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When Do Environmental Regulations Lead to Green Practices? The Role of Resource Commitment and Corporate Entrepreneurship

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ABSTRACT

Environmental regulations increasingly pressure firms to adopt green practices, yet their effectiveness remains debated. Drawing on institutional theory and the resource-based view, this study investigates the mechanisms linking environmental regulations to green supply chain management (GSCM) practices. We propose and test a moderated mediation model using data from 231 Chinese manufacturers. Results show that circular-oriented resource commitment mediates the regulation–GSCM relationship, whereas corporate entrepreneurship selectively moderates the path from regulations to resource commitment. These findings extend theory by showing how regulatory pressures shape resource deployment in environmental management and how entrepreneurial orientation enhances firms' ability to transform regulatory requirements into strategic resource commitments.

1 | Introduction

The growing global concern over sustainability challenges has led to the establishment of environmental regulations that encourage firms to adopt eco-friendly practices. These regulations can take various forms, including domestic environmental protection laws, international environmental conventions, global environmental standards, government subsidies, tax incentives, and broader sustainability initiatives (Jaffe et al. 2002). Their primary objectives are to address market failures—where environmental costs are externalized—and to establish accountability mechanisms that promote sustainable business practices. In doing so, these regulations help protect natural ecosystems

and preserve natural resources for future generations (Wiredu et al. 2023; Khan et al. 2022).

The increasing regulatory pressures have made green supply chain management (GSCM) a critical consideration for companies across various industries (Diabat and Govindan 2011). GSCM serves as a key strategy for integrating environmental considerations into supply chain operations, aiming to minimize the ecological impact of business activities throughout the entire lifecycle—from raw material sourcing to end-of-life management (Liu et al. 2020; Srivastava 2007; Zhu et al. 2008). It is a systematic approach to environmental management that extends beyond individual firms to encompass entire supply chains. The importance of GSCM has

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grown significantly in recent years for several compelling reasons. First, according to Tetteh et al. (2025), logistics operations are responsible for roughly 13% of greenhouse gas emissions worldwide. These emissions increased by 14% in 2022, reaching 8 billion metric tons of GtCO₂e, and are projected to rise by up to 60% by the year 2050. Second, manufacturing companies face intense pressure from stakeholders to improve their ecological and social sustainability performance (Nureen et al. 2023). Third, firms implementing GSCM practices can potentially achieve a triple-bottom-line benefit—enhancing environmental performance, improving social outcomes, and boosting economic results (El Mokadem and Khalaf 2025).

Recent evidence suggests that effective GSCM practices can reduce carbon emissions, minimize waste, preserve biodiversity, and enhance resource efficiency throughout supply chains (Wiredu et al. 2023). GSCM practices, when implemented alongside renewable energy consumption, can significantly influence carbon emissions patterns in major economies like China and India (Wen et al. 2025). Both internal and external GSCM implementation can enhance corporate sustainability performance, with green innovation playing a crucial mediating role in this relationship (Ning et al. 2025). The business benefits of GSCM extend beyond environmental improvements. GSCM can increase customer satisfaction, lower production costs, maximize profits, improve cooperation, and create competitive advantages (Khan et al. 2022). GSCM practices directly affect environmental, social, and operational performance, whereas their effect on economic performance is mediated through these other performance dimensions (El Mokadem and Khalaf 2025).

Although environmental regulations can act as coercive pressures motivating organizations to implement proactive environmental practices (DiMaggio and Powell 1983), research on the impact of environmental regulations on GSCM adoption has produced inconsistent results. Some studies have found a positive influence (e.g., Wu et al. 2012), whereas others suggest limited effectiveness in driving meaningful change (Bello-Pintado et al. 2023; Lintukangas et al. 2023). This inconsistency indicates that regulations alone may not fully explain the varied environmental behaviors of firms (Aronson and LaFont 2022; Cassells and Lewis 2011).

Importantly, GSCM practices often require substantial long-term investments and a systematic approach to resource utilization throughout the entire supply chain (Liu and Chang 2017). Resource commitment represents a specific pattern of resource allocation essential for implementing GSCM practices, particularly in supporting closed-loop supply chains and other circular economy initiatives (Liu et al. 2020; Schmidt et al. 2021). Resource commitment encompasses investments in technologies for processing used materials, establishing environmental management systems, training employees, and developing specialized knowledge related to material recycling (Liu and Chang 2017). Recent evidence suggests that circular-oriented resource commitment enables firms to translate regulatory pressures into tangible operational changes in their supply chains (Kholaf and Tang 2024).

Although resource commitment provides the necessary financial and organizational foundation for GSCM implementation, corporate entrepreneurship offers the strategic mindset and

innovative approach needed to effectively leverage these resources in response to environmental regulations. Corporate entrepreneurship—defined as a firm's propensity for innovation, proactiveness, and risk-taking (Morris and Paul 1987)—has emerged as a potential element in addressing environmental issues (Aronson and LaFont 2022; Chavez et al. 2020). Corporate entrepreneurship can help firms develop innovative GSCM solutions that enhance sustainability performance (Behl et al. 2023). Companies with strong corporate entrepreneurship are more likely to perceive environmental regulations not as constraints but as opportunities—aligning with the Win-Win perspective (Hamdy 2024)—and consequently demonstrate stronger resource commitments.

Given the conflicting findings on environmental regulations' effect on GSCM adoption and the emerging importance of corporate entrepreneurship in sustainable development, our research aims to further examine the mechanisms through which environmental regulations influence GSCM, focusing on two firm-level factors: resource commitment and corporate entrepreneurship. We attempt to address three interrelated questions:

- a. How do environmental regulations influence GSCM?
- b. What role does resource commitment play in the relationship between environmental regulations and GSCM?
- c. How does corporate entrepreneurship affect the impact of environmental regulations on GSCM?

Drawing on institutional theory, entrepreneurship theory, and the resource-based view (RBV), we develop an integrated conceptual framework that posits that resource commitment mediates the relationship between environmental regulations and GSCM practices, whereas corporate entrepreneurship moderates how firms allocate resources in response to regulations. This theoretical integration connects external regulatory pressures to internal resource allocation decisions (resource commitment) while explaining heterogeneous firm responses through the moderating effect of corporate entrepreneurship. In contrast, previous GSCM research has relied on single theoretical frameworks, including institutional theory to explain regulatory pressures (Zhu et al. 2013), stakeholder theory to examine diverse external expectations (Xing and Liu 2023), natural RBV for environmental competitive advantages (Nureen et al. 2023), dynamic capability theory for adaptation processes (Hamdy 2024), and self-determination theory for employee motivation (Behl et al. 2023).

To test our hypotheses, we conducted a survey with a sample of 231 manufacturing firms in China's Guangdong province. This context is particularly suitable as Chinese manufacturers face increasing environmental regulations while contributing significantly to global production. Guangdong, known as the “world's factory,” led China's manufacturing and contributed 10.8% of China's GDP in 2023 (Guangdong Provincial Government 2024). We employed bootstrapping procedures to test the mediation model and to examine the moderated mediation effects.

This study advances understanding of environmental management in several important ways. First, it identifies resource commitment as the key mediating mechanism through which

regulations influence GSCM practices, explaining previously inconsistent findings about regulations' direct effects. Second, it extends the institutional theory–RBV integration by showing how regulatory pressures shape resource deployment in environmental management. Third, it demonstrates how corporate entrepreneurship enhances firms' ability to respond to environmental regulations through resource commitment.

2 | Theories and Hypotheses

2.1 | Theoretical Foundations

Previous GSCM research has employed various theoretical frameworks, including stakeholder theory to explain diverse external pressures (Xing and Liu 2023), dynamic capability theory to address adaptive processes (Hamdy 2024; Wiredu et al. 2023), natural RBV to connect environmental practices with competitive advantage (Nureen et al. 2023), self-determination theory to examine employee motivation (Behl et al. 2023), and RBV to understand organizational resources and capabilities (Ning et al. 2025; Khan et al. 2022). Although each perspective offers valuable insights, they often address isolated aspects of the GSCM phenomenon. This study integrates institutional theory, RBV, and entrepreneurship theory to develop a comprehensive framework explaining how environmental regulations influence GSCM adoption.

2.2 | Institutional Theory

Institutional theory explains how organizations respond to external pressures in order to gain legitimacy within their operating environments (DiMaggio and Powell 1983). Within this framework, environmental regulations function as a key form of coercive pressure, shaping organizational behavior by compelling firms to adopt environmentally responsible practices such as GSCM (Delmas and Toffel 2004; Zhu et al. 2013). As key institutional forces, these regulations signal societal expectations regarding environmental responsibility. They significantly influence GSCM adoption patterns, with varying regulatory approaches leading to different levels of carbon emission reductions across economies (Wen et al. 2025). These institutional pressures affect both internal GSCM practices (e.g., process improvements and waste reduction) and external ones (e.g., green procurement and supplier collaboration), thereby contributing to improved corporate sustainability performance (Ning et al. 2025).

However, empirical findings regarding their impact remain inconsistent (Bello-Pintado et al. 2023; Lintukangas et al. 2023). Some firms adopt GSCM practices substantively, aiming for genuine performance improvements, whereas others adopt them symbolically, seeking only to meet minimum compliance standards (Boubaker et al. 2024; Hong et al. 2021; Bello-Pintado et al. 2023; Lintukangas et al. 2023). The effectiveness of these regulations depends not only on their stringency but also on how firms interpret and operationalize them within their strategic and operational contexts (Ning et al. 2025). Therefore, although institutional theory provides a valuable lens for understanding external pressures, it alone cannot fully explain the

heterogeneous responses of firms to similar regulatory environments. This necessitates the integration of additional theoretical perspectives that account for firm-level characteristics, strategic intent, and resource configurations.

2.3 | RBV

The RBV explains how firms achieve a sustained advantage by utilizing internal resources that are valuable, rare, difficult to imitate, and not easily substituted (Barney 1991). Building on this, the natural RBV focuses on how environmental practices can contribute to firm success through pollution prevention, product stewardship, and long-term sustainability goals (Hart 1995).

In GSCM, the commitment of resources plays a central role. Effective GSCM implementation depends on allocating specific types of capital, such as investments in green technologies, environmental management systems, and environmental expertise (Liu and Chang 2017). The degree to which resources are allocated with clear intent—known as resource specificity—can determine the success of environmental initiatives, particularly when supported by digital tools (Kholaf and Tang 2024). Today, technologies that enable data-driven decision-making and improve supply chain coordination further support the implementation of GSCM by turning sustainability strategies into practice (Hamdy 2024). The RBV perspective shows how internal decisions around resource use are essential in responding to environmental expectations and improving operational outcomes.

2.4 | Entrepreneurship Theory

Entrepreneurship theory explains how firms identify and exploit opportunities amid uncertainty through innovativeness, proactiveness, and risk-taking (Miller 1983; Anderson et al. 2015). Corporate entrepreneurship expands this concept to established organizations, enabling them to create new value through resource reconfiguration and strategic renewal (Narayanan et al. 2009).

Applied to sustainability, corporate entrepreneurship helps firms shift from inefficient operations to innovative environmental practices (Ardito and Dangelico 2018). Firms with stronger entrepreneurial orientation are more likely to interpret environmental regulations as opportunities for improvement rather than mere compliance obligations (Dangelico 2016). Methods such as gamification can increase motivation among employees to engage with. Corporate entrepreneurship also supports flexible resource allocation. Firms that are more willing to take calculated risks and act ahead of competitors are better equipped to commit resources and respond to external conditions, including new or changing regulations (Bierwerth et al. 2015).

2.5 | Integrated Theoretical Framework

The integration of these three perspectives provides a holistic framework for understanding both the direct and indirect mechanisms that translate environmental regulations into

effective GSCM practices. This integration explains previously inconsistent findings by identifying the mechanisms and boundary conditions in the relationship between environmental regulations and GSCM practices. Following this integrated framework, we propose that environmental regulations influence GSCM practices through the mediating role of resource commitment, with corporate entrepreneurship positively moderating the relationship between environmental regulations and GSCM practices.

3 | Hypotheses

3.1 | Environmental Regulations and GSCM Practices

Institutional theory has been applied to supply chain management research for over a decade (e.g., Zhu et al. 2013). This theory suggests that organizations adopt certain business practices to gain legitimacy by responding to three types of institutional pressures: normative, mimetic, and coercive (DiMaggio and Powell 1983; Wang et al. 2018). Normative pressures arise from industry standards and professionalization. Mimetic pressures occur when organizations imitate others due to uncertainty or ambiguity. Coercive pressures stem from formal and informal pressures exerted by other organizations and societal expectations (DiMaggio and Powell 1983).

This study focuses on coercive pressures, specifically environmental regulations imposed by regulatory authorities (Delmas and Toffel 2004; Zhu et al. 2013). These regulations can impede or threaten an organization's operations based on environmental performance (Delmas and Toffel 2004). Many researchers recognize environmental regulations as important tools for promoting pro-environmental operations (Boubaker et al. 2024; Hong et al. 2021; Zhao and He 2022; Zhu et al. 2013). However, the impact of these regulations on GSCM adoption remains unclear. Some studies report a positive relationship (Wu et al. 2012), whereas others find no significant effect (Bello-Pintado et al. 2023; Lintukangas et al. 2023; Liu et al. 2020). Tachizawa et al. (2015) even found that regulations can positively affect some GSCM practices while negatively impacting others.

Following the institutional theory, firms' business practices are influenced by institutional pressures, including coercive pressures exerted by government and regulatory authorities (He et al. 2019; Hong et al. 2021). This study focuses on coercive pressures, specifically environmental regulations imposed by regulatory authorities (Delmas and Toffel 2004; Zhu et al. 2013). Many studies have questioned the credibility of self-regulation and highlighted the importance of government regulation in shaping responsible business practices and achieving environmental effectiveness (Arora et al. 2020).

Piila et al. (2022) provide insights into how firms progress from regulatory compliance to more proactive environmental management strategies. This progression aligns with the adoption of GSCM practices, which often go beyond mere compliance to embrace a more holistic approach to environmental management throughout the supply chain. Moreover, Eikelenboom

and de Jong (2022) highlight the importance of managerial interpretations and network interactions in integrating circularity into business strategy. Environmental regulations can shape these interpretations and interactions, potentially catalyzing the adoption of GSCM practices across supply chain networks. Therefore, we propose

Hypothesis 1. *Environmental regulations have a positive effect on the adoption of GSCM practices.*

3.2 | The Mediation of Resource Commitment

Circular-oriented resource commitment (resource commitment for short) represents an organization's dedication to investing in technologies, processes, and infrastructure that enable circular economy principles, including resource allocation to recycling systems, waste management, and material recirculation efforts (Liu and Chang 2017; Schmidt et al. 2021). These investments are crucial as they form the foundation for the operational capabilities necessary to implement GSCM practices effectively.

Environmental regulations play a pivotal role in compelling firms to reconfigure their business models and allocate significant resources to environmental practices (Sharma et al. 1999). Acting as catalysts, these regulations prompt firms to develop resource commitment to meet compliance requirements and align with sustainability objectives. Although certain circular activities, such as basic recycling, can lead to cost savings (Tilley 1999), the implementation of comprehensive GSCM practices requires extensive long-term investments across various supply chain dimensions (Ardito and Dangelico 2018; Rauer and Kaufmann 2015; Vachon and Klassen 2006).

Recent evidence shows that mandatory environmental regulations can promote green innovation through penalty mechanisms, though effectiveness varies across firm ownership types and industry contexts (Wang et al. 2023). Similarly, Yin et al. (2023) find that environmental regulations can drive green technological innovation, particularly when supported by green finance. Cross-country evidence from G7 nations further suggests that environmental regulations' effectiveness depends on complementary factors like renewable energy investment and financial development (Liu et al. 2023). Resource commitment serves as a critical link, enabling the translation of regulatory pressure into tangible operational changes that facilitate GSCM. The pursuit of sustainability-oriented innovation necessitates a shift from resource-intensive practices toward a systematic reconfiguration of processes (Ardito and Dangelico 2018; Dangelico 2016). We posit that

Hypothesis 2. *Resource commitment mediates the relationship between environmental regulations and GSCM practices.*

3.3 | The Moderation of Corporate Entrepreneurship

Existing research on GSCM has identified multiple factors that influence regulatory responses, including organizational culture (El-Garaihy et al. 2022), leadership approaches

(Tetteh et al. 2025), market orientation (Agyabeng-Mensah et al. 2020), and technological capacity (Hamdy 2024). However, emerging studies suggest corporate entrepreneurship holds particular significance in sustainability (Behl et al. 2023; Chavez et al. 2020), making it especially appropriate for investigating the relationship between regulations and GSCM implementation.

Conceptually, corporate entrepreneurship consists of three core dimensions—innovativeness, proactiveness, and risk-taking (Miller 1983; Anderson et al. 2015)—with each dimension contributing distinctively to the relationship between environmental regulations and GSCM practices. Innovativeness enables firms to develop new products, processes, or practices aligned with sustainability goals (Anderson et al. 2015; Miles et al. 2009). These innovative capabilities foster creative approaches to environmental challenges, transforming regulatory pressures into distinctive competencies that create competitive advantages (Narayanan et al. 2009). Proactiveness allows firms to anticipate regulatory developments and respond strategically in advance of competitors (Lumpkin and Dess 1996; Miller 1983). This forward-looking orientation helps organizations identify emerging sustainability trends early, enabling them to commit resources before regulatory enforcement and gain first-mover advantages in environmental markets (Kreiser et al. 2021). Risk-taking supports the willingness to allocate resources toward uncertain but potentially impactful environmental initiatives (Covin and Slevin 1989; Morris and Paul 1987). This psychological readiness to embrace uncertainty facilitates substantial investments in environmental technologies and practices despite unclear short-term returns, which is essential for addressing complex sustainability challenges that require significant resource commitments (Kuratko et al. 2021).

As an integrative construct, corporate entrepreneurship enables more effective adaptation to external requirements (Covin et al. 2021). When facing environmental regulations, firms with strong corporate entrepreneurship reinterpret regulatory pressures as opportunities for strategic improvement rather than as compliance costs (Kuratko et al. 2021; Porter and Linde 1995). They typically perceive such regulations through a Win-Win lens, viewing them as opportunities rather than constraints (Porter and Linde 1995). This perspective stems from their capacity to reconfigure resources and develop new competencies (Zahra et al. 1999), enabling more effective responses to institutional requirements (Shu et al. 2019). It is consistent with evidence that corporate entrepreneurship supports strategic repositioning (Zahra et al. 1999) and facilitates positive responses to institutional pressures (Shu et al. 2019).

Organizationally, corporate entrepreneurship promotes cross-functional knowledge sharing and experimentation, which accelerates the translation of regulatory requirements into operational practices (Tandon et al. 2024). Empirical evidence shows that when firms develop sustainable corporate entrepreneurship—integrating responsible environmental management, social accountability, and economic performance with significant innovation in products, processes, and business models (Miles et al. 2009)—they are better able to align strategic priorities with regulatory requirements (Amankwah-Amoah et al. 2021),

thereby strengthening the implementation of green practices across the supply chain. Therefore

Hypothesis 3. *Corporate entrepreneurship positively moderates the relationship between environmental regulations and GSCM practices.*

The implementation of GSCM practices necessitates substantial resource commitment, representing a strategic allocation decision that determines both the scope and effectiveness of environmental initiatives. Corporate entrepreneurship functions as a resource configuration mechanism (Bierwerth et al. 2015), improving firms' ability to access, mobilize, and reconfigure resources in response to institutional pressures such as environmental regulations (Teng 2007). This capability enables value creation through resource reconfiguration and strategic renewal (Narayanan et al. 2009; Capron and Mitchell 2009), transforming compliance-focused resource allocation into strategic investment decisions with broader competitive implications.

The core dimensions of corporate entrepreneurship—innovativeness, proactiveness, and risk-taking (Miller 1983; Anderson et al. 2015)—work alongside psychological readiness to invest despite uncertainty (Kuratko et al. 2021) to change how firms approach investment decisions under regulatory pressures. These mechanisms enable firms to identify strategic opportunities within regulatory challenges, take calculated risks in resource allocation despite uncertainty, and proactively commit resources before implementation requirements. Similarly, strategic entrepreneurship provides organizational mechanisms for allocating time, rewards, and management attention to innovative initiatives (Kuratko and Audretsch 2013), counteracting organizational resistance that typically impedes resource reallocation toward environmental compliance.

Recent studies identify resource constraints as a major challenge in sustainability transitions, with corporate entrepreneurship serving as an effective mechanism for overcoming this barrier (Tandon et al. 2024). Resource redeployment has been documented as a key motivation for entrepreneurship-driven sustainability initiatives when regulatory frameworks create strategic opportunities (Mäkitie 2020). Overall, entrepreneurial firms not only perceive regulatory requirements differently but also possess better capabilities to mobilize resources in response to these requirements.

Hypothesis 4. *Corporate entrepreneurship positively moderates the relationship between environmental regulations and resource commitment.*

Figure 1 illustrates the hypothesized relationships in a theoretical framework.

4 | Method

4.1 | Sample and Data

Our study adopts a postpositivist approach, examining objective relationships between measurable constructs while acknowledging the complex contextual factors that influence firms' responses

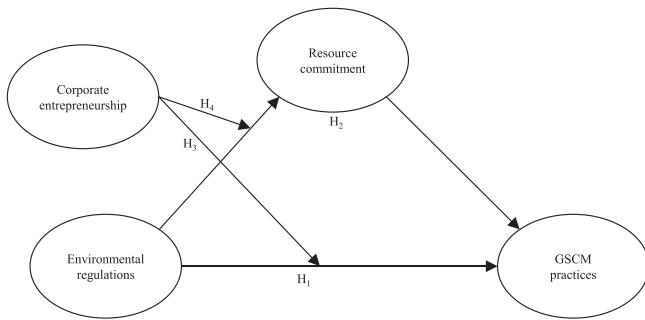


FIGURE 1 | Theoretical model.

to environmental regulations. We used an online questionnaire to test the research hypotheses, collecting data from the manufacturing industry in China. Manufacturers, as major polluters and resource consumers, face significant pressure to adopt environmental practices like GSCM (Zhu et al. 2013). China, with the world's largest manufacturing capacity, produces 30% of global goods (The State Council Information Office of China 2022). Guangdong, the “world's factory,” led China's manufacturing and contributed 10.8% of China's GDP in 2023 (Guangdong Provincial Government 2024). Data from Guangdong manufacturing firms offer a strong representation of GSCM practices.

The questionnaire was distributed via WeChat to targeted groups using purposive sampling (Christmann and Taylor 2001). As the most widely used social media platform in China, WeChat provided an efficient and accessible channel for engaging professionals in real time. The purposive sampling approach ensured that the respondents were highly relevant to the study and likely to provide thoughtful responses. From January 27 to February 7, 2022, it was shared with alumni of three major universities and enterprise groups in Guangdong province. Only managerial personnel were invited, and after two reminders, we received 290 responses, with 231 usable questionnaires. The data collection period coincided with the Lunar New Year, when professionals typically have more availability, likely enhancing participation. The quality of responses (e.g., completeness and lack of random patterns) confirms the appropriateness of the data collection period, and the resulting sample size of 231 is robust for meaningful analysis.

The respondent sample includes various industries ranging from electrical and electronic (13.9%), pharmaceutical (13.9%), chemical (6.5%), automobile (5.6%), to petroleum (0.4%). In terms of firm ownership, the sample is split with over half being privately owned (69.3%), 14.3% being Foreign Direct Investments (FDI), and 10.8% being state-owned. The sample includes firms of different sizes: 45.1% with less than 100 employees, 24.2% with 100–499 employees, and 30.7% with 500 employees. In terms of firm age, 15.6% are less than 5 years old, 25.5% are 6–10 years old, 44.6% are 11–25 years old, and 14.3% are more than 25 years old.

To test nonresponse bias, we compared the responses of early ($n = 125$) and late ($n = 106$) waves of responses received. The results of t -tests showed that there are no significant differences between the two groups.

In surveys on ethical behavior, social desirability bias can arise when respondents provide answers they think are socially

acceptable (Podsakoff et al. 2003). To reduce this bias, we assured participants of confidentiality and framed questions around the organization rather than the individual.

4.2 | Construct Measures

The measures for all constructs were adapted from existing literature. A 5-point Likert scale was used, except for GSCM practices, which ranged from 1 (not considering it) to 5 (successfully implemented). The questionnaire was developed in English and translated into Chinese using a back-translation procedure. It was pilot tested by three academics and seven industry experts for face validity.

Environmental regulations were measured using a six-item scale from Jaffe et al. (2002), with items like “Our products must comply with domestic environmental laws.” Resource commitment was measured using a six-item scale by Liu and Chang (2017), including items like “We invested in technologies for processing used materials.”

Corporate entrepreneurship was assessed using eight items adapted from Covin and Slevin's (1989) scale. Although originally conceptualized with three dimensions, our study employed a two-dimensional structure based on subsequent research (Anderson et al. 2015; Morris and Paul 1987). This approach combines innovation and proactiveness into a single “innovativeness” dimension (e.g., “strong emphasis on R&D and innovation”), as these aspects tend to covary in organizational settings (Lumpkin and Dess 1996), with risk-taking as the second dimension (e.g., “proclivity for high-risk projects”). Factor analysis confirmed this two-factor structure, consistent with Morris and Paul's (1987) findings.

GSCM practices, adapted from Zhu and Sarkis (2004), included four dimensions: internal environmental management, green purchasing, eco-design, and investment recovery. Each dimension was assessed using items such as “cross-functional collaboration for environmental management” (internal management) and “design of products to reduce material/energy use” (eco-design).

4.3 | Descriptive Statistics

Table 1 displays descriptive statistics for each variable. The results indicate significant correlation coefficients among variables. Notably, the correlation between environmental regulations and GSCM practices was the weakest. To assess multicollinearity, variance inflation factors (VIFs) were calculated, and all variables had VIF values lower than 2.5, indicating no evidence of multicollinearity.

4.4 | Common Method Bias (CMB)

Since a single informant provided data for all constructs, CMB was a potential issue (Podsakoff et al. 2003). Several measures were taken during the data collection process to prevent such bias. First, respondents were assured of anonymity.

TABLE 1 | Descriptive statistics.

Variables	Mean	SD	1	2	3	4
1. Environmental regulations	4.217	0.722	1			
2. Resource commitment	3.318	0.878	0.677**	1		
3. GSCM practices	3.653	0.889	0.392**	0.565**	1	
4. Corporate entrepreneurship	3.887	0.656	0.544**	0.588**	0.459**	1

Note: Pearson correlation.

** $p < 0.01$ (two-tailed test).

Additionally, the questionnaire was structured so that respondents would read the instructions and then answer the questions in each section. Adjacent measurement variables were placed in different sections (Podsakoff et al. 2003). To test for CMB, Harman's single-factor test was conducted, which showed that no single factor explained more than 50% of the variance (Podsakoff et al. 2003). For a more robust assessment of CMB, the unmeasured latent method construct (ULMC) approach was employed (Williams and McGonagle 2016). Using AMOS, the model fit was compared before and after adding a common method factor as a latent variable. The results showed that the change in model fit indices was less than 0.02 (Before: $\chi^2/df = 1.639$, RMSEA = 0.053, TLI = 0.954, CFI = 0.960, IFI = 0.960; After: $\chi^2/df = 1.537$, RMSEA = 0.048, TLI = 0.962, CFI = 0.969, IFI = 0.969). These results alleviate concerns about CMB and confirm that it is not a concern in this study.

4.5 | Measurement Reliability and Validity

We evaluated the measurement model using different psychometric properties, such as Cronbach's α values, composite reliabilities (CRs), item loadings, the average variance extracted (AVE), and construct correlations.

Table 2 shows that all Cronbach's α values are greater than 0.70, indicating good construct reliability (Nunnally 1978). The R^2 values of all items are above 0.30 (Chen and Paulraj 2004). Moreover, all the CR values are higher than 0.70, which confirms the satisfactory CR of the constructs (Hair et al. 2020). The results also show that all the item factor loadings to the corresponding constructs are higher than 0.60 and significant ($p < 0.001$), and all the AVE values are higher than 0.50, thus showing a good convergent validity (Fornell and Larcker, 1981).

Fornell and Larcker (1981) argue that discriminant validity is satisfactory if the squared interconstruct correlations are lower than the AVE values of each construct. The results shown in Table 3 indicate that the squared interconstruct correlation values between all pairs of constructs are less than the AVE values of the individual construct in the pair, thus suggesting good discriminant validity of the constructs (Fornell and Larcker 1981).

5 | Analysis and Results

PROCESS macro is a robust analytical tool that supports testing complex models, including moderated mediation effects, by

enabling the analysis of conditional indirect effects (Hayes 2017; Preacher et al. 2007). Its bootstrapping technique enhances result reliability by addressing potential issues related to non-normal data distributions and small sample sizes (Hayes 2017; Shrout and Bolger 2002). These features make the PROCESS macro particularly well-suited for our study, which examines how environmental regulations influence GSCM practices through the mediating role of resource commitment and the moderating role of corporate entrepreneurship. Therefore, we use the PROCESS macro in SPSS 27.0 (Bootstrap = 5000 samples) to test the hypotheses while controlling for firm age and size. A 95% bias-corrected confidence interval (95% CI) is constructed to analyze the mediating and moderating mechanisms underlying the relationship between environmental regulations and GSCM practices. This approach ensures the statistical rigor of our findings and supports a deeper understanding of how environmental regulations shape GSCM practices through resource commitment and corporate entrepreneurship.

Model 4 (Hayes 2017) was employed to examine the mediating effect of resource commitment between environmental regulation and GSCM practices. The results are presented in Table 4. The direct effect of environmental regulation on GSCM practices is nonsignificant ($\beta = 0.021$, $t = 0.239$, $p > 0.05$); thus, Hypothesis 1 is not supported. The effect of environmental regulation on resource commitment is significant ($\beta = 0.825$, $t = 13.772$, $p < 0.001$), and the effect of resource commitment on GSCM practices is also significant ($\beta = 0.537$, $t = 7.658$, $p < 0.001$). Additionally, the bootstrap 95% confidence interval for the mediating effect of resource commitment does not include zero, whereas the bootstrap 95% confidence interval for the direct effect of environmental regulation on GSCM includes zero (see Table 5), indicating that resource commitment serves as a full mediator between environmental regulation and GSCM practices. Thus, Hypothesis 2 is supported.

Model 8 (Hayes 2017) was used to test the moderated mediation model. The results are shown in Table 6. The interaction term between environmental regulations and corporate entrepreneurship does not significantly impact GSCM practices ($\beta = 0.118$, $t = 1.494$, $p > 0.05$), thus indicating that Hypothesis 3 is not supported. However, it does have a significant positive effect on resource commitment ($\beta = 0.163$, $t = 2.332$, $p < 0.05$), thus supporting Hypothesis 4. Additionally, at all three levels of entrepreneurship, the impact of environmental regulations on GSCM practices is nonsignificant (see Table 7). Conversely, the effect of environmental regulation on resource commitment is significant at all levels of corporate entrepreneurship, and this positive impact strengthens as

TABLE 2 | Construct reliability and convergent validity.

Constructs	AVE	CR	R ²	Factor loadings
Environmental regulations (Cronbach's $\alpha = 0.902$)	0.594	0.895		
ER1: Our products must comply with the relevant environmental protection provisions of domestic laws and regulations.			0.492	0.702
ER2: Our products must meet the standards of international environmental protection conventions.			0.903	0.950
ER3: Our production must meet the requirements of international environmental standards.			0.894	0.945
ER4: The government provides subsidies related to the implementation of environmental measures of our company.			0.378	0.615
ER5: The government gives our company tax breaks for implementing environmental measures.			0.391	0.626
ER6: The government's promotion of environmental protection through regulations has a positive effect on our company.			0.509	0.713
Resource commitment (RC, Cronbach's $\alpha = 0.928$)	0.689	0.930		
RC1: We invested in technologies for processing used materials.			0.579	0.761
RC2: We have specialists to manage end-of-life products.			0.637	0.798
RC3: We established an environmental management system for material recycling.			0.757	0.870
RC4: We communicate about the recyclability of products across all business functions.			0.755	0.869
RC5: We have information and know-how relating to material recycling in our industry.			0.669	0.818
RC6: We have recycling training programs for employees.			0.739	0.859
Corporate entrepreneurship				
Innovativeness (Cronbach's $\alpha = 0.896$)	0.637	0.898		
Innovativeness 1: We favor a strong emphasis on R&D, technological leadership, and innovation.			0.547	0.739
Innovativeness 2: Many new lines of products have been marketed in the past 5 years.			0.611	0.782
Innovativeness 3: Changes in product lines have usually been quite dramatic.			0.716	0.846
Innovativeness 4: Typically, we initiate actions to which competitors then respond.			0.648	0.805
Innovativeness 5: We are very often the first business to introduce new products, administrative techniques, processing technologies, etc.			0.664	0.815
Risk-taking (Cronbach's $\alpha = 0.826$)	0.621	0.830		
Risk-taking 1: We have a strong proclivity for high-risk projects.			0.515	0.718
Risk-taking 2: We believe that, owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives.			0.624	0.790
Risk-taking 3: When confronted with decision-making situations involving uncertainty, we typically adopt a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities.			0.724	0.851

(Continues)

TABLE 2 | (Continued)

Constructs	AVE	CR	R ²	Factor loadings
GSCM practices				
Internal environment management (Cronbach's $\alpha = 0.966$)	0.878	0.966		
IEM1: Commitment of GSCM from senior managers			0.892	0.945
IEM2: Support for GSCM from mid-level managers			0.907	0.952
IEM3: Cross-functional cooperation for environmental improvements			0.877	0.937
IEM4: Total quality environmental management			0.834	0.913
Green purchasing (Cronbach's $\alpha = 0.955$)	0.824	0.949		
GP1: Cooperation with suppliers for environmental objectives			0.882	0.939
GP2: Environmental audit for suppliers' internal management			0.875	0.935
GP3: Suppliers' ISO14000 certification			0.782	0.884
GP4: Second-tier supplier environmentally friendly practice evaluation			0.760	0.872
Eco-design (Cronbach's $\alpha = 0.935$)	0.828	0.935		
ED1: Design of products for reduced consumption of material/energy			0.801	0.895
ED2: Design of products for reuse, recycle, recovery of material, component parts			0.829	0.911
ED3: Design of products to avoid or reduce use of hazardous products and/or their manufacturing processes			0.851	0.923
Investment recovery (Cronbach's $\alpha = 0.915$)	0.787	0.896		
IR1: Investment recovery (sale) of excess inventories/materials			0.715	0.845
IR2: Sale of scrap and used materials			0.819	0.905
IR3: Sale of excess capital equipment			0.828	0.910

the level of entrepreneurship increases (see Table 7). This indicates that corporate entrepreneurship moderates the effect of environmental regulations on resource commitment, but it does not moderate the effect of environmental regulations on GSCM practices.

To gain a clearer understanding of the moderation effect, a simple slope test was conducted, as illustrated in Figures 2 and 3. Figure 2 illustrates that environmental regulations exhibit a nonsignificant negative effect on GSCM practices in the case of low entrepreneurship ($\beta = -0.078$, $t = -0.857$, $p > 0.05$). This effect turns positive, but it remains nonsignificant in the case of high entrepreneurship ($\beta = 0.077$, $t = 0.659$, $p > 0.05$). This indicates that higher levels of entrepreneurship do not make environmental regulation more effective in directly improving GSCM practices.

Figure 3 illustrates that environmental regulations exhibit a significant positive effect on resource commitment in the case of low entrepreneurship ($\beta = 0.547$, $t = 7.486$, $p < 0.001$), and this effect strengthens in the case of high entrepreneurship ($\beta = 0.761$, $t = 8.344$, $p < 0.001$). This further demonstrates that as corporate entrepreneurship increases, environmental regulations can more effectively enhance a company's resource commitment.

6 | Discussion and Conclusion

This study aimed to examine the mechanisms through which environmental regulations trigger the adoption of GSCM practices, with a focus on the mediating role of resource commitment and the moderating role of corporate entrepreneurship. Our findings reveal several important insights into how regulatory pressures translate into firms' actions in sustainable supply chain practices.

6.1 | Discussion of Findings

The nonsignificant finding for Hypothesis 1 challenges the simple compliance view, where firms directly translate regulatory requirements into operational practices. This finding aligns with recent studies showing no significant direct relationship (Bello-Pintado et al. 2023; Liu et al. 2020) and suggests that the complexity of GSCM implementation and firms' strategic responses to regulations may explain this nonsignificant finding. From an institutional theory perspective, this indicates that coercive pressures alone are insufficient to drive substantive organizational changes in supply chain practices. GSCM requires systematic changes across organizational boundaries (Rauer and Kaufmann 2015), and simple

TABLE 3 | Construct discriminant validity.

	Environmental regulations	Resource commitment	Innovativeness	Risk-taking	Internal environment management	Green purchasing	Eco-design	Investment recovery
Environmental regulations	0.594							
Resource commitment	0.372	0.689						
Innovativeness	0.276	0.436	0.637					
Risk-taking	0.088	0.201	0.389	0.621				
Internal environment management	0.232	0.406	0.242	0.057	0.878			
Green purchasing	0.061	0.245	0.209	0.109	0.475	0.824		
Eco-design	0.052	0.211	0.230	0.097	0.450	0.643	0.828	
Investment recovery	0.083	0.251	0.177	0.040	0.516	0.527	0.599	0.787

Note: The bold numbers in the diagonal are AVE values.

compliance responses may be inadequate for such complex transformations. The mediation through resource commitment suggests that firms need to develop internal capabilities rather than just comply with regulations, indicating a more strategic response to regulatory pressures than previously assumed.

The full mediation of the relationship between environmental regulations and GSCM practices by resource commitment highlights the critical role of resource allocation in translating external pressures into tangible operational changes. This finding supports the RBV by demonstrating that regulatory pressure influences resource deployment patterns, which in turn enable GSCM implementation. As Oliver (1997) theorized, regulatory pressures shape resource deployment decisions, but without dedicated resource commitment, firms struggle to implement complex supply chain changes. This explains the inconsistent direct effects of regulations on GSCM found in previous studies (Bello-Pintado et al. 2023; Liu et al. 2020), which may reflect situations where regulations prompted intentions for change, but without sufficient resource allocation, these intentions did not translate into comprehensive GSCM adoption.

This finding aligns with recent research by Kholaf and Tang (2024), who found that resource allocation through green finance initiatives significantly enhances GSCM implementation. It also complements Hamdy's (2024) discovery that technological resource deployment mediates the relationship between digital transformation and supply chain capabilities. Our results provide empirical validation of the crucial intermediary role of resource commitment in transforming external pressures into operational capabilities.

The nonsignificant moderating effect of corporate entrepreneurship on the regulation–GSCM relationship (Hypothesis 3) provides important theoretical insights. This suggests that although entrepreneurship helps in resource deployment decisions, the actual implementation of GSCM may depend more on operational capabilities than entrepreneurial orientation. From an entrepreneurship theory perspective, this indicates that entrepreneurial orientation primarily influences strategic decisions rather than operational execution. Once resources are committed, the transformation process may follow more standardized patterns.

This result differs from Behl et al.'s (2023) finding that entrepreneurial approaches like gamification directly enhance GSCM implementation. However, it aligns with Tetteh et al.'s (2025) framework, suggesting that entrepreneurial leadership primarily influences GSCM through competency development rather than directly affecting implementation. This adds nuance to our understanding of where corporate entrepreneurship exerts its influence in the GSCM adoption process.

The significant moderation effect of corporate entrepreneurship on the regulation–resource commitment relationship provides valuable insights into the role of entrepreneurial orientation in resource allocation decisions. This finding supports entrepreneurship theory by demonstrating that

TABLE 4 | Mediation test results.

Outcomes	Independent variables	Coefficient	<i>t</i>	LLCI	ULCI
Resource commitment	Age	−0.040	−0.786	−0.140	0.060
	Size	0.034	0.934	−0.038	0.106
	Environmental regulations	0.825	13.772***	0.707	0.944
GSCM practices	Age	−0.106	−1.966	−0.212	0.000
	Size	0.224	5.769***	0.147	0.300
	Resource commitment	0.537	7.658***	0.399	0.675
	Environmental regulations	0.021	0.239	−0.148	0.190

****p* < 0.001 (two-tailed test).**TABLE 5** | Total effect, direct effect, and indirect effect.

	Coefficient	SE	LLCI	ULCI
Total effect	0.464	0.071	0.324	0.603
Direct effect	0.021	0.086	−0.148	0.190
Indirect effect	0.443	0.062	0.326	0.572

entrepreneurial firms are better equipped to reconfigure resources (Bierwerth et al. 2015) and accept innovation uncertainty (Bloodgood et al. 2015), making them more likely to commit resources in response to regulations. Specifically, as corporate entrepreneurship increases, the positive effect of environmental regulations on resource commitment strengthens, indicating that entrepreneurial orientation enhances firms' ability to translate regulatory pressures into strategic resource investments.

This finding complements recent work by Wiredu et al. (2023), who found that supply chain competitive advantage—a product of both resource commitment and entrepreneurial orientation—moderates the relationship between institutional pressure and environmental performance. It also aligns with El Mokadem and Khalaf's (2025) discovery that innovative approaches to management enhance the effectiveness of GSCM implementation. Our results specifically identify where in the causal chain corporate entrepreneurship exerts its influence.

6.2 | Theoretical Implications

First, by establishing resource commitment as the key mediating mechanism between environmental regulations and GSCM practices, we resolve inconsistencies in previous research. The full mediation effect reveals that regulatory pressure alone is insufficient to drive substantive changes in supply chain practices. This finding extends institutional theory by showing that firms' responses to coercive pressures are more strategic and nuanced than direct compliance, particularly for complex organizational changes like GSCM adoption. For institutional theory, our study demonstrates that the path from institutional

pressures to practice adoption is not direct but mediated by internal resource allocation decisions—a significant refinement to how institutional theory is applied in environmental management research.

Second, we advance RBV theory by empirically demonstrating how external pressures shape specific patterns of resource deployment in environmental management. Although prior RBV applications in GSCM typically focus on how existing resources influence adoption, our study reveals the dynamic process by which firms develop new resources in response to regulatory pressures. This extends Oliver's (1997) institutional resource-based integration by providing a detailed empirical account of the mechanisms linking external pressures to internal resource configurations. In the context of circular economy transitions (Korhonen et al. 2018), this explains why some firms struggle with GSCM implementation despite regulatory pressure.

Third, our study contributes to entrepreneurship theory by identifying the specific conditions under which corporate entrepreneurship influences environmental management. The significant moderation effect on the regulation–resource commitment relationship, but not on direct GSCM implementation, reveals that entrepreneurial orientation particularly matters for strategic resource allocation decisions rather than operational execution. This extends entrepreneurship theory by mapping precisely where in the organizational change process entrepreneurial orientation exerts its influence. Rather than assuming a universal effect of corporate entrepreneurship on all aspects of environmental management, our findings reveal its targeted impact on resource configuration processes.

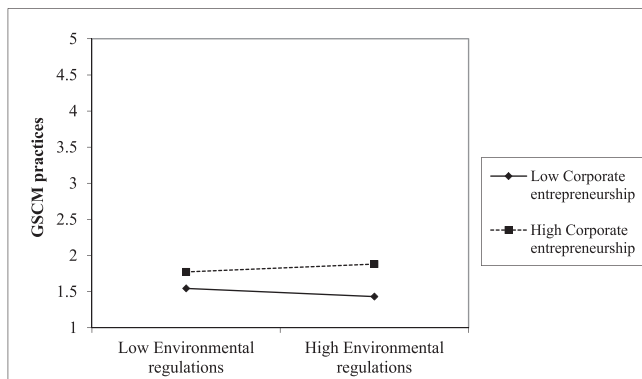
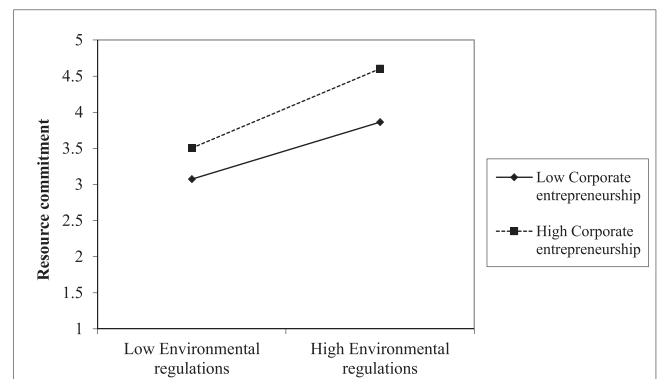
Fourth, our integrated theoretical framework makes a substantial contribution to the literature by explaining how external regulatory pressures interact with internal organizational characteristics to determine environmental management approaches. By combining institutional theory, RBV, and entrepreneurship theory, we provide a more comprehensive explanation of the pathway from regulatory pressures to GSCM implementation than previous studies using single theoretical lenses. This addresses Ning et al.'s (2025) call for more integrative theoretical approaches to understanding the internal and external dimensions of GSCM implementation.

TABLE 6 | Moderated mediation model test results.

Outcomes	Independent variables	Coefficient	<i>t</i>	LLCI	ULCI
Resource commitment	Age	−0.003	−0.060	−0.097	0.091
	Size	0.010	0.295	−0.058	0.078
	Environmental regulations	0.654	9.518***	0.518	0.789
	Environmental regulations × Entrepreneurship	0.163	2.332*	0.025	0.301
GSCM practices	Age	−0.089	−1.656	−0.194	0.017
	Size	0.214	5.541***	0.138	0.289
	Environmental regulations	−0.001	−0.007	−0.180	0.179
	Resource commitment	0.452	6.056***	0.305	0.599
	Environmental regulations × Entrepreneurship	0.118	1.494	−0.038	0.275

p* < 0.05.**p* < 0.001 (two-tailed test).**TABLE 7** | Conditional effects at different levels of corporate entrepreneurship.

		Effect	SE	LLCI	ULCI
Environmental regulations on GSCM	Mean − SD	−0.078	0.091	−0.258	0.102
	Mean	−0.001	0.091	−0.180	0.179
	Mean + SD	0.077	0.117	−0.153	0.307
Environmental regulations on resource commitment	Mean − SD	0.547***	0.073	0.403	0.691
	Mean	0.654***	0.069	0.518	0.789
	Mean + SD	0.761***	0.091	0.581	0.940

****p* < 0.001 (two-tailed test).**FIGURE 2** | The moderating effect of corporate entrepreneurship on environmental regulations and GSCM practices.**FIGURE 3** | The moderating effect of corporate entrepreneurship on environmental regulations and resource commitment.

In sum, our findings significantly advance GSCM literature by clarifying the mechanisms and boundary conditions that translate regulatory pressures into effective GSCM implementation. By identifying resource commitment as the critical mediating mechanism and corporate entrepreneurship as a selective moderator, we resolve previous inconsistencies in the literature and provide a more nuanced understanding of how firms respond to environmental regulations. These insights not only enhance theoretical understanding but also provide practical guidance

for managers and policymakers seeking to promote sustainable supply chain practices.

6.3 | Practical Implications

Our study offers several important managerial implications. First, our findings suggest that merely responding to environmental regulations is not sufficient for successful GSCM

implementation. Instead, managers need to focus on developing resource commitments across their supply chains. This includes strategic investments in recycling technologies, environmental management systems, and employee training (Liu and Chang 2017; Schmidt et al. 2021). The mediation effect through resource commitment suggests managers should prioritize systematic resource allocation patterns rather than piecemeal responses to regulatory requirements.

Second, firms can leverage corporate entrepreneurship to better respond to environmental regulations, particularly in resource deployment decisions. Organizations aiming to improve their environmental performance should cultivate innovation, proactiveness, and risk-taking capabilities (Anderson et al. 2015). This could involve developing mechanisms to identify opportunities in regulatory challenges and willingly allocate resources despite uncertainty. However, managers should recognize that entrepreneurial orientation particularly matters for strategic resource decisions rather than operational implementation of GSCM practices.

Third, policymakers should recognize that regulations work through resource commitment rather than direct compliance. This suggests potential value in policies that encourage or facilitate resource allocation to environmental practices. Policy instruments might include incentives for circular economy investments or support programs that help firms develop capabilities for resource reconfiguration. Given the importance of corporate entrepreneurship in strengthening regulatory effects on resource commitment, policies could also aim to foster entrepreneurial approaches to environmental challenges.

6.4 | Limitations and Future Research

This study has several limitations that warrant further research. The cross-sectional design using questionnaire surveys may not fully capture the long-term impact of environmental regulations on firms' practices, suggesting the need for longitudinal studies. In addition, different industries face varying levels of environmental regulatory pressure, and firms with different ownership structures (e.g., state-owned vs. foreign direct investment) may exhibit distinct entrepreneurial characteristics. To address these limitations, future research should investigate GSCM practices across diverse industries and ownership structures. Furthermore, the study is limited to one mediator and one moderator; future studies might explore alternative mediators such as organizational learning capabilities, absorptive capacity, or environmental management capabilities, and potential moderators such as organizational culture, leadership style, or market orientation.

Author Contributions

Shumin Liu: conceptualization, writing, data collection, data analysis. **Qile He:** conceptualization, writing, data analysis. **Zhibin Lin:** conceptualization, writing. **Nicholas O'Regan:** writing. **Zuchang Zhong:** conceptualization, data collection.

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Conflicts of Interest

The authors declare no conflicts of interest.

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