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Greening the Supply Chain: Drivers and Outcomes in the Korean Manufacturing Industry

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ABSTRACT

This research investigates the determinants of green supply chain management (GSCM) adoption and its impact on organizational performance, while considering the potential moderating factors influencing GSCM adoption. Despite the growing prevalence of GSCM practices among Korean firms, the factors driving their adoption have not received sufficient attention. To bridge this gap, the study uses structural equation modeling, integrating stakeholder theory and resource-based theory to explore how green entrepreneurial orientation (GEO), institutional pressure, and relational capital affect GSCM adoption. Additionally, the study explores the effects of GSCM implementation on competitiveness and economic performance. Drawing data from a sample of 213 Korean manufacturing firms, the PLS-SEM analysis highlights the significant influence of GEO, institutional pressure, and relational capital on GSCM adoption. Additionally, the study emphasizes the positive impact of GSCM implementation on firm competitiveness. These findings provide valuable insights for enhancing sustainability in supply chain management and are applicable to similar context countries such as Taiwan, China, Japan, and the Netherlands.

Keywords: Green supply chain management; Green entrepreneurial orientation; Institutional pressure; Relational capital; Competitiveness; Economic perform

1. Introduction

The 2015 Paris Agreement and the 2021 sixth special report by the Intergovernmental Panel on Climate Change (IPCC) have created increased pressure

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on firms worldwide to adopt strategies that reduce the negative impact of their products and services on the environment. With customers and regulatory authorities overwhelmingly supporting environmental protection, conservation is a top priority for firms worldwide [1,2]. In response, Korean firms are complying with strict operational standards to mitigate climate change and environmental damage. Accordingly, efforts are underway to strengthen organizational processes and behaviors to pursue green business strategies and practices [3,4]. These practices can help firms address key regulatory issues, such as competitive pressure, business performance, environmental protection, and operational excellence. Despite the growing interest of many Korean companies in environmentally friendly practices such as green supply chain management (GSCM), there is a lack of research on who actually adopts this approach and what its effects are. This study was conducted to address this curiosity and fill the research gap.

Primarily, the concept of GSCM integrates sustainable environmental practices into the traditional supply chain processes. This comprehensive business approach is designed to mitigate environmental degradation, focusing on green purchasing, manufacturing, logistics, and investment recovery [5]. Implementing GSCM practices helps firms improve their environmental, social, and operational performance, leading to a competitive advantage [6,7]. Waste reduction has emerged as a viable solution for reducing manufacturing costs, and GSCM is recognized as a key tool for achieving this goal [8,9]. Thus, firms must adopt innovative GSCM practices to enhance their operational efficiency, reduce costs, and improve existing value chains.

Several dimensions of GSCM have been examined in previous studies, including definition and scope, and the concept has been identified as the summation of green purchasing, integrated supply chains, and reverse logistics [10,11]. Researchers have also examined ecological supply chain management and its determinants and impact on various aspects of organizational performance (e.g., [11]). Firms are improving their supply chain management to maintain ecological standards through inter-organizational relationships, particularly with customers and suppliers [12]. For example, SONY has implemented a "green partner quality certification system", and encouraged its suppliers to follow environmental standards. Other global firms such as NIKE, IKEA, BOEING, and Ford are participating in sustainability projects with their customers and suppliers to restrict the use of chemicals and waste materials that endanger human and environmental health [13]. An increasing number of companies are incorporating sustainable practices in their supply chain management strategies to reduce their environmental impact and contribute to global efforts to save the planet.

Nevertheless, the existing literature lacks a comprehensive framework to explain the relationship between GSCM and operational performance. While some studies explore GSCM's antecedents, they often overlook the internal and external factors influencing this relationship [8]. Focusing on these factors is crucial as it provides a deeper understanding of how organizations can effectively implement GSCM practices and improve their operational performance [8,14,15]. To bridge this gap, our study analyzes real-world scenarios in the context of GSCM practices in South Korea, aiming to identify the antecedents, conduct, and performance while considering both internal and external influences. By unraveling these complexities, our research aims to provide valuable insights for researchers and practitioners and contribute to the advancement of sustainable supply chain management practices in the Korean industry.

This study explores various issues related to GSCM, leading to the following research questions:

Q1: To what extent do a firm's internal conditions impact GSCM adoption? Do a firm's green entrepreneurial orientation (GEO) and relational capital influence its GSCM adoption?

Q2: How do external conditions affect GSCM adoption? Specifically, to what degree do government institutional efforts influence firms' effective adoption of GSCM?

Q3: What is the impact of implementing GSCM practices on firm performance? This question is important, as it seeks to understand the extent to which the adoption of GSCM practices improves performance outcomes for firms.

This study addresses vital questions relevant to any firm considering or implementing GSCM. Drawing on stakeholder theory and resource-based theory, the research emphasizes the crucial role of GEO, relational capital, and institutional efforts in GSCM adoption within the Korean context. Investigating their interplay advances the understanding of their collective influence, offering valuable insights for academia and industry. Synthesizing relevant literature, the research constructs a comprehensive model based on key findings. Using 213 valid surveys from Korean manufacturing firms, the study examines how internal and external factors influence GSCM adoption. Despite the growing importance of GSCM, the existing literature lacks a comprehensive framework to elucidate its relationship with operational performance, especially regarding internal and external factors. This research fills the crucial gap in GSCM practices by examining antecedents, conduct, and performance in the Korean context, considering internal and external influences. The study's results provide valuable insights into academic literature and practical GSCM applications.

2. Literature review

2.1 Green supply chain management (GSCM)

A supply chain involves moving goods or services from their origin to end users, both internally and externally, within a firm [12]. However, traditional supply chain management results in energy wastage and environmental damage, leading to the emergence of GSCM as a solution [16]. In response to increasing societal and governmental pressure, GSCM has been implemented to reduce resource usage and pollution. As a result, academic research and literature have focused on areas such as institutional pressure, implementation, and evaluation of GSCM. Insights into these areas are essential for justifying the adoption of GSCM practices [8,17].

Described as a set of supply chain management (SCM) strategies, initiatives, and partnerships developed in response to environmental concerns, GSCM encompasses all stages of a product or service life cycle from design and procurement to production, distribution, utilization, reuse, and disposal [18,19]. Srivastava (2007) defined GSCM as "the integration of environmental considerations into SCM, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to customers, and end-of-life management of the product after its useful life." [20]. Similarly, some scholars define GSCM as an environmentally friendly practice or eco-initiative that encompasses all stages of a product's lifecycle, including the design, production, and distribution phases [21,22].

2.2 Organizational performance

This study investigates the influence of GSCM techniques on organizational performance, encompassing both environmental and economic aspects. Existing research indicates that GSCM implementation positively impacts environmental performance but yields varying results for economic performance [23-25]. The heterogeneity of findings may stem from limited studies and the influence of internal and external factors on the GSCM-organizational performance link. This ambiguity poses a challenge for companies attempting to justify GSCM adoption, irrespective of their motives [26,27]. To accurately assess GSCM's impact, a comprehensive approach is essential [28]. Studies propose a multidimensional framework, combining financial and non-financial metrics, to gain a holistic understanding of GSCM's effects. By incorporating financial, environmental, and social dimensions, organizations can make informed decisions and align their strategies with sustainability goals, ultimately bolstering performance evaluations. This multidimensional perspective facilitates a more robust evaluation, leading to a deeper comprehension of GSCM's influence on organizational outcomes [29,30].

2.3 Theoretical background

This study is conducted in the context of two major theories. First, the stakeholder theory proposed by Freeman (1984) posits that organizations must maximize stakeholder value. These stakeholders comprise the organization, and the management must strive to fulfil their needs and interests while ensuring their rights and participation in the decision-making process [31]. The fundamental premise of stakeholder theory is the shift in accountability from beneficiaries to those affected or impacted by the firm's activities [32]. The normative, imperative, and strategic nature of the theory implies that stakeholders are intrinsically valuable and have a discernible effect on the organization's business performance [33]. Additionally, the theory contends that stakeholder pressure compels organizations to adopt strategies that promote environmental protection [34].

Freeman's (1984) seminal definition of stakeholders as "any group or individual who can affect or is affected by the achievement of the organization's objectives" encompasses shareholders, investors, employees, customers, suppliers, and public stakeholder groups, such as legislative governments and regulatory authorities that build infrastructure and markets, whose laws and regulations must be observed, and to whom taxes and other obligations are payable [35,36]. This definition establishes a connection between stakeholders and firm activities [37]. Regulatory stakeholders, such as the government and legislators, formulate and enforce environmental protection laws, whereas internal stakeholders wield relative power within the organization and influence firm performance. In contrast, market-oriented stakeholders affect firm performance through market relationships or trade [38]. As organizations generate externalities that cause negative and positive environmental outcomes, organizational and regulatory stakeholders exert increasing pressure on firms to mitigate the negative impact and promote positive environmental outcomes [39].

The resource-based theory contends that an organization's sustained competitive advantage is influenced by its heterogeneous resources that are valuable, rare, inimitable, and non-substitutable [40,41]. Resources refer to "stocks of available factors that are owned or controlled by the firm" [42]. The theory assumes that firms differ due to their unique resources, thereby establishing a connection between internal characteristics and competitive advantage [43]. Additionally, sustainable competitive advantage depends on the firm's ability to reintegrate its asset stocks and use them for new market opportunities, and to synchronize all resource management processes, including bundling and structuring the portfolio resources, while receiving feedback from the external environment, such as market forces [44]. According to Hitt et al. (2016), managers are responsible for selecting, developing and bundling resources to create, design and implement strategies [43]. These internal processes should also be linked to external suppliers in the supply chain because each activity along the chain requires resources and capabilities [43]. Thus, adopting GSCM enables firms to create valuable resources and capabilities, which are critical for competitiveness in the current eco-friendly business environment.

Informed by stakeholder and resource-based theories, this study proposes that green entrepreneurial orientation, institutional pressure, and relational capital, which are critical organizational resources and stakeholder pressures, influence a firm's decision-making concerning GSCM, and, subsequently, its outcomes. This approach is consistent with previous studies that accentuate the impact of internal and external stakeholder groups on a firm's adoption of GSCM practices [45]. **Figure 1** illustrates the study's conceptual model, and using this framework, hypotheses are developed to capture the relationships between the different constructs in the subsequent section.

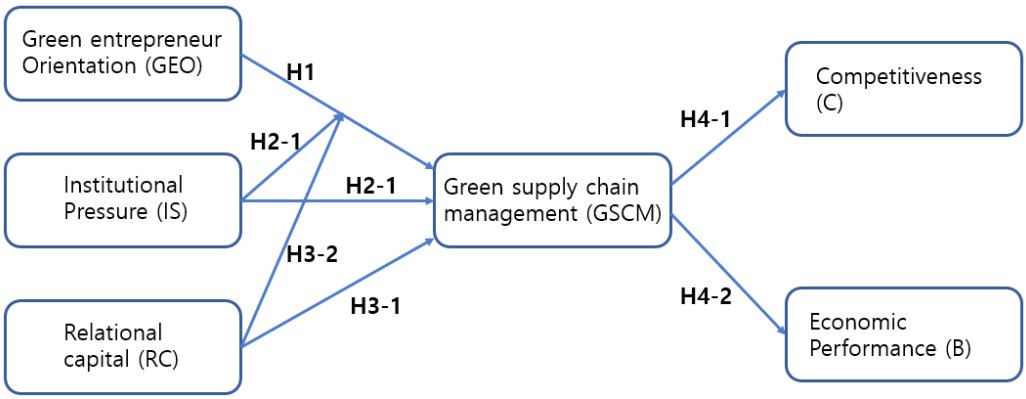

Figure 1. Conceptual model.

3. Model development and hypotheses

3.1 Green entrepreneurial orientation (GEO) and GSCM

A firm's GEO influences the adoption of GSCM practices significantly. Even though previous studies demonstrate a positive association between GEO and firm performance [46,14], the underlying mechanism remains largely unknown. Hughes et al. (2017) contend that the precise pathways through which GEO enhances organizational performance are not well understood beyond the direct effect [47]. To enhance comprehension, it is essential to employ a comprehensive measurement method to investigate how a firm's GEO serves as a critical antecedent to GSCM adoption [14].

The concept of GEO is defined as "the inclination of an entrepreneur to explore potential opportunities that reduce both economic and environmental costs by initiating green activities" [14]. The concept of GEO differs from environmental entrepreneurship and eco-entrepreneurship as it focuses on innovative behavior, proactive market participation, and commitment to take risks to promote green practices [14,48]. Three key factors explain the emergence of GEO: entrepreneurs' emotional attachment to green issues, regulatory and social pressure, and the desire to improve environmental and economic performance [49,50]. Entrepreneurs create value and drive business growth through their innovation, proactive behaviors, and risk-taking strategies. Similarly, green entrepreneurs create value beyond profit maximization by adopting green and sustainable business practices.

Entrepreneurial orientation (EO) encompasses a firm-level decision-making attitude that drives strategic processes and generates innovative ideas for organizational growth and rejuvenation [47]. In a similar vein, GEO seizes potential business opportunities through green activities, leading to both economic and ecological benefits [51]. This study firmly posits that GEO plays a pivotal role in motivating firms to adopt GSCM practices. The adoption and implementation of GSCM practices are recognized as inherently risky endeavors, primarily due to the increasing information asymmetry between firms and their suppliers [46,52]. Without a resolute commitment to green and sustainable growth, as well as a willingness to integrate GSCM principles into supplier relationships, firms may encounter considerable challenges in implementing these practices. However, when firm leadership demonstrates conscious engagement and a steadfast dedication to managing the supply chain, it can greatly facilitate the adoption of GSCM practices [53,54]. Consequently, this study hypothesizes that GEO exerts a positive influence on the adoption of GSCM practices.

H 1: GEO robustly and positively influences the adoption of GSCM practices.

3.2 Institutional pressure and GSCM

This study argues that while a strong leader's inclination towards GSCM is important, external factors contribute to the adoption of GSCM practices. Previous research has identified institutional pressure

as a key facilitator in adopting GSCM [55,38,15,53,56]. This study proposes that institutional pressure, as an external factor, is a crucial determinant of GSCM adoption. Governments are increasingly demanding corporate action toward environmental sustainability by enforcing regulations, resulting in many firms developing green strategies to meet customer requirements and gain competitive advantage, such as obtaining ISO 14001 certification for environmental management [57].

Institutional pressure is a key area in sustainability research, and this study examines the mechanisms through which it affects the adoption of GSCM practices. Institutional pressure creates a sense of urgency to comply with regulations and societal expectations. For example, governments may penalize firms that do not adhere to environmental standards, urging them to adopt GSCM practices. Customers, investors, and other stakeholders can exert institutional pressure to demand sustainable products and services, forcing firms to meet these expectations and remain competitive. Moreover, institutional pressure legitimizes GSCM practices and can help firms overcome their internal resistance to change. Conforming to societal norms and expectations, firms are likely to gain support from employees and other internal stakeholders for implementing GSCM initiatives. Thus, institutional pressure plays a critical role in GSCM adoption by incentivizing and legitimizing sustainable business practices.

This study highlights the increasing demand for environmentally sustainable strategies from stakeholders and interest groups, such as customers, political and social entities, religious groups, local communities, and regulatory bodies [58,59]. Specifically, this study argues that green entrepreneurs who perceive the importance of legitimizing their operations in a sustainability-oriented environment are more responsive to institutional pressure and adopt green business approaches, such as GSCM, to survive [60,12].

The study suggests that green entrepreneurs, who view "green" as a new paradigm and "greening" as a sustainability-oriented business management approach, recognize the significance of legitimizing their operations within a sustainability-focused business environment [52].

Thus, this study hypothesizes that:

H 2: Institutional pressure affects GSCM adoption.

H 2-1: Institutional pressure positively influences the adoption of GSCM practices.

H 2-2: The outcome of GEO on GSCM practices is more substantial when institutional pressure increases.

3.3 Relational capital and GSCM

A firm's internal conditions play a critical role in the adoption of GSCM practices. Relational capital is an essential aspect of green practices as it captures the value inherent in collaborative buyer-supplier relationships and the knowledge derived from such relationships [61]. Trust, obligation, respect, and friendship are integral components of relational capital that actors have formed with each other through a history of interactions [62]. Research shows that relational capital is the lubricant that stimulates environmental responsibility and the adoption of GSCM practices, including a wide range of inter-firm activities such as green innovation in co-procurement, co-production, reverse logistics, and distribution [52,63,64]. Relational capital supports green innovation activities in GSCM by engaging valuable members in the supply chain network [65].

Social network theory contends that promoting cooperation among supply chain members is a significant challenge in implementing GSCM [66]. Effective communication, reduced opportunism, cooperative response to unforeseen issues, and the ability to adapt are critical to GSCM practices [67,68]. Strong social capital improves GSCM engagement by building and maintaining relationships based on trust and loyalty and indicates a greater capacity for green innovation and better deployment of GSCM practices [69,61]. Thus, leaders with strong GEO are more likely to adopt GSCM practices when their firms possess strong social capital.

Thus, this study hypothesizes that:

H 3: Relational capital impacts the adoption of

GSCM practices.

H 3-1: Relational capital directly influences the adoption of GSCM initiatives.

H 3-2: The effect of GEO on GSCM practices is stronger when a firm possesses sufficient relational capital.

3.4 Impact of adopting GSCM practices on firm performance

Adopting GSCM practices can enhance a firm's performance across multiple dimensions, including environmental, economic, and social [67,56]. Environmental performance, the first dimension, involves reducing air and water pollution, solid waste, and hazardous materials, and minimizing environmental accidents during economic activities. The second dimension, economic performance, focuses on enhancing efficiency and cost savings through the adoption of GSCM practices such as waste reduction, improving resource productivity, and enhancing energy efficiency. Social performance measures the impact of GSCM practices on the well-being and satisfaction of employees, customers, suppliers, and other stakeholders in the community [30,67]. These multiple dimensions of organizational performance must be considered when implementing GSCM practices to realize optimal benefits.

Implementation of GSCM is expected to improve firm performance; however, empirical evidence shows mixed results. Specifically, in the context of the Chinese market, some studies have found that GSCM has a positive influence on economic performance by improving environmental and operational performance [70]. Additional research by Yu et al. (2017) demonstrated that collaboration with green initiative suppliers affects environmental and operational performance positively [71]. Feng and Choi (2017) reported that GSCM practices such as green purchasing and innovation can enhance environmental and economic performance [72]. Feng et al. (2018) also suggested that improved environmental and operational performance through GSCM adoption can enhance financial performance [73]. However, some studies have reported adverse performance outcomes with GSCM. For example, eco-design, reverse logistics, green purchasing, and customer cooperation have not significantly improved performance [74,67].

The impact of GSCM practices on firm performance is mixed, stemming from a multitude of factors such as varying industry contexts, complexity and variability of GSCM practices due to different approaches and implementation levels, and the lack of standardized performance measurement methods [75]. Previous research showed that using a combination of economic performance and competitiveness may yield a more comprehensive evaluation of the impact of GSCM practices on firm performance [76,54]. Economic performance and competitiveness are widely accepted as measures of business performance. They are easily quantifiable and comparable across firms, enabling a direct assessment of the impact of GSCM practices on performance [76]. Additionally, examining financial and non-financial factors by focusing on economic performance and competitiveness facilitates a more holistic evaluation of firm performance, eventually providing a more comprehensive understanding of the impact of GSCM practices on a firm's overall performance.

This study defines economic performance as financial performance, encompassing metrics such as revenue, profit, return on investment, and market share [76]. In contrast, competitiveness pertains to a firm's ability to compete effectively in the marketplace, considering factors such as cost efficiency, product quality, and innovation [54,28]. These measures offer a concrete and tangible means to evaluate the financial and operational advantages of GSCM practices, namely cost savings achieved through waste reduction and increased supply chain efficiency [18,76]. Economic performance and competitiveness are crucial for a company's long-term success, as they are interdependent. However, economic performance is a relevant short-term performance measure, given that financial metrics such as revenue and profit clearly indicate a firm's financial health in the short term [76]. In contrast, competitiveness measures may require more time to reflect a firm's performance changes.

This study posits that the adoption of GSCM

practices yields positive outcomes on economic performance and competitiveness. First, such practices can help firms reduce their environmental impact by reducing waste, conserving resources, and mitigating negative environmental effects. These practices can have positive long-term implications for operational efficiency as they can lead to cost savings owing to improved energy efficiency, increased recycling, and reduced waste, ultimately resulting in lower operating costs. Additionally, firms can manage their supply chain risks better, improve product quality, and enhance customer satisfaction, leading to increased competitive advantage and customer loyalty. In fact, GSCM practices improve firms' financial performance by increasing their revenue and profits. For instance, by enhancing the sustainability and efficiency of their supply chain operations, firms can reduce costs, improve productivity and innovation, and respond better to market demand, thereby improving their overall competitiveness.

Thus, this study hypothesizes that:

H 4: Adopting GSCM practices impacts firm performance positively.

H 4-1: Adopting GSCM practices has a positive influence on firm competitiveness.

H 4-2: Adopting GSCM practices positively affects a firm's economic performance.

4. Research methods

4.1 Sampling and data collection

Drawing on prior research [9,77], firms that hold ISO 14000 series certification are defined as entities that implement GSCM practices. A sample of 926 manufacturers was selected from the Corporate Information Database (TS2000) using predetermined selection criteria, and e-mail surveys were conducted to collect the data. The Korea Chamber of Commerce and Industry provides information on companies through the TS2000. It includes databases of business and audit reports submitted to the Financial Supervisory Service by various corporations, such as technology-intensive small and medium enterprises (SMEs), young entrepreneurial firms, well-established firms, and strongly internationalized firms. The diverse backgrounds of target firms were relevant to this study.

The online survey collected a demographic profile and measurement items related to GEO, GSCM, competitiveness, economic performance, and internal/external conditions. To ensure the choice of suitable respondents, this study targeted founders and senior and mid-level managers of listed firms. Recruitment was conducted via email, social networking sites, and telephone. Of the 926 survey questionnaires, 213 effective responses were obtained between June 2022 and September 2022. The minimum sample size for reliable PLS-SEM analysis depends on model complexity, effect sizes, and desired power. Some recommend a minimum of 100 samples [78], but no fixed rule exists. The response rate exceeded the minimum standard of 20% [79], reaching 23%. **Table 1** provides an overview of the participating firms' characteristics.

4.2 Measurements

The items were assessed on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). Drawing on Li et al. [80] and Jian et al. [14], four items were employed to measure the GEO. GSCM practices were evaluated using five items based on the work of Zhu et al. [67], focusing on the green supplier and customer management practices of the value chain's upstream, internal, and downstream components. Drawing on prior research, two items were used to assess the extent of institutional pressure as an external condition. Relational capital was measured using three items as suggested in the literature [45,61]. Finally, four items were used to measure a firm's competitiveness and assess improvements in quality, efficiency, design, and patenting. Economic performance was evaluated based on respondents' views of their respective firm's performance over the past three years in terms of market share, customer satisfaction, and profitability using three items, as outlined in the previous literature [18,76]. **Table 2** summarizes all the constructs, measurement items, and their respective sources.

Table 1. Sample profile (n = 213).

Respondent composition		**Firm composition**	
Gender		Type of manufacturing	
Male	194	Information Technology	49
Female	19	Automobile	42
		Machine & equipment	41
Age		Transportation & logistics	35
31-40	53	Chemical	32
41-50	83	Others	14
51-60	77	No. of employees	
		< 50	17
Education		51-300	108
Post-graduate (Master, Ph.D.)	55	301-500	34
Graduate	153	501-1,000	32
High school	5	1,000 <	22
		Revenue ($1 = 1,240 won)	
		< $8mil	41
		$8mil-$40mil	53
		$40mil-$80mil	66
		$80mil-$400mil	28
		$400mil <	25

Table 2. Measurement of construct items.

Construct	**No.**	**Item**	**Sources**
Green entrepreneurial orientation (GEO)	GEO1	Our firm favors a strong emphasis on green practices, such as R & D, technological leadership, and innovation	[14]
	GEO2	When facing uncertainty, we adopt a proactive position to seize potential green opportunities	
	GEO3	In dealing with competitors, we initiate green actions that competitors respond to	
	GEO4	In dealing with competitors, we adopt a competitive “undo- the competitors” position	
Green supply chain management practices (GSCM)	GSM1	Providing design specifications to suppliers that include environmental requirements for purchased items	[67, 12]
	GSM2	Cooperation with suppliers for environmental objectives	
	GSM3	Suppliers’ ISO14001 certification	
	GSM4	Second-tier supplier environmentally friendly practice evaluation	
	GSM5	Cooperation with customers for cleaner production	
Competitiveness (C)	C1	Improvement in product and process quality	[76]
	C2	Improvement in efficiency and productivity	
	C3	Innovation in product and process design	
	C4	Patenting of products and processes	
Economic performance (B)	B1	Our market share and sales has increased during the last three years compared to competitors	[18]
	B2	Our customer satisfaction level has increased during the last three years compared to competitors	
	B3	Our profitability has increased during the last three years compared to competitors	
Institutional pressure (IP)	IST1	There are frequent government inspections or audits on my firm to ensure that the firm complies with environmental laws and regulations	[45]
	IST2	Increased awareness of environmental issues among our customers and stakeholders	
Relational capital (RC)	RC1	Relationship with key suppliers is characterized by close, personal interactions at multiple levels	[61]
	RC2	Relationship with key suppliers is characterized by mutual respect at multiple levels	
	RC3	Relationship with key suppliers is characterized by mutual trust at multiple levels	

4.3 Method of analysis

This study uses the structural model to examine the path relationships among the various constructs in the proposed model (see **Figure 2**). The PLS-SEM (4.0) technique was employed to test the proposed hypotheses, as it is capable of assessing the measurement of latent variables, while also testing the relationship between latent variables with a relatively small sample size [78]. A T-test was conducted to evaluate non-response bias, and the results showed no significant differences in basic attributes, such as size, industry, sales, etc., between early and late responses. Therefore, non-response bias is not expected to impact the subsequent analysis.

5. Results and discussion

5.1 Measurement model

Confirmatory factor analysis (CFA) was used to assess the reliability and validity of the measured constructs [81]. Composite reliability and Cronbach's alpha were used to determine the reliability. **Table 3** shows that all composite reliability values for the first-order constructs exceeded the 0.6-0.7 threshold value, and Cronbach's alpha values also matched or exceeded this threshold. These findings support the model's reliability [78]. This study employed the average variance extracted (AVE) approach to assess convergent validity. The AVE values for all constructs exceed the acceptable threshold value of 0.5, indicating good convergent validity. Discriminant validity was evaluated using the Fornell-Larcker criterion, which requires that the square root of each construct's AVE exceed its correlations with other constructs. **Table 4** presents the results of the Fornell-Larcker criterion, demonstrating that the square roots of the diagonal elements (representing the construct's AVE) were greater than those of the off-diagonal correlations, providing evidence of discriminant validity.

Table 3. CFA results.

Construct and items	Loading	Cronbach's α	CR	AVE
Green entrepreneurship orientation				
GEO 1	0.847	0.806	0.831	0.630
GEO 2	0.827			
GEO 3	0.781			
GEO 4	0.714			
Green Management Practice				
GSM 1	0.765	0.853	0.854	0.630
GSM 2	0.812			
GSM 3	0.817			
GSM 4	0.833			
GSM 5	0.737			
Economic performance				
B1	0.779	0.664	0.678	0.580
B2	0.684			
B3	0.816			
Competitiveness				
C1	0.735	0.743	0.746	0.563
C2	0.754			
C3	0.782			
C4	0.729			
Institutional pressure				
INST1	0.932	0.852	0.852	0.871
INST2	0.934			
Relational Capability				
RC1	0.835	0.780	0.818	0.695
RC2	0.915			
RC3	0.741			

Table 4. Discriminant validity (Fornell-Larcker criterion).

	B	C	G	GEO	IST	RC
B	**0.762**					
C	0.064	**0.750**				
G	0.139	0.676	**0.794**			
GEO	0.086	0.527	0.543	**0.794**		
IST	0.103	0.422	0.525	0.322	**0.933**	
RC	0.134	0.405	0.528	0.678	0.346	0.833

5.2 Structural model

Based on the analysis using the PLS-SEM technique, the result of hypotheses testing is presented in **Figure 1** and **Table 5**. This study followed two steps to test the proposed study hypotheses. First, a direct path analysis of latent variables was tested for significance through bootstrapping of 5000 subsamples. Second, we analyzed the moderating effects of institutional pressure and relational capital on GSCM. The explanatory power of the structural model was examined using the R-square value of the dependent variable. The results of the structural model, as presented in **Figure 1**, demonstrate that GEO, institutional pressure, and relational capability explain 45.8% of the variance in green management practices, which in turn explains 45.6% of competitiveness, thereby providing a good explanation for the variance in each latent variable [78,81].

The association between independent and dependent variables was tested using the path coefficient β and t-statistics. According to the PLS-SEM results in **Figure 2**, GEO (H 1: β = 0.276, t-statistics = 3.019), institutional pressure (H 2-1: β = 0.348, t-statistics = 4.030), and relational capital (H 3-1: β = 0.187, t-statistics = 2.011) significantly influence the adoption of GSCM, in turn, this enhances the competitiveness of the responding firms (H 4-1: β = 0.676, t-statistics = 13.705). However, institutional pressure and relational capital do not moderate the relationship between GEO and the adoption of GSCM (H 2-2: β = 0.017, t-statistic = 0.169, and H 3-3: β = 0.053, t-statistic = 0.696, respectively). Furthermore, adopting GSCM did not improve economic performance (H 4-2: β = 0.139, t-statistics = 1.723). The findings of the hypotheses tests are summarized in **Table 5**.

5.3 Discussion

This study investigated the relationship between green-oriented leadership and the adoption of GSCM practices in the Korean manufacturing sector. The results support the first hypothesis, that green-oriented leaders are more likely to adopt GSCM practices than their non-green counterparts [54,28]. To effectively

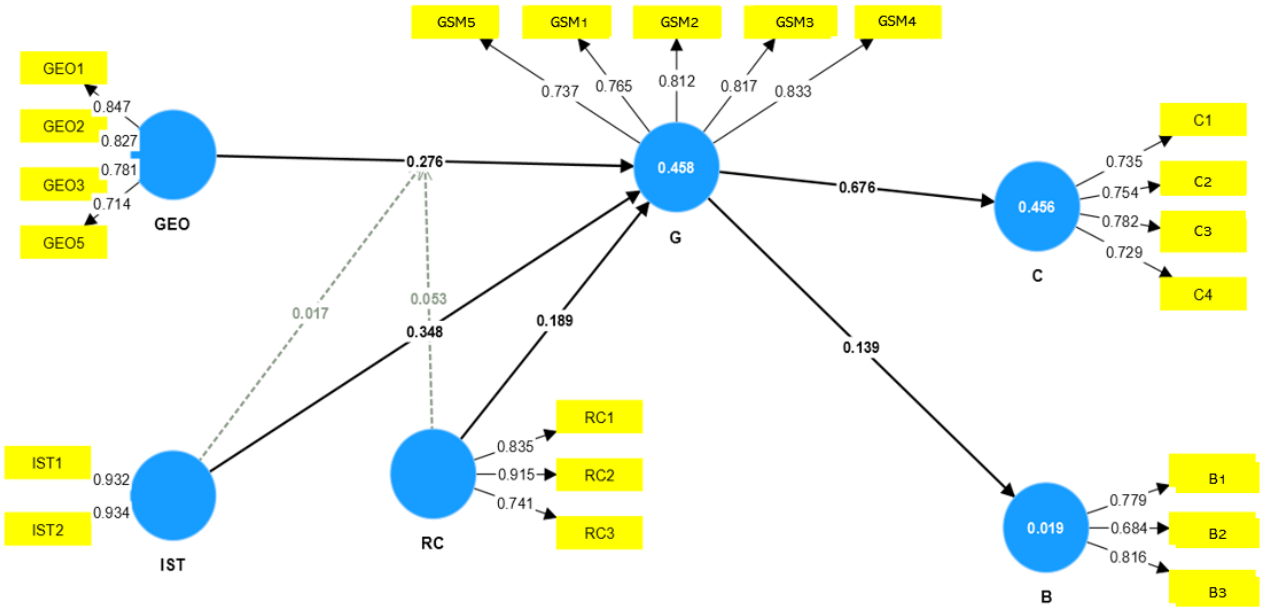

Figure 2. PLS-SEM results.

Table 5. Summary of hypotheses results.

Hypotheses	Result
H 1: Green entrepreneurial orientation (GEO) influences the adoption of GSCM practices positively.	Supported
H 2-1: Institutional pressure influences direct adoption of GSCM practices. H 2-2: The effect of GEO on GSCM practices will be stronger when institutional pressure increases.	Supported Not supported
H 3-1: Relational capital influences the adoption of GSCM practices directly. H 3-2: The effect of GEO on GSCM practices is stronger and more pronounced when a firm possesses sufficient relational capital.	Supported Not supported
H 4-1: Adopting GSCM practices has a positive impact on firm competitiveness. H 4-2: Adopting GSCM practices will positively impact a firm's economic performance.	Supported Not supported

implement GSCM, proactive efforts are required to transform traditional supply chain management practices and identify new opportunities for environmental change. Compliance with environmental regulations and the need to address public concerns in the South Korean context requires efficient use of energy and natural resources. Achieving an integrated ecological and sustainable economy through GSCM demands close collaboration with suppliers and customers, departing from decentralized management and transforming operating systems into a social-ecological economy. However, the successful implementation of GSCM practices relies on proactive and risk-taking green leaders in the Korean manufacturing sector. Their commitment and visionary attitudes drive adoption and implementation, overcoming barriers and fostering a culture of sustainability throughout the supply chain. Green leadership is vital for achieving environmental protection, social responsibility, and long-term business success.

Institutional pressures, including government regulations and incentives, have positively influenced the adoption of GSCM practices in Korean firms, as supported by this study's second hypothesis. The Korean government is committed to achieving carbon neutrality and reducing greenhouse gas emissions by 2050, leading to the implementation of ESG (environmental, social, and governance) supply chain management practices for Korean companies. The government requires ESG due diligence in the supply chain, with penalties imposed on non-compliant companies, and support for GSCM practices through various partnership programs and funding loan-use products. This study provides empirical evidence affirming the efficacy of government initiatives in promoting GSCM practices [45]. It emphasizes the significance of institutional pressure as a driving force for fostering environmentally responsible practices within the manufacturing sector. The study underscores that the successful implementation of GSCM practices hinges upon firms' willingness to undergo transformative changes in traditional supply chain management approaches. Additionally, collaboration with suppliers and customers is vital in collectively working towards the establishment of a sustainable social-ecological economy. These findings highlight the crucial role of both governmental and organizational efforts in advancing sustainable practices and fostering a more environmentally conscious and socially responsible manufacturing sector.

Previous research suggests that embracing green policies enhances institutional legitimacy and moral support for green entrepreneurs [38,15,53]. However, this study does not find evidence to support the notion that institutional pressure, as an external moderating condition, enhances or moderates Korean green entrepreneurs' propensity to adopt GSCM practices. It is commonly believed that a social policy, such as GSCM, can promote social consensus. Contrary to expectations, the findings of this study do not provide evidence to support the notion that institutional pressure, as an external moderating condition, enhances or moderates the propensity of Korean green entrepreneurs to adopt GSCM practices. While it is commonly believed that social policies, such as GSCM, can promote social consensus, the study reveals that institutional pressure for GSCM does not primarily act as a coercive force compelling Korean

green entrepreneurs to conform to green government policies. Instead, the adoption of GSCM practices is driven by the entrepreneurs' personal vision and does not necessarily align with the pursuit of institutional legitimacy or social consensus. Consequently, the findings of this study do not support hypothesis 2-2, indicating a deviation from the anticipated relationship between institutional pressure and the adoption of GSCM practices among Korean green entrepreneurs.

Effective coordination between suppliers and customers forms a unique aspect of GSCM practices, distinguishing them from other practices, according to previous studies. Such close coordination facilitates knowledge sharing and collaboration and green environmental collaboration in GSCM. However, not all firms can fully realize the benefits of GSCM through close coordination and cooperation. Firms with strong relational capital, including comprehensive partner and supplier networks that provide valuable resources and information, are better positioned to exploit the benefits of GSCM. Trust and loyalty are intrinsic components of relational capital, and they can be effectively harnessed through the profound knowledge possessed by partner members. This study confirms that Korean firms with strong relational capital are more likely to adopt GSCM practices, thus supporting H 3-1. Relational capital, such as in-depth knowledge and a mutual understanding of government regulations, industry standards, and market conditions, enables firms to address complex issues more effectively. However, firms with strong relational capital may also face increased pressure from partners to adopt GSCM.

This study shows that, primarily, green entrepreneurs are not motivated to increase their engagement in GSCM practices by perceiving stronger relational capital, which does not support H 3-2. Further examination is necessary to confirm these findings. This finding can be attributed to various factors that deserve careful consideration. One potential reason is the possibility that a lack of awareness hampers the conversion of robust social capital into knowledge of GSCM practices and their associated benefits. Alternatively, green entrepreneurs, despite possessing stronger social capital, may prioritize other pressing business concerns over the adoption of GSCM practices. Moreover, cost constraints could discourage green entrepreneurs with substantial social capital from embracing GSCM practices. These multifaceted dynamics underscore the need for a comprehensive understanding of the contextual factors influencing the adoption of GSCM practices among green entrepreneurs.

H 4-1 is supported showing that GSCM practices improve firm competitiveness. Previous studies yielded mixed outcomes regarding the impact of GSCM on organizational performance, possibly because of measurement limitations and lack of empirical evidence. This study's focus on two dimensions of organizational performance—competitiveness and economic performance—clarifies the benefits of adopting GSCM. The respondents deemed that GSCM practices contributed toward a firm's competitiveness by improving the efficiency of green operations, reducing disposal costs, and avoiding penalties and future compliance costs in the global supply chain. Additionally, the adoption of GSCM practices enhances a firm's positive image, creating a competitive advantage among consumers. However, the respondents did not associate GSCM practices with short-term economic profits due to increased costs of pollution-free equipment and opportunistic behavior between partners until conformity was achieved. Thus, the respondents were not optimistic about short-term profitability and failed to support H 4-2.

6. Conclusions

This empirical study investigated the determinants and performance outcomes of adopting GSCM practices, including green suppliers and customer management targeting Korean manufacturers for the first time in the recent decade. This study identifies GEO, institutional pressure, and relational capital as determinants of GSCM adoption, with institutional pressure and relational capital acting as moderating factors. Competitiveness and economic performance

were measured as the outcomes of GSCM practices. This study is both relevant and timely, given South Korea's increasing concern for global environmental conservation, particularly in the manufacturing sector, which has seen substantial growth and government support for environmental sustainability. The PLS-SEM approach provides significant theoretical and practical insights, summarized as follows:

This study makes valuable contributions to the understanding of sustainable supply chain management practices. The relationships between GEO, institutional pressure, relational capital, and GSCM adoption were explored for the first time to clarify the drivers and enablers of GSCM adoption among Korean firms. However, the absence of a moderating effect of institutional pressure and relational capital suggests that these factors may not be critical in influencing GSCM adoption, as previously deemed. Korean firms in the study may have developed strong and well-established GSCM practices that are relatively independent of external pressures or relationships with stakeholders. Their internal commitment to sustainability might be driving their GSCM adoption, rendering external moderating factors less influential. Therefore, more sophisticated statistical techniques are required to fully understand these relationships.

This study offers actionable insights for organizations and policymakers. It emphasizes the role of GEO as a driver for GSCM adoption, underscores the importance of considering multidimensional sustainability outcomes, and highlights the need to address barriers to successful GSCM implementation. First, it highlights the crucial role of GEO as a driver of GSCM adoption, and this can guide organizations in developing strategies to enhance their green orientation. This study's findings hold relevance for similar contexts in countries like Japan and Taiwan, facing comparable challenges and opportunities in Green Supply Chain Management (GSCM) practices. By examining factors influencing GSCM adoption and its impact on competitiveness in these countries, valuable insights can be gained to enhance sustainable supply chain practices. Policymakers can use these findings to formulate policies that promote sustainable supply chain management practices. For instance, they can provide tax incentives or subsidies to companies that reduce their carbon emissions, use renewable energy sources, or implement waste reduction strategies. Additionally, when evaluating the benefits of GSCM adoption, the lack of a significant impact of GSCM on economic performance emphasizes the importance of considering other factors such as environmental and social sustainability. Second, the study underscores the need for organizations to address the barriers to GSCM adoption, including lack of institutional pressure and relational capital. By actively seeking collaborations and fostering strong relationships, companies can overcome these challenges and achieve successful adoption of sustainable supply chain practices.

To provide a balanced interpretation of our findings, it is crucial to acknowledge and discuss the limitations of our study. This includes examining potential biases, limitations related to sample size and geographical scope, and other influencing constraints. The limited sample size affects the generalizability of our findings beyond this research's specific scope. Moreover, our study focused solely on the impact of GSCM on competitiveness enhancement and economic performance, omitting considerations of other potential benefits like improved environmental outcomes and stakeholder satisfaction. We also did not explore the potential moderating effects of variables such as firm size, industry type, economic context, or corporate culture. Recognizing these limitations and addressing them in future research will contribute to advancing knowledge in sustainable supply chain management. By considering biases, sample size, scope limitations, and other constraints, researchers can build upon our findings and foster a more comprehensive understanding of the subject. Acknowledging these limitations facilitates a realistic interpretation of our results and encourages further exploration in this field.

Conflict of Interest

The author(s) declare that they have no known

competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

The data that has been used is confidential at the request of the participants of the study.

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