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How Does Green Search Promote Green Innovation? The Mediating Role of Green Control

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Abstract: The importance of a knowledge search for green innovation has been recognized, but our understanding of the influence of green search is still unclear. We used 198 Chinese manufacturing data to sort the influential mechanism of green search on green innovation based on resource-based theory, information processing theory, and transaction cost theory. We also explored the intermediate role of green control (i.e., output and behavior control) between the two dimensions of green search (i.e., search breadth and depth) and green innovation (i.e., exploratory and exploitative innovation). The results show that the diversified green information searched from outside must be controlled through the behavior process and results in improving the quality of existing green products and developing new green products. A continuous and deep search for green knowledge can achieve the results of green innovation by setting goals and monitoring processes. When Chinese manufacturing enterprises are searching for knowledge to produce green products, they must pay attention to the supervision and control of the knowledge integration process and results to ensure the effective utilization and transformation of knowledge.

Keywords: green search; green control; green innovation; mediating effect

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1. Introduction

Chinese manufacturers are making efforts to produce and export green products due to the desire of downstream actors for eco-friendly products. Such actors include retailers and industrial buyers in North America and Europe. However, in recent years, some situations such as outdated equipment and backward technology have evidently hindered the supply of green products by Chinese enterprises. Combined with the strategic goals of China's "carbon peak" and "carbon neutral", Chinese manufacturing enterprises have an increasingly strong demand for green innovation.

Many firms have attempted to improve the technical level and create green products meeting the environmental needs through green innovation. However, green innovation is essentially a complex and systematic knowledge creation activity involving many technical fields such as green manufacturing process, circular production, green product design, and others [1]. Few enterprises have all the resources needed for the above progress of creating knowledge [2]. Thus, enterprises are increasingly trying to search for external knowledge to overcome the lack of green innovative resources [3]. In this study, a green search is described as a collection of activities in that enterprises access environmental protection knowledge, information, and resources from external partners to create green products that meet the market.

This research aims to explore the impact of a green knowledge search on green innovation. Although the interest in green search is increasing, the results of the impact of green search on green innovation in the past are confusing. Will the search for external knowledge bring the results of green innovation? Some studies have found that an external knowledge search is conducive to the firms' innovative performance [4,5], but others have reported a non-significant or even negative impact [6–8].

Due to the contradictory conclusion of the effectiveness of a knowledge search, some scholars have tried to explain the inconsistency from the type of innovation [9] or search [10,11]. Nevertheless, they only considered one aspect and failed to combine the two types of search and innovation effectively. Different types of knowledge search obtain different information. The requirements for the novelty and complexity of green knowledge are difficult. Moreover, the high uncertainty of the external environment requires that enterprises should not carry out exploratory or exploitative innovation alone, but should try to maintain a balance [12,13]. Nevertheless, many practitioners have ignored this key problem [14]. How to balance the relationship between exploratory and exploitative innovation by using knowledge is crucial in the current research. Thus, balancing such a relationship has different effects on the innovative development of the original and new green products. Accordingly, the impact of the knowledge search on innovation should be further explored. In addition, whether the external knowledge can be fully used by enterprises may also be an important factor in affecting the results of green innovation [15]. However, the existing studies have paid little attention to the application of external knowledge in enterprises, which aggravates the uncertainty of green innovation [16,17].

Cui et al. (2020) believed that the full absorption and effective processing of information greatly affected the firm's external learning achievements [11]. Considerable complex technical information increases the difficulty of integrating knowledge, making it hard to transform and absorb knowledge completely [18]. However, the enterprises are still committed to searching for and developing new technical knowledge, which will seriously increase the search and time costs. This case is not only inconducive to the breakthrough of the original technology, but also increases the pressure on green innovation. Moreover, the process of integrating knowledge is full of great uncertainty. For instance, does the process (result) of producing products meet (achieve) the green environmental protection standards required by the enterprise? Are employees willing to integrate complex green knowledge to ease the difficulty and complexity of technical knowledge? These uncertainties require the organization to have comprehensive supervision and regulation. More particularly, the process of knowledge integration should be supervised, and the results of resource application must also be guided. Thus, this research used organizational information processing theory and transaction cost theory to study the intermediary role of green control between green search and green innovation.

This study selected 198 Chinese manufacturing enterprises as the research object. Based on the data provided by the manufacturing enterprise, we explored the direct effects of the two dimensions of green search (i.e., green search breath and green search depth) on green exploratory innovation and green exploitative innovation. Then, we explored the intermediate role of green output control and green behavior control. This study attempts to identify the following two questions. First, does an extensive and deep search of green information by manufacturing enterprises effectively promote exploratory and exploitative innovation? Second, what kind of control can the external green technical knowledge achieve a breakthrough in innovation to meet the needs of the market and end customers?

2. Literature Review and Hypothesis Development

2.1. Green Search and Green Innovation

Green innovation is a crucial way for enterprises to solve environmental pollution under environmental regulations. It can not only reduce the total carbon emissions and the existing environmental load, but also meet the consumers' green preferences [19,20]. More specifically, green innovation can support a healthy lifestyle and reduce the customers' health risks [21]. For enterprises, green innovation can not only improve the corporate image [22–24] and achieve better customer satisfaction, but also improve the market share, profit growth, return on sales, and others [21,25,26]. Green search is described as a collection of activities in which firms span temporal, spatial, and organizational boundaries to search and identify new knowledge, aiming to create green products that meet the market. The innovative search for external resources can be divided into the search breadth and search depth [27,28]. This study defined the green search breadth as the scope of the external search for green knowledge. For example, the enterprise often participate sin trade exhibitions and academic conferences related to environmental protection and reads professional journals and magazines to follow the latest trends in the market and emerging environmental protection technologies. The search depth describes the depth of the external search. For instance, the enterprise will continue to search for green information until all relevant information is determined, reflecting the deeper relationship between enterprises and green resources. In addition, green innovation includes green exploratory and exploitative innovation [15]. The former refers to using new knowledge and skills to create new green products or green markets [9]. Then, the latter is how enterprises use environmental knowledge, technology, and ability to improve the original green products and green design [29].

Considerable green heterogeneous resources exist outside the enterprises [9]. As training bases for national talents, universities and research institutes possess the most advanced technology and the strongest research and development capabilities [30]. As the initiator of ecological innovation, the government has proposed various environmental regulations and punitive measures, requiring the production of enterprises to meet the requirements of ecological environmental protection [11]. Meanwhile, the government has proposed various subsidy policies to reduce the cost of high-quality development [31]. Supply chain partners enjoy novel ideas [26], the latest market information [11] as well as advanced ecological technologies, green processes, marketing concepts, and others [32,33]. All kinds of professional knowledge generated from these different complementary sources supplement the capability and resource base for green development.

According to resource-based theory, valuable and scarce resources determine the sustainable competitive advantage of enterprises [34]. Collecting information from various external sources can help enterprises quickly obtain the resources and capabilities needed for innovation. On one hand, an extensive collection of ecological technologies and green processes related to green environmental protection will promote the diversification of green innovative knowledge sources. This case is beneficial for obtaining complementary and more valuable information based on original knowledge [35]. Meanwhile, the efficiency of solving the original problems can be effectively improved by recombining the external complementary resources with the original environmental knowledge within the enterprise, which will lay a knowledge foundation for enterprises to break through the original bottleneck of ecological technology [36]. On the other hand, regularly participating in trade exhibitions and academic conferences related to environmental protection can increase the diversity of knowledge, enrich the original knowledge base, and broaden the vision of new knowledge in developing new green products. Such participation can stimulate the generation of new ideas related to green production [37] and provide enterprises with more options to solve new problems [35]. Hence, this event will lay a foundation for enterprises to create new green products and green markets and is beneficial to green exploratory innovation. Thus, the following hypotheses are posited:

Hypothesis 1a (H1a): *The green search breadth has a positive impact on green exploitative innovation.*

Hypothesis 1b (H1b): *The green search breadth has a positive impact on green exploratory innovation.*

In addition to the green search breadth, a deep interaction also exists between enterprises and their knowledge sources. This case can be described as enterprises that continue to search for similar green knowledge outside. Based on the resource-based theory, when enterprises obtain the information they need continuously, they have the corresponding ability to create new things. On one hand, continuously searching for knowledge related to existing green products in the organization is conducive to strengthening the understanding of original knowledge [38]. Organizations may have more opportunities to identify the potential value of energy-saving materials and the internal relationship among the knowledge components of green products [39], which helps firms reduce the possibility of innovative errors and failures [27]. Consequently, such a continuous search for knowledge is helpful in breaking the innovation bottleneck of existing research and achieving green exploitative innovation. For example, a garment enterprise located in Wenzhou, Zhejiang Province, has collected, sorted, and loosened waste textiles by obtaining professional knowledge of recycled fiber spinning technology from external sources, which, in turn, reduces the environmental pollution.

On the other hand, the continuous search for similar environmental knowledge can strengthen the frequent communication with external knowledge sources (e.g., green suppliers and green environmental protection organizations). This search is conductive to understand the potential value and front-end demand of the green product market and consumer market. Therefore, aiming at the forefront of environmental protection technology and ecological practice is favorable, and new green products and green markets should be explored. For example, the carton packaging industry has conducted cross-border research on the dairy industry, and the results showed that consumers generally disliked yogurt sticking to the container wall. Hence, the company shifted to foldable packaging as the research direction for new products, which improved the recycling rate of cartons through ecological product design. Based on these findings, we propose that:

Hypothesis 1c (H1c): *The green search depth has a positive impact on green exploitative innovation.*

Hypothesis 1d (H1d): *The green search depth has a positive impact on green exploratory innovation.*

2.2. Mediating Role of Green Output Control

As few firms have the complete knowledge and resources to achieve green innovation [2], several firms are trying to achieve high-quality development with the help of external search [40]. When the enterprise obtains external knowledge and information related to green products, some situations will affect the transmission efficiency and quality of ecological technology and knowledge. These situations involve the opportunistic behavior of idleness and "free-riding" [41], the lack of transparency and asymmetry of green information [42], the environmental uncertainty in technology, demand, and supply, and others [26,43,44]. The above problems will increase the transaction cost of ecological knowledge transfer and the uncertainty of the productive process. In addition, the more knowledge you search for, the more difficult it is to integrate and absorb knowledge [11,45]. As a result, the demand for knowledge processing will become stronger.

According to information processing theory, the organizational structure of enterprises can be regarded as an information processing system. When the uncertainty of the organizational environment increases, the organization will face more information processing demands [26,46,47]. Thus, its ability to collect, integrate, process, and distribute information should be improved to match the processing demands [26,48]. Based on transaction cost theory, some problems such as unsmooth information communication channels, high information collection costs, and asymmetric and opaque information will generate large transaction costs in the process of the internal governance of enterprises [42,49].

The mechanism of internal control has properties of inherent information processing [50]. Internal control can not only improve the quality of information transmission, but also effectively reduces opportunistic behavior and transaction costs [51,52]. Therefore, according to transaction cost theory and organizational information processing theory, enterprises need to establish a mechanism of green control within the organization. The reason is that this mechanism will reduce environmental uncertainty and opportunistic behavior [53] and achieve a firm's sustainable development goal. Green control can be divided into green output control and green behavior control [51,54,55]. Output control aims to supervise and control the specific objectives and results that the organization needs to achieve [51]. The measures of control include goal setting, performance reports, a reward and punishment system, and others. Meanwhile, output control will often examine the results of the realization of the goal instead of interfering with the realization process [56].

More specifically, the employees are allowed to achieve their goals in different ways [57]. The setting of goals provides a standard for performance evaluation. Simultaneously, the setting of goals allows for the clarification of the expectations of all parties and improving the consistency of goals [58]. Many enterprises regard output control as an effective measure to encourage employees to develop green products. For example, the company Gree adheres to the development strategy of green innovation. Moreover, an employee who successfully develops low-carbon, environmentally friendly, and energy-saving products will receive a substantial reward. Inspired by this goal, the staff developed and manufactured ecological products actively and achieved good economic and environmental benefits.

Green information such as green materials, green processes, and the consumers' preferences for green products can be searched by suppliers, customers, scientific research institutions, and others. These sources of information are relatively extensive; meanwhile, the types and quantity of knowledge are varied. Quickly identifying knowledge needed for green product innovation from a large amount of knowledge is difficult for enterprises. According to the theory of organizational information processing, organizations must screen and integrate the vast knowledge to ensure that the knowledge can be quickly absorbed and transformed. That is, enterprises need to realize the matching of the information processing ability and processing needs. Therefore, the external knowledge must be processed before it can be used effectively. On one hand, organizations prefer to follow the original track in production to reduce the costs, uncertainty, and meet the needs of the original product market [59]. In other words, organizations are more likely to improve the quality, save energy, and reduce consumption based on original green products. Employees can be guided to screen ecological technologies, green materials, and green market information related to original green products actively through rewarding and punishing depending on the results of the green information screening and integration and whether the product meets the expected specifications and standards. Meanwhile, applying the screened knowledge to the original green product and green process specifications can meet the needs of the enterprise for the transformation and utilization of green information. Hence, improving the original products and technologies is beneficial, that is, it has a positive impact on green exploitative innovation.

On the other hand, as diversified green knowledge consumes too much channel management and search costs, enterprises are more inclined to maximize the use of knowledge [43]. In particular, firms tend to use knowledge to develop new products and expand new markets under the condition of meeting the original market [60]. However, developing new green products is full of great uncertainty [43,44], and it is not only difficult but also time-consuming. Employees can be endowed with some autonomy through rewards and punishments, depending on the results of the screening and integration of diversified green knowledge without intervening in its process [56,58]. The flexibility of employees in processing and integrating green information will also be improved. This case is more likely to generate innovative and flexible ideas [61], which will increase the possibility of new ecological knowledge combinations and create new ecological products. Thus, this event will realize the matching between the information processing capability and requirements [62,63] and lay the foundation for green exploratory innovation. Thus, we assume that:

Hypothesis 2 (H2): *The green output control plays an intermediary role between green search breadth and green innovation ((a) green exploitative innovation and (b) green exploratory innovation).*

To produce green products that meet the market and the end customers, a deep search of green knowledge is also essential to control the results.

On one hand, searching for external green knowledge frequently can strengthen the organizations' understanding of the original green products or services [9]. Nevertheless, with the deepening of the search, the specialization and structural complexity of knowledge will increase [38]. Moreover, employees may have more difficulties in understanding and integrating green knowledge. Rewarding employees by successfully integrating knowledge or creating high-quality green products can increase the consistency of the objectives [64]. Meanwhile, sharing, exchanging, and integrating tacit knowledge and complex technologies actively related to original green production are conductive [65], which will improve the information integration and absorption abilities of the employees. Employees can easily identify the potential value of the original energy-saving materials and the internal relationship of the original green product knowledge components. Therefore, breaking through the bottleneck of green innovation and promoting green exploitative innovation are beneficial [39].

On the other hand, the continuous search for environmental knowledge may confine the enterprises' perspective to the current knowledge framework, which is liable to form functional fixation and inertial thinking [66]. This search is not only inconducive to the understanding and acceptance of new knowledge, but is also unable to meet the needs of the development of new markets. Limiting the time of developing new products, putting forward the expected green environmental protection standards for the final new products (new services), clarifying the required objectives in environmental protection, that is, controlling the results of the employees' exploratory learning will help employees remove the constraints of prior experience and inertial thinking. Meanwhile, fully tapping the technology that is hidden behind similar knowledge is helpful, which benefits the development of new products. Finally, the continuous search for environmental knowledge lays the foundation for creating and designing green products and green processes that are different from the original production [67] and promotes green exploratory innovation. Therefore, we proposed that:

Hypothesis 3 (H3): *The green output control plays an intermediary role between green search depth and green innovation ((a) green exploitative innovation and (b) green exploratory innovation).*

2.3. Mediating Role of Green Behavior Control

Ensuring that the product meets the expected environmental standard (i.e., green output control) can promote the transformation of knowledge into innovation effectively. If the behaviors or processes to achieve the goal can be monitored at once, then the synergistic effect of the two controls may be realized. That is, the overall effect of "1 + 1 > 2" [57]. An organization can adopt diversified advanced technologies. However, if the internal employees of the enterprise are not willing to take the initiative in environmental collaboration, then this diversity may not work and the uncertainty of green innovation will also increase [68]. Accordingly, in addition to the result control, having a green behavior control for the green processes, ecological technologies, and green marketing concepts obtained from the government, supply chain partners, and other organizations is particularly important.

Behavior control is used to reduce the uncertainty by setting appropriate boundaries on the firm's behavior [44,69] and pays more attention to the process of achieving the goal [56]. The control measures include the regular or irregular supervision and inspection of enterprises, whether the process of the product meets the green environmental protection standards, and others [70,71]. Behavior control requires departments or employees to participate in and take risks actively [55]. Simultaneously, some rigid measures will be taken to prohibit or punish the behaviors that violate the requirements of green environmental protection [56]. Moreover, behavior control will put forward improvement suggestions for the production activities and processes of enterprises regularly [70,71], which will promote communication among the employees positively.

In the process of the internal governance of an enterprise, some problems such as information asymmetry and opacity caused by poor information communication often exist. These problems will cause large transaction costs and increase the operating burden [42,49]. Based on transaction cost theory, enterprises must take effective control measures to reduce invalid transaction costs to improve the performance of the firms. On one hand, the diversity of green knowledge has enriched the reservoir of original knowledge [35], which contributes to improving the ability to identify the value of original ecological knowledge. Nevertheless, the existence of internal opportunistic behaviors will reduce the knowledge sharing among employees [41], which is not conducive to a breakthrough in the original products and technologies. When the organization supervises the behavior of knowledge sharing and the communication of employees, employees can acquire knowledge related to the original production in time, which will reduce the search and time costs. Meanwhile, the efficiency of reorganization and transformation toward external and original knowledge will be improved [65]. Therefore, this case provides a knowledge base for enterprises to break through the original bottleneck of green innovative technology and promote green exploitative innovation.

On the other hand, the diversification of green knowledge increases the possibility of a combination of new knowledge [72]. The organization can develop new products and new markets through diversified ecological knowledge. However, diversified knowledge increases the difficulty of knowledge integration and the uncertainty of the knowledge integration results [9,73]. Employees have difficulties in ensuring that knowledge can be transformed and utilized successfully. Some measures such as requiring employees to strictly abide by the manufacturing process and green environmental protection standards specified by the organization and having feedback for the results of integrating knowledge actively are absolutely necessary. The reason is that such measures can reduce the invalid transaction costs caused by poor information communication and the nonstandard process of integrating knowledge. These measures can also improve the efficiency of knowledge integration. Therefore, the possibility of developing new products and achieving green exploratory innovation would increase.

Based on the above analysis, this study puts forward the following assumption:

Hypothesis 4 (H4): *Green behavior control plays an intermediary role between green search breadth and green innovation ((a) green exploitative innovation and (b) green exploratory innovation).*

In addition to controlling the diversified green knowledge integration process, having a behavior control for some information related to their own production searched deeply by enterprises is particularly important. Such information includes green processes, environmental protection technology, green marketing concepts, and others. On one hand, searching for similar environmental protection technologies, green processes, and green raw materials continuously is conducive to deepening the understanding of original knowledge [9]. However, a continuous search for similar knowledge can easily lead to organizational rigidity [9]. For instance, to maintain a firm's status quo, employees may hide the problems caused by the original knowledge, whereas the company will become increasingly rigid by constantly searching for similar knowledge [73,74]. One of the characteristics of green behavior control is the regular or irregular supervision and inspection of the process of using knowledge. This case can not only find and correct the problems in the original production process in time [52], but also avoid the invalid transaction cost caused by the failure of the innovation process [52]. Moreover, this event will improve the transformation efficiency of knowledge. All of these will lay a solid foundation for green exploitative innovation.

On the other hand, the encouragement and guidance for actively participating in external learning, which includes conferences, workshops, and seminars related to new environmental protection products, can expand their awareness of similar green knowledge outside the enterprise. Meantime, fully tapping the deep-seated and cutting-edge green technology knowledge hidden behind similar environmental protection technologies is conducive [68]. This event will reduce the repeated search cost of green knowledge and increase the possibility of new green knowledge reorganization. Finally, the green exploratory innovation of enterprises will be promoted.

Based on the above analysis, this study proposes the following assumption:

Hypothesis 5 (H5): *Green behavior control plays an intermediary role between green search depth and green innovation ((a) green exploitative innovation and (b) green exploratory innovation).*

The research model is shown in Figure 1.

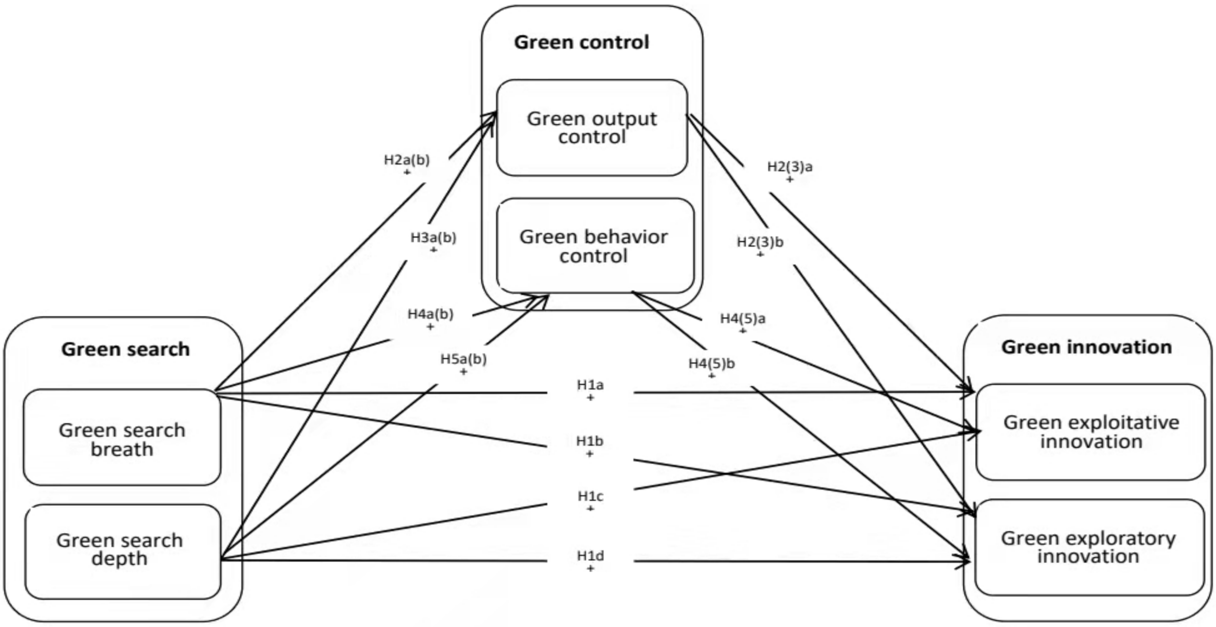

Figure 1. The conceptual mode.

3. Methods

3.1. Sample and Data Collection

This study collected data from different manufacturing enterprises in several provinces of China to eliminate the differences among industries. These provinces include Guangdong, Shandong, Jiangsu, Shanxi, and Henan, which reflect different levels of China's manufacturing development and market economy. To mitigate the potential impact of regional bias, we selected 600 enterprises from these provinces randomly. As the data came from different industries, the potential impact of inter-industry differences was reduced. We initially adopted the English questionnaire, and then the experts with refined English translated it into Chinese, with the aim to make it easier to investigate China's manufacturing industry. We used the two methods of translation and reverse translation to ensure the reliability of the questionnaire.

For the first time in designing the questionnaire, we consulted professional researchers and managers for some suggestions. Then, we revised the questionnaire in time. Second, to ensure the reliability of the questionnaire, we selected eight representative companies to conduct pilot tests and interviews, which aimed to clarify the meaning of the project. According to the suggestions in the interview, we revised the wording of the questionnaire again. Before the beginning of the survey, we asked these firms whether they were willing to participate, to which we received replies from 284 enterprises. We collected data twice, with an interval of 6 months. In the first survey, we collected data on the enterprise characteristics, technical dynamic, market dynamic, green search, and green control. In the second survey, we collected the data on green exploratory innovation and green exploitative innovation. We received questionnaires from 206 enterprises. Eight questionnaires with incomplete answers were removed, with a total of 198 valid questionnaires. The effective rate was 33%. Table 1 shows the demographic characteristics of the sample companies.

Table 1. The profile of the sampled firms.

Characteristics of Samples	Frequency	Percentage (%)
Positions of respondents		
President/CEO/vice president	34	17.2
Senior managers	73	36.9
Middle-level managers	40	20.2
Low-level managers	51	25.7
Industry		
Rubber, plastics and non-metallic mineral products	36	18.2
Chemical and pharmaceutical products	23	11.6
Metal products	21	10.6
Transport equipment	21	10.6
Electrical machinery and equipment	20	10.1
Food products	20	10.1
Instruments and related products	17	8.6
Machinery	14	7.1
Others manufacturing industries	26	13.1
Number of employees		
Less than 25	1	0.5
26–75	74	37.4
76–200	40	20.2
201–400	25	12.6
401–750	10	5.1
No less than 750	48	24.2
Ownership		
State-owned		
Privately-owned	38	19.2
Foreign-invested	160	80.8

3.2. Non-Response Bias and Common Method Bias

Employees individually filled the green search breadth, green search depth, green output control, green behavior control, green exploratory innovation, and green exploitative innovation involved in this study. Thus, this process may cause common method deviation [75]. Therefore, we used the Harman one-factor test to test the common method deviation of all the items in this study. We conducted principal component analysis on six items of the scale using spss23.0. Six components were extracted [76], and the total variation explained was 68.106%. Among them, the maximum factor interpretation rate was 15.285%, which was less than the 40% specified in the study. Thus, the question of common method deviation was not serious. Moreover, we performed a confirmatory factor analysis on Harman's one-factor test [76]. The fitting results had several different factors, showing that no serious common method deviation existed in this study.

3.3. Measures

The questionnaire measurement items in this research are used from previous studies. Items for the constructs were measured by using five-point Likert scales. We provide all the measurement items of the questionnaire in this study in Appendix A.

3.3.1. Green Search Breath

The measurement of the green search breadth in this paper was based on the green search breadth scale of Danneels (2008) [77]. Five items were used to measure this variable. Sample items included “Our professionals often attend academic or professional conferences on green sustainable development” and “We maintain close contact with universities or research institutions that study the direction of sustainable development”.

3.3.2. Green Search Depth

We used the scale from Qiang et al. (2013) [78]. The scale of green search depth includes five items to measure. Example items include “We invested a lot of time and energy in collecting valuable green information” and “When we searched for green information, we continued to search until all relevant information is determined”.

3.3.3. Green Output Control

Four items adapted from Hernández et al. (2010) were used to measure the green output control [79]. Example items include “Our partners will put forward expected green environmental protection standards for products (services)” and “Our partners will control the process of achieving cooperation objectives according to green environmental protection standards”.

3.3.4. Green Behavior Control

Four items of Challagalla et al. (2010) were used to measure the green behavior control [80]. Example items include “Our partners put forward green environmental protection requirements for cooperation related activities” and “Our partners monitor the implementation of activities according to green environmental standards”.

3.3.5. Green Exploitative Innovation and Green Exploratory Innovation

Green exploitative innovation was assessed with five items adapted from Fernhaber et al. (2012) [81]. Sample items include “We always provide more and better supporting services for existing green and environment-friendly products” and “We often reduce the production cost of existing products (services) by choosing low energy consuming materials”. Green exploratory innovation was evaluated by five items adapted from Fernhaber et al. (2012) [81]. Example items include “We often adjust our product structure to make our products (services) more environmentally friendly” and “We often introduce new environmental protection technology ”.

3.3.6. Control Variables

This paper controlled the variables such as enterprise type, enterprise age, enterprise scale, ownership type and environmental dynamics (i.e., technical dynamics and market dynamics). Enterprise type was measured with dummy variables (1 = high-tech company and 0 = other). Enterprise age was measured by taking the natural logarithm of the company’s operating time. Enterprise size was measured by the natural logarithm of the number of employees. Ownership type was measured by two dummy variables (the first dummy variable: 1 = state-owned enterprise, 0 = other; the second dummy variable: 1 = private enterprise, 0 = other). The variable of environmental dynamics can be divided into technical dynamics and market dynamics, and this scale was adapted from Jansen et al. (2006) [82]. There are five items for technical dynamics. Example questions include “The generation of innovative technologies can bring great opportunities to the industry” and “Technological changes in the industry will have a great impact on the production and operation of our companies”. There are five items for market dynamics. Example questions include “The competition between us and other companies in the industry is becoming fiercer and fiercer” and “The products and services in the industry are increasingly diversified”.

3.4. Reliability and Validity

First, we used Cronbach's alpha and combination reliability to test the reliability of the variables. The results are shown in Table 2. Cronbach's alpha and combination reliability of all variables were greater than 0.7, which means that the items in the scale are reliable [83]. Meanwhile, we used the maximum variance rotation for exploratory factor analysis (EFA) to test the model. The results presented six factures and explained 69.017% of the total variance. Furthermore, most of the items belonged to their own variable, which showed that the results were better.

Table 2. The construct reliability and validity analysis.

Construct	Item Code	Factor Loading	Cronbach's Alpha	AVE	Composite Reliability
Green search breadth	1	0.795	0.912	0.6778	0.913
	2	0.880			
	3	0.841			
	4	0.798			
	5	0.799			
Green search depth	1	0.748	0.931	0.7397	0.9339
	2	0.877			
	3	0.925			
	4	0.882			
	5	0.858			
Green output control	1	0.741	0.875	0.6594	0.8849
	2	0.874			
	3	0.879			
	4	0.743			
Green behavior control	1	0.890	0.928	0.7663	0.9291
	2	0.892			
	3	0.887			
	4	0.831			
Green exploratory innovation	1	0.870	0.934	0.7383	0.9338
	2	0.850			
	3	0.844			
	4	0.860			
	5	0.872			
Green exploitive innovation	1	0.877	0.928	0.7197	0.9277
	2	0.853			
	3	0.828			
	4	0.812			
	5	0.870			

Second, we examined the validity of the measurement items in the scale. According to the existing literature, we established the content validity by developing scale items. Based on this, we used confirmatory factor analysis (CFA) to examine the convergence validity. The measurement results were satisfactory ($x^2/df = 2.347$; CFI = 0.914; IFI = 0.915; TLI = 0.903). To examine discriminant validity, we compared the correlation of all potential structural pairs with AVE [84]. Table 3 shows the correlation of each variable, thus ensuring the discriminant validity.

Table 3. The mean, standard deviations, and correlations of the constructs.

Constructs	Mean	SD	1	2	3	4	5	6	7
1 Market dynamics	3.5051	0.76965							
2 Technical dynamics	3.6182	0.77346	0.521 **						
3 Green search breadth	3.4202	0.95396	0.112	0.291 **					
4 Green search depth	3.7727	0.87182	0.183 **	0.228 **	0.555 **				
5 Green exploitive innovation	4.1091	0.82709	0.183 **	0.322 **	0.539 **	0.626 **			
6 Green exploratory innovation	3.9919	0.77991	0.163 *	0.373 **	0.496 **	0.655 **	0.667 **		
7 Green output control	3.7323	0.83564	0.147 *	0.187 **	0.691 **	0.613 **	0.621 **	0.545 **	
8 Green behavior control	3.6982	0.95630	0.114	0.183 **	0.676 **	0.613 **	0.691 **	0.585 **	0.827 **

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

In Table 3, the correlation coefficients of the six variables were less than 0.9, indicating that the collinearity in this paper was not serious. Furthermore, all VIFS were less than 10, which also verified the conclusion that collinearity was not serious.

This paper conducted a correlation analysis and descriptive analysis on all variables. The results are shown in Table 3. It can be seen from Table 3 that all of the variables including the green search breadth, green search depth, green output control, green behavior control, green exploratory, and exploitative innovation were related in this paper. The correlation analysis provides an important premise for the further study of the relationship between variables.

4. Regression Analysis and Hypothesis Test

4.1. The Test of the Direct Effect of Green Search Breadth and Green Innovation

In order to examine the impact of the green search breadth on green innovation, this paper conducted a regression analysis between the green search breadth and green exploratory innovation and green exploitative innovation. The results are shown in Table 4. The green search breadth had a positive impact on green exploitative innovation (β = 0.428, $p < 0.01$). Meanwhile, the green search breadth had a positive impact on green exploratory innovation (β = 0.335, $p < 0.01$). The results showed that the breadth of green search can promote green exploitative and exploratory innovation. Therefore, the hypotheses of H1a and H1b are supported.

Table 4. The regression results of the direct effect of the search breadth on green innovation.

Variable	Green Exploitative Innovation		Green Exploratory Innovation	
	Model 1a	Model 2a	Model 3a	Model 4a
Constant	2.595 ***	1.778 ***	2.464 ***	1.825 ***
Industrial type	0.014	−0.004	−0.043	−0.057
Firm age	0.009	0.008	0.022	0.022
State-owned enterprises	0.010	−0.051	−0.019	−0.066
Private enterprises	−0.045	0.042	−0.238	−0.170

Table 4. *Cont.*

Variable	Green Exploitative Innovation		Green Exploratory Innovation	
	Model 1a	Model 2a	Model 3a	Model 4a
Firm size	0.017	−0.002	0.029	0.014
Market dynamics	0.053	0.055	0.006	0.007
Technical dynamics	0.344 ***	0.175 *	0.416 ***	0.284 ***
Green search breadth		0.428 ***		0.335 ***
R^2	0.117	0.335	0.173	0.322
Adj.R^2	0.083	0.306	0.142	0.293
F	3.506 ***	11.655 ***	5.562 ***	10.995 ***
Tolerance	≥0.421	≥0.419	≥0.421	≥0.419
VIF	≤2.375	≤2.385	≤2.375	≤2.385

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

4.2. The Test of the Direct Effect of Green Search Depth and Green Innovation

To examine the impact of the green search depth on green innovation, we conducted a regression analysis between the green search depth and green exploratory innovation and green exploitative innovation. The results are shown in Table 5. The green search depth had a positive impact on green exploitative innovation (β = 0.573, $p < 0.01$). At the same time, the green search depth had a positive impact on green exploratory innovation (β = 0.546, $p < 0.01$). The results indicate that the depth of green search has a significant influence on green exploitative and exploratory innovation. This result supports H1c and H1d.

Table 5. The regression results of the direct effect of search depth on green innovation.

Variable	Green Exploitative Innovation		Green Exploratory Innovation	
	Model 3b	Model 4b	Model 1b	Model 2b
Constant	2.595 ***	0.890 *	2.464 ***	0.839 *
Industrial type	0.014	0.219	−0.043	0.153
Firm age	0.009	−0.020	0.022	−0.005
State-owned enterprises	0.010	0.151	−0.019	0.116
Private enterprises	−0.045	0.227	−0.238	0.022
Firm size	0.017	0.047	0.029	0.057
Market dynamics	0.053	−0.035	0.006	−0.078
Technical dynamics	0.344 ***	0.213 **	0.416 ***	0.291 ***
Green search depth		0.573 ***		0.546 ***
R^2	0.117	0.441	0.173	0.503
Adj.R^2	0.083	0.417	0.142	0.481
F	3.506 ***	18.276 ***	5.562 ***	23.380 ***
Tolerance	≥0.421	≥0.409	≥0.421	≥0.409
VIF	≤2.375	≤2.444	≤2.375	≤2.444

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

4.3. The Test of the Intermediary Role of Green Output Control between Green Search Breadth and Green Innovation

In order to verify the intermediary role of green output control between the green search breadth and green innovation, three steps are necessary. First, we needed to examine the impact of the green search breadth on green exploitative innovation and green exploratory innovation. Second, we needed to test the influence of the green search breadth on the green output control. Finally, we needed to examine the impact of the green search breadth and green output control on green exploitative innovation and green exploratory innovation. Models 1c to 7c in Table 6 constitute the regression results of this mediating effect. The intermediary role of the green output control in the impact of the green search breadth on green exploratory innovation are shown in models 1c, 2c, 5c, and 6c. The mediatorial role of the green output control in the impact of the green search breadth on green exploitative innovation is shown in models 3c, 4c, 5c, and 7c.

Table 6. The regression results of the mediating effect of green output control under the condition of search breadth.

Variable	Green Exploratory Innovation		Green Exploitative Innovation		Green Output Control	Green Exploratory Innovation	Green Exploitative Innovation
	Model 1c	**Model 2c**	**Model 3c**	**Model 4c**	**Model 5c**	**Model 6c**	**Model 7c**
Constant	2.464 ***	1.825 ***	2.595 ***	1.778 ***	1.201 ***	1.379 ***	1.199 **
Industrial type	−0.043	−0.057	0.014	−0.004	−0.249	0.036	0.116
Firm age	0.022	0.022	0.009	0.008	−0.012	0.026	0.014
State-owned enterprises	−0.019	−0.066	0.010	−0.051	−0.180	0.001	0.036
Private enterprises	−0.238	−0.170	−0.045	0.042	0.059	−0.192	0.013
Firm size	0.029	0.014	0.017	−0.002	0.051	−0.005	−0.027
Market dynamics	0.006	0.007	0.053	0.055	0.112	−0.035	0.001
Technical dynamics	0.416 ***	0.284 ***	0.344 ***	0.175 *	−0.054	0.304 ***	0.201 **
Green search breadth		0.335 ***		0.428 ***	0.623 ***	0.104	0.128
Green output control						0.371 ***	0.482 ***
R^2	0.173	0.322	0.117	0.335	0.523	0.397	0.448
Adj.R^2	0.142	0.293	0.083	0.306	0.503	0.368	0.421
F	5.562 ***	10.995 ***	3.506 ***	11.655 ***	25.402 ***	13.468 ***	16.601 ***
Tolerance	≥0.421	≥0.419	≥0.421	≥0.419	≥0.419	≥0.419	≥0.419
VIF	≤2.375	≤2.385	≤2.375	≤2.385	≤2.385	≤2.388	≤2.388

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

The results of the sample for this test are shown in Table 6. The green search breadth had a significant positive impact on the green output control in model 5c (β = 0.623, $p < 0.01$) while the green output control had a significant impact on the green exploitative innovation in model 7c (β = 0.482, $p < 0.01$) and the green search breadth was not significant. This shows that the green output control plays a complete intermediary role in the impact of the green search breadth on green exploitative innovation. H2a is supported. Similarly, the green output control had a significant impact on green exploratory innovation in model 6c (β = 0.371, $p < 0.01$), while the green search breadth was not significant. Therefore, the green output control plays a complete intermediary role in the impact of the green search breadth on green exploratory innovation. Therefore, H2b is supported. Moreover, in order to verify the intermediary role of green output control, the Bootstrap method was used in this research. We set the sample size to 5000 with a confidence of 95%. The results showed in Table 7 that the confidence intervals of Bootstrap were [0.1196, 0.3393] and [0.2034, 0.4073]. None of them contained 0, which indicates that the mediating effect of the green output control was significant. Therefore, H1a and H1b are supported again. In conclusion, the green output control plays an intermediary role in the influence of the green search breadth on green exploitative and exploratory innovation.

Table 7. The Bootstrap test of the mediating effect of green output control under the condition of search breadth.

Search Breath → Output Control → Green Exploratory Innovation	**Coefficient**	**SE**	**t**	***p***	**LLCI**	**ULCI**
Total effect	0.3348	0.0525	6.3805	0.0000	0.2313	0.4383
Direct effect	0.1037	0.0693	1.4961	0.1363	−0.0330	0.2404
		BootSE			BootLLCI	BootULCI
Indirect effect	0.2312	0.0561			0.1196	0.3393
Search breath → output control → green exploitative innovation	coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.4285	0.0549	7.7980	0.0000	0.3201	0.5369
Direct effect	0.1283	0.0701	1.8303	0.0688	−0.0100	0.2665
		BootSE			BootLLCI	BootULCI
Indirect effect	0.3002	0.0514			0.2034	0.4073

4.4. The Test of the Intermediary Role of Green Output Control between Green Search Depth and Green Innovation

As we can see, seven models are shown in Table 8. The result in model 5d suggests that the green search depth has a great positive impact on the green output control (β = 0.585, $p < 0.01$). At the same time, the green output control had a good influence on the green exploitative innovation in model 7d as well as the green search depth (β = 0.362, $p < 0.01$; β = 0.361, $p < 0.01$), which implies that the green output control plays a partial mediating role in the impact of the green search depth on green exploitative innovation. Therefore, H3a is supported. Similarly, the green output control and green search depth were both significant (β = 0.185, $p < 0.01$; β = 0.43, $p < 0.01$). Accordingly, the green output control plays a partial mediating role in the impact of the green search depth on green exploratory innovation. Therefore, H3b is supported.

Table 8. The regression results of the mediating effect of the green output control under the condition of search depth.

Variable	**Green Exploratory Innovation**		**Green Exploitative Innovation**		**Green Output Control**	**Green Exploratory Innovation**	**Green Exploitative Innovation**
	Model 1d	**Model 2d**	**Model 3d**	**Model 4d**	**Model 5d**	**Model 6d**	**Model 7d**
Constant	2.464 ***	0.839 *	2.595 ***	0.890 *	0.647	0.720 *	0.656
Industrial type	−0.043	0.153	0.014	0.219	−0.013	0.156	0.224
Firm age	0.022	−0.005	0.009	−0.020	−0.040	0.002	−0.005
State-owned enterprises	−0.019	0.116	0.010	0.151	0.053	0.107	0.132
Private enterprises	−0.238	0.022	−0.045	0.227	0.211	−0.017	0.151
Firm size	0.029	0.057	0.017	0.047	0.110 **	0.037	0.007
Market dynamics	0.006	−0.078	0.053	−0.035	0.020	−0.082	−0.042
Technical dynamics	0.416 ***	0.291 ***	0.344 ***	0.213 **	0.058	0.280	0.192 **
Green search depth		0.546 ***		0.573 ***	0.585 ***	0.438 ***	0.361 ***
Green output control						0.185 **	0.362 ***

Table 8. *Cont.*

Variable	Green Exploratory Innovation		Green Exploitative Innovation		Green Output Control	Green Exploratory Innovation	Green Exploitative Innovation
	Model 1d	Model 2d	Model 3d	Model 4d	Model 5d	Model 6d	Model 7d
R^2	0.173	0.503	0.117	0.441	0.403	0.526	0.521
Adj.R^2	0.142	0.481	0.083	0.417	0.377	0.503	0.498
F	5.562 ***	23.380 ***	3.506 ***	18.276 ***	15.618 ***	22.688 ***	22.246 ***
Tolerance	≥0.421	≥0.409	≥0.421	≥0.409	≥0.409	≥0.406	≥0.406
VIF	≤2.375	≤2.444	≤2.375	≤2.444	≤2.444	≤2.465	≤2.465

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

We used Bootstrap to fully verify the mediating role of the green output control. The results are shown in Table 9. The confidence intervals of Bootstrap were [0.0229, 0.2071] and [0.1271, 0.3155], not including 0. Thus, the partial intermediary role was confirmed, and H3a and H3b are supported.

Table 9. The Bootstrap test of the mediating effect of the green output control under the condition of search depth.

Search Depth → Output Control → Green Exploratory Innovation	Coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.5460	0.0493	11.0743	0.0000	0.4487	0.6433
Direct effect	0.4378	0.0602	7.2713	0.0000	0.3190	0.5566
		BootSE			BootLLCI	BootULCI
Indirect effect	0.1082	0.0460			0.0229	0.2071
Search depth → output control → green exploitative innovation	coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.5730	0.0552	10.3729	0.0000	0.4640	0.6820
Direct effect	0.3614	0.0640	5.6479	0.0000	0.2351	0.4876
		BootSE			BootLLCI	BootULCI
Indirect effect	0.2116	0.0488			0.1271	0.3155

4.5. The Test of the Intermediary Role of Green Behavior Control between Green Search Breadth and Green Innovation

According to the inspection methods of the intermediary role, we constructed models 1e, 2e, 5e, and 6e to examine the mediating role of the green behavior control between the green search breadth and green exploratory innovation. Meantime, we used models 3e, 4e, 5e, and 7e to test whether green behavior control plays an intermediary role between green search breadth and green exploitative innovation. As seen in the results in Table 10, the green search breadth had a positive effect on the green behavior control in model 5e ($\beta = 682$, $p < 0.01$), and the coefficients of green behavior control were significant from model 6e ($\beta = 0.526$, $p < 0.01$), while the green search breadth was not significant. Thus, it can be seen that the green behavior control plays a complete mediating effect in the influence of the green search breadth on the green exploitative innovation relationship. Therefore, H3a is supported.

Table 10. The regression results of the mediating effect of the green behavior control under the condition of search breadth.

Variable	Green Exploratory Innovation		Green Exploitative Innovation		Green Behavior Control	Green Exploratory Innovation	Green Exploitative Innovation
	Model 1e	Model 2e	Model 3e	Model 4e	Model 5e	Model 6e	Model 7e
Constant	2.464 ***	1.825 ***	2.595 ***	1.778 ***	0.818	1.511 ***	1.348 ***
Industrial type	−0.043	−0.057	0.014	−0.004	−0.268	0.046	0.137
Firm age	0.022	0.022	0.009	0.008	0.003	0.020	0.007
State-owned enterprises	−0.019	−0.066	0.010	−0.051	−0.055	−0.045	−0.022
Private enterprises	−0.238	−0.170	−0.045	0.042	0.098	−0.207	−0.010
Firm size	0.029	0.014	0.017	−0.002	0.056	−0.008	−0.031
Market dynamics	0.006	0.007	0.053	0.055	0.094	−0.029	0.006
Technical dynamics	0.416 ***	0.284 ***	0.344 ***	0.175 *	−0.026	0.294 ***	0.189 **
Green search breadth		0.335 ***		0.428 ***	0.682 ***	0.073	0.070
Green behavior control						0.384 ***	0.526 ***
R^2	0.173	0.322	0.117	0.335	0.490	0.433	0.521
Adj.R^2	0.142	0.293	0.083	0.306	0.468	0.405	0.498
F	5.562 ***	10.995 ***	3.506 ***	11.655 ***	22.258 ***	15.621 ***	22.278 ***
Tolerance	≥0.421	≥0.419	≥0.421	≥0.419	≥0.419	≥0.418	≥0.418
VIF	≤2.375	≤2.385	≤2.375	≤2.385	≤2.385	≤2.390	≤2.390

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

In model 7e, the coefficients of green behavior control were significant (β = 0.384, $p < 0.01$). The green search breadth was not significant, which shows that the green behavior control plays a complete intermediary role between the green search breadth and green exploratory innovation. Therefore, H3b is supported. Similarly, the result in Table 11.was further confirmed by Bootstrap. The results show that the confidence intervals of Bootstrap were [0.1523, 0.3765] and [0.2355, 0.4910]. It did not contain 0, which indicates that the mediating effect of the green behavior control was significant. Therefore, H3a and H3b are supported again.

Table 11. The Bootstrap test of the mediating effect of the green behavior control under the condition of search breadth.

Search Breadth → Behavior Control → Green Exploratory Innovation	Coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.3348	0.0525	6.3805	0.0000	0.2313	0.4383
Direct effect	0.0732	0.0649	1.1268	0.2613	−0.0550	0.2013
		BootSE			BootLLCI	BootULCI
Indirect effect	0.2616	0.0578			0.1523	0.3765
Search breadth → behavior control → green exploitative innovation	coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.4285	0.0549	7.7980	0.0000	0.3201	0.5369
Direct effect	0.0699	0.0631	1.1081	0.2693	-0.0546	0.1943
		BootSE			BootLLCI	BootULCI
Indirect effect	0.3586	0.0660			0.2355	0.4910

4.6. The Test of the Intermediary Role of Green Behavior Control between Green Search Depth and Green Innovation

The results of the sample for this test are shown in Table 12. The green search depth had a great positive impact on the green behavior control in model 5f (β = 0.666, $p < 0.01$). The green behavior control and green search depth had a significant influence on green exploitative innovation in model 7f (β = 0.412, $p < 0.01$; β = 0.299, $p < 0.01$). This implies that green behavior control plays a partial mediating role in the impact of the green search depth on green exploitative innovation. Therefore, H4a is supported. Similarly, the green behavior control and green search depth had a significant impact on green exploratory innovation in model 6f (β = 0.216, $p < 0.01$; β = 0.402, $p < 0.01$). Therefore, green behavior control plays a partial mediating role in the impact of the green search depth on green exploratory innovation. Therefore, H4b is supported. Moreover, in order to verify the intermediary role of green behavior control, the Bootstrap method was used in this research. The results showed in Table 13 that the confidence intervals of Bootstrap were [0.0592, 0.2543] and [0.1699, 0.3979]. None of them contained 0, which indicates that the mediating effect of green behavior control was significant. Therefore, H4a and H4b are supported. In conclusion, green behavior control plays an intermediary role in the influence of the green search depth on green exploratory and exploitative innovation.

Table 12. The regression results of the mediating effect of green output control under the condition of search depth.

Variable	Green Exploratory Innovation		Green Exploitative Innovation		Green Behavior Control	Green Exploratory Innovation	Green Exploitative Innovation
	Model 1f	Model 2f	Model 3f	Model 4f	Model 5f	Model 6f	Model 7f
Constant	2.464 ***	0.839 *	2.595 ***	0.890 *	0.138	0.809 *	0.833 *
Industrial type	−0.043	0.153	0.014	0.219	−0.001	0.153	0.220
Firm age	0.022	−0.005	0.009	−0.020	−0.029	0.001	−0.008
State-owned enterprises	−0.019	0.116	0.010	0.151	0.207	0.072	0.066
Private enterprises	−0.238	0.022	−0.045	0.227	0.276	−0.038	0.114
Firm size	0.029	0.057	0.017	0.047	0.121 **	0.031	−0.003
Market dynamics	0.006	−0.078	0.053	−0.035	−0.011	−0.076	−0.030
Technical dynamics	0.416 ***	0.291 ***	0.344 ***	0.213 **	0.091	0.272 ***	0.176 **
Green search depth		0.546 ***		0.573 ***	0.666 ***	0.402 ***	0.299 ***
Green behavior control						0.216 ***	0.412 ***
R^2	0.173	0.503	0.117	0.441	0.404	0.544	0.575
Adj.R^2	0.142	0.481	0.083	0.417	0.378	0.522	0.554
F	5.562 ***	23.380 ***	3.506 ***	18.276 ***	15.647 ***	24.392 ***	27.671 ***
Tolerance	≥0.421	≥0.409	≥0.421	≥0.409	≥0.409	≥0.404	≥0.404
VIF	≤2.375	≤2.444	≤2.375	≤2.444	≤2.444	≤2.472	≤2.472

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

Table 13. The Bootstrap test of the mediating effect of green output control under the condition of search depth.

Search Depth → Behavior Control → Green Exploratory Innovation	**Coefficient**	**SE**	**t**	***p***	**LLCI**	**ULCI**
Total effect	0.5460	0.0493	11.0743	0.0000	0.4487	0.6433
Direct effect	0.4019	0.0591	6.8062	0.0000	0.2854	0.5184
		BootSE			BootLLCI	BootULCI
Indirect effect	0.1441	0.0502			0.0592	0.2543
Search depth → behavior control → green exploitative innovation	coefficient	SE	t	*p*	LLCI	ULCI
Total effect	0.5730	0.0552	10.3729	0.0000	0.4640	0.6820
Direct effect	0.2989	0.0603	4.9606	0.0000	0.1800	0.4178
		BootSE			BootLLCI	BootULCI
Indirect effect	0.2741	0.0585			0.1699	0.3979

5. Discussion

5.1. Conclusions and Discussion of the Results

First, the breadth and depth of the green knowledge search are conducive to green exploratory innovation and green exploitative innovation. As the forefront of firms' technology, green innovation has high complexity and uncertainty. Therefore, the enterprises should improve their ability of green innovation through the acquisition of external knowledge [3,9,40]. However, the inconsistent findings in the previous studies require further research on the impact of the green knowledge search on green innovation [9]. The present study divided green search and green innovation into two dimensions. The objective was to explore the impact of the scope and depth of the knowledge search on exploratory and exploitative innovation. The results indicate that the scope and sustainability of the knowledge search are conducive to making breakthroughs in original and new technologies. Promoting green innovation only by a single knowledge diversity or complexity is impossible. Compared with the scope of the green search (0.335, 0.428), a continuous and deep search for green knowledge (0.546, 0.573) had a greater impact on exploratory and exploitative innovation. However, further tests showed that the difference was not significant ($p > 0.05$). Therefore, an extensive and deep search for environmental knowledge is particularly important to green innovation. These studies illustrate the benefits of incorporating the knowledge search into the quality of the original products and the development of new green products, strengthening the necessity for enterprises to obtain heterogeneous resources from outside to realize green innovation.

Second, green output control and green behavior control play an intermediary role between green search and green innovation. Meanwhile, the two dimensions of green control, respectively, play a complete and a partial intermediary role between the breadth and the depth of green search and green innovation. Although we have realized the importance of the scope and degree of the knowledge search for the supply of green products, the previous literature lacked a theory to explain why the searched knowledge may not promote or even restrain green innovation. Combined with information processing theory and transaction cost theory, this study concludes that external knowledge can effectively guide the transformation of knowledge to innovative achievements through the monitoring of the knowledge integration process and results. A large number of external heterogeneous knowledge may lead to unqualified green products or fail to meet the needs of end customers because it fails to use or communicate information effectively in accordance with the environmental protection standards of the enterprise. Accordingly, enterprises should control the process of knowledge integration and the results of knowledge utilization strictly, which aims to improve the employees' ability to process information to meet the needs of the organization for knowledge integration and utilization. In addition, the results show that green output control and green behavior control, respectively, play a fully and partial mediation between the breadth and the depth of green search and green innovation. This result indicates that green knowledge obtained by expanding the scope of the search cannot be directly used to develop new green products and improve product quality. The process of knowledge integration is full of great uncertainty. Organizations must supervise and control the process and results of knowledge integration to ensure the transformation of knowledge into innovative achievements. For the knowledge of continuous and deep search, the process of knowledge integration will be closer to the firms' environmental protection standards because of the employees' experience in the original field and familiarity with the knowledge. Employees can also easily develop and utilize familiar knowledge. Therefore, the monitoring of the behavior process and results is not strictly necessary, but can play a role in guidance and incentives.

5.2. Theoretical Contribution

First, our research expands the dimension of the green knowledge search and provides a new perspective for understanding green innovation. Although the existing research emphasizes the importance of the knowledge search to innovation, few studies have considered how to search, which plays a crucial role in improving the efficiency of green innovation. Combined with the resource-based theory and the dualistic characteristics of the knowledge search, this study puts forward the green search breadth and green search depth. This proposal is a response to Laursen et al. (2014) on how to search for knowledge [85]. Simultaneously, this study expands the application of resource-based theory in the green knowledge search.

Second, this study contributes to the transaction cost economics and organizational information processing theory by exploring the intermediary role of green control (including green output control and green behavior control) between green search and green innovation. Most of the previous studies only discussed the direct impact of the knowledge search on performance, ignoring its internal mechanism. Searching for knowledge without controlling the internal processing of knowledge may lead to invalid acquisition and idleness of knowledge. If we can monitor the integration process and the target results of knowledge, then the internal transaction costs will be reduced, and the efficiency of transforming knowledge into innovative achievements will be improved. Finally, enriching the application scenarios of transaction cost economics and organizational information processing theory is helpful.

More broadly, the conclusions of this study favor the theory of green open innovation. A paradox has always existed in the theory of open innovation. The paradox is how to determine the scope of the search in the context of limited resources [85,86]. Based on the resource-based theory, this study puts forward the concept of green search breadth and depth, providing a new perspective for solving this paradox. This study found that the enterprise can realize the balanced development of the two search strategies by coordinating the breadth and depth of the knowledge search. This finding is helpful for enterprise to realize that paying a lot of attention to the scope or depth of the knowledge search is a not a good way to reduce the risk of innovation. In other words, the balance between the search breadth and search depth can effectively improve the performance of green innovation.

5.3. Management Enlightenment

From the aspects of management practice, managers can acquire a better understanding of the external environmental knowledge search through this research. First, searching for environmental protection knowledge from outside will cost enterprises a lot of time and energy. Thus, managers often face a basic choice of whether they should pay attention to the diversity or depth of knowledge. Our research found that both the range and the depth of the knowledge search were particularly important. Compared with the diversity of knowledge, the depth of knowledge had a greater impact on green innovation. Accordingly, Chinese enterprises should first strive to improve the degree of the knowledge search and mine similar knowledge continuously.

Second, ensuring the realization of green innovation only by searching for knowledge is difficult. Supervising the production process in time and formulating corresponding reward and punishment measures for innovative results are necessary to reduce the cost of continuous knowledge search and meet the requirements of the market and end consumers. The purpose of the above actions is to improve the quality of green products (services) from the behavior process and results. More precisely, these actions attempt to meet the needs of downstream actors for green products and realize the innovative development of enterprises.

Finally, to achieve green innovation, some measures regarding the breadth of green search described in Appendix A can help managers to identify specific actions to be taken. An example is attending academic and professional conferences on green and sustainable development as often as possible. Meanwhile, managers can effectively control the search knowledge according to the measures of the output and behavior control (Appendix A). An example is supervising whether the knowledge integration process meets the green environmental protection standards specified by the company, whether the employees achieve the expected environmental protection objectives, and others. These measurement items provide detailed specifications for managers to implement their knowledge search and minimize the possibility of the ineffective utilization of knowledge.

5.4. Limitations and Future Prospects

We discuss the impact of green search and green control on green innovation. The results showed that green control plays a complete intermediary role between the green search breadth and green innovation. Simultaneously, green control plays a partial intermediary role between the green search depth and green innovation. Although this study is helpful in understanding how a green search affects green innovation, some limitations still exist that need further research.

First, we discuss the intermediary role of output control and behavior control in the formal control between green search and green innovation. However, informal control is also important for the firms' innovation. Future research can continue to explore whether informal control (i.e., corporate culture and trust) also plays an intermediary role between green search and green innovation. Second, green control plays a partial intermediary role in the depth of green search and green innovation, which shows that green search can also affect green innovation through other paths. This notion can be further explored in future research.

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Appendix A Questionnaire Used in the Study

Table A1. Questions included in the questionnaire.

Market dynamics(MD) (Jansen et al., 2006) (1 = strongly disagree, 5 = strongly agree)
MD1: Our industry has a high degree of market dynamics.
MD2: The products and services in the industry are increasingly diversified.
MD3: The competition between us and other companies in the industry is becoming fiercer and fiercer.
MD4: Changes in our customers demand and preferences are hard to predict.
MD5: The demand of new customers for products and services is obviously different from that of old customers.
Technical dynamics (TD) (Jansen et al., 2006) (1 = strongly disagree, 5 = strongly agree)
TD1: Our industry has a high degree of technological innovation turbulence.
TD2: Newer technologies can help us develop new products and services.
TD3: It is difficult for us to predict the trend of technology change in three years.
TD4: The generation of innovative technologies can bring great opportunities to the industry.
TD5: Technological changes in the industry will have a great impact on the production and operation of our companies.
Green exploitative innovation (GTI) (Fernhaber et al., 2012)(1 = strongly disagree, 5 = strongly agree)
GTI1: We usually improve the environmental quality of our existing products (services).
GTI2: We always provide more and better supporting services for existing green and environmentally friendly products.
GTI3: We often reduce the production cost of existing products (services) by choosing low energy consuming materials.
GTI4: We often refine the types of green products (services) available.
GTI5: We often improve the quality of the existing green products.
Green exploratory innovation (GRI) (Fernhaber et al., 2012) (1 = strongly disagree, 5 = strongly agree)
GRI1: We often create or introduce new green products (services).
GRI2: We often introduce new environmental protection technology.
GRI3: We often develop new green products (services) into emerging markets.
GRI4: We often adjust our product structure to make our products (services) more environmentally friendly.
GRI5: We often improve our business processes to make our products (services) more environmentally friendly.
Green search breadth (GSB) (Danneels E, 2008) (1 = strongly disagree, 5 = strongly agree)
GSB1: We often participate in environmental protection association activities.
GSB2: Our professionals often attend academic or professional conferences on green sustainable development.
GSB3: We often participate in green trade exhibitions.
GSB4: We maintain close contact with universities or research institutions that study the direction of sustainable development.
GSB5: We follow the latest trends of the market and emerging environmental protection technologies by reading professional journals and magazines.

Table A1. *Cont.*

Green search depth (GSD) (Qiang et al., 2013) (1 = strongly disagree, 5 = strongly agree)
GSD1: We regard searching for green information as an important task.
GSD2: We invested a lot of time and energy in collecting valuable green information.
GSD3: We tried our best to find the information source of green environmental protection information.
GSD4: When we searched for green information, we continued to search until all relevant information is determined.
GSD5: When we searched for green information, we searched and studied every possibility as much as possible.
Green output control (GOC) (Miguel et al., 2010) (1 = strongly disagree, 5 = strongly agree)
GOC1: Our partners will put forward expected green environmental protection standards for products (services).
GOC2: Our partners will control the process of achieving cooperation objectives according to green environmental protection standards.
GOC3: Our partners ensure that we know the environmental objectives of our cooperation.
GOC4: If we fail to achieve the expected cooperative environmental protection goal, our company will be punished.
Green behavior control (GBC) (Challagalla and Shervani, 1996) (1 = strongly disagree, 5 = strongly agree)
GBC1: Our partners put forward green environmental protection requirements for cooperation related activities.
GBC2: Our partners monitor the implementation of activities according to green environmental standards.
GBC3: Our partners ensure that we know the environmental standards stipulated in the cooperation.
GBC4: If we fail to comply with the environmental protection standards stipulated in the cooperation, our company will be punished.

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