sustainability

MDPI

Article

Understanding Firm Performance on Green Sustainable Practices through Managers' Ascribed Responsibility and Waste Management: Green Self-Efficacy as Moderator

Lingjun Guo [1,2], Yi Xu [1,*], Guangfu Liu[1], Tao Wang [3,4] and Chengliang Du [2]

[1] School of Economics and Management, Tongji University, Shanghai, 200092, China
[2] School of Business, Guilin University of Technology, Guilin 541004, China
[3] Institute for Advanced Study, Tongji University, Shanghai, 200092, China
[4] UNEP-Tongji Institute of Environment for Sustainable Development, Tongji University, Shanghai 200092, China
* Correspondence: 1610321@tongji.edu.cn

Received: 16 August 2019; Accepted: 6 September 2019; Published: 11 September 2019

Abstract: Firms' performance in sustainable development has caused increasing concerns. A key issue is that the environmental characteristics of business managers may be an important driver to promote the sustainable practice of enterprises. This study explores the relationship between ascribed responsibility of managers and green sustainable practice of enterprises by introducing the waste management as mediation variable and green self-efficacy as a moderating variable. A survey was conducted in manufacturing enterprises from the Yangtze River Delta in China in 2019, where 149 valid questionnaires were collected out of 200 surveyed enterprises. Subsequently, the data were analyzed through an analytic hierarchy process. The results show that: (1) ascribed responsibility of managers has a positive impact on green sustainable practices ($\beta = 0.428$, $p < 0.001$), and waste management plays a full mediating role during this process ($\beta = 0.428$, $p < 0.001$); (2) managers' green self-efficacy strengthens the positive impact of waste management on sustainable practices ($\beta = 0.284$, $p < 0.05$); (3) green self-efficacy has positively moderated the indirect effect of managers' ascribed responsibility for sustainable practice through waste management. The research enriches the theories on sustainable practice of enterprises from the perspective of managers' environmental characteristics and provides insights for enterprises to promote sustainable development practice.

Keywords: Ascribed responsibility; green sustainable practices; green self-efficacy; waste management

1. Introduction

In the 21st century, the extensive economic growth has caused serious negative impacts on the ecological environment, where the shortage of resources, the environmental pollution, and ecological degradation are the critical challenges faced by the countries around the world [1]. According to the report of the United Nations environment programme (UNEP) [2], more than 40% of cities around the world have faced the problem of air quality and more than 1,200 people died because of environment-related events every year. Hence, environmental problems have become the biggest threat to human pursuit of ecological well-being index[1].Strengthening corporate environmental responsibility and practicing green sustainable practice have become important

strategic measures related to national economy and people's livelihood. In 2017, China has announced the documents of national green development strategy that clarify the green development concept that "clear water and green mountains are as valuable as mountains of gold and silver", providing a new development path for enterprise development in the new era[3]. Green sustainable practice is an important measure of the national green strategy system, which involves energy conservation, emission reduction, waste management, pollution control, and other aspects, all of which aim to reduce the damage to the ecological environment caused by the production process of enterprises and achieve the goal of harmonious economic and environmental development[4]. With the increasing concern for environmental issues, green sustainable practice is no longer a fashionable term[4,5]. Under the government's environmental regulation, how to promote energy conservation and emission reduction, strengthen waste management and improve green sustainable practice of enterprises have become challenging practical problems faced by the government and enterprises [4], which attract attention from academia, politicians and commercial circles.

Enterprises are regarded as important subjects to perform sustainable practice, who should take ecological environment into account and promote the coordinated and sustainable development of economy and ecological environment [6,7]. Due to the complexity of green sustainable practices, the incentives of enterprises are not only driven by commercial demand and environmental protection [8,9], but also the responsibility of enterprises to pursue environmental sustainability[10,11]. However, the urgency of environmental protection and the ability of practice may vary with the environmental beliefs and attitudes of managers of the enterprises [12]. Robertson and Barling (2011) suggest that environmental characteristics of managers are an important source to motivate enterprises to conduct environmental protection behaviors and promote green and sustainable practices [13]. However, the current academic research on the environmental behavior of enterprises in China mostly places attention on the factors regarding enterprise strategy. For instance, Jabbour[14] discussed environmental activities of enterprises; Pinzone [15]analyzed the green supply chain management; Bai and Zeng studied enterprise environment behavior under the national system theory[1]. The research on the correlation between managers' environmental characteristics and enterprises' environmental behaviors is still weak, which lacks the interpretation of green sustainable practices. Hence, it is necessary to deepen the role of managers' environmental factors in pro-environment activities of enterprises, and to carry out research on environmental protection behavior of enterprises at the managerial level by focusing on the senior leaders. In addition, waste management is a pro-environment activity aiming at mitigation of negative impacts of waste and is argued to be one of the key driving forces for sustainable practice of enterprises [16–18]. However, existing literature mainly focuses on the perspective of green innovation or environmental regulation [19–21] while there is inadequate research regarding the influence of environmental characteristics of managers on firms' pro-environmental behavior such as waste management.

In order to extend the research paradigm of green sustainable practices and enrich the theoretical basis, this study focuses on the impacts of environmental characteristics of managers on sustainable practice and applies the cognitive-behavioral theory to explore the mechanism of how the managers' ascribed responsibility can affect the sustainable practice. In particular, the authors introduce waste management as mediation variable, green self-efficacy as moderating variable and builds the moderator mediation model indicating the action path of "responsibility attribution to waste management to sustainable practice". Hence, this paper can fill the academic gap from the perspective of managers to explore the research paradigm of sustainable practices. Revealing the impacts of environmental characteristics of managers on enterprise's pro-environment activities, this paper aims to provide theoretical and practical support for managers to strengthen responsibility attribution and practice green sustainable practice under government environmental regulation.

The structure of this paper is as follows: the first part is the introduction; the second part elaborates the theory and hypothesis; the third part discusses the research methods of this paper.

The fourth section is the empirical analysis of the research hypothesis; the last part is the conclusion and limitations of this study.

2. Theory and Hypotheses

2.1. Ascribed Responsibility Waste Management and Green Sustainable Practice

Based on the research of Steg and Groot, ascribed responsibility is one of the key factors affecting environmental behavior[22].According to normative activation theory (NAT), ascribed responsibility not only affects individual pro-environmental behavior, but also acts as a catalyst for pro-environmental behavior[12].Zhang et al studied on the attribution of corporate managers' responsibility and concluded that when managers identify their own behavior as a responsibility, they will take positive measures to promote corporate environmental protection behavior[23]. In addition, managers with responsibility will actively promote enterprises to adopt energy technology[24]and strengthen ecological innovation[25]. According to NAT and empirical research, once the managers identify reducing environmental impacts as the responsibility of enterprise, they are more willing to take active green practices to promote enterprises to practice green sustainability. In particular, waste management, as an important part of green practice, will inevitably receive the positive response under the responsibility of managers. Therefore, this research hypothesizes that

Hypothesis 1. *Ascribed responsibility positively affects waste management of enterprises.*

Hypothesis 2. *Ascribed responsibility has a significant positive impact on green sustainable practice.*

2.2. Waste Management and Green Sustainable Practice.

Waste management refers to utilization of waste resources to reduce costs and increase efficiency during the production process [26,27]. However, most manufacturing enterprises continue to adopt the traditional model, which neglects waste disposal and directly discharges waste into the environment [28,29], resulting in increased pollution and negative environmental impact.

Weerasiri believes that enterprises' recognition of the importance of waste management can stimulate their green sustainable practice [30]; Zang Wenchao indicates that waste management can facilitate waste harmless disposal and promote enterprises' green development [31]. Therefore, waste management is considered to be an important driving factor of green sustainable practice and the implementation of waste management can realize the green sustainable practice of enterprises [32,33]. Hence, this study investigates the impacts of waste management on sustainable green practices for manufacturing enterprises and this research hypothesizes that

Hypothesis 3. *Waste management has a significant positive impact on enterprise green sustainable practice.*

2.3. Mediating Role of Waste management

The ascribed responsibility not only affects individual pro-environmental behavior, but also acts as a catalyst for pro-environmental behavior [13,34]. In the context of enterprise management, managers' ascribed responsibility can strengthen the management of waste resources and other management activities [19,23]. In detail, waste management can contribute to the harmless treatment of waste and promote the green development of enterprises [35,36]. Thus, waste management seems to be one of the important processes for enterprises to respond to the government's environmental policies and practice the strategy of ecological development [37,38]. Through reducing the destructive impact on the ecological environment by implementing green production; waste management can be regarded as the bridge between the manager's ascribed responsibility and green sustainable practice. In addition, targeting at manufacturing industries and other heavily polluting enterprises, strengthen the management of environmental responsibility consciousness can promote enterprise actively perform green production and improve the ecological environment. Thus, this research hypothesizes that

Hypothesis 4. *Ascribed responsibility has a positive indirect effect on green sustainable practice through waste management.*

2.4. Moderate Effect of Green Self-Efficacy

Green self-efficacy incorporates green environmental factors on the basis of self-efficacy, especially the evaluation of an individual or organization's ability to achieve environmental goals [39]. Past literature has shown that green self-efficacy is a kind of self-cognition, which has a positive influence on pro-environment behavior. With the improvement of green self-efficacy, individual pro-environment behaviors will be activated [40]. Nordlund et al. believe that green self-efficacy can activate an individual's environmental beliefs and attitudes, and subsequently adopt pro-environmental behaviors [41]. Jansson et al. indicate that the green self-efficacy of managers has a positive and significant impact on the behavior norms of managers [25] .In addition, Steg, suggests that there is a significant correlation between managers' environmental beliefs and attitudes and green self-efficacy[42,43]; while green self-efficacy is an important component of environmental beliefs and attitudes, which means that the green self-efficacy will strengthen the responsibility of managers and promote enterprises to adopt pro-environmental activities such as waste management[44]. Therefore, this research hypothesizes that:

Hypothesis 5. *Green self-efficacy positively moderated the positive impact of waste management on sustainable practices.*

2.5. A Moderated Mediation Model

In the transformation process of responsibility attribution to green sustainable practice, enterprises are required to undertake green production [45]. According to the existing literature, green self-efficacy of managers has a significant impact on green sustainable practice of enterprises that have undertaken green production practice [12,22]. Because managers' green self-efficacy can interfere with the process of responsibility attribution through waste management to green sustainable practices [40,46]. So With high green self-efficacy, managers will actively respond to the green and sustainable practices of the government, improve waste management and promote the green and sustainable development of enterprises [42,44]. In other words, green self-efficacy can strengthen the positive role of responsibility attribution in green sustainable practice through waste management. Based on Hypothesis 4 and 5, this study hypothesizes that responsibility attribution can have a positive impact on green sustainable practices of enterprises through waste management, while the indirect effect is affected by green self-efficacy of managers. In particular, green self-efficacy plays a positive role in regulating intermediate variable (waste management) in the path of "responsibility attribution to waste management to green sustainable practice". Therefore, this research hypothesizes that:

Hypothesis 6. *Green self-efficacy positively moderated the mediating role of "ascribed responsibility → waste management → sustainable practice".*

2.6. Theoretical Model Construction

With reference to existing literature, this study builds a model of ascribed responsibility and influence mechanism of green sustainable practice based on the above hypothesis, which is as shown in Figure 1.

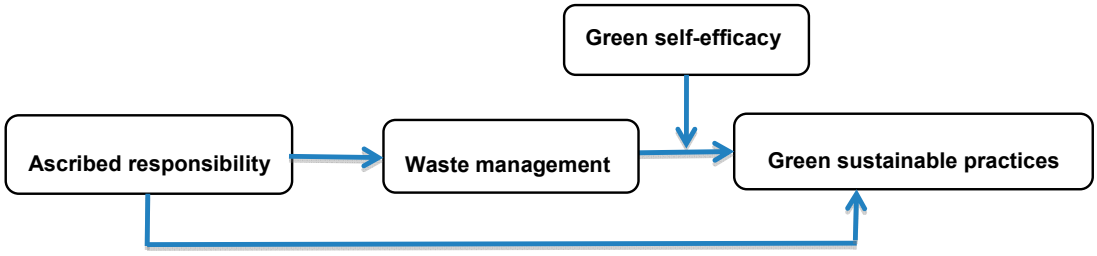

Figure 1. Path model of responsibility attribution on green sustainable practice.

3. Methods

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

3.1. Sample and Procedures

The measurement content of empirical analysis is based on the mature measurement content which has been formed in the existing literature at home and abroad, However, considering the cultural differences at home and abroad, in order to ensure the validity of the measurement, the authors conducted in-depth interviews with middle and senior managers of pre-cooperative enterprises before the questionnaire was conducted. Subsequently, face-to-face interviews with senior and middle-level intentional enterprises and questionnaire surveys were conducted with the help of industry associations; the support of government cooperation projects and in collaboration with MBA students in Tong Ji university in China. The survey was conducted from March to May in 2019. Finally, 171 questionnaires were collected out of 200 visited enterprises with the response rate of 85.5%; and 149 questionnaires were collected with the effective rate of 74.5%. Among the sample enterprises, there exists 82 state-owned enterprises accounting for 55%, and the rest were joint-stock enterprises, private enterprises, joint ventures and so on. Regarding the industry type, 31% of the sample enterprises are recognized as non-ferrous metal manufacturing industry, with the scale of employees varying from 50 to 1000 or more. The enterprises involved in this study constitute different types of ownership, company size, and industry, which have a strong overall representation.

3.2. Measurements

3.2.1. Variable Measurement

This study involves four variables: ascribed responsibility, waste management, green sustainable practices, and green self-efficacy. In order to ensure the reliability and validity of the variable measurement in this study, the authors refer to the existing research, and determine the final scale measurement with the consultation and review of experts, which is shown in Appendix A.

Green sustainable practice refers to the sustainable practice with integration of green concept to reduce the damage of ecological environment resulted from enterprise production process [45]. Green sustainable practice was measured using 5 items (see Appendix A), adapted from Kerr [45] et al. The Cronbach's alpha coefficient is 0.826, which indicates that the measurement of this variable has high reliability [46].

Ascribed responsibility is an important part of normative activation theory, which emphasizes whether an individual can take responsibility for the consequences of a certain behavior and change the unfavorable behavioral attitude [22]. Ascribed responsibility was measured using 4 items (see

Appendix A), adapted from Steg and De Groot et al [22]. The Cronbach's alpha coefficient is 0.707, which is higher than 0.7, indicating that the variable has good reliability].

Waste management refers to the effective management of solid wastes and wastewater produced by enterprises during the process of production and operation, which aims to reduce the negative environment impacts; promote utilization of resources; and maximize the economic and environmental benefits [17]. In order to measure it scientifically, 4 items (see Appendix A), adapted from Tchobanoglous et al [26] was applied. The Cronbach's alpha coefficient is 0.881, showing that the measurement of this variable has high reliability .

Green self-efficacy integrates self-efficacy with green factors, which emphasizes the subjective judgment of whether an individual can effectively solve environmental problems.

Green self-efficacy was measured using 5 items (see Appendix A), adapted from Chen et al [39]. The Cronbach's alpha coefficient is 0.932, which shows that the green self-efficacy measurement scale has good reliability.

Independent variables, dependent variables, mediating variables and moderating variables in this study were all measured using Likert scale: 5 means "strongly agree";1 means strongly disagree.

In addition, in order to ensure the robustness of the hypothesized relationship, enterprise type, age, and education level of managers were conducted as control variables in this study.

3.3. Analytical Strategy

Before testing the hypothesis in this study, LISREL8.7 (Scientific Software International, Inc., Lincolnwood, IL, USA, 2004) was used to conduct confirmatory factor analysis for four variables: ascribed responsibility waste management, green sustainable practice and green self-efficacy. The mediating effect of waste management was analyzed through method proposed by Baron and Kenny. The moderate effect is tested by referring to Cohen's method. In addition, the authors adopted Collaborative-bootstrapping method posed by Edwards and Lambert to analyze the mediating effect of waste management between managers' responsibility and green sustainable practice under different levels of green self-efficacy.

4. Data Analysis and Results

4.1. Measurement Model Evaluation

4.1.1. Reliability Analysis

This study applied Cronbach's alpha coefficient to test the reliability of the questionnaire and it is generally believed that Cronbach's alpha value between 0.7 and 0.8 represent high reliability value [47]. The reliability values of each scale in this study are shown in Table 1, which are all greater than 0.7, showing that the questionnaire scale has good internal stability and consistency and can reflect the measured variables to be uniformly stable [47]. In addition, Table 1 shows that the combination reliability (CR) of the variables is higher than the acceptable value of 0.7 (between 0.716 and 0.934)[47], and the aver variance extraction volume (AVE) of the variables exceeds the acceptable level of 0.5, indicating that the variables designed in this study have high stability[47].

Table 1. Reliability and validity analysis.

Variable	CR	AVE	Cronbach's α
Ascribed responsibility	0.716	0.598	0.707
Waste management	0.832	0.632	0.881
Green self-efficacy	0.934	0.639	0.932
Green sustainable practices	0.829	0.604	0.826

4.1.2. Validity Analysis

According to the model detection method proposed by Mathieu and Farr in 1991[48], the authors tested convergence validity and differential validity of module-to-variable and results are shown in Table 2 (LISREL8.7 was used). According to the model-fitting index, the four-factor model is superior to other groups, verifying that there is an obvious difference between variables of this research. Besides, the Table 2 shows the single factor model fitting index (χ^2/df = 23.067; RMSEA = 0.386; CFI = 0.210; NLI = 0.211; RFI = 0.058; IFI = 0.220), all of which have not reached the critical value of fitting. Thus, the single-factor model has the worst fitting degree compared with other model indexes and the four-factor model in this study has the best fitting degree with all the indexes falling into the acceptable range (χ^2/df = 2.071; RMSEA = 0.085; CFI = 0.972; NLI = 0.941; RFI = 0.933; IFI = 0.970) [49].

Table 2. Factor analysis results.

Model		χ^2 / DF	RMSEA	CFI	NFI	RFI	IFI
Model1	4 Factors：AR、WM、GSE、GSP	2.071	0.085	0.972	0.941	0.933	0.970
Model2	3 Factors：AR+WM、GSE、GSP	7.257	0.206	0.600	0.578	0.486	0.602
Model3	2Factors：AR+WM+GSE、GSP	15.946	0.318	0.454	0.437	0.332	0.464
Model4	1 Factors：AR+WM+GSE+GSP	23.067	0.386	0.210	0.211	0.058	0.220

AR = Ascribed responsibility; WM = waste management, GSP = Green sustainable practices, GSE = Green self-efficacy

4.1.3. Common Method Bias Test

In order to further verify the common source deviation of questionnaire data in this study, the authors adopted program control during questionnaire design and used concise context to reduce the understanding error of the respondents with reference to Podsakoff's [50] research. During the process of anonymous questionnaire, the authors promise that there are no right or wrong answers in this questionnaire, and there is no moral constraint. With application of Harman single factor method, the results show that, under the condition of no rotation, the cumulative variance contribution rate was 78.84%, and the variation of the first factor was explained as 14.32%, less than 50%. Therefore, common source bias can be ignored in this study.

4.1.4. Descriptive and Correlation Analysis

This paper applied SPSS19.0 to analyze the data. The mean value, standard deviation and correlation coefficient matrix of each variable were shown in Table 3. It can be seen that ascribed responsibility is significantly positively correlated with waste management (r = 0.421, $p < 0.001$); green self-efficacy (r = 0.290, $p < 0.001$); green sustainable practices (r = 0.217, $p < 0.01$) waste management and green sustainable practices (r = 0.173, $p < 0.05$) are also significantly positively correlated. Since the correlation coefficient between all variables was less than 0.6, the influence of multicollinearity can be neglected. In addition, in order to further verify whether this study is affected by multicollinearity, VIF coefficient of each regression equation is calculated. The results show that VIF value is less than 3, which is less than the critical value of 10[51]. Therefore, the authors conclude that the influence of multicollinearity can be ignored in this study.

Table 3. Descriptive and correlation analysis.

Variable	Mean	SD	1	2	3	4
1.Ascribed responsibility	3.718	0.460	0.773			
2.Waste management	4.033	0.517	0.421 ***	0.795		
3.Green self-efficacy	3.718	0.588	0.290 ***	0.001	0.799	
4.Green sustainable practices	1.837	1.502	0.217 **	0.173 *	0.313	0.777

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; N = 149, The diagonal underscore value is the square root of AVE

4.2. Result of Hypotheses Testing

In order to clearly verify the relationship between the hypotheses in this study, this research adopts analysis strategies posed by Baron and Kenny [52]. The authors applied stepwise regression method, and subsequently introduced variables including age and educational level of managers, type of enterprises, ascribed responsibility, waste management, green sustainable practice and green self-efficacy into regression equation (shown in Table 4; Table 5). Firstly, the authors verified the direct effects of responsibility, waste management and green sustainable practice. Secondly, the authors verified the mediating effect of waste management on responsibility attribution and green sustainable practice; finally, the authors tested the moderating effect of green self-efficacy.

4.2.1. Direct Effect Test

In order to verify the positive impact of managers' ascribed responsibility on waste management, this study involves ascription of responsibility as the independent variable and waste management as the dependent variable. The results are shown in Table 4, model 2 or see Figure 2.,where ascribed responsibility has a positive impact on waste management ($\beta = 0.428$, $p < 0.001$). Therefore, Hypothesis 1 is accepted. Similarly, ascribed responsibility has a significant positive effect on green sustainable practices ($\beta = 0.180$, $p < 0.05$) and Hypothesis 2 is accepted (see Table 4, model 4 or see Figure 2). Waste management has a positive impact on green sustainable practices ($\beta = 0.233$, $p < 0.01$) and thus, Hypothesis 3 is accepted (see Table 5, model 7 or see Figure 2).

Table 4. Hierarchical regression results (N = 149).

Variable	Waste Management		Green Sustainable Practices			VIF
	Model 1	Model 2	Model 3	Model 4	Model 5	
Age	−0.041	0.022	−0.201	−0.173	−0.182	1.142
Education level	0.087	0.087	0.193 *	0.193*	0.204 *	1.177
Enterprise type	0.123	0.143	0.228 ***	0.216 **	0.237 **	1.201
Ascribed responsibility		0.428 ***		0.180*	0.101	1.253
Waste management					0.182 *	1.255
R^2	0.031	0.201	0.153	0.180	0.210	
R^2 change	0.031	0.178	0.153	0.033	0.032	
F	1.485	9.513 ***	8.756 ***	8.204 ***	7.660 ***	
F change	1.486	32.582 ***	8.762 ***	5.667	5.243 **	
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; N = 149						

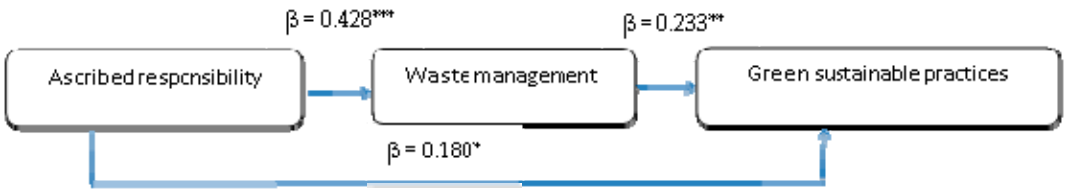

Figure 2. Direct path effects (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

4.2.2. Mediating Effect Test

In order to clearly define the mediating role of waste management, the authors verified whether there exists mediating effect between ascribed responsibility and green sustainable practice with application of intermediary analysis method proposed by Baron and Kenny [52]. In detail, the authors firstly verified the direct effects of ascribed responsibility on waste management and green sustainable practice. Secondly, the authors verified the direct effects of waste management on green sustainable practice. Given that step 1 and step 2 are established, the intermediary role of waste management will be established if the managers ascribed responsibility weakens or does not play a

significant role in the green sustainable practice of enterprises after introducing waste management as intermediary variable.

The direct relationship between managers' ascribed responsibility, enterprise waste management and green sustainable practice in this study has been verified (see Section 4.2.1 direct effect test for details). Subsequently, in order to verify the mediating role of waste management, the authors added waste management as mediating variable into model 4 to form the new model 5. The results (see Table 4 or see Figure 3) show that the ascribed responsibility has no significant impact on sustainable practice (β = 0.101, NS). However, waste management has a positive impact on sustainable practices (β = 0.182, $p < 0.05$), Thus, it can be seen that waste management plays a completely mediating role in the affecting mechanism of ascribed responsibility to green sustainable practice, that is, Hypothesis 4 is accepted.

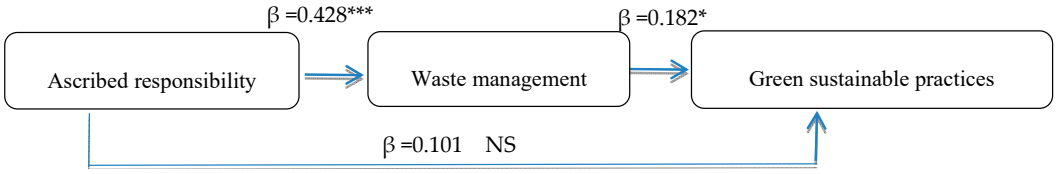

Figure 3. Mediating path effects (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

4.2.3. Moderate Effect Test

The moderate effect is tested with reference to Cohen's method [53]. Taking green sustainable practice as the dependent variable, the independent variable and the moderate variable are standardized, and the product term is constructed respectively for hierarchical regression analysis. Firstly, control variables are introduced to establish model 6. Subsequently, waste management is introduced and model 7 is established. Based on model 7, green self-efficacy is further introduced to establish model 8. Finally, the product terms of waste management and green self-efficacy are involved (to avoid multicollinearity, the product term is the centralized variable product), and the model 9 is established.

Regarding the moderate effect of green self-efficacy, it can be seen from Table 5 and Figure 4 that the product terms of moderating variable green self-efficacy and waste management have significant positive impacts on green sustainable practice (model 9, β = 0.284, $p < 0.05$). It can be concluded that green self-efficacy plays a moderating role in the relationship between waste management and green sustainable practice. Thus, Hypothesis 5 is accepted.

Table 5. Hierarchical regression results (N = 149).

Variable	Green Sustainable Practices				VIF
	Model 6	Model 7	Model 8	Model 9	
Age	−0.202	−0.202	−0.152	−0.171	1.182
Education level	0.187 *	0.211 *	0.187*	0.175 *	1.846
Enterprise type	0.231 ***	0.263 **	0.211**	0.202 *	1.261
Waste management		0.233 **	0.220*	0.253 **	1.067
self-efficacy			0.186*	0.055	1.648
Waste management× self-efficacy				0.284 *	1.557
R^2	0.152	0.202	0.228	0.284	
R^2 change	0.152	0.053	0.029	0.029	
F	8.756 ***	9.150 ***	8.720 ***	8.612 ***	
F change	8.756 ***	8.883 **	5.785	6.380 *	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; N = 149

In order to further verify whether the moderate effect is consistent with the research hypothesis, this study adopts Aiken and West's method to draw the relationship of waste management and green sustainable practices under the level of one standard deviation above and below the mean of green self-efficacy (see Figure 5) [54]. As can be seen from Figure 5, regarding managers with high green self-efficacy, there is a strong positive relationship between waste management and green sustainable practice, and the slope is positive (simple slope = 0.349, $p = 0.007$). With reference to managers with low green self-efficacy, waste management has no significant impact on green sustainable practice. Therefore, Hypothesis 5 is further verified.

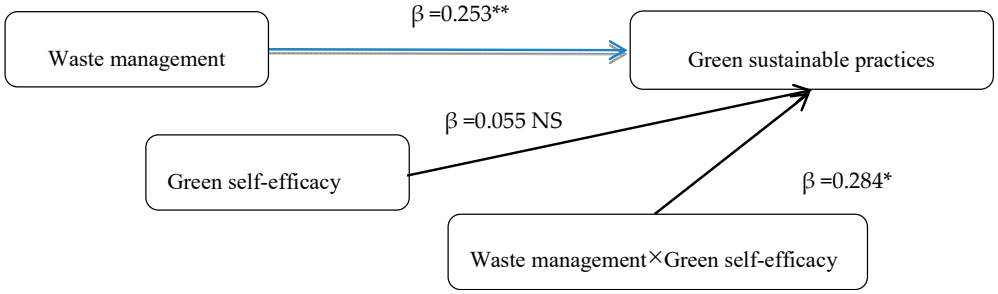

Figure 4. Moderate path effect. (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

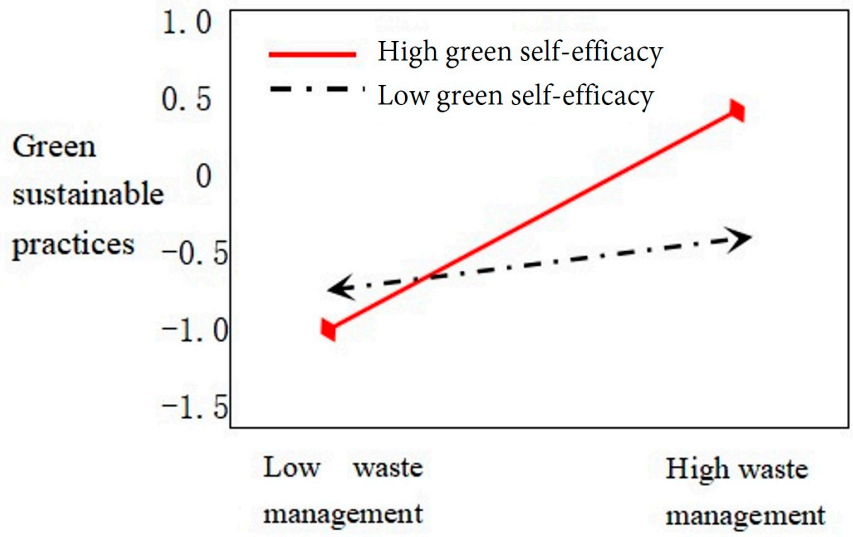

Figure 5. Schematic diagram of interaction effect.

As can be seen, managers with higher green self-efficacy and perception of capability taking measures to fulfill environmental protection behavior will stimulate enterprises to practice waste management. In addition, the research conclusion shows that managers' ascribed responsibility has

a situational dependence on the impact of waste management, that is, there is heterogeneity in the intensity of waste management practiced by managers under different green self-efficacy levels.

4.2.4. Moderating Mediating Effect Test

In order to test the moderate mediating effect of green self-efficacy on waste management, the authors adopted two-stage analytical method posed by Edwards and Lambert [55]. At the first stage, the authors analyzed the impact of ascription of responsibility on waste management; and at second stage, the authors analyzed the impact of waste management on green sustainability practices.

As seen from Table 6, waste management has no significant impact on the green sustainable practice ($\beta = 0.014$, NS) when the green self-efficacy of managers is low; while waste management has a positive impact on the green sustainable practice of enterprises ($\beta = 906$, $p < 0.01$) when the green self-efficacy of managers is high. Furthermore, there exists significant difference between coefficients of these two variables ($\Delta\beta = 0.892$, $p < 0.05$). Thus, green self-efficacy reinforces the impact of waste management on sustainable practices, which further verifies Hypothesis 5. In addition, the results (see Table 6) show that ascribed responsibility has an indirect effect on green sustainable practices through the role of waste management. This indirect impact is insignificant ($\beta = 0.006$, NS) when green self-efficacy is low while it is positively significant ($\beta = 0.547$, $p < 0.01$) when green self-efficacy is relatively high. The difference of these two circumstances is significant ($\Delta\beta = 0.541$, $p < 0.01$). Therefore, Hypothesis 6 is accepted.

As can be seen, the higher the managers' green self-efficacy is, the more significant the promotion of managers' ascribed responsibility can be to stimulate sustainable practice through waste management. This also shows that the indirect effect of ascribed responsibility to sustainable practice is heterogeneous under different levels of green self-efficacy.

Table 6. Moderating mediating effect.

Moderator Variable	Stage		Effect		
	First Stage	Second Stage	Direct Effect	Indirect Effect	Total Effect
	β_{XM}	β_{MY}	β_{XY}	$\beta_{XM} \times \beta_{MY}$	$\beta_{XY} + \beta_{XM} \times \beta_{MY}$
Green self-efficacy	(X) → (M) → (Y)				
Low-green self-efficacy	0.416*	0.014	0.229	0.006	0.235
High-green self-efficacy	0.604 ***	0.906 **	0.371	0.547 **	0.918 **
Differences	0.188	0.892 *	0.142	0.541 *	0.683

*$p < 0.05$; **$p < 0.01$; X = ascribed responsibility; M = waste management; Y = green sustainability practices; moderating variable: green self-efficacy; High green self-efficacy represents the mean + 1 SD, while low green self-efficacy represents the mean − 1 SD

5. Discussion and Implications

5.1. Discussion

Managers' ascribed responsibility has a positive impact on green sustainable practice, which shows the importance of environmental characteristics of managers. When managers have environmental responsibility consciousness, they tend to consider ecological environment during decision-making and actively respond to national environmental regulations such as energy saving and consumption reduction, which finally promote enterprises' sustainable practice [56,57]. In addition, this study further validates the positive impact of responsibility of managers on waste management practices, which is consistent with existing research of normative activation theory and cognitive behavior theory[58]. Managers with the ascribed responsibility are more inclined to

perform sustainable production and operation activities and balance the conflicts between enterprise development and environmental protection. Thus, promoting responsibility of managers seems to be a new solution on stimulating ecological green development of enterprises [24,25].
This study verifies the mediating role of waste management in the affecting mechanism of ascribed responsibility on green sustainable practice. In detail, the ascribed responsibility of managers can be transferred into application of waste management and thus promoting sustainable practice. The mediating role of waste management suggested by this study is different from the research of Peter [58]who suggested partially mediated role. The conclusions are different due to two possible reasons: cultural differences or the validity of the questionnaire data.

This study validates the moderating effect of green self-efficacy. In particular, different green self-efficacy situations can affect the performance of waste management by managers who have ascribed responsibility[12]. Although the existing literatures have verified the positive role of green self-efficacy in the field of environment, most of them present it as independent variable or dependent variable instead of moderating variable. Therefore, this study expands the application of self-efficacy theory [52] and enriches the influence of managers' environment characteristics on enterprise sustainable practice.

Compared with the existing literature, which focus on the discussion of pro-environmental behavior of enterprises from policy perspectives (Jabbour [14]; Pinzone [15]), this study explores the sustainable practice of enterprises from the perspective of managers' environmental characteristics, so as to provide theoretical contributions for sustainable development of enterprises. Moreover, this study indicates the importance of ascribed responsibility and green self-efficacy and provides references for enterprises to promote sustainable development [59].

In a word, this study enriches the action path of green sustainable practice [44] and verifies the important role of environmental characteristics of managers in enterprises' practice of green sustainable practice. That is, when managers integrate environment into individual values, it will affect the organization to adopt green strategy in daily production and operation and promote green and sustainable practice [39].

5.2. Implications

Managers' ascribed responsibility is an important factor that promotes firm performance on pro-environment activities, which provides reference for enterprises to practice green sustainable practice. Furthermore, green self-efficacy of managers strengthens managers' determination on carrying out pro-environment practice. Hence, this study suggests that enterprises should pay attention to promote managers' environmental awareness, making it a unique and irreplaceable core competitive advantage for enterprises to practice green sustainable practice. At the same time, enterprises should pay more attention to those managers with higher moral obligations and responsibilities to the environment and improve the goal of green sustainable practice [60]. In addition, enterprises should support training aimed at improving managers' environmental awareness and attitude, through which their awareness and green self-efficacy can be improved, and thus facilitating green processes such as waste management and promoting practice of green sustainable development [61].

During the process of green sustainable practice, waste management is the key segment transferring managers' ascribed responsibility to promote green sustainable practice. Therefore, enterprises can encourage the research and development of waste utilization technology and improve the utilization rate of waste disposal. In parallel, a symbiotic system among enterprises can be established based on industry chain to promote the comprehensive utilization of waste resources and the green sustainable practice; In addition, enterprises in the production process to strictly implement the three waste standards, promote enterprises green sustainable practice [62].

6. Conclusions

Based on normative activation theory and cognitive behavior theory, this study introduces intermediary variable—waste management, moderating variable—green self-efficacy, constructs

moderated mediation model, and focuses on the relationship between environmental characteristics of managers and green sustainable practice，Highlight the importance of managers' ascribed responsibility and green self-efficacy. The empirical results show that managers with ascribed responsibility will consider the impact of their own decisions on the environment, and then strengthen waste management in the process of enterprise operation and management, so as to promote the development of enterprise green and sustainable practice. Meanwhile, waste management is the key driving force for enterprises to practice green and sustainable practices. In addition, green self-efficacy of managers positively regulates the action path of waste management on green sustainable practice, and positively regulates the indirect effect of managers' ascribed responsibility attribution on green sustainable practice through waste management. That is to say, managers with higher green self-efficacy are more likely to have a positive impact on enterprise green sustainable practices through enterprise waste management. The research conclusion verifies the research paradigm proposed in this study, which is helpful for enterprises to extract the successful factors and influencing paths of enterprises' green sustainable practice from the perspective of managers' environmental protection beliefs and attitudes and promote the healthy and steady development of green sustainable practice.

Although this study has achieved certain theoretical and practical significance, it also has limitations. First of all, the samples in this study mainly refer to manufacturing enterprises. In future studies, the sample area and industry scope can be expanded to improve the universality of the research. Secondly, this study takes green self-efficacy as the only moderating variable while there may exist other moderating variables. Thirdly, enterprise environmental protection behavior involves not only waste management, but also green technology innovation and energy conservation, which can be expanded in future studies. In addition, the manager of this study is only defined as the middle and senior leaders who are responsible for the production and operation of the enterprise and does not include stakeholders. Future research can be integrated with stakeholders to deepen the research content and ensure the scientific nature of the research.

Author Contributions: Conceptualization, L.G. and Y.X.; methodology, L.G. and Y.X.; software, L.G.; validation, L.G. and Y.X. and T.W.; formal analysis, G.L.; investigation, Y.X.; resources, C.D.; data curation, C.D.; writing—original draft preparation, L.G. and Y.X.; writing—review and editing, Y.X. and L.G.; visualization, T.W.; supervision, T.W.; project administration, G.L.; funding acquisition, G.L.

Funding: This research was funded by the Major projects of the National Social Science Fund (15ZDC030); and Shanghai Philosophy and Social Science Planning Project (120024205460).

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Latent variables and their respective measurement items.

Variables	Items
Green Sustainable practices	1.The raw materials purchased by the enterprise meet certain environmental standards
	2.Our products can identify activities that are harmful to the environment and provide alternatives to minimize negative environmental impacts
	3.Our products are designed to minimize the adverse impact on the environment
	4.This enterprise can carry on the prompt processing of harmful substance generated during production
	5.Our products will be designed to reduce the adverse impact on the environment
	6.Our enterprise will conduct environmental audit on the production process regularly
	7.Our enterprise has a clear understanding of the importance of environmental policy
Variables	Items
Ascription of responsbility	1.I feel responsible for energy saving and waste reducing
	2.I feel responsible for the disposal of solid and toxic waste
	3.My contribution to energy saving and waste reducing is negligible
	4.Not only the government and industry are responsible for the treatment of solid and toxic wastes, so am I

Variables	Items
Waste management	1.The enterprise sets measurable targets for waste reduction
	2.The enterprise applies the most environmentally friendly and safe procedures to promote waste recycling
	3.The enterprise properly dispose of hazardous waste, and comply with regulated standards
	4.The waste storage facilities of our enterprise meet environmental requirements
Variables	Items
Green self-efficacy	1.I think I can succeed in environmental protection
	2.I think I have the ability to deal with the environment problem effectively
	3.I think I can overcome the environmental problems
	4.I feel that my scientific research is actually fulfilling the mission of environmental protection
	5.I think I can find creative solutions to environmental problems

References

1. Bai, X.; Zeng, J. Air pollution, environmental regulation and industrial development—Evidence from sulfur dioxide emissions. *Soft Sci.* **2019**, *33*, 1–4. (In Chinese)
2. UNEP. *Global Waste Management Outlook*; United Nations Environment Programme: Washington, DC, USA, 2015.
3. Shen M. Germination and sublimation of Xi Jinping's ecological civilization thought. *China Popul. Resour. Environ.* **2018**, *28*, 1–7.
4. Jabbour, C.J.C.; Neto, A.S.; Gobbo, J.A.; de Souza Ribeiro, M.; de Sousa Jabbour, A.B.L. "Eco-innovations in more sustainable supply chains for a low-carbon economy: A multiple case study of human critical success factors in Brazilian leading companies". *Int. J. Prod. Econ.* **2015**, *164*, 245–257.
5. Neves, T.; Drohomeretski, E.; Da Costa, S.E.G.; De Lima, E.P. Sustainable operations management: Practices and measures in the food industry. *Int. J. Adv. Oper. Manag.* **2014**, *6*, 335–352.
6. Bonney, M. Environmentally responsible inventory models: Non-classical models for a non-classical era. *Int. J. Prod. Econ.* **2011**, *2*, 157–209.
7. Da Silva Rocha, A.B.; Salomão, G.M. Environmental policy regulation and corporate compliance in evolutionary game models with well-mixed and structured populations. *Eur. J. Oper. Res.* **2019**, *279*, 486–501.
8. Hemingway, C. Managers' personal values as drivers of corporate social responsibility. *J. Bus. Ethics* **2004**, *50*, 33–44.
9. Abbas, J.; Sagsan, M. Impact of knowledge management practices on green innovation and corporat sustainable development: A structural analysis. *J. Clean. Prod.* **2019**, *229*, 611–620.
10. Mohammad Dalvi, E. Psychological factors influencing the managers' intention to adopt Green IS: A review-based comprehensive framework and ranking the factors. *Int. J. Strat. Decis. Sci.* **2015**, *6*, 28–56.
11. Kim, Y.; Rhee, D.-E. Do Stringent Environmental Regulations Attract Foreign Direct Investment in Developing Countries? Evidence on the "Race to the Top" from Cross-Country Panel Data. *Emerg. Mark. Financ. Trade* **2019**, *55*, 2796–2808.
12. Esfahani, M.D.; Rahman, A.A.; Zakaria, N.H. Green IT/IS adoption as corporate ecological responsiveness: An academic literature review. *J. Soft Comput. Decis. Support Syst.* **2015**, *2*, 35–43.
13. Robertson, J.L.; Barling, J. Contrasting the Nature and Effects of Environmentally Specific and General Transformational Leadership. *Leadersh. Organ. Dev. J.* **2017**, *38*, 22–41.
14. Jabbour, C.J.C.; de Sousa Jabbour, A.B.L. Green Human Resource Management and Green Supply Chain Management:Linking Two Emerging Agendas. *J. Clean. Prod.* **2016**, *112*, 1824–1833.
15. Pinzone, M.; Guerci, M.; Lettieri, E.; Redman, T. Progressing in the Change Journey Towards Sustainability in Healthcare: The Role of 'Green' HRM. *J. Clean. Prod.* **2016**, *122*, 201–211.
16. Cordente-Rodríguez, M.; Mondéjar-Jiménez, J.A.; Meseguer-Santamaría, M.L.; Mondéjar-Jiménez, J.; Vargas-Vargas, M. Environmental behavior and selective waste management in Spanish housing. *Environ. Eng. Manag. J.* **2010**, *9*, 1165–1171.
17. Akdag, H.C.; Beldek, T. Waste management in green building operations using GSCM. *Int. J. Suppl. Chain Manag.* **2017**, *6*, 174–180.

18. Ferreira, M.A.; Jabbour, C.J.C.; de Sousa Jabbour, A.B.L. Maturity levels of material cycles and waste management in a context of green supply chain management: An innovative framework and its application to Brazilian cases. *J. Mater. Cycles Waste Manag.* **2017**, *19*, 516–525.
19. Wu, J.S.; Tseng, H.K.; Ferrell, J.C.; Liu, X. Transforming waste management operations to green energy initiatives: Opportunities and challenges. *Int. J. Energy Econ. Policy* **2017**, *7*, 50–57.
20. Ding, Z.; Wang, Y.; Zou, P.X.W. An agent based environmental impact assessment of building demolition waste management: Conventional versus green management. *J. Clean. Prod.* **2016**, *133*, 1136–1153.
21. Zamparas, M.; Kapsalis, V.C.; Kyriakopoulos, G.L.; Aravossis, K.G.; Kanteraki, A.E.; Vantarakis, A.; Kalavrouziotis, I.K. Medical waste management and environmental assessment in the Rio University Hospital. Western Greece. *Sustain. Chem. Pharm.* **2019**, *13*, 100163.
22. Steg, L.; De Groot, J. General antecedents of personal norms, policy acceptability, and intentions: The role of values, worldviews, and environmental concern. *Soc. Nat. Resour.* **2011**, *24*, 349–367.
23. Zhang, Y.; Wang, Z. Antecedents of employee electricity saving behavior in organizations: An empirical study based on norm activation model. *Energy Policy* **2013**, *62*, 1120–1127.
24. Villanueva-Alvaro, J.-J.; Mondejar-Jimenez, J.; Saez-Martinez, F.-J. Rural tourism: Development, management and sustainability in rural establishments. *Sustainability* **2017**, *9*, 818.
25. Jansson, J. Green consumer behavior: Determinants of curtailment and eco-innovation adoption. *J. Consum. Mark.* **2010**, *27*, 358–370.
26. Tchobanoglous, G. Environmental Engineering: Environmental Health and Safety for Municipal Infrastructure, Land Use and Planning, and Industry. *Solid Waste Manag.* **2009**, *21*, 177–307.
27. Brebbia, C.A.; Itoh, H.; Beldek, T.; Camgöz-Akdağ, H.; Hoşkara, E. Green supply chain management for construction waste: case study for turkey. *Int. J. Sustain. Dev. Plan.* **2016**, *11*, 771–780.
28. Patrício, J. Urban material cycle closing-assessment of industrial waste management in Lisbon region. *J. Clean. Prod.* **2015**, *106*, 389–399.
29. Winfrey, B.K.; Tilley, D.R. An emergy-based treatment sustainability index for evaluating waste treatment systems. *J. Clean. Prod.* **2016**, *112*, 4485–4496.
30. Weerasiri, S. Attitudes and awareness towards environmental management and its impact on environmental management practices (EMPS) of SME in Sri Lanka. *J. Soc. Dev. Sci.* **2012**, *3*, 16–23.
31. Zang, W.; Wang, F. Adhere to green development and promote the management, utilization and disposal of industrial solid waste. *Environ. Prot.* **2008**, *46*, 12–16. (In Chinese)
32. Luca, F.A.; Ioan, C.A. Implementation of green marketing in the analysis of municipal waste produced in Romania, correlated with environmental policy management. *Environ. Eng. Manag. J.* **2014**, *13*, 3131–3142.
33. Isya, M.; Rani, H.A.; Utama, F.P. Effect of Green Road Concept on Waste Management on Road Construction in the Banda Aceh City. *IOP Conf. Ser. Mater. Sci. Eng.* **2019**, *469*, 012061.
34. Aykol, B.; Leonidou, L.C. Researching the green practices of smaller service firms: Atheoretical, methodological, and empirical assessment. *J. Small Bus. Manag.* **2015**, *53*, 1264–1288.
35. Oo, E.; Jung, H.; Park, I.J. Psychological Factors Linking Perceived CSR to OCB: The Role of Organizational Pride, Collectivism, and Person–Organization Fit. *Sustainability* **2018**, *10*, 2481.
36. Kyriakopoulos, G.L.; Arabatzis, G.; Tsialis, P.; Ioannou, K. Electricity consumption and RES plants in Greece: Typologies of regional units. *Renew. Energy* **2018**, *127*, 134–144.
37. Zaman, A.U. A comprehensive review of the development of zero waste management: Lessons learned and guidelines. *J. Clean. Prod.* **2015**, *91*, 12–25.
38. Leonidou, L.C.; Leonidou, C.N.; Fotiadis, T.A.; Zeriti, A. Resources and capabilities as drivers of hotel environmental marketing strategy: Implications for competitive advantage and performance. *Tour. Manag.* **2013**, *35*, 94–110.
39. Chen, Y.S.; Chang, C.H.; Yeh, S.L.; Cheng, H.I. Green shared vision and green creativity: The mediation roles of green mindfulness and greenself-efficacy. *Qual. Quant.* **2015**, *49*, 1169–1184.
40. Meinhold, J.L.; Malkus, A.J. Adolescent environmental behaviors: Can knowledge, attitudes, and self—efficacy make a difference. *Environ. Behav.* **2005**, *37*, 511–532.
41. Nordlund, A. Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. *J. Environ. Psychol.* **2003**, *23*, 339–347.
42. Steg, L. Explaining prosocial intentions: Testing causal relationships in the norm activation model. *Br. J. Soc. Psychol.* **2010**, *49*, 725–743.

43. Ervin, D.; Wu, J.; Khanna, M.; Jones, C.; Wirkkala, T. Motivations and barriers to corporate environmental management. *Bus. Strategy Environ.* **2013**, *22*, 390–409.
44. Gholami, R. Senior managers' perception on green information systems (IS) adoption and environmental performance: Results from a field survey. *Inf. Manag.* **2014**, *50*, 431–438.
45. Kerr, I.R. Leadership strategies for sustainable SME operation. *Bus. Strategy Environ.* **2006**, *15*, 30–39.
46. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *Mark. Res.* **1981**, *18*, 39–50.
47. Bentler, P.M.; Bonett, D.G. Significance tests and goodness of fit in the analysis of covariance structures. *Psychol. Bull*. **1980**, *88*, 588–606.
48. Brown, T.A. *Confirmatory Factor Analysis for Applied Research*; Guilford Press: New York, NY, USA, 2006.
49. Ployhart, R.E.; Oswald, E.L. Applications of mean and covariance structure analysis: Integrating correlational and experimental approaches. *Organ. Res. Methods* **2004**, *7*, 27–65.
50. Podsakoff, P.M.; Mac Kenzie, S.B.; Lee, J.-Y. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **2003**, *88*, 879–903.
51. Menard, S. *Applied Logistic Regression Analysis: Quantitative Applications in the Social Sciences*; Sage Publications: Thousand Oaks, CA, USA, 1995.
52. Baron, R.M.; Kenny, D.A. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J. Personal. Soc. Psychol.* **1986**, *51*, 1173–1178.
53. Cohen, J.; Cohen, P.; West, S.G. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*; Routledge: London, UK, 2013.
54. Aiken, L.S.; West, S.G. *Multiple Regression: Testing and Interpreting Interactions*; Sage: Newbury Park, CA, USA, 1991.
55. Edwards, J.R.; Lambert, L.S. Methods for integrating moderation and mediation: A general analytical frame work using moderated path analysis. *Psychol. Methods* **2007**, *12*, 1–10.
56. Yacob, P.; Wong, L.S.; Khor, S.C. An empirical investigation of green initiatives and environmental sustainability for 2 manufacturing SMEs. *J. Manuf. Technol. Manag.* **2019**, *30*, 2–25.
57. He A.; An M. Local government competition, environmental regulation and green development efficiency. *China Popul. Resour. Environ.* **2019**, *29*, 21–30.
58. Nordlund, A.; Jansson, J.; Westin, K. Acceptability of electric vehicle aimed measures: Effects of norm activation. *Perceived Just. Eff.* **2018**, *117*, 205–213.
59. Watson, C. Edward.Self-Efficacy and Diffusion Theory, AV Akademikerverlag: Riga, Latvia, 2012.
60. Lin, H.Y.; Hsu, M.H. Using Social Cognitive Theory to Investigate Green Consumer Behavior. *Bus. Strategy Environ.* **2015**, *17*, 326–343.
61. Williams, S.; Schaefer, A. Small and medium-sized enterprises and sustainability: Managers' values and engagement with environmental and climate change issues. *Bus. Strategy Environ.* **2013**, *22*, 173–186.
62. Marcinkowski, A. The Spatial Limits of Environmental Benefit of Industrial Symbiosis–Life Cycle Assessment Study. *J. Sustain. Dev. Energy Water Environ. Syst.* **2019**, *7*, 521–538.