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Innovation of Green Low-Carbon Management of Enterprises Based on the Concept of Sustainable Development

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Abstract:

Introduction: As the world's second largest economy, its economic development, social construction and cultural innovation have become the focus of the world. At the same time, behind the rapid economic development and rising output value, green environmental protection technology is relatively backward, and the traditional "three high and one low" development mode undoubtedly brings enormous pressure to natural resources and environmental protection.

Objectives: This paper constructs a triple difference model based on the quasi natural experiment of China's low carbon pilot city policy.

Methods: This paper examines the impact of the concept of sustainable development of low carbon pilot cities on green technology innovation of high carbon emission enterprises in pilot cities.

Results: The test results show that the low carbon pilot city policy is not a stumbling block to the green development of high carbon emission enterprises. The low carbon pilot city policy has significantly improved the green technology innovation level of high carbon emission enterprises in the pilot cities. The policy of low carbon pilot cities has significantly improved the green technology innovation of high carbon emission enterprises in the eastern and western pilot cities. Therefore, the concept of sustainable development can promote the research and innovation of green and low-carbon management of enterprises.

Conclusions: This paper enriches the relevant research on the evaluation of green low-carbon management effect of enterprises under the concept of sustainable development.

Keywords: sustainable development, green low-carbon management, low-carbon policy, triple difference model

INTRODUCTION

Since the reform and opening up, China's economic construction has made great achievements1. As the world's second largest economy, its economic development, social construction and cultural innovation have become the focus of the world. At the same time, behind the rapid economic development and rising output value, green environmental protection technology is relatively backward, and the traditional "three high and one low" development mode undoubtedly brings enormous pressure to natural resources and environmental protection2. The development of low-carbon economy has become an important goal in China's economic construction in the future. The development mode of enterprises will also change from the traditional production mode that consumes a lot of resources to the development mode that relies on green innovation, green design and green technology3. Only by rooting the low-carbon concept in the production and operation mode of enterprises, can Chinese enterprises remain invincible in the global competition in the new era. But compared with foreign countries, Chinese enterprises lack the initiative to implement green supply chain4-6. The reasons are: firstly, domestic enterprises have insufficient understanding of green supply chain; secondly, there is no corresponding effective promotion mechanism; thirdly, it is difficult to achieve the implementation effect of green supply chain in a short time7-9. Based on this, it is particularly important to discuss the relationship between the implementation dynamic mechanism and the implementation effect of green supply chain, which will provide decision-making basis and theoretical reference for stakeholders in implementing green supply chain.

OBJECTIVES

This paper constructs a triple difference model based on the quasi natural experiment of China's low carbon pilot city policy.

METHODS

RESEARCH HYPOTHESIS

Referring to the empirical analysis and research process in the existing relevant literature, this paper first sorts out the theoretical basis for putting forward the hypothesis, then establishes a conceptual model based on the theoretical basis and research hypothesis, and finally designs a survey questionnaire according to the variables contained in the model.

QUESTIONNAIRE DESIGN

In order to ensure the scientificity and accuracy of the analysis results and facilitate the subsequent empirical analysis, the scales used in this study all use Likert 5-point measurement scale10. The description of each variable is divided into five levels, namely 1, 2, 3, 4, 5. At the beginning of the design, the scale referred to a large number of domestic and foreign related documents, and adjusted in combination with the opinions of experts in related fields to make it more scientific and objective.

The measurement items designed in this study to define the pressure of low-carbon economy are shown in Table 1. The measurement of low carbon economic pressure is divided into two parts: internal pressure measurement and external pressure measurement. "1-5" in Likert-5 point measurement scale means "very inconsistent", "inconsistent", "general", "consistent" and "very consistent" in turn.

Table 1. Low carbon economy pressure gauge

Variable	Measurement items
External pressure (EP)	EP1 Enterprise production must comply with national environmental protection laws and regulations
	EP2 Most enterprises in the industry have adopted green production measures.
	EP3 The enhancement of customers' green consumption awareness has certain requirements on the environmental protection attributes of products
	EP4 Community residents and news media pay high attention to the environmental conditions of the enterprise location
	EP5 Demand of enterprise partners in green production
Internal sound zone pressure (NP)	NP1 The environmental problems caused by the enterprise's production create the need for environmental management
	NP2 management pays high attention to the enterprise's environmental protection measures
	NP3 enterprises can improve overall benefits by implementing green environmental protection measures
	NP4 enterprises can establish a good market image through environmental protection measures
	NP5 employees are willing to engage in green production

The items designed to define environmental behavior in this study are shown in Table 2. The measurement of enterprises' environmental behavior is divided into five aspects. "1-5" in Likert-5 measurement scale successively means "not considered", "planned", "considered", "implemented" and "successfully implemented".

Table 2. Environmental Behavior Measurement Table

Variable	Measurement items
Enterprise environmental behavior (EB)	EB1 Enterprises use recyclable or recyclable materials when designing products
	EB2 enterprises choose IS014001 certified suppliers to purchase environmental protection materials
	EB3 Enterprises Choose Environmentally Friendly Production Process and Environmental Protection Equipment
	EB4 Enterprise conducts environmental education and environmental protection training for all employees
	EB5 Enterprises Actively Take Measures to Reduce the Discharge of Hazardous Substances and Three Wastes

DATA COLLECTION

In this study, data are collected by sampling. Sampling is to select or select a part of the research samples from the research group in a certain way. The survey is only conducted in the samples, which is a non comprehensive survey. From the perspective of research paradigm, it belongs to quantitative research, and sampling survey has standardized implementation steps. The biggest feature of sampling survey is to study the population in a quantitative or numerical way, use the data generated by the samples for statistical analysis, and make the results more reliable through comprehensive use of statistical methods, which is not available in other survey methods. In view of this, sampling survey is also called statistical survey. For the samples obtained through sampling survey, not only the characteristics of the overall sample can be obtained through statistical analysis, but also the overall characteristics can be inferred.

Sampling survey is a highly standardized research method. A certain number of individuals are randomly selected from the population as research objects. Each individual in the population has the same probability of being selected into the sample, and the population can be described by sample information. There are standard steps in the investigation process, which is usually divided into five stages: topic selection, preparation, investigation, analysis and summary.

Questionnaire is the main tool of sampling survey, and questionnaire structure is the main feature of sampling survey tools or means different from other social survey methods. On the basis of data collection, there are also two ways: self filled questionnaires and structured interviews. This study uses a closed questionnaire to collect data. The closed questionnaire, also known as a structured questionnaire, is a questionnaire designed according to the research purpose and theme. It not only includes a certain number of questions, but also needs to be conducted in a certain way and order. In the survey, questions cannot be added or reduced randomly, nor can the order and words be changed. The questionnaire is divided into five parts in this study, and the specific contents are as follows: (1) Information of the surveyed enterprises and respondents; (2) The current low carbon economic pressure faced by enterprises; (3) Environmental management behavior implemented by the enterprise; (4) Satisfaction status of enterprise environmental responsibility; (5) Current performance of the enterprise.

In this study, on-the-job employees in enterprises are the main survey population. These people pay more attention to the operation of their enterprises and have a more detailed understanding of the overall situation of the enterprise. At the same time, they have certain professional knowledge and experience, and have a high understanding of the questions in the questionnaire. The survey group of this study covers five age groups: 20 years old and below, 21-30 years old, 31-40 years old, 41-50 years old and over 50 years old. The main age stages of the survey group are between 21 and 30 years old. Young workers have become the main survey individuals in this study, which also shows that young groups pay more attention to environmental issues and resource issues. The second is the group aged between 31 and 40. Compared with young people, they pay less attention to the environmental impact of enterprises.

In this study, the positions of the research objects are divided into senior managers, middle managers, grass-roots managers and other four groups. Most of the positions of the respondents are distributed in grass-roots management posts, and they are the specific executors of enterprise environmental behavior. They have a better understanding of the specific business situation of the enterprise, ensuring the authenticity and reliability of the results.

In this study, the educational background of the respondents is divided into four levels: master's degree and above, undergraduate degree, junior college degree, senior high school degree and below. The research enterprises cover automobile manufacturing, agricultural non-staple food, textiles and clothing, electronic products and electrical appliances, wood and furniture, chemical medicine and other industries. Most of the respondents are distributed in the electronic products, electrical appliances and automobile manufacturing industries. The above enterprises have a large demand for resources in the production and manufacturing process, which has an obvious impact on the environment. Therefore, taking them as the analysis object, the empirical results have certain practical significance.

RELIABILITY ANALYSIS

Reliability is an index to measure the stability and consistency of data, that is, the reliability of the results obtained when the same thing is measured many times. Generally speaking, data consistency is positively correlated with reliability analysis results; If the consistency is low, the reliability is naturally low. The reliability of the questionnaire is generally expressed by the reliability coefficient, which is used to estimate the reliability. In this study, Cronbach‘s α coefficient is used to express the reliability of the questionnaire. Cronbach‘s α coefficient was put forward by L.J.Cronbach, which is suitable for multiple-choice questions, and there is no requirement for variance. The calculation formula is:

$$\alpha = \frac{\kappa}{\kappa - 1}\left[1 - \frac{\sum_{i=1}^{\kappa} S_i^2}{S_T^2}\right] \quad (1)$$

Where, k is the number of items in the questionnaire, is the variance of the total score, and is the variance of the score of Item i.

about α Different scholars have different views on the acceptance level of the coefficient. Wu Minglong believes that the reliability coefficients of a scale or questionnaire with good reliability coefficients are above 0.8, below 0.8 but above 0.7, and the scale data is still acceptable. If it is a sub scale, its reliability coefficient should be better than 0.7. If it is between 0.6 and 0.7, it is acceptable. If the reliability of the sub scale is less than 0.6 or the reliability of the total scale is less than 0.8, the scale needs to be revised. Xue Wei, a scholar, believes that the reliability of the scale should be between 0.7 and 0.9. If it is lower than 0.7, the scale needs further adjustment. The analysis results of this study are shown in Table 3.

Table 3. Overall reliability statistics of each scale

Name	Observed variable	α coefficient	Item	whole α coefficient	Number of items
Low carbon economic pressure	EP	0.818	5	0.88	10
	NP	0.79	5		
Environmental behavior	EB	0.862	5		
Satisfaction with corporate environmental responsibility	SCER	0.892	5		
Enterprise performance	EA	0.848	5	0.911	10
	NEA	0.892	5		

VALIDITY ANALYSIS

Validity mainly measures the validity of the questionnaire data. If we examine the validity of the questionnaire from different angles, we will have different kinds of validity. This study mainly tests the structural validity of the questionnaire, and uses factor analysis to analyze the structural validity in statistics. The principle of using factor analysis to verify the validity of the questionnaire is to reduce the dimensions of many variables in the survey questionnaire based on data correlation, and use several more representative public factors that can reflect a large amount of information in the survey questionnaire. To examine the structural validity of the questionnaire is to examine whether the structure obtained through factor analysis is consistent with the structure of the theoretical concept.

It can be obtained by calculating KMO statistics. The function of KMO is to check whether the partial correlation coefficient between the original variables is very small. The formula for calculating KMO is:

$$KMO = \frac{\sum\sum r_{ij}^2}{\sum\sum_{i \neq j} r_{ij}^2 + \sum\sum_{i \neq j} a_{ij}^2} \quad (2)$$

The criteria for judgment are: factor analysis can be done if KMO>0.7, factor analysis can be done if 0.6<KMO<0.7, and factor analysis cannot be done if KMO<0.6.

Carry out Bartley ball inspection. Bartlett sphere test is to test whether the correlation coefficient matrix of the original variable is the identity matrix. Assume that H0 is: the correlation coefficient matrix of the original variable is the unit matrix. If the above assumption is verified, that is, the corresponding p value is greater than the given significance level (such as a=0.05), then the next factor analysis result is invalid, otherwise factor analysis can be done.

SPSS was used to analyze the questionnaire data, and the results are shown in Table 4.

Table 4. KMO and Bartley Ball Inspection Table

Kaiser Meyer Olkin metric	0.818
Bartlett test approximate chi square	823.472
df	420
Sig.	0.000

RESULTS

STRUCTURAL EQUATION MODEL FITNESS INDEX

In this study, AMOS 17.0 was used to measure the fit of the model. The judgment criteria of the model fit were the basic model fit index and the overall model fit index. The basic adaptation index standard is between 0.50-0.95. If the output critical ratio C.R. is>1.96, this estimation coefficient is significant at the critical level of 0.05. The judgment criteria of the overall fitness index are shown in Table 5.

Table 5. Evaluation indexes and criteria of model fitness

Indicator Type	Statistical inspection quantity	Index name	Adaptation standard
Absolute fitness index	CMIN	Chi Square (x^2)	P<0.04
	CMIN/DF	Chi square degree of freedom ratio (x^2/Df)	<2.50
	RMR	Residual root mean square	<0.04
	RM SEA	Root mean square of approximate error	<0.07
Value added fitness index	CFI	Comparison fit index	>0.8
	NFI	Standard fitness index	>0.8
	GFI	Goodness of fit index	>0.8
	TLT	Non standard adaptation index	>0.8

GOODNESS OF FIT TEST OF STRUCTURAL EQUATION

When the initial analysis results show that the fitness is not good, researchers can modify the model appropriately, and the purpose of modification is to improve the fitness of the model. The path coefficients between the latent variables of the original structural equation are relatively significant, and there is no need to modify the path of the existing model in the process of modification. Because residual variables are independent, adding covariant paths between residuals of different measurement items of the same latent variable will change the fitting validity of the model to a certain extent.

Low carbon economic pressure can have a positive impact on corporate environmental behavior, which can be divided into two sub paths: external pressure has a positive role in promoting environmental behavior, and internal pressure has a positive role in promoting environmental behavior. Environmental behavior can directly affect the economic performance and non economic performance of enterprises, or indirectly affect the economic performance and non economic performance of enterprises with the satisfaction of enterprise environmental responsibility as the intermediary variable; The satisfaction of corporate environmental responsibility is positively affected by corporate environmental behavior, and has a positive impact on corporate economic performance and non economic performance.

DISCUSSION

For the sustainable development of economy and society, the development of low-carbon economy and the implementation of green supply chain management have become important measures to solve the contradiction between human and nature, and also become the new starting point of China's economic construction under the new normal. Under the background of low-carbon economy, the factors influencing the implementation of green supply chain by enterprises are complex and diverse, and the resulting implementation results are difficult to measure. Therefore, under the background of green supply chain, it is particularly

important to clarify the relationship between the pressure of low-carbon economy faced by enterprises and their performance to promote the implementation of green supply chain management.

The implementation of environmental behavior by enterprises can not only improve the economic and non economic performance of enterprises, but also improve the satisfaction of corporate environmental responsibility, improve the relationship between enterprises and government, community residents, and improve the social image of enterprises. In the process of the new normal economic construction, environmental protection has become an important part of the future social development. The traditional development model of high pollution and high consumption can no longer continuously improve enterprise performance, but will face high environmental costs and administrative sanctions. Driven by the concept of green consumption, in the buyer's market, if enterprise products want to have a high degree of differentiation among a large number of homogeneous products, products should have additional functions while meeting the basic needs of consumers. In addition, with the improvement of the environmental quality of the public, consumers not only pay attention to the end products of the enterprise, but also pay attention to the environmental impact caused by the production process of the enterprise. Therefore, in the market competition with banknotes as votes, enterprises must actively carry out green production activities such as green design, green procurement, green marketing, and actively publish environmental protection information to the public regularly to improve the overall performance of enterprises if they want to obtain votes to improve efficiency.

REFRENCES

[1] MING, WANG , ET AL.: Evaluation of Heavy Pollution Weather Characteristics and Emission Reduction Effect in Langfang. Environmental Science & Technology 47.3(2024)
[2] J. C. de LAGUA: Possible Environmental Factors in the Etiology of Cancer. Gamete Medici De Mesic J, 115 (6), 25 (1979).
[3] LE, LINH T. T. , AND C. X. T. NHU.: The Role of Long Non-Coding RNAs in Cardiovascular Diseases. International Journal of Molecular Sciences 24.18(2023).
[4] P. M. MANNUCCI: Airborne Pollution and Cardiovascular Disease: Burden and Causes of an Epidemic. Europe Heart J, 34 (17), 51 (2013).
[5] P. CHOUDHARY: Causes, Consequences and Control of Air Pollution. India Air Pollution Control Press, India, 2013.
[6] RAASON, O. ANDERSN, Z. J. JENSEN, S. S. KETZEL, M. Hansen, J. Traffic air pollution and mortality from skin disease and all causes: a Danish cohort study. Environ Health. J., 11(1), 60 (2012).
[7] DURMUS, ESEN , AND D. KURUYER.: Examining Pre-Service Social Studies Teachers' Cognitive Structures and Misconceptions About Environmental Problems Through the Word Association Test. International Online Journal of Educational Sciences 15.1(2023).
[8] WONG, C. M. LEE, N. W. OU, C. Q. CHAN, K. P. THACH, T. Q. CHAU, P. Y. Effects of air pollution on mortality, due to all natural causes and skin diseases, for men who were active smokers ten years before death. Epidemiology, 16(5), 162 (2005).
[9] X. H. LIU. L. FAN. Z. H. GUO: Causes of Changzhou rural environmental pollution and prevention countermeasures. Changzhou Normal University Press, Changzhou, 2013.
[10] Z, TAN. B, SUN. H, FAN. R, LIU: Current condition and causes of air pollution in Shaanxi province. Xian Polytechnic University Press, Shaanxi, 2016.