

Original Research Article

Research on the influence mechanism of green supply chain management on corporate performance under the "dual carbon" goals

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Abstract: Against China's "Dual Carbon" goals, Green Supply Chain Management (GSCM) is critical for high-quality economic development and ecological civilization. Based on the Resource-Based View and Institutional Theory, this study builds a model to examine how GSCM affects corporate economic and environmental performance, with an empirical analysis of 328 Chinese manufacturing enterprises. Results show that green procurement, green production and reverse logistics significantly improve both environmental and economic performance, where environmental performance partially mediates the GSCM–economic performance link. "Deep green" management focusing on life-cycle emission reduction enhances long-term competitiveness more effectively than compliance-oriented "light green" management. Government environmental regulation positively moderates the relationship between GSCM and corporate performance. The findings offer empirical support for enterprises to overcome cost and technical barriers, and drive industrial upgrading from "light green" to "deep green" development.

Keywords: green supply chain management; dual carbon goals; sustainable development; environmental performance

1. Introduction

Amid global climate change, China has proposed the "Dual Carbon" goals (carbon peak by 2030, carbon neutrality by 2060). Traditional end-of-pipe governance can no longer support high-quality development, making Green Supply Chain Management (GSCM) a key focus for academia and practice. Existing studies have reached a consensus that GSCM brings environmental and economic win-win outcomes, but many enterprises still suffer from high costs, technical bottlenecks, and low motivation. Most firms only implement "light green" practices to meet basic regulations, lacking incentives for "deep green" transformation. This study empirically examines: (1) Whether GSCM can simultaneously improve corporate environmental and economic performance; (2) Whether significant performance differences exist between "light green" and "deep green" strategies.

2. Theoretical analysis and research hypotheses

2.1. Green supply chain management and corporate performance

From the Resource-Based View, GSCM practices optimize resources and reduce emissions, directly improving environmental performance. According to the Porter Hypothesis, environmental regulation and innovation compensation can offset costs and enhance economic performance via higher efficiency and brand image. Accordingly, hypotheses are proposed: H1a: GSCM practices significantly positively affect corporate environmental performance. H1b: GSCM practices significantly positively affect corporate economic performance. H1c: Environmental performance mediates the relationship between GSCM practices and corporate economic performance.

2.2. Heterogeneous impacts of "light green" and "deep green" management

Some enterprises only meet basic regulatory requirements, while others go beyond compliance to focus on energy saving, emission reduction and recycling. Although deep green management needs higher initial investment, it can build competitive barriers via innovation and bring greater long-term benefits. Thus, we propose: H2: Compared with light green management, deep green management has a more significant positive

effect on enterprises' long-term economic performance.

2.3. The moderating effect of government environmental regulation

Institutional Theory points out that external institutional pressure is an important driving force for organizational change. Under the context of strong environmental regulation, the cost of enterprise violations is high, and the marginal benefits of implementing GSCM increase; on the contrary, if supervision is inadequate, enterprises may choose to "pay for pollution discharge" rather than carry out green transformation. Based on this, this paper proposes the following hypothesis: H3: The intensity of government environmental regulation positively moderates the relationship between GSCM practices and corporate performance.

3. Research design

3.1. Data source and sample selection

Data were collected via questionnaire survey, using mature scales from Zhu & Sarkis (2004) and domestic studies, including green procurement, green manufacturing, reverse logistics, environmental and financial performance. The sample targets highpollution and highenergyconsuming manufacturing enterprises. A total of 500 questionnaires were distributed through industry associations and thirdparty agencies, with 328 valid responses (effective rate = 65.6%). The sample includes 35% stateowned, 52% private, 13% foreignfunded enterprises; 40% largescale and 60% SMEs.

3.2. Variable definition and measurement

All variables in this study are measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The specific definition and measurement indicators of each variable are shown in **Table 1**.

Table 1. Variable definition and measurement indicators.

Variable Type	Variable Name	Examples of Measurement Indicators
Independent Variable	GSCM Practices	1. Conduct environmental audits on suppliers; 2. Adopt ecological design for products; 3. Realize waste recycling and reuse;
Dependent Variable	Environmental Performance (EP)	1. Reduction of harmful gas emissions; 2. Reduction of solid waste discharge; 3. Decrease in energy consumption
Dependent Variable	Economic Performance (FP)	1. Growth of return on investment (ROI); 2. Expansion of market share
Moderating Variable	Environmental Regulation (ER)	1. Intensity of local environmental law enforcement; 2. Standards of sewage discharge fees
Control Variable	Enterprise Characteristics	Enterprise scale, enterprise operating years, nature of ownership, industry affiliation

3.3. Model construction

To test the proposed research hypotheses, this paper constructs multiple linear regression models to verify the main and mediating effects, and further introduces a moderating effect model to examine the regulatory role of government environmental regulation intensity. All models are set as follows:

Main and Mediating Effect Models:

$$FP_i = \alpha_0 + \alpha_1 GSCM_i + \alpha_2 Controls_{si} + \varepsilon_i$$

$$EP_i = \beta_0 + \beta_1 GSCM_i + \beta_2 Controls_{si} + \varepsilon_i$$

$$FP_i = \gamma_0 + \gamma_1 GSCM_i + \gamma_2 EP_i + \gamma_3 Controls_{si} + \varepsilon_i$$

$$\text{Moderating Effect Model: } FP_i = \delta_0 + \delta_1 GSCM_i + \delta_2 ER_i + \delta_3 (GSCM_i \times ER_i) + \delta_4 Controls_{si} + \varepsilon_i$$

4. Empirical results and analysis

4.1. Reliability and validity tests

This study uses SPSS 26.0 software to conduct reliability and validity tests on the research scale. The test results show that the Cronbach's α coefficient of each variable is greater than 0.8, the composite reliability is greater than 0.7, and the average variance extracted (AVE) is greater than 0.5, which indicates that the scale has good internal consistency reliability and convergent validity. In addition, the confirmatory factor analysis (CFA) results show that the model has a good fitting effect ($\chi^2/df=823.251/452<3$, CFI=0.902>0.9, IFI=0.906>0.9, GFI=0.858, RMSEA=0.053<0.08, RMR=0.041<0.05), which verifies the good construct validity of the scale.

4.2. Descriptive statistics and correlation analysis

The correlation matrix shows that GSCM practices are significantly positively correlated with environmental performance ($r=0.62$, $p<0.01$) and economic performance ($r=0.48$, $p<0.01$), which initially verifies Hypothesis H1 and provides a preliminary empirical basis for subsequent regression analysis. Meanwhile, the correlation coefficients between all variables are within a reasonable range, indicating that there is no serious multicollinearity problem in the research model.

4.3. Regression analysis results

Model (2) shows GSCM significantly improves environmental performance ($\beta=0.58$, $p<0.001$, H1a supported). Model (1) shows GSCM significantly promotes economic performance ($\beta=0.41$, $p<0.001$, H1b supported), indicating a winwin effect. In Model (3), environmental performance is positively significant ($\beta=0.35$, $p<0.01$), while the GSCM coefficient decreases but remains significant ($\beta=0.21$, $p<0.05$). The Sobel test is significant ($p<0.05$), supporting the partial mediating role of environmental performance (H1c). Group regression reveals that deep green management improves longterm economic performance more strongly ($\beta=0.65$) than light green management ($\beta=0.22$), supporting H2. Model (4) shows the interaction term $\text{GSCM} \times \text{ER}$ is significantly positive ($\beta=0.19$, $p<0.05$). Simple slope analysis confirms that stronger environmental regulation enhances the GSCM–performance link, supporting H3.

5. Discussion, management implications, limitations and future research

5.1. Research conclusions

Empirical analysis of 328 Chinese manufacturing enterprises shows: 1. GSCM enhances environmental and economic performance, acting as a core competitiveness tool; 2. Environmental performance partially mediates GSCM's impact on economic performance; 3. "Light green" brings short-term savings, while "deep green" delivers sustainable benefits; 4. Strict government environmental regulation positively moderates GSCM's performance effect.

5.2. Management implications

Enterprises: Abandon "environmental protection as cost" perception, integrate GSCM into strategy, shift to "deep green" management, and build green supply chain partnerships via digital technologies.

Government: Strengthen environmental regulation enforcement, adopt source incentives (unified standards, differentiated policies), and improve green infrastructure/technical support for SMEs.

6. Limitations and future research

Limitations include cross-sectional data, manufacturing-focused samples, undivided "deep green" technical paths, and limited consideration of external factors. Future research should use longitudinal data, expand to multiple industries, quantify green technology effects, and explore social responsibility pressure, consumer green demand, and other institutional factors.

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