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The Impact of Green Supply Chain Management Practices of County Enterprises on Enterprise Performance-Based on the Empirical Analysis of 65 Sample Enterprises in Southern Jiangsu, China

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Abstract: Optimizing the structure of green supply chain management (GSCM) of county enterprises and further developing the low-carbon economy is a breakthrough point for the green development of the county economy. A causal relationship model was constructed to quantify the degree of carbon emission reduction practices in GSCM and the degree of impact on performance of 65 enterprises in China. It is found that organizational system innovation has a positive impact on environmental performance and environmentally friendly design on operational performance, environmentally friendly design and cooperation with suppliers have a negative impact on economic performance, and promoting CSR and CSV and cooperation with customers have no obvious impact on performance. We recommend that companies strengthen cooperation with suppliers and promote CSV, and explore ways of cooperation that presuppose the promotion of CSR and CSV strategies and the realization of common interests.

1. Introduction

As the issue of climate warming has become a hot spot of global concern, some enterprises in order to improve the resource utilization efficiency of the entire supply chain and achieve the double improvement of economic and environmental benefits, their environmental management is not only implemented within the enterprise, but also cooperates with upstream suppliers and downstream customers to implement the supply chain as a unit, that is, the implementation of green supply chain management (hereinafter referred to as GSCM).

In order to actively respond to the demand for transparency of carbon emissions in the supply chain, companies around the world pay special attention to the carbon emission reduction practices in GSCM. The county economy is the foundation of China's macroeconomy, and county enterprises, as the main body to promote development, should actively adapt to new technological and management trends at home and abroad. Therefore, focusing on carbon emission reduction measures and discussing the practical structure of GSCM of county enterprises has important guiding significance for establishing an enterprise GSCM model that is compatible with the development of

low-carbon economy in counties.

2. Theoretical Review and Research Hypotheses

GSCM practices refer to environmental management activities implemented at all stages of a company's supply chain, from suppliers to producers and consumers. Studies have shown that internal practices include organizational innovation [1], environmentally friendly design [2], and corporate social responsibility (CSR). [3], etc., external practices include cooperation with suppliers and cooperation with customers [4], etc., and this paper puts carbon reduction practices among them Included in the scope of studies. In recent years, the number of enterprises incorporating the concept of Creating Shared Value (CSV) into low-carbon business strategies and implementing it has increased sharply, and CSV is a concept proposed by Michael E. Porter of Harvard University in 2011, advocating that enterprises integrate environmental and other social problems into production and business activities, while creating economic and social value. [5] Existing studies have paid insufficient attention to this new environmental management practice, especially the research on its formation path, performance impact and development trend has not been based on statistical analysis. Therefore, this paper includes carbon emission reduction practices that incorporate CSV concepts as a form of internal practice.

Research on the relationship between GSCM practices and environmental and economic performance has been attracting much attention. First, there is a general view that practices have a positive impact on environmental performance. Like Arimura [1] and Gotschol [6](2014) empirically tested the positive impact of obtaining ISO14001 (environmental management system) certification, environmentally friendly design, publishing environmental reports in CSR promotion, and working with suppliers and customers in organizational system innovation. Second, there are studies that generally agree that GSCM practices have a positive or negative impact on economic performance. For example, Watson and others [7] and Hasan [8] pointed out that organizational system innovation, CSR promotion, and cooperation with suppliers and customers have a positive impact on economic performance. Zhu & Sarkis points to environmentally friendly design and collaboration with customers build again. The use of the system has a negative impact on economic performance [9]. At present, due to the increasingly stringent environmental regulations and other reasons, domestic and foreign companies have made large environmental investments to implement GSCM, and the negative impact on economic performance can be speculated as the resulting cost increase. In addition, some scholars have confirmed that some practices have a positive impact on operational performance such as product quality and productivity. For example, Vachon & Klassen[4]Taking the North American manufacturing industry as the survey respondent, it was pointed out that cooperation with suppliers and customers promotes the optimization of manufacturing processes and the improvement of product quality, respectively.

In summary, although existing studies have discussed the impact of various practices of green supply chain management on environmental, operational and economic performance, it has not yet been clear how much carbon reduction practices in green supply chain management contribute to corporate performance, and through what paths. The trend of low-carbon economy poses new challenges to green supply chain management, and it is necessary to explore the impact of carbon reduction practices in green supply chains on corporate performance (environmental, economic and operational performance). Based on the existing research, this paper proposes the following hypothesis:

H1: Carbon reduction practices in green supply chains have a positive impact on environmental performance.

H2: Carbon reduction practices in green supply chains have positive and negative impacts on

economic performance.

H3: Carbon reduction practices in green supply chains have a positive impact on operational performance.

3. Summary of the Questionnaire

The data used in this paper comes from a sample survey of manufacturing enterprises in southern Jiangsu from September 2022 to December 2022. Southern Jiangsu is a key area supported by the Chinese government to support the green development of the county manufacturing industry, and in recent years, it has actively built a green manufacturing system throughout the life cycle, and established a number of green factories and green industrial parks within the county, which provides objective and realistic research materials for this paper. According to the economic development level of southern Jiangsu, the research group selected 8 counties (cities) under the jurisdiction of Suzhou, Wuxi and Changzhou in southern Jiangsu as the survey area, and distributed questionnaires to 82 manufacturing enterprises in the survey area, and the questionnaire was mainly filled out by the middle and senior managers of these enterprises, and finally 65 valid questionnaires were recovered, and the industry categories of valid questionnaire source enterprises are shown in Table 1.

Table 1: Valid questionnaire answers to the industry category of enterprises.

Industry category	Number of enterprises	Proportion (%)
Food manufacturing	5	7.7
Textile industry	8	12.3
Paper and paper products industry	2	3.0
Chemical raw materials and chemical products manufacturing	4	6.15
Rubber products manufacturing industry	1	1.5
Beverage manufacturing	2	3.1
Agricultural and sideline food processing industry	2	3.1
Non-metallic mineral products industry	3	4.6
Metal products industry	2	3.1
General-purpose, special-purpose equipment manufacturing	10	15.4
Electrical machinery and equipment manufacturing	12	18.5
Transportation machinery manufacturing	8	12.3
other	6	9.2
total	65	100

The questionnaire is divided into three parts: (I.) basic information of the enterprise in 2022 (industry type, number of employees, etc.), (II.) the degree of implementation of various practices, and (III.) the intensity of the impact of various practices on enterprise performance. In (II.), the setting is based on the actual situation of the survey subject's GSCM learned from the previous interview28specific forms of practice (see Table 2). The theoretical basis for the practical form identified as "CSV propulsion" is Porter & Kramer [6]three ways to practice CSV are proposed (new product development incorporating the CSV concept, CSV practice along the value chain, and CSV business in business regions). There are five options for the level of practice, from highest to lowest, namely: "1. Not considered", "2. Although discussed, but not implemented", "3. Although the implementation has been decided, the specific plan is still under discussion", "4. Tried to implement",

and "5. Formally implemented".

Table 2: Descriptive statistics of item (II.) in the questionnaire.

classify	Project name	N	Mean	SD
Organizational system innovation	1. Cooperation between departments to reduce carbon emissions	65	4.25↑	1.3
	2. Different sectors have different carbon emission reduction measures	65	4.47↑	1.17
	3. Subsidiaries and affiliates have carbon emission reduction measures	65	3.96↑	1.39
	4. The senior management of the enterprise is committed to carbon emission reduction	65	4.33↑	1.31
	5. The middle management of the enterprise is committed to carbon emission reduction	64	3.91↑	1.26
Environmentally friendly design	6. Consider the reduction of carbon emissions in the design of the production process	65	3.96↑	1.43
	7. Consider reducing carbon emissions in the use stage in product design	65	3.52↑	1.53
	8. Consider transportation efficiency in product design	62	3.42↑	1.68
	9. Consider the reduction of packaging materials in product design	63	3.55↑	1.63
	10. Obtained environmental label certification	65	2.88	1.65
Promote CSR	11. Set up a full-time CSR department	65	3.49↑	1.58
	12. Set up full-time CSR practitioners	65	3.53↑	1.53
	13. Public disclosure of carbon emission information	63	2.98	1.55
	14. Subsidiaries and affiliates perform CSR	62	3.39	1.6
	15. Publication of CSR reports, environmental reports, and sustainable development reports	62	3.95↑	1.52
Advance CSV	16. Provide products and services that contribute to reducing carbon emissions	63	2.86	1.77
	17. Improve energy efficiency throughout the supply chain by introducing new technologies, such as cogeneration projects	63	2.41	1.57
	18. Improve the logistics efficiency of the entire supply chain by shortening transportation distances and optimizing distribution routes	63	3.41↑	1.63
	19. Improve resource utilization efficiency through the reduction, reuse and recycling of water, raw materials and container packaging	62	4.28↑	1.19
Work with suppliers	20. There are carbon emission reduction requirements for suppliers	65	3.57↑	1.56
	21. Carbon reduction ability is one of the supplier selection criteria	65	2.63	1.46
	22. Require suppliers to obtain ISO14001 or other environmental management system certification	65	3.12	1.63
	23. Environmental supervision of suppliers' production processes	65	2.91	1.61
	24. Require secondary suppliers to have carbon reduction measures	65	1.74↓	1.12
Work with customers	25.Cooperate with customers to develop environmentally friendly design	65	3.61↑	1.61
	26. Work with customers to reduce carbon emissions in shipments	65	3.03	1.67
	27. Cooperate with customers to carry out eco-friendly packaging research and development	63	3.31	1.59
	28. Apply for environmental label certification to meet customers' green consumption needs	65	2.65	1.64

Note: ↑ indicates items with ceiling effect. ↓ Indicates items with floor effect.

In (III.), according to H1, H2 and H3, the impact of each specific form of practice in Table 2 on enterprise performance is divided into four categories, with reference to Watson etal[7]Zhu and Sarkis[9]and Vachon & Klassen[4]Set up13specific impacts (see Table 3). There are five levels of impact from low to high, which are "1. no impact at all", "2. slightly impact", "3. moderate impact",

"4. large impact", and "5. significant impact".

Table 3: Descriptive statistics of items (III.) in the questionnaire.

classify	Project name	N	Mean	SD
Have a positive impact on environmental performance	1. Reduced carbon emissions	65	3.63	1.29
	2. Achieve waste emission reduction	63	3.47	1.19
	3. Reduced energy usage	65	3.92↑	1.25
Have a positive impact on operational performance	4. Reduced inventory levels	64	3.42	1.29
	5. The waste generation rate is reduced	64	3.43	1.22
	6. Product quality improvement	63	3.62	1.31
Has a positive impact on economic performance	7. Reduction of procurement and supply costs	65	3.68	1.25
	8. Reduction of manufacturing costs	64	3.90↑	1.28
	9. Increased sales	65	3.75↑	1.38
	10. Increased market share	65	3.65↑	1.29
	11. Get new customers	63	3.48	1.28
Has a negative impact on economic performance	12. Purchasing environmentally friendly raw materials leads to higher costs	65	3.15	1.29
	13. Rising labor costs	65	3.31	1.21

Note: ↑ indicates items with ceiling effect. ↓ Indicates items with floor effect.

4. Analysis Results

In this paper, SPSS is used to analyze factors and covariance structural analysis (structural equation model) on the impact of GSCM practices on firm performance. Before performing factor analysis, remove items that have little impact on the results. The specific steps are as follows: (1) calculate the descriptive statistics to obtain the mean and standard deviation of each item in Table 2 and Table 3; (2) Examine the ceiling effect (Mean+SD>5) and the floor effect (Mean-SD<1); (3) Analyze the distribution and importance of items with these two effects, removing the underlined items in the table.

4.1. Factor Extraction

Using the questionnaire data, factor analysis (principal component analysis, Kaiser normalized orthogonal rotation method) was performed on carbon reduction practices and firm performance in GSCM. The KMO (Kaiser-Meyer-Olkin) sampling suitability measures are 0.89 and 0.91, respectively, which can determine suitability for factor analysis. To ensure a close correlation between each item, factor analysis is repeated after deleting items until there are no more items with an absolute value of factor load less than 0.50 to obtain a factor load matrix (as shown in Tables 4 and 5). In Table 4, the cumulative contribution rate of six factors: "organizational system innovation", "environment-friendly design", "promotion of CSR", "promotion of CSV", "cooperation with suppliers", and "cooperation with customers" is 75.2%. In Table 5, the cumulative contribution rate of the four factors of "positive impact on environmental performance", "positive impact on operational performance", "positive impact on economic performance" and "negative impact on economic performance" is 82%. In addition, to ensure the internal consistency of each factor, their Kronbach coefficient was calculated, and all 10 factors were higher than 0.70 (generally above 0.7 is

acceptable). The extent of carbon emission reduction practices and impact on corporate performance in GSCM are shown in Table 6.

Table 4: Analysis results of carbon emission reduction practice factors.

	F1	F2	F3	F4	F5	F6
Different sectors have different carbon reduction measures	0.85	0.08	0.15	0.16	0.11	0.07
Cooperation between departments to reduce carbon emissions	0.86	0.14	0.15	0.15	0.11	0.04
Senior management is committed to carbon reduction	0.79	0.08	0.12	0.17	0.17	0.08
The middle management of the enterprise is committed to carbon emission reduction	0.76	0.17	0.11	-0.08	0.21	0.26
Help suppliers improve their carbon management capabilities through capacity building training and other forms	0.16	0.79	0.03	0.08	0.16	0.28
Share the carbon reduction costs of suppliers	0.08	0.81	0.17	0.11	-0.11	0.05
Communicate with suppliers on carbon reduction	0.14	0.77	0.12	0.16	0.2	0.15
Require secondary suppliers to have carbon reduction measures	0.14	0.77	0.07	0.05	0.22	0.01
Provide carbon reduction technologies to suppliers	0.12	0.71	0.19	0.24	-0.04	0.36
Carbon reduction ability is one of the supplier selection criteria	0.24	0.78	0.12	0.15	0.44	-0.14
Set up a full-time CSR department	0.19	0.17	0.81	0.13	0.18	0.07
Set up full-time CSR practitioners	0.21	0.15	0.66	0.15	0.11	0.04
Publication of CSR reports, environmental reports, and sustainability reports	0.27	0.1	0.65	0.14	0.21	0.2
Subsidiaries and affiliates fulfill CSR	0.25	0.15	0.68	0.32	0.21	0.18
Cooperate with customers to carry out eco-friendly packaging research and development	0.16	0.17	0.29	0.79	0.21	0.14
Collaborate with customers on environmentally friendly design	0.26	0.14	0.17	0.71	0.11	0.19
Work with customers to reduce carbon emissions in their shipments	0.15	0.3	0.15	0.75	0.3	0.08
Reducing carbon emissions during the use phase is considered in product design	0.27	0.15	0.18	0.13	0.75	0.19
Transportation efficiency is considered in product design	0.23	0.24	0.31	0.3	0.71	0.15
Reducing packaging materials is considered in product design	0.15	0.14	0.34	0.31	0.68	0.14
Cultivate suppliers through education, financial assistance, and technical support	0.15	0.42	0.27	0.33	0.04	0.63
Provide products and services that contribute to reducing carbon emissions	0.13	0.24	0.15	0.11	0.45	0.65
We carry out activities in our business regions that achieve both social contribution and competitiveness improvement	0.19	0.16	0.21	0.33	0.33	0.61
α	0.89	0.79	0.91	0.86	0.85	0.82
Factor load	18.72	16.21	12.55	10.85	10.22	6.77

Note: The factor extraction method is a principal component analysis method with six rotations using the Kaiser normalized orthogonal rotation method.

4.2. Causality Model

The covariance structure analysis was performed using the factors extracted above (see Table 4 and Table 5) to construct a causal model of carbon emission reduction practices and firm performance

in GSCM (see Figure 1). The adaptability of the model is CFI=0.918, RMSEA=0.065, and it can be considered that the model can cope with changes in practice to a certain extent from the number of observed variables. The arrows indicate the causal relationship between the variables, the path coefficient marked horizontally indicates the magnitude of its impact, and the number of asterisks marked at the top right of the value is used to illustrate significance.

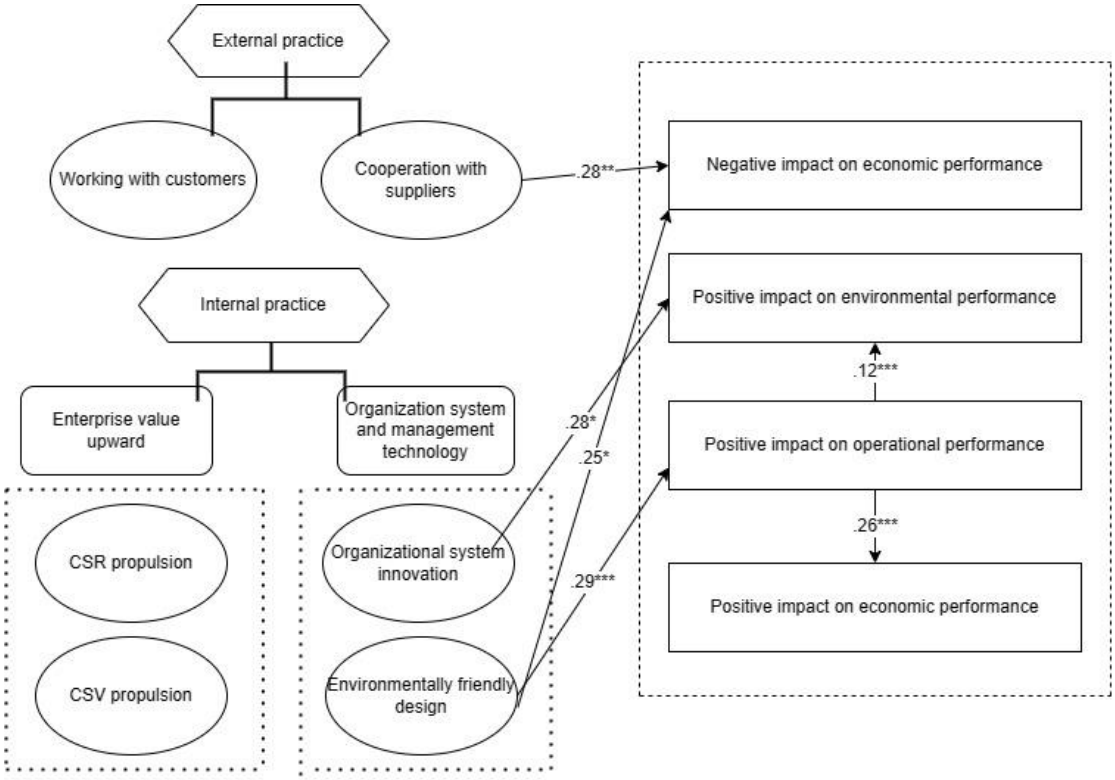
Table 5: Analysis results of enterprise performance factors.

	P1	P2	P3	P4
Increased compliance rate	0.87	0.23	0.13	0.24
Product quality improved	0.82	0.28	0.14	0.3
Shorter production cycles	0.79	0.2	0.16	0.32
Reduce waste emissions	0.27	0.84	0.15	0.1
Reduced carbon emissions	0.23	0.83	0.18	0.22
Reduced energy usage	0.18	0.83	0.15	0.25
Increased investment in technology and equipment	0.02	0.23	0.84	0.16
Acquire new customers	0.51	0.15	0.79	0.19
Buying environmentally friendly raw materials leads to higher costs	0.11	0.28	0.33	0.85
Rising labor costs	0.18	0.25	0.35	0.71
α	0.96	0.89	0.81	0.96
Factor load	32.72	20.09	14.66	13.74

Note: The factor extraction method is a principal component analysis method, using the Kaiser normalized orthogonal rotation method for five rotations.

Table 6: Descriptive statistics for each factor.

	Number of items	N	Mean	SD
F1 Organizational system innovation	6	65	3.9	1.85
F2 works with suppliers	6	65	1.88	1.11
F3 CSR promotion	4	64	3.75	1.27
F4 works with customers	3	65	2.85	1.88
F5 is environmentally friendly in design	3	65	2.98	1.95
F6 CSV propulsion	3	63	3.22	1.36
P1 has a positive impact on operational performance	3	65	3.31	1.19
P2 has a positive impact on environmental performance	3	64	3.55	1.18
P3 has a positive impact on economic performance	2	65	2.88	0.95
P4 has a negative impact on economic performance	2	65	2.68	1.33



Note: CFI=.918, RMSEA=.065; *<0.1, **<0.05, ***<0.01.

Figure 1: Causal model of carbon emission reduction practice and enterprise performance in GSCM.

4.3. Hypothesis Testing

The analysis of the causality model in Figure 1 is as follows:

Organizational innovation in internal practice has a positive impact on environmental performance (.28*); "Environmentally friendly design" has a positive impact on economic performance (.2 5*) and positive impact on operational performance (.29***).Environmentally friendly design has an indirect positive impact on environmental and economic performance through positive impact on operational performance (.29***×.42***=.12***) (.29***×.92***=. 26***). Promoting CSR" and "promoting CSV have no significant impact on corporate performance. Working with suppliers in external practice has a negative impact on economic performance (.28**). Therefore, the hypotheses of 1, 2, and 3 are supported.

5. Research Results

Based on the above results, the following phenomena can be pointed out, and the causes of the phenomena can be analyzed in combination with field investigations.

From the analysis results, it can be seen that the carbon emission reduction practices in GSCM have the following impacts on enterprise performance: (1) organizational system innovation has a positive impact on environmental performance; (2) Environmentally friendly design and cooperation with suppliers have a negative impact on economic performance. (3) Environmentally friendly design has a positive impact on operational performance, through which it can indirectly have a positive impact on environmental and economic performance. (1) The reason that organizational system innovation encourages all departments of the enterprise to jointly implement the low-carbon

development policy plan, which undoubtedly helps the enterprise to further reduce carbon emissions and improve environmental performance. (2) The reason that if the carbon emissions of the product are to be cut in the use stage, the choice of packaging materials will be limited, resulting in increased costs. In addition, working with suppliers to implement GSCM will inevitably lead to stricter implementation of green procurement guidelines, and may require technical support to suppliers and share the cost of carbon reduction for suppliers, which may incur significant costs. (3) The reason that environmentally friendly design advocates the realization of environmental friendliness in the procurement, design, manufacturing, packaging, recycling, etc. of raw materials of products, which not only helps to improve the productivity and product quality of enterprises, but also reduces greenhouse gas emissions and has the possibility of acquiring new customers and increasing sales.

Finally, from the analysis results, it can be seen that the promotion of CSR and CSV, and cooperation with customers, have not had a significant impact on corporate performance. In China, CSR practices should remain purely social and environmental contributions, which are related to the improvement of corporate image, but do not necessarily improve corporate performance. For example, as a practice of CSR, although the environmental reports or CSR reports of Chinese companies detail the goals and performance, most of them do not reflect the impact of CSR on corporate strategy. In addition, even though CSV is more focused on building corporate strategy than CSR, it is still in its infancy and has not yet reached a stage where it can fully affect corporate performance.

6. Conclusion

This paper provides an overview of the implementation of GSCM carbon emission reduction practices in county manufacturing enterprises in Southern Jiangsu and China, and clarifies the extent of impact on enterprise performance. Although environmentally friendly design and cooperation with suppliers have a negative impact on economic performance, environmentally friendly design does have a promoting effect on operational performance and organizational system innovation on environmental performance. In addition, environmentally friendly design indirectly promotes environmental and economic performance. In addition, the promotion of CSR and CSV, and cooperation with customers have little impact on the performance of various companies. Therefore, in order to improve the contribution of carbon emission reduction practices to corporate performance, it is necessary to integrate CSR into the whole process of enterprise technology research and development, product design, employee training, and public welfare publicity, and build a CSR strategy system that can achieve both social and economic benefits. In addition, it is necessary to explore ways of cooperation that presuppose the realization of mutual interests, so that cooperation with suppliers can have a positive impact on economic performance.

The survey objects of this paper are limited to county green manufacturing demonstration enterprises such as green industrial parks and green factories in Southern Jiangsu in China, and future research should include other county manufacturing enterprises in the survey objects, and fully consider the influence of different industrial characteristics and positions in the supply chain, and explore the more common and scientific GSCM practice rules of county manufacturing enterprises.

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