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Article

Green Innovation, Green Entrepreneurial Orientation and Supply Chain Learning: Evidence from Manufacturing Firms in China.

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Abstract: As a combination of both concepts of innovation and environmental development, green innovation is of great significance to the sustainable development of the country and industry. Previous literatures have found the separate roles of green entrepreneurial orientation and inter-organizational learning in understanding green innovation issues. However, few studies have done a comprehensive analysis of integrating three streams of research: green entrepreneurial orientation, green innovation and supply chain learning capability. Based on the resource-based view and dynamic capability theory, we examine the direct of green entrepreneurial orientation on green innovation as well as indirect effect through the mediation of supply chain learning capability. Meanwhile, an empirical data set of 228 manufacturing companies in China (Shaanxi, Guangdong, Hebei, Jiangsu, and Shandong) was used to test our hypotheses. Findings from our empirical study suggest that supply chain learning capability partially mediates the positive relationships between green entrepreneurial orientation and its two consequences—green incremental innovation and green radical innovation. In addition, this research implies that when enterprise has a strong green entrepreneurial orientation, the enterprise should make an effort to enhance the level of supply chain learning capability so as to fully develop their green innovation.

Keywords: green entrepreneurial orientation; green innovation entrepreneurship; supply chain learning; inter-organizational learning; learning capacity; technology innovation

1. Introduction

The global environmental degradation, is a constantly increasing concern for public makers, people and various countries[1]. As a result, pursuing green economic growth and development has become a new global economic development trend [2,3]. As a combination of both concepts of innovation and environmental development, green innovation involves dual externalities that traditional innovation does not have [4]. Green innovation can improve production efficiency, save resources and reduce environmental pollution by learning advanced green technology, becoming an effective way to promote green economic growth, which has more significance than ever before[5]. Under this situation, it is essential for enterprises to integrate environmental ideas with innovation. On the one hand, enterprises need to face powerful pressure from the set of environmental norms and regulations by the government. On the other hand, greening innovation process is becoming a strategic business opportunity for enterprises to cope with the market requirements that are more environmentally friendly [6]. Thus, enterprises which drive growth by green innovation strategy might have unprecedented opportunities for the development of green by leaps and bounds. In view of this, successful green innovation enable enterprises to respond to the environmental tendency as well as improve their green image and achieve competitive advantages [1,7,8].

Previous research on the determinants of green innovation is vast, such as government environmental regulations, consumer demand and factors from competitors [3,7,9–11]. Meanwhile,

a growing literature analyzed the antecedents of green innovation from the inter-organizational perspective, such as senior managers' environmental awareness[12], green shared vision[13], cooperation with competitors[14] and environmental managerial concern [15]. In particular, some empirical studies showed that the enterprise's green innovation is influenced by the path of innovation, the accumulation of knowledge, the capabilities of organization and the learning of organization [14,16–18]. However, little empirical research addressed the question of how green entrepreneurial orientation as an antecedent, affects the improvement of green innovation. In this respect, Mengucu Auh & Ozanne believed that organizational capabilities such as learning and continuous innovation may appear when entrepreneurial orientation is strong enough, promoting the environmental strategic initiatives [19]. Nevertheless, some scholars demonstrated that entrepreneurial orientation has no significant effect on corporate innovation [20]. Consider the above, the findings of the relationship between entrepreneurial orientation and corporate innovation are controversial and need further exploration.

In this article, we intend to extend this line of analyzing how green entrepreneurial orientation affects green innovation. More precisely, we fill a gap in the previous research by developing theory and present empirical evidence to identify supply chain learning as a mediate variable between green entrepreneurial orientation and green innovation. Few studies analyzed entrepreneurial orientation in context of supply chain management [21,22], especially for the green entrepreneurial orientation, which is different from general entrepreneurial orientation for it also improves environment quality. Besides, scant research examined how green entrepreneurial orientation as a strategic posture, affects the improvement of green innovation, especially in the supply chain context. Based on the resource-based view and dynamic capability theory [23], we examine the relationship among green entrepreneurial orientation, supply chain learning and green innovation in order to develop a better understanding of the mechanism through which green entrepreneurial orientation can efficiently and effectively influence companies' innovation outcomes. Our study focus on the following research questions: (1) Does a company's green entrepreneurial orientation motivate it to develop supply chain learning capability? (2) Dose a company's supply chain learning capability affect the company's green innovation? (3) Would the relationship between green entrepreneurial orientation and green innovation be mediated by supply chain learning?

To achieve our goals, the remainder of the study as follows. The next section presents the literature review and hypothesis. Section 3 describes the research methodology, followed by the data analysis and results in section 4. Finally, in section 5, the paper presents the conclusion, implications, limitations of this study and suggestion for future research.

2. Literary review and hypothesis development

2.1. Green entrepreneurial orientation and green innovation

Over the years many researchers indicated that entrepreneurial orientation can help in a general improvement of corporation performance [24]. As a strategic orientation, entrepreneurial orientation affects enterprise innovation directly or indirectly [22,25–27], however, some scholars found that entrepreneurial orientation has no significant effect on corporate innovation [20]. Consider the above, though there are some studies on the relationship between entrepreneurial orientation and corporate innovation, the results are controversial and need further exploration. Furthermore, the research of the impact of the green entrepreneurial orientation on green innovation are less well established, which our study intend to explore.

Green entrepreneurial orientation research was originated from the combination of theories of entrepreneurial orientation and green entrepreneurship. For the component dimension of green entrepreneurship orientation, Arruda [28] believed that green entrepreneurship consists of proactivity and environmental orientation while Becker [29] divided green entrepreneurship into innovativeness and social orientation. Cohen et al. [30] argued that sustainable entrepreneurship has two significant characteristics: social orientation and environmental orientation. In line with the recent work of li and Chen [31], in our research green entrepreneurial orientation refers to an

independent system, which is treated as a unique pattern of organizational operation and strategic decision-making.

For green innovation, which is first mentioned by Fussler and James [32], refer to develop and apply new products, new process and new services to achieve improvements in overall environmental performance, including innovations in product innovation, process innovation and project innovation [33]. According to different levels of technology innovation, green innovation consists of either green radical innovation or green incremental innovation [13]. Based on previous research [37], this study gives a definition to "green radical innovation" as 'a novel, unique and artistic creation caused by fundamental changes of existing green products, processes or services'. Meanwhile, we refer to the definition of previous researchers [13,34,35], and state the term "green incremental innovation" as 'the minor improvements and enhancements to make existing green products, processes or services enhance or expand by means of environmental technology'.

2.2. Supply chain learning

Supply chain learning originates from inter-organizational learning and involves how members of the organization jointly create collective knowledge [36]. Bessant and Tsekouras [37] are the first to study learning at the network level and view supply chain as one of these networks. Then, O'Keeffe et al. [38] further found that supply chain possess "knowledge flow", which can be fully utilized among upstream and downstream enterprises, and multi-win cooperation can be realized through inter-organization learning. Later, New, S. J et al. [39] defined "supply chain learning" as a learning behavior in an inter-organizational context, and identified three different stages of supply chain learning. Furthermore, Flint et al. [40] provided a formal definition of supply chain learning: "interaction and learning among diversified supply chain partners on supply chain problems and solutions". In our study, based on the dynamic capability theory, we regard supply chain learning capabilities as a dynamic capability which is a key component of supply chain management, because the transformation of knowledge can encourage enterprises to share their experiences and to learn from the cooperation with upstream and downstream customers, which can greatly reduce the potential probability of making mistakes.

2.3. The influence of green entrepreneurial orientation on supply chain learning capability

New et al. revealed six pre-dependent variables of supply chain learning capability: trust and commitment, communication, types of relationships among supply chain members, decision-making styles, and company culture [39]. Besides, previous research summarized four antecedents of supply chain learning in the context of supply management: team-oriented, system-oriented, learning-oriented and memory-oriented [40,41]. In recent years, some literature find a direct link between entrepreneurial orientation and organizational learning [24,25,40]. For example, based on learning theory and behavioral science theory, Lambrechts et al. [42] discussed the mechanisms of entrepreneurial orientation affect organizational learning. Moreover, it is concluded that enterprises with entrepreneurial orientation tend to form learning atmosphere, promote learning behavior and provide direction and scope of enterprise learning [43]. In addition, entrepreneurial orientation provides management support for the learning process of supply chain [44]. Furthermore, green entrepreneurial companies generally encourage organizational structures which can promote creativity and collaboration [45], result in developing supply chain learning capability. Therefore, green entrepreneurial orientation which possess a combination of entrepreneurship and environmentally friendly features can lighten the psychological burden of supply chain members, enhancing information and knowledge flows among organizations and thereby have a positive impact on supply chain learning. Hence, we propose the following hypothesis:

H1: Green entrepreneurial orientation has a positive influence on green supply chain learning capability.

2.4. The influence of supply chain learning on green innovation

Recently, Jean et al. indicated a potential positive impact of joint learning capacity among supply chain partners on relationship innovation [34]. Learning among supply chain members can be seen as a strategic resource that contribute to performance of the supply chain [13,41], meanwhile, supply chain learning capability can be seen as a dynamic capability based on dynamic theory. Furthermore, five outcomes of supply chain learning were summarized and supply chain learning was defined as "a process through which participants can learn together about how to rethink and update their supply chain framework to develop a new knowledge Infrastructure" [42]. From the perspective of dynamic capability, learning among alliance partners improve the technology information and knowledge base and thus become a powerful stimulus to green technology innovation in alliance products [43]. In this sense, supply chain learning emphasizes interaction among organizations so that green technology information and knowledge such as green experience of the organization can be shared and innovated. In other word, by learning and mastering partners' green technology resources, a company can generate new ideas which enable the company's green technology to be innovated. More specifically, there exist differences in the supply chain partners' resources and capabilities for green technology, and to the fact that their green innovation outcomes can be complementary by supply chain learning. Hence, green technology acquired from their supply chain partners can be expected to help enterprises overcome their limited green knowledge and be able to make better programs regarding green technology, which finally result in higher level green innovation. Thus, green innovation can be regarded as a process of inter-organizational learning and we argue that supply chain learning capability promote the effectiveness and efficiency of green innovation. Consider the above:

H2: Green supply chain learning is positively associated with green innovation

H2a: Green supply chain learning is positively associated with green radical innovation

H2b: Green supply chain learning is positively associated with green incremental innovation.

2.5. The influence of green entrepreneurial orientation on green innovation

Some experts pointed out that entrepreneurial orientation has a direct or indirect impact on enterprise innovation [24,44]. Some studies regarded technological innovation results as an indicator of entrepreneurship [45] or the practice of innovation [46], reflecting the view of Drucker, who claimed the importance of entrepreneurial function on firm's innovation [47]. In fact, firms with green entrepreneurial orientation may tend to achieve green innovation more easily than those which strive merely for economic interests [48]. Besides, executive teams which emphasize environmental orientation may set an example for their subordinates by shaping their behavior, thereby promoting firm's green technological innovation come from their employees [49]. Green entrepreneurial orientation, which is regarded as a strategic resource can increase firms' proactivity and their willingness to take risks of green technology, making it possible for firms to achieve higher green innovation. Hence, based on the resource-based theory, this paper argues that green entrepreneurial orientation could be considered as a major factor of green innovation.

We therefore put forward the following hypotheses:

H3: Green entrepreneurial orientation is positively associated with green innovation.

H3a: Green entrepreneurial orientation is positively associated with green radical innovation.

H3b: Green entrepreneurial orientation is positively associated with green incremental innovation.

2.6. The mediating influence of supply chain learning

In the academic circles, great attention should be paid to the basic process of clarifying the contribution of entrepreneurial orientation to the company innovation, and it is particularly necessary to explore a complete analytical framework of entrepreneurial orientation and enterprise innovation. The relationship between entrepreneurial orientation and innovation was empirical examined in previous studies [50], however, most studies focused on a direct link between entrepreneurial orientation and innovation[27,51], while few studies examined the mechanism that mediate the entrepreneurial orientation-to-innovation link, especially in the contextual of environment. To address this gap, we focus on supply chain learning as a key determinant of green

innovation. As a strategic gesture, green entrepreneurial orientation enables enterprise to form an internal organizational strength, which can not only support enterprises to produce as many green innovative products as possible, but also helps the green technology content of products. In fact, the influence of green entrepreneurial orientation on green innovation should not be separated from organizational factors [22,25], especially the inter-organizational learning, such as supply chain learning, which perform a vital role in the influence of green entrepreneurial orientation on green innovation. Specifically, one of the significant roles of green entrepreneurship orientation might be its association with supply chain learning, which would facilitate company's ability to provide innovative proposals for new environmental product development. According to the dynamic capability theory, supply chain learning capability is regarded as a dynamic capability involves company strategic activities which are critical to the impact of green entrepreneurship orientation on green innovation. Therefore, we propose that supply chain learning capability can enhance the impact of green entrepreneurial orientation on green innovation. In other word, when possess strong green entrepreneurial orientation, enterprises will attempt to enhance their supply chain learning capability to develop green innovation.These lines of argument lead us to the following hypothesis:

H4 : Supply chain learning acts as a mediating variable between green entrepreneurial orientation and green innovation.

H4a: Supply chain learning acts as a mediating variable between green entrepreneurial orientation and green radical innovation.

H4b: Supply chain learning acts as a mediating variable between green entrepreneurial orientation and green incremental innovation.

3. Method

3.1. Variable measurement and questionnaire design

The survey questionnaire was structured into three sections, namely, green entrepreneurial orientation, supply chain learning and green innovation. All measurements used a seven-point Likert scale. In order to ensure the reliability and validity, we assembled our questionnaire utilizing established survey items to fit our research context. The research questionnaire was first compiled in English and then translated into Chinese. A preliminary questionnaire was pretested by firm's mid-level or senior-level managers, graduate students, and three business management professors. They hold sufficient knowledge about the innovation management and then made some minor modifications to the questionnaire before a formal investigation. The Chinese questionnaire with such alterations was subsequently back-translated into English by a third party to ensure that the items included accurately reflect the original meanings in the Chinese context. We reviewed carefully these two English versions, and were satisfied that there were no substantial differences between the two versions in the meanings of the scales. First, entrepreneur orientation were measured by five items adapted from Naman and Slevin [52]. Next, five items for measuring supply chain learning capability were adopted from the study of Quan Zhu et al [41] and Flint et al.[40]. Finally, we measured green innovation. Four items measured green incremental innovation, all adopted from Jing Dai et al. [35],Yuan Li [53]. Four items measured green radical innovation, all adopted from Jing Dai et al. [35]. For details of variable measurements, see the Appendix.

3.2. Sample and data collection

Using the questionnaire, we sought responses from top executives of the firms in our study sample. We used the EMBA/MBA/IE graduates lists in our school. To avoid the biases, we randomly selected sample graduates from the list. The sample firms are of all sizes in a broad range of manufacturing industries (such as electronic, transportation equipment, and chemical), located in five provinces (Shaanxi, Guangdong, Hebei, Jiangsu, and Shandong), which cover Western, Central, and Eastern areas of China.

We phoned that randomly selected graduates who were at least R&D or general managers in manufacturing firms to join the project. If these graduates we selected happened not to be the best

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informants to answer the questionnaires, we requested them to help us pass the questions to the very respondents in their companies, or introduce the most appropriate answers to us, to finish this survey. The questions were all mailed with a cover letter which highlight the survey's background and goals. Follow-up calls were made by our research team to improve the response rate.

We issued a total of 728 questionnaires and 270 questionnaires were returned, which yield a response rate of 37.08%. We excluded 42 questionnaires due to incomplete database, thus 228 valid questionnaires were utilized for analyzing. Details of the companies and respondents are given in Table 1.

Table 1. Respondent profile information (N=228).

Information	Characteristics	Samples	Percent（%）
Size (Employee)	Less than 50	23	10.01
	50-100	20	8.77
	101-300	33	14.50
	301-500	39	17.1
	501-1000	37	16.4
	1001-2000	16	7.02
	2001-5000	38	16.67
	More than 5000	22	9.65
Sales revenue (RMB)	Less than 5 million	16	7.02
	5-10 million	19	8.33
	10-20 million	36	11
	20-50 million	31	15.79
	50-100 million	49	21.49
	More than 100 million	77	33.77
Industry	Textiles & Apparel	8	3.51
	Food, beverage, alcohol and cigars	13	5.70
	Chemicals and petrochemicals	28	12.28
	Furniture, wood and concrete products	6	2.63
	Electronics & Appliances	78	32.89
	Fabricated metal product & Machinery	32	14.04
	Transportation equipment	27	6.15
	Rubber & Plastics	6	2.69
	Pharmaceutical and medical	12	5.26
	Others	18	7.89
Type of firm	State-owned enterprise	83	36.40
	Collective enterprise	21	9.21
	Private enterprise	32	14.04
	Foreign-funded enterprise	40	17.51
	Joint venture	27	11.84
	Others	25	10.96
Job position of respondent	President/CEO	103	45.18
	Vice President	57	25.00
	R&D/General manager	50	21.93
	Others	18	7.89

Table 1 indicates the distribution of the respondent companies in terms of industry, company's size using employment levels, company's type and annual revenue. We can notice that respondents are mainly from foreign-funded companies and state-owned companies. Firm's size ranged from under 50 to over 5000 employees with nearly half of companies belonging to the relatively large company classification of over 500 employees. Moreover, firms above 100 million in annual revenue

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make up one-third of the samples. Hence, the data is relatively mature and has enough capability to implement green innovation.

4. Data analysis and results

4.1. Tests for potential bias in survey data

Two issues commonly raised in the literature concern with survey methodology are non-response bias and common method variance bias.

4.1.1. Non-response bias

To evaluate non-response bias (the difference between the answers of respondents and non-respondents) [54], the final sample was divided into two: 121 responses received at the beginning of data collection process and the remaining 107 responses received in the middle and latter of the data collection period. We compared the early (121 responses) and late data (107 responses) [54,55] to examine if they differed in their questionnaire responses. The t-test results performed no statistically significant differences on demographic characteristics at $p \leq 0.05$, indicating that the data was relatively free from non-response bias issues.

4.1.2. Common method bias

We mitigated the potential dangers of common method variance bias. First, we surveyed two informants to assess all the variables for each firm, in accord with the study of Podsakoff and Organ [56]. Second, we surveyed top managers who are knowledgeable about the firms' green innovation management. These individuals are considered to provide accurate and reliable information [57]. Finally, we examined the potential of common method variance based on Harman's single factor test for all variables in the study [56].The un-rotated factor analysis shows that no single factor occupies the majority of the variance, and even the first factor captures only 25% of the overall variance. Besides, the dependent variables and independent variables loading on different factors. The above findings show that the data was unlikely affected by common method variance in our study.

4.2. The result of the measurement model

We adopt the two-step approach from Gerbing and Anderson [76] to examine the reliability and validity of constructs.

4.2.1. Reliability analysis

The reliability of the data was indicated by Cronbach's a. If construct's reliability coefficient turns out to be 0.7 or greater, it can be considered reliable [58]. Table 2 lists the scale's Cronbach's a calculated using SPSS. Because it can be observed that the reliability of each construct is higher than the threshold value 0.7, thereby we suggest that the theoretical constructs in this paper exhibit good internal consistency.

4.2.2. Content validity

The validity of the data was tested by the structural validity and the content validity. Instructions on the cover of our questionnaires make informants knowledgeable about the purpose of this research was to examine firms' green innovation practices and outcomes. Confidentiality nature is also ensured. In addition, we design in-depth managerial interviews and a preliminary test to modify our measurement items so as to ensure they actually capture constructs of interests. Thus the scale of this study has a good content validity.

4.2.3. Construct validity

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Construct validity includes convergent validity and discriminant validity. This research verify the construct validity through confirmatory factor analysis by using AMOS. Convergent validity is "the degree to which multiple attempts to measure the same concept by different methods are in agreement" [59]. We use AMOS to calculate the average variance extracted (AVE). Table2 indicates that average variance extracted is more than 0.6, the composite reliability (CR) for each scale is well above 0.7 and all factor loadings are greater than 0.5. It suggests the acceptability of convergent validity of all constructs.

Table 2. Convergent validity and reliability.

		convergent validity			Reliability
construct	label	Standardized loading	CR	AVE	cronbach's a
Green entrepreneur orientation	GEO1	0.825	0.882	0.677	0.873
	GEO2	0.892			
	GEO3	0.853			
	GEO4	0.815			
	GEO5	0.806			
Supply chain learning	SCL1	0.822	0.824	0.635	0.861
	SCL2	0.861			
	SCL3	0.798			
	SCL4	0.803			
	SCL5	0.785			
Green incremental innovation	GII1	0.718	0.738	0.592	0.775
	GII2	0.801			
	GII3	0.797			
	GII4	0.832			
Green radical innovation	GRI1	0.826	0.750	0.608	0.821
	GRI2	0.813			
	GRI3	0.809			
	GRI4	0.729			

For discriminant validity, table 3 indicates that the diagonal elements in bold representing the square roots of the AVE for constructs are significantly higher than the off-diagonal elements, satisfying Fornell and Larcker's [60] criterion for discriminant validity.

Table 3. Descriptive statistics and correlations matrix.

	Descriptive statistics		Correlations matrix			
Constructs	Mean	SD	1	2	3	4
1Green entrepreneur orientation	3.292	1.043	0.823			
2Supply chain learning	4.027	0.897	0.59***	0.797		
3Green incremental innovation	3.715	0.938	0.55***	0.48**	0.769	
4Green radical innovation	3.640	0.951	0.51**	0.63***	0.57***	0.866

Note: (a) The diagonal elements in bold are square roots of average variance extracted and (b) the off-diagonal elements represent correlations between constructs. ***p < 0.001, **p < 0.01, *p < 0.05.

4. 3.The result of the Structural model

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4.3.1. The goodness of fit test of the model

We tested our hypotheses using structural equation model (SEM), and draw the results of the overall analysis of the model (see Table 4).The goodness of fit indices meet the evaluation criterion suggested by Hu and Bentler [61] (X2/df=1.28, GFI=0.912,AGFI=0.835,NFI=0.912,IFI=0.923,CFI=0.922 and RMSEA=0.037). So it suggests that the model has consistency with the actual survey data and this model has good fitness.

Table 4. The fitness of the model.

Fitting index	X2/df	GFI	AGFI	NFI	IFI	CFI	RMSEA
Test value	1.28	0.912	0.835	0.912	0.923	0.922	0.037

4.3.2. The results of hypothesis tests

To examine the model structure, we first assess multi-collinearity using SPSS for the predicting constructs. All constructs in this paper indicate to have an acceptable level of above 0.2 and VIF below 5, suggesting non-collinearity. The structural equation model (SEM) and all standardized coefficients of the path are revealed in Fig.1. The statistical results show that the p-values of H1, H2a, H2b, H3a and H3b are all significant, thus all hypotheses of this study are supported. As indicated in table 5 and figure 1, the green entrepreneurial orientation is positively related to supply chain learning capability. Thus, H1 received support. Supply chain learning capability is positively related to both green radical innovation and green incremental innovation, H2a, H2b were supported. Green entrepreneurial orientation is positively related to the green incremental innovation as well as the green radical innovation, providing support for H3. In addition, the results prove that supply chain learning capability partially mediates the positive relationships between green entrepreneurial orientation and its two consequences—green incremental innovation and green radical innovation. It means that green entrepreneurial orientation can not only directly affect green incremental innovation and green radical innovation, but also indirectly affect them positively via supply chain learning capability. Figure 1 presents the model results.

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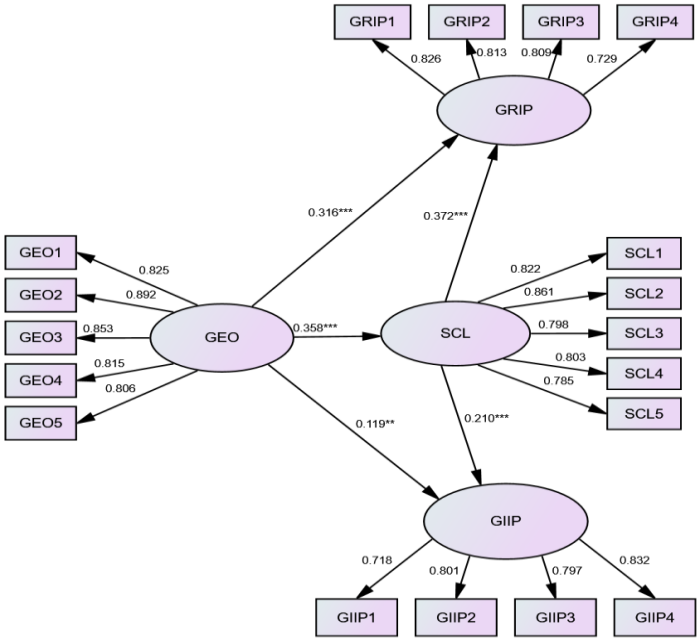

Figure 1. The result of the model

Table 5. The fitness of the model.

Hypothesis	Path coefficient	Proposed effect	P	Result
H1	0.358	+	***	Support
H2a	0.372	+	***	Support
H2b	0.210	+	***	Support
H3a	0.316	+	***	Support
H3b	0.119	+	**	Support

Note: ***p < 0.001, **p < 0.01, *p < 0.05.

5. Discussion and conclusions

Our study demonstrates that supply chain learning play a mediating role: the green entrepreneurial orientation enhance the supply chain learning capability, which in turn benefit the green innovation outcome, including green radical innovation and green incremental innovation. These results make an important contribution to extend the recent research stream focusing on the mechanism of the green entrepreneurial orientation-green innovation relationship as well as the supply chain research in the environmental context. Our study indicates that higher supply chain learning capability can be reinforced with a higher green entrepreneurial orientation and as a consequence green innovation is also increased. In this regard, our results could answer the question why a company get a low development of green innovation even though its management show a higher green entrepreneurial orientation: the inter-organizational learning capability such as supply chain learning links would be missing.

5.1. Theoretical contributions

This research has the following theoretical contributions. Firstly, we contribute to the green

innovation research by extending the research beyond the conventional antecedents to demonstrate the importance of the two factors: green entrepreneurial orientation and supply chain learning. Specifically, on the one hand, results of entrepreneurial orientation-innovation relationship in previous research are controversial, and studies in the environmental contextual are less well established. On the other hand, there are few empirical studies about the association between supply chain learning and green innovation. We examine green innovation by focusing on supply chain learning capability, an inter-organizational variable that foster the increase of the company's green innovation, providing a unique perspective. Secondly, our research broaden the current literature of the contextual analysis of green entrepreneurial orientation [62] to supply chain management by exploring the supply chain learning factor links the relationship between green entrepreneurial orientation and green innovation. We claim that the relationship between green entrepreneurial orientation and green innovation cannot be addressed as a simply direct relationship and the effect of green entrepreneurial orientation on green innovation in the supply chain context may be conditional or dependent on the capability of supply chain learning.

5.2. Implications for practitioners

Managerial implications represented by this research point to the important factors that companies should make an effort to promote not only within their organization, but also extend to their supply chain organizations in order to increase their green innovation. Our findings strengthen such a belief that a firm with a higher green entrepreneurial orientation could show a better development of their supply chain learning, and combine this opportunity to develop their green innovation.

When initially enhancing their green innovation, management should first focus on enhancing their management green entrepreneurial orientation. This research contributes to the implications for practitioners by suggesting the importance of management as well as their posture and attitude so as to effectively and efficiently implement the conditions to learn among different organizations. Therefore, as a company seeks to achieve a high level green innovation, the management need to take green entrepreneurial orientation into their strategies and develop it. At the same time, the government especially in developing countries should encourage and advocate companies' green entrepreneurial orientation by setting up a set of policies for graduating and training programs.

It is difficult to achieve green innovation within a single organization and it requires complementary collaboration with their relevant organizations to create valuable green products and services continually [63]. We conduct our research in the supply chain context, which can make a contribution for managers to understand how to conduct their green entrepreneurial action in the development of their green innovation. We suggest enhancing supply chain learning capability when senior management attempt to follow a higher green entrepreneurial orientation. Moreover, supply chain learning capability may be necessary for every company, especially these companies with high green entrepreneurial orientation to achieve green innovation because the different ideas, information and resources provided by supply chain partners are crucial for companies to solidify their green entrepreneurial orientation. Our study implies that companies should enhance the level of their supply chain learning capability. For example, they can try to emerge their atmosphere of supply chain learning, encourage more investments and strengthen their relationships with their supply chain partners, which may be more important in developing countries such as China. As a

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result, green innovation may be enhanced by a high level of supply chain learning capability, which provides a better condition under which companies can make the best of green entrepreneurial orientation in the supply chain context.

5.3. Limitations and future research directions

Our study is subject to several limitations that make opportunities for future research. First, because this study take supplier learning and customer learning together to value the supply chain learning scale, it is important for additional research to recognize the individual effects of each dimension. More precisely, future research should address the impact of different supply chain learning dimensions, explore how each dimension operate independently, making a deeply understanding of the relationship between green entrepreneurial orientation and green innovation in supply chain context.

Second, from the variable point of view, we only examined the supply chain learning as a mediator between green entrepreneurial orientation-green innovation relationship and didn't explore the possible moderating roles of environmental conditions. However, other organizational issues which related to organizational learning and innovation, are not considered in our study, such as collaborative commitment [14], supply chain integration [41], technological resources [64] and information technology [65] may also likely to have effects in our conceptual model. Future research should explore the impacts of these variables on the green entrepreneurial orientation -green innovation relationship.

Third, as a cross-sectional research, our study is based on just a snapshot data of ongoing time and we can't exactly assess the future implication of green entrepreneurial orientation on green innovation. Future longitudinal research should try to replicate this study to examine the dynamics of the relations established in the theoretical model. Furthermore, our results is based on the information from just one company of a partnership, which may reduce the robustness. We are aware of the difficulties of obtaining data from all relevant companies in supply chain. Future research relied on data from all supply chain partners is going to be a meaningful extension.

Author Contributions: Ying Guo initiated the project, designed the article framework and wrote the paper. Lifang Wang made contributions in data collection and then analyzed the data. Yan Xie designed the questionnaire and reviewed the paper.

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

Appendix A

Construct items

Constructs	Label	Measurement items	Sources
Green entrepreneur orientation	GEO1	A strong tendency for high-risk environmental projects (with chances of very high returns)	Naman & Slevin (1993), Hult et al.(2007) and Gima(2
	GEO2	In dealing with its competitors, my firm typically initiates actions that competitors respond to.	
	GEO3	To seek environmental development, my firm typically adopts a very competitive, undo-the-competitor" posture.	
	GEO4	Changes in environmental product or service lines have been quite dramatic.	

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	GEO5	A strong emphasis on environmental R&D, environmental technological leadership and environmental innovations.	001)
Supply chain learning capability	SCL1	we ensure that our employees and managers change their behaviors and processes appropriately as they gain new knowledge from our key suppliers	Quan Zhu et al. (2017) and Flint et al. (2008)
	SCL2	we ensure that our employees and managers change their attitudes about our market situation as they gain new knowledge from our key supply chain partners	
	SCL3	we ensure that managers in our key suppliers learn better ways to manage their business and work with us	
	SCL4	we ensure that managers in our key suppliers are learning better ways to operate and serve us	
	SCL5	we ensure that our employees and managers change their attitudes when needed about customers and sending customers as they gain new new knowledge about customers	Flint et al. (2008)
Green incremental innovation	GII1	We often improve an existing product to make it more environmentally friendly	Jing Dai et al.(2015) and Yuan Li(2007)
	GII2	We often improve existing processes to make them more environmentally friendly	
	GII3	We often exploit existing technologies to make processes more environmentally friendly.	
	GII4	We often exploit existing technologies to make products more environmentally friendly	
Green radical innovation	GRI1	We often introduce radically new concept innovations to make products more environmentally friendly	
	GRI2	We often develop and introduce radically new environmentally friendly technologies intothe industry	
	GRI3	We often create radically new environmentally friendly products.	
	GRI4	We often introduce radical innovations to make processes more environmentally friendly	

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Note: All items were of 7-level Likert scale in the questionnaire.

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