address the imbalance between demand and natural supply if they want to be sustainable and achieve the United Nations' Sustainable Development Goals (SDGs; Dasgupta, 2021). Therefore, scholars have been raising the need for stakeholder governance (Barney, 2018; Amis et al., 2020; Barney et al., 2021) to correct the supply–demand imbalance of resource depletion. They point out that attention should be paid to reducing their demand for environmental, social, and governance-related (ESG) footprints and helping to sustain their supply capacity.

Recent studies on these discussions emphasize the harmonious development of the economy, society, and the environment to achieve corporate sustainability (Dey et al., 2020; Henderson, 2021; Alkaraan et al., 2022). Previously, the literature mainly focused on economic (or financial) performance when predicting a firm's sustainability. Lately, however, there has been consensus on the argument that sustainability can be improved when firms coexist with society (Ben-Amar et al., 2017; Holden et al., 2017). These discussions initially developed around international organizations (e.g., the UN, the OECD, and the World Bank), but have now expanded to include the private sector. Meanwhile, a number of studies examining this have shown that firms can benefit financially when they address environmental or societal concerns, but dismiss situations in which environmental and social aspects cannot be aligned with financial performances (Hahn et al., 2015). Accordingly, there is an increasing need for firms to understand their impact on society and the environment through non-financial performance (Schaltegger and Hörisch, 2017). When evaluating this non-financial performance, the environmental, social, and governance (ESG) framework is the one most commonly used and has emerged as a new measure for predicting corporate sustainability. Note that the ESG framework was initially used as an indicator to measure non-financial performance when investors (or asset management institutions) make investment decisions.

However, the ESG concept has recently been recognized as an essential management strategy for the survival of firms. There is a growing trend worldwide for firms to voluntarily disclose ESG information using standards and frameworks presented by the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB). As such, ESG activities have become a trend for sustainable growth, but it is also true that many firms are unable to respond to these changes. For example, in South Korea (hereafter, Korea), the government encourages firms to engage in ESG activities, but only some corporations respond systematically to these changes, and most firms are not even discussing it. In addition, in order to achieve the lofty goal of sustained competitive advantage, the majority of Korean firms have profit maximization as their objective at the cost of ESG degradation. Therefore, for many Korean firms to continue to achieve competitive advantage without falling behind in the global market, it is necessary to identify the strategic approach that allow firms to respond quickly to environmental changes and seek effective management strategies for sustainability.

Achieving a competitive advantage is a strategic approach that is being pursued by all competitors in parallel. When a firm has a sustained competitive advantage, the strategic approach is to create value that belongs only to that firm, where imitation is not possible (Barney, 1991, 2001; Bhandari et al., 2020; Barney et al., 2021). With the rapidly changing business environment, there is an increasing interest in how to create unique value. The dynamic capabilities (DCs) perspective is actively used as a theoretical framework in this vein. Therefore, the focus of our research is on the firm's DCs and how they create sustained competitive advantage.

The DCs perspective explains that a firm can achieve a sustainable competitive advantage by reconfiguring various resources and capabilities according to the changing environment (Teece et al., 1997). Previous studies have shown that a firm develops DCs through three standard features and processes that directly or indirectly affect its competitive advantage. The first factor is *absorptive capability*, which recognizes new-value external information, assimilates it, and applies it to commercial ends (Cohen and Levinthal, 1990). The second factor is *adaptive capability*, which is defined as a firm's ability to identify and capitalize on new market opportunities (Miles et al., 1978; Chakravarthy, 1982; Hooley et al., 1992). The third factor is *innovative capability*, which refers to a firm's ability to develop new products and/or markets by aligning an innovative, strategic orientation with innovative behaviors and processes (Wang and Ahmed, 2004, 2007).

Meanwhile, all these studies focus on creating financial value in achieving a competitive advantage based on DCs. However, a severe problem still resides in the fact that all three of these approaches (i.e., DCs) are experiencing a lack of sustainable social value that modern society is recently aiming for. In other words, although a firm's competitive advantage desperately needs the creation of sustainable social value, the extant literature tends to shed light only on economic value, such as corporate growth and increases in sales. In particular, firms should be aware of the value of social responsibility and should meet the ethical demands of stakeholders because they are strategically crucial to improving a firm's long-term performance. In this vein, no one can guarantee that a firm will be a long-lived organization if it does not appropriately assess the importance of sustainable social value, which indicates the necessity for a study dealing with cementing the gap between extant theoretical discussions and reality.

Based on the series of discussions above, we suggest several research objectives. First, we would like to provide a foundation for understanding the capabilities and structures to achieve competitive advantage by creating sustainable management performance (SMP) using ESG strategies. The DCs-related studies mentioned above have developed around a firm's financial performance, making it somewhat challenging to understand the management trends that have been changing due to recent social and environmental value considerations. In other words,

as these values emerge as a critical factor influencing corporate sustainability, the activities to find capabilities to create them are accelerating around various firms. In particular, we argue that it is necessary to discuss the implementation of an ESG strategy as a mediating variable for achieving SMP based on social and environmental values as well as financial values. Second, to the best of our knowledge, we have not seen an empirical analysis successful exploring how to improve a firm's SMP by setting an ESG framework as a strategic process. Porter and Kramer (2019) confront the firm's sustainability and ESG literature at the firm level through the concept of "shared value." However, attempts to measure the "shared value" have not been very successful, even after Porter et al.'s (2011) contribution in this direction. Extant research has applied survey data or archival proxies in strategic management in general terms, with the latter predominating in highly cited contributions. We will design a research model suitable for measuring ESG and we will prove it through empirical analysis for firms that are pursuing a strategic approach for actual ESG implementation.

The potential expected effects of this study and the subsequent contributions are as follows. First, we propose an integrated framework to realize sustainable values or address social and environmental problems, such as development- and pollution-caused polarization, as well as economic value from the sustainable management perspective. Such a framework will help minimize the gap between extant theoretical discussions and reality and will set a direction to improve corporate sustainability. Second, we present the DCs and the ESG strategy needed for firms eager to achieve sustainable development, significantly providing the direction and foundation necessary to implement the ESG strategy.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

The theoretical basis of our analysis is DCs perspective. DCs theory provides the understanding of the critical role of firm's capabilities and their changes in shaping organizational behavior and performance (Teece et al., 1997; Teece, 2007; Wang et al., 2015). The core idea of this DCs theory is that in order to develop core competencies for competitive advantage in a rapidly changing business environment, firms should integrate, nurture, and reorganize internal and external resources in response to environmental changes (Teece et al., 1997). DCs theorists, including Teece et al. (1997), argue that through this framework, firms can understand the importance of innovation and achieve long-term surviving. This theory aims to examine sustainable growth methods based on firm's capabilities and excellent strategies, while also containing innovation rather than just accepting the status quo of business environment. According to this perspective, firm's decision-making process, behavior, and strategic response are primarily shaped by the rationale for achieving competitive advantage and restructuring the business environment. Competitive advantage is ensured for long-term competitiveness by generating sustainable management performance (SMP) in a constantly changing business environment (Barney et al., 2021; Bhandari et al., 2022). To achieve competitive advantage, firms typically strive to reduce uncertainty and improve performance through their strategies to meet the expectations of their stakeholders (Freeman et al., 2021). In the same vein, Gueler and Schneider (2021) posited that firms can achieve SMP by constantly supplementing and changing capabilities according to the needs of stakeholders. From this perspective, we argue that competitive advantage can be achieved by developing and fostering the DCs for firms to respond to changing environments. Specifically, the recent business environment requires a paradigm shift to coexist with stakeholders rather than prioritizing shareholder interests (Henderson, 2021). For this reason, many firms are expected to attempt to integrate and coordinate internal and external resources to acquire their DCs to meet the expectations of stakeholders. In particular, the movement to redefine the core values, strategies, and structures of firms is spreading as the social demand for a shift to stakeholder capitalism increases. In addition, firms will strive to improve SMP in a changing business environment by establishing strategies that are considered socially and institutionally appropriate based on these DCs. Therefore, unlike previous studies that primarily considered exploring the relationship between a firm's own resources and its financial performance, we are interested in examining the DCs and ESG strategy of firms to achieve significant SMP to enhance their competitive advantage.

Dynamic Capabilities and Sustainable Management Performance

Recently, competition between firms has intensified with the deepening uncertainty in the business environment. Accordingly, it not easy to guarantee a firm's survival with existing strategic thinking that only seeks solutions based on its core resources and assets. Many scholars, including Teece et al. (1997), argued that DCs are needed for a firm's survival and prosperity in a rapidly changing environment, through which the CEO can gain an innovative perspective to secure long-term competitiveness (Eisenhardt and Martin, 2000; Rindova and Kotha, 2001; Zollo and Winter, 2002; Teece, 2007).

Specifically, Tallman (1991) and Luo (2002) highlighted DCs as a source that enables MNCs to achieve a sustainable competitive advantage in the global market. According to Uhlenbruck et al. (2003) and Cepeda and Vera (2007), DCs develop strategies necessary to maintain a long-term competitive advantage in a highly uncertain and changing environment, enabling them to cope with crises occurring in a business environment. It has been widely agreed that there is a direct and positive relationship between DCs and a firm's performance (Wang and Ahmed, 2007; Wilden et al., 2013; Wilhelm et al., 2015; Girod and Whittington, 2017). Meanwhile, some studies showed that DCs do not guarantee successful results for firms (Eisenhardt and Martin, 2000; Zahra et al., 2006). However, the existing literature has focused on the financial aspects of corporate performance due to DCs and does not deal with how it can affect the sustainable (including social and environmental) performance recently required by society (see **Appendix 1**).

As we all know, firms' business environments have more volatility, complexity, uncertainty, and ambiguity than before (Teece, 2018). In particular, advances in technology (e.g., the Fourth Industrial Revolution) and the COVID-19 pandemic are accelerating these changes in the business environment. As uncertainty in corporate management grows, a firm's competitive advantage is focused on sustainability rather than economic (or financial) growth. In this vein, many firms have recently shifted their operational objectives to a direction that increases sustainability. For example, firms such as Apple, Amazon, and GM are revising their strategies to meet the needs of stakeholders and secure capabilities to achieve a competitive advantage, breaking away from the existing strategic framework that strives to maximize shareholder profits.[1]

Focusing on this stakeholder capitalism perspective, scholars are increasingly discussing how firms should cover not only financial performance but also social and environmental value creation in order to improve sustainability (Henderson, 2021). Hussain et al. (2018) highlighted how a firm's social responsibility activities could eventually improve shareholder profits. Kanashiro and Rivera (2019) explained that firms should shift their management policies from economic performance oriented to sustainable management that emphasizes environmental management and social responsibility at the same time. Therefore, it is essential for firms to secure DCs that help improve sustainability in order to effectively and innovatively change existing lagging operational systems according to volatile business trends.

In a similar vein, Cohen and Levinthal (1990) and Zahra and George (2002) pointed out that the more dynamic the business environment, the more critical the absorptive capability to improve sustainability. Absorption capacity refers to an organization's ability to acquire, absorb, and use new information and knowledge (Cohen and Levinthal, 1990; Reinhardt, 1998). An absorptive capability provides a platform for generating sustainability-oriented learning, which in turn encourages organizations to adopt the necessary behaviors in response to sustainability situations and opportunities (Todorova and Durisin, 2007). Therefore, Lichtenthaler (2009) highlighted the importance of absorbing market knowledge for a firm's sustainable growth. Moreover, Bhupendra and Sangle (2017) showed that an absorptive capability helps build a strong reputation, and gives legitimacy to the firm's activities through sustainable strategies and knowledge management, which creates differential advantages and improves performance in the market. That is, deeper learning and dynamic awareness of stakeholder preferences through absorption capabilities can help a firm create solid growth in a future market.

Meanwhile, Oktemgil and Greenley (1997) argued that firms should be based on adaptive capabilities to achieve sustainable performance. In particular, an adaptive capacity is increasingly recognized as a critical attribute of environmental management. Tuominen et al. (2004) found that firms with an adaptive capacity create innovations that benefit not only financial performance but also social equity and conservation of the environment. Wong (2013) pointed out that the adaptive capabilities of firms in environmental management are critical organizational capabilities that are valuable to sustainable performance. In particular, as interest in environmental issues such as climate change has grown recently, strengthening an adaptive capability to environmental transformation is emerging as a very important competency for corporate sustainability.

As such, the literature reveals that absorptive and adaptive capabilities lead to sustainable performance improvement. In order to create SMP, including for society and the environment, the presence or absence of DCs to adapt and lead changing management trends can be a crucial factor. Based on the previous arguments, we propose the following hypotheses.

H.1-1 An absorptive capability will positively affect the creation of sustainable management performance.

H.1-2 An adaptive capability will positively affect the creation of sustainable management performance.

The Mediating Effect of an ESG Strategy

No one will object to the argument that strategy is a key factor influencing the sustainable growth of a firm. That is because a successful strategy guarantees a firm's prosperity, but a failed strategy can bring disaster. In this vein, Teece (2007, 2012) explained that firms could seek effective strategies to respond to environmental changes based on DCs linked to the development of competitive advantage. Ringov (2017) emphasized that firms create value if they develop and implement a suitable strategy based on their resources and capabilities (i.e., operational and dynamic capabilities). As such, firms can achieve superior performance if DCs underpin their strategies.

In this research, an ESG strategy, as one of the critical determinants of sustainable growth, was chosen in order to examine its mediating effect on the link between DCs and a firm's SMP, because more firms are seeking strategies in terms of ESG to improve sustainability. According to the changing business environment, firms are considering their roles and responsibilities in order to secure sustainability beyond simply pursuing profits, and there is a movement to redesign the existing management systems based on an ESG strategy (Van Duuren et al., 2016). For example, Microsoft established a strategy to achieve a carbon-negative footprint by 2030 (i.e., carbon absorption is to be higher than carbon emissions) and is actively participating in solving climate problems. Netflix set inclusion as a corporate cultural value in 2017, revealed the gender and racial proportions of its employees, and is increasing recruitment of Hispanic and Latino talent. SK has increased the board of directors' independence, and strengthened management monitoring and check functions by separating the roles of CEO and chairman of the board of directors to enhance the trust of stakeholders. As such, numerous firms are looking for ways to effectively allocate their resources on ESG, checking whether firms are realizing social functions and

[1]The CEO of the U.S. Business Roundtable deleted the phrase "maximizing shareholder value" from the firm's purpose, and argued that firms should also invest in employees and provide value to customers (*New York Times*, 2019.8.19).

moving away from existing management strategies focused on profits maximization.

Meanwhile, to establish a successful overall strategy for a firm, it is necessary to focus core competencies on the ESG strategy. In particular, in any strategic management process, DCs should be taken into consideration to enable businesses to achieve their ESG goals. Amit and Schoemaker (1993) argued that DCs enable firms to develop strategies necessary to maintain long-term competitive advantages in highly uncertain and changing environments, and such strategies enable firms to respond well to crises occurring in competitive environments. Therefore, we argue that DCs create sustainable value if they positively contribute to the development and support of an ESG strategy.

The literature shows there is no doubt about the positive contribution of an ESG strategy to value creation (Wang and Ahmed, 2007; Parnell, 2011). Indeed, firms develop ESG strategies to create value for their stakeholders. However, different empirical studies postulate various relationships among firms' strategies, DCs, and performance or value (Parnell et al., 2015; Yi et al., 2015; Rashidirad et al., 2017). We propose that sustainable value creation may not be perfectly accessible if DCs do not foster the firm's ESG strategy. For instance, one of the primary sources of value in an ESG strategy is to develop long-term relationships with stakeholders for coexistence and co-prosperity.

We posit that such goals can be achieved if a firm develops a strategy to improve a shareholder capitalism system that is fostered by their DCs. Thus, ESG strategies will assist firms in deploying DCs that achieve SMP (see **Figure 1**).

H2. An ESG strategy mediates the positive effect of dynamic capabilities (absorptive and adaptive capabilities) on a firm's sustainable management performance.

METHODOLOGY

Sample and Data Collection

The population for this study was firms with total assets of 2 trillion Korean won or more and that were listed on the Korea Exchange (KRX) as of December 2020. In order to promote ESG activities, the Korean government has made it mandatory for ESG activities (e.g., environmental information, sustainability, and firm governance) to be disclosed by firms with total assets of more than 2 trillion won as of 2021. The standard for disclosure is total assets, and the Korean government plans to reduce the standard amount every year to expand the number of firms subject to disclosure. For example, governance of disclosure will expand to firms with total assets of more than 1 trillion won in 2022, dropping to assets totaling more than 500 billion won in 2024, and governance will apply to all KRX-listed firms from 2026 on. For 2021, 215 firms were subject to disclosure, and this study surveyed them to collect data.

For the survey, each firm's website was visited and checked for the email address of the ESG manager. However, one problem revealed at this time was that many firms did not disclose email addresses and contact names of ESG managers on the website. For this reason, helped by PhD students, there was no choice but to call as many firms as possible to inquire about the email address of the ESG manager, and firms that did not provide that email address were asked for the contact information of an investor relations (IR) representative. We selected senior managers who responsible of ESG, such as chief executive, vice president, senior director, and general managers in each firm to serve as key informant. The survey was assigned one person per firm, who have a wide knowledge of firm's capabilities and ESG strategy. In particular, several firms were piloted to have representation of the firm. As a result of such pilot tests, some validity was obtained for these processes.

Building on the previous literature (Wang and Ahmed, 2007; Abdul-Rashid et al., 2017; Dey et al., 2020), we used Korean questionnaires to collect data for this research. The questionnaire was modified and written appropriately for this study based on items used in a previous study. Once the draft questionnaire was developed, we got feedback from several academic and managerial experts. Feedback from these experts was then taken and integrated into the final questionnaire. Several Korean professors and managers were invited to check whether the questionnaire was precise. A few minor changes were applied to increase clarity based on their feedback.

Before conducting the survey, a pilot test was undertaken to check the appropriateness of each question. Five ESG managers from SK and POSCO, and professors studying ESG strategies of Korean firms participated in the preliminary investigation. They confirmed that most of the questions were easily understood, but they also advised us to replace some words with better terms. Their suggestions were reflected in the final version. The finalized questionnaire was emailed to the firm's ESG managers and investor relations representatives; emails sent to IR managers included a request to deliver the questionnaire to ESG-related departments and managers.

The survey was conducted over the 2 months from November to December 2021. At the end of that time, 80 questionnaires were finally collected, of which 78 were used for the final analysis because two were missing too much information (a response rate of 36.27%).

Variable Measurement

The dependent variable in this study was the firm's SMP combining economic, environmental, and social performance (Abdul-Rashid et al., 2017). To measure this, we inquired about (1) financial and market-based performance, (2) social performance, and (3) environmental performance. A firm's financial and market-based performance was evaluated by modifying the measurement factors recommended by Panigyrakis and Theodoridis (2007). Specifically, we included three items: growth in sales, growth in profitability (He and Wong, 2004; Lumpkin and Dess, 2006), and growth in market share (Wang and Ahmed, 2007). The firm's social and environmental performances were evaluated by referring to measurement factors used in Dey et al. (2020), including three additional items in each. A firm's social performance alleviates inequality,

strengthens social safety, and solves social problems. The firm's environmental performance reduces carbon emissions, reduces resource usage, and improves the environment. These items were designed based on Zhu et al. (2008), Adebanjo et al. (2016), Abdul-Rashid et al. (2017), and Inman and Green (2018). Each item was rated on a five-point Likert scale ranging from 1 (much worse) to 5 (much better) by comparing the firm's performance to its competitors over the previous 5 years.

The independent variable in this study was DCs. This study adopted the item scale of García-Morales et al. (2008), which was based on the definition of absorptive capability by Cohen and Levinthal (1990). Moreover, this study referred to items used to measure adaptive capability as defined by Gibson and Birkinshaw (2004) and Wang and Ahmed (2004). Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree; see **Appendix 2** for details).

The mediation variable in this study was ESG strategy. This study included questions based on the K-ESG index developed by the Ministry of Trade, Industry, and Energy in 2021. Specifically, it requested four items for each strategy implementation. It asked about the establishment of environmental management strategies and action plans, management of environmental business performance, and support for stakeholders' environmental protection activities. The social strategy asked about consumer protection, improvement of the working environment, and win-win activities with partner firms (or competitors). Regarding governance strategy, the survey asked about process design to guarantee shareholder rights, continuous monitoring through an independent audit team, and reflecting stakeholders' opinions. Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

This study used three control variables: firm size, industry type, and externalities. It measured firm size as a natural log of the firm's total assets (in millions of Korean won) for 2020. This study controlled for size because larger firms have access to more or better capabilities than smaller firms, while smaller firms may have more flexibility and the ability to develop DCs more quickly. It measured the industry type based on data submitted by firms to the KRX. This study assigned a dummy variable to each firm based on dominant industry types: processing and manufacturing (MFG), which included 32 firms; sales and service (SVC), which included 34 firms; and 12 firms in other industries such as utilities, energy, chemicals, and transportation (Khanna and Rivkin, 2001; Kriauciunas and Kale, 2006). We used measures for the other industries as control variables with regard to manufacturing and industry, sales, and service. This study also included externalities in the models as a separate measure for control purposes because social concern may influence firm performance (Leong and Yang, 2020).

Common Method Bias

In this study, the dependent and independent variables were subjectively measured by the same person at the same time. In this case, the answer itself might contain the respondent's bias, which implies the possibility or risk of common method bias. Therefore, we verified whether standard method bias applied or not by performing one-factor analysis before conducting a full-scale statistical analysis.

According to Podsakoff et al. (2003), "One of the most widely used techniques that have been used by researchers to address the issue of common method bias is what has come to be called Harman's one-factor (or single-factor) test" (p. 889). We entered all variables measured subjectively by the respondents into this testing method. The results showed that four factors were divided, and the largest factor was 43.34%, which suggests that common method bias was not a concern in this study. According to Podsakoff et al. (2003), the presence of a substantial number of common methods should be suspected in cases where (1) a single factor emerges from the factor analysis or (2) one largest factor accounts for the majority of the covariance among the measures (i.e., more than 50%).

We used externalities as a marker variable. Bootstrapping for the path coefficient and significance verification confirmed that a marker variable was not significant with all variables. In addition, it was proven that the path coefficient is greater before a marker variable is controlled for (see **Table 1**). This result indicates that common method bias is not a major problem in our data.

ANALYSES AND RESULTS

Analysis Method

We applied the partial least squares structural equation model (PLS-SEM), which is considered suitable for complex path models, and it has the advantage of being relatively free from strict and unrealistic assumptions (e.g., multivariate normality) and sample size (Hair et al., 2017). In general, the PLS-SEM focuses on predictive and exploratory analysis, compared to the covariance base SEM (Hair et al., 2018).

This study discusses the ESG strategy and DCs to achieve a firm's SMP. There were relatively few prior studies that were not systematized; therefore, a strong attribute of the research is selection and analysis of measurement items. In particular, to consider sustainable management, analysis should be conducted from an integrated perspective that connects the firm's capabilities and ESG strategy. For this reason, we decided that using PLS-SEM is more effective for stably estimating parameters and examining integrated causal relationships.

Construct Validity

The validity was verified by analyzing the measurement model and the structural model. Measurement model analysis was verified in the following order: Cronbach's alpha, multicollinearity, convergent validity, and discriminant validity. Cronbach's alpha coefficient of all constituent concepts was 0.70 or higher ($0.882 <$ all alpha coefficients < 0.932). Multicollinearity is evaluated by the variance inflation factor (VIF), and in this study, the VIF values of all measured variables were less than 5 ($2.254 <$ all VIF values < 4.659), which confirmed there was no problem with multicollinearity. Convergent validity uses factor weights, outer loads, and average variance extracted (AVE). As shown

TABLE 1 | Marker variable analysis results.

Marker control	Path	Original sample	Sample mean	Standard deviation	*T*	Value of *p*
Before	Absorptive capability → SMP	0.409	0.414	0.159	2.573	**
	Absorptive capability → ESG strategy	0.312	0.313	0.113	2.755	**
	Adaptive capability → SMP	−0.342	−0.366	0.178	1.916	0.056
	Adaptive capability → ESG strategy	0.531	0.540	0.109	4.863	***
	ESG strategy → SMP	0.581	0.607	0.159	3.662	***
After	Absorptive capability → SMP	0.372	0.357	0.186	2.003	*
	Absorptive capability → ESG strategy	0.311	0.316	0.112	2.789	**
	Adaptive capability → SMP	−0.323	−0.343	0.180	1.793	0.074
	Adaptive capability → ESG strategy	0.531	0.530	0.111	4.779	***
	ESG strategy → SMP	0.588	0.619	0.173	3.399	***
	Marker 1 → Absorptive capability	0.216	0.221	0.123	1.757	0.080
	Marker 2 → Adaptive capability	0.123	0.124	0.155	0.789	0.430
	Marker 3 → ESG strategy	0.004	0.004	0.084	0.044	0.965
	Marker 4 → SMP	0.075	0.087	0.112	0.616	0.538

*$p<0.05$, **$p<0.01$, ***$p<0.001$.

in **Table 2**, the factor weights and factor loadings of all variables were significant, and the AVE values were greater than 0.50 for all constructs (0.597 < all AVE values <0.890), which provides strong evidence of convergent validity. Discriminant validity was evaluated by comparing the AVE estimates for each construct with the square of the parameter estimates between two constructs. According to Fornell and Larcker (1981), discriminant validity is achieved if the AVE of each construct exceeds the square of the standardized correlations between the two constructs. All AVE estimates were greater than the squared correlations between all constructs. Thus, multicollinearity, convergent validity, and discriminant validity were established (see **Tables 2** and **3**).

The PLS-SEM can evaluate the structural model with the coefficient of determination (R^2) and predictive relevance (Q^2). The coefficient of determination from building an ESG strategy was 0.656, and SMP was 0.436. Moreover, blindfolding was performed to examine the predictive relevance of endogenous reflection indicators and single-item scales. Q^2 was obtained from the sum of squares of observations (SSO) for SMP and the sum of squares for predictive error (SSE). Looking at the analysis results, the Q^2 of SMP was 0.237 with a value of 0 or higher, and hence, the Q^2 of the structural model for endogenous potential variables exists (Sarstedt et al., 2016, see **Table 4**).

Hypothesis Testing

Figure 2 presents the results of the structural equation model. The results show that the absorptive capability ($\beta = 2.188$, $p < 0.05$) had a positive relationship with SMP. However, the adaptive capability ($\beta = 1.606$, $p = 0.109$) had no significant relationship with SMP. These results support Hypothesis 1–1, but not Hypothesis 1–2. Furthermore, we examined the mediating effects of the ESG strategy between the DCs (absorption and adaptation capabilities) and SMP. As a result of bootstrapping, absorptive capability ($\beta = 2.885$, $p < 0.01$) and adaptive capability ($\beta = 4.832$, $p < 0.001$) were analyzed as having a positive effect on the ESG strategy. The path from the ESG strategy to SMP was also positive and significant ($\beta = 3.022$, $p < 0.01$). In addition, the indirect path (DCs → ESG strategy → SMP) was also analyzed as significant, and it is possible to determine whether there is partial mediation. More importantly, when the mediating variable (i.e., the ESG strategy) was included in the model, the R^2 of SMP further increased from 0.372 to 0.436. Overall, these results demonstrate that ESG strategy implementation plays an important role in mediating between DCs and SMP. Thereby Hypotheses 2 is supported. Meanwhile, investigating whether control variables such as firm size, firm type, and externalities affected SMP did not show statistically valid results.

DISCUSSION AND CONCLUSION

In this study, we theorized and addressed two central research questions: (1) What capabilities and structures are required to achieve a firm's SMP? (2) How does the ESG strategy improve this performance? We developed a series of hypotheses by adopting a DCs perspective to explore the capabilities and strategies needed to create a firm's SMP. According to previous studies, DCs is generally a key factor that closely affects achieving a competitive advantage by improving a firm's performance. In particular, we argued that SMP can be achieved when implementing an ESG strategy based on DCs. Given the recent changes and uncertainties surrounding the business environment, we suggested that implementing strategies that meet social trends, such as having an ESG strategy, can serve as an essential mechanism for a firm's economic (or financial) performance as well as social and environmental performance.

The DCs perspective has long highlighted that a firm's competitive advantage is driven by the capabilities built into the process of responding to environmental changes. Building upon this analytical and theoretical underpinning, we linked two types of capabilities (absorptive capability and adaptive capability) to respond to the rapidly changing business environment, and business performance is important to a firm's sustainability. Moreover, we argued that firms should implement ESG strategies in order to achieve the sustainable value required

TABLE 2 | Analysis results from measurement model.

Variable	Indicators	Cronbach's α	VIF	Outer weights	Outer loadings	AVE
Absorptive capability	Ab1	0.931	2.304	0.171	0.802	0.674
	Ab2		2.617	0.144	0.787	
	Ab3		3.516	0.111	0.786	
	Ab4		3.025	0.126	0.731	
	Ab5		4.107	0.167	0.874	
	Ab6		3.442	0.158	0.808	
	Ab7		4.388	0.163	0.895	
	Ab8		4.140	0.173	0.873	
Adaptive capability	Ad1	0.921	4.334	0.202	0.891	0.718
	Ad2		2.623	0.156	0.773	
	Ad3		4.128	0.218	0.876	
	Ad4		2.349	0.167	0.811	
	Ad5		3.935	0.218	0.863	
	Ad6		3.808	0.214	0.863	
ESG strategy	ESG1	0.932	3.674	0.096	0.670	0.651
	ESG2		3.780	0.113	0.700	
	ESG3		3.110	0.147	0.765	
	ESG4		4.295	0.154	0.901	
	ESG5		3.636	0.140	0.838	
	ESG6		3.704	0.145	0.840	
	ESG7		4.190	0.130	0.836	
	ESG8		4.581	0.143	0.851	
	ESG9		4.659	0.163	0.831	
SMP	SMP1	0.903	2.611	0.160	0.753	0.597
	SMP2		2.254	0.170	0.677	
	SMP3		3.310	0.132	0.789	
	SMP4		2.580	0.163	0.775	
	SMP5		3.283	0.206	0.846	
	SMP6		4.190	0.166	0.774	
	SMP7		4.581	0.155	0.750	
	SMP8		4.659	0.143	0.808	
Externalities	Ex1	0.882	2.648	0.644	0.968	0.890
	Ex2		2.648	0.411	0.918	

TABLE 3 | Fornell–Larcker criterion.

Variable	1	2	3	4	5	6	7	8
1. Firm size	–							
2. Type (MFG)	–0.003	–						
3. Type (SVC)	0.012	–0.713	–					
4. Externalities	0.143	0.202	0.046	**0.943**				
5. Absorptive capability	0.167	–0.111	0.180	0.215	**0.821**			
6. Adaptive capability	0.153	–0.119	0.165	0.094	0.840	**0.847**		
7. ESG strategy	0.131	–0.196	0.211	0.099	0.759	0.791	**0.807**	
8. SMP	0.206	–0.131	0.188	0.178	0.567	0.467	0.606	**0.773**

by modern society. An empirical test on a sample of firms that implemented an ESG strategy in Korea supports some of our hypotheses. We obtained partially significant statistical effectiveness from the hypothesis that DCs (i.e., absorption and adaptation capabilities) respond to a changing environment and directly or indirectly affect SMP. In addition, we found that if the firms implemented an ESG strategy through DCs, they were more likely to achieve SMP. This evidence suggests that a firm's ESG strategy implementation has a vital role in promoting competitive advantage based on DCs. Our empirical findings demonstrate that firms' ESG implementation efforts can help strengthen their competitive position in terms of sustainability. Meanwhile, The Korean government is enacting various norms from an institutional perspective to facilitate ESG implementation in firms. This can act as regulatory pressure on firms, leading to an increase in the cost of regulatory compliance. Our research results can suggest a direction for firms to redefine their capabilities and develop ESG strategies in terms of preemptive response.

Our study offers important theoretical contributions to DCs research. First, our study contributes to the literature on a firm's sustainable competitive advantage creation. Specifically,

we adopted a DCs perspective to show the importance of a firm's capabilities and its strategy in affecting SMP. More importantly, this study contributes to the competitive advantage literature by providing new insights into the role of an ESG strategy in creating SMP. We expand corporate sustainable development research through strategic frameworks based on two types of DCs. These two DCs seem important in encouraging firms to implement ESG strategies. In addition, we contribute to the literature theoretically by identifying and capturing the social and environmental performance required for firms to improve sustainability. Despite great efforts by prior scholars on this issue, they generally focused on achieving results in terms of finance and innovation, ignoring the possibility that competitive advantage may influence social and environmental performance. We thus advance the understanding of the literature on sustainability and DCs by linking capabilities with sustainability, and by capturing and measuring effects at the firm level. By integrating ESG literature with the DCs perspective, we highlighted ESG strategy implementation based on DCs in achieving sustainable performance. To the best of our knowledge, our study is one of the first to examine how the various types of DCs shape an ESG strategy and the benefits such an ESG strategy provides to a firm's SMP.

Our study also provides important implications for a practical audience. This study shows that ESG strategy implementation can positively contribute to enhancing a firm's SMP. Undoubtedly, firms can benefit from implementing ESG activities when operating their businesses. Our study particularly suggests that firms can improve their SMP in terms of social and environmental performance as well as financial performance by actively responding to changing environments through implementation of ESG strategies based on DCs. Furthermore, managers of firms should be aware that DCs might not directly contribute to SMP. Therefore, most importantly, firms should recognize the importance of effectively implementing ESG strategies through DCs.

Like all research, this study has limitations. First, our sample only consists of firms in Korea, which may raise concerns about generalizing on the effectiveness of ESG strategies. Future research can verify the generalization of our frameworks and empirical results by expanding our study with samples of firms operating in other countries that promote ESG implementation. Second, we acknowledge that this study incorporated only a limited set of DCs and outcome variables into the analysis. Additional variables and conditions should be considered when exploring the forces to form a firm's ESG strategy and its implications. Previous research has emphasized the importance of a firm's

TABLE 4 | Predictive relevance (Q2) results.

Variable	SSO	SSE	Q2
Firm size	78.000	78.000	
Type (MFG)	78.000	78.000	
Type (SVC)	78.000	78.000	
Externalities	156.000	156.000	
Absorptive capability	624.000	624.000	
Adaptive capability	468.000	468.000	
ESG strategy	702.000	410.349	0.415
SMP	624.000	475.923	0.237

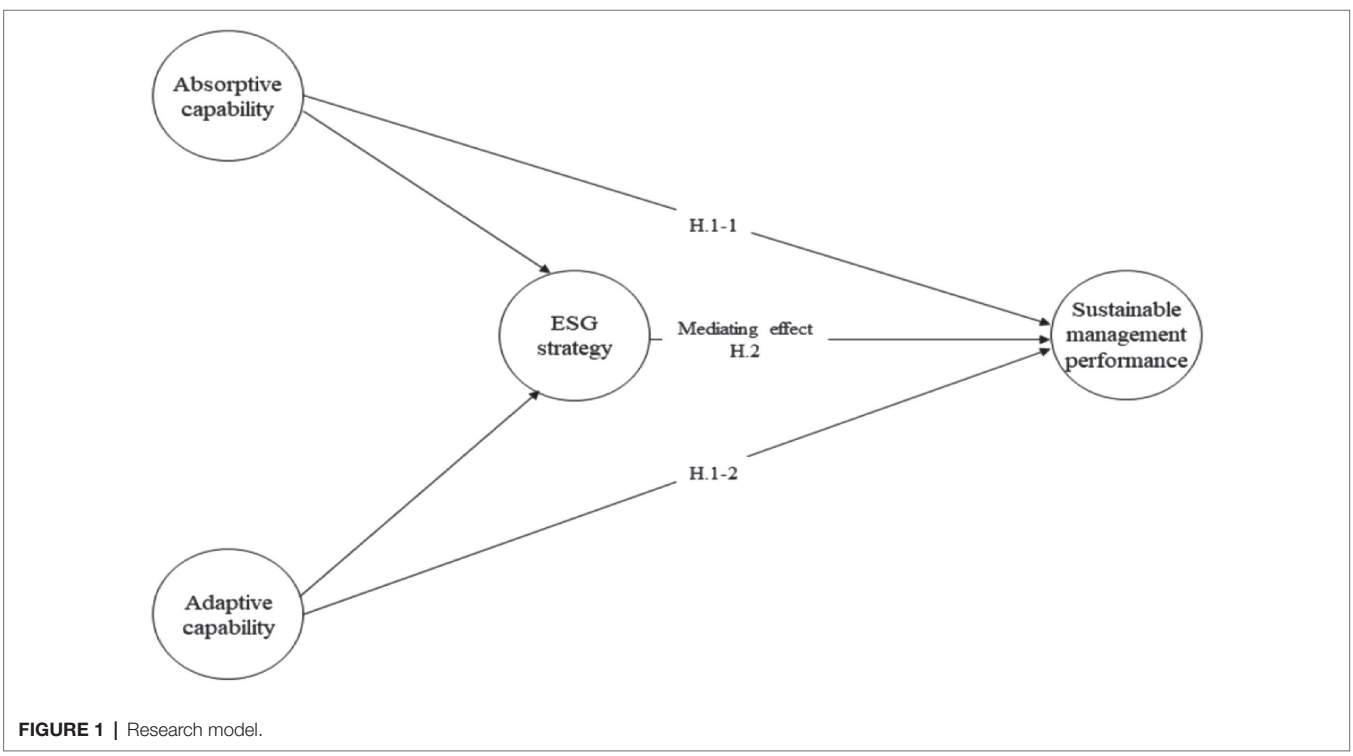

FIGURE 1 | Research model.

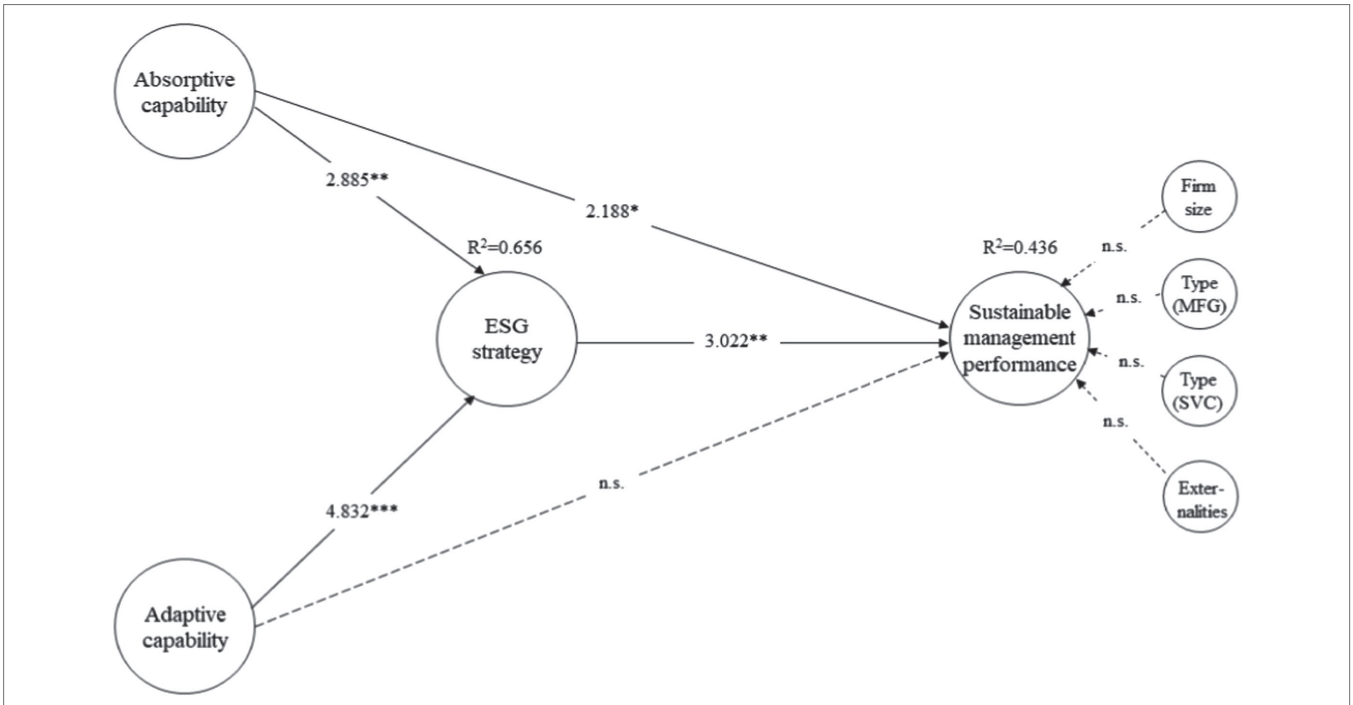

FIGURE 2 | Estimated results of a structural equation analysis. Non-significant paths are shown with a dotted line; n.s. = not significant. *$p<0.05$, **$p<0.01$, ***$p<0.001$.

various dynamic capabilities in forming suitable strategic choices (e.g., Wang and Ahmed, 2004, 2007; Agarwal and Selen, 2013; Ringov, 2017). Therefore, future research is recommended to investigate whether and how firms' various DCs can form ESG strategies differently and how these firms can achieve successful SMP by using ESG strategies. In the same line, the detailed process (e.g., sensing, integrating, and reconfiguration) of constituting DCs can be considered. Third, although we argue that the issue of reverse causality is of less concern in our study, we acknowledge that the problem may still be found in this type of cross-sectional research. As well, data constraints do not adopt longitudinal data or experimental methods to guard against the possibility of having a reverse-causality effect that biases the results. Moreover, due to data unavailability, we cannot capture in this study the possible dynamic nature of ESG strategy forces. Future research can further capture the dynamic effect of ESG strategies using longitudinal data. Studies can also explore how various DCs respond to environmental changes during implementation, and how ESG strategies contribute to a firm's strategic response and various types of performance. This is another potential future research avenue. Finally, as in a recent study by Bhandari et al. (2022), empirical analysis using ESG disclosure data emerged. This study used secondary data through a survey, which can be limiting in terms of ensuring the legitimacy of the data.

Meanwhile, using ESG disclosure could have been even better because this information is publicly out with some evidence at least (Christensen et al., 2013; Winkler et al., 2020). Using ESG disclosure data is useful to ensure the legitimacy of the methodology. For reference, in Korea, each firm discloses an ESG implementation report annually. However, these reports have no standards, and there are limitations in using them as analysis data because the contents are different for each firm. Of course, the Korean government is gradually promoting the disclosure of such ESG-related information, which is expected to be supplemented in future research issue.

In conclusion, our study offers a nuanced understanding of how a firm's DCs may influence its ESG strategy, and how they can be used to achieve sustainable performance in Korean context (institutional and social). We believe our findings provide valuable insights for improving a firm's sustainability by enabling scholars and practitioners to deepen their understanding of the importance of ESG strategic management.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

YL and ML contributed to the conceptualization, methodology, investigation and writing – original draft. ML and JJ performed research model, data collection, data curation and formal analysis. YL, ML, and JJ participated in the manuscript revision, review, editing and validation. All authors have read and approved the final manuscript.

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APPENDIX 1 PREVIOUS LITERATURE ON DYNAMIC CAPABILITIES

Performance measures	DCs → Performance	Antecedents to DC → DC (mediator or intermediate outcomes) → Performance	DC → Mediator/intermediate variable → Performance
Innovation performance	Agarwal and Selen (2013), Cheng et al. (2014), Chiu et al. (2016), Falasca et al. (2017)	Zheng et al. (2011), Cheng et al. (2014), Han and Li (2015), Wu et al. (2016), Falasca et al. (2017)	
Economic/financial performance	Wu (2007), Wilden et al. (2013), Wang et al. (2015), Ringov (2017), Fainshmidt et al. (2017), Girod and Whittington (2017), Konwar et al. (2017), Kumar et al. (2018)	Wu (2007), Lin and Wu (2014), Piening and Salge (2015), Wang et al. (2015), Fainshmidt et al. (2017), Ko and Liu (2017)	Liu and Hsu (2011), Ju et al. (2016), Vickery et al. (2013), Mu (2017)
Operation/process performance	Drnevich and Kriauciunas (2011), Wilhelm et al. (2015), Ju et al. (2016), Kumar et al. (2018)	Blome et al. (2013)	Ju et al. (2016)
Organizational/firm performance	Hung et al. (2010), Chien and Tsai (2012), Hsu and Wang (2012), Jiang et al. (2015), Peng and Lin (2017)	Hung et al. (2010), Chien and Tsai (2012), Hsu and Wang (2012), Sarkar et al. (2016), Peng and Lin (2017), Wamba et al. (2017)	Vanpoucke et al. (2014), Jiang et al. (2015), Wilden and Gudergan (2015, 2017), Lee and Rha (2016), Battisti and Deakins (2017), Mu (2017)
Competitive advantage	Li and Liu (2014), Schilke (2014), Wu (2010), Gelhard et al. (2016), Lin and Chen (2017)		Lin and Chen (2017), Mikalef and Pateli (2017), Ferreira et al. (2020)
Export performance	Monteiro et al. (2019)	Villar et al. (2014), Monteiro et al. (2019)	
International performance	Pinho and Prange (2016), Swoboda and Olejnik (2016)	Monferrer et al. (2015), Pinho and Prange (2016), Swoboda and Olejnik (2016)	
Portfolio performance	Mitrega and Pfajfar (2015)	Mitrega and Pfajfar (2015), Hermano and Martín-Cruz (2016)	
Product development performance	Chen and Chang (2013)	Zhang and Wu (2017)	Chen and Chang (2013), Cai et al. (2014), Mu (2017)
Project performance		Hermano and Martín-Cruz (2016)	
Response performance	Karimi and Walter (2015)		Karimi and Walter (2015)

APPENDIX 2 VARIABLES AND MEASURES

Variable	Measurement (5-point scale)	References
SMP	[SMP1] What is your firm's net profit growth level compared to its competitors over the previous five years?	Lumpkin and Dess, 2006; Panigyrakis and Theodoridis, 2007; Wang and Ahmed, 2007; Zhu et al., 2008; Adebanjo et al., 2016; Wu et al., 2016; Abdul-Rashid et al., 2017; Inman and Green, 2018
	[SMP2] What is the level of increase in your firm's market share compared to its competitors over the previous five years?	
	[SMP3] What is the level of contribution to alleviating your (individual, regional, and national) inequality compared to competitors over the previous five years?	
	[SMP4] What is the level of contribution to strengthening your firm's social safety compared to your competitors over the previous five years?	
	[SMP5] What is the level of contribution of your firm to solving overall social problems compared to its competitors over the previous five years?	
	[SMP6] What is your firm's level of reduction in carbon emissions compared to its competitors over the previous five years?	
	[SMP7] What is the level of reduction in your firm's resource (energy) usage compared to its competitors over the previous five years?	
	[SMP8] What is your firm's level of overall environmental performance compared to its competitors over the previous five years?	
Absorptive capability	[Ab1] Your employees have sufficient learning ability to acquire external knowledge.	García-Morales et al., 2008
	[Ab2] Your firm actively participates in activities to acquire external knowledge.	
	[Ab3] Your firm implements externally acquired knowledge (or information) in the organization.	
	[Ab4] Your firm uses a variety of processes within the organization to capture external knowledge (or information).	
	[Ab5] Your firm converts (socializes) the acquired knowledge (or information) appropriately for your organization.	
	[Ab6] Your firm combines the acquired knowledge (or information) with the organization and seeks transformation.	
	[Ab7] Your firm links new knowledge (or information) to work.	
	[Ab8] Your firm improves problem-solving functions by applying new knowledge (or information).	
Adaptive capability	[Ad1] Your firm monitors customers and competitors to respond quickly to changing market conditions.	Gibson and Birkinshaw, 2004; Wang and Ahmed, 2004
	[Ad2] Your firm allocates resources to marketing activities to respond quickly to changing market conditions.	
	[Ad3] Your firm has strategies and processes to respond to the changing market environment quickly.	
	[Ad4] Your firm encourages employees to challenge outdated traditions and practices.	
	[Ad5] Your firm has a system (or process) that can quickly redefine itself according to changes in business priorities.	
	[Ad6] Your firm has a management system (or process) that can determine whether you are responding quickly to market changes.	
ESG strategy	[ESG1] Your firm is establishing environmental management strategies and action plans.	Developed for this study based on the K-ESG index.
	[ESG2] Your firm manages its environmental performance through evaluation and audit systems.	
	[ESG3] Your firm actively supports the environmental protection activities of stakeholders.	
	[ESG4] Your firm actively participates in consumer protection.	
	[ESG5] Your firm actively participates in improving the working environment.	
	[ESG6] Your firm actively participates in mutual life with its partners (or competitors).	
	[ESG7] Your firm is building a process to guarantee shareholders' rights.	
	[ESG8] Your firm has established independent audit organizations inside and outside and monitors them at all times.	
	[ESG9] Your firm listens to opinions from stakeholders and markets and reflects them in management.	
Externalities	[Ex1] What is the community's level of interest in implementing ESG strategies?	Leong and Yang, 2020
	[Ex2] What is the level of customer or public expectations for ESG performance?	

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Exploring Trends in Environmental, Social, and Governance Themes and Their Sentimental Value Over Time

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Environmental, social, and governance (ESG) is an indicator that measures a company's non-financial performance. Many firms have recently emphasized the importance of ESG. Ascertaining what topics are being discussed around ESG and how they change over time will contribute significantly to gaining insight into ESG. Using 73,397,870 text data scraped and refined from publicly available Twitter data, this study applied Latent Dirichlet Allocation (LDA) and the dynamic topic model (DTM) to ascertain the hidden structure of the ESG-related document collection and the topics being discussed. The study further conducts a sentiment analysis to examine the sentiment of the general public regarding ESG. Topic modeling shows that various topics regarding ESG are being discussed and evolve over time. Sentiment analysis shows that many people have neutral or positive sentiments toward ESG-related issues. This study contributes to exploring insights into ESG among the public and understanding public reactions toward ESG. We further conclude the study with a discussion of managerial implications and potential future research.

Keywords: topic modeling, Latent Dirichlet Allocation (LDA), dynamic topic model (DTM), sentiment analysis, ESG, Twitter data, natural language processing (NLP)

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INTRODUCTION

There is no management concept that has been receiving as much attention as environmental, social, and governance (ESG) recently. To be ESG-compliant (an extension of corporate social responsibility and sustainability) used to merely mean being a "good company." Recently, however, ESG has come to mean a "company strong in crisis." In other words, how well a company can respond to and continuously manage risks, such as "environmental, social, and governance" risks, is becoming crucial in the face of increasing uncertainty in the corporate environment (Jo and Na, 2012). Particularly, many companies have been affected negatively by the recent COVID-19 pandemic. Interest in ESG has further sparked in terms of crisis management. For example, Díaz et al. (2021) show a change in the stock price gap between the top 25 and bottom 25 companies of the S&P 500 since the outbreak of the COVID-19, proving that companies with higher ESG ratings can mitigate the crisis.

Along with financial performance, the ESG index has become a significant indicating factor of a company's non-financial performance. Moreover, investments based on it have recently become the "new normal." According to Broadridge Data and Analytics (2021), ESG investment has increased to approximately seven trillion dollars; it is predicted that by 2030, it could increase to 30 trillion dollars. This expansion of ESG investment stems from the fact that the ESG concept emerges from the needs of investors who want to adequately evaluate the value of a company. Corporate social responsibility (CSR) is considered the incidental activity of a company to enhance corporate image and reputation. Accordingly, there are limitations in linking it with corporate management performance. In contrast, ESG pursues corporate sustainability based on environmental, societal, and governance themes. Moreover, the evaluation of corporate non-financial performance and investment are the most important factors. Rather than examining these changes, academia often considers ESG similar to the CSR concept and applies previous research perspectives and methods as they are. Therefore, there are few empirical studies on ESG. Moreover, most existing research focuses on the relationship between ESG and corporate performance or ESG assessment and evaluation.

Our study focuses on the ESG theme and the changes in its trends. We derive the most discussed topics about ESG and explore how society interprets and accepts ESG, and how society's understanding and interest in ESG change over time. We achieve this by scraping vast amounts of text data from Twitter using keywords, ESG, and #ESG, and analyzing the unstructured text content using machine learning techniques (ML). Twitter was used as a data source because it allows us to obtain a large amount of textual data of public opinion on ESG in real time (Gaytan Camarillo et al., 2021). Although information about ESG is abundant in corporate official documents and other social media services, we chose "public" Twitter as our data source because no other social media channel makes sharing information as easy. In other words, Twitter is suitable for our study, which aims to analyze ESG trends, as it allows for reading real-time trends through powerful information sharing (Vargas et al., 2021). The types of data also vary, from office domains such as businesses and governments to personal messages, which helps generalize the results of the analysis.

This study analyzes ESG-related big data in Twitter texts and classifies ESG-related Twitter conversations into several topics. Additionally, we examine the changes and trends in these topics over time. We further conduct sentiment analysis to examine society's overall sentiments toward ESG.

This study differs from most existing studies that consider ESG a performance or evaluation target. We focus more on the concept of ESG. We further examine what the general public is saying and communicating about ESG, its sentiment toward ESG, and how these conversations and emotions change over time.

This study can be replicated by scraping and analyzing tweet data in real-time. This can help managers understand public sentiment, gain insights into ESG, and establish management strategies. Analyzing the discussion of ESG in tweets worldwide also provides a global perspective.

Our research questions are

(1) What is the latent topic structure of ESG?
(2) How have the structures of ESG-related topics changed over time?
(3) What are the sentiments of ESG-related discussions?

This paper proceeds as follows. See section "Literature Review" briefly reviews related research. See section "Data and Methodology" presents the data and the model. See section "Empirical Results" discusses the findings and implications. See section "Discussion" further presents the conclusions and future research directions.

LITERATURE REVIEW

Environmental, Social, and Governance

The ESG concept refers to environmental, social, and governance structures, which are non-financial factors of a company, and is among the main indicators for evaluating a company's value. The UN emphasizes that a systematic response to ESG is essential for companies to achieve sustainable growth in future and, accordingly, devised the ESG concept in the UN Global Compact (2004), to highlight non-financial issues that may or may not significantly affect a company's investment value.

To understand ESG better, there is a need to understand the concept of corporate social responsibility (CSR), which is the precursor to ESG. Since Friedman (1970) seminal work, the discussion on the role of business in society has continued and expanded for more than 50 years. Accordingly, CSR has become an important element in corporate management and has been actively studied academics (Lee, 2008; Wang et al., 2016). However, it is becoming increasingly difficult to objectively define CSR and measure its performance as society's complexity increases and the scope of CSR expands to shareholders, society, customers, the economy, and the environment (Khojastehpour and Shams, 2020).

The ESG concept has been widely used as an alternative to CSR in the media, and in many studies; ESG and CSR are often defined as the same concept. However, ESG is more detailed than CSR in terms of definition and evaluation. While CSR aims to hold companies accountable, ESG defines the social role of companies in three domains: environmental, social, and governance (Dahlsrud, 2008). Moreover, CSR considers all stakeholders in a company while ESG focuses on ESG investors.

The idea of ESG began with investors' concerns and dissatisfaction with traditional CSR. Although companies' CSR activities may have helped enhance corporate image and reputation, investors were skeptical about whether they were effective and strategic in enhancing long-term corporate value. There were also complaints about companies' disclosure of CSR information. Corporate CSR reports had promotions and boasted about CSR activities but had little connection with corporate performance. Moreover, traditional financial statements could not report ESG performance adequately. Factors such as corporate carbon emissions, corporate governance, and

stakeholder management were not disclosed in financial statements (Amel-Zadeh and Serafeim, 2018).

Various disclosure standards and frameworks of ESG information, including the Sustainability Accounting Standard Board (SASB) and Taskforce on Climate Related Financial Disclosure (TCFD), have been suggested. The SASB was established to connect investors and companies in terms of ESG performance. The board divided companies into 77 sectors and selected factors that have high investor interest and financial relevance among the ESG factors that affect the company's financial performance, production, and operating activities in each sector (Busco et al., 2020). The TCFD was established by the G20 finance ministers and central bank heads of each country to establish climate change-related disclosure guidelines for companies. Companies must explain how climate change-related risks and opportunities are to be managed and how they relate to financial statements (Nelson, 2018).

The corporate standards of institutions such as "MSCI" and "Sustainalytics," which existed before ESG, were developed in line with the new ESG concept (Escrig-Olmedo et al., 2019). Moreover, companies increasingly made efforts to convert ESG standards into corporate profits by applying ESG standards to all areas of their business. Further, many investors created funds to invest in companies with high ESG performance based on these ESG standards.

Based on this ESG concept, ESG evaluation indexes of various ESG evaluation agencies such as "MSCI" and "Sustainalytics" were created and developed (Escrig-Olmedo et al., 2019). Additionally, companies converted ESG indicators, which many investors use to create funds that invest in companies with high ESG performance, into actual business profits. In 2020, global ESG investments more than doubled to $371 billion (Broadridge Data and Analytics, 2021), demonstrating just how significant the effect of ESG was on the business.

Additionally, concerns about the effects of environmental and climate change have raised the public demand for corporate accountability and transparency. Increasing public engagement, especially following the spread of social media, increases public pressure. Moreover, companies make ESG a top corporate agenda.

From this perspective, it is meaningful to examine the concept of ESG and examine the flow of change and the general public's sentiment toward ESG.

Research on Environmental, Social, and Governance in Business

Environmental, social, and governance-related research in the business area mainly focuses on evaluating ESG and analyzing the relationship between ESG and corporate performance. ESG assessment can be considered a continuum as it is a prerequisite for corporate performance analysis.

Research on the relationship between ESG and corporate financial performance has been ongoing for more than 40 years. Whether a company with high ESG can generate good financial performance has been a topic of interest for many scholars. Friede et al. (2015) conducted a meta-analysis of over 2,000 related papers on the relationship between ESG and corporate financial performance (CFP). ESG and CFP are classified as positive, negative, and neutral; the negative relationship accounts for only 10%. Similarly, most CSR research shows that CSR has a positive effect on corporate performance (Becker-Olsen et al., 2006).

There are several explanations for the positive relationship between ESG and CFP. Bénabou and Tirole (2010) analyzed three motivations for corporate ESG initiatives: adopting a long-term view of the company, delegating pro-social action on behalf of stakeholders, and insider-led corporate philanthropy. Thus, corporate performance can be created in the process of avoiding short-sighted judgments and increasing shareholder value from a long-term perspective. Baron (2008) argues that customers prefer products and services of ESG companies from the perspective of shareholders and that corporate members can increase productivity through conducting CSR activities within the company. Jo and Na (2012) found that a firm's active ESG activities reduce its overall risk, which drove a recent study by Díaz et al. (2021) showing that companies with high ESG were better able to withstand and overcome the crisis caused by COVID-19.

Because the concept of ESG is subjective and changes slightly over time, research on how to evaluate it has attracted attention. However, owing to the diversity of stakeholders, various methods for measuring corporate ESG performance have been proposed. Moreover, ESG is primarily concerned with managing the relationship between a company and its stakeholders such as consumers and communities. Therefore, according to Brammer et al. (2007) and Lee et al. (2016), ESG performance can be measured differently, depending on stakeholders' interests.

Further, the diversity of stakeholders' interest in ESG has created various institutions and measurement methods that evaluate ESG. Therefore, comparing and tracking changes in the evaluation of ESG has become an academic topic. For example, Escrig-Olmedo et al. (2019) analyzed how standards used by ESG institutions have changed over the past decade. Over time, standards have been consolidated in terms of environment and governance, rather than "sustainability."

Most ESG business studies focus on uncovering the relationship between ESG (CSR) and a company's financial performance. This is possible because many standards and evaluations generated by ESG rating agencies and the financial reports of numerous listed companies are readily available to researchers.

However, research on the ESG concept is relatively scant. The ESG concept is clearly explained using three keywords: environment, society, and governance. However, it is important to note that ESG is also a socially constructed concept, and the composition of that concept may vary with the influence of time and environmental changes.

Topic Modeling and Sentiment Analysis in Business Research

Since their inception by Blei et al. (2003), topic models have become one of the most important fields of modern machine

learning in natural language processing (NLP). Topic modeling is gaining traction because it allows for the definition of potential topics drawing on large unstructured text data (Indulska et al., 2012; Jeyaraj and Zadeh, 2020; Xiang et al., 2022). Storopoli (2019) explained the advantages of topic modeling as follows: First, topic modeling can be used to identify important topics that humans cannot discern. Second, it can be used to evaluate large-scale social phenomena. Third, the results of statistical validation eliminate the need for researchers to manually code and interpret data. Consequently, topic modeling has been widely applied in various fields such as geography (Cristani et al., 2008), political science (Quinn et al., 2010), hospitality and tourism (Lee, 2021) and medical science (Tran et al., 2019), etc. However, its application in business research has been quite limited.

Latent Dirichlet Allocation (LDA) has been applied in various fields. Nam et al. (2017) used LDA to extract hidden topics from brand perceptions of user segments. Kaplan and Vakili (2015) used LDA to develop text-based measures of unique patent ideas. Chae and Park (2018) analyzed CSR-related texts on Twitter to examine how CSR-related topics are being delivered, determine the main topics, examine how these topics are interrelated, and how they change over time.

Some business studies use an extended LDA model or develop a model based on LDA, including correlated topic modeling (CTM), to identify correlations between topics (Blei and Lafferty, 2007), structural topic modeling (STM) for discovering topics and revealing latent topical structures simultaneously (Otsuka et al., 2021), and the author topic model (ATM) for incorporating authorship information into the LDA (Rosen-Zvi et al., 2012). To measure business proximity, Shi et al. (2016) developed LDA and proposed a new method. Our study contributes to the second stream of research by applying dynamic topic modeling (DTM) to the analysis of Twitter data (Blei and Lafferty, 2006). The advantage of the DTM analysis is that it can detect changes in the trend of a subject over a time series.

Recent studies have attempted to measure human sentiments and predict future emotions through textual data analysis. Although it is difficult to accurately measure an individual's sentiment, the sentiment accumulated through verbal expressions can be measured if certain criteria are given. Simply put, it is a method of arranging various words corresponding to sentiments and measuring the degree of sentiment through factors such as detection frequency (Medhat et al., 2014; Koto and Adriani, 2015). Sentimental analysis has developed following the development of text analysis technology as well as the growth of online social media platforms, such as Twitter and Facebook (Zimbra et al., 2018). Companies and various social groups have recently paid close attention to the value of messages and opinions generated on social media, which is also an important driver of research development.

Business research using sentiment analysis is largely divided into two types, according to the research subject. The first research stream investigates and forecasts stock market movements using sentiment analysis of online news or social media related to the stock market. Das and Chen (2007) analyze the sentiment of investors toward Amazon in the stock discussion on Yahoo from 1998 to 2005, and show the relationship between investor sentiment and stock value. Bollen et al. (2011) classified the sentiment of Twitter text into six moods (calm, alert, sure, vital, kind, and happy) as well as positive and negative emotions, and forecasted the fluctuations of the stock market price. Similarly, Bing et al. (2014) proposed a stock price forecast model based on the sentiment analysis of social media text. Previous studies mainly investigated the effect of opinions on stock prices. However, Deng et al. (2018) find that stock prices are expanding into their effect on microblog sentiment.

The second research stream involves the analysis of product or service reviews using sentiment analysis. These studies on customer reviews initially focused on numerical analysis, such as rating rankings and the number of reviews (Chevalier and Mayzlin, 2006; Huang and Chen, 2006; Archak et al., 2011). For example, Lu et al. (2013) show a positive correlation between review volume and sales revenue. In addition to the numerical analysis of customer reviews, the content of customer reviews was analyzed by analyzing the text. Text analysis is mainly performed based on sentiment analysis. For example, Hu et al. (2014) calculated the sentiment index by integrating the title and content of Amazon reviews, and showed that the sentiment index of reviews has a more direct effect on sales than customer ratings. Marchand et al. (2017) found that the volume of customer reviews influences sales of up to 10 weeks after the launch of a product, and positive/negative sentiments from reviews influence sales of up to 6 weeks. However, the amount of microblogging affects sales only during the first week of the launch. Gräbner et al. (2012) proposed a methodology for constructing a domain-specific lexicon to classify customer reviews into good or bad sentiments.

Few studies have used text analysis as a methodology in ESG. This is because the research subject was limited to the data disclosed by the company. Early studies were aimed at deriving ESG-related words and examining trends. However, it was difficult to analyze a large amount of information owing to the limitations of early text analysis technology. Nielsen and Thomsen (2007) analyzed reports from

TABLE 1 | Text analysis (ML) and sentimental analysis about ESG.

Data	Method		
	Text analysis		Sentiment analysis
	Manual	ML/DL (Automated)	
Corporate Report (CSR Report, Disclosure, Financial Report, company website)	Nielsen and Thomsen, 2007; Gao, 2011; Castellanos et al., 2015; Lock and Seele, 2016	Te Liew et al., 2014; Liu et al., 2017; Lee and Huang, 2020; Kiriu and Nozaki, 2020; Raghupathi et al., 2020; Raman et al., 2020; Lee et al., 2021; Ning et al., 2021	Mućko, 2021
Social Media (Twitter, News. . .)	–	Lee et al., 2016; Chae and Park, 2018; Borms et al., 2021, Our study	Ballestar et al., 2020, Our study

six companies, and Castellanos et al. (2015) used reports from seven companies. Since the mid-2010s, the development of big data handling technologies, such as deep learning and machine learning, has made it possible to automate and analyze large amounts of data. For example, Te Liew et al. (2014) used the term frequency-inverse document frequency (TF-IDF) methodology to analyze more than 100 companies. Recently, studies have applied the LDA model: Ning et al. (2021) analyzed 680 company disclosure data, and Raghupathi et al. (2020) derived automated results (topics) through 1,737 more reports.

Environmental, social, and governance-related text analysis has expanded its research topics from traditional initial public offering (IPO) studies to larger and broader areas, such as Twitter and Internet news. Chae and Park (2018) derived CSR-related topics through topic modeling using over 1.2 million Twitter posts via Twitter API. Lee et al. (2016) extracted approximately 17,000 CSR corpora from newspaper articles and research papers, and generated a CSR vocabulary based on them.

The subject of the study has been expanded from corporate disclosure data to Twitter and news, which means that ESG research, which has been narrowly studied from a corporate perspective, has been expanded to include a wider range of ideas and opinions from society. Given ESG is not only a topic of interest to companies, but an area of interest to various stakeholders such as the government, investors, and consumers, it is an appropriate change to expand ESG research to various social media platforms.

Most sentiment analysis research in the business domain focuses on stock market forecasts and the customer reviews of products or services. ESG-related sentiment analysis using corporate disclosure data has many difficulties in deriving managerial implications through sentiment analysis owing to the lack of positive disclosure data. Recently, studies have been conducted using social media data to overcome the shortcomings of corporate disclosure data with too many positive messages. Ballestar et al. (2020) showed that it is possible to classify Twitter users into groups of positive and negative sentiments by using ESG-related tweet text. This is because of the nature of Twitter data, in which various stakeholders express various positive/negative sentiments, unlike corporate disclosure data, which are naturally full of positive messages.

As shown in **Table 1**, some text studies use machine learning techniques, and some recent studies have started to apply sentiment analysis. Unlike previous studies that applied text analysis or sentiment analysis, our study applies both text and sentiment analyses to explore insights into ESG among the public and understand public reactions toward ESG.

DATA AND METHODOLOGY

Data

We chose Twitter as a data source because not only is it one of the most popular social media platforms, but is also a microblogging platform which provides data on real-time communication and information sharing in text form. Using #ESG and keyword ESG, we collected tweet data through Academic Research Track, a Twitter API that offers an unlimited time service for ten million tokens per month. The use of the term ESG began to increase rapidly after the Paris Climate Agreement in December 2015. We further set the data collection period from January 1, 2016, to December 31, 2020. We discarded retweets during this period using the Twitter API filter. The number of original tweets collected using the Twitter API with #ESG and ESG keywords totaled 1,787,230.

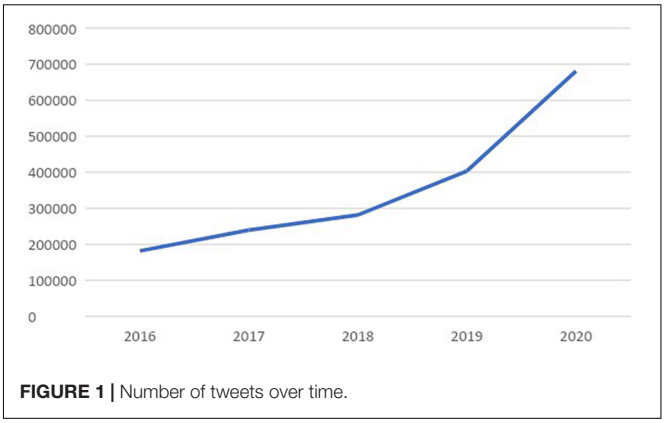

FIGURE 1 | Number of tweets over time.

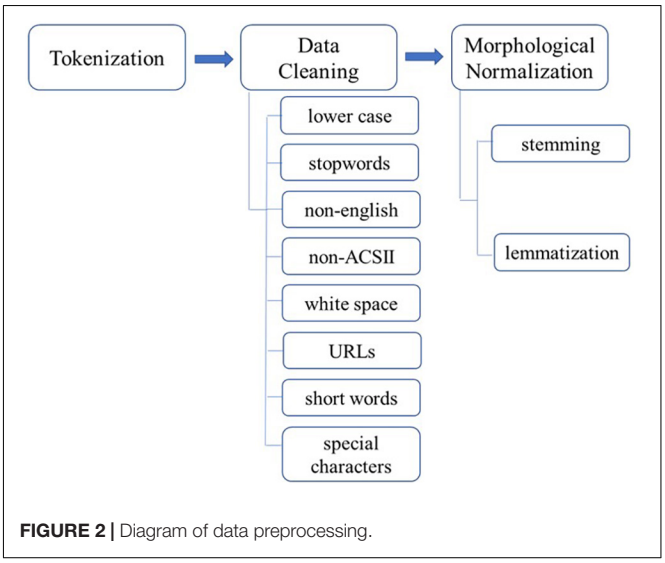

FIGURE 2 | Diagram of data preprocessing.

Figure 1 shows the volume of tweets collected by year. The number of ESG-related tweets continues to grow, reflecting the recent growing interest of businesses and the general public in ESG.

The collected text data were then normalized, a process of transforming language that humans can understand into a standard form that can be understood by computers or machines. This normalization follows the procedures of tokenization, stop word removal, and morphological normalization. The diagram in **Figure 2** shows the procedure of data preprocessing normalization.

First, tokenization was performed to break down each sentence and word into understandable minimum units. To

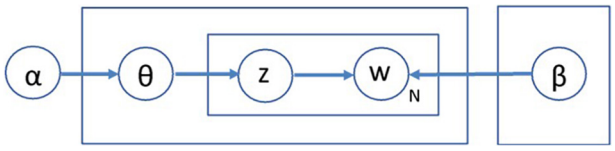

FIGURE 3 | Plate notation representing LDA.

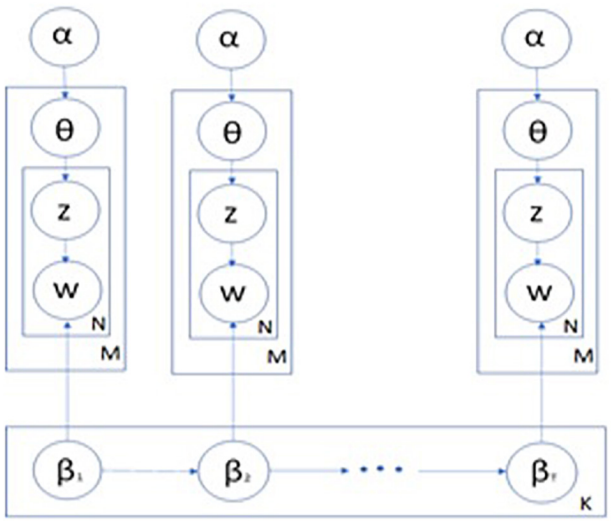

FIGURE 4 | Plate notation representing DTA.

smooth or remove noise in our textual data, we cleaned our data by converting all characters to lowercase, trimming non-English tweets, and eliminating stop words that are frequently used in the text but have no significant contribution to the meaning of the text, special characters, words less than four in length, unicode characters that are unreadable in an ASCII format, mentions, URLs, hashtags, and unnecessary white spaces. To remove stop words, we used the list of stop words provided by NLTK in Python. Third, stemming and lemmatization were performed for morphological normalization. Porter's algorithm from the NLTK library was used to extract the stems of words. Using lemmatization, the inflectional endings of words are removed, and the root forms of words are obtained. Our preprocessing using Python resulted in 73,397,870 words.

For further empirical analysis, we converted our text data into a format that could be used as an input for the topic model. Each sentence in our dataset was sentenced into a list of words, after eliminating unnecessary characters such as emoticons and punctuation. The two main inputs to the topic model, corpus and dictionary, were further created.

The sentiment score for each tweet was measured using the Valence Aware Dictionary for Sentiment Reasoning (VADER), which is a lexicon and rule-based sentiment analysis available in Python. See section "Sentiment Analysis" provides more details on this measure.

Model

Topic Model

In summary, the topic model is an unsupervised machine learning model used to ascertain the latent thematic structure in a collection of documents with hierarchical probabilistic models. Among several algorithms such as latent semantic analysis (LSA), LDA has been one of the most widely used methods in topic modeling since its inception by Blei et al. (2003). LDA is a generative probabilistic model that describes a collection of documents as a text corpus. LDA presupposes a fixed number of topics, and further assumes that each document is represented as a distributional integration of these topics and words. As shown in **Figure 3**, the observed documents and words (w) in a dataset are generated using latent structures, such as the topic assignment of each word in each document (z), topic distribution of each document (θ), word distribution for each topic (β), and specific input number of topics, k.

The generative probabilistic process of document collection shown in **Figure 3** can be summarized as follows:

1. For each topic $k = 1, \ldots, K$,

generate $\beta_k \sim \text{Dir}(\cdot|\ \varphi)$

2. For each document $d = 1, \ldots, N$,

generate $\theta_m \sim \text{Dir}(\cdot|\ \alpha)$
For each word w in document m,
generate $z_{m,n} \sim \text{Mult}(\cdot|\ \theta_d)$
generate $w_{m,n} \sim \text{Mult}(\cdot|\ \beta z)$
where Dir denotes a Dirichlet distribution and Mult denotes a multinomial distribution.

Using this hierarchical generative process of LDA, the joint distribution of the observed and hidden variables in Eq. 1 is obtained by:

$$p(\beta, \theta,\ z,\ w) = \prod p(\beta) \prod p(\theta) \prod p(z|\theta)\ p(w|\beta,\ z) \quad (1)$$

The hidden structure of the observed and hidden variables was inferred by posterior inference using the Gibbs sampling MCMC algorithm.

Latent Dirichlet Allocation is very useful for performing the dimensionality reduction and qualitative summary of topics of large corpora; however, it does not consider the temporal order of when the tweets are written. We extended LDA into a dynamic topic model (DTM) by considering a topic as a sequence of distributions over fixed time intervals, such as years and months. Therefore, DTM allows us to discover the richer posterior structure of topics and explore the evolution of ESG-related topics over time and how the probability of top words within a topic changes over time. Considering the temporal aspect of documents is important because, for example, the term "ESG" did not even exist 15 years ago and has only been actively used recently.

Dynamic topic model assumes that each document is arranged in a preset time span, each with its own topics. Each topic in each time span was randomly selected from the same topic in the previous time span. The probabilistic generative process of

FIGURE 5 | Word cloud of the most common cleaned words after normalization.

a document in a specific time span follows the same process as that of LDA. **Figure 4** shows the plate notation of DTA, where *t* denotes the time slice, which is the year, and the other notations are the same as the LDA in **Figure 3**. Each topic at time *t* evolves from a corresponding topic at time *t-1*.

Sentiment Analysis

While topic modeling is an analysis of what topics are being discussed and how those topics evolve over time, sentiment analysis is a method used to understand the general public's sentiments or opinions about a particular topic.

There are two major approaches to sentiment analysis: supervised machine learning, and unsupervised lexicon- and rule-based learning. This study was conducted using Python NLTK VADER (valence aware dictionary for sentiment reasoning (NLTK VADER) for the lexicon- and rule-based unsupervised learning methods). VADER is well suited for our study, as it is designed for sentiment analysis expressed on social media (Hutto and Gilbert, 2014).

Valence Aware Dictionary for Sentiment Reasoning provides a quantified sentiment output of compound scores for each sentence based on the polarity (positive or negative) and the intensity of the sentiment of each word. VADER uses a dictionary to map the lexical features of each word to its polarity and intensity, which are used to assess the sentiment of each word. By identifying the sentiment score of each word in a sentence, the compound score of sentiment in each sentence is calculated by summing the sentiment scores of each word in a sentence and then normalizing it to a number in the range of −1 to 1. A compound score greater than 0.5, less than −0.5 and between −0.5 and 0.5 is classified as positive, negative, and neutral, respectively. The number of tweets varies by date; for example, on October 29, 2020, there were 6,399 tweets, whereas on January 1, 2017, there were 159 tweets. We computed the mean compound scores for each date to determine the change in sentiment over time.

EMPIRICAL RESULTS

We generated the word clouds to visualize the important words based on their frequency, as shown in **Figure 5**. The word clouds in **Figure 5** show the differences before and after normalization. Words that are not useful for text analysis, such as https and not RT in **Figure 5**, do not appear in **Figure 5** after normalization.

To conduct LDA topic modeling, we used the Gensim-LDA library in Python. To derive meaningful results from topic modeling, it is important to determine the number of topics. This is because if the number of topics increases, various ESG-related trends can be extracted, but similar topics can occur, which can distort the evolution of each topic. In this study, 20 topics were chosen to produce the most interpretable and manageable number of topics, considering the tradeoff between semantic coherence in **Figure 6** and exclusivity (Roberts et al., 2014).

Of the 20 topics found through topic modeling, we eliminated two topic clusters (topics 9 and 20) that were difficult or irrelevant to the label. The labels were chosen through discussion and consensus among the authors by reviewing the most likely tweets per topic and considering the top 30 most frequent words by topic and their probabilities. The 18 labeled topics and words that appeared the most in each topic are summarized in **Table 2**.

Figures 7, **8** show a visualization of the topics in two dimensions. The visualization has two components: the

intertopic distance map in **Figure 7** and the bar charts in **Figure 8**. **Figure 7** shows an overview of the topic model. Different topics are plotted as circles, where the importance of the incidence of each topic is indicated by the size of a circle. Using multidimensional scaling, the distance between each topic is expressed as the distance between the center points of each circle. For example, **Figure 7** indicates that climate change in topic 1 with a relatively high share is far apart from transparency in topic 19, as climate change in topic 1 has some overlaps in words used with cluster 5, the topic of investor.

The 18 topics discovered and labeled in this study are climate change, investment, training, funds, investors, stocks, disclosure, data, carbon, conferences, business, market growth, green, ESG, rating, asset value, transparency, and consulting. Based on the intertopic distance map in **Figure 7**, the topic groups can be divided into four groups. The clusters of investment, fund, investor, asset value, business, stock, and market growth in the first quadrant of **Figure 7** can be classified into investment groups. The climate change, carbon, ESG, and green clusters in the second quadrant of **Figure 7** can be classified into environmental topic groups. Transparency and rating in the first quadrant and consulting, and training in the fourth quadrant of **Figure 7** can be broadly classified into topics related to evaluation and education, respectively. In summary, ESG-related tweets were composed of 19 topics, which were further classified into four topics: environment, investment, education, and evaluation.

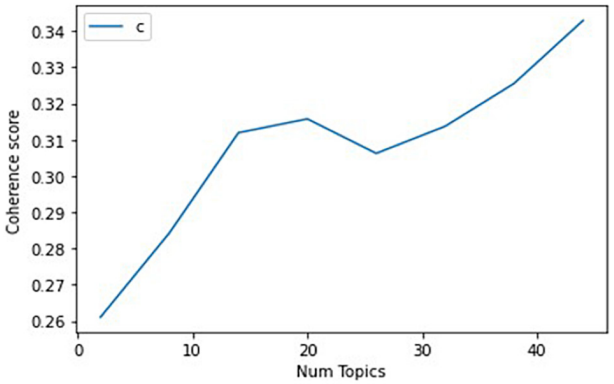

FIGURE 6 | Coherence score for each number of topics.

TABLE 2 | Labeled topics and its top words.

Labeled topic	Best topic words	Number
Climate change	financial, trillion, billion, climate, change	1
Investment	investment, responsible, global	2
Asset value	value, asset, management	3
Fund	fund, pension, invest, credit	4
Carbon	carbon, reduce, impo	5
Stock	stock, exchange, ethical	6
Disclosure	disclosure, public, report	7
Business	business, responsibility, forward	8
Green	green, sustainable, energy, innovation	10
Data	data, analytics, performance, infrastructure	11
Investor	investor, executive, giveaway	12
Market growth	market, growth, performance	13
Conference	conference, join, panel, register	14
ESG	social, governance, environmental	15
Rating	rating, standard, socially, responsible	16
Training	trainee, guidance, forum, school	17
Transparency	transparency, trust, role, code	18
Consulting	consultant, research, money	19

Figure 8 shows a bar chart in descending order of the top 20 most frequently occurring terms for topic disclosure. Overlaid bars indicate the corpus-wide and topical frequencies of a given term. We used the top 30 frequently used words to label each topic and interpret its meaning. Evidently, the terms "disclosure," "report," "risk," and "financial" frequently appear in the cluster of topic 7.

Dynamic topic model results for topics of "climate change," "green," "rating," "data," "ESG," and "investment" are shown in the following **Table 3**. For each topic, we selected the most interesting keywords and visualized them as time-series graphs to identify trends over time.

(A) "Climate Change" shows the annual trends for the probability of frequently occurring words – financial, trillion, billion, digital, and risk – within "Climate change" topic. The increasing use of the term "risk" in climate change topics seems to reflect growing awareness and interest in the risks associated with climate change. A decrease in the term "billion" and an increase in the term "trillion" among the unit words indirectly suggests that the risk of climate change is significantly increasing (Zhongming et al., 2021). The decline in the term "financial" and the increase in the term "digital" indicate that what previously focused on analyzing the risks of climate change financially is now starting to look for a solution, digital transformation.

(B) The term "green" shows that technology, plan, fund, and green are increasingly used within the "Green" topic. Given that this is a "green" topic to an environmental crisis, the growing use of these words translates into an effort to find alternatives in terms of the environment, one of ESG.

(C) The term "rating" shows that the use of the words shareholder, standard and institutional is a growing trend within the topic "Rating." These trends reflect the growing importance of ESG evaluation standards and institutions performing evaluations in addition to shareholders' interest in ESG.

(D) The term "data" shows that the demand for data analysis and reporting is increasing owing to the increase in ESG-related data.

(E) The abbreviation "ESG" shows that with respect to the ESG topic, the use of the words responsibility and transition is increasing and the use of the word good is decreasing. These trends indicate that the meaning of ESG is shifting from simply being a good company to one that is socially responsible.

(F) The term "investment" shows that the use of the words increasingly, industry, fund is increasing and the use of the word affect does not show a growing trend but it is consistently used. These trends indicate that interest in investing in ESG funds continues to grow, and the recent trend in which ESG funds are invested in by the industry sector is also recognized.

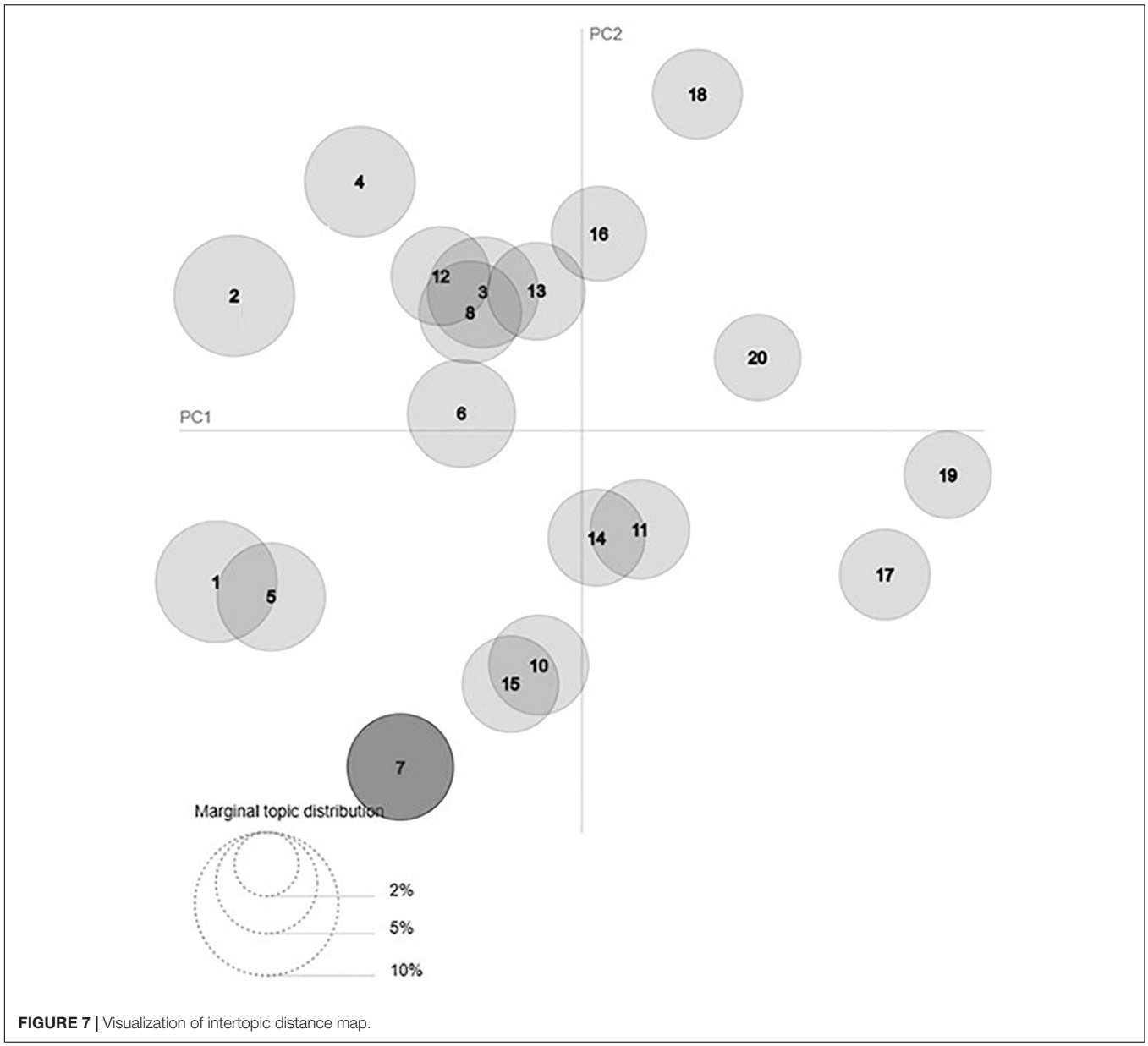

FIGURE 7 | Visualization of intertopic distance map.

The number of tweets varies by date; for example, on October 29, 2020, there were 6,399 tweets, whereas on January 1, 2017, there were 159 tweets. The number of Twitter posts per day in **Figure 9** shows that it follows a right-skewed distribution. Therefore, the sentiment score on a particular day was calculated by computing the mean of the compound scores for each date. **Figure 10** shows a histogram of sentiments per day that appears to follow a normal distribution with a positive mean.

Figure 9 shows that more than approximately half of public sentiments are neutral and that positive sentiments are approximately three times more common than negative sentiments. These findings could be understood by noting that the ESG concept should be viewed from two perspectives. Fundamentally, it aims for positive values that pursue corporate responsibility in terms of environment, society, and governance, and simultaneously serves as a standard for evaluating the activities of companies pursuing these values. The former can be interpreted as positive sentiments and the latter as neutral sentiments.

As shown in **Figure 10**, the number of tweets per day follows the right skew distribution, and the tweet volume changes daily. We computed the mean compound scores for each date to determine the change in sentiment over time.

Figure 11 shows that the sentiment of public tweets for ESG was calculated for each date as the timeline fluctuates considerably depending on the date. The biggest peak occurred on September 14, 2018 with a sentiment score of 0.359, but was not accompanied by a surge in the amount of tweet volume. A closer look at the tweets on September 14, 2018 reveals why. One of the main reasons for this is that the global climate

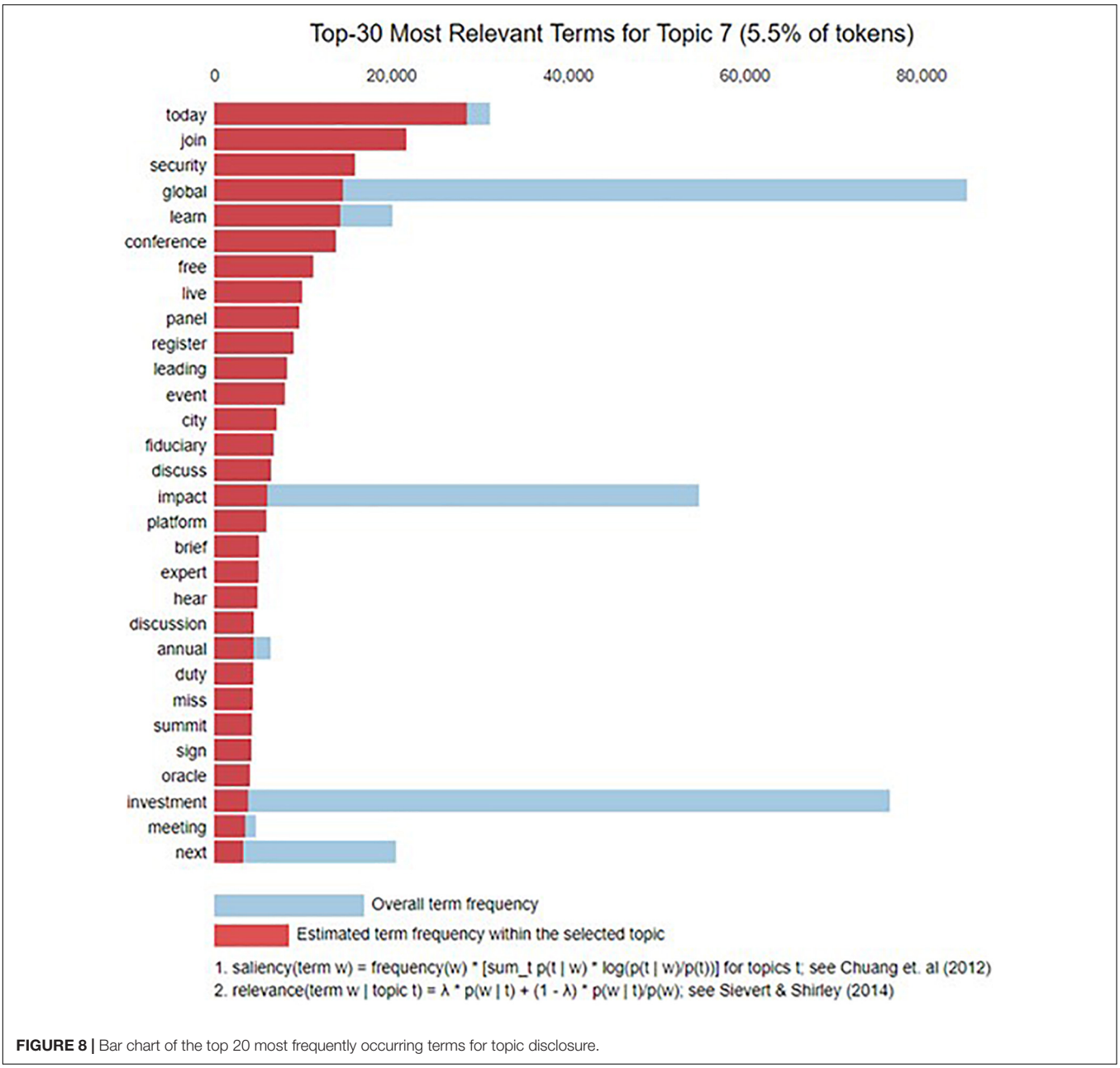

FIGURE 8 | Bar chart of the top 20 most frequently occurring terms for topic disclosure.

action summit (GCAS) was held for 3 days, from September 12, 2018 to September 14, 2018. Heads of state, government representatives, industry and civil society leaders, and officials from international organizations gathered to discuss specific plans for climate change, such as the implementation of the Paris agreement. On the 14th, the last day of the summit, positive tweets about ESG activities seem to have exploded owing to the activities of GCAS.

April 22, 2018, was also one of the days when positive sentiment surged. A closer look at the tweets indicates that it was designated as Earth Day to show support for environmental protection. Earth Hour, which advocates switching off lights at 8:30 pm in more than 193 countries, is a very popular Earth Day event. Moreover, the success of these light-out events has been instrumental in the surge in positive ESG tweets.

The significant increase in negative sentiment tweets on October 24, 2018 (score −0.216) and October 29, 2018 (score −0.180) appears to be related to President Trump's conservative stance on environmental policy. During the United States presidential debate between Trump and Biden on the 23rd, Trump made headlines online when he made anti-environmental remarks, "wind energy is very expensive. kills all the birds." On the 29th, an article was published stating that a bill to ban retirement pensions from investing in ESG funds was being pursued quickly, which drew criticism from many ESG investors.

TABLE 3 | Time series transition of probability of selected words in the topic.

Regarding the surge in negative sentiment on October 24, 2018, negative newspaper article feedback appeared to have an impact on ESG. A rare negative comment on ESG in the *Financial Times*, "The fallacy of ESG investing: Win-win arguments promoting both bigger profits and better social returns are illogical" seemed to trigger many negative tweets.

The reason for the high negative sentiment score on June 9, 2018, is interesting. This is because of the surge in negative sentiments caused by tweets about the losses incurred by an online gaming team that uses the abbreviation ESG. For further research, tweets about the game team ESG should be eliminated as noise. See **Table 4** for examples of tweets from days when positive and negative sentiments surged.

Although we presumed and investigated that there could be a correlation between the number of tweets and sentiment score in ESG, an insignificant Pearson correlation between tweet volume and sentiment score (r = 0.110) indicates that conversation volume is not significantly related to the sentiment score.

The above results show how text analysis using LDA, DTM, and sentiment analysis can help uncover narratives in unstructured text data.

DISCUSSION

Authors' conversations in social media change rapidly so that we can determine the general public's reaction or emotion to a specific topic at this point in time. ESG is widely used to evaluate non-financial factors such as corporate sustainability and social responsibility, and its importance is being increasingly emphasized. This study proposes a method to obtain real-time information and track evolution on the topics the general public is talking about ESG and how the public feels about it using publicly available Twitter data.

By applying LDA, DTM, and sentiment analysis, we were able to identify unobserved topics and sentiments in a collection of ESG-related Twitter posts and ascertain how they evolve over time. DTM was performed on seven out of 18 topics found through LDA, which allowed us to reveal characteristic evolutionary processes by time-series tracking of seven topics and frequently used words within each topic.

Our study shows that ESG-related tweets are composed of 18 topics, which are further classified into four groups: environment, investment, education, and evaluation. Among these, the most frequently mentioned topic is investment. In **Figure 7**, seven topics (investment, asset value, fund, stock, investor, business, and market growth) out of a total of 18 topics are located close to each other in the investment group, whereas in the ESG cluster closest to a pure ESG concept, there are only four labeled topics (environment, carbon, green, ESG). There are two topics near the investment group: rating and transparency, which can be considered extensions of ESG investment from an ESG evaluation point of view.

The background of ESG growth means that there is a need for investors to evaluate and invest in the value of a company's sustainable growth. Corporate CSR activities have been implemented to enhance social pressure and corporate image, and whether these activities actually increase corporate profits is controversial in academia and management fields; however, investors are not interested. In a situation in which the capitalist system and the sustainability of the planet are at stake, such as the global financial crisis and global warming problem, and COVID-19, investors are also aware of the crisis and are encouraging and pressing companies to solve ESG issues. The results of our study explain this social phenomenon.

We show that identifying the evolution of frequently used words in each topic over time could provide an opportunity to gain a broader understanding of the analysis and predictions about current and future trends in that topic. For example, the increasing use of the word "risk" in climate change topics reflects growing awareness and interest in the risks associated with climate change. Additionally, words such as, "technology," "plan," and "fund" are increasing in green topics, implying that resources such as alternative green technologies and investment to address current environmental challenges are increasing, and these investments are expected to continue in the future.

We show that daily sentiment scores fluctuate over time without any particular pattern, and that most sentiment scores are positive when summed over days. For specific days with significantly higher or lower sentiment scores, it is most understandable if we consider the tweets on that day. For example, sentiment in the September 14, 2018 tweets appear to have surged

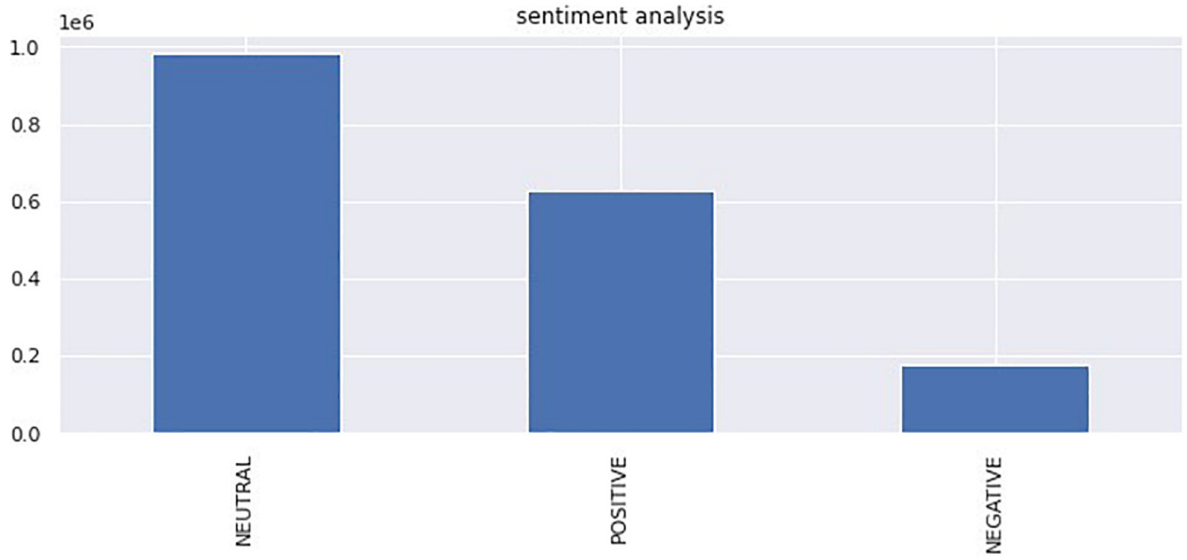

FIGURE 9 | Bar chart of the sentiment score of each tweet.

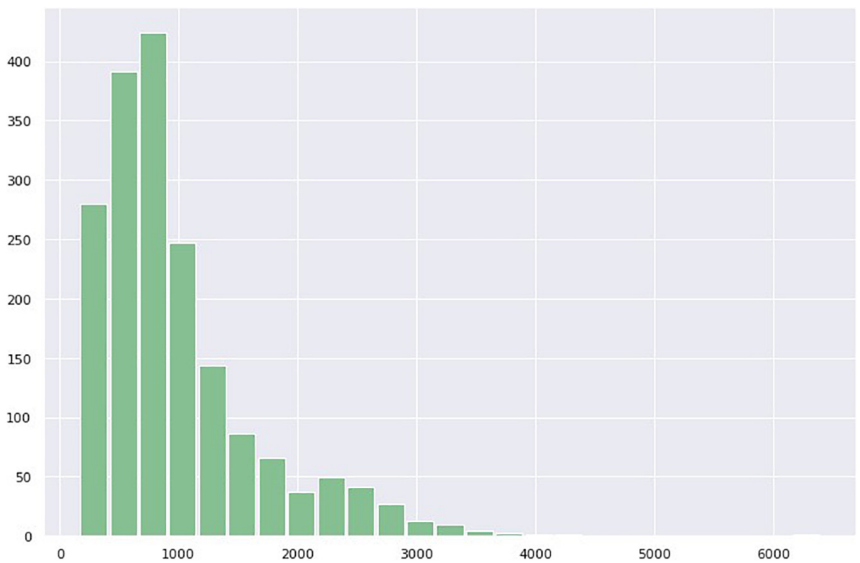

FIGURE 10 | Histogram of the amount of twitter per day.

to high positive values on the final day of the global climate action summit (GCAS) as a result of the 3-day GCAS activity.

In this study, we applied LDA, DTM, and sentiment analysis to derive potential topics related to ESG and ascertain how the ESG theme is structured and changes over time and how the public's emotions are related to this change. Whereas existing text analysis studies on ESG mainly apply simple text analysis methods or topic modeling methods, our study is meaningful in that we take an integrated approach to ESG themes by adding time-series analysis (DTM) and sentiment analysis.

The results of this study are managerially and practically relevant. The results of our research can serve as a guideline for companies or organizations with a poor understanding of ESG, to easily prepare for ESG management. For example, ESG is a relatively recent concept that has received a lot of attention since the Paris Climate Agreement. For companies that understand ESG as an extension of CSR unrelated to investment or simply as being a good company, our research helps clarify that ESG is a new concept linked to investment. The sentiment analysis of ESG fluctuates and has no specific pattern. It can be used as an appropriate media response tool by analyzing ESG in real time for a specific company or organization.

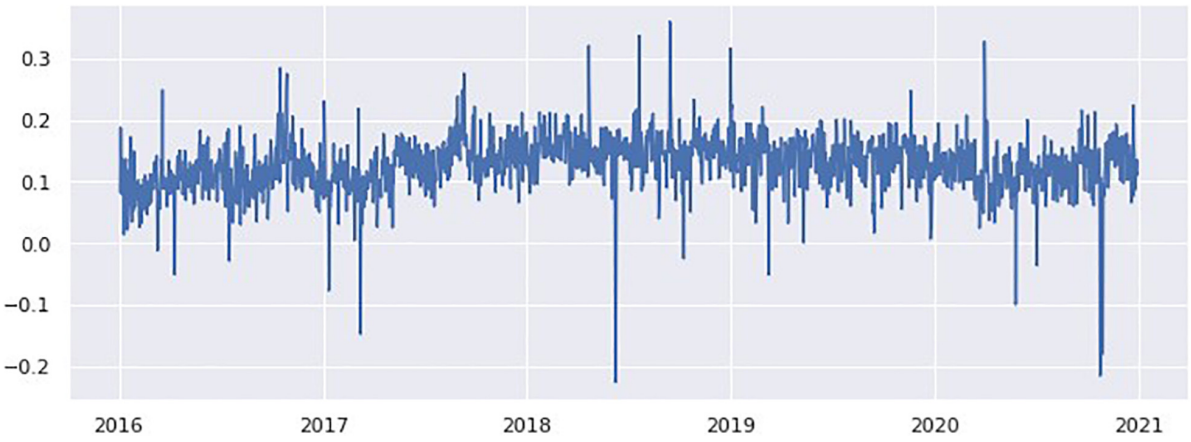

FIGURE 11 | Public sentiment of tweets on ESG with timeline.

TABLE 4 | Examples of tweets from days when positive and negative sentiment surge.

Date	Tweets
14-09-2018	@DanielRossPerry "You have to face this now. You're going to feel pressure from investors, employees, consumers, vendors. It's a fabulous opportunity for entrepreneur. Don't work on your #ESG story, figure out your #ESG impacts" inspiring stuff to wrap up @NasdaqTech #GCAS2018
14-09-2018	@evanharvey99 "When should #starups thinking about #ESG? Right now" @Nasdaq @nasdaqcenter @GCAS2018
22-04-2018	@BradZarnett We must act before it's too late. On Earth Day today commit to the planet! Thanks Nath Paresh for this powerful cartoon! #EarthDay #EarthDay2018 #ESG #climate #climate change
22-04-2018	@kmahnhw Happy #EarthDay! Good time to look at #sustainable, responsible and #impact investing with @SmartTrustUIT #ESG
24-10-2020	@ChrisLu44 Trump literally doesn't understand anything about wind or solar power.
24-10-2020	@TomPowdrill This article seems to have annoyed a lot of people in my microcosm, but I think it has a lot of sense in it. "The fallacy of ESG investing"
24-10-2020	@Benefits_PRO Trump administration moves at "warp speed" to kill ESG in retirement plans
09-06-2018	@Sky_LoL_At How can a pta fiora, who shittalks entire game, perma ff, starts dorans blade vs. pantheon, keeps 1v1 after being 0 3, get into ESG. Idk man, this guy every single time I see him he talks so much SHIT

LIMITATIONS AND FUTURE RESEARCH

This study has some limitations. LDA and DTM are general topic models. However, they are based on simplified assumptions. First, models are required for the number of topics to be predetermined and fixed in advance, which is subjective and may not reflect the true distribution of topics. Second, the models are based on the bag-of-words assumption that the order of words in a document and that of documents can be ignored. Future research should consider using extended topic models that consider word dependency and are more flexible in their basic assumptions, such as the extended global topic random field (Wang et al., 2015).

In most previous research on topic modeling, the topics in each cluster were manually named, and in this study, the topics were manually named according to previous studies. However, this method may result in judgment bias that is influenced by the subjectivity of the researcher. Therefore, in future studies should strive to minimize judgment bias through the automatic naming of word clusters without human intervention, as in Hindle et al. (2013).

Twitter is the most popular social media platform for academic research because it makes it easy to obtain data through an application programming interface (API). However, tweet data contain many expressions that differ from everyday life, such as slang, emoticons, hashtags, and ironic sentences, which makes it difficult to find the exact meaning using text-mining techniques. These difficulties pose problems for many natural language processing methods such as sentiment analysis. Because results can vary significantly by using different types of stemmers or lemmatizes and extraction of data, it is important to try various and tuned methods using a wider range of social media text data.

A major challenge in using social media data to identify real-world trends is the bias caused by the self-reporting nature of social media. As discussed in organizational behavior research (Podsakoff et al., 2003) a common technique for mitigating self-reporting bias is collecting self-reported data through experience sampling methods; this is not applicable to a passive setting of social media analysis. Recently, Sheth (2009), Cheng et al. (2011), and Kıcıman (2012) showed the need for a better understanding of the self-reporting bias inherent in social media by integrating

social media analysis with location-based social networks. The problem of self-reporting bias inherent in social media data is considered an important future research stream because little empirical research has been conducted relative to its importance.

To deepen our understanding of the dynamics of topics and sentiments about ESG, future research could conduct analyses that consider the dynamics and evolution of topics and sentiments together. In this study, topic modeling and sentiment analysis were conducted separately. Because we can conduct sentiment analysis using the probability of words that are frequently used in each topic, it is important to understand the complex dynamics if we understand how evolution over time of topics is related to the sentiment score and how it is affected by sentiments. Second, many ESG-related studies suggest a positive effect of ESG activities, including financial performance, on companies. Collecting ESG-related tweets about individual companies and analyzing relationships between sentiments and financial performance, such as stock price, are expected to contribute to existing research. Third, many studies have found that companies with high ESG are strong against risk. Computing the ESG scores of individual companies using tweet data and examining the role ESG plays in the crisis triggered by COVID-19 would be interesting. An event study could be used to observe stock price changes before and after the outbreak of COVID-19.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

S-UJ: study conception and design. WC: data collection. S-UJ and JP: analysis and interpretation of results and draft manuscript preparation. All authors reviewed the results and approved the final version of the manuscript.

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Exploring the impact of environmental, social, and governance on clean development mechanism implementation through an institutional approach

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The study hypothesizes that the environmental, social, and governance (ESG) of the host country have a significant effect on clean development mechanism (CDM) implementation. As CDM incorporates sustainable development as one of the objectives for the green transition, many countries endeavor to adopt and implement CDM as their cleaner production method. Based on the institutional theory, the study aims to investigate the mechanism by which the institutional process of each ESG pillar makes an opportunity for a host country and to see how such country-specific factors influence the implementation of CDM projects. A county-year unbalanced sample drawn from World Bank and multinational CDM project data was analyzed using panel logistic and Poisson regression. Panel regression results show that high-energy intensity and low renewable electricity output as an environmental pillar positively affect CDM implementation. Unemployment and undernourishment as a social pillar positively affect CDM whereas low government effectiveness and the high rule of law positively affect CDM. In the results of zero-inflated Poisson regression, the direction of government effectiveness was upturned. The findings have broadened and deepened the ESG pillar based on the institutional theory and emphasized sustainable development rather than economic outputs.

KEYWORDS

CDM implementation, CDM projects, ESG, institutional theory, sustainable development

Introduction

The impact of global warming has become an urgent issue worldwide, which severely impacts ecological and environmental well-being, and ongoing industrial development worsens this at an unprecedented pace (Ji et al., 2021a; Khan and Ozturk, 2021). Various efforts have been made to reduce greenhouse gas (GHG) emissions, the fundamental causes of global warming. Collaborative actions through various environmental and economic strategies are required to reduce GHG emissions (Wang R. et al., 2020; Wang Y. et al., 2020; Cheng T. et al., 2021; Cheng Y. et al., 2021; Ji et al., 2021b). It also includes cooperation between developed and developing countries. The United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992 and entered into force in 1994, was launched to promote international efforts to address the challenges caused by climate change. The initial implementation phase of the UNFCCC supports the concept of "common but differentiated responsibilities (CBDR)." (Castro, 2016) In other words, it places a greater burden on developed countries, recognizing that they are primarily responsible for historical emissions.

The Kyoto Protocol, adopted in 1997 and entered into force in 2005, is the first international regulation designed to implement the UNFCCC based on the concept of CBDR. The clean development mechanism (CDM) is one of the Kyoto mechanisms introduced through the Kyoto Protocol; Annex I countries called advanced countries under the UNFCCC can cost-effectively achieve their binding reduction goals. Developed countries support through capital and technology to carry out the projects to reduce GHG emissions in developing countries; the reductions generated from these projects are recognized as certified emission reductions (CERs) and can be used as domestic reductions. CERs generated can be traded between countries/companies. In other words, developing countries can sell CERs for reduced environmental pollutants to developed countries and thereby gain an opportunity to participate in the global carbon market and achieve sustainable development (Purohit, 2009; Lim and Lam, 2014; Zainuddin et al., 2017).

Clean development mechanism has started with the expectation that it will become a win-win system that benefits both developed and developing countries. CDM finances emission reduction projects with technologies needed for host countries, thereby contributing to low-carbon technology-related skills, employment, and capacity building for developing countries (Purohit and Michaelowa, 2008; Paulsson, 2009; Seres et al., 2009; CDM Policy Dialogue, 2012; Lim and Lam, 2014).

Contrary to the earlier implementation principles, the Paris Agreement and the United Nations 2030 Agenda for Sustainable Development, finalized in 2015, emphasize sustainable development visions through self-differentiation of countries' responsibilities. To achieve this ultimate goal, the Paris Agreement provides countries in need of a framework for financial, technical, and capacity-building assistance. In other words, the implementation of the Paris Agreement is essential for achieving the sustainable development goals (SDGs) and provides the most comprehensive roadmap for climate actions that will reduce emissions and strengthen climate resilience. Previous studies found that climate actions outlined in the nationally determined contributions (NDCs) voluntarily submitted by each country to carry out the Paris Agreement promote synergies with national development priorities that reflect the 2030 Agenda (Junsheng et al., 2019; Zheng et al., 2019). In this regard, it is necessary to interpret CDM from a sustainable development point of view. In particular, sustainable development mechanism (SDM), a new carbon market mechanism for the new climate regime according to the Paris Agreement, further underscores the sustainable development of the country based on the existing CDM framework.

To address the above issues, we aim to explore the environmental, social, and governance (ESG) pillars at a country level that affects the implementation of the CDM based on a sustainable development perspective. Previous literature focuses on how factors of ESG at the firm level have affected CDM project acceptance, technology transfer, and environmental contribution (Kuo et al., 2021; Stefanoni and Voltes-Dorta, 2021). However, few studies bind the theoretical lens with ESG as a precondition for implementing CDM projects at a national level. In other words, although ESG competency at the national could suggest the possibility of winning an order for an eco-friendly national industry or project, existing studies emphasized the importance of each competency individually, which might lead to overlooking the exhaustive framework. Maignan (2001), Chapple and Moon (2005) tried to explain that national factors or national ideologies can explain the socially responsible activities of corporations. Ebrahimi and Koh (2021) combined institutional theory with product life-cycle thinking, serving as a sustainability decision assessment (Durana et al., 2021). However, factors that explain the social activities at the national level remain to be studied. This research is vital because when countries try to implement CDM projects, it cannot be successful without the host country's reciprocal relationship and the ESG of the host country. Verifying the assumption that consideration of ESG can be adopted at the national level of CDM projects with an institutional perspective has high value as research on the ongoing carbon market.

By filling the above research gaps, our research has made three contributions to the literature on the implementation of CDM projects by ESG at the national level. First, based on the institutional theory, we extend the understanding that the environmental and social characteristics of CDM beneficiaries can provide cost-benefit opportunities for investment countries. Successful CDM projects continue to be copied and benchmarked through a mimetic isomorphism when additionality should be allowed. Second, our exhaustive

approach provides a theoretical understanding of the contextual characteristics of each national ESG in a CDM project. Our findings suggest that interactions with stakeholders in the feasibility examination can act as an opportunity to strengthen the legitimacy of accepting and internalizing the norm for CDM projects in interacting with the environment rather than unilaterally. Third, this study presents a paradoxical perspective that the CDM project was originally designed to help the sustainability of least developed and small countries, but it may not. This finding suggests that remedies are needed by coordinating structural or substantive examination of the organizational body that manages CDM according to the country's ESG situation.

Theoretical background and hypothesis development

Institutional theory

While various theories and frameworks have been used to explain the responses to climate change, institutional approach has been widely embraced, along with legitimacy theory and stakeholder theory (Pellegrino and Lodhia, 2012; Ortas et al., 2015; Bazo et al., 2019; Kitsis and Chen, 2021). These frameworks describe how companies maintain legitimacy to meet social expectations (Hrasky, 2011), report on GHG emissions to meet the information needs of stakeholders (Liesen et al., 2015), and determine the business strategies driven by institutional pressures (Aerts et al., 2006; Higgins and Larrinaga, 2014). In particular, institutional theory has been used to explain the external influence on an organization to move toward sustainability trajectories (Ioannou and Serafeim, 2012). The core of the theory is that the environment and social surroundings could significantly affect the development of formal structures within an organization exerting significant influence on the organization's decision-making (Campbell et al., 1991; Campbell, 2007). The deeper features of social structure impact the norms, rules, and routines and act as the guidelines in an organization (Kauppi, 2013). In addition, institutional theory has explained corporate social responsibility (CSR) activities since CSR activities are shaped by social contexts and national systems and are influenced by general institutions and policies for engaging in socially responsible activities (Aguilera et al., 2007; Jackson and Apostolakou, 2010). Furthermore, recent studies applied institutional theory to explain ESG, providing empirical evidence on how different country-specific social and institutional schemes influence companies' ESG performance (Ortas et al., 2015). In this study, we assume that since CDM as a representative method for responding to climate change has recently been widely implemented as a means of CSR and ESG activities, it is inevitable to regard CDM as an institutional instrument. CDM has incorporated sustainable development as one of its objectives, along with reducing GHG emissions. CDM is being implemented as a means of CSR (Johannsdottir et al., 2014; Benites-Lazaro and Mello-Théry, 2017).

From an institutional point of view, the existing literature related to the carbon project verified forest-based mitigation (Boyd et al., 2007), REDD+ (Peskett et al., 2011), and CDM (Alizadeh et al., 2014), respectively. Boyd et al. (2007) emphasized the importance of carbon finance as a potential policy strategy to address global climate change, deforestation, and social development in underdeveloped countries while focusing on the socioeconomic impact of forest-based mitigation projects that emerged under the United Nations Framework Convention on Climate Change. Taking Uganda as a sample, Peskett et al. (2011) looked into how chances for underprivileged rural producers or people close to the project are impacted by the changes in institutional arrangements related to the carbon finance portion of a project. Alizadeh et al. (2014) presented the case in Iran, where the implementation of the CDM project progressed improperly due to the factors such as a lack of adequate infrastructure and skilled professionals. Despite the exploratory approach of the existing literature, the discussion on how the theoretical mechanism of ESG at the national level attracts the CDM project remains in its infancy. Given that CDM must be founded on international cooperation before it can be used as a part of these activities, we suggest that it is an appropriate chance to examine CDM projects from an ESG perspective using institutional theory.

Clean development mechanism project implementation

Clean development mechanism has started expecting that it would benefit both developed and developing countries. Developed countries can use CDM to minimize the relatively expensive domestic reduction burden and fulfill their reduction goals at a low cost through abroad projects. In contrast, underdeveloped countries can adopt it for transfer to boost national development. However, it is hard to measure the achievement of carbon offsetting since there is no agreed standard for evaluation. Also, the minor participation of local stakeholders or authorities makes the CDM lack transparency and accountability (Lövbrand et al., 2009; Kuchler, 2017), thus making the contribution to sustainable development vague. It shows that the CDM installation purpose of contributing to the sustainable development of developing countries is likely to be neglected in operating the CDM. Therefore, this study suggests that the CDM projects promoted so far from the ESG perspectives in implementing CDM projects integrate the needs and situation of the developing country and local authorities. Accordingly, the hypothesis corresponding to the three pillars, ESG, is as follows.

Environmental determinants for clean development mechanism implementation

Clean development mechanism projects are more likely to invest in countries with a high-energy intensity than those with low-energy intensity to obtain more credits through projects. Of the proposed CDM projects from 2008 to 2012, the energy-intensive countries such as South Korea, India, Brazil, and China possessed the potential for green technology (Ellis et al., 2007). However, Bayer et al. (2013) verified the relationship between inflows of foreign direct investment (FDI) and CDM project implementation in China and found that FDI limits the implementation of CDM projects. Developed countries with FDI experiences have access to advanced technology, leading to significant productivity increases and lower-energy intensity and carbon dioxide emissions. Energy intensity is a concept that indicates how much economic output is produced with the same amount of energy, and if the level of technology increases and produces more economic output with the same amount of energy, energy intensity is considered low. In countries with low-energy intensity, the marginal cost for carbon emission reduction increases, and the profitability of CDM projects decreases (Saggi, 2002; Popp, 2011). Therefore, this study assumes that energy intensity and CDM projects have a positive relationship.

To earn more carbon credits through the project, CDM-investing countries are more inclined to participate in host countries with high renewable electricity generation opportunities. Pata (2018) conducted a study to verify the relationship between economic development and urbanization, renewable energy consumption, and CO2 emission in Turkey during 1974–2014. The results show that as urbanization progresses by 1%, CO2 emission per population increases by 0.272–0.482%, and when economic development goes by 1%, CO2 emission per population increases by 0.082–0.096%. However, although renewable energy consumption is considered one of the main CO2 emission reduction methods, it does not significantly affect CO2 emissions. This is because renewable energy consumption in Turkey accounted for only about 6.49% of total energy consumption. China is notorious for using a lot of fossil fuels worldwide, but at the same time, it actively promotes the use of renewable energy nationwide. As of 2019, China's renewable electricity output has grown quite rapidly, accounting for about 27% of China's electricity output. Given the rapid renewable electricity output growth rate, China is projected to peak its emissions in 2030 while achieving its carbon-neutral target by 2060 (IRENA, 2019; Gao et al., 2021; Li et al., 2021). This can be estimated that CO2 emissions will be effectively reduced when renewable electricity output is nationally active. Therefore, since investing countries trade CERs by reducing CO2 emissions in developing countries through CDM, CDM projects will be actively implemented if a host country's renewable electricity output is high and CO2 emission reduction can be effectively achieved.

> **H1.** The host country's energy intensity will positively impact the CDM project.

> **H2.** The host country's renewable electricity output will negatively impact the CDM project.

Social determinants for clean development mechanism

Unemployment of the unskilled population is a pivotal contributor to crime, political violence, and social backwardness. Income inequality generated through unemployment stimulates crimes while instilling a sense of relative deprivation in the low-income class (Mocan, 1999; Kelly, 2000; Kliestik et al., 2020; Valaskova et al., 2021a). However, CDM projects create opportunities for creating more jobs for the population. By assuming the co-benefits associated with logging residues for bioenergy production in East Texas, United States, Gan and Smith (2007)'s input–output modeling revealed that the most noticeable benefits of bioenergy production were income and job creation. Similarly, unemployment in the host country can help to meet the needs of the CDM project. Therefore, unemployment as a factor for investors' social opportunity is expected to positively impact the CDM project's activation for host countries.

The use of fossil fuels for producing goods and services is increasing worldwide (Koçak and Şarkgüneşi, 2018). Fossil fuel consumption releases greenhouse gases that contribute to climate change (Bilgili et al., 2016; Zhou et al., 2017; Čuljkovic, 2018), adversely affecting the poor in Asia and Africa. Poor households are dependent on ecosystem-based livelihoods and experience production loss due to several obstacles (e.g., climate change, temperature rise, different rainfall patterns, natural disasters, heat exposure, malnutrition, and disease transmission) to poverty eradication and sustainable economic development (Zhou et al., 2017; Valaskova et al., 2021b). From a long-term perspective, one way to respond to climate change is to convert existing industries into cleaner production. The increase in cleaner production helps to improve environmental pollution and solve the problem of poverty (Khan, 2021). CDM projects help to solve the host country's environmental issues and improve the people's household income. Carfora and Scandurra (2019) found that the annual income of rural residents increased by 5.75% through biomass-based CDM projects in rural China. Therefore, it can be assumed that countries with widespread poverty will be active in

implementing the CDM project to solve climate change and poverty problems.

Countries with high poverty rates may prefer environmentally friendly technologies. Although developing countries do not have high-energy demand as industrialized countries, interest in growing crops for biofuel production by utilizing vast available arable land is growing. Through this, developing countries can expect job creation and income increase in rural areas, and advanced countries can respond to rising fossil fuel costs, instability of oil supplies, and climate change. Nevertheless, the pace of biofuel development in Sub-Saharan Africa is relatively low. This is because a significant proportion of Africa's residents are net food buyers, and repurposing land used to produce food crops for biofuels could increase food security concerns and exacerbate poverty (Jumbe and Mkondiwa, 2013; Silva Filho et al., 2018). Therefore, in countries with extreme poverty, it can be interpreted that the food problem takes priority over benefits such as job creation and income increase. Based on this, this study assumes a positive relationship between the prevalence of undernourishment and the CDM project.

> **H3.** The host country's unemployment will positively impact the CDM project.

> **H4.** The host country's prevalence of undernourishment will positively impact the CDM project.

Governance determinants for clean development mechanism

Governance is a multidimensional concept that can be divided into civic participation, political stability and absence of violence, government efficiency, regulatory quality, the rule of law, and corruption control. Civic participation refers to the freedom of expression and speech and the degree to which citizens can participate in elections, whereas political stability and the absence of violence refer to the likelihood that a government will be destabilized or overthrown by violent means. Government efficiency refers to the quality of public services and independence from political pressure, the quality of policy establishment and execution, and the reliability of government policy implementation. The rule of law refers to the level of trust and observance of social discipline by the elected, and corruption control refers to the extent to which public power is exercised for private gain (Halkos and Tzeremes, 2013).

Governance can influence the implementation of CDM due to a variety of factors. Environmental regulation is one such factor. According to the institutional theory, companies show that they care about legitimacy, image, and reputation to external stakeholders by complying with the system (Bansal and Hunter, 2003). Moreover, long-term growth may be hindered if a company does not meet institutional expectations (Teo et al., 2003). Therefore, firms are motivated to adopt practices that are assessed to be socially valuable to maintain legitimacy (Raza, 2020). Since these factors induce companies to adopt green management practices (Delmas and Toffel, 2004), an empirical finding that environmental regulation affects CDM supports this claim (Zainuddin et al., 2017).

Ucar and Staer (2020) examined that managers tend not to engage in anti-social behavior because the costs of violating social norms are high when corruption is absent; on the other hand, they tend to reduce pro-social behavior in highly corrupt environments. Corruption also reduces the rigor of government energy policies (Fredriksson et al., 2004) and weakens environmental regulation enforcement (Arminen and Menegaki, 2019). From the CDM investor's point of view, severe institutional corruption hurts the project by incurring very high transaction costs for CDM investors and project executors (Phillips and Newell, 2013).

It is difficult to effectively promote low-carbon communities and respond to climate change through government policy. To further enhance the effectiveness of government policies, transparency in government policies is essential. The financial burden is significantly difficult to meet the GHG emissions reduction target. A country with low corruption can build trust

TABLE 1 Clean development mechanism implementations by year.

Year	CDM_{No}	CDM_{Yes}	$CDM_{Yes/Total}$ (%)	CDM_{Number}
2000	187	6	3.11	14
2001	187	6	3.11	36
2002	184	9	4.66	49
2003	178	15	7.77	67
2004	176	17	8.81	78
2005	171	22	11.40	78
2006	171	22	11.40	145
2007	164	29	15.03	275
2008	162	31	16.06	371
2009	160	33	17.10	499
2010	159	34	17.62	610
2011	159	34	17.62	607
2012	153	40	20.73	439
2013	154	39	20.21	246
2014	167	26	13.47	66
2015	175	18	9.33	29
2016	180	13	6.74	19
2017	183	10	5.18	20
2018	188	5	2.59	5
2019	191	2	1.04	2
Total		100	3655	

and secure funding for climate change from the international community (Hasan et al., 2020). In addition, when economic policy uncertainty is high, firms become more conservative in their management because it is difficult to predict future cash flows and try to hold more cash (Li, 2019; Phan et al., 2019). In other words, when policy uncertainty is high, companies reduce eco-friendly activities to avoid cost concerns, uncertainties, and risks (Hou et al., 2022). As a result, uncertainty becomes an obstacle to committing their resources to low-carbon projects such as CDM (Hultman et al., 2012). Therefore, this study assumes that government effectiveness will positively affect the CDM project.

Welsch (2004) argues that a strict rule of law pressures companies to follow environmental policy guidelines, inducing companies to comply with pollution prevention protocols and reduce CO2 emissions. The strict rule of law, along with institutional capacity, is a factor that reduces uncertainty and creates a stable investment environment for CDM (Phillips and Newell, 2013).

> **H5.** The host country's governance effectiveness will positively impact the CDM project.

> **H6.** The host country's rule of law will positively impact the CDM project.

Methodology

Research context

Table 1 shows the cases of CDM implementation and non-implementation, the ratio of implementation and non-implementation, and the frequency of CDM implementation by years. The frequency of CDM implementation during the entire sample period increased sharply as of 2005 and then decreased significantly from 2012.

Table 2 shows CDM frequency in the top 10 countries where CDM was actively implemented at a 5-year interval during the sample period. China and India accounted for a significantly high proportion of all our countries, and CDM was gradually implemented until 2010. However, the frequency of CDM gradually tended to decrease from 2015.

Figure 1 is a visual representation of the results of Table 2. It was analyzed to determine the frequency of CDM implementations by regions and continents; the darker the green color in the figure is, the higher the frequency. The lowest CDM frequency recorded 1, whereas the highest reached 1,716, and approximately 80% of CDM was concentrated in Asia.

Figure 2 shows the changes in the institutional background at the time of CDM implementation fluctuation over the years mentioned above. The international community has been pouring in efforts by concluding various conventions for the ultimate efforts to respond to climate change through GHG reduction. For example, Marrakesh Accords was adopted during the Conference of the Parties (COP) 7 hosted in 2001. It led to the agreement on detailed rules for implementing the Kyoto Protocol, a climate change-related international convention. By officially adopting the Marrakesh Accords in COP11 in 2015, the Montreal protocol facilitated the implementation of the Kyoto Protocol (UNFCCC, 2021a). Moreover, as the first phase of the EU Emission Trading System (ETS), the international emissions trading system targeted most countries obligated to reduce GHG under the Kyoto Protocol, was carried out during 2005–2007, international activities for GHG reduction garnered attention (European Commission, 2021a). As the concrete carbon offset demand market activated, CDM adoption rapidly accelerated after 2005; CDM business rapidly increased during 2008–2012 when the Kyoto Protocol was first implemented, along with the 2nd phase of EU ETS (European Commission, 2021a,b).

However, despite the third phase of EU ETS during 2013–2020, CDM showed a declining trend as of 2012 (European Commission, 2021a) due to two main pillars. First, the decrease in CDM is caused by the SDM that will arrive as the next-generation global carbon market as a resolution of the UNFCCC COP. It was inferred that the CDM projects significantly decreased as the international community's climate change measures to comply with the Paris Agreement shifted from CDM to SDM (Carbon Market Watch, 2017). In 2015, the Paris Agreement envisioned a framework for global climate change after 2020 and agreed to establish SDM. Thus, SDM is expected to grow based on CDM businesses and institutional foundations, in a form similar to that of CDM, as SDM aims to reduce GHG and pollutant emissions and sustainable development. Second, as EU-ETS entered the third phase, CERs were amended to be tradable in the market only when the CDM's host country is an LDC, and carbon projects that clean HFC-23 and N2O, both of which are gray carbons, are not approved (ICAP, 2021).

TABLE 2 Top 10 countries' CDM implementations by year.

Country	2000	2005	2010	2015	2019	Total
China	0	6	404	0	0	1716
India	8	27	85	10	0	817
Brazil	2	13	13	2	0	184
Mexico	0	7	2	0	0	90
Vietnam	0	0	18	0	1	78
Thailand	0	1	6	0	0	74
South Korea	0	0	16	0	1	65
Indonesia	0	2	12	1	0	60
Malaysia	1	1	11	0	0	59
Chile	0	2	3	1	0	45

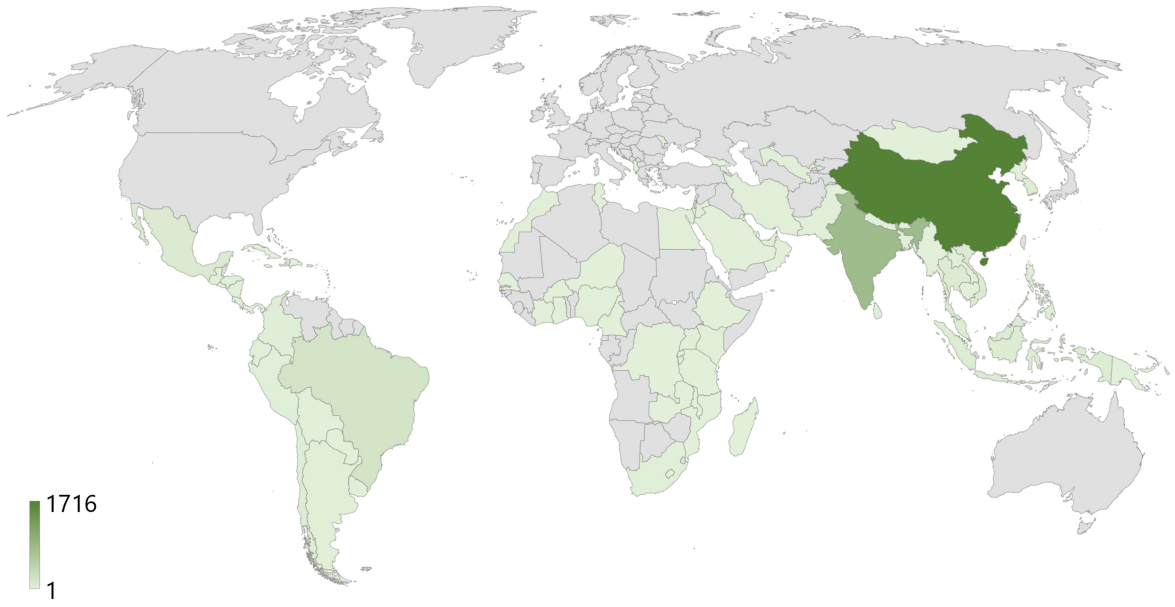

FIGURE 1
Clean development mechanism implementations by country (*N* = 3655).

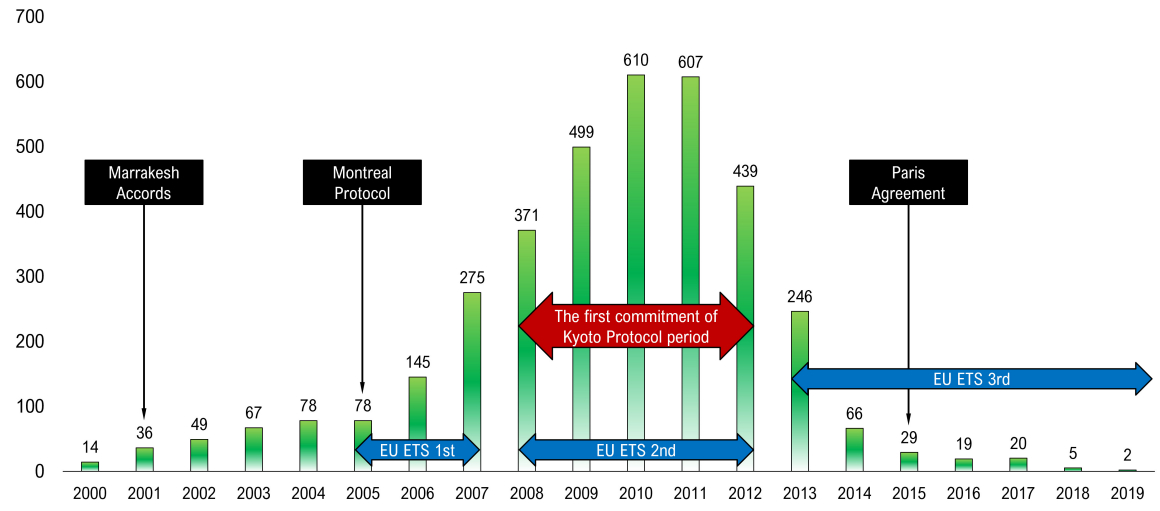

FIGURE 2
Institutional schemes over climate change and CDM implementations by year (*N* = 3655).

Sample and measurement

Table 3 shows the variables, definition/measurement, and reference used in this study. The dependent variables of this study are CDM_{Yes} and CDM_{Number}, which refers to whether the CDM project was adopted or not, and the number of adoptions, respectively. This study developed variables by acquiring and analyzing CDM data by countries from 1999 to 2019 from UNFCCC CDM (UNFCCC, 2021a). CDM process consists of project design and national approval, validation, project registration, monitoring, verification and certification, and CERs issuance. Stages until project registration were regarded as *ex ante*, promoting GHG reduction activities, whereas the stages from which the previous stages' result monitoring began were considered *ex post*. There are 15 sectors in the CDM, which are classified as large-scale and small-scale depending on the amount of GHG emission reduction and the project scale. Furthermore, CDM can be divided into Program CDM (PoA, Program of activities) and Project CDM, where the unit project constituting a program is classified as component of

TABLE 3 Definition/measurement and reference of variables.

Variables	Definition/Measurement	Ref.
Dependent variables		
CDM_{Yes}	1: The country implemented at least one CDM in a given year 0: The country implemented no CDM in a given year	UNFCCC, 2021a
CDM_{Number}	Number of CDM project activity by the country in a given year	UNFCCC, 2021a
Control variables		
Import	Imports of goods and services/GDP	World Bank WDI, 2021
Export	Imports of goods and services/GDP	World Bank WDI, 2021
Industry value added	Industry value (including construction)/GDP	World Bank WDI, 2021
CO2 emissions	Metric tons per capita	World Bank ESG, 2021
Independent variables		
Environment in ESG		
Energy intensity level	MJ/$2011 PPP GDP	World Bank ESG, 2021
Renewable electricity output	Renewable electricity/Total electricity output	World Bank ESG, 2021
Society in ESG		
Unemployment	Unemployment/Total labor force	World Bank ESG, 2021
Prevalence of undernourishment	Prevalence of undernourishment/Population	World Bank ESG, 2021
Governance in ESG		
Government effectiveness	Quality of public services, civil service, the degree of independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	World Bank WGI, 2021
Rule of law	The extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence	World Bank WGI, 2021

Data sources: World Bank ESG (https://databank.worldbank.org/source/environment-social-and-governance-(esg)-data), World Bank WDI (https://databank.worldbank.org/source/world-development-indicators), World Bank WGI (https://databank.worldbank.org/source/worldwide-governance-indicators), UNFCCC CDM (https://cdm.unfccc.int/Projects/index.html).

program activities (CPAs). For analysis, researchers in this study divided all CDMs into project units and analyzed them. Thus, if a country implemented the CDM project at least one time during a specific year, 1 was recorded in CDM_{Yes}, and if not 0; CDM_{Number} represents the number of CDM implementations during the year.

TABLE 4 Descriptive statistics.

Variables	Obs.	Mean	*SD*	Min	Max
CDM_{Yes}	3,860	0.11	0.31	0	1
CDM_{Number}	3,860	0.95	12.11	0	404
Import	3,736	46.93	26.72	0.06	236.39
Export	3,736	40.81	27.98	0.10	228.99
Industry value added	3,863	26.75	12.30	3.15	87.80
CO2 emissions	3,800	4.37	5.41	0	47.70
Energy intensity level	3,139	6.63	5.20	1.09	43.35
Renewable electricity output	3,288	31.40	33.94	0	100
Unemployment	3,915	7.92	5.98	0.11	37.25
Prevalence of undernourishment	2,981	11.35	11.87	0.93	81.70
Government effectiveness	3,792	−0.07	0.99	−2.48	2.44
Rule of law	3,819	−0.06	1.02	−2.61	2.13

The first control variable in this study is export. This represents the value of services and goods sold to the global market. Export was measured through the exports of goods and services to GDP. Import was measured by the imports of goods and services to GDP. As the sum of values created by producers of all industries, excluding the value of intermediate goods and services from gross production, industry value added was measured by industry value (including construction) to GDP. As a by-product of fossil fuels, CO2 emissions were measured by annual metric tons per capita. Data for import, export, and industry value added were acquired from World Bank WDI (2021) and CO2 emissions data from World Bank ESG (2021).

Independent variables of this study are 6 different variables corresponding to E, S, and G. Variables under E are energy intensity level and renewable electricity output. The energy intensity level is the ratio of energy supply measured by purchasing power parity and GDP; it was measured by dividing the energy supply by GDP calculated in the value of USD in 2011. Renewable energy output is the power generated by renewable power generation and was measured by the ratio of renewable energy to the total annual power generation. All variables corresponding to E were acquired from World Bank ESG (2021). Variables under S are unemployment and prevalence of undernourishment. Unemployment is the

proportion of the job-seeking labor force that is not working but can work. The prevalence of undernourishment refers to the proportion of all populations who do not eat enough food for a normal, active, and healthy life. All variables corresponding to S were obtained from World Bank ESG (2021). G consists of government effectiveness and the rule of law. Government effectiveness refers to efficiency, quality of public services, quality of public officials, independence from political pressure, quality of policy establishment and implementation, reliability in government policy, etc. The rule of law refers to "the perception of the possibility of agents abiding by social rules, contracts, property rights, police, courts, etc., and committing crimes and violence." All variables under G were acquired from World Bank WGI (2021).

TABLE 5 Panel logistic regression results.

Variables dependent variable: CDM_{Yes}	Model 1	Model 2	Model 3	Model 4
	RE	FE	RE_{Lagged}	FE_{Lagged}
Import	0.006	0.018	0.020^{+}	0.056**
	(0.013)	(0.020)	(0.012)	(0.020)
Export	−0.010	0.024	−0.016	0.001
	(0.015)	(0.021)	(0.014)	(0.021)
Industry value added	0.046*	−0.001	0.089***	0.108**
	(0.023)	(0.040)	(0.023)	(0.041)
CO2 emissions	−0.166*	0.160	−0.247**	0.006
	(0.072)	(0.139)	(0.077)	(0.151)
Energy intensity level	−0.116^{+}	−0.178	−0.067	−0.132
	(0.068)	(0.118)	(0.062)	(0.102)
Renewable electricity output	0.001	−0.009	−0.005	−0.021
	(0.007)	(0.013)	(0.007)	(0.014)
Unemployment	−0.107**	0.003	−0.105**	0.000
	(0.036)	(0.056)	(0.037)	(0.057)
Prevalence of undernourishment	−0.075**	−0.095**	−0.038^{+}	−0.020
	(0.024)	(0.032)	(0.022)	(0.031)
Government effectiveness	0.587	−0.012	0.352	−0.428
	(0.548)	(0.647)	(0.548)	(0.640)
Rule of law	−1.004^{+}	0.250	−0.372	0.676
	(0.517)	(0.685)	(0.522)	(0.684)
Constant	−1.386		−3.191**	
	(0.934)		(0.979)	
Observations	1947	874	1947	874
Log-likelihood	−597.972	−338.662	−604.144	−339.435
Chi2	38.721	31.063	35.796	37.840
Prob > Chi2	0.000	0.001	0.000	0.000
AIC	1219.945	697.324	1232.288	698.870
Hausman Chi2 test	35.85**		41.11***	

RE, random-effect model; FE, fixed effect model; AIC, Akaike information criterion; standard errors in parentheses, $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Model estimations

We statistically test our theory using panel logistic regression. The model is specified as follows:

$$\Pr\left(y_{it} \neq 0 | X_{it}\right) = P(X_{it}\beta + v_i)$$

where P is the probability that country i will host the CDM project. Vector X_{it} represents the properties of country i (i.e., independent and control variables) in a given year. We partially corrected unobserved differences by adding a random-effect term in the random-effects model and excluding the time-invariant effect in the fixed-effects model (Greene, 2000). After examining the results of panel logistic analysis as random- and fixed-effects models, the Hausman Chi2 test was conducted for

TABLE 6 Panel Poisson regression results.

Variables	Model 5	Model 6
Dependent variable: CDM_{Number}	FE	FE_{Lagged}
Import	−0.031***	−0.050***
	(0.009)	(0.009)
Export	0.013	0.029***
	(0.008)	(0.008)
Industry value added	0.309***	0.368***
	(0.013)	(0.014)
CO2 emissions	0.495***	0.193***
	(0.038)	(0.036)
Energy intensity level	0.180***	0.209***
	(0.043)	(0.045)
Renewable electricity output	−0.024***	−0.025***
	(0.007)	(0.007)
Unemployment	0.051^{+}	0.081**
	(0.027)	(0.026)
Prevalence of undernourishment	−0.224***	−0.190***
	(0.013)	(0.012)
Government effectiveness	−0.740***	0.197
	(0.195)	(0.201)
Rule of law	1.178***	2.019***
	(0.219)	(0.209)
Observations	902	902
Log-likelihood	−1633.068	−1754.975
Chi2	1208.747	1172.588
Prob > Chi2	0.000	0.000
AIC	3286.136	3529.951

FE, fixed effect model; AIC, Akaike information criterion, standard errors in parentheses, $^{+}p < 0.1$, $^{**}p < 0.01$, $^{***}p < 0.001$.

TABLE 7 Panel Poisson regression results with LDCs/non-LDCs.

Variables	Model 7	Model 8	Model 9	Model 10
Dependent variable: CDM_{Number}	Non-LDCs		LDCs	
	FE	FE_{Lagged}	FE	FE_{Lagged}
Import	−0.037***	−0.057***	0.046	0.074*
	(0.009)	(0.009)	(0.038)	(0.037)
Export	0.016^{+}	0.033***	0.039	−0.042
	(0.008)	(0.008)	(0.067)	(0.062)
Industry value added	0.316***	0.376***	−0.092	0.037
	(0.014)	(0.014)	(0.106)	(0.095)
CO2 emissions	0.505***	0.204***	2.563^{+}	1.999
	(0.038)	(0.037)	(1.546)	(1.586)
Energy intensity level	0.192***	0.243***	−0.407	−0.500
	(0.045)	(0.046)	(0.321)	(0.305)
Renewable electricity output	−0.027***	−0.023**	0.006	−0.005
	(0.007)	(0.007)	(0.014)	(0.016)
Unemployment	0.053^{+}	0.079**	−0.208	−0.047
	(0.027)	(0.027)	(0.227)	(0.214)
Prevalence of undernourishment	−0.230***	−0.198***	−0.072	−0.017
	(0.014)	(0.013)	(0.068)	(0.069)
Government effectiveness	−0.717***	0.249	−0.179	1.341
	(0.199)	(0.207)	(1.472)	(1.451)
Rule of law	1.165***	2.087***	0.025	−2.256
	(0.222)	(0.211)	(1.737)	(1.708)
Observations	734	734	168	168
Log-likelihood	−1554.118	−1662.542	−64.811	−69.716
Chi2	1202.962	1184.620	19.838	18.619
Prob > Chi2	0.000	0.000	0.031	0.045
AIC	3128.236	3345.084	149.623	159.431

LDC, least developed country; FE, fixed effect model; AIC, Akaike information criterion, standard errors in parentheses, $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

which model is more appropriate (Baltagi, 2021). In each model, vector X_{it} was t-1 lagged for the robustness check.

Our second estimation is panel Poisson regression using a fixed-effects model. For modeling count data, Poisson regression is frequently employed. There are a variety of adaptations to Poisson regression that are useful for count models. This model is often adopted when the dependent variable is a non-negative count. The model is specified as follows:

$$\Pr\left(Y_{it} = y_{it}|X_{it}\right) = F(y_{it}, X_{it}\beta + v_i)$$

where *Pr* is the probability that country *i* will host the number of CDM projects. The explanatory variables used are the vector X_{it} as in the panel logistic regression above. Since the fixed-effects model has already been proved to be more suitable for the model of this study than the random-effects model in panel logistic regression analysis, the fixed-effects model was used in our Poisson model with robust standard errors (Wooldridge, 1999). For the robustness check, vector X_{it} was t-1 lagged. In addition, we derived implications by splitting samples according to LDCs and SIDS using the fixed-effects Poisson model.

Results

Descriptive statistics

Table 4 shows the unbalanced pooled samples that integrated data from UNFCCC and World Bank and descriptive statistics of each variable. This study faced issues, including the absence of records of imports and exports in a specific year or country when extracting multiple years of data from different countries. As a result, the number of observations of each variable was uneven; thus, an unbalanced pooled sample was constructed.

CDM_{Yes} recorded an average of 0.11 and a standard deviation of 0.31 for 3,860 observations. Response of CDM_{Yes} was only possible with 0 and 1, so the minimum value was 0, and the maximum value was 1. CDM_{Number} recorded an average of 0.95 and a standard deviation of 12.11 for 3,860 observations. Most of the coefficients were also significant at 0.05 in the correlation matrix. The variance inflation factor (VIF) range for all variables, including two dependent variables, was a minimum

TABLE 8 Panel Poisson regression results with SIDS/non-SIDS.

Variables	Model 11	Model 12	Model 13	Model 14
Dependent variable: CDM_{Number}	Non-SIDS		SIDS	
	FE	FE_{Lagged}	FE	FE_{Lagged}
Import	−0.030**	−0.051***	−0.199^{+}	−0.057
	(0.009)	(0.009)	(0.110)	(0.093)
Export	0.012	0.030***	0.234	0.110
	(0.008)	(0.008)	(0.143)	(0.120)
Industry value added	0.311***	0.372***	−0.812	−0.419
	(0.013)	(0.014)	(0.554)	(0.446)
CO2 emissions	0.497***	0.194***	1.897	2.157
	(0.038)	(0.036)	(1.846)	(1.962)
Energy intensity level	0.181***	0.209***	−0.568	−0.140
	(0.043)	(0.045)	(1.298)	(1.065)
Renewable electricity output	−0.025***	−0.026***	0.110	0.064
	(0.007)	(0.007)	(0.093)	(0.076)
Unemployment	0.054*	0.085**	−1.140	−0.651
	(0.027)	(0.027)	(0.707)	(0.627)
Prevalence of undernourishment	−0.224***	−0.191***	−0.385	−0.277
	(0.013)	(0.013)	(0.280)	(0.198)
Government effectiveness	−0.752***	0.180	−2.418	−1.642
	(0.196)	(0.204)	(3.615)	(3.253)
Rule of law	1.227***	2.106***	5.052	1.265
	(0.221)	(0.210)	(4.265)	(3.419)
Observations	818	818	84	84
Log-likelihood	−1602.419	−1717.516	−19.576	−25.048
Chi2	1210.773	1180.864	11.646	6.794
Prob > Chi2	0.000	0.000	0.309	0.745
AIC	3224.838	3455.032	59.152	70.096

SIDS, small island developing states; FE, fixed effect model; AIC, Akaike information criterion, standard errors in parentheses, $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

of 1.17 and a maximum of 3.69, confirming that there was less risk of multicollinearity (Hair et al., 1998).

Panel logistic regression

Table 5 is the result of panel logistic regression, which was carried out for the data analysis of this study. Logistic regression analysis is an appropriate method for analyzing the relationship between the dependent variable and the independent variable in a non-linear relationship, such as whether CDM, the dependent variable of this study, is executed or not. Moreover, the Hausman specification test was conducted in this study to determine which random-effects (RE) model and the fixed-effects (FE) model were more suitable. When modeling panel data, the Hausman specification test is employed to determine whether a RE estimator uses time-invariant with constant value regardless of time or an FE estimator which does not use or reflect time-invariant as a dummy variant is suitable (Frondel and Vance, 2010). The Hausman specification test confirms the endogenous generation of time-invariant because bias may occur if the time-invariant is endogenous. FE can be considered more suitable because a significant value was derived from the Hausman specification test of this study. However, the RE model was also analyzed in this study to find out the difference from FE. Furthermore, Akaike information criteria (AIC) was utilized in this study for the suitability of the model. AIC score can determine the suitability of the model, where the model with the smallest score among other models after deriving scores using maximum log-likelihood from estimated parameters and models can be considered the most optimal (Salem and Salem, 2017; Zhang et al., 2020). In addition, FE_{Lagged} and RE_{Lagged} were used to see the effect when a 1-year lag was given to whether CDM was implemented.

There are 1,947 observations for Model 1 and 3 and 874 observations for Model 2 and 4. Income, the control variable of this study, was found to be significant at the level of 0.1, 0.01 in Model 3 and Model 4, respectively. For industrial competitiveness, Model 1, Model 3, and Model 4 resulted in meaningful results at the 5, 0.1, and 1% levels, respectively. Finally, regarding CO2 emissions, Model 1 and Model 3 reached 5 and 1%, respectively, recording meaningful results.

The energy intensity level, an independent variable, showed partially meaningful results at the level of 10% in Model 1 regarding whether CDM was executed. As for unemployment, Models 1 and 3 showed statistical significance at the 1% level. Regarding the prevalence of undernourishment, results were derived from Model 1, Model 2, and Model 3 regarding the country's CDM adoption. The rule of law shows that only Model 1 has a meaningful relationship at the 10% level regarding whether or not CDM is implemented.

However, there may be bias because relatively few countries with "Yes" were collected than countries with "No" CDM status. Therefore, since it may be difficult to analyze data only with logistic regression analysis, panel Poisson regression analysis was further conducted in this study.

Panel Poisson regression

Table 6 represents the result of the Poisson regression analysis. The Poisson regression method is considered appropriate when the dependent variable is count data, such

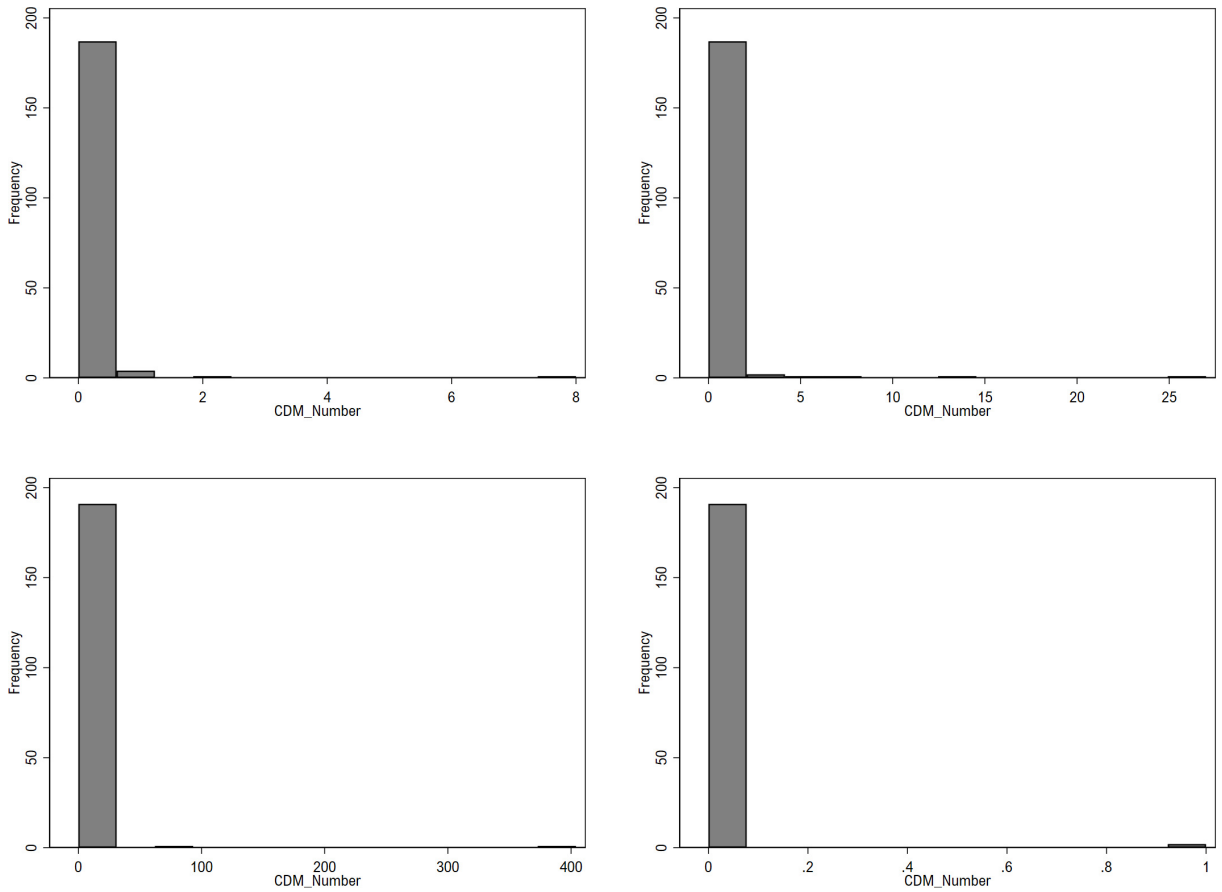

FIGURE 3
Histogram of CDM_{Number} by year 2000, 2005, 2010, and 2019 (from top left to bottom right).

as the CDM_{Number}, the dependent variable of this study. Based on the Hausman test in Table 5, FE was more suitable than RE, so FE was applied in Table 6, and the time lag was applied in Model 6.

There are 902 observations for CDM_{Number} in Table 6. Import, industry value-added, CO2 emissions, and the control variables reached meaningful 0.1% levels in both Models 5 and 6. Export was not statistically meaningful in Model 5 but highly significant in Model 6 ($p < 0.001$).

Energy intensity level, renewable electricity output, the prevalence of undernourishment, and the rule of law, the independent variables, all turned out to be significant in both Models 5 and 6 ($p < 0.001$). For unemployment, the coefficient was 0.051 in Model 5, partially statistically meaningful at 10% level, but in Model 6, the coefficient was 0.081, whereas the significant level was 1%, showing the differences among the models. For government effectiveness, a negative correlation with the coefficient of −0.750 was meaningful in Model 5 ($p < 0.001$), but the coefficient turned positive in Model 6, thereby losing its statistical significance.

Table 7 shows comparing LDCs and non-LDCs with panel Poisson regression. The dependent variable in Table 7 is CDM_{Number}; FE and FE_{Lagged} were applied to Model 7 and Model 8 related to 734 non-LDCs; FE and FE_{Lagged} were applied to Model 9 and Model 10 related to 168 LDCs.

All control variables in Model 7 and Model 8 showed meaningful statistical results; exports reached 10% levels in Model 7, which was partially significant but reached 0.1% level with high statistical significance in Model 8.

In Model 7, all ESG variables, the independent variables, were meaningfully correlated with dependent variables, but the significance level of renewable electricity output dropped to 1% in Model 8. The coefficient value turned positive for government effectiveness but was insignificant. On the other hand, the significance level for unemployment stood at 1% in Model 8, having more statistical significance than Model 7.

On the contrary, in Models 9 and 10 related to LDCs, apart from the fact that import which is the control variable, reached 10% levels in Model 10, thereby being significant, whereas CO2 emissions turned out to be partially significant at 10% level in Model 9, all control variables turned out to be statistically

TABLE 9 Results of zero-inflated Poisson with corrected Vuong.

Variables	Model 15	Model 16
Dependent variable: CDM_{Number}	**ZIPCV**	**$ZIPCV_{Lagged}$**
Energy intensity level	0.284***	0.271***
	(0.008)	(0.007)
Renewable electricity output	−0.011***	−0.011***
	(0.001)	(0.001)
Unemployment	−0.174***	−0.177***
	(0.008)	(0.009)
Prevalence of undernourishment	−0.024***	−0.031***
	(0.005)	(0.005)
Government effectiveness	0.967***	1.272***
	(0.113)	(0.116)
Rule of law	0.581***	0.443***
	(0.087)	(0.089)
Constant	0.678**	−0.682**
	(0.235)	(0.212)
Year dummies	Yes	Yes
Observations	1594	1594
Log-likelihood	−3111.543	−3063.320
Chi2	8298.517	8545.827
Prob > Chi2	0.000	0.000
AIC	6277.086	6180.641
Vuong statistics	6.504***	6.389***

ZIPCV, zero-inflated Poisson with corrected Vuong; AIC, Akaike information criterion, standard errors in parentheses, $^{**}p < 0.01$, $^{***}p < 0.001$.

insignificant. Also, all independent variables did not have a significant relationship with dependent variables. Thus, it is interpreted that ESG variables, including control variables, do not have a statistically significant effect on CDM in LDCs.

Table 8 shows the result of comparing SIDS and non-SIDs with panel Poisson regression. The dependent variable for Table 8 is the CDM_{Number}; FE and FE_{Lagged} were applied to Model 11 and Model 12 related to 818 non-SIDS, whereas FE and FE_{Lagged} were applied to Model 13 and Model 14 regarding 84 SIDS.

In Model 11, all control variables have a meaningful statistical correlation with the dependent variables. Export was insignificant in Model 11 but was statistically significant in Model 12 with a 0.1% level. As a result of verifying the relationship between ESG variables and CDM_{Number} in non-SIDS, the overall ESG variables were verified to have a statistically significant relationship with the CDM_{Number}. Unemployment in Model 11 was significant at 5% and in Model 12 with 1%. The value for government effectiveness resulted in a negative correlation in Model 11 and turned positive in Model 12, although it was not statistically significant.

Except for import, control variables had no statistically significant correlations with dependent variables. In addition, significant statistical correlations between all independent variables and CDM_{Number} were not verified. Therefore, control and ESG variables did not affect CDM in LDCs and SIDS.

Robustness check: zero-inflated Poisson with corrected Vuong regression

Poisson regression is commonly used when the dependent variable is count data (Liu et al., 2021). On the other hand, there is a possibility that the ratio of zeros increases by an additional mechanism that generates zeros in event-count processes, and verification through zero-inflated regression is preferred when the discrete data contain quite a lot of zeros (Desmarais and Harden, 2013; Yan et al., 2021).

Figure 3 shows the number of CDM projects in 2000, 2005, 2010, and 2019. In many countries, the number of CDM projects was 0, and a value other than 0 was exceptional.

Therefore, this study attempted to verify the robustness of our hypotheses through zero-inflated Poisson with corrected Vuong regression. The Vuong test is generally used to determine which zero-inflation component or single-equation count model is appropriate. Zero-inflated models contain more parameters than single-equation models, and the Vuong test can provide corrections for comparing models with different numbers of parameters (Vuong, 1989). When the result of the Vuong test added to the zero-inflated Poisson regression is significant, the zero-inflated model can be judged as more desirable. Vuong test result was statistically significant ($p < 0.001$).

In Table 9, all control and independent variables had a statistically significant relationship with the dependent variable. However, the difference from the panel Poisson regression result was that unemployment negatively affects the number of CDM, although the directions of the other independent variables were consistent. It can be interpreted as reflecting the characteristics of a country that has never implemented CDM to some extent.

Table 10 summarizes the comparison between the predicted direction of each hypothesis in this study and the main test results. H1, H2, and H6 were consistently supported in all analysis results. Consistent with the panel Poisson model, H3 was supported, but the opposite result was derived in the zero-inflation model. It reflects the correction of errors in the characteristics of a country that has never implemented the CDM. H4 was rejected because it appeared opposite to the hypothesis. Although we predicted that H1, H2, H3, and H4 would all act as opportunities for host countries to implement CDM, it is interpreted that high poverty could play as a threat to investing countries. H5 was supported only in the zero-inflation model. It could be understood that the government's efficient implementation of the CDM can operate as a barrier to having it even once experienced.

TABLE 10 Summary of hypothesis tests.

Hypothesis	Predicted direction	PP-FE	PP-FE $_{Lagged}$	ZIPCV	ZIPCV $_{Lagged}$
(H1) Energy intensity level	+	+	+	+	+
(H2) Renewable electricity output	−	−	−	−	−
(H3) Unemployment	+	+	+	−	−
(H4) Prevalence of undernourishment	+	−	−	−	−
(H5) Government effectiveness	+	−	n.s.	+	+
(H6) Rule of law	+	+	+	+	+

PP, panel Poisson; FE, fixed effects; ZIPCV, zero-inflated Poisson with corrected Vuong; n.s., non-significant.

Conclusion and discussions

As the most representative technology transfer model of "GHG reduction" for climate change response, CDM has gone through continuous institutional supplementation based on numerous actual cases that took place during its long history. At the same time, it is expected to provide environmental-social benefits, including the environment and climate change response to both developed and developing countries (Stuchi Cruz et al., 2017). Through CDM, developed countries can ease the relatively high-cost domestic reduction burden and achieve the reduction goals with a comparatively low cost through overseas projects. Developed countries achieved technological transfer and additional capital investments through CDM, promoting national growth (UN, 2008). In this vein, it is forecasted that CDM can be utilized as an essential platform for green technology transfer in implementing the new climate regime according to the Paris Agreement (Benites-Lazaro and Mello-Théry, 2017).

Unlike the Kyoto Protocol, where GHG reduction obligations were only given to developed countries, the new climate regime under the Paris Agreement requires 165 countries, which account for about 96% of the world's GHG emissions, to be obliged to reduce domestic GHG emissions through establishing national NDC (Liu and Feng, 2018). The UNFCCC COP26 mentioned that the role of the carbon market as a means for the parties to achieve their reduction goals would be further strengthened (UNFCCC, 2021b). In particular, based on the existing CDM, the aspect of voluntary cooperation and sustainability is suggested to be further highlighted under the new SDM framework, so the parties need to consider this in developing reduction businesses.

Sustainable development goals ultimately emphasize the need to tackle new global environmental issues, including developmental gaps, worsening inequality, climate change, and the international community's solidarity to implement balanced growth considering the economic, social, and environment. Taking this into account, a carbon reduction strategy using CDM, which promotes GHG reduction under the new climate regime and sustainable growth, is even more vital as it can contribute to achieving both GHG reduction and SDG goals (Abdulrahman et al., 2015).

In this vein, this study was carried out to suggest ESG perspectives and examine the effects of each pillar as a host country-specific characteristic regarding the purpose of CDM, a global climate technology cooperation platform, to respond to market mechanisms. The theoretical and policy implications derived from this study are as follows.

Theoretical contributions

This study viewed CDM from the perspective of ESG by applying institutional theory. The results of this study will be discussed in this section. First, from the perspective of institutional theory, environmental/social factors of CDM recipients can serve as an opportunity for investing countries regarding the cost-benefits. As a mimetic isomorphism in the institutional theory, the higher the energy intensity from an environmental perspective and the lower the renewable electricity output. The existing successful fields and national projects continue to be copied and benchmarked when CDM projects' additionality should be acknowledged. This can also be linked to unemployment and the prevalence of undernourishment. More CDM businesses were carried out at times of higher unemployment rates and lower undernourishment rates, which shows that technology projects for GHG reduction were promoted by targeting countries with infrastructures relatively established at a certain level. In other words, from an investor's perspective, business development is likely to take place focusing on business sectors where additionality may be acknowledged, mainly among emerging developing countries with economic development above a certain level. It is highly likely to be carried out by benchmarking the best practices performed by countries or companies of a similar status. It is in line with the fact that colleagues influence corporate CSR participation in the community discovered (Singh et al., 2021). Therefore, investors willing to start their businesses through CDM can find more practical solutions, ensure legitimacy, and succeed through existing cases by spending less through imitative actions (DiMaggio and Powell, 1983). In particular, the environmental uncertainty of the global carbon market will further strengthen this mechanism.

Second, from the governance perspective, it was expected that more CDM businesses would be carried out with higher government effectiveness and the rule of law. Nevertheless, our result shows that more CDM businesses were implemented with low government effectiveness and a high rule of law. It can be implied as a result of explaining minimum normative isomorphism. In other words, it might be a country with relatively low government efficiency, and CDM businesses are being carried out in countries with normative pressure in promoting CDM projects. In particular, validation by a third party in the CDM business might be a mechanism to strengthen it. Normative pressure in neo-institutionalism is a process in which organizations implicitly accept norms and internalize the language in interacting with the environment; instead, a unilateral and direct influence on the organization from the environment. The stakeholder consultation process amid the feasibility test should have served as an opportunity to strengthen them. The above results are consistent with the previous study (Daddi et al., 2020), which revealed that corporate climate sensitivity is affected by normative and imitative pressures. To distinguish their strategies, companies explore core "institutional" players, and imitative actions inspired by such experience of competitors are also demonstrated in the result of the climate change sector.

Managerial contributions

The ESG perspectives as host country-specific characteristics are presented for the cause of CDM implementation, and each pillar's analysis and consideration of the impact are as follows. First, from the environmental point of view, the higher the energy intensity and the lower the renewable electricity output, the more CDM that was expected to be implemented was consistently supported. CDM implementation centered on countries with relatively high-energy intensity, in other words, in developing countries pouring efforts to enhance their energy efficiency. Considering that Energy Intensity in Asian developing countries is improving at an annual rate of 3.3% (IEA, 2021), CDM might have been utilized as a tool for this. On the other hand, the renewable energy output is supported because countries with relatively low renewable energy ratios would have tried to increase their renewable energy ratio through CDM. CDM has indeed been contributing to reducing emissions since it was first implemented (UNFCCC, 2018); nevertheless, several limitations are also being pointed out (Kumazawa and Callaghan, 2012; Grunewald and Martinez-Zarzoso, 2016; Almer and Winkler, 2017; Maamoun, 2019). In particular, the most representative limitation of CDM business is that current CDM projects are not evenly carried out across all 15 fields but are concentrated in specific sectors, such as the power sector (UNFCCC, 2018). Such sector-biased phenomenon is caused by the need to carry out business in a stable manner and introduce technologies that can maximize the effect of GHG reduction from technology donor countries (investors) rather than the technology needs in developing countries (CDM Policy Dialogue, 2012). According to Peters and Geden (2017), investment decisions for carbon dioxide removal are made under deep uncertainty, capturing a combination of geopolitical uncertainties, technological uncertainties, and social acceptance. In other words, our results can reflect that the technology donor country promotes energy sector projects to maximize the emission reduction effect during technology transfer more than any other environmental factors when selecting a target country.

Second, it was expected that the higher the unemployment rate and undernourishment rate were from a social point of view, the more CDM implementations would be carried out. Nevertheless, the result showed that the higher the unemployment rate and the lower the undernourishment rate, the higher the frequency of CDM implementations. It can be inferred that technology projects for GHG reduction, such as CDM, have been promoted in countries with certain levels of infrastructure. The most critical factor in a CDM business is providing "additionality," with the same recognition of "real" and "measurable" GHG reduction following the Kyoto Protocol Article 12 (Schneider, 2009). Additionality proves the additional occurrence of GHG reduction compared to baseline for the absence of CDM activities through CDM activities; it requires proving economic additionality apart from environmental additionality, GHG reduction (UNFCCC CDM, 2007). Economic additionality is a process of proving that unless investments take place through CDM, it is most unlikely for activities such as CDM to take place voluntarily (Schneider, 2009). To pass the validation in the CDM registration process of proving economic additionality, a specific CDM business should occur at a level where it does not generate "additional economic income." The economic feasibility of just jumping over the hurdle of additional activity for GHG reduction must be proved. Therefore, what can be drawn from this result is that CDM is a business inevitably implemented in countries where job-seeking activities are actively taking place and in countries at the level of an "emerging" state, which has moved beyond the hunger state to a certain extent.

Third, from the governance perspective, it was expected that the higher the government of effectiveness, along with the rule of law, the more CDM projects were to be implemented. However, the result demonstrated that the lower the government effectiveness, the higher the rule of law, and the more CDM implementations took place. It can be perceived that traits of CDM projects have been reflected in the results. Once CDM successfully passes the validation process, the CDM is officially registered as a carbon offset business under the UNFCCC. The process of officially confirming the project approval of a host country is mandatorily required in this validation process; CDM project approval is issued by government organizations designated as Nationally Determined Authority

(NDA) according to the UNFCCC regulations. According to the result, the lower the government of effectiveness, the more CDM implementations occurred; this demonstrates SDM's opportunity of functioning as a mechanism complementing political uncertainty as well as government efficiency of the host country.

Limitations and future studies

First, it should be possible to analyze the extent to which CERs are obtained through the CDM project and quantitatively analyze how much the results contributed to the GHG reduction of investing countries/corporates and developing countries. Second, a study on indicator development for sustainability is required. For example, CDM mandates the consideration of understanding and participation of residents as the direct beneficiaries of carbon reduction activities; however, verification has not been conducted closely due to a lack of data to verify this area. Thus, indicators on unemployment and undernourishment rates were inevitably used in this study as social factors. Still, indicators that can measure social impacts more accurately in the future should be developed through comparative research. Third, although the CDM projects are mutually reciprocal activities occurring in the relationship between developers and beneficiaries, studies on incentives that can be derived from CDM have not been conducted in various aspects. It is expected that if quantitative analysis of the CDM sector is possible, it will help to complement the limitations of the current research from an ESG perspective. In addition, looking at the purpose and interests of corporates carrying out individual CDM projects, it is hoped that they will be able to make more theoretical contributions in connection with CSR research. Furthermore, hopefully, the limitations of CDM will be supplemented, including the inconsideration of specific technology demands of development, regional bias, and the absence of technology business diversification. Finally, we expect the CDM-based SDM projects to become more prevalent as the role of the international carbon market is expected to attract more attention in achieving carbon neutrality. However, for SDM projects to succeed, it will be necessary to clearly understand the success/failure factors of the CDM project that has been promoted for the past 20 years. Based on this backdrop, the global climate consensus will accelerate and facilitate more efficient technology projects from an ESG point of view.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

TR supervised the data, did the conceptualization, performed the methodology, carried out the formal analysis, investigated the data, wrote the original draft, and wrote, reviewed, and edited the manuscript. SKL and GC did the conceptualization, wrote the original draft, and wrote, reviewed, and edited the manuscript and contributed equally to this work as first authors. SYL and D-BU wrote the original draft and wrote, reviewed, and edited the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

SKL was employed by the company SK Forest, Seoul.
The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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