



Green Supply Chain Management and Sustainable Competitive Advantage: The Mediating Role of Green Innovation and the Moderating Role of Institutional Pressure

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ABSTRACT

In the emerging economies, the ability of manufacturing companies to demonstrate that the adoption of environmental responsibly can be a powerful tool to ensure long-term competitiveness rather than simply an increased cost has become a growing concern. This study explored the role of Green Supply Chain Management (GSCM) in building sustainable competitive advantage (SCA) via green innovation (GI) and if institutional pressure (IP) enhances this relationship. A quantitative explanatory design was used and the data were collected from 260 organizations working in manufacturing and industrial sector of Multan District in Punjab, Pakistan from the managers and supervisory level employees by self-administered questionnaires. The hypotheses were tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) method with bootstrapping. The results showed that GSCM had a significant positive effect on both green innovation and sustainable competitive advantage. The direct link between GSCM and sustainable competitive advantage was also positive and partially mediated by green innovation, and was positively moderated by institutional pressure (favored by greater regulatory, customer, competitor pressure). This study combines the natural-resource-based view and institutional theory and provides practical suggestions for managers and policymakers who would like to turn green supply-chain practices into lasting competitive advantages.

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Introduction

Environmental performance is a strategic concern for manufacturers as a result of environmental degradation, regulatory tightening and changing customer expectations. The increasing environmental responsibility of firms is linked to the fact that a high portion of environmental impacts is associated with the procurement and transportation processes as well as with the suppliers' (upstream) activities (Carter & Rogers, 2008; Seuring & Müller, 2008). Recognizing environmental issues into the procurement process, production process, logistics and supplier involvement, is now the main way to do such as Green Supply Chain Management (GSCM) (Ma et al., 2022; Srivastava, 2007; Zhu et al. 2008).

The durability of these investments in providing competitive advantages is a key question. Green supply-chain practices have been found to enhance environmental, operational and organizational performance (Green et al., 2012), and it has been reported that environmental management practices to be associated with competitiveness (Chen et al., 2006). However, the processes by which greening is realised in benefit are less obvious and critics have pointed out that the practices that can be easily replicated are not sufficient to provide a sustainable advantage for themselves (Hart & Dowell, 2011; Sibte ali et al., 2024; Song et al., 2024).

There's a plausible explanation, and that's green innovation. Green innovation, which is defined as new or improved products, processes, and management approaches that help minimize environmental impacts, has been linked to improved green image and core competence, and provides a competitive advantage (Chen, 2008; Chen et al., 2006). There are different reasons companies would implement green product and process innovation such as regulation, market opportunity and seeking differentiation (Liang et al., 2024; Zhu et al., 2024; Dangelico & Pujari, 2010), and innovation in the context of uncertainty can be managed to achieve better performance (Tseng et al., 2013). There is also some evidence that there is a mediating effect between environmental effort and competitiveness through the use of environmental innovation strategy (Eiadat et al., 2008). GSCM can thus provide opportunities for green innovation, such as knowledge transfer to suppliers and redesign of materials and processes.

The second aspect is the institutional setting. The expectations of the regulatory, customer, competitor and community environment affect both the introduction and the reward of green practices (Sarkis et al., 2011). The findings from a number of studies have revealed that the relationship between emergent green supply-chain practices and performance can be moderated by institutional pressures (Zhu & Sarkis, 2007). In recent years, research on corporate responsibility has also confirmed that environmental strategy and green innovation are important paths that external expectations influence environmental outcomes (Kraus et al., 2020). In high-pressure environments, companies can take more action towards going green, and customers and regulators can recognize them more overtly.

Although these advances have been made, little effort has been made to combine all four of these concepts in one model, and evidence from PDI industrial districts like Multan is scarce. This study was based on the natural-resource-based view (Hart & Dowell, 2011) and institutional perspectives (Sarkis et al., 2011; Zhu & Sarkis, 2007) to test the direct effect of GSCM on sustainable competitive advantage, the mediating role of green innovation, and the moderating role of institutional pressure. The study adds to the literature by integrating a mediation and a moderation mechanism in the same one and by offering context-specific evidence from an emerging economy.

Literature Review

Theoretical foundation

The natural-resource-based view suggests that capabilities can create competitive advantage in consideration of the natural environment constraints, specifically in the areas of pollution prevention, product stewardship and sustainable development (Hart & Dowell, 2011). GSCM is such a capability since it incorporates environmental considerations into processes that cross organizational boundaries (Carter & Rogers, 2008; Seuring & Müller, 2008). In addition, institutional theory accounts for the explanation of why firms engage in green practices and when they do get benefits out of them: institutional theory suggests that institutional pressures such as from governments, customers, competitors, and other stakeholders shape firms' adoption of green practices (Sarkis et al., 2011; Zhu & Sarkis, 2007). The two perspectives suggest that it is a combination of internal green capabilities and external pressures that determine competitive outcomes. The concept of sustainable competitive advantage in this study is defined as being able to outperform competitors both in terms of performance and differentiation in the long term.

Green Supply Chain Management

GSCM includes green purchasing, green production, green transportation and logistics, and working with suppliers on environmental issues (Srivastava, 2007; Zhu et al., 2008). Green purchasing and supplier cooperation minimizes risks and expenditure of inputs, environmentally-friendly production minimizes waste and energy consumption, while green logistics minimizes emissions and fuel expenditure. While Green et al., (2012) determined that GSCM practices had positive impact on environmental and

organizational performance, Chen et al., (2006) made a connection between environmental performance and corporate advantage in Taiwan. Practices that are in place and part of supplier relationships and internal processes, are also less easily replicated by competitors and are conducive to durability of advantage (Hart & Dowell, 2011).

H1: The relationship between sustainable competitive advantage and H1 is positive and significant.

Green supply chain management and green innovation

When firms engage in collaboration with their suppliers, they gain knowledge about materials, technologies, and regulations which are important for their green product and process innovations (Dangelico & Pujari, 2010). Green purchasing drives companies to define and create environmental services, and environmental production is a call to better manage wastes and resources in production processes. Researches on green innovation drivers focus on green core competence, which is the important organizational environmental capability in enabling innovation (Chen, 2008); and the practices of green innovation must be coordinated throughout the chain in the presence of uncertainty (Tseng et al., 2013). Thus:

H2: GSCM plays an important positive role for green innovation.

Green innovation has the potential to lower material and energy costs, create new markets, enhance corporate image, and differentiate products all of which can lead to advantage (Chen et al., 2006; Dangelico & Pujari, 2010). Green core competence can lead to green innovation and green image, which can improve competitiveness, as demonstrated by Chen (2008); and in a paper that looked at a sample of firms in Singapore, Eiadat et al. (2008) concluded that an environmental innovation strategy was beneficial for firms to be both green and competitive. Innovations are knowledge-intensive and firm-specific and, therefore, hard to copy, consistent with the logic of sustained advantage.

H3: Green innovation is an important positive factor in sustainable competitive advantage.

Mediating effect of green innovation.

Given that GSCM is known to stimulate green innovation and green innovation is known to provide advantage, then a part of the impact of GSCM to advantage should be indirect. This is in accordance with evidence that the relationship between environmental effort and competitiveness is mediated by environmental innovation strategy (Eiadat et al., 2008), and that green innovation carries the effects of environmental strategy to outcomes (Kraus et al., 2020). Mediation is assessed via the product of the component paths with bootstrapped confidence intervals, instead of the previous causal-steps method (Hayes, 2013).

H4: The relationship between GSCM and sustainable competitive advantage is mediated by Green innovation

The moderating role of institutional pressure

The expectations that firms are expected to have towards institutional practices, such as those of governments, customers, competitors, and other institutions is what is known as institutional pressure. Zhu and Sarkis (2007) demonstrated how external pressures alter the relationships between green supply-chain practices and performance, while organizational-theoretic literature on GSCM indicates that institutional pressures are an important catalyst for GSCM adoption and effectiveness (Sarkis et al., 2011). Firms under high pressure tend to adopt the practices more extensively and to receive positive rewards in terms of legitimacy, preferred-supplier status, market access and this strengthens the competitive value of GSCM. If

there is a lack of pressure, practices could be embraced symbolically with smaller gains. Moderation is assessed with an interaction term (Hayes, 2013).

H5: The relationship between GSCM and sustainable competitive advantage is moderated positively by institutional pressure with the relationship being stronger at high institutional pressure.

Conceptual framework

The conceptual model suggests that GSCM is the independent variable, sustainable competitive advantage is the dependent variable, green innovation acts as a mediator between GSCM and sustainable competitive advantage, and institutional pressure as a moderator on the GSCM → sustainable competitive advantage path.

Methodology

Research design

The quantitative explanatory research design was used to answer the following research questions to see if GSCM positively influences sustainable competitive advantage through green innovation and if institutional pressure enhances this relationship. A quantitative method was used in the study because the study sought to test theory-derived hypotheses and generate estimates for the size and significance of the direct, indirect, and interaction effects of the study based on numerical data. It was a cross-sectional design and data was gathered from a single time from several organizations.

Population, sampling, and sample

The study centered upon the manufacturing and industrial organizations in Multan District of Punjab (Pakistan) which is a major industrial area with significant manufacturing and allied activity in textile and garment industries. The population consisted of managers and supervisory level staff in production, procurement, environmental management and supply-chain related areas. Purposive sampling was used in this study because the employees were believed to have first-hand knowledge of the environmental and innovation practices in the organization. Eligible workers were sent a self-administered questionnaire, and 260 valid returns were received. The sample size was larger than the minimum sample size required for the PLS-SEM models used in this study, including the interaction term (Hair et al., 2019). The survey was anonymous and non-committal.

Instrument and measurement

The four assessment methods for GSCM were green purchasing, environmentally friendly production, green transportation and the cooperation between suppliers and the environment. Green innovation was assessed based on innovation in environment product, environmentally friendly production processes, and improvements in waste and resource management. Sustainable competitive advantage was evaluated in terms of the organization's performance in sustaining the advantage over the competitors and its differentiation by environmental practices. Institutional pressure was assessed in terms of the perception of pressure from government regulations, customers, competitors, or other relevant institutions to engage in environmentally responsible practices. All constructs were assessed with several items which used a five-point likert scale from 1 (strongly disagree) to 5 (strongly agree). The instrument was previously subjected to a pilot survey in order to clarify and adapt the instrument for the final data collection and items that were ambiguous were reworded. The employers were approached at the place of work, the purpose of the study was explained to the employees and their anonymity and confidentiality were guaranteed. Questionnaires were checked for complete responses and pattern responses prior to analysis. To reduce common method bias (Podsakoff et al., 2012), procedural measures of anonymity, neutral wording, and that there were no

right or wrong answers were applied to the data, which were self-reported, and a full collinearity assessment was conducted in the structural analysis.

Data analysis

For this reason, the data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique appropriate for the Predictive theory-building research model with latent variables and interaction terms (Hair et al., 2019). Descriptive statistics were computed and presented to describe the characteristics of the respondents and distribution of study variables at first. The factor loadings, Cronbach's alpha and composite reliability were used to assess the reliability and convergent validity of the measurement model, while the heterotrait–monotrait (HTMT) ratio and the Fornell–Larcker criterion measured discriminant validity (Henseler et al., 2015). The model was then tested using the structural model. First, the direct effect of GSCM on sustainable competitive advantage was explored, and then the indirect effect via green innovation. An interaction-term analysis was used to examine the moderating effect of institutional pressure on the relationship between GSCM and sustainable competitive advantage, to see if institutional pressure influenced the relationship between GSCM and sustainable competitive advantage. To test the significance of direct, indirect and moderating effects, bootstrapping with 5,000 resamples was used (Hayes, 2013).

Analysis and Results

For the author: The numbers used in the tables (1–4) are fictitious and indicate the reporting structure. Do not submit them, but instead, include the output from your own PLS-SEM software, for example, SmartPLS.

Respondent profile

Table 1 is a summary of the characteristics of the 260 respondents. The majority of respondents had a male gender, managerial/supervisory role and over five years' experience, reflecting their capacity to draw on supply-chain, environmental and innovation practices.

Table 1: Profile of respondents (N = 260)

Characteristic	Category	Frequency	Percentage
Gender	Male	196	75.4
	Female	64	24.6
Position	Manager	96	36.9
	Supervisor	164	63.1
Experience	Less than 5 years	71	27.3
	5–10 years	112	43.1
	More than 10 years	77	29.6
Department	Production	91	35.0
	Procurement/supply chain	98	37.7
	Environmental management	71	27.3

Reliability and convergent validity

The results of this study provide evidence of reliability and convergent validity. The results of the measurement model are presented in Table 2. The Cronbach's alpha values and composite reliability scores were all above 0.70, and the AVE scores were above 0.50, which demonstrates acceptable reliability and convergent validity (Hair et al., 2019).

Table 2: Reliability and convergent validity

Construct	Items	Loadings range	Cronbach's α	CR	AVE
GSCM	8	0.70–0.84	0.88	0.90	0.57
Green innovation	7	0.72–0.85	0.87	0.90	0.58
Institutional pressure	6	0.73–0.84	0.86	0.90	0.60
Sustainable competitive advantage	7	0.70–0.82	0.87	0.90	0.56

Descriptive statistics and discriminant validity

The validity of the descriptive statistics and discriminant validity is assessed. Means, standard deviations, on the diagonal the correlation with the square root of AVE, and HTMT ranges are given for Table 3. The mean scores were above the mid-point of the scale. All AVE values were above the values of their correlations with the other constructs and all HTMT values were < 0.85 , indicating discriminant validity for all constructs (Henseler et al., 2015).

Table 3: Descriptive statistics, correlations, and discriminant validity

Construct	Mean	SD	1	2	3	4	HTMT range
GSCM	3.88	0.63	0.75				0.49–0.68
Green innovation	3.74	0.68	0.61	0.76			0.54–0.69
Institutional pressure	3.81	0.66	0.44	0.48	0.77		0.49–0.56
Sustainable competitive advantage	3.79	0.60	0.60	0.62	0.50	0.75	0.56–0.69

Note. Diagonal values are the square roots of AVE. All correlations are significant at $p < 0.01$.

Structural model and hypothesis testing

The structural results from 5,000 bootstrap resamples are shown in Table 4. GSCM positively influenced sustainable competitive advantage ($\beta = 0.27$, $p < .001$) (H1 supported), and positively influenced green innovation ($\beta = 0.61$, $p < .001$) (H2 supported). Also, green innovation was a significant predictor of sustainable competitive advantage ($\beta = 0.38$, $p < .001$), which lent credence to H3. The effect of GSCM on sustainable competitive advantage was indirect through green innovation, which was significant ($\beta = 0.23$, 95% CI [0.15, 0.31]) and supported H4, as the direct effect remained significant. The result showed that the relationship between GSCM and institutional pressure was positive and significant ($\beta = 0.12$, $p = 0.016$) which supported H5. The model explained 37% of the variance in green innovation and 58% of the variance in sustainable competitive advantage.

Table 4: Structural Model Results

Hypothesis	Path	β	SE	t	p	95% CI	Decision
H1	GSCM $\rightarrow$ SCA	0.27	0.06	4.50	< 0.001	[0.15, 0.39]	Supported
H2	GSCM $\rightarrow$ Green innovation	0.61	0.05	12.20	< 0.001	[0.51, 0.70]	Supported
H3	Green innovation $\rightarrow$ SCA	0.38	0.06	6.33	< 0.001	[0.26, 0.49]	Supported
H4	GSCM $\rightarrow$ Green innovation $\rightarrow$ SCA (indirect)	0.23	0.04	5.75	< 0.001	[0.15, 0.31]	Supported (partial mediation)
H5	GSCM $\times$ Institutional pressure $\rightarrow$ SCA	0.12	0.05	2.40	0.016	[0.02, 0.22]	Supported
Control path	Institutional pressure $\rightarrow$ SCA	0.17	0.05	3.40	< 0.001	[0.07, 0.27]	Significant

Note: SCA = sustainable competitive advantage. $R^2 = 0.37$ (green innovation); $R^2 = 0.58$ (SCA). Total effect of GSCM on SCA = 0.50

Discussion

The findings showed that GSCM has a direct impact on the sustainable competitive advantage in manufacturing companies in Multan, Pakistan. This is in line with studies that found green supply-chain practices enhance organizational performance (Green et al., 2012) and environmental performance is beneficial to the advantage of the company (Chen et al., 2006). It also endows the natural-resource-based proposition that capabilities and routines within the firm are hard to imitate, thus providing a basis for maintaining advantage (Hart & Dowell, 2011). In an industrial environment where buyers who rely on export demand are progressively auditing suppliers, it seems that green purchasing, cleaner production and supplier cooperation is not just a compliance cost but rather a differentiator.

The high influence of GSCM on green innovation is consistent with the studies that have found that green product and process innovation are influenced by the organizational environmental capabilities and the collaboration with suppliers (Chen, 2008; Dangelico & Pujari, 2010; Tseng et al., 2013). The importance of green innovation on advantage is consistent with previous findings that innovation contributes to green and competitive advantage (Chen et al., 2006; Eiadat et al., 2008). The partial mediation suggests that green innovation is a channel but not the only channel; the added value provided by GSCM is part of the direct value, which probably comes from cost savings, reputation, and the quality of the relationships between the buyer and supplier. The result was consistent with the studies which see green innovation as a middleman between environmental strategy and results (Kraus et al., 2020).

Institutional pressure had a positive interaction effect on the GSCM–advantage relationship; that is, the same amount of green practices was associated with more competitive advantages for businesses with higher expectations from regulators, customers, and competitors. This is consistent with the empirical results that show that institutional pressures affect the performance outcomes of GSC practices (Zhu & Sarkis, 2007) and organizational-theoretical explanations of GSCM (Sarkis et al., 2011). It is likely that practices would be undertaken more fully and would be recognized by stakeholders under strong pressure; adding to the value of practices. This finding indicates that the natural-resource-based view and the institutional theory are complementary; the internal capabilities create potential for advantage, and the institutional environment shapes the extent of the actual advantage.

Conclusion and Recommendations

The present study aimed to investigate the role of GSCM in sustainable competitive advantage through green innovation in manufacturing and industrial firms of Multan District, Pakistan under the influence of different institutional pressures. The results revealed that the direct and indirect effects of GSCM can enhance the sustainable competitive advantage, the direct effect of GSCM can be strengthened by green innovation, and the institutional pressure enhances the direct effect of GSCM. Theoretically the study is based on the natural-resource-based view plus institutional theory, and it is a clarification of one mediating mechanism and one moderating mechanism in one model. In other words, it demonstrates that the most enduring value created by green supply-chain programs is achieved when they are tied to innovation and when the company is located in an institutional setting that is challenging.

Based on these results, managers are recommended to incorporate environmental considerations in supplier selection, promote collaborative environmental programs with suppliers, and actively transfer GSCM knowledge into green product and process innovation through R&D investments, multi-functional working teams, and supplier innovation events. Regulatory or customer expectations should also be regarded as strategic indicators and should be employed to manage, record and communicate green strategies, not await enforcement. This impact can be further reinforced by imposing environmental standards consistently and by delivering technical assistance to SMEs to meet the environmental requirements of export customers, and by offering incentives to companies, such as green financing, tax relief measures and recognition initiatives for companies investing in green innovation.

There are a number of caveats. Because of the cross-sectional design, causal inferences cannot be drawn, and because of the purposive sampling in one district, the results are not generalizable. Common method bias is possible even after taking procedure steps to prevent it, because the data are self-reported by one respondent per firm (Podsakoff et al., 2012). Longitudinal and/or multi-source designs are recommended for future research, as are objective competitive and environmental indicators, comparisons of industry and region, separation of coercive and normative and mimetic pressures, and the testing of other moderators, including top management commitment or firm size.

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