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Radical or incremental? The effects of green innovation on the supply base stability of logistics service providers

Abstract

Logistics service providers (LSPs) are increasingly adopting green innovation to mitigate their environmental impacts. However, little is known about how such innovation influences their supply base stability (SBS), even though supplier inputs are essential for LSPs to meet the requirements of their stakeholders. To narrow this gap, this study draws on recombinant search theory to examine whether LSPs' incremental green innovation (IGI) and radical green innovation (RGI) exert differential effects on their SBS. By analyzing data from 88 publicly listed Chinese LSPs over the period 2011–2019, this study reveals a positive relationship between IGI and SBS but a negative relationship between RGI and SBS. Furthermore, our findings indicate that top management teams play a critical role in shaping these relationships. In particular, executive environmental attention weakens the positive IGI–SBS association while executive environmental expertise attenuates the negative RGI–SBS association. Our study extends the operations and technology management literature by uncovering the differential effects of IGI and RGI on LSPs' SBS and the boundary conditions that alter these effects. LSPs are advised to strategically navigate various types of green innovation to better maintain the stability of their supply bases.

Keywords: green innovation; logistics service provider; supply base stability; top management team; recombinant search theory

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Managerial relevance statement

This study provides several critical managerial insights for LSPs. First, the results indicate that incremental green innovation leads to stable supply bases, while radical green innovation decreases supply base stability, necessitating a discerning approach to green innovation adoption. Managers should leverage incremental green innovation for environmental improvements and enhanced supply base stability. Moreover, they need to strategically integrate radical green innovation within supply chain management to lessen supply base instability. Employing advanced forecasting techniques, enhancing supplier collaboration, and diversifying supply bases are recommended practices. Additionally, this study reveals that executive environmental attention weakens the positive impact of incremental green innovation. Hence, executives with heightened environmental attention should remain vigilant about potential supply base instability risks when pursuing green innovation. This study also suggests that executive environmental expertise mitigates the negative effects of radical green innovation. Therefore, it is essential for firms to include executives with environmental expertise in their top management teams to navigate the complexities of green innovation and better maintain supply chain stability. As for policy implications, this study suggests that policymakers can support firms by providing guidelines, incentives, or subsidies that encourage the implementation of green innovation.

I. INTRODUCTION

In alignment with the objectives set forth by the 2015 Paris Agreement, the logistics sector is identified as a significant contributor to greenhouse gas (GHG) emissions, accounting for approximately 30% of total emissions [1]. Regrettably, transportation emissions led to the premature deaths of 385,000 people in 2015, with estimated health damage costs reaching up to 1 trillion dollars [2]. Beyond emissions, logistics activities also precipitate a wide range of environmental issues, including waste disposal, wastewater discharge, release of toxic substances, and noise pollution [3-4].

Given these alarming environmental impacts, LSPs must transition toward green development and the achievement of net zero emissions. They predominantly pursue two principal approaches to adopt green technologies [5]. The first approach focuses on optimizing and refining existing operational processes, such as employing intelligent transportation systems to cut mileage and increase operational efficiency, optimizing flight plans, and adopting slow steaming to lower GHG emissions. These practices represent a form of incremental green innovation (IGI), concerned with environmental improvements that leverage existing resources and competencies [6-8]. For instance, by optimizing transportation trunk routes, ZTO Express reached a 99.93% utilization rate of its transportation network, equivalent to averting the felling of approximately 520,000 fast-growing eucalyptus trees [9]. The second approach involves embracing emerging green technologies to decarbonize the logistics industry, including utilizing new energy vehicles (NEVs), alternative and clean fuels, and recyclable packaging materials. This approach represents a form of radical green innovation

(RGI), which involves a significant departure from LSPs' current knowledge base [6], [10]. For example, the "Whole Life Cycle Carbon Neutral Oil" project in 2021, which was a joint effort by China Eastern Airline, COSCO Shipping, and SINOPEC, realized carbon neutrality throughout the entire process of aviation fuel production and utilization [11].

In their quest for green innovation, LSPs can benefit from reevaluating and upgrading their relationships with upstream suppliers, since suppliers are one of the key sources of external resources and knowledge [12]. In the logistics industry, primary suppliers provide LSPs with critical components and services such as transportation outsourcing, vehicles, fuels, and various logistics equipment and materials [13]. These inputs offer LSPs significant potential for environmental performance improvements, such as adopting green packaging, logistics optimization, clean fuels, and energy-efficient vehicles. At the same time, LSPs' pursuit of green innovation may affect their maintenance and adjustment of supplier relationships. A notable example is DHL Express's purchase of 12 fully electric freighters from Eviation, a start-up manufacturer of all-electric aircraft, aimed at establishing an electrified international express delivery network [14]. However, changes in supplier relationships and structures can also influence supply base stability (SBS), which refers to the continuity and consistency of upstream supply chain relationships and orders [15-16]. The instability in the supply base can lead to adverse outcomes such as inconsistent material supply and reduced purchase discounts [17-18]. For instance, shipping companies, which often outsource a portion of their capacity, have experienced tremendous shifts in cargo ships from Asia to the U.S., driven by the impact of COVID-19. This supply-side instability has resulted in a significant increase in shipping costs across the entire Asian region [14].

Therefore, LSPs encounter a potential trade-off between the environmental advantages of green innovation and the desire to maintain a stable supply base, underscoring the imperative for further investigation. In the field of supply chain management, most studies on green innovation focus on diverse factors within the supply chain, such as supply chain integration, supplier cooperation, and customer feedback, examining how these factors influence the adoption and diffusion of sustainable practices [7-8], [19]. However, there is scant research exploring how green innovation affects the stability of the supply base. This research gap is significant, given that a stable supply base can enable LSPs to provide consistent and reliable services to fulfill the requirements of their stakeholders [17-18], [20].

To narrow this gap, this study investigates the effects of green innovation on LSPs' SBS and the contingent factors shaping these effects. Utilizing recombinant search theory (RST) [21-22], we posit that IGI, which involves recombining existing knowledge components within LSPs and their supply bases, is anticipated to stabilize supply bases. Conversely, RGI, characterized as a form of distant search, can induce significant shifts in the relationships and structures between LSPs and their suppliers, thereby impairing SBS. Moreover, the attributes of the top management team (TMT) can significantly impact the implementation and outcomes of green innovation [23-26]. Recognizing the growing importance of the TMT in green innovation, our study extends knowledge on how TMT characteristics (i.e., executive environmental attention and executive environmental expertise) alter the effects of distinct types of green innovation on SBS. Consequently, this study focuses on the following research questions (RQs):

RQ1: How do different types of green innovation (i.e., IGI and RGI) affect the stability of LSPs' supply bases?

RQ2: Do the attributes of the TMT (i.e., executive environmental attention and executive environmental expertise) moderate the relationships between green innovation and SBS?

China presents an ideal context for answering these research questions, given its considerable efforts to decarbonize its logistics sector. In addition, the total volume of Chinese freight has expanded almost sevenfold in the past two decades, reaching 22,616 billion ton-kilometers in 2022 [27] and posing significant environmental challenges. Therefore, it is imperative to examine green innovation in the Chinese logistics industry.

In sum, this study aims to investigate the effects of LSPs' green innovation on their SBS. Furthermore, it intends to explore how executive environmental attention and executive environmental expertise influence these effects. To accomplish these objectives, we compile archival data from multiple sources to construct a dataset of 88 large LSPs in China from 2011 to 2019. The results reveal that IGI increases LSPs' SBS while RGI decreases their SBS. Interestingly, we discover that executive environmental attention attenuates the positive relationship between IGI and SBS, but it does not significantly modify the relationship between RGI and SBS. Executive environmental expertise helps mitigate the negative impact of RGI on SBS, yet it does not significantly alter the impact of IGI on SBS. These findings make contributions on three fronts. First, this study is the first to explore the distinct impacts of IGI and RGI on SBS within the Chinese logistics sector, advancing the literature on green logistics beyond their conventional focus on environmental and financial performance to consider its implications for the broader upstream supply chain management. Second, this study unravels the roles of local and distant search processes in the green innovation of LSPs, extending RST's scope from the knowledge base to the supply base. Lastly, this research illuminates the critical yet neglected roles of executive environmental attention and executive environmental expertise in shaping the impacts of green innovation on SBS. By examining how these TMT attributes influence the supply chain consequences of green innovation, the study offers LSPs novel insights into managing SBS strategically.

II. LITERATURE REVIEW

A. Green Innovation and Supply Chain Management

1) Extant Literature on Green Innovation and Supply Chain Management: Green innovation, which encompasses the development and application of environmentally sustainable products, processes, and technologies, is pivotal in reducing environmental impacts while enhancing operational efficiency and competitiveness [5-6], [28]. With the ongoing advancement of sustainable development goals (SDGs) and the growing importance of supply chain management, the integration of green innovation within supply chains has emerged as a critical topic in both academia and practice.

Most research to date has focused on the diverse factors within the supply chain that influence the adoption and diffusion of green innovation. For instance, Zhang et al. [8] demonstrated that green supply chain integration is critical in facilitating both incremental and radical green innovation activities, leading to improved environmental performance. Similarly, Dai et al. [7] underscored the importance of both collaboration and competition between suppliers in driving innovation in green technologies and processes. These interactions create a favorable environment where green innovation can flourish. In addition, Huang et al. [19] emphasized that customer feedback mechanisms serve as a driver of green innovation by shaping corporate strategies toward more sustainable product offerings. Furthermore, Nair et al. [29] argued that dynamic interactions within supply chain networks play a crucial role in accelerating the diffusion of green innovation, ensuring that sustainable practices and technologies are rapidly disseminated across different stages of production and distribution. Taken together, prior studies illustrate the multifaceted nature of the drivers behind green innovation within supply chains.

However, very few studies have examined the impact of green innovation on the supply chain, especially concerning the logistics industry. As summarized in Table I, the limited existing research has primarily focused on industries such as manufacturing, hospitality, and fast-moving consumer goods, covering various regions such as North America, China, and the Middle East [30-34]. While these studies collectively highlight the important role of green innovation in affecting supplier–customer dynamics, trade credit attainment, and greenhouse gas leakage, they do not investigate how LSPs' green innovation influences the stability of their supply bases.

Moreover, existing research on LSPs' green transformation predominantly addresses the "what" and "why" questions. For instance, El Baz and Laguir [35] interviewed 10 Moroccan LSPs and classified four primary types of green practices according to LSPs' service phases:

transportation and vehicle use, warehousing and handling, environmental training and control, and supply chain environmental collaboration. Anderhofstadt and Spinler [36] investigated the factors affecting the purchasing decisions of electric vehicles in the German logistics industry, underlining that cost-benefit analyses, total cost of ownership, and regulatory incentives significantly impact LSPs' adoption of green technologies. Consequently, the critical issue of how LSPs' green innovation influences their supply bases remains largely underexplored, creating a noticeable research gap. Addressing this gap is essential to advance our understanding of how LSPs can strategically manage green innovation to maintain stable supply bases.

[Insert Table I here]

2) Literature Gap between Green Innovation and Supply Base Stability: Extant SBS literature has underscored the importance of sustaining long-term and stable supplier relationships [37-39]. A stable supply base enhances firms' competitiveness, which is attributed to the resultant benefits such as high-quality products and services, consistent material supply, purchase discounts, and efficient sharing of timely information [17-18], [20]. Conversely, volatility in a firm's supply base harms its operations, implying unreliability and potential disruptions in its upstream supply chain [38]. The instability in firms' supply bases originates from multiple sources, with a notable cause being the volatility that results from the amplification effect, referring to the phenomenon where fluctuations arising from the downstream firms intensify as they propagate to their supply bases [15-16]. Such amplification can be driven by various factors within the focal firm, including unstable production processes, self-induced price variations, inaccurate forecasting, shifts in market strategies, or changes in production requirements [40].

In this context, green innovation is likely to induce significant fluctuations in a firm's operations, thus affecting its upstream supply chain. Moreover, given that LSPs have tremendous carbon reduction opportunities in areas such as the fuels, vehicles, and transportation services provided by their suppliers, their sourcing strategies may lead to considerable fluctuations in the upstream supply chain as a result of their green innovation efforts. However, as highlighted by cross-industry comparisons presented in Table 1, even in industries extensively studied such as manufacturing, prior research has not examined the impact of green innovation on SBS, representing a pivotal issue that warrants further investigation. To this end, our study aspires to address this issue by examining the impact of LSPs' green innovation on their SBS, deepening our understanding of how to leverage green innovation to boost SBS. This examination is particularly important and relevant in the context of China, which is a major global player in logistics and transportation [27]. With its large transportation volumes, diverse transportation modes, and substantial investments in the green transformation of its logistics industry, China offers an ideal setting for exploring the impact of LSPs' green innovation on their SBS.

B. Recombinant Search Theory and Green Innovation

Scholars have highlighted that recombination is a fundamental source of novelty, driving advancements and breakthroughs across various fields [21-22], [41-42]. RST holds that knowledge consists of different components, including concepts, data, skills, and technologies

[21]. Creating any novelty, whether in art, science, or practical applications, largely relies on the recombination of these existing knowledge components [22], [41]. This knowledge recombinant mechanism is applicable to green innovation in the logistics industry. For LSPs, green innovation refers to adopting green technologies, products, or processes in logistics activities that mitigate adverse environmental impacts by bolstering resource efficiency and reducing environmental pollution [5], [43]. Following previous research on innovation management [21], [44-45], we further focus on two prevalent approaches: local search and distant search.

"Local search" arises when inventors recombine components from a familiar knowledge base or refine a combination previously utilized [21]. Most inventors typically conduct exploitation within the "neighborhood" of their previous successful innovations, adhering closely to known and tested fields [44]. Consequently, they can effectively sift out failed knowledge areas and focus on areas with greater potential and lower uncertainty. In the realm of green innovation, IGI can be perceived as a form of local search, which involves the enhancement or utilization of existing technologies, products, and processes to address environmental concerns swiftly [6-8]. Specifically, for LSPs, IGI centers on optimizing and improving existing processes to enhance energy efficiency and reduce emissions, including route and loading optimization and energy-saving transportation equipment modifications [5]. IGI is characterized as low-risk, given that it typically presents a lower threshold for breakthroughs [46].

"Distant search" occurs in the opposite situation of local search, when inventors explore fresh ideas and new opportunities from distant or diverse knowledge bases [21], [41], [47]. Such broad information searching and recombination of varied types of knowledge can break conventional bonds and inspire creativity, potentially leading to creation with high novelty and economic value [41]. However, this exploratory process introduces a heightened level of uncertainty as inventors navigate through unfamiliar components and combinations, culminating in a more complex knowledge base [21], [44]. As a distant search approach to green innovation, RGI represents a firm's novel creation in green products or processes, achieved through the development or introduction of radical environmental technologies [6], [10], [48]. For LSPs, RGI involves transformative changes and new inventions regarding green products or processes, such as developing NEVs, utilizing alternative and clean fuels, and introducing recyclable packaging [5]. Although RGI has the potential to lessen fuel consumption and emissions in logistics operations significantly, it spans multiple knowledge and technological domains, thus inducing considerable complexities and uncertainties [6], [8].

III. HYPOTHESES DEVELOPMENT

A. Green Innovation and SBS in the Logistics Industry

As mentioned before, the IGI of LSPs is primarily concerned with improving existing products, processes, or technologies to reduce their environmental harm [6], [10]. Based on RST, IGI involves recombining existing knowledge components from LSPs and their supply bases to foster environmental sustainability. During the local search for existing green knowledge components, the shared knowledge base between LSPs and their suppliers is further developed and refined, which enhances the mutual understanding of each party's respective knowledge and capabilities [49-51]. Consequently, IGI facilitates the communication and collaboration between LSPs and their suppliers regarding energy-saving and emission reduction, which is beneficial for LSPs to accomplish environmental goals. Hence, we posit that IGI fosters the development of long-term, stable relationships between LSPs and their suppliers, leading to a more stable supply base.

H1a. Incremental green innovation increases an LSP's supply base stability.

In contrast, RGI is more uncertain and complex as it involves searching for multiple knowledge bases and technological domains [46], [52]. In line with the observation of Meyer-Krahmer and Schmoch [53], the existent "logistics" technology sector is relatively less grounded in scientific research compared to other more advanced technological domains. Consequently, the green knowledge components essential for RGI may not be readily accessible within LSPs' existing knowledge base and supply base. Therefore, LSPs striving to integrate groundbreaking green components, such as alternative fuels, NEVs, and recyclable packaging, must extend their search beyond their existing supply bases [5]. Such a distant search may significantly modify the relationships and structures between LSPs and their suppliers, potentially compromising stability in the supply base.

H1b. Radical green innovation decreases an LSP's supply base stability.

B. The Moderating Effects of the Top Management Team

Drawing upon RST, we posit that LSPs' green innovation processes involve a mix of local and distant searches for knowledge. The TMT, with its cognition and capability, plays a pivotal role in steering these search processes. The TMT significantly influences organizational outcomes through strategic decisions, which are profoundly influenced by top managers' values, preferences, and experiences [54-55]. Furthermore, the attributes of the TMT significantly influence organizational operations, innovation, and performance [54-55]. Moreover, various TMT characteristics, such as attention allocation and experience, can impact the implementation and outcomes of these green innovation initiatives [23-25]. Therefore, we investigate how changes in LSPs' SBS, stemming from green innovation, are influenced by two critical TMT traits: executive environmental attention and executive environmental expertise.

1) Executive Environmental Attention: Managerial cognition and perceptions have a profound impact on a firm's strategic decision-making processes [56-57]. Among these cognitive factors, executive environmental attention stands out as particularly important, referring to the degree to which top managers focus on environmental issues and acknowledge their firms' responsibilities in contributing to sustainable development [58].

First, when executives exhibit a high level of environmental awareness, they pay greater attention to environmental challenges within the industry [58]. Compared to managers who merely meet minimal regulatory requirements, environmentally attentive executives are more inclined to break existing paradigms and pursue larger-scale environmental gains [57]. Second, heightened executive environmental attention prompts managers to view environmental challenges as opportunities rather than threats [56], [59]. This mindset leads them to proactively promote green innovation, embed it into the firm's strategic agenda, and allocate resources toward cultivating new, more sustainable suppliers [60].

As a result, when executives have stronger environmental attention, LSPs are less constrained by their existing suppliers and become more proactive in seeking eco-friendly external partners or technology providers. Such proactive expansion can loosen the limitations of the current supply base. Moreover, even for IGI, environmentally attentive executives are more likely to make targeted adjustments to the supply chain to achieve better environmental performance. Therefore, we propose the following hypotheses:

H2a. Executive environmental attention attenuates the positive relationship between incremental green innovation and supply base stability.

H2b. Executive environmental attention strengthens the negative relationship between radical green innovation and supply base stability.

2) Executive Environmental Expertise: We further explore the moderating effects of executive environmental expertise. A plethora of studies have demonstrated that the expertise of executives in specific fields considerably influences a firm's development and innovation [61-62]. In the context of green innovation, the environmental expertise of executives is a critical "green" knowledge component embedded in LSPs' knowledge base. Specifically, throughout the LSPs' development, including establishing their supply bases, these executives have cultivated a certain level of environmental capability for LSPs. Accordingly, the enriched knowledge base may reduce the imperative for the distant search of green components during RGI while strengthening the local search process within IGI.

Moreover, executives with a higher level of environmental expertise are often more adept at understanding and managing the integration of green innovation into established business models and supply chains [61-62]. Thus, LSPs possessing greater executive environmental expertise demonstrate improved capability in conducting local searches for the development of IGI, thus boosting SBS to a larger extent. In addition, they can balance the need to pursue breakthrough green innovation and maintain a stable supply base. Therefore, executive environmental expertise will alleviate the supplier changes brought about by distant knowledge search, as executives are more proficient in adapting to environmentally conscious suppliers and tackling environmental challenges. Therefore, we propose the following hypotheses:

H3a. Executive environmental expertise strengthens the positive relationship between incremental green innovation and supply base stability.

H3b. Executive environmental expertise attenuates the negative relationship between radical green innovation and supply base stability.

Figure 1 visualizes the conceptual model of this study.

[Insert Figure 1 here]

IV. METHOD

A. Sample and Data

To test our hypotheses, secondary data on Chinese listed LSPs are collected through various sources. The original dataset encompasses all 132 firms listed on China's Shenzhen and Shanghai Stock Exchanges, specifically within the transportation, storage, and postal sectors. This study employs green patent data from the Chinese Research Data Services (CNRDS) database to measure two types of green innovation (i.e., IGI and RGI). Since the data on green patents in the Chinese logistics industry are predominantly available from 2011, we select 2011–2019 as the timeframe for our analysis. Green patents are identified by the "green list" in the International Patent Classification system, designed by the World Intellectual Property Organization.

In addition, data on the top five suppliers' purchase ratios and TMT members' resume texts are obtained from the China Stock Market & Accounting Research (CSMAR) database. Other financial data are also gathered from the CSMAR database. From the initial set of 132 firms, we remove 38 companies that focus on non-logistics operations. We further exclude six firms owing to incomplete data on key variables, resulting in a final sample of 88 LSPs.

To measure SBS, we follow prior research [17-18] by examining changes in the concentration of the top five suppliers over three consecutive years. We choose this three-year window as it provides enough time to observe meaningful shifts in supplier relationships without losing too many observations. Consequently, the dependent variable (i.e., SBS) relies on top-five supplier data spanning from 2011 to 2021. After aligning the measurement window for SBS with the 2011–2019 period for green patents, our final sample comprises 360 firm-year observations from 88 LSPs. Table II shows the sample distributions by year and industry.

[Insert Table II here]

B. Measures

1) Dependent Variable: Following prior research [17-18], this study quantifies supply base stability (*SBS*) as the variation in supplier concentration over three continuous years, which serves as an appropriate timeframe to capture meaningful changes in supplier relationships while minimizing data loss and avoiding inaccurate short-term fluctuations. Since

Chinese public firms are only required to disclose information about the top five suppliers, we calculate the firm's supplier concentration (SC) as the sum of the purchase ratio for the top five suppliers as follows:

$$SC_{i,t} = \sum_{j=1}^{5} Purchase\_ratio_{i,j,t} \quad (1)$$

where $Purchase\_ratio_{i,j,t}$ represents the purchase ratio of firm *i* from its j-th largest supplier in year *t*. Then, we compute the standard deviation of $SC_{i,t}$, $SC_{i,t+1}$, and $SC_{i,t+2}$ and denotes it as $SD_{i,(t,t+1,t+2)}$, using the following equation:

$$SD_{i,(t,t+1,t+2)} = \sqrt{\left(SC_{i,t} - \overline{SC}\right)^2 + \left(SC_{i,t+1} - \overline{SC}\right)^2 + \left(SC_{i,t+2} - \overline{SC}\right)^2} \quad (2)$$

where $\overline{SC}$ is the average of $SC_{i,t}$, $SC_{i,t+1}$, and $SC_{i,t+2}$. Finally, the measure of SBS is given by:

$$SBS_{it} = -\frac{SD_{i,(t,t+1,t+2)}}{\overline{SC}} \quad (3)$$

Thus, SBS is estimated by the negative ratio of the standard deviation of supplier concentration for three continuous years to the average of supplier concentration in the same period. This method normalizes the variance in purchase amounts from the top five suppliers, ensuring comparability across different LSPs.

2) Independent Variables: Following previous studies [6], [63], the quantity of green patent applications is utilized as a metric for assessing green innovation. Avoidance of granted green patents is due to time lag disruptions, as the patent approval process in China can take several years. Moreover, China issues two principal types of patents: utility model patents, which address technical solutions related to the configuration, structure, or materials of an object; and invention patents, which pertain to new, inventive, and practical technical breakthroughs. While invention patents reflect distinct and novel technological advancements, utility model patents focus more on modifications to an object's shape, structure, or components. As a result, researchers have extensively employed these two categories of patents to distinguish incremental innovation from radical innovation [6], [10], [19], [64].

Likewise, in this study, we differentiate between green utility model patents and green invention patents to represent IGI and RGI, respectively. Consistent with prior research that measures incremental and radical green innovations using these two types of green patents [65], we address potential skewness in the data by applying a natural logarithm transformation. Specifically, IGI is calculated as the natural logarithm of one plus the count of green utility model patent applications, and RGI is measured as the natural logarithm of one plus the count of green invention patent applications.

3) Moderating Variables: First, drawing on previous studies [62-63], we use the Management Discussion and Analysis (MD&A) section from firms' annual reports as our textual dataset and employ the frequency of environmental protection keywords to measure executive environmental attention. MD&A texts offer managerial perspectives on the firm's current business performance and future development plans, making them well-suited for capturing executives' environmental attention. Specifically, referring to keywords used in prior research [66-67], we identify the terms "environmental protection", "green", "resources", "energy saving", "pollution", "consumption reduction", "low carbon", "sustainable development", "clean", "ecology", "purification", "conservation," "CO_2", "recycling", “emission reduction”, and “environment”. Therefore, we calculate executive environmental attention (*Attention*) using the environmental keyword frequencies in the MD&A section.

Second, the original text data on executive environmental expertise are derived from personal resume information collected from the CSMAR database. This study conducts a textual analysis of the resumes of TMT members from each LSP. The presence of keywords such as “eco-friendly”, “environment-friendly”, “sustainable”, “renewable energy”, “carbon reduction”, and “green” within a resume qualifies the individual as having an environmental background [61-62]. Based on this method, the study counts TMT members who have an environmental background. Hence, executive environmental expertise (*Expertise*) is quantified by the proportion of TMT members who possess environmental expertise.

4) Control Variables: To mitigate factors that may impact firms’ SBS, we control for several variables. First, we consider firm size and firm age as control variables. Existing studies suggest that younger and smaller firms typically have access to a more diverse array of resources than their larger and older counterparts, potentially influencing their management of the supply base [68-69]. Firm size (*Size*) is quantified using the natural logarithm of a firm’s total assets, while firm age (*Age*) is determined by the natural logarithm of the number of years since a firm’s establishment. Additionally, the financial conditions of customers, which can influence a major supplier’s financial health, are considered [70]. We, therefore, control for financial leverage, Tobin’s q, and equity-to-debt ratio. Financial leverage reflects financing risk that may impact suppliers’ capital structure [71]. We quantify financial leverage (*Lev*) as the ratio of a firm’s long-term debt to its total assets [72]. Tobin’s q (*TobinQ*) is calculated as the ratio of a firm's market capitalization to the book value of its total assets [73]. Equity-to-debt ratio (*ETD*) is calculated as the proportion of shareholders' equity to total liabilities [74]. Moreover, this study considers instances where operational issues within a firm lead to upstream volatility [15], [40]. Therefore, we control for inventory turnover (*Inventory*), calculated by the ratio of sales to finished goods inventory [75]. We also account for labor productivity (*Productivity*), which is computed as the natural logarithm of the ratio of sales to the number of employees [76].

Besides, the study incorporates some industry-level variables, as previous research indicates that industry contexts can influence firms' SBS [40]. Industry size (*In_size*) is defined as the natural logarithm of the total assets of all firms within the same three-digit China Securities Regulatory Commission (CSRC) industry [77]. Industry growth (*In_grow*) is calculated by the sales growth rate within the same three-digit CSRC industry [77]. Industry competition (*In_comp*) is measured by the Herfindahl index, calculated as one minus the sum of the squares of the market shares of all firms in the same three-digit CSRC category [77]. Lastly, year dummies are used to control for unobserved heterogeneity specific to different time periods.

C. Model Specification

Due to the lagged impact of green innovation on SBS, we assess SBS for the three continuous years immediately following the implementation of green innovation. Additionally, we perform the Wald test to check for heteroskedasticity [78]. Our findings confirm that this issue does affect our data. As such, we use robust standard errors to estimate the firm fixed-effect regression models, which helps mitigate this problem and control for unobservable time-invariant firm heterogeneity. We utilize the following equation to examine our hypotheses:

$$SBS_{it} = \beta_0 + \beta_1 IGI_{it} + \beta_2 RGI_{it} + \beta_3 Attention_{it} + \beta_4 IGI_{it} \times Attention_{it} + \beta_5 RGI_{it} \times Attention_{it} + \beta_6 Expertise_{it} + \beta_7 IGI_{it} \times Expertise_{it} + \beta_8 RGI_{it} \times Expertise_{it} + \beta_i Control_{it} + \gamma_i + \eta_t + \varepsilon_{it} \quad (4)$$

where β_0 denotes the intercept, β_n signifies the coefficients for the explanatory variables, γ_i represents the firm fixed effect, η_t indicates the year fixed effect, and ε_{it} is the error term. All variables are described in the above section.

V. RESULTS

A. Main Results

Table III displays the descriptive statistics of all variables. Table IV presents the correlation matrix. Additionally, by examining the variance inflation factor values for all variables and noting that they fall below the threshold of 10 [79], this study confirms that multicollinearity does not pose a significant issue.

[Insert Table III and Table IV here]

Table V presents the results of the firm fixed-effect regression analyses. Model 1 examines H1a by including IGI and all moderating and control variables. Model 2 assesses H1b, incorporating RGI with the same set of variables. Model 3 introduces executive environmental attention-related interaction terms to test H2a and H2b. Model 4 evaluates H3a and H3b by including executive environmental expertise-related interaction terms. Finally, Model 5 is the full model that combines the analyses of all hypotheses.

[Insert Table V here]

Model 1 reveals a significant, positive estimated coefficient for IGI ($\beta = 0.061$, $p < 0.05$), which validates the positive relationship between IGI and SBS, thereby supporting H1a. Furthermore, Model 2 shows a significant negative coefficient for RGI ($\beta = -0.030$, $p < 0.05$), which confirms the negative relationship between RGI and SBS. Hence, H1b is supported.

In Model 3, the interaction term between executive environmental attention and IGI is found to be significantly negative ($\beta = -0.011$, $p < 0.05$), indicating that it weakens the positive relationship between IGI and SBS. Hence, H2a is supported. Besides, Model 3 reveals an insignificant coefficient of the interaction term between executive environmental attention and RGI, suggesting that it does not influence the negative relationship between RGI and SBS. Thus, H2b is not supported. Figure 2 illustrates the difference in the IGI–SBS relationship at low and high levels of executive environmental attention, represented by the mean minus one S.D. and the mean plus one S.D., respectively. It is shown that the positive IGI–SBS relationship is flatter for LSPs with a high level of executive environmental attention, which further corroborates H2a.

Model 4 shows that the coefficient of the interaction term between executive environmental expertise and IGI is insignificant. As such, H3a is not supported. Moreover, it is found that the interaction term between executive environmental expertise and RGI has a significantly positive coefficient ($\beta = 0.212$, $p < 0.05$). This finding suggests that executive environmental expertise mitigates the negative relationship between RGI and SBS, thus supporting H3b. Figure 3 illustrates the difference in the RGI–SBS relationship at low and high levels of environmental expertise, represented by the mean minus S.D. and the mean plus S.D., respectively. The negative RGI–SBS relationship turns to be positive for LSPs with a high level of executive environmental expertise, indicating that executive environmental expertise mitigates the negative impact of RGI on SBS. This further corroborates H3b. Finally, the results from Model 5 align with those of the preceding models.

[Insert Figure 2 and Figure 3 here]

B. Endogeneity

To address endogeneity concerns in our primary models, we employ multiple strategies. One approach involves introducing a temporal lag between the independent and dependent variables, which helps mitigate the concerns of reverse causality and simultaneity. We also incorporate a comprehensive set of control variables, along with firm- and year-fixed effects in our models, in order to eliminate the potential influence of omitted variables.

To further address potential endogeneity issues, we apply a two-stage least squares (2SLS) approach [80]. First, we employ the industry average of green innovation as an instrumental variable (IV), calculated using the logarithm of the average number of green patents held by other LSPs within the same three-digit CSRC industry, excluding the LSP itself. When making green innovation decisions, LSPs encounter the influences of industry competitors, which makes them learn from and imitate the green innovation behaviors of peer LSPs [81-83]. This suggests a strong connection between the industry average of green innovation and firms' IGI and RGI. However, peers' green innovation is not likely to affect the supply base of an individual LSP. A regression analysis is conducted to corroborate this assumption, revealing no significant relationship between the industry average of green innovation and the SBS of LSPs ($\beta = 0.084$, $p > 0.1$), thereby confirming the appropriateness of using the industry average of green innovation as an IV. In the first stage of the 2SLS, when RGI serves as the dependent variable, the coefficient of the industry average of green innovation is found to be significantly positive ($\beta = 0.728$, $p < 0.01$). However, when IGI is the dependent variable, the coefficient of the industry average of green innovation is insignificant. In the second stage, we find that the coefficient of estimated RGI is significant and negative ($\beta = -0.076$, $p < 0.05$), confirming the negative relationship between RGI and SBS.

Second, we adopt government environmental attention as another IV for green innovation. Government environmental attention is measured by the proportion of environment-related terms (e.g., environmental protection, environmental quality, particulate matter, carbon dioxide, new energy) in the work reports of the municipal governments where LSPs are headquartered [62]. Governments with high environmental attention can stimulate green innovation in firms through various means, such as higher environmental subsidies and stringent regulations [62], [84]. However, it is unlikely to influence an LSP's SBS. We conduct a regression analysis to verify this assumption, finding no significant relationship between government environmental attention and SBS ($\beta = 10.311$, $p > 0.1$). Therefore, we consider government environmental attention to be an appropriate IV. Different from the previous IV, in the first stage of the 2SLS, when IGI is the dependent variable, the coefficient of government environmental attention is significantly positive ($\beta = 53.100$, $p < 0.05$); however, when RGI is the dependent variable, the coefficient of government environmental attention is not significant. In the second stage, we only find that the coefficient of estimated IGI is significant and positive ($\beta = 0.354$, $p < 0.1$), confirming the positive relationship between IGI and SBS. In conclusion, these findings demonstrate that endogeneity does not distort the results of our study.

C. Robustness Checks

To ensure the robustness of our findings, we conduct several supplementary tests. The results from these robustness tests are compiled in Table VI. First, we mitigate potential biases from outliers by winsorizing the top and bottom 1% of the dependent variable (i.e., SBS). Model 1 in Table VI demonstrates that the results are consistent with those in Table V. Second, we use an alternative firm size measure, defined as the natural logarithm of a firm's revenue [85-86]. Model 2 in Table VI shows that the results are in line with our main findings. Additionally, in Model 3, we adopt an alternative approach to calculate Tobin's q, which involves summing a company's market capitalization and the book value of total liabilities, and then dividing this total by total assets [87]. The results based on this alternative measure remain consistent with our main findings.

[Insert Table VI here]

VI. DISCUSSION AND CONCLUSIONS

A. Theoretical Contributions

Our research offers a number of notable theoretical implications. First, it broadens the green logistics literature by offering sound empirical evidence regarding the distinct impacts of IGI and RGI on SBS within the Chinese logistics sector. While earlier research has focused on green innovation's effects on firms' financial and environmental performance [5], [88-89], there is a lack of exploration into its influence on the upstream supply chain. Given that upstream stability can significantly impact a company's operational and financial performance [17-18], [20], understanding this linkage is essential for comprehensively assessing the supply chain implications of green innovation. More importantly, this research provides nuanced insights by uncovering that IGI increases LSPs' SBS whereas RGI decreases their SBS. These differential impacts of IGI and RGI are critical, as they highlight the multifaceted nature of implementing different types of green innovation, especially in the logistics industry which is closely associated with environmental pollution yet encounters less stringent regulations and standards [5], [90]. Overall, our research extends the green logistics literature by illuminating the distinct impacts that IGI and RGI exert on the stability of the supply base in the logistics industry context.

Second, our study enriches the RST literature by delineating the processes of local and distant searches within the context of LSPs' green innovation and illustrating their differing impacts on SBS. We offer theoretical validation for the different nature of local search, associated with lower uncertainty and simplified knowledge complexity, against distant search, which entails higher uncertainty and leads to a more complex knowledge base [21], [47]. Although previous research on RST has primarily concentrated on the impact of knowledge search strategies on a firm's knowledge base [42], [47], our study advances this theoretical framework by empirically uncovering the differential effects of IGI and RGI on LSPs' SBS, thereby extending RST to the field of supply base management. This offers a fresh perspective to comprehend how knowledge search and recombination influence the supply chain, providing fine-grained insights into the distinctive effects of local search and distant search, particularly in the context of environmental sustainability.

Finally, this study sheds light on the supply base management literature by elucidating the boundary conditions under which the effects of IGI and RGI on SBS may vary. The extant literature has offered few insights into the contingency factors that alter the impact of green innovation on firms' SBS. Our interesting findings reveal that executive environmental attention weakens the positive relationship between IGI and SBS whereas it does not significantly affect the relationship between RGI and SBS. A possible reason is that RGI necessitates firms to conduct distant search behaviors, yet executive environmental attention might be confined to the pursuit of short-term environmental objectives, which makes the relationship between RGI and SBS insignificant. Moreover, we discover that executive environmental expertise attenuates the effect of RGI on SBS, but it does not significantly influence the effect of IGI on SBS. The explanation for this intriguing finding is that as the local search process within IGI does not demand a highly rich and complex knowledge base, executive environmental expertise may not play a pronounced role in altering the IGI–SBS relationship. These findings expand the literature on supply base management [17-18], [20], thus contributing to a more differentiated understanding of how TMT characteristics (i.e., executive environmental attention and executive environmental expertise) play different roles in shaping the supply chain outcomes of IGI and RGI, particularly in the logistics industry where supply chain management is vital to LSPs' operational success [91]. By uncovering the distinct contingency effects of these key TMT characteristics, our study also sheds light on the

RST literature [42-43] by introducing the boundary conditions to the application of RST in the field of supply chain management.

B. Managerial Implications

This study provides essential managerial insights. First, it demonstrates that IGI increases LSPs' SBS while RGI decreases their SBS. This distinction highlights the need to adopt tailored strategies to engage in different green innovations, given their varied impacts on the supply chain. This is especially relevant in the Chinese logistics industry, an emerging market characterized by rapid growth, an influx of start-ups, and increasing environmental awareness. Therefore, we strongly recommend that LSPs adopt a discerning approach toward green innovation, carefully weighing the potential trade-off between green innovation-driven environmental benefits and SBS. Managers are advised to strategically integrate RGI within comprehensive supply chain management practices to mitigate potential operational disruptions. For example, LSPs can establish cross-functional teams to evaluate both the risks and benefits of RGI initiatives, conducting pilot projects before large-scale implementation. They can also employ advanced forecasting techniques to anticipate shifts in demand and supply patterns, enhance supplier collaboration through shared environmental objectives, and diversify their supply bases to reduce overreliance on any single source. Meanwhile, policymakers can support such endeavors through targeted guidelines, incentives, or subsidies that foster the responsible adoption of RGI while minimizing destabilizing effects on existing supply networks. Concurrently, leveraging IGI can strengthen the stability of supply bases by gradually improving processes, technologies, and materials in alignment with sustainable development principles.

Second, our findings suggest that executive environmental attention dampens the positive relationship between IGI and SBS. Consequently, executives with strong environmental attention must remain vigilant about potential risks to the supply chain, even when the firm adopts IGI. Although IGI typically introduces gradual improvements, heightened managerial focus on environmental issues can lead to shifts in resource allocation, priority changes, or new operational processes, which may inadvertently strain supplier relationships. Managers should therefore balance environmental objectives with maintaining stable supply bases by continuously assessing potential trade-offs and reinforcing collaboration with key suppliers.

Finally, our findings suggest that executive environmental expertise alleviates the negative RGI–SBS relationship. Therefore, for LSPs implementing RGI, integrating executives with environmental expertise into their strategic planning is crucial for reducing supply chain risks and uncertainties. The expertise that environmentally knowledgeable TMT members bring can help LSPs navigate the complexities of RGI, aligning it with supply chain practices. This approach can help alleviate volatility in the upstream supply chain triggered by RGI. Thus, LSPs should ensure that their TMTs include members with environmental expertise to oversee green innovation while effectively maintaining stable supply bases.

C. Conclusions, Limitations, and Future Research

Drawing on RST, this research investigates the impacts of IGI and RGI on LSPs' SBS. Additionally, we examine how executive environmental attention and executive environmental expertise moderate these impacts. By analyzing data from 88 Chinese LSPs in the period 2011–

2019, we find a positive relationship between IGI and SBS but a negative relationship between RGI and SBS, affirming the differential roles of different types of green innovation. Furthermore, executive environmental attention weakens the positive IGI–SBS association, whereas it does not significantly affect the RGI–SBS association. Additionally, executive environmental expertise attenuates the negative RGI–SBS linkage, while it has no significant effect on the IGI–SBS linkage. These findings underscore the nuanced roles of TMT characteristics in shaping the supply chain outcomes of green innovation.

Nevertheless, several limitations of this paper offer opportunities for future research. First, the limited number of publicly listed LSPs in our dataset results in a relatively small sample size, constraining the generalizability of our findings. Future research could expand the sample size to include non-public LSPs or international LSPs, thereby enhancing the robustness of the findings. Second, the focus on the Chinese logistics industry context may limit the applicability of our results to other industries or regions, given China's distinctive cultural, institutional, and economic characteristics. Thus, we encourage future studies to incorporate data from other industries or nations, extending the application of RST and offering richer insights through comparative analyses. Third, although we measure green innovation using publicly available patent data, such data may not encompass all green innovations within firms, particularly those not formally patented or still in development. Future research employing other methods, such as surveys or case studies, could capture broader green innovation activities and provide more insights. Fourth, while this research relies on changes in supplier concentration to assess SBS, this single metric may not fully capture the nuanced dynamics of supplier relationships.

Employing more comprehensive measures, potentially informed by systems analysis approaches, could offer deeper insights into the complexity of SBS. Finally, this research opens an avenue for examining how green innovation affects other stakeholders of LSPs, particularly customers, which can offer more insights into the supply chain implications of green innovation. Moreover, a pathway for future research is to explore other potential moderating factors such as environmental strategy, innovation capacity, and supply chain flexibility, which can deepen our understanding of the boundary conditions shaping the linkage between green innovation and SBS.

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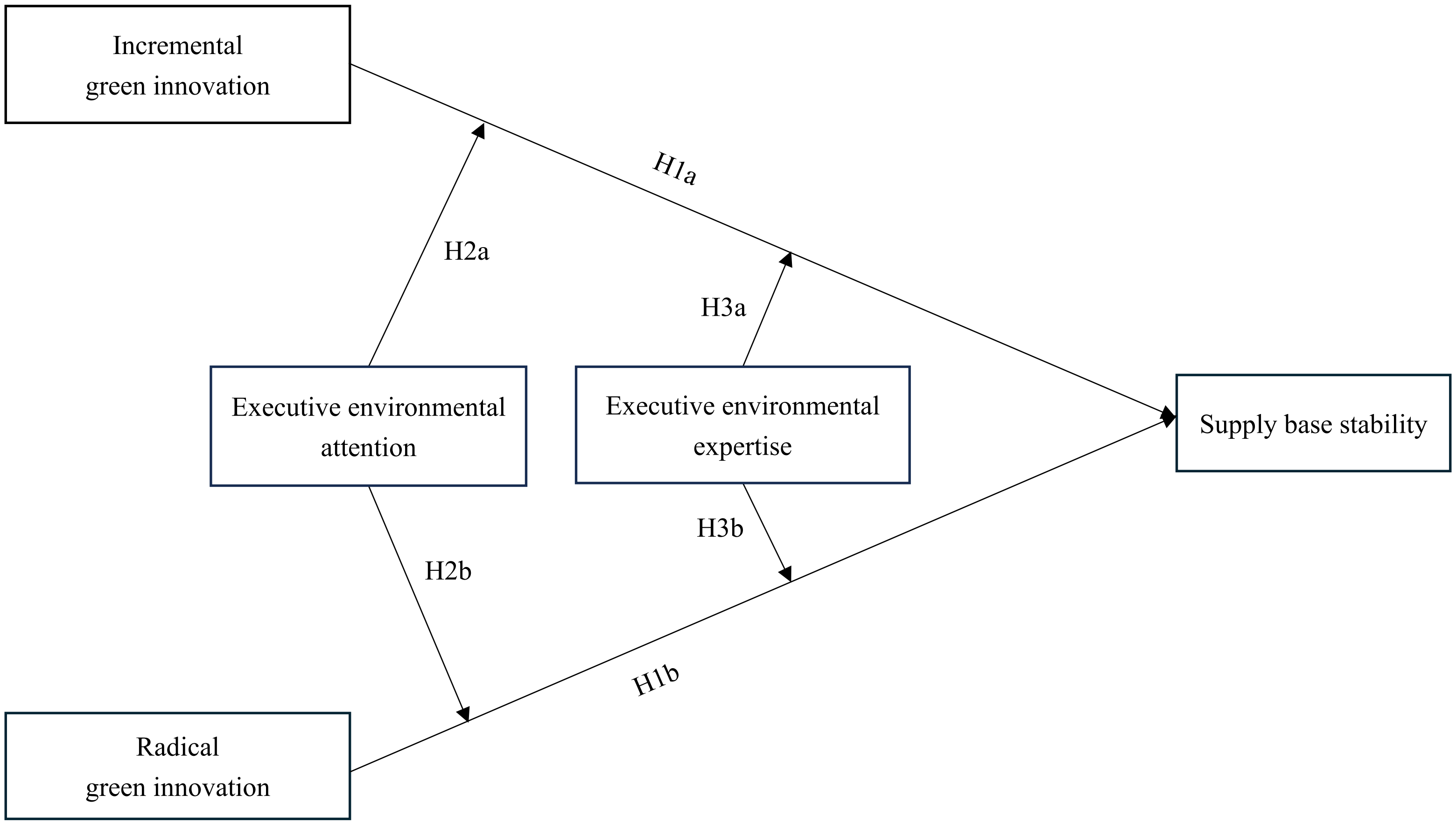

Figure 1. Conceptual model

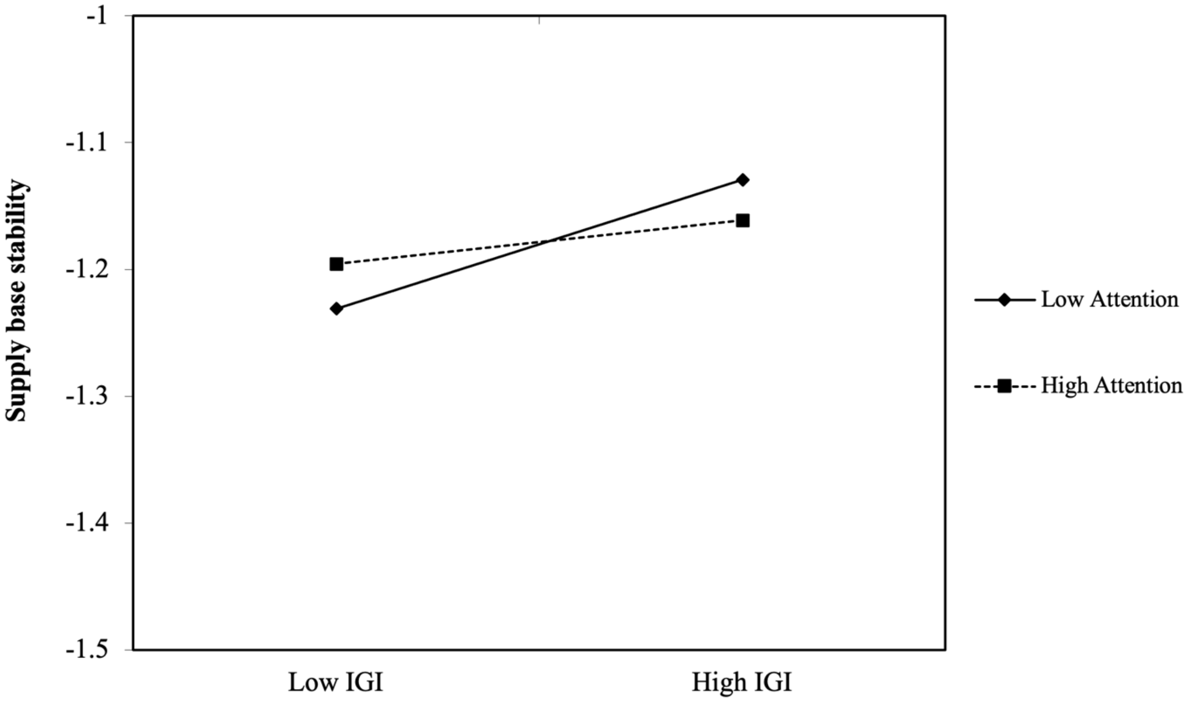

Figure 2. Moderating effect of executive environmental attention on the IGI–SBS association

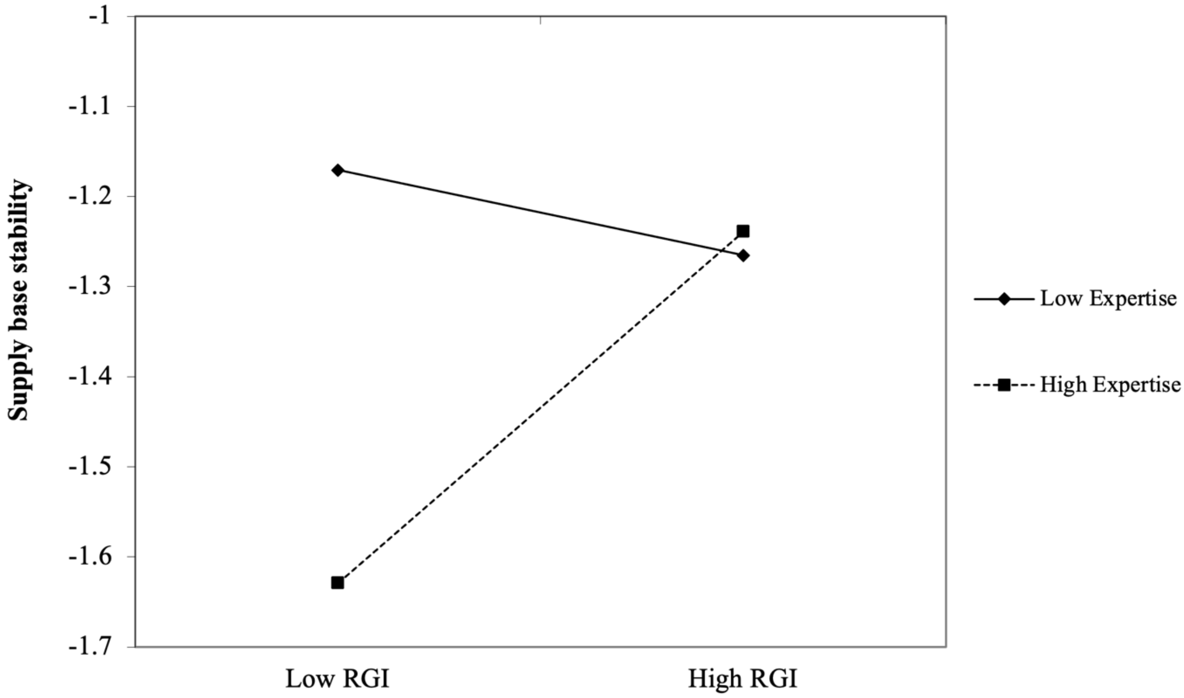

Figure 3. Moderating effect of executive environmental expertise on the RGI–SBS association

Table I

TYPICAL STUDIES ON THE IMPACT OF GREEN INNOVATION ON SUPPLY CHAINS

Study	Independent variable	Supply chain-related outcome	Industry	Country / Region	Main findings
Khassawneh et al. (2024) [30]	Eco-innovation	Customer satisfaction	Hospitality	Dubai	Green innovation implementation has a positive impact on customer satisfaction.
Li et al. (2023) [31]	Green innovation	Trade credit from suppliers	Non-finance industries	China	Green innovation can improve firms' access to trade credit from their suppliers.
Shao et al. (2025) [32]	Green innovation	Trade credit from suppliers	Manufacturing	China	Both incremental green innovation and radical green innovation exert a positive effect on trade credit.
Song et al. (2023) [33]	Eco-innovation	Supply chain leakage	Manufacturing	North America	The supplier's eco-innovation can be a major reason behind the supply chain leakage of greenhouse gas emissions.
Wang et al. (2020) [34]	Green innovation	Customer relationships	Manufacturing, information technology, fast-moving consumer goods, transportation, and construction	United States	Supplier green innovation effort is positively associated with relational performance.

Table II

SAMPLE OVERVIEW

Sample distribution by year	Frequency	%	Sample distribution by industry	Frequency	%
2011	8	2.22	G53 Railway transportation	15	4.17
2012	23	6.39	G54 Road transportation	89	24.72
2013	14	3.89	G55 Water transportation	129	35.83
2014	19	5.28	G56 Air transportation	59	16.39
2015	25	6.94	G58 Stevedoring service	17	4.72
2016	52	14.44	G59 Storage service	37	10.28
2017	63	17.50	G60 Postal service	14	3.89
2018	75	20.83	Total	360	100
2019	81	22.50			
Total	360	100			

Table III

DESCRIPTIVE STATISTICS

Variable	Mean	S.D.	Min	Max
SBS	–0.224	0.184	–0.957	–0.009
IGI	0.155	0.497	0	2.944
RGI	0.436	0.859	0	4.970
Attention	2.072	3.120	0	20
Expertise	0.120	0.150	0	0.750
Size	22.217	1.566	18.828	25.762
Age	2.840	0.389	1.386	3.555
Lev	0.148	0.132	0	0.603
TobinQ	1.539	1.598	0.730	24.495
ETD	2.406	6.068	0.166	96.384
Inventory	3.697	1.788	–1.537	9.525
Productivity	13.945	0.914	11.847	17.087
In_size	25.752	1.949	21.883	28.226
In_grow	0.154	0.289	–0.130	4.230
In_comp	0.785	0.176	0.203	0.951

Table IV

CORRELATION MATRIX

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. SBS	1														
2. IGI	–0.103	1													
3. RGI	–0.079	0.421***	1												
4. Attention	0.051	0.072	0.092	1											
5. Expertise	0.011	–0.045	–0.031	0.003	1										
6. Size	0.059	0.320***	0.404***	0.193***	–0.052	1									
7. Age	0.032	0.046	0.085	–0.134**	–0.013	0.098	1								
8. Lev	–0.033	0.111**	0.086	0.206***	0.172***	0.355***	0.015	1							
9. TobinQ	–0.005	–0.089	–0.074	–0.095	0.033	–0.231***	0.042	–0.237***	1						
10. ETD	–0.148***	–0.034	–0.083	–0.079	–0.014	–0.197***	–0.101	–0.253***	0.045	1					
11. Inventory	0.082	–0.080	0.020	–0.051	0.057	0.089	–0.184***	–0.065	0.044	0.066	1				
12. Productivity	0.066	–0.035	0.073	0.149***	0.086	0.449***	0.048	0.291***	–0.003	–0.127**	–0.023	1			
13. In_size	0.001	–0.011	0.001	–0.071	–0.001	–0.039	–0.074	–0.034	0.096	0.016	0.039	–0.001	1		
14. In_grow	–0.666	–0.008	0.023	–0.079	0.003	–0.049	0.061	–0.174***	0.028	–0.044	–0.03	0.016	0.068	1	
15. In_comp	0.073	–0.008	–0.072	0.182***	0.001	–0.031	0.071	0.253***	–0.012	–0.041	–0.145***	–0.105**	–0.103	–0.288***	1

Notes: $N = 360$. *** and ** are significant at the levels of 1% and 5%, respectively.

Table V

FIXED-EFFECT REGRESSION ANALYSES RESULTS

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Attention	–0.000	(0.003)	–0.000	(0.004)	0.002	(0.004)	–0.000	(0.003)	0.002	(0.004)
Expertise	–0.200	(0.134)	–0.199	(0.135)	–0.195	(0.132)	–0.269*	(0.140)	–0.274*	(0.139)
IGI	0.061**	(0.025)			0.100***	(0.038)	0.068**	(0.033)	0.096**	(0.041)
RGI			–0.030**	(0.014)	–0.031**	(0.015)	–0.060***	(0.021)	–0.056***	(0.021)
IGI × Attention					–0.011**	(0.005)			–0.011**	(0.005)
RGI × Attention					0.001	(0.003)			0.002	(0.003)
IGI × Expertise							0.013	(0.121)	0.034	(0.125)
RGI × Expertise							0.212**	(0.103)	0.217***	(0.100)
Size	0.011	(0.048)	0.019	(0.052)	0.020	(0.050)	0.020	(0.050)	0.020	(0.051)
Age	0.037	(0.224)	0.041	(0.244)	0.002	(0.222)	0.023	(0.223)	0.006	(0.219)
Lev	–0.199	(0.208)	–0.210	(0.219)	–0.182	(0.214)	–0.232	(0.212)	–0.223	(0.212)
TobinQ	–0.012***	(0.004)	–0.011***	(0.004)	–0.012***	(0.004)	–0.013***	(0.004)	–0.013***	(0.004)
ETD	–0.004***	(0.001)	–0.004***	(0.001)	–0.004***	(0.001)	–0.004***	(0.001)	–0.004***	(0.001)
Inventory	–0.012	(0.017)	–0.013	(0.017)	–0.015	(0.017)	–0.016	(0.017)	–0.017	(0.017)
Productivity	0.039	(0.029)	0.039	(0.032)	0.035	(0.030)	0.039	(0.030)	0.037	(0.031)
In_size	–0.004	(0.007)	0.001	(0.007)	–0.003	(0.007)	–0.002	(0.007)	–0.001	(0.008)
In_grow	–0.072***	(0.026)	–0.065***	(0.024)	–0.068***	(0.024)	–0.068***	(0.024)	–0.068***	(0.024)
In_comp	0.221	(0.167)	0.172	(0.164)	0.217	(0.172)	0.210	(0.168)	0.197	(0.169)
Year FE	Yes		Yes		Yes		Yes		Yes	
Firm FE	Yes		Yes		Yes		Yes		Yes	
R^2	0.144		0.143		0.164		0.167		0.173	

Notes: $N = 360$. ***, **, and * are significant at the levels of 1%, 5%, and 10%, respectively. Robust standard errors are in parentheses.

Table VI

RESULTS OF ROBUSTNESS CHECKS

Variable	Model 1		Model 2		Model 3	
Attention	0.002	(0.004)	0.002	(0.004)	0.002	(0.004)
Expertise	–0.263**	(0.133)	–0.270*	(0.142)	–0.271**	(0.137)
IGI	0.096**	(0.041)	0.091**	(0.039)	0.098***	(0.041)
RGI	–0.055**	(0.022)	–0.051**	(0.022)	–0.057***	(0.021)
IGI × Attention	–0.011**	(0.005)	–0.010*	(0.005)	–0.011**	(0.006)
RGI × Attention	0.002	(0.003)	0.002	(0.003)	0.002	(0.003)
IGI × Expertise	0.031	(0.125)	0.137	(0.135)	0.030	(0.125)
RGI × Expertise	0.214**	(0.099)	0.224**	(0.099)	0.212**	(0.099)
Size	0.019	(0.050)	–0.110**	(0.054)	0.016	(0.051)
Age	0.002	(0.219)	–0.019	(0.208)	–0.008	(0.219)
Lev	–0.222	(0.211)	–0.167	(0.208)	–0.226	(0.211)
TobinQ	–0.013***	(0.004)	–0.013***	(0.004)	–0.011***	(0.004
ETD	–0.004***	(0.001)	–0.004***	(0.001)	–0.004***	(0.001)
Inventory	–0.017	(0.017)	–0.023	(0.017)	–0.017	(0.017)
Productivity	0.037	(0.031)	0.045	(0.030)	0.037	(0.031)
In_size	–0.002	(0.008)	–0.002	(0.007)	–0.001	(0.008)
In_grow	–0.067***	(0.023)	–0.066**	(0.024)	–0.066***	(0.024)
In_comp	0.197	(0.169)	0.212	(0.176)	0.180	(0.169)
Year FE	Yes		Yes		Yes	
Firm FE	Yes		Yes		Yes	
R^2	0.175		0.190		0.173	

Notes: ***, **, and * are significant at the levels of 1%, 5%, and 10%, respectively. Robust standard errors are in parentheses.