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Can Company Size and Region Shape the Sustainability Landscape?

Exploring Their Moderating Effects on Green Innovation in Chinese Manufacturing

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ABSTRACT

This research investigates the status of green innovation within the supply chain context, emphasizing the roles of organizational support, competitive pressure, and relative advantage. A total of 286 valid samples collected from employees within the supply chain of the manufacturing industry in China were analyzed. Findings reveal significant impacts of organizational support, competitive pressure, and relative advantage on green supply chain innovation adoption, with nuances observed based on organizational characteristics and regional differences. Competitive pressure is a key driver for small organizations to adopt green supply chain innovations, whereas the relative advantage significantly influences larger organizations' adoption intentions. Organizations in different regions exhibit different adoption intentions of green supply chain innovations. Practical implications for managers in different contexts are discussed, emphasizing the importance of tailored strategies to leverage strengths and mitigate challenges in fostering sustainable and innovative supply chains.

KEYWORDS

Organizational Support, Competitive Pressure, Relative Advantage, Green Supply Chain, Adoption Intention

In the contemporary global landscape, the imperative of green innovation has emerged as a critical strategic direction for ensuring the sustainability of organizations. This emphasis on green innovation is particularly pertinent within the supply chain, given its direct impact on the environmental sustainability of the entire value chain (Shahzad et al., 2022). Consequently, gaining a comprehensive understanding of how factors such as organizational support, competitive pressure, and relative advantage influence green innovation in the supply chain is of practical significance for individual enterprises and the industry at large.

Green supply chain innovation involves adopting environmentally friendly processes in design, production, distribution, and recycling, aimed at reducing negative environmental impacts and enhancing resource efficiency (Feng et al., 2022). The impact of these innovative activities on supply chain members is primarily reflected in cost savings, risk reduction, improvement of corporate image, and enhancement of compliance (Novitasari & Agustia, 2021).

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Green innovation within the supply chain is situated within the broader realm of innovation, thereby benefiting from insights gleaned from scholarly research on innovation. Scholars' findings in the domain of innovation furnish valuable experiential knowledge for advancing green innovation initiatives within supply chains.

Organizational support assumes a central role in propelling green innovation forward. An exploration into how organizational support shapes the attitudes and behaviors of stakeholders in the supply chain concerning green innovation unveils internal mechanisms that either foster or impede green innovation (Al-Ghazali & Afsar, 2021).

As societal environmental consciousness continues to intensify, the influence of green competitive pressure has emerged as a pivotal determinant prompting enterprises to embrace green innovation. Examining the manner in which green competitive pressure compels firms to reconfigure their supply chains to effectively confront environmental imperatives holds significant promise for yielding valuable managerial insights (Li et al., 2019).

An examination of the impact of relative advantage contributes to an understanding of the challenges enterprises may encounter in embracing green innovation (Jiao et al., 2020). Scrutinizing how relative advantage influences a company's willingness and behavior toward innovation provides insights into effective strategies for achieving green innovation.

The relationship between organizational size and innovation remains a subject of contention. While some scholars contend that larger organizations, boasting a greater pool of colleagues contributing innovative ideas, harbor superior innovation potential (Forés & Camisón, 2016), a minority of studies propose that smaller organizations, endowed with greater organizational flexibility, may also foster green innovation (Miroshnychenko et al., 2021). Treating organizational size as a confounding variable enables an analysis of the extent to which organizational size shapes the transmission of innovative ideas within an organization. This approach also facilitates an exploration of how organizational policies may differentially impact the willingness to adopt green innovation in the supply chain based on organizational size differences.

Disparities in organizational culture or structure between regions add another layer of complexity. In regions where a culture receptive to open innovation prevails, widespread knowledge-sharing behaviors and heightened trust among members may foster supportive conditions for innovation. Conversely, regions characterized by intense environmental competition may prompt organizations to adopt flexible and flattened designs (Bogers et al., 2017). Regional differences may contribute to distinct interpretations of organizational support, competitive pressures, and relative advantages, thereby influencing the willingness to adopt innovative technologies. Therefore, incorporating regional differences as a confounding variable can facilitate the evaluation of the impact of regional cultural or organizational design disparities on the adoption of innovations, particularly within the domain of green innovation in supply chains characterized by intricate network organizational structures.

The significance of this research lies in its ability to inform strategic decision-making within organizations seeking to adopt green innovation practices. By understanding the interplay of organizational support, competitive pressure, relative advantages, organizational size, and region, businesses can tailor their approaches to leverage strengths, mitigate challenges, and foster a more sustainable and innovative supply chain. Ultimately, this study contributes to the broader discourse on environmental sustainability and provides a foundation for future research endeavors in the field of green innovation within the global supply chain.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Adoption Intention of Green Supply Chain Innovation

Green innovation encompasses improvements in products, processes, and management practices undertaken by enterprises to mitigate adverse environmental impacts and promote sustainable development (Khan et al., 2021). Its scope is multifaceted, covering tangible components like products

and processes, as well as intangible elements such as management methods (Singh et al., 2020). The primary goal is to reduce negative externalities on the environment, emphasizing a dedication to sustainable development that aligns economic prosperity, societal well-being, and environmental stewardship (Yuan & Cao, 2022). In essence, green innovation signifies a proactive commitment by enterprises to engage in transformative, environmentally beneficial activities contributing to broader environmental improvement and sustainable business practices (Song & Yu, 2018). Approaching green innovation from a supply chain perspective underscores the interconnectedness of various business operations, highlighting the need for a holistic integration of environmentally conscious practices throughout the entire production and distribution continuum.

From an organizational standpoint, adoption intention of green supply chain innovation involves the intentional integration of environmentally sustainable practices throughout the entire supply chain (Zailani et al., 2015). It includes implementing innovative approaches in product design, manufacturing processes, and management systems to reduce negative environmental impacts (Aboelmaged & Hashem, 2019). Organizations strategically embrace green innovation within their supply chains to enhance resource efficiency, minimize waste, and achieve sustainability goals (Cherrafi et al., 2018). This adoption reflects a proactive commitment to environmentally conscious decision-making, demonstrating a comprehensive organizational effort to balance economic objectives with ecological responsibility.

Organizational Support and Adoption Intention of Green Supply Chain Innovation

General organizational support is defined as the extent to which management is willing to provide or allocate resources to employees to achieve organizational goals (AlNasrallah & Saleem, 2022). In the realm of corporate innovation, Alpkan et al. (2010) propose that organizational support comprises five factors:

(1) Management support for generating and developing new business ideas,
(2) Allocation of free time,
(3) Facilitating organizational structure, especially with regard to the level of decentralization or decision-making autonomy,
(4) the appropriate use of incentives and rewards, and
(5) the tolerance of trial and error or failure in the case of creative undertakings or risky project implementation (p. 734).

Organizational support has a direct impact on corporate innovation performance with interaction effects (Chouchane et al., 2023). In terms of organizational support for green innovation, Zhao and Huang (2022) reported that under the green system requirements of national regulatory agencies, organizational support can more effectively guide employees to participate in the company's green innovation development, thus influencing green transformation leadership and sustainable business performance.

Green innovation plays a pivotal role in advancing sustainable environmental management. As the required resource investments for organizations to adopt environmentally friendly practices become more readily available, the enthusiasm to guide employees to engage in environmentally sustainable behaviors grows, making support for green innovation initiatives more feasible (Al-Ghazali & Afsar, 2021). Organizational incentives for green innovation adoption, coupled with the assurance of financial and technical resources, have been found to have a positive impact on the adoption of green technological innovations (Lee et al., 2014; Shahadat et al., 2023).

Zhang et al. (2020) assert that green innovation operates in a virtuous cycle of ecological efforts and performance improvement to achieve corporate sustainable development. Green innovation involves continuous investment of available resources within the organization and the ongoing cultivation of organizational culture to drive it forward. Organizational support is demonstrated through

the implementation of new technologies and the training of employees on green practices (Liu et al., 2020). A study on perceived organizational support (POS) by Kusi et al. (2021) demonstrated that when organizations provide economic and social support to employees, they are more likely to align their actions with leaders' instructions on green reforms in their job functions. This commitment extends to employees going above and beyond their capabilities, especially under the influence of a transformational leader, to achieve green improvements in processes, product quality, and customer service. As a result, the following hypothesis is proposed:

H1: Organizational support has a positive impact on adoption intention of green supply chain innovation.

Competitive Pressure and Adoption Intention of Green Supply Chain Innovation

Competitive pressure is defined by the level of industry competition arising from factors such as globalization, advancements in technology, and the utilization of knowledge (Wiersema & Bowen, 2008). It serves as an indication of external pressure stemming from various sources including competitors, suppliers, customers, industry alliances, and partners (Saeed et al., 2018). Within highly competitive environments, companies often employ innovation as a strategy to foster sustainable business development (Hanaysha et al., 2022). In doing so, they may emulate competitors' product designs, production technologies, or marketing strategies to enhance their own competitiveness. Rui and Lu (2021) contend that the risk and complexity associated with green innovation can be mitigated through the process of learning from and imitating the innovative practices of successful green competitors.

Research conducted by Yang et al. (2021) indicates that the adoption of supply chain digital technologies is influenced by competitive pressures. Chen et al. (2018) emphasize the significant role of competitive pressure in the context of green supply chain management practices. In a study on the adoption of green innovation, Tu and Wu (2021) found that organizations are more likely to adopt innovative technologies to maintain or gain a competitive advantage in highly competitive markets. Similarly, Li et al. (2019) posit that intense competition compels companies to explore green innovation strategies for acquiring new ideas, technologies, and expertise. Therefore, the following hypothesis is proposed:

H2: Competitive pressure has a positive impact on adoption intention of green supply chain innovation.

Relative Advantage and Adoption Intention of Green Supply Chain Innovation

Promoting the adoption of green innovations in supply chains can be achieved by employing technology indicators derived from the diffusion of innovation theory (DOI) (Zhu et al., 2012). A pivotal factor in this process is “relative advantage,” which is considered to be the extent to which an innovation outperforms previous approaches to performing the same task (Khan et al., 2022). The relative advantage of green innovation can enhance both the economic and environmental efficiency of the supply chain, thereby enabling organizations to gain a competitive advantage (Wang et al., 2021).

Relative advantage has found extensive use in research focused on comprehending the organizational adoption of innovations. Maroufkhani et al. (2020) and Wong et al. (2020) contend that firms, through leveraging their relative advantage in a specific technological domain, can drive the adoption and development of technology. In their examination of the determinants of collaborative robot innovation technology adoption by small and medium-sized enterprises (SMEs), drawing from the technology organization-environment framework (TOE) and the DOI, Liu and Cao (2022) revealed that relative advantages positively impact the adoption of collaborative robots.

On the other hand, relative advantage is also a crucial influencing factor for individuals to embrace green innovative products. For instance, autonomous vehicles offer relative advantages compared to traditional vehicles, including enhanced safety, comfort, shorter transportation time, mobility options in case of damage, and lower fuel consumption (Chen & Yan, 2019). These advantages contribute to the functionality and economy of such products, making customers more willing to adopt them for their benefits to the public (Yuen et al., 2020). Therefore, the relative advantage that companies can gain by practicing green innovation is to meet customers' growing demand for sustainable products, thereby increasing market share and customer loyalty (Barforoush et al., 2021). This leads to the hypothesis that relative advantage significantly influences the adoption and development of green innovation.

H3: Relative advantage has a positive impact on adoption intention of green supply chain innovation.

While we aim to verify these direct links, we are equally focused on understanding how factors like the size of the organization and its geographical location might influence these relationships. For instance, the impact of competitive forces—such as the emergence of new competitors and technological shifts—on a company's inclination toward international expansion could be shaped by its network of knowledge (Saxena & Das, 2022). In this context, this research considers that external factors, including the size and region of an organization, may play a role in moderating the effects of competitive pressures and the adoption intention. Consequently, we propose the following hypotheses:

Hypothesis 4a: The greater the organizational size, the greater the positive relationship between competitive pressure and adoption intention.
Hypothesis 5a: Different organization regions have different impacts on the relationships between competitive pressure and adoption intention.

Similarly, the connection between the perceived benefits of adopting mobile health services and the willingness to implement them might be affected by the level of uncertainty in the environment (Chen & Zhang, 2016). Building on this idea, the study examines how external factors, such as the size and geographical location of an organization, could influence the relative advantage and adoption intention. Thus, we put forth the following hypotheses:

Hypothesis 4b: The greater the organizational size, the greater the positive relationship between relative advantage and adoption intention.
Hypothesis 5b: Different organization regions have different impacts on the relationships between relative advantage and adoption intention.

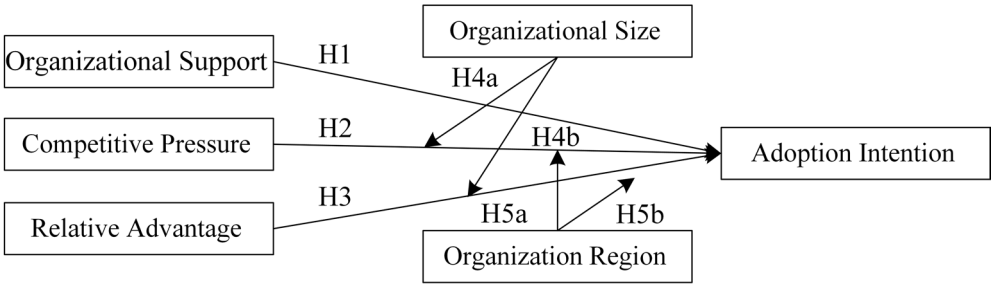
METHODS

Construct Measurement

The target group for this research consists of individuals employed within the supply chain of the manufacturing industry in China. To gather data, a survey was constructed using the SurveyMonkey online platform, and the link to this survey was shared with potential participants via WeChat in November 2023. Of the total of 301 received responses, 286 were considered valid and suitable for further analysis.

Items within the constructs are assessed using a 7-point Likert scale. The specific questionnaire employed in this study is presented in Table 1. Theoretical framework is shown as Figure 1.

Figure 1. Theoretical Framework



Questionnaire Reliability and Validity

All constructs exhibit strong composite reliability and average variance extracted (AVE), meeting recommended standards (Fornell & Larcker, 1981; Chin, 1998; Hair et al., 2019). See Table 1 for details on standard deviations and composite reliabilities in the range of 0.785 to 0.935. These results confirm acceptable convergent validity as shown in Table 2.

Discriminant validity, assessed following Fornell and Larcker's (1981) method, confirms that all AVE values exceed correlation coefficients (see Table 3), demonstrating strong discriminant validity among constructs.

Table 1. Research Questionnaire

Variable	Code	Description of Indicator Item	Source
Organizational Support (OS)	OS01	Higher management always encourages our employees to learn supply chain green innovation knowledge.	Lin et al. (2020)
	OS02	Necessary support for supply chain green innovation adoption within the firm is always given by our higher management.	
	OS03	Higher management would be enthusiastic about adopting supply chain green innovation.	
	OS03	Necessary resources are provided by the higher management for the adoption of supply chain green innovation.	
Competitive Pressure (CP)	CP01	Our company believes that the adoption of supply chain green innovation has an impact on the competition in the industry.	Liu and Cao (2022)
	CP02	Our company is facing pressure from competitors. It is challenging to survive in the fierce competition without using supply chain green innovation.	
	CP03	Some of our competitors have started to adopt supply chain green innovation.	
Relative Advantage (RA)	RA01	Adoption of supply chain green innovation will enable our company to increase productivity.	Liu and Cao (2022)
	RA02	Adopting supply chain green innovation will enable our company to improve work performance.	
	RA03	Adopting supply chain green innovation will enhance the image of our company.	
	RA04	Adopting supply chain green innovation will increase our company's profitability.	
Adoption Intention (AI)	AI01	Our organization intends to adopt supply chain green innovation in the near future.	Kumar et al. (2021)
	AI02	I believe that my organization intends to adopt supply chain green innovation in the future.	
	AI03	Our organization is likely to adopt supply chain green innovation on a regular basis in the near future.	

Table 2. Means, Standard Deviation (Std Dev), Composite Reliability (CR), and AVE of Each Construct

Construct	Item	Mean	Std Dev	Std.	CR	AVE
OS	OS01	5.63	0.96	0.785	0.832	0.554
	OS02	5.84	1.04	0.663		
	OS03	5.73	1.21	0.697		
	OS04	5.74	1.18	0.822		
CP	CP01	5.45	1.24	0.935	0.828	0.621
	CP02	5.69	1.44	0.752		
	CP03	5.44	1.53	0.651		
RA	RA01	6.06	1.23	0.794	0.871	0.627
	RA02	5.93	1.39	0.817		
	RA03	5.96	1.37	0.786		
	RA04	6.08	1.25	0.770		
AI	AI01	5.48	1.54	0.793	0.850	0.655
	AI02	5.81	1.46	0.828		
	AI03	5.92	1.42	0.806		

Note. Std., Standardized factor loadings; OS, Organizational Support; CP, Competitive Pressure; RA, Relative Advantage; AI, Adoption Intention.

Table 3. Results of Discriminant Validity by AVE

	AVE	OS	CP	RA	AI
OS	0.554	**0.744**			
CP	0.621	0.245	**0.788**		
RA	0.627	0.044	0.219	**0.792**	
AI	0.655	0.438	0.440	0.530	**0.809**

Note. The items on the diagonal on bold represent the square roots of the AVE; off-diagonal elements are the correlation estimates. OS, Organizational Support; CP, Competitive Pressure; RA, Relative Advantage; AI, Adoption Intention.

RESULTS

Sample Profile

The research encompasses a sample size of 286 individuals. Females make up the majority of the sample (57.24%), as shown in Table 4.

Model Fit

Model fit tests ensure the research model accurately represents the observed data, facilitating robust and reliable statistical inference. Tiffany and Schumacker (2022) recommend reporting nine widely accepted fitness metrics to assess model fit. A good model fit typically results in a chi-square value/degrees of freedom ratio below 3. Additionally, Hu and Bentler (1999) recommend evaluating each fitness metric independently and simultaneously controlling for type I errors with more stringent model fit metrics, such as the comparative fit index (CFI) > 0.90, standardized root mean square residual (SRMR) < 0.08, and root mean square error of approximation (RMSEA) < 0.08. The model fit tests are shown in Table 5.

Table 4. Sample Profile

Variable	Value Label	Frequency	Valid Percent	Value Label	Frequency	Valid Percent
Gender	1. Male	121	42.76			
	2. Female	162	57.24			
Age	1. 30 or under	37	13.07	1. 35 or under	210	74.20
	2. 31-35	173	61.13			
	3. 36-40	45	15.90	2. 36 or over	73	25.80
	4. over 41	28	9.89			
Education	1. 2-year college or under	8	2.83	1. 4-year university degree or under	217	76.68
	2. 4-year university degree	209	73.85			
	3. Graduate school	66	23.32	2. Graduate school	66	23.32
Employee size	1. 400 or under	121	42.76			
	2. 401 or over	162	57.24			
Region	1. Beijing-Tianjin-Hebei Region	87	30.74			
	2. Yangtze River Delta Region	116	40.99			
	3. Pearl River Delta Region	80	28.27			
	Total	283	100			

Path Analysis

In Table 6, the path analysis results demonstrate significant associations among the constructs. Organizational support (OS) (b=0.575, $p < 0.0001$), competitive pressure (CP) (b=0.265, $p < 0.0001$), and relative advantage (RA) (b=0.574, $p < 0.0001$) significantly affected adoption intention (AI). The combined influence of these values explained 51.0% of the variance of AI. The structural equation modeling (SEM) is shown in Figure 2.

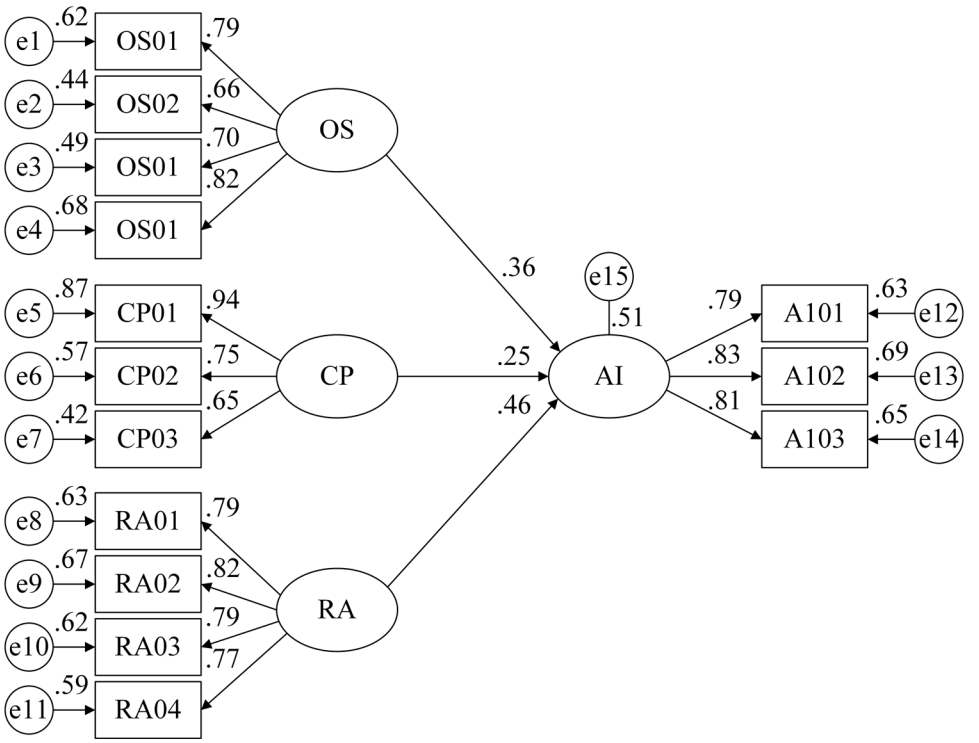
Table 5. Model Fit

Model fit	Criteria	Model fit of research model
MLχ^2	The small the better	105.258
DF	The large the better	71.000
Normed Chi-sqr (χ^2/DF)	1<χ^2/DF<3	1.483
RMSEA	<0.08	0.041
SRMR	<0.08	0.035
TLI (NNFI)	>0.9	0.976
CFI	>0.9	0.981
GFI	>0.9	0.945
AGFI	>0.9	0.93

Table 6. Regression Coefficient

DV	IV	Unstd	S.E.	Unstd./S.E.	*p*-value	Std.	R^2
AI	OS	0.575	0.101	5.691	0.000	0.356	0.510
	CP	0.265	0.065	4.086	0.000	0.252	
	RA	0.574	0.079	7.225	0.000	0.459	

Figure 2. SEM Model



Moderator Effects

Organizational Size

In examining the moderating effect of organizational size, there are 121 and 162 respondents who work for the companies that have employees under or above 400, respectively. Table 7 and Table 8 the show regression coefficients of these two groups. By comparing the slopes from independent variables to dependent variables, only paths CP to AI and RA to AI show statistical significance. Therefore, the moderating effects of organizational size are partially supported. Notably, the coefficient of CP to AI in under 400 employee organizations is higher than that of 400 or above. By contrast, the slope of RA to AI in over 400 employee organizations is steeper than that of organizations that have 400 employees or under.

Region

In examining the moderating effects of regions, there are 87 respondents from the Beijing-Tianjin-Hebei region, 116 from the Yangtze River Delta region, and 80 from the Pearl River Delta

Table 7. Employee of Regression Estimates

IV	DV	400 or under (121)				over 400 (162)			
		Estimate	S.E.	z	*p*	Estimate	S.E.	z	*p*
OS	AI	0.500	0.156	3.193	0.001	0.521	0.132	3.947	*
CP	AI	**0.428**	0.099	4.323	*	0.086	0.081	1.062	0.288
RA	AI	0.404	0.113	3.589	*	**0.726**	0.11	6.607	*

Note. *p<0.001.

Table 8. Organizational Size Nested Model Differences

Model	Model fit				Nested model differences		
	NPAR	χ^2	DF	χ^2/DF	ΔDF	Δχ^2	*p*
Default	68	193.305	142	1.361			
OS→AI	67	193.316	143	1.352	1	0.010	0.919
CP→AI	67	200.197	143	1.400	1	6.892	0.009
RA→AI	67	197.260	143	1.379	1	3.954	0.047

Note. NPAR: number of parameters.

Table 9. Region of Regression Estimates

IV	DV	Beijing-Tianjin-HebeiRegion (87)				Yangtze River DeltaRegion (116)				Pearl River DeltaRegion (80)			
		Estimate	S.E.	z	P	Estimate	S.E.	z	P	Estimate	S.E.	z	P
OS	AI	0.000	0.007	-0.022	0.983	0.526	0.140	3.755	*	0.813	0.167	4.863	*
CP	AI	0.220	0.115	1.905	0.057	0.374	0.096	3.889	*	0.032	0.105	0.306	0.759
RA	AI	0.712	0.154	4.637	*	0.414	0.095	4.344	*	0.818	0.227	3.603	*

region. In Table 9, OS to AI between Beijing-Tianjin-Hebei region and Yangtze River Delta region shows significant differences. Consequently, the moderating effects of region on OS to AI is partially supported. Table 10 shows that regression coefficient of OS to AI in Yangtze River Delta region is significantly higher than that of Beijing-Tianjin-Hebei region.

In Table 11, CP to AI between Yangtze River Delta region and Pearl River Delta region shows significant differences. Consequently, the moderating effects of region on CP to AI is partially supported. Table 8 shows that regression coefficient of CP to AI in Yangtze River Delta region is significantly higher than that of Pearl River Delta region.

In Table 12, OS to AI between Beijing-Tianjin-Hebei region and Pearl River Delta region shows significant differences. Consequently, the moderating effects of region on OS to AI is partially supported. Table 10 shows that regression coefficient of OS to AI in Pearl River Delta region is significantly higher than that of Beijing-Tianjin-Hebei region.

DISCUSSIONS AND CONCLUSIONS

This study confirmed the significant impact of organizational support, competitive pressure, and relative advantages on the adoption of green supply chain innovations particularly within the context of China's manufacturing industry, further demonstrating that factors such as market competition

Table 10. Beijing-Tianjin-Hebei Region and Yangtze River Delta Region of Nested Model Differences, Region

Model	Model fit				Nested model differences		
	NPAR	χ^2	DF	χ^2/DF	ΔDF	$\Delta\chi^2$	*p*
Default	102	247.509	213	1.162			
OS→AI	101	254.117	214	1.187	1	6.608	0.010
CP→AI	101	248.383	214	1.161	1	0.874	0.350
RA→AI	101	250.361	214	1.170	1	2.852	0.091

Note. NPAR: number of parameters.

Table 11. Yangtze River Delta Region and Pearl River Delta Region of Nested Model Differences, Region

Model	Model fit				Nested model differences		
	NPAR	χ^2	DF	χ^2/DF	ΔDF	$\Delta\chi^2$	*p*
Default	102	247.509	213	1.162			
OS→AI	101	249.279	214	1.165	1	1.770	0.183
CP→AI	101	252.309	214	1.179	1	4.800	0.028
RA→AI	101	250.365	214	1.170	1	2.856	0.091

Note. NPAR: number of parameters.

Table 12. Beijing-Tianjin-Hebei Region and Pearl River Delta Region of Nested Model Differences, Region

Model	Model fit				Nested model differences		
	NPAR	χ^2	DF	χ^2/DF	ΔDF	$\Delta\chi^2$	*p*
Default	102	247.509	213	1.162			
OS→AI	101	256.799	214	1.200	1	9.290	0.002
CP→AI	101	248.711	214	1.162	1	1.202	0.273
RA→AI	101	247.649	214	1.157	1	0.140	0.708

Note. NPAR: number of parameters.

and changes in consumer preferences are major drivers for companies to adopt environmentally friendly practices.

Discussions

The Impact of Organizational Support on the Adoption Intention of Green Supply Chain Innovation in Manufacturing Sectors

In the context of China's manufacturing landscape, the study underlines the pivotal role of organizational support in encouraging green supply chain innovations. Financial assistance from organizations is crucial in hastening the adoption of eco-friendly advancements, allowing firms to explore sustainable technologies and practices like advanced recycling and improved logistics to reduce waste and enhance resource efficiency.

Additionally, organizational support encompasses employee training, equipping them with knowledge in green practices, as highlighted by Liu et al. (2020). This not only deepens employees' understanding of environmental innovations but also cultivates a culture that values sustainability, driving participation in green initiatives. The unique environment of China's manufacturing, influenced

by strict environmental regulations as noted by Chen et al. (2018), emphasizes the necessity of organizational backing in complying with laws and reducing ecological impacts. Companies are motivated to adopt sustainable materials and alter production processes to lower emissions, illustrating how regulatory policies and organizational support collaboratively promote green supply chain innovations, as discussed by Al-Ghazali and Afsar (2021).

The Impact of Competitive Pressure on Adoption Intention of the Green Supply Chain Innovation in Manufacturing Sectors

The research highlights how China's manufacturing realm is deeply influenced by competitive pressures to adopt green supply chain innovations, a multi-dimensional concept. In the face of intense global competition, Chinese manufacturers are increasingly turning to green supply chain practices to gain a competitive advantage, improve efficiency, reduce costs, and enhance their brand's appeal. This involves the use of energy-efficient materials and processes to lower expenses and attract eco-conscious consumers, as outlined by Tu and Wu (2021).

Market dynamics and consumer preferences for sustainable products play a crucial role, pushing firms to revamp their supply chains to lessen their environmental impact. Adopting recyclable materials, reducing waste, and cutting emissions not only appeals to a broader market but also strengthens relationships with suppliers and partners through shared green values, thereby bolstering a firm's position in the market and attracting business from those prioritizing sustainability.

Furthermore, environmental regulations by governments mandate green initiatives, compelling companies to adapt to avoid penalties and align with policies. Technological progress and the growing ease of adopting green solutions enhance their appeal, offering benefits that extend beyond compliance. This complex web of pressures and incentives highlights the profound influence of competitive forces on the embracement of green supply chain innovations within China's manufacturing sector.

The Impact of Relative Advantage on Adoption Intention of the Green Supply Chain Innovation in Manufacturing Sectors

The adoption of green supply chain innovations in China's manufacturing industry holds considerable significance due to the concept of relative advantage, which highlights the perceived superiority of these eco-friendly practices over conventional methods. This advantage is crucial in influencing the decision to adopt such green innovations, offering a range of benefits from environmental conservation to economic savings. These green practices lead to efficient resource use, resulting in cost reductions, improved product quality via sustainable materials, and an enhanced corporate image through commitment to sustainable practices.

Economically and environmentally, green supply chain innovations contribute to significant efficiencies, including minimized waste, reduced energy consumption, and a lower carbon footprint, aligning with both ecological goals and financial advantages. For example, optimizing logistics can decrease transportation costs and emissions, promoting environmental sustainability alongside economic savings (Wang et al., 2021).

Furthermore, companies incorporating green supply chain practices may achieve a competitive edge in increasingly sustainability-conscious markets. This edge is vital as consumer preferences shift toward eco-friendly products, potentially enlarging market share and enhancing customer loyalty (Barforoush et al., 2021). Green innovations also support compliance with stringent environmental regulations, thus avoiding legal penalties and aligning with governmental sustainability efforts, a critical aspect in the regulatory environment of China.

In summary, adopting green supply chain innovations is a strategic move for businesses, offering enduring advantages in sustainability and market positioning. Companies proactive in implementing these practices are poised to navigate the evolving environmental standards and market trends toward sustainability more effectively.

The Moderation Effect of Organizational Size on Competitive Advantage, Relative Advantage, and Adoption Intention

The study reveals a nuanced understanding of how organizational size influences the adoption of green supply chain innovations. Specifically, it was found that competitive pressure plays a more significant role in driving the adoption intention of green supply chain innovations among organizations with fewer than 400 employees, compared to their larger counterparts. Conversely, the relative advantage of adopting these innovations has a more pronounced impact on the adoption intention among organizations with 400 or more employees, where the slope indicating this relationship is steeper.

For smaller organizations, it is crucial to remain vigilant about market dynamics and competitive pressures. Managers should prioritize the implementation of tools and processes that allow for real-time monitoring of industry trends, competitors' sustainability efforts, and customer preferences, enabling swift adaptation of supply chain strategies. Cultivating a culture that values agility in decision-making can empower these organizations to respond quickly to changes in competitive pressure. Flexibility in supply chain operations is key to promptly meet market demands.

Smaller entities might find strategic value in targeting niche markets or specific sustainability niches. Identifying and leveraging unique selling points related to green supply chain practices can offer a competitive edge. Additionally, emphasizing the organization's commitment to sustainability through marketing and branding efforts can attract environmentally conscious consumers and enhance market perception.

In contrast, larger organizations should utilize their scale to achieve cost efficiencies in adopting green supply chain innovations. Negotiating with suppliers, making bulk purchases of sustainable technologies, and spreading implementation costs across a larger volume can be effective strategies. Forming strategic alliances to tackle industry-wide sustainability challenges can also be beneficial, allowing for the sharing of best practices and resources.

For organizations with fewer than 400 employees, the focus should be on lean management to optimize processes and reduce waste. Embracing cost-effective green innovations that offer clear benefits in terms of efficiency and cost savings is crucial. A culture that encourages experimentation and flexibility can be particularly advantageous for smaller firms, enabling them to quickly try and adopt new sustainable practices.

Larger organizations, on the other hand, should allocate resources to dedicated research and development teams to spearhead the identification and implementation of advanced green supply chain innovations. Investing in innovation hubs and collaborating with external research institutions can keep these organizations at the forefront of sustainable technology. Continuous improvement programs that regularly assess and enhance the supply chain are vital for maintaining a competitive advantage in sustainability practices.

The Moderation Effect of Organization Region on Competitive Advantage, Relative Advantage, and Adoption Intention

The influence of relative advantage on the adoption intentions toward green supply chain innovation within China's manufacturing sector, particularly when examining regional disparities such as those found in the Beijing-Tianjin-Hebei region, the Yangtze River Delta region, and the Pearl River Delta region, is multifaceted and significant. These variations stem from a plethora of factors intrinsic to each region.

The industrial composition of these areas greatly influences the perception and integration of green supply chain innovations. For example, the Beijing-Tianjin-Hebei region, with its emphasis on high-tech and service industries, may prioritize green innovations that boost efficiency and sustainability. Conversely, the Pearl River Delta, known for its heavy industries and export-driven economy, might focus on different aspects of green supply chain practices that align with its industrial objectives.

The environmental policies in place across these regions also play a crucial role. Stricter regulations in areas like the Beijing-Tianjin-Hebei region highlight the relative advantage of green supply chain practices by aligning them with regulatory compliance and environmental performance improvements. This regulatory landscape shapes the adoption of green practices differently across regions.

The demand for eco-friendly products and the preferences of consumers varies regionally. In locales with a denser population of environmentally aware consumers, businesses might view the adoption of green supply chain practices as more beneficial due to the potential for attracting customers and gaining market share.

Economic priorities and regional initiatives further influence this adoption. Regions that earmark sustainable development and green technology as key to their economic strategy are more likely to perceive a higher relative advantage in embracing green supply chain innovations.

The disparity in infrastructure and technological capabilities across regions affects the feasibility and perceived benefits of adopting these innovations. Areas with advanced infrastructure and technology are better positioned to implement green supply chain practices effectively.

This regional differentiation highlights the need for a localized approach in understanding the adoption of green supply chain innovations within China's complex manufacturing sector. It underscores how a combination of industrial focus, regulatory environments, consumer demands, economic strategies, and technological infrastructure shapes the perceived advantages of green supply chain practices across different regions. This nuanced perspective is essential for comprehensively grasping how regional characteristics influence the move toward sustainable supply chain management in China's diverse manufacturing landscape.

CONCLUSIONS

Through empirical investigation, this study unveils the influence of various factors on the adoption of green supply chain innovations within China's manufacturing sector. It elucidates that this adoption is intricately shaped by the interplay of organizational support, competitive pressures, perceived advantages, and is further nuanced by moderators such as organizational size and regional dynamics.

An emphasis on organizational support within the realm of green development, encompassing financial backing and personnel training, emerges as a pivotal catalyst for fostering the integration of environmentally sustainable advancements. Such support not only facilitates adherence to stringent environmental regulations but also cultivates a corporate ethos inclined toward sustainability.

Competitive pressures stemming from environmental regulations play a significant role in propelling manufacturers toward embracing green supply chain practices, driven by the pursuit of sustainable competitive advantages, cost reduction, and alignment with consumer preferences for eco-friendly products. Market dynamics, consumer behavior, and regulatory frameworks further amplify these pressures.

Similarly, the perceived superiority of green supply chain practices vis-à-vis traditional methodologies profoundly influences adoption intentions. These practices offer multifaceted benefits, including cost reduction, enhanced product quality, and regulatory compliance, thus bolstering competitiveness and market positioning.

Furthermore, the moderating influences of organizational size and regional disparities significantly shape adoption decisions. Smaller entities tend to be more susceptible to competitive pressures, whereas larger organizations capitalize on the comparative advantages afforded by green innovations. Regional nuances, encompassing industry composition, regulatory landscapes, consumer preferences, economic strategies, and technological capabilities, also exert considerable influence on adoption dynamics.

In essence, nurturing organizational support, responding adeptly to competitive exigencies, and elucidating the advantages inherent in green supply chain practices are imperative for fostering sustainable innovation within China's diverse manufacturing landscape. A nuanced comprehension of these factors, coupled with tailored strategies that accommodate organizational dimensions and regional peculiarities, is essential for effectively steering the transition toward environmentally responsible and competitive supply chain practices.

RESEARCH LIMITATIONS AND PROSPECTS

Research Limitations

While this study offers valuable insights into the sustainable development landscape within China's manufacturing industry, it is not without limitations. Its narrow focus on specific manufacturing sectors and green supply chain innovation pilot regions may constrain its generalizability and overlook variations in green supply chain adoption across different industries and regions within China. Relying solely on data from one industry may introduce biases that could compromise the validity of the study's conclusions. Additionally, the absence of comparative analysis using longitudinal data restricts the elucidation of the dynamics underlying green supply chain adoption.

Prospects for Future Research

Despite these limitations, there are promising avenues for future research. Broadening the study's scope to encompass comparative analysis across diverse industries or regions would enhance comprehension of the subject matter. Diversifying data sources to encompass a wider array of sectors within China's manufacturing industry can provide a more comprehensive perspective. Mitigating biases in data collection and analysis, monitoring trends in green supply chain adoption over time, and involving stakeholders from varied organizational echelons and geographical locations would enrich the analytical framework. By exploring these opportunities, future research endeavors can contribute to a deeper understanding of how organizational attributes and regional disparities influence the sustainability of manufacturing practices in China.

DATA AVAILABILITY

The figures and tables used to support the findings of this study are included in the article. The data analyzed during the current research period can be obtained from the communication author according to reasonable requirements.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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