

Environmental Orientation, Green Innovation and Enterprise Performance: A Moderated Mediating Examination——Multivariate Linear Regression Analysis Based on STATA

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Abstract. Based on the theoretical analysis of environmental orientation, green innovation, and high-performance work systems (HPWS), this research proposes a theoretical framework of environmental orientation and enterprise performance in Chinese context. We use the data of 302 manufacturing enterprises in the Yangtze River Delta region, use STATA to analyze the data, use multiple linear regression method to examine the relationship of these factors to enterprise performance. The results show that environmental orientation is positively correlated with enterprise performance. Moreover, green innovation has a mediating effect between environmental orientation and enterprise performance. Furthermore, HPWS moderate the mediating effect of green innovation in the relationship between environmental orientation and enterprise performance. This study discusses the management implications of green environmentally friendly practices to promote the performance of enterprises in China.

Keywords: multivariate linear regression; environmental orientation; green innovation; high-performance work systems; enterprise performance; sustainability

1 Introduction

The fine ecological environment is the inherent request of China's sustainable development and the primary task of enhancing people's well-being. However, the rapid economic development worsened the problems of resource waste and environmental pollution. This has made the relationship between enterprise environmental orientation and enterprise performance an increasingly important area of research. At the same time, innovation is the driving force for an enterprise to keep moving forward. Green innovation is an important way for enterprises to adhere to environmental orientation and take the initiative to seize development opportunities. In addition, within the organization, only fully and efficiently allocate various resources, stimulate the endogenous motivation of employees, adjust the organizational structure and production process, that is, use HPWS to improve and innovate the original way, and realize the green and sustainable development of the enterprise.

Based on resource-based theory, strategic management theory and corporate social responsibility, we introduced green innovation and HPWS as mediators and moderators, and observed their roles in the relationship between green orientation and enterprise performance.

This paper applies multiple linear regression analysis. In regression analysis, if there are two or more independent variables, it is called multiple regression. However, a phenomenon is often affected by multiple variables. Therefore, multiple linear regression can more comprehensively, accurately and intuitively reflect the relationship between the influencing variables. This paper used STATA to conduct multiple linear regression analysis.

2 Theory Development and Hypothesis

2.1 Environmental Orientation

The traditional view of environmental orientation holds that there is an irreconcilable contradiction between environmental protection and enterprise performance^[1]. It holds that higher environmental protection standards will bring additional pollution control costs to enterprises^[2]. However, more and more research as well as practical experience has shown that the more enterprises invest in maintaining the ecological environment, the higher the level of economic returns they can accrue^[3]. The negative impact of lack of social responsibility, such as environmental irresponsibility, may lead an increase in hidden costs^[4], and ultimately negatively impact enterprise performance. In other words, enterprises that do not attach importance to environmental protection may achieve performance in the short term, but the pollution they cause will inevitably lay hidden dangers for their future development. Therefore, we want to discuss how environmental orientation specifically affects enterprise performance. Based on this, this paper proposes:

H1: Environmental orientation has a positive impact on enterprise performance.

2.2 Green Innovation

In practice, enterprises should actively carry out green product innovation and green process innovation to realize the smooth transformation from green entrepreneurship orientation to enterprise performance^[5]. A forward-looking enterprise will often adopt an environmentally oriented strategy, which then becomes the top management team's driving force for innovation as they integrate "green" into their products and designs^[6]. The decrease of environmental cost is mainly due to the improvement of energy utilization rate and the decrease of unit energy consumption caused by innovation, which leads to the decrease of enterprise mandatory environmental cost^[7]. To summarize, the increasing environmental orientation of corporate strategy has prompted companies to increase the investment in technological innovation resources, which improves green innovation^[8] and ultimately affects their performance. Based on this, this paper proposes:

H2: Green innovation has a mediating effect between environmental orientation and enterprise performance.

2.3 High-Performance Work Systems

An effective employee incentive system and fair job promotion further stimulate the enthusiasm and potential of employees. These factors enable the implementation of green innovation to be more efficient and easier to translate into enterprise performance. When the level of HPWS is low, mechanisms such as a training system, promotion system, incentive system and employee

participation system cannot be effectively implemented. Poorly implemented performance and salary systems will reduce employees' sense of fairness, trust, and support of the organization^[9]. In this case, even if enterprises implement green innovation, they will find that employees are less able to accept or implement this strategy, weakening the role of green innovation in promoting enterprise performance. Therefore, this paper proposes:

H3: HPWS positively moderate the relationship between green innovation and enterprise performance, that is, when HPWS are at a high level, the positive relationship between green innovation and enterprise performance is stronger.

Combining H2 and H3, this study argues that HPWS not only moderate the relationship between green innovation and enterprise performance, but also strengthen the mediating effect of green innovation in environmental orientation and enterprise performance. These suggestions will help enterprises turn environmental awareness into actual green innovation. In addition, in environmentally oriented enterprises, HPWS strengthen organizational trust^[10]. Through this beneficial knowledge sharing and voluntary cooperation among employees^[11], the process of transforming green innovation into enterprise performance is accelerated. In short, environmental orientation influences enterprise performance not only through green innovation but also by effective internal employee processes. HPWS can enhance employee responsibility and knowledge sharing through the implementation of employment safety and fairness practices, information sharing, and organizational commitment. Therefore, the following hypothesis is put forward:

H4: The mediating effect of green innovation on the relationship between environmental orientation and enterprise performance is stronger when effective HPWS exist.

3 Method

3.1 Data

This paper selects manufacturing enterprises in the Yangtze River Delta region of China as a sample for research. We distributed 450 questionnaires, and 302 valid questionnaires were obtained. The industry distribution of the sample is shown in Table 1.

Table 1. Sample industry distribution.

Industry	Number	Proportion
Machinery and equipment manufacturing	29	9.60%
Metal and non-metallic mineral manufacturing	41	13.58%
Electronics	23	7.62%
Petroleum and chemical	22	7.28%
Textile and garment	51	16.89%
Papermaking and printing	67	22.19%
Pharmaceuticals and food	36	11.92%
Wood, furniture, others	33	10.93%

3.2 Measures

We used the seven-point Likert scale to measure the variables of the questionnaire (except for objective variables). To ensure accuracy, we used the scale developed in the existing literature^[12-15]. This method translates the scale first and then asks relevant experts to provide suggestions to improve the scale so that it can adapt to the Chinese context.

4 Results

4.1 Descriptive Statistics and Correlation Analysis

We used STATA to conduct descriptive statistics and correlation analysis on environmental orientation, green innovation, HPWS, enterprise performance and control variables. Table 2 shows statistics of the sample data. Table 3 presents the Pearson correlation coefficient. The absolute value is less than 0.7 and is within the acceptable range.

Table 2. Descriptive statistics of sample data.

Variables	Cases	Minimum	Maximum	Mean	S.D.
Enterprise performance	302	1.00	7.00	4.2583	1.57203
Environmental orientation	302	2.00	7.00	5.2020	1.15663
Green Innovation	302	2.00	7.00	4.9603	1.11992
HPWS	302	1.00	7.00	3.4139	1.42505
Firm size	302	1.00	5.00	3.1689	0.86341
Firm age	302	2.00	68.00	17.4437	22.40495
Ownership	302	0.00	1.00	0.8874	0.31661
R&D expenditure	302	1.00	7.00	4.6523	1.34002
Valid cases	302				

Table 3. Pearson correlation matrix.

	1	2	3	4	5	6	7	8
1. Enterprise performance	1							
2. Green Innovation	0.423**	1						
3. Environmental orientation	0.329**	0.686**	1					
4. HPWS	0.360**	0.135*	0.171**	1				
5. Firm size	0.249**	0.151**	0.076	-0.019	1			
6. Firm age	0.136*	0.052	-0.027	-0.058	0.209**	1		
7. Ownership	0.039	0.109	0.171**	0.074	-0.052	-0.086	1	
8. R&D expenditure	0.451**	0.334**	0.277**	0.192**	0.306**	0.046	0.048	1

Note: ** $p < 0.01$ level; * $p < 0.05$ level.

4.2 Regression Analysis

Then, we used STATA for regression analysis. Table 4 shows that there is a significant positive correlation between environmental orientation and enterprise performance (Model 1, $b = 0.309$, $p < 0.001$), while the firm age ($b = 0.007$, $p < 0.05$) and R&D expenditure ($b = 0.413$, $p < 0.001$) have a positive correlation with the enterprise performance. This shows that environmental orientation has a positive effect on enterprise performance, H1 is supported.

Table 4. Regression analysis results.

	Model 1	Model 2	Model 3	Model 4	Model 5
	Enterprise performance	Green innovation	Enterprise performance	Enterprise performance	Enterprise performance
Environmental orientation	0.309***	0.625***	0.084	0.040	0.020
Green innovation (GI)			0.361***	0.359***	0.359***
HPWS				0.307***	0.250***
GI*HPWS					0.115*
R&D expenditure	0.413***	0.115**	0.372***	0.313***	0.305***
Firm size	0.186	0.064	0.163	0.200*	0.205*
Firm age	0.007*	0.003	0.006	0.007*	0.007*
Ownership	-0.015	-0.003	-0.014	-0.066	-0.087
Industry	Controlled	Controlled	Controlled	Controlled	Controlled
	$R^2=0.273$	$R^2=0.499$	$R^2=0.307$	$R^2=0.379$	$R^2=0.392$
	$F=22.284$	$F=58.919$	$F=21.737$	$F=25.652$	$F=23.588$
	$p=0.000$	$p=0.000$	$p=0.000$	$p=0.000$	$p=0.000$

Note: *** $p < 0.001$ level; ** $p < 0.01$ level; * $p < 0.05$ level.

The results of model 2 show that environmental orientation is positively correlated with green innovation (Model 2, $b = 0.625$, $p < 0.001$). This provides evidence that environmental orientation makes enterprises more inclined to adopt green innovation. The results of model 3 show that the impact of environmental orientation on enterprise performance is mediated by green innovation. Using STATA, this study further uses the bootstrap method to test the mediating effect with bootstrapping a sample of 5000. The mediating effect is 0.347, and the 95% confidence interval of mediation test excludes 0 [0.200, 0.487], which indicates that the mediating effect of green innovation is significant. Therefore, H2 is supported.

HPWS are used as an independent variable in the regression model. In Table 4, HPWS are positively correlated with enterprise performance (Model 4, $b = 0.307$, $p < 0.001$). The results of model 5 show that HPWS positively moderate the relationship between green innovation and enterprise performance (Model 5, $b = 0.115$, $p < 0.05$). Thus promoting green innovation, improving performance. Therefore, H3 is supported.

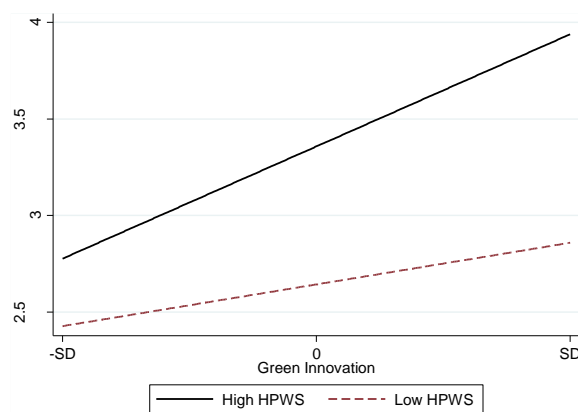


Fig 1. The moderating effect of HPWS on the relationship between green innovation and enterprise performance.

In order to test the moderated mediating effect, based on the influence of environmental orientation on enterprise performance, we use green innovation as the mediator and HPWS as the moderator. Table 5 shows that when HPWS are low, the mediating effect of green innovation is 0.251; when HPWS are medium, the mediating effect of green innovation is improved to 0.365; when HPWS are high, the mediating effect of green innovation continues to increase to 0.479 (95% C.I. always does not include 0). Therefore, H4 is supported.

Table 5. Mediating effect of green innovation under different levels of HPWS.

Mediator	Conditional indirect effects of HPWS			
	Condition	b	SE	95%CI
Green innovation	Low	0.251	0.099	[0.067–0.449]
Green innovation	Medium	0.365	0.077	[0.222–0.522]
Green innovation	High	0.479	0.092	[0.306–0.654]

Note: SE= Standard error; CI= Confidence interval.

5 Conclusion

This study explores the relationship between environmental orientation, green innovation, HPWS, and enterprise performance, and draws the following conclusions: (1) Environmental orientation can promote enterprise performance. (2) Green innovation has a mediating effect between environmental orientation and enterprise performance. (3) HPWS enable green innovation to have a stronger mediating effect between environmental orientation and enterprise performance. This research enriches the specific relationship between environmental orientation and corporate performance, and further discusses the mechanism between independent variables and dependent variables through mediation and regulation. Therefore, this study also has several practical implications.

(1) The enterprise should include environmental concerns in their corporate strategy and should strengthen the environmental awareness of its executives. The enterprise should analyze its current business and should rectify or eliminate the business that is harmful to the environment, in order to eliminate environmental risks.

(2) Strengthen employees' awareness of environmental protection. Enterprises can promote employees' knowledge of environmental protection regulations in order to ensure that they incorporate this environmental awareness into their regular job activities.

(3) Enterprises should support and advocate green innovation and increase its investment in this area. They can create new product R&D centers, so as to improve their green innovation capabilities.

(4) Enterprises should refine their human resources management systems with the goal of building HPWS. They should improve the incentive system, establish an effective communication mechanisms and a corporate culture that encourages them to innovate.

Using multiple linear regression analysis method, this paper intuitively shows the relationship between the variables, and the conclusions of the paper are also conducive to the green

sustainable development of enterprises. However, this study still has some limitations and shortcomings, specifically the following: (1) In the process of data collection, the deviation of the measurement results caused by the subjectivity of the respondents still cannot be ruled out, which may have a potential influence on the reliability and accuracy of the data. (2) Due to the poor direct accessibility of variables, this study obtains direct data by constructing indicators and issuing questionnaires based on results of previous studies, which will inevitably affect the overall quality of the data.

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