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Greening the Path to Disruptive Innovation: The Roles of CEOs Characteristics, Green Organizational Identity, and Green Product Competitiveness

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Declarations

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Ethics approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent: Informed consent was obtained from all individual participants included in the study.

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Abstract

This study explores the link between sustainability orientation and disruptive innovation in small and medium-sized enterprises (SMEs) by embracing both the natural resource-based view (NRBV) and upper echelons theory. By drawing on these theories and extending them, it sheds light on the executives' characteristics and organizational contingencies leading to disruptive innovation. Starting from the CEOs' sustainability orientation, it investigates if and how it leads to disruptive innovation through the mediating role of green organizational identity and the moderating influence of both green product competitiveness and CEOs' gender-related characteristics. Two wave time-lagged survey data from 257 Chinese SMEs are analyzed to empirically test these relationships. Results suggest that SMEs with CEOs characterized by sustainability focus foster a green organizational identity, enabling them to generate disruptive innovations. Additionally, the presence of high green product competitiveness strengthens the connection between sustainability orientation and green organizational identity. Lastly, the relationship between this latter and disruptive innovation can be further enhanced by female CEOs by leveraging their specific skills and abilities.

Keywords: CEO characteristics; sustainability orientation; green organizational identity; green product competitiveness; disruptive innovation, SMEs

1. Introduction

In today's dynamic business landscape, the relationship between sustainable business and economic growth is widely recognized (Fernandes et al., 2021; Si et al., 2023). Embracing and nurturing a culture of innovation can lead to sustained economic prosperity and global competitiveness. One of the key drivers of economic growth is disruptive innovations and technologies, which have the potential to revolutionize markets (Antonio & Kanbach, 2023; Kraus et al., 2023; Millar et al., 2018) and environmental performance (Chiarini, 2021) significantly. Disruptive innovation refers to innovations that fundamentally change market performance metrics, consumer expectations, and can introduce entirely new functionality, technical standards, or ownership models (Nagy et al., 2016, p. 122). For small and medium-sized enterprises (SMEs), continuous innovation is crucial to maintaining competitiveness in the global marketplace (Yuan et al., 2023). While previous research has emphasized the importance of disruptive innovation for business survival and growth, particularly for SMEs (e.g., Kraus et al., 2019; Majumdar et al., 2018; Zheng et al., 2021), there is limited understanding of what are the executives' characteristics and organizational contingencies that foster disruptive innovation.

Despite the growing theoretical and empirical interest in disruptive innovation (e.g., Antonio & Kanbach, 2023; Palmié et al., 2020; Wang et al., 2023; Wang et al., 2022), our current understanding of how sustainability-related CEOs' characteristics and organizational contingencies relate to disruptive innovation remains limited. A sustainability-oriented firm endeavors to synchronize its goals with the preservation of the planet, even amid the fast-paced dynamics of today's disruptive markets. In our study, we contend that CEOs' sustainability orientation can stimulate disruptive innovation by encouraging organizations to adopt a green organizational identity (Chen, 2011). We argue that a strong green organizational identity unites

employees, stakeholders, and customers with a shared dedication to sustainable practices, fostering a harmonious synergy that fuels creativity and innovative thinking in the realm of green solutions. By investigating this mediating mechanism both theoretically and empirically, we aim to demonstrate how sustainability orientation influences disruptive innovation. To do so, we also introduced two contingency variables that moderated this mediated relationship and are able to shed light on how sustainability orientation and green identity can lead to disruptive innovation.

First, there is a paucity of research examining the relevant contingencies concerning green organizational identity. Therefore, we aim to enhance the existing theory of the relationship between sustainability orientation and green organizational identity by introducing green product competitiveness (Afum et al., 2021; Kam-Sing Wong, 2012) as a contingent variable. Our objective is to investigate the circumstances under which sustainability orientation plays a significant role in driving disruptive innovation. Although there is a growing trend of research on the sustainability orientation-innovation nexus (e.g., Cheng et al., 2020; Clauß et al., 2022; Zoppelletto & Bullini Orlandi, 2022), the potential impact of green product competitiveness as an important capability on this relationship has not been adequately explored in the current literature. This research gap is noteworthy, considering that green product competitiveness can significantly influence a firm's ability to mobilize and utilize key resources, ultimately determining their success or failure.

Second, we argue that another important CEO-related contingency comes into play in the relationships between sustainability orientation, green organizational identity, and disruptive innovation, namely the CEO gender. Previous research has already investigated the relevance of female CEOs in enhancing firms' sustainability (e.g., Atif et al., 2020). Conversely, there are few studies addressing the role of CEO gender in relation to innovation; besides, they provide

contrasting results. On the one hand, it has been suggested that, on average, male-related characteristics, such as higher risk-taking, can be positively associated with innovation (Expósito et al., 2021). On the other hand, it has been recently suggested that female CEOs can have intrinsic characteristics that foster innovation (Javaid et al., 2023). However, scant research has addressed the role of female CEO specificities in influencing the relationship between sustainability orientation and disruptive innovation. Therefore, we argue here that CEO female characteristics can be leveraged to enhance the impact of green organizational identity over disruptive innovation.

Finally, much of the current literature tends to focus primarily on large corporations in developed countries, leaving a notable gap in understanding the sustainability orientation activities of SMEs in developing nations. These small businesses often face significant challenges, including limited financial resources to implement proactive environmental strategies and institutional voids such as restricted access to financial credit, lack of institutional support, and weak legal enforcement systems, which hinder their ability to compete effectively (Adomako et al., 2021; Kiani et al., 2022; Danso et al., 2020). Consequently, managers of small businesses in such contexts often express concerns about the adverse effects of environmental sustainability initiatives, such as increased costs and complexities associated with their implementation (Amankwah-Amoah et al., 2019; Calic & Mosakowski, 2016; Feng et al., 2022; Zhao et al., 2021). While the interplay and mechanisms of firms' green product competitiveness and green organizational identity on the sustainability orientation-innovation relationship are essential areas for scholarly exploration, only a limited number of researchers have delved into this subject.

In response to these gaps in the literature, our study aims to develop and test a model within the specific context of an emerging country—China. Firms in China encounter numerous institutional challenges, making it essential to explore how the resource-based view can offer

valuable structural support to mitigate the impact of weak institutional structures. By doing so, we aim to enhance the disruptive innovation of firms operating in this context.

Our study makes significant contributions in four main areas. First, the papers extend the sustainability literature (Calic & Mosakowski, 2016; Clauß et al., 2022; Danso et al., 2020; Zhao et al., 2021) by showing the impact of sustainability orientation on firm disruptive innovation. Organizations adopt sustainability strategies for two primary reasons: first, in response to pressure from stakeholders to act responsibly (e.g., customers, employees, policymakers), and second, because integrating sustainability principles leads to long-term organizational benefits (Watson et al., 2018). By aligning economic gains with social and environmental aspects of sustainability, firms demonstrate moral behavior and achieve superior innovation outcomes (Adomoko et al., 2021; Kraus et al., 2023; Zoppelletto & Bullini Orlandi, 2022), and there is untapped potential in this segment. Second, we enrich the research on corporate environmental strategy (Chan et al., 2022) by integrating insights from the natural resource-based theory (Hart, 1995) and strategic capabilities (Yuan et al., 2023), specifically green product competitiveness. Third, our research contributes to the upper echelons theory applied in the sustainability context by showing that female CEO not only seems to be more sustainable (Atif et al., 2020), but they also have specific characteristics that can be employed to leverage the green organizational identity mediation between sustainable orientation and disruptive innovation.

Lastly, it adds to the existing body of knowledge on the strategic orientation of small firms (e.g., Eggers et al., 2020; Kiani et al., 2022; Zhang et al., 2023). We demonstrate that when competitive strategic capabilities are employed, the impact of sustainability orientation as a driver of disruptive innovation is amplified. This finding extends the scope of previous studies, as our investigation was conducted in a context not extensively represented in the literature on sustainability orientation.

Lastly, our study distinguishes itself from prior research that primarily focuses on multinationals (Chan et al., 2021; Dickel & Eckardt, 2021; Kraus et al., 2019) by examining small firms as the primary unit of analysis.

The structure of this paper is organized as follows. Following the introduction, the second section presents the theoretical background and the development of hypotheses. Subsequently, the research method and findings are analyzed. The final section discusses the implications of the results, as well as the study's limitations, and outlines potential directions for future research.

2. Theoretical Background and Hypothesis Development

2.1 The resource-based view and the upper echelons theory in the sustainability context

The resource-based view (RBV) of the firm asserts that a company's competitive strategies and overall success are significantly shaped by the resources and capabilities it possesses. This perspective has garnered support from prominent scholars like Barney (1991), Dierickx and Cool (1989), and Grant (1991) through their extensive research. Hart (1995) introduced a seminal concept in this domain - the natural resource-based view (NRBV). He advocates for adopting this approach to cultivate firm-specific competitive advantages by adeptly managing the firm's relationship with the natural environment. As such, the natural environment imposes increasingly strict constraints, making a firm's ability to effectively navigate and overcome these challenges a valuable, rare, and difficult-to-replicate organizational capability (Hart, 1995). Consequently, this skillful management of natural resources leads to superior economic and social outcomes for the firm (Yuan et al., 2023).

According to the NRBV, organizations that base their strategies on the effective utilization of natural resources and prioritize sustainability possess distinct advantages in sustainable practices, environmental consciousness, and stakeholder engagement (Chen, 2011). These unique resource-based assets enable them to identify and seize opportunities for disruptive innovation that align with their sustainability objectives (Anderson, 2021; Liu et al., 2021). In the following hypotheses development, we argue that a strong green organizational identity can enable the translation of sustainability orientation and natural resource-based capabilities into tangible actions and decisions that support disruptive innovation endeavors (Song et al., 2019). This identity fosters a shared understanding and commitment among employees, facilitating the integration of sustainability principles into innovation processes and the exploration of novel solutions that make efficient use of natural resources (Liu et al., 2021). Organizations with high levels of green product competitiveness could be better positioned to leverage their sustainability orientation and reinforce their green organizational identity. Green product competitiveness as a capability enhances the acceptance of the organization's sustainability initiatives, thereby strengthening the relationship between sustainability orientation and green organizational identity (Afum et al., 2021; Kam-Sing Wong, 2012). By capitalizing on their unique resources and capabilities associated with sustainability and the effective use of natural resources, organizations can cultivate a robust green organizational identity, align their innovation endeavors with sustainability goals, and ultimately gain a competitive advantage through disruptive innovation. However, the process of leveraging the organizational resources related to the natural environment and to the prioritization of sustainability to reach disruptive innovation requires what Child called a specific executives' "strategic choice" (1972) and can be strongly related to executives' personal experience, values, and personalities (Hambrick, 2007; Hambrick & Mason, 1984). As a matter of fact, contemporary

executives can have different levels of concern and interest toward sustainability, and they can prioritize (or not) those sustainability concerns inside their organizations, creating differential conditions in terms of sustainability competitiveness and performance (Adomako et al., 2021). Besides, previous research embracing upper echelons theory in the sustainability context has shown that CEOs' characteristics can be related to organizational outcomes (Shahab et al., 2020).

Therefore, in the hypotheses development, we tap into both NRBV and upper echelons literature to develop our research model in the following sections.

2.2 Role of CEO sustainability orientation in enhancing firms' disruptive innovation

Sustainability orientation prompts organizations to reassess their business models, processes, and products in light of sustainability goals (Adomako et al., 2021). Through this critical examination of existing practices, innovative alternatives can be identified that disrupt established norms and practices. Sustainability challenges often require innovative solutions to address complex environmental, social, and economic issues (Watson et al., 2018). CEOs with a sustainability orientation are more inclined to invest in research and development efforts to find creative ways of mitigating environmental impacts (Kraus et al., 2020), enhancing social equity (Si et al., 2023), and promoting economic resilience (Sultana et al., 2022). Consequently, this problem-solving focus and the search for sustainable alternatives can give rise to disruptive innovations.

It has been suggested that sustainability orientation encourages organizations to adopt a system-thinking approach, considering the interconnectedness of environmental, social, and economic factors (Danso et al., 2020). By analyzing the broader context and understanding the interdependencies between various elements, organizations can identify opportunities to introduce disruptive innovations that bring about transformative change across entire systems or industries

(e.g., Kraus et al., 2021). Additionally, sustainability-oriented organizations often engage in partnerships and collaborations with stakeholders from different sectors, including academia, NGOs, and government agencies (Clauß et al., 2022; Dickel & Eckardt, 2021). These collaborative networks facilitate the sharing of knowledge, the generation of ideas, and access to diverse perspectives (Amankwah-Amoah et al., 2019). Thus, by leveraging these networks, organizations can tap into a wealth of expertise and resources, fostering an environment conducive to disruptive innovation.

Indeed, the sustainability orientation of CEOs emphasizes the engagement of stakeholders to understand their needs, expectations, and concerns (Afum et al., 2021; Danso et al., 2020). This stakeholder engagement process can uncover valuable insights and identify latent market opportunities. By incorporating stakeholder perspectives into the innovation process, organizations can develop disruptive solutions that meet sustainability goals and address the evolving demands of the market (Cheng, 2020). Moreover, sustainability-oriented organizations often seek to differentiate themselves by offering products or services that align with environmental and social values (Adomako et al., 2023). This is essential given that such differentiation can create competitive advantages, attract a niche market segment, and drive disruptive changes within the industry (Antonio & Kanbach, 2023). Sustainable innovations that challenge traditional practices and offer improved environmental or social performance can disrupt existing market dynamics (Calic & Mosakowski, 2016). Governments and regulatory bodies are increasingly implementing policies and regulations (Chiarini, 2014, 2019) that incentivize sustainability practices and discourage unsustainable behaviors (Si et al., 2023; Song et al., 2019). Organizations with a sustainability orientation can leverage these supportive frameworks to drive disruptive innovation. Regulatory mandates and incentives can encourage the adoption of

sustainable technologies, business models, and practices, thereby fostering disruptive change (Kraus et al., 2020). As discussed above, the successful realization of disruptive innovation requires a combination of strategic vision, leadership commitment, and access to resources. In line with this reasoning, a strong sustainability orientation of CEOs increases the likelihood of exploring and embracing disruptive innovations as part of their sustainable product development journey. Taken together, we suggest the following hypothesis:

Hypothesis 1. CEO sustainability orientation positively leads to disruptive innovation.

2.3. CEO sustainability orientation, green organizational identity, and green product competitiveness

As per the organizational identity theory, an organization's identity is formed by its shared cognitive framework, which has the power to influence the behaviors of all its employees (Albert & Whetten, 1985). This implies that an organization's identity plays a crucial role in shaping how its employees think and act. Moreover, when faced with changes in the environment, managers have an opportunity to adapt their interpretations and reshape the organization's identity accordingly (Gioia & Thomas, 1996). Once environmental factors become deeply integrated into the organization's identity, the significance of the environmental impact can no longer be disregarded. As a result, the focus on sustainability becomes an integral and legitimate aspect of the organization's identity (Liu et al., 2021).

Building upon organizational identity, Chen (2011) introduced the concept of green organizational identity, which adopts a broader approach to studying the sustainable development of firms. While previous studies have explored the antecedents of green organizational identity, such as environmental leadership (Xu et al., 2022), corporate social responsibility (Song et al.,

2019), and green innovation strategy (Song & Yu, 2018), there is still a gap in understanding the relationship between CEO sustainability orientation and green organizational identity.

A sustainability-oriented CEO embraces environmentally responsible practices, aligns its operations with sustainable principles, and actively seeks to contribute to environmental stewardship (Muñoz & Dimov, 2015). This commitment to sustainability can shape the organization's identity and how it is perceived by internal and external stakeholders. Previous studies indicate that a sustainability-oriented CEO places a high value on environmental responsibility and sustainability principles. These values and principles become embedded in the organization's mission, guiding its strategic direction and decision-making processes. Indeed, the organization's commitment to sustainability becomes a central part of its identity, influencing its actions and shaping stakeholders' perceptions.

Sustainability-oriented CEOs adopt proactive environmental management practices, such as energy and resource efficiency, waste reduction, pollution prevention, and sustainable supply chain management (Adams et al., 2016). These practices demonstrate the organization's commitment to environmental sustainability and contribute to the development of a green identity. They signal to stakeholders that the organization prioritizes environmental protection and strives to minimize its ecological footprint (Bouncken et al., 2023). Moreover, sustainability orientation often leads to the cultivation of an organizational culture that promotes environmental responsibility (Xu et al., 2022). Indeed, this culture encourages employees to embrace sustainable practices in their daily work and decision-making processes. Thus, a sustainability-focused culture fosters a sense of collective responsibility for the environment and shapes employees' perceptions of the organization's green identity.

Previous studies indicate that a sustainability-oriented CEO's actions and initiatives in environmental sustainability can shape how stakeholders perceive its identity (Aguilera et al., 2021; Amankwah-Amoah et al., 2019). For instance, stakeholders, including employees, customers, investors, and the community, often associate sustainability-oriented practices with a positive green organizational identity. When an organization consistently demonstrates its commitment to sustainability, it can earn recognition and accolades from external bodies, which further reinforce its green identity (Afum et al., 2023). Effective communication about sustainability initiatives and achievements is essential for shaping and reinforcing a green organizational identity. CEOs with sustainability goals transparently share information about their environmental progress and performance, both internally and externally (Alerasoul et al., 2022). Accordingly, clear and authentic communication of sustainability efforts demonstrates the organization's commitment and reinforces its green identity in the eyes of stakeholders.

Sustainability-oriented CEOs actively engage stakeholders in their sustainability efforts (Dangelico et al., 2017; Feng et al., 2022). This engagement can take the form of partnerships, collaborations, and consultation processes (Breuer et al., 2018). Involving stakeholders in sustainability-related decision-making fosters a sense of ownership and shared responsibility. It demonstrates the organization's commitment to incorporating diverse perspectives and ensures that sustainability is an integral part of its identity. Embracing sustainability can contribute to market differentiation and enhance an organization's reputation (Alerasoul et al., 2022). As environmental concerns grow, customers increasingly seek out environmentally responsible products and services. Thus, a sustainability-oriented organization's green identity can attract environmentally conscious consumers and stakeholders, enhancing its competitive advantage and reputation in the market. Based on the above analysis, we propose that:

Hypothesis 2a. CEO sustainability orientation positively leads to green organizational identity.

Green product competitiveness focuses on the uniqueness of a firm's environmental management practices and strategies, which enhance its market position and lead to improved economic benefits compared to its competitors. It allows organizations to differentiate themselves in the market based on the environmental performance and sustainability attributes of their products (Afum et al., 2021; Kam-Sing Wong, 2012). For instance, when sustainability-oriented organizations develop and promote green products that align with their sustainability orientation, it reinforces their green organizational identity. In this vein, the ability to offer competitively superior green products strengthens the organization's identity as an environmentally responsible and sustainable entity. Moreover, green product competitiveness enhances consumer perception and recognition of an organization's green organizational identity. When sustainability-oriented organizations develop and market highly competitive green products, it signals their commitment to sustainability and environmental responsibility (Song et al., 2019; Qiu et al., 2020). Thus, consumers associate these products with the organization's green identity, leading to increased recognition and positive perception of the organization's sustainability efforts.

We theorize that green product competitiveness reinforces the alignment between a CEO sustainability orientation and a firm green organizational identity. When sustainability-oriented CEOs focus on developing and promoting competitive green products, it reflects their internal commitment to sustainability (Afum et al., 2023; Li et al., 2019). The organization's green identity is reinforced as employees witness the organization's efforts to create and deliver environmentally responsible products, strengthening their belief in the organization's sustainability orientation. Green product competitiveness helps meet stakeholder expectations for sustainable and environmentally friendly products (Wang, 2019; Zameer et al., 2022). As consumers increasingly

seek environmentally responsible alternatives, sustainability-oriented organizations need competitive green products to satisfy these expectations (e.g., Xie et al., 2019). Therefore, when an organization's green products successfully compete in the market, it validates its green organizational identity and demonstrates its ability to meet stakeholder demands for sustainable solutions.

We propose that green product competitiveness contributes to the reputation and brand image of sustainability-oriented organizations (Afum et al., 2020; Qiu et al., 2020). When an organization consistently offers competitive green products, it enhances its reputation as an environmentally responsible entity (Griskevicius et al., 2010). This positive reputation reinforces the organization's green organizational identity, as it is perceived as a credible and trusted provider of sustainable solutions. Similarly, green product competitiveness creates a feedback loop that reinforces the relationship between sustainability orientation and green organizational identity. As sustainability-oriented organizations develop and market competitive green products, they receive feedback from the market, customers, and stakeholders (Eiadat et al., 2008; Yuan et al., 2023). Positive feedback and market success further validate the organization's commitment to sustainability, reinforcing its green organizational identity and motivating further sustainability-oriented actions (Chen et al., 2023). Thus, when sustainability-oriented organizations successfully compete with their green products, it strengthens their green organizational identity and solidifies their position as environmentally responsible entities. Thus, we suggest that:

Hypothesis 2b. The positive relationship between the CEO sustainability orientation and green organizational identity is positively moderated by the green product competitiveness, such that as the green product competitiveness increases, the relationship becomes stronger.

2.4 Green organizational identity, CEO gender, and disruptive innovation

A green organizational identity fosters a mindset and culture that values sustainability and environmental responsibility (Chen, 2011). This cultural emphasis encourages employees to think creatively, challenge the status quo, and seek innovative solutions to environmental challenges (Hatch & Schultz, 2002; Song et al., 2018). The organization's commitment to being green creates an environment that supports and encourages disruptive thinking and innovation. Green organizational identity places a strong emphasis on addressing environmental challenges and finding sustainable solutions (Soewarno et al., 2019). This focus on problem-solving prompts organizations to explore new technologies, processes, and business models that can disrupt existing practices (Liu et al., 2021; Zoppelletto et al., 2023). The commitment to environmental sustainability pushes organizations to develop innovative and disruptive approaches that improve environmental performance and reduce ecological footprints. Green organizational identity often involves actively engaging with stakeholders, including customers, suppliers, NGOs, and communities (Scott & Lane, 2000). Through collaborative efforts, organizations gain access to diverse perspectives and knowledge, which can spark innovative ideas and approaches (Glavas & Godwin, 2013). Engaging stakeholders in the innovation process enables organizations to develop disruptive solutions that align with environmental values and address the needs and expectations of various stakeholders.

A green organizational identity can open up new market opportunities and create a competitive advantage (Chang & Chen, 2013). As consumers increasingly prioritize sustainability and seek environmentally friendly products and services, organizations with a strong green identity can disrupt existing markets by offering innovative and sustainable alternatives (Miller & Wesley, 2010). By differentiating themselves through green products, organizations can capture new

market segments and challenge established players, leading to disruptive innovation. Green organizational identity promotes a culture of continuous learning and adaptability (Omrani et al., 2022). Organizations that embrace sustainability as part of their identity are more likely to invest in research and development, experimentation, and knowledge sharing. This focus on learning and adaptability creates a dynamic environment where disruptive ideas can emerge and be implemented to drive sustainable innovation (Bouncken et al., 2015; Liu et al., 2021). A strong green organizational identity enhances an organization's reputation as a sustainable and environmentally responsible entity (Hatch & Schultz, 2002; Song et al., 2019). This positive reputation can attract partnerships, collaborations, and investments from stakeholders who share similar values and are interested in supporting disruptive innovation (Chang & Chen, 2013). Hence, we propose the following hypothesis:

Hypothesis 3a: Green organizational identity is positively related to disruptive innovation.

Leadership plays a vital role in driving disruptive innovation within a green organizational identity. Leaders who are committed to sustainability and environmental stewardship set the strategic direction (Shabab et al., 2020) and encourage disruptive innovation (Chen et al., 2022). The leveraging of a green organizational identity to generate higher levels of innovation should be supported by executives. Therefore, their personal characteristics, attitudes, and interest toward sustainability can interact with this relationship. As a matter of fact, female CEOs show a higher level of concern toward sustainability issues and a higher ability to enhance organizational suitability performance (Atif et al., 2020; Shabab et al., 2020). At the same time, CEOs' individual characteristics can be linked to their ability to support innovation, a topic that is longstandingly debated and has led to contrasting evidence. On the one hand, some studies suggest that male-related peculiarities, such as higher risk propensity, can be related to innovation performance (e.g.,

Expósito et al., 2021). On the other hand, it has been recently suggested that female CEOs can have several peculiarities that can foster innovation (Javaid et al., 2023). Here, we argue that those peculiarities can play a role in leveraging the relationships between organizational identity and disruptive innovation. First of all, female CEOs are more focused on sustainability and have a long-term vision (Atif et al., 2020); therefore, they can be more committed to supporting innovation efforts related to sustainability aims. Besides, female executives are characterized by peculiarities that can boost innovation, such as the ability to encourage communication, sharing, and integration of existing knowledge and to promote collaboration and negotiation among the different stakeholders (Adams et al., 2023). By championing sustainability and leveraging their peculiar abilities, female leaders can inspire and empower employees to think innovatively and develop disruptive solutions that align with the organization's environmental values. Therefore, we propose:

Hypothesis 3b: The relationship between green organizational identity and disruptive innovation is moderated by the CEOs' gender-related peculiarities, such as when the organization is led by a female CEO, the relationship is stronger.

2.4.Moderated-mediation relationships between CEO sustainability orientation and disruptive innovation

Our study hypothesizes several relationships in our theoretical model (depicted in Figure 1). H1 suggests that the CEO's sustainability orientation will be connected to disruptive innovation within firms. H2a proposes an association between the CEO's sustainability orientation and the green organizational identity. Additionally, H2b predicts that the impact of the CEO's sustainability orientation on green organizational identity will be influenced by green product competitiveness. Furthermore, H3a predicts a positive relationship between green organizational identity and

disruptive innovation. Lastly, H3b suggested that the female CEO peculiarities can boost the translation of green identity in innovation and positively moderate this relationship. Prior research has identified this model configuration as a moderated mediation model (Preacher et al., 2007). It is important to note that evaluating the significance of individual paths (H1-3b) in the model is insufficient for establishing mediation and moderated mediation effects, as suggested by previous studies (Edwards & Lambert, 2007). As a result, we propose a final hypothesis to examine the overall moderated mediation effects as predicted by our model.

Hypothesis 4. The relationship between CEOs' sustainability orientation and disruptive innovation is mediated by green organizational identity and moderated by green product competitiveness and CEO gender-related characteristics. When the firm's green product competitiveness increases and the firm is led by a female CEO, the relationship between the CEO's sustainability orientation, green organizational identity, and disruptive innovation is stronger.

Aligned with the previously discussed theoretical background, the research model and hypotheses of the study are illustrated in Figure 1.

3. Research methodology

3.1. Data collection

We selected a sample of firms that operate within China. China provides an ideal context for our model's examination due to its status as one of the largest emerging markets undergoing significant market and technological transformations. With the dynamic nature of demand and technological advancements in China, the importance of innovation has become increasingly prominent for Chinese companies. The data for this study were collected through a structured survey

questionnaire. We selected a sample of 1200 companies from a directory of technology firms located in Guangdong Province, China. A notable characteristic of the manufacturing companies in Guangdong Province is their integration into global manufacturing networks. Hence, we specifically targeted manufacturing firms in this province when distributing the surveys. We gathered data on 257 Chinese SMEs that focus on technology for two main reasons. Firstly, China has implemented various policies to support research and development, innovation, and technology, such as R&D tax credits, industrial district development, and start-up support. Secondly, we chose to focus on SMEs because they are the backbone of the economy and important innovators, making them a suitable research laboratory for our study. In line with the existing literature (e.g., Kiani et al., 2021), we defined new firms as those that were less than eight years old.

The data regarding the independent variables were collected during T1, spanning from March 2017 to August 2018. Subsequently, the data concerning the dependent variable were collected during T2, which occurred between 12 months after the initial data collection period. In order to ensure a high response rate, we initially sent letters to the CEOs of the chosen firms, who acted as the lead entrepreneurs (e.g., Kiani et al., 2022). These letters explained the purpose of our research and invited their participation. Subsequently, we engaged in discussions with these CEOs after receiving their approval to determine the survey timeline. We obtained responses from 262 firms after conducting multiple rounds of phone calls, emails, and personal follow-ups. After excluding five responses with excessive missing data, we had usable responses from 257 firms. This response rate for data analysis is consistent with other research studies conducted in China. Respondents were guaranteed anonymity throughout the survey process. See Table 1 for demographics.

[Insert Table 1 about here]

The survey was initially created in English based on existing literature and subsequently translated into Chinese using the methodology described by Hoskisson et al. (2000). To ensure the accuracy of the translation, we performed a back-translation of the survey to identify and rectify any significant differences in meaning between the original and translated versions (Li et al., 2008). Before circulating the survey, we sought the input of two academics to assess the questionnaire. Additionally, we conducted pretesting with three firms. These steps helped us refine the wording of the items and ensured that the selected respondents possessed sufficient knowledge to complete the questionnaire satisfactorily.

3.2. Measures

CEO sustainability orientation. We assessed the degree of CEO sustainability orientation using a six-item scale adopted from Kuckertz and Wagner (2010). The scale was evaluated on a seven-point rating system, ranging from 1 (strongly disagree) to 7 (strongly agree). The Cronbach's alpha is 0.892.

Green organizational identity. Green organizational identity, a new concept introduced by Chen (2011), originates from Gioia and Thomas's (1996) organizational identity measure. In Chen's research, green organizational identity is described as a collective interpretive framework established by group members to give significance to their environmentally friendly actions and commitment to environmental management and protection (Chen, 2011). To evaluate this idea, we employed six items in our assessment. One example item was "The company's top managers, middle managers, and employees feel that the company has carved out a significant position with respect to environmental management and protection." The Cronbach's alpha is 0.885.

Green product competitiveness. We used a set of five items of green product competitiveness that were adapted from Chang (2011). Participants were asked to indicate their level of agreement with each item on a 5-point Likert scale, where 1 represented "strongly disagree" and 5 represented "strongly agree." The Cronbach's alpha is 0.867.

CEO female/male. We employed the CEO gender to create the moderating variable in the relationship between green organizational identity and disruptive innovation (the variable equals 0 when the CEO is female and 1 when the CEO is male).

Disruptive innovation. The degree of innovation was assessed using the framework of disruptive, radical, or breakthrough innovations, which encompass "new-to-the-world" ideas that deliver substantial and unique value to customers. These types of innovations typically address emerging and previously unmet customer needs. The measurement scale used in this study is based on the work of Spanjol et al. (2012). The Cronbach's alpha is 0.081.

Control variables. Control variables incorporated in the study are firms' assets, firm size (number of employees), and firms' age at the organizational level. Respondents' age and education at the individual level. These latter variables were introduced as previous research (e.g., Papadakis & Barwise, 2002) has suggested that they may influence managers' decision-making processes. Besides, firm assets and age were taken into consideration to disentangle the effect of the firm's size from the other two variables that are found to be linked with innovation (Hansen, 1992; Lawson et al., 2012).

4. Results

4.1. Preliminary Analyses

Confirmatory factor analysis. Before testing the hypothesized relationships, we used Mplus 8.3 to conduct confirmatory factor analysis (CFA) to evaluate the suitability of our measurement model. As shown in Table 2, the proposed four-factor model fit the data well ($\chi2(164) = 220.274$, CFI =0.977, TLI = 0.973, RMSEA =0.037, SRMR =0.043) and offered a significant improvement in chi-squared over a one-factor model combining sustainability orientation, green product competitiveness, green organizational identity, and disruptive innovation ($\chi2(170) = 1533.403$, CFI =0.445, TLI =0.380, RMSEA = 0.177, SRMR =0.157, $\Delta\chi2\ (6) = 1313.129$, $p < .001$). The validities and reliabilities of the measures are shown in Table 3.

[Insert Table 2 about here]

[Insert Table 3 about here]

Common method variance test. To minimize the effect of common method variance (Podsakoff et al., 2003), we specifically controlled for the measurement procedure. We conducted a two-wave survey by administering the questionnaire to the same employees at two separate time points. Also, we randomly arranged the measurement items in the questionnaire and ensured anonymity for all employees to reduce employee speculation about the measurement items. We also checked for potential CMV by utilizing Harman's one-factor test. In exploratory factor analysis, the outcome indicated four variables with eigenvalues greater than one, representing 66.379 percent of the total variance, and the first factor only accounted for 30.747 percent of the difference. The results indicated that the model did not fit well, suggesting that the items were not solely influenced by a single common method factor (e.g., Cai et al., 2021; Kiani et al., 2020). Secondly, following the

suggestion of Podsakoff et al. (2003), a two-factor model was established, controlling for the non-measured common method variance, which is not related to other homologous latent variables. The results showed that, compared to the four-factor model, the fit of the model did not significantly improve in the presence of common method variance ($\chi 2 = 183.8$, df = 144, RMSEA = 0.033, CFI = 0.984, TLI = 0.979). The changes in the main fit indices for the confirmatory factor analysis model and the model with the method latent factor are: △ CFI =0.007, △ TLI =0.006, △ RMSEA =0.004, and the changes in each fit index did not exceed 0.03, indicating that the addition of the common method factor did not significantly improve the model. This indicates that the common method variance did not have a severe impact on the model.

Descriptive statistics. This study utilized SPSS 28 for descriptive statistics and correlation analysis of the research variables. The means, standard deviations, and intercorrelations of all the variables used in the present study are shown in Table 4. The results showed that sustainability orientation is positively correlated with green organizational identity ($r = 0.286$, $p < 0.01$) and disruptive innovation ($r = 0.288$, $p < 0.01$). Green organizational identity is positively correlated with disruptive innovation ($r = 0.319$, $p < 0.01$). Our research hypotheses are preliminarily supported. The reliability coefficients of all measures were above 0.80, thereby passing the 0.70 threshold that is considered acceptable for research use.

[Insert Table 4 about here]

4.2. Hypotheses testing

The main hypotheses of this study were tested using hierarchical regression analysis (refer to Table 5). Models 5 and 6 show that sustainability orientation significantly predicts disruptive innovation in a positive manner ($b = 0.29$, $p < 0.001$), thus supporting Hypothesis 1. Models 2 and 3 reveal

that sustainability orientation has a significant positive effect on green organizational identity (b = 0.16, p < 0.001), providing support for Hypothesis 2a.

[Insert Table 5 about here]

Model 3 indicates that the interaction term between sustainability orientation and green product competitiveness significantly and positively influences green organizational identity (b =0.10, p < .01), lending support to Hypothesis 2b. Simple slope analysis (see Figure 2) demonstrates that under conditions of high green product competitiveness, the positive effect of sustainability orientation on green organizational identity is significant (b = 0.27, 95% CI = [0.16, 0.38], p < 0.001). However, when green product competitiveness is low, the positive effect of sustainability orientation on green organizational identity is not significant (b = 0.05, 95% CI = [-0.068, 0.170], ns). Therefore, Hypothesis 2b is supported.

[Insert Figure 2 about here]

Models 5 and 6 demonstrate that green organizational identity significantly positively influences disruptive innovation (b = 0.29, p < 0.001), thus supporting Hypothesis 3a. Model 6 shows that the interaction term between CEO gender and green organizational identity is negative and significant (b = -0.34, p < 0.05). The previous evidence, jointly with the slope analysis (see Figure 3), suggests that when the CEO is female, the relationship between green organizational identity and disruptive innovation is stronger.

[Insert Figure 3 about here]

Furthermore, bootstrap analysis indicates a significant moderated mediated conditional effect that reflects the proposed H4 (see Table 6). In the high-scoring group for green product competitiveness

and with female CEO, the indirect effect of sustainability orientation on disruptive innovation, mediated by green organizational identity, is stronger (b = 0.145, 95% bootstrapped CI = [0.061, 0.248]) compared with the male CEO group (b = 0.052, 95% bootstrapped CI = [0.002, 0.111]). However, the indirect effect is not significant in the low-scoring group for green product competitiveness for both female and male CEO groups. Furthermore, the index of conditional moderate mediation suggests that this effect is significant only in the female CEO group (index = 0.052, 95% bootstrapped CI = [0.009, 0.105]), while it is not significant for the male CEO group. In summary, Hypothesis 4 is supported.

[Insert Table 6 about here]

5. Discussion

5.1. Theoretical implications

The study contributes to the existing academic literature by merging the NRBV framework with upper echelons theory, focusing in particular on the CEO characteristics related to sustainability and examining the relationship between CEOs' sustainability orientation and disruptive innovation. Firstly, it reinforces the notion that a firm's unique resources and capabilities, particularly those related to sustainability, play a crucial role in achieving competitive advantage through innovation (Adomako et al., 2021; Feng et al., 2022; Zhao et al., 2021). The study underscores the significance of developing and leveraging sustainability-oriented resources to drive disruptive innovation and enhance organizational performance (Dickel & Eckardt, 2021; Zoppelletto & Bullini Orlandi, 2022). By highlighting the mediating role of green organizational identity, this study extends our understanding of how sustainability orientation translates into disruptive innovation outcomes. It

emphasizes that a strong green organizational identity serves as a bridge between sustainability orientation and the implementation of disruptive innovation strategies. This finding underscores the importance of nurturing a culture and identity that align with sustainability values, as they enable organizations to effectively integrate sustainability into their innovation processes.

Secondly, the research sheds light on the influence of green product competitiveness in the relationship between sustainability orientation and green organizational identity. The exploration of business sustainability with a focus on environmentally friendly operational activities has emerged as a captivating research subject (Kraus et al., 2023; Majumdar et al., 2018), stimulating discussions within the realm of business dynamics and the pursuit of a competitive edge (Kraus et al., 2020; Omrani et al., 2022; Soewarno et al., 2019). Organizations with high levels of green product competitive advantage have a stronger link between their sustainable approach and the development of a distinct green organizational identity. This finding underscores the role of market demand and green product competitive positioning in reinforcing the relationship between sustainability and disruptive innovation.

Thirdly, the study contributes to our understanding of disruptive innovation. In 1997, Christensen gained prominence in the study of technological innovation within commercial enterprises with the publication of his influential book titled "The Innovator's Dilemma." This best-selling book presented a comprehensive and detailed theory of disruptive technology at the time (Christensen, 1997). The theory of disruptive innovation has had a substantial influence on management practices and has sparked extensive debates within academic circles (Antonio & Kanbach, 2023; Palmié et al., 2020; Wang et al., 2023). We participate in the ongoing debate by investing in CEOs' characteristics that are relevant to the process of leveraging the organizational resources related to the natural environment and to the prioritization of sustainability to reach

disruptive innovation. Namely, we argue that CEOs with a strong sustainability orientation can leverage their unique organizational resources and capabilities to pursue disruptive innovations that align with sustainability goals. Thus, our study underscores the need for strategic alignment between sustainability orientation and innovation efforts (Kraus et al., 2023), highlighting the importance of embedding sustainability into the core of disruptive innovation strategies. Besides, we embrace and extend the literature about the differential impact of female CEOs on innovation (Javaid et al., 2023) and sustainability performance (Atif et al., 2020). By showing that female CEOs can leverage their peculiarities and specific skills and abilities to enhance the relationship between green organization identity and innovation, we add to the existing literature suggesting that female CEOs should also be investigated as potential moderators of the existing relationships among organizational variables and innovation outcomes.

Finally, the theoretical implications of this study contribute to the NRBV perspective and provide insights into the relationship between sustainability orientation and disruptive innovation. In this study, we examine the NRBV of the firm, originally proposed by Hart (1995), and show how our study has expanded upon it. Over the past 25 years since the NRBV's inception, empirical studies have tested several of Hart's propositions. However, the majority of this research has concentrated on establishing connections between pollution prevention and firm profitability, leaving other aspects of Hart's theoretical framework less explored. Thus, our study adopts the NRBV perspective to explore the mediating role of green organizational identity and the moderating influence of green product competitiveness. By doing so, we aim to enhance the understanding of how organizations can effectively utilize their resources and capabilities to foster sustainable and disruptive innovation outcomes (Rehman et al., 2021; Yuan et al., 2023).

5.2. Practical implications

The study highlights the importance of adopting a strong sustainability orientation as a strategic imperative for organizations. CEOs and managers should prioritize sustainability practices and integrate them into their overall business strategy (Si et al., 2023). This comprises setting sustainability goals, allocating resources to sustainability initiatives, and fostering a culture that values sustainability. By doing so, organizations can enhance their resource base and position themselves to drive disruptive innovation that aligns with their sustainability goals. Moreover, CEOs should focus on cultivating a strong green identity by fostering a shared understanding and commitment to sustainability among employees, promoting a values-driven culture that aligns with sustainability principles, and embedding sustainability into the firm's core identity (Kraus et al., 2023). By developing a strong green organizational identity, CEOs can effectively translate their sustainability orientation into actions and decisions that support disruptive innovation efforts. Firms should enhance their green product competitiveness by developing environmentally friendly products that meet market demands, investing in research and sustainable manufacturing, and effectively communicating the environmental benefits to strengthen the link with their sustainability orientation (e.g., Clauß et al., 2022). This, in turn, facilitates the pursuit of disruptive innovation. Managers should strategically integrate sustainability and innovation efforts by aligning sustainability orientation with disruptive innovation strategies, fostering cross-functional collaboration, and incorporating sustainability principles into the innovation process to drive aligned outcomes.

CEOs should recognize the importance of market positioning and competitive advantage in leveraging sustainability-oriented disruptive innovation. By developing environmentally friendly products that offer competitive advantages in the marketplace, organizations can strengthen their green organizational identity and enhance their overall sustainability orientation.

This positions them as leaders in sustainability-driven disruptive innovation, enabling them to gain a competitive edge and capture market opportunities. By adopting these practices, organizations can leverage their resources and capabilities to drive disruptive innovation that aligns with their sustainability goals, ultimately leading to a competitive advantage in the market.

5.3. Limitations and future research directions

The study's findings are based on survey data from a specific sample of 257 Chinese SMEs. First, while the data offers valuable insights into the hypothesized relationships, caution should be taken in generalizing the results to SMEs in other industries or geographical contexts, and future research could enhance the findings' generalizability by using larger and more diverse samples. Second, the study's design is cross-sectional. This limits the ability to establish causality or examine the dynamics of the relationships over time. Longitudinal or experimental designs would provide a stronger basis for causal inference and allow for the examination in a more dynamic manner. Third, the study uses self-report measures, with efforts to ensure validity and reliability, but potential biases or common method variance remain (e.g., Bullini Orlandi, 2016). Future research could incorporate objective performance metrics. Fourth, integrating qualitative approaches, like interviews or case studies, with quantitative survey data can provide a richer understanding of underlying mechanisms and contextual factors influencing relationships, uncovering organizational dynamics and managerial practices that quantitative measures might miss. Finally, Further research could investigate additional mediators and moderators, such as organizational culture, employee engagement, stakeholder collaboration, industry dynamics, or government policies, in the relationship between sustainability orientation and disruptive innovation (Zoppelletto et al., 2023). Moreover, investigating the impact of sustainability orientation on

various performance outcomes, such as financial performance, market share, or brand reputation, would provide valuable insights into the business value of these constructs.

6. Conclusion

In conclusion, this study contributes to the understanding of the relationship between sustainability orientation and disruptive innovation in SMEs, utilizing the NRBV framework and upper echelons theory. The findings highlight the positive association between CEO sustainability orientation and disruptive innovation, emphasizing the leverage of unique resources and capabilities related to sustainability practices. The mediating role of green organizational identity is emphasized, as it facilitates the translation of CEO sustainability orientation into tangible actions and decisions supporting disruptive innovation. Additionally, the study demonstrates the moderating influence of green product competitiveness and female CEOs, reinforcing the link between CEO sustainability orientation, green organizational identity, and disruptive innovation. These findings underscore the importance of aligning CEO sustainability-oriented practices with innovation strategies, fostering a values-driven organizational culture, and leveraging CEOs' characteristics and peculiarities to reach innovative outcomes. By aligning those organizational and executive-level variables, SMEs can contribute to a more sustainable future while enhancing their competitive edge in the long run.

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Figure 1. Research Model

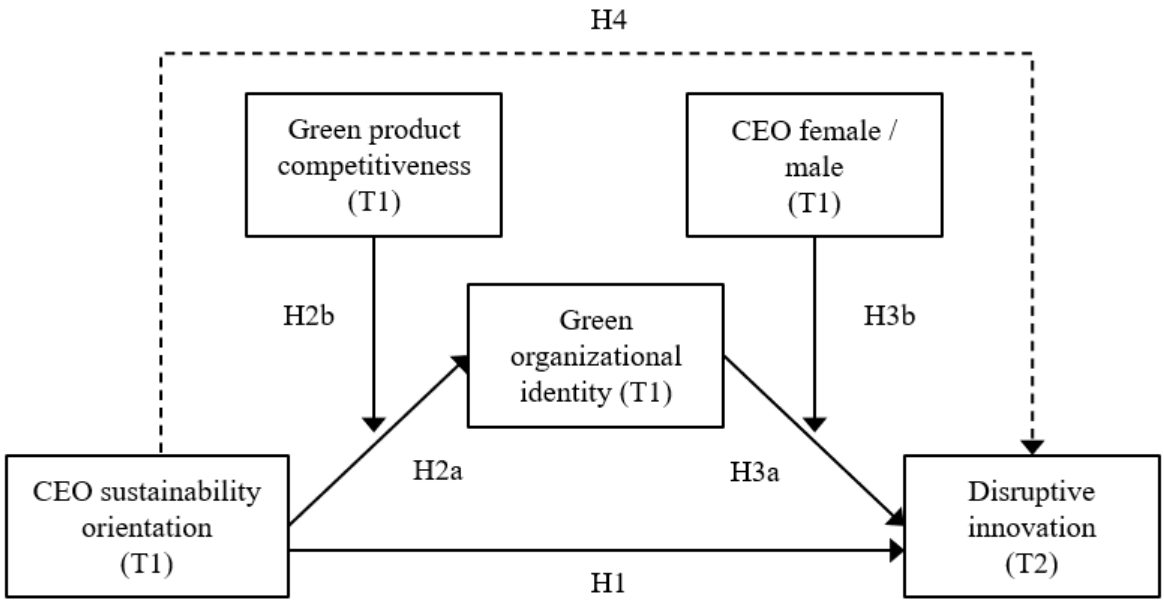

Figure 2. Moderating effect of green product competitiveness on the relationship between sustainability orientation and green organizational identity.

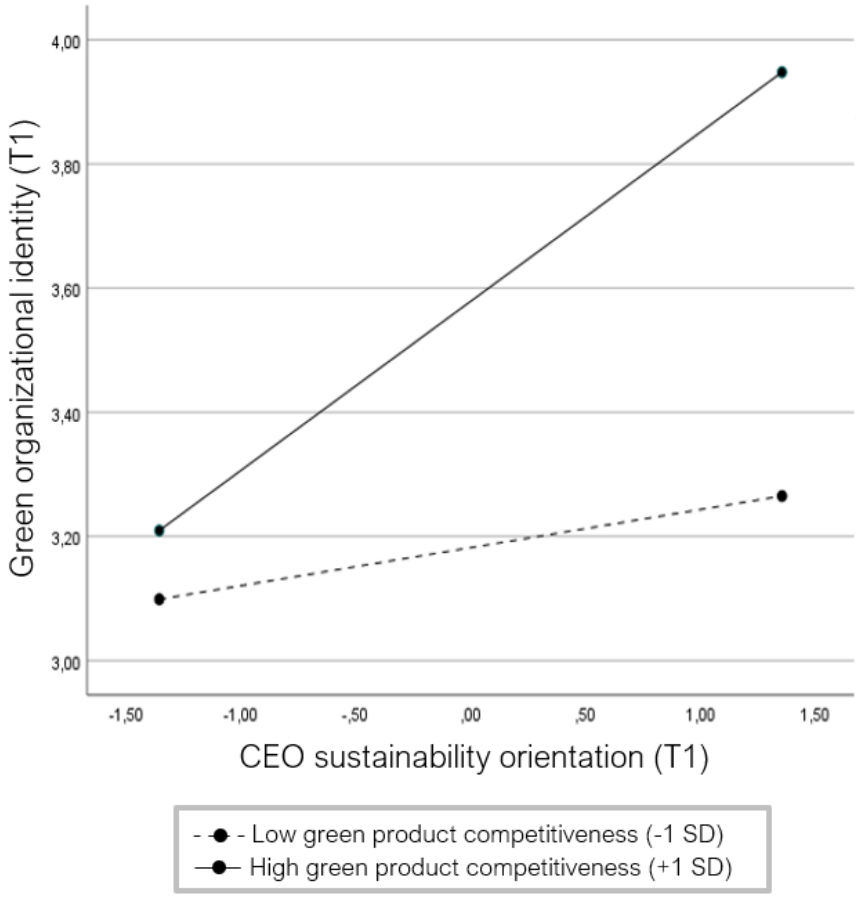

Figure 3. Moderating effect of CEO gender on the relationship between green organizational identity and disruptive innovation.

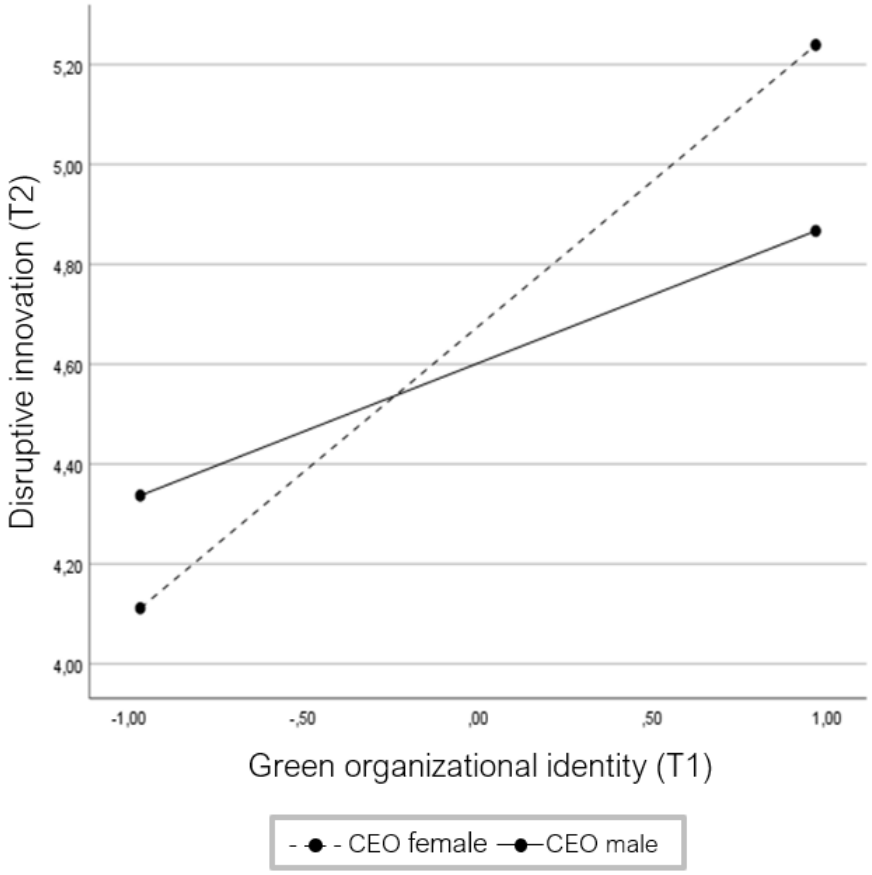

Table 1. Demographic information of the respondents

Variables	*N*	Percentage
Gender		
Male	182	70.8
female	75	29.2
Age of individual (in years)		
Less than 29	7	2.7
29~39	37	14.4
39~49	129	50.2
49~59	70	27.2
Above 59	14	5.4
Education		
High school	88	34.2
Associate's	96	37.4
Bachelor's	55	21.4
Other	18	7.0
Firm age (in years)		
1~4	58	22.6
4~7	54	21.0
7~10	90	35.0
Above 10	55	21.4
Firm size (number of employees)		
<10	16	6.2
10~50	100	38.9
51~100	60	23.3
101~250	60	23.3
> 251	23	8.9
Firm assets (in millions)		
<10	85	33.1
10 ~18	52	20.2
19 ~27	60	23.3
> 27	60	23.3

Table 2. Results of confirmatory factor analysis

Model	$\chi 2$	df	$\chi 2$ / df	CFI	TLI	RMSEA	SRMR
Four-factor model: CSO; GOI; GPC; DI	220.274	164	1.343	0.977	0.973	0.037	0.043
Three-factor model: CSO + GOI; GPC; DI	820.481	167	4.913	0.734	0.697	0.123	0.119
Two-factor model: CSO + GOI + GPC; DI	1364.079	169	8.071	0.513	0.452	0.166	0.154
One-factor model: CSO + GOI + GPC + DI	1533.403	170	9.020	0.445	0.380	0.177	0.157

Note. CFI = comparative fit index; TLI = Tucker–Lewis Index; RMSEA = root mean square error of approximation; SRMR = standardized root means square residual; N = 257, CSO = CEO sustainability orientation; GOI = green organizational identity; GPC = green product competitiveness; DI = disruptive innovation.

Table 3. Reliability and validity analysis

Variables	Items	loadings	CA	CR	AVE
CEO sustainability orientation	6	0.758-0.805	0.892	0.909	0.625
Green organizational identity	6	0.702-0.820	0.867	0.901	0.602
Green product competitiveness	5	0.733-0.839	0.885	0.895	0.6304
Disruptive innovation	3	0.773-0.816	0.801	0.844	0.643

Note. loading = standardized loading; CA = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted.

Table 4. Means, standard deviations, and correlations

Variable	M	SD	1	2	3	4	5	6	7	8	9	10
Age	45.455	7.902										
Education	2.012	0.916	0.008									
Firm age	1.791	0.816	-0.101	0.069								
Firm size	4.089	1.092	-0.033	0.048	0.069							
Firm asset	1.099	0.416	-0.002	0.029	.266**	0.089						
CEO sustainability orientation	3.685	1.354	0.038	0.041	0.119	0.122	-0.049	(0.892)				
Green organizational identity	3.398	0.966	-0.025	.143*	0.078	.174**	-0.034	.286**	(0.885)			
Green product competitiveness	4.595	1.130	-0.027	0.083	.214**	-0.032	0.096	0.121	.245**	(0.867)		
CEO female / male	0.708	0.455	-0.016	-0.039	-0.042	0.05	0.007	0.051	0.053	0.06		
Disruptive innovation	4.616	1.317	-0.077	.252**	.199**	.148*	0.057	.288**	.319**	.366**	-0.01	(0.801)

Note. N = 257. Firm age=Log (firm age), Firm size = Log (firm size); Firm asset = Log (firm asset); M = mean; SD = standard deviation. Reliability estimates appear in parentheses across the diagonal. *p < .05, **p< .01 (two-tailed).

Table 5. Results through hierarchical regression

	Green organizational identity (T1)			Disruptive innovation (T2)		
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	2.61*** (0.47)	2.15*** (0.46)	2.18*** (0.46)	3.29*** (0.62)	2.14** (0.64)	2.11** (0.64)
Control variables						
CEO age	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
CEO education	0.14* (0.06)	0.13* (0.06)	0.14* (0.06)	0.34*** (0.09)	0.29** (0.08)	0.29*** (0.08)
Firm age	0.09 (0.08)	0.05 (0.07)	0.05 (0.07)	0.27** (0.1)	0.2* (0.1)	0.2* (0.1)
Firm size	0.15** (0.05)	0.12* (0.05)	0.12* (0.05)	0.15 (0.07)	0.08 (0.07)	0.08 (0.07)
Firm asset	-0.17 (0.15)	-0.11 (0.14)	-0.15 (0.14)			
Predictors						
CEO sustainability orientation (T1)		0.17*** (0.04)	0.16*** (0.04)		0.2** (0.06)	0.2** (0.06)
Green product competitiveness (T1)		0.19*** (0.05)	0.18** (0.04)			
Green organizational identity (T1)					0.29*** (0.08)	0.29*** (0.08)
CEO female / male					-0.09 (0.16)	-0.1 (0.16)
Interaction terms						
CSO × GPC			0.10** (0.04)			
GOI × CEOF						-0.34* (0.17)
Total R^2	0.06	0.17	0.19	0.12	0.22	0.23
ΔR^2		0.11***	0.02**		0.10***	.01*

Note: N = 257. Bootstrap samples = 5000. Firm age=Log (firm age), Firm size = Log (firm size); Firm asset = Log (firm asset). CSO = CEO sustainability orientation; GOI = green organizational identity; GPC =green product competitiveness; CEOF = CEO female / male; DI = disruptive innovation. Except for the Total R^2 and ΔR^2 rows values are unstandardized regression coefficients. Standard errors are provided in parentheses next to the standardized regression coefficients. *p < .05; **p < .01; ***p < 0.001.

Table 6: Results of the analysis for the moderated mediation model

Indirect effect: CEO sustainability orientation (T1) → Green organizational identity (T1) → Disruptive innovation (T2)					
GPC (T1)	CEO female /male	Effect	Bootstrapped S.E.	Bootstrapped LLCI	Bootstrapped ULCI
-1.13	Female	0.027	0.041	-0.045	0.122
-1.13	Male	0.009	0.016	-0.018	0.048
1.13	Female	0.145	0.048	0.061	0.248
1.13	Male	0.052	0.028	0.002	0.111
Index of conditional moderated mediation:		Index			
	Female	0.052	0.025	0.009	0.105
	Male	0.019	0.012	-0.000	0.047

Note: *N* = 257. Bootstrap samples = 5000. S.E.: standard error. LLCI: Lower Level Confidence Interval. ULCI: Upper Level Confidence Interval