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A Study on the Effect of Environmental Regulation on Green Innovation Performance: A Case of Green Manufacturing Enterprises in Pearl River Delta in China

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Abstract

Green innovation has become the topic of corporate sustainable development. Countries in the world formulate environmental regulation to drive corporate green innovation, while enterprises are getting lost in the selection of innovation strategy in environmental regulation. This study intends to discuss the effect of environmental regulation on exploration innovation, exploitation innovation, and green innovation performance. Based on the questionnaire survey of 220 green manufacturing enterprises in Pearl River Delta in China, Structural Equation Model is used for the analysis. The empirical results reveal insignificant effects of environmental regulation on green innovation performance that environmental regulation does not directly affect green innovation performance; exploration innovation requires more support of environmental regulation than exploitation innovation, while exploitation innovation shows better green innovation performance than exploration innovation; and, dual interaction between exploration and exploitation appears positive and remarkable effects on green innovation performance. As a result, an enterprise should develop dual interaction between exploration and exploitation, and environmental regulation is the drive and guarantee of green innovation.

Keywords: environmental regulation, exploration innovation, exploitation innovation, green innovation performance, green manufacturing enterprises

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INTRODUCTION

Green innovation becomes the topic of corporate sustainable development, and countries in the world formulate environmental regulations to drive corporate green innovation. To cope with global climate change and economic recession, enterprises promoting economic growth with green innovation and aiming at high value-added development result in global economic development largely stepping in "green economy". *Made in China 2025* regards green development as one of the major directions and definitely proposes the comprehensive promotion of green manufacturing. Focusing on enterprises and developing the construction of green manufacturing systems are the keys in the implementation of five major development ideas and the establishment of strong manufacturing nation. It presents significant meanings on the harmonious integration of industrial civilization and ecological civilization. The nation and local governments successively propose policies and measures to encourage the introduction of green low-carbon development. The green technological innovation and speeding industrialization facilitate the application of green manufacturing and green supply chain achieving certain outcomes.

The development of environmental regulation driving corporate green innovation is generally proved in the world and becomes a popular research issue in developing countries. Theory of environmental regulation indicated that governments, through environmental policies, could effectively solve "market failure" caused by green technological innovation (Kriecher and Ziesemer 2009). Porter (1995) proposed that proper environmental regulation could induce innovation and enhance competitive advantage of an enterprise. Past research revealed that environmental regulations, with innovative compensation effect, could

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enhance enterprises developing and spreading green technology and environmental regulation showed positive incentives on green innovation technology and green innovation performance of enterprises (Feng and Chen 2018, Hamamoto 2006, Tian and Lin 2017). Research in China also proved the positive effect of environmental regulation on green technological innovation (Wang et al. 2018, Zhang and LV 2018), especially on the exploration innovation of emerging industries. Research also proposed that environmental regulation increased pollution control costs and occupied the investment in green innovation to further hinder green technological innovation (Gray 1987, Hamamoto 2006). The effect of environmental regulation on green technological innovation was uncertain, i.e. obvious differences in the effect of environmental policy and strength on green technological innovation. In this case, theory of environmental regulation considered environmental regulations as the governmental policy of an enterprise to induce the re-allocation of innovation factors and the change in innovation direction and size. Enterprises presented different selection of innovation strategy in environmental regulation.

Under "green economy", green innovation is considered as the key in business growth, competitiveness promotion, and sustainable development (Christensen 1995, Drucker 1985). Green economic growth relies on green technology and green innovation, which therefore become the bases of green economic development; and, the selection of green innovation strategy becomes the key for an enterprise. Jansen et al. (2006) regarded exploration innovation and exploitation innovation as two common innovation strategies for enterprises. Exploration innovation presented high risks, uncertainties, and uniqueness, while exploitation innovation showed practicality, efficiency, and learnability. There were correlations between the two, but also revealed difference and competition. Both exploration innovation and exploitation innovation required the support of innovative resources, such as knowledge, technology, talent, and capital. An enterprise needed strong innovation control ability for searching, finding out, selecting, controlling, and utilizing innovative resources.

In sum, past research on environmental regulation focused on macro data analyses, but lacked micro experiments. Exploratory research was done for exploration innovation and exploitation innovation, but separate empirical research on such two innovation strategies was short (He and Wong 2006). For this reason, taking green manufacturing enterprises in Pearl River Delta as examples, this study intends to analyze the relationship among environmental regulation, innovation strategy, and green innovation performance. Structural equation analysis is applied to fill in the gap of research on innovation strategy and green innovation as well as provide reference for enterprises selecting innovation strategy.

LITERATURE REVIEW AND RESEARCH HYPOTHESIS

Relationship among Environmental Regulation, Exploration Innovation, and Green Innovation Performance

Environmental regulation aims to enhance green innovation performance and competitiveness to further construct national competitiveness. Environmental regulation includes financial incentive, support measure, and protection policy, as the innovation policy of local government, into relevant regulations for the practice, generally covering green technology, green products, clean production, tax preference, R&D grant with rent reduction, talent introduction, and protection of patents and intellectual property rights, in order to provide support and guarantee for the professional, directional, and prospective development of industry and the green innovation activity of enterprises. It was concerned in resource-based view that environmental regulation could benefit the development of green technological innovation and present positive and notable function on green innovation performance (Feng and Chen 2018, Tian and Lin 2017). An enterprise would develop innovation activity with internal and external resources to promote the innovation ability and further enhance the learning ability and green innovation performance (Caloghirou et al. 2004, Romijn and Albaladejo 2002). Patent database and governmental investment in research and development, financial subsidies, and tax preference policy were generally the sources of external resources (Caloghirou et al. 2004). Local governments increased the green industry fund, establishment of environmental protection industry fund, investment in research and development, and tax preference in past years. The governmental innovation policy encouraged the R&D expenditure investment of enterprises in green products and green technology to result in higher rewards for the society.

Exploration innovation preceded disruptive innovation based on new knowledge, technology,

design, and product to create customer value (Jansen et al. 2006). March (1991) pointed out the importance of exploration innovation and exploitation innovation to the competitive advantage and sustainable development of an enterprise. Exploration innovation presented novelty and particularity on required knowledge and showed the characteristics of search, discovery, high risk, experiment, and flexibility. An enterprise could acquire new knowledge, technology, and workmanship through exploration innovation to adapt to the market environment change, enter the new product or market, and even result in new niche. Nevertheless, enterprises stressing on exploration innovation might appear high risks, acquire immature creativity for not being able to establish unique competitive advantage, and get into the failure trap of "exploration→failure→re-exploration". For this reason, an enterprise required large amount of resources and new technology in the exploration innovation process for the guarantee.

Past research revealed the positive effect of tax deduction or direct financial subsidy in environmental regulation on R&D activity of enterprises. However, there were differences in technology development and tax deduction or direct financial subsidy among various countries (Becker 2015, Garcia-Quevdo 2004). Since innovation was a dynamic process with uncertainties and high risks, and enterprises required innovative resources in the green innovation process for the guarantee, single enterprises had to rely on self-owned resources to practice innovation activity and promote competitiveness to fulfill the business objectives with high financial costs, encountered huge risks of inadequate organizational management ability, large investment in product research and development, and high process improvement costs. In this case, it required the governmental environmental regulation with innovation policies of investment in research and development, tax preference, and financial subsidy. The development of exploration innovation would not affect the financial performance of an enterprise, but would erode the resources (Jansen et al. 2006). He and Wong (2006) found out the positive and significant effects of exploration innovation on sales growth and green innovation performance of enterprises. It is therefore considered in this study that environmental regulation shows correlations with exploration innovation and green innovation performance. Hypotheses H1 and H2 are further inferred.

H1: Environmental regulation presents positive relationship with exploration innovation.

H2: Exploration innovation shows positive relationship with green innovation performance.

Relationship among Environmental Regulation, Exploitation Innovation, and Green Innovation Performance

Exploitation innovation precedes progressive innovation based on existing technology, product, and service to satisfy customer and market requirements (Jansen et al. 2006). Based on current businesses, exploitation innovation satisfied customer needs, improved existing knowledge, technology, product, and workmanship to enhance or expand product efficiency, and presented the characteristics of production, efficiency, quality, lean, and marketization. March (1991) considered that exploitation innovation revealed higher success rate, would enhance the application of organization, process, product, and service process in enterprises, generate new knowledge through the "learning→transformation→internalization" process, and eventually result in "success trap". Innovation was also the learning and transformation process (Hitt et al. 2000). An enterprise had to integrate internal and external resources, acquire technology, knowledge required for product design, manufacturing, and assembly in the product manufacturing process, equipment personnel, and professional knowledge, enhance innovation ability, and strengthen market competitiveness and green innovation performance (Huang et al. 2018, Yam et al. 2011). Innovation ability presented critical function in the prediction of sustainable development of an organization that an enterprise with high performance generally showed better innovation ability than low-performance ones.

An enterprise with environmental regulation technology could promote the technology innovation ability through green product R&D, introduction of new technology, talents, and equipment, and organization and service innovation as well as enhance the scale benefit by expanding the production scale and investment to improve the green innovation performance. According to resource-based view, organizational innovation ability was the direct source of competitive advantage of an enterprise and could improve the green innovation performance (OECD 2010). Foray (2000) proposed that an enterprise would realize internal innovation by constructing formal or informal innovation network and learning external knowledge. Product innovation aimed to satisfy customer needs, occupy market share, or create new market to directly affect green innovation performance.

Process innovation was extremely important for product realization, green innovation performance growth, and sustainable development (Camisón and Villar-López 2014). Process innovation could reduce product delivery cycle or low-cost operation and enhance cost leading strategy of enterprises (Damanpour 2010). Competitive advantage of an enterprise might be the efficiency and ability from new product development. Investment in R&D was regarded as the key in corporate innovation. Nonetheless, some researchers also discovered that merely providing large amount of investment in R&D could not maintain green innovation performance and competitiveness of an enterprise (Feng and Chen 2018, OECD 2010, Tian and Lin 2017, Yam et al. 2011). He and Wong (2006) found out the positive and remarkable effects of exploitation innovation on sales growth and green innovation performance of enterprises. Accordingly, exploitation innovation in environmental regulation would appear notable effects on green innovation performance. Hypotheses H3 and H4 are therefore inferred in this study.

H3: Environmental regulation reveals positive relationship with exploitation innovation.

H4: Exploitation innovation appears positive relationship with green innovation performance.

Meanwhile, the coordination and continuous development of social, economic, and environmental systems were considered as the research objective and human-environment systems were regarded as the control object in theory of environmental regulation to comprehensively interpret the basic theories of environmental regulation, to systematically analyze law, economy, administration, technology, and education which supported environmental regulation, and to explore control measures and management strategy. An enterprise directly acquiring incomes beyond the major businesses might lack innovation motivation, precede green innovation to cater to the government for subsidies, rather than for the development of the enterprise, and even appear negative correlations with the economic benefits of listed companies. Although the effect of environmental regulation on green innovation performance was distinct, it was still regarded as the public policy in various countries to stimulate or encourage enterprises increasing the investment (Feng and Chen 2018, Mario et al. 2016) and providing guarantee for national innovation systems. Consequently, it is inferred in this study that environmental regulation would promote green innovation performance. H5 is therefore proposed.

H5: Environmental regulation presents positive relationship with green innovation performance.

Relationship between Dual Interaction between Exploration and Exploitation and Green Innovation Performance

In past research, it was considered that enterprises could hardly distinguish exploration innovation from exploitation innovation in the innovation process. Exploration innovation presented high risks, uncertainties, and uniqueness, while exploitation innovation revealed practicality, efficiency, and learn ability. Although there were differences and competition between the two, they showed correlations and complementarity, and differences existed in the theoretical and empirical research conclusions (Jansen et al. 2006, March 2006). March (1991) proposed exploration and exploitation innovation and proposed the incompatibility with separate arguments that the distribution of innovative resources often got into dilemmas. Researchers further found out commonality, complementarity, and extensibility between exploration innovation and exploitation innovation (Fajoun et al. 2010, Gupta et al. 2006, Jaffe and Palmer 2006). In the research on the innovation activity of the US Cisco Systems, Inc., Gupta et al (2006) discovered that preceding exploration innovation on product R&D and exploitation innovation on manufacturing, sales, and service would form the complementary relationship and further enhance the innovation performance. From the aspect of organization, Fajoun et al (2010) indicated that a certain element in another type of innovation was necessary for developing exploration and exploitation innovation, between which there was complementary relationship. In other words, an enterprise could rapidly research and develop new product, enter new market, and discover new niche with exploration innovation and realize products, maintain competitive advantage, and continuously make profits with synchronous exploitation innovation; it required coordination and balance between the two. As a result, it is considered in this study that dual interaction between exploration and exploitation innovation is correlated with green innovation performance. H6 is therefore inferred.

H6: Dual interaction between exploration and exploitation shows positive relationship with green innovation performance.

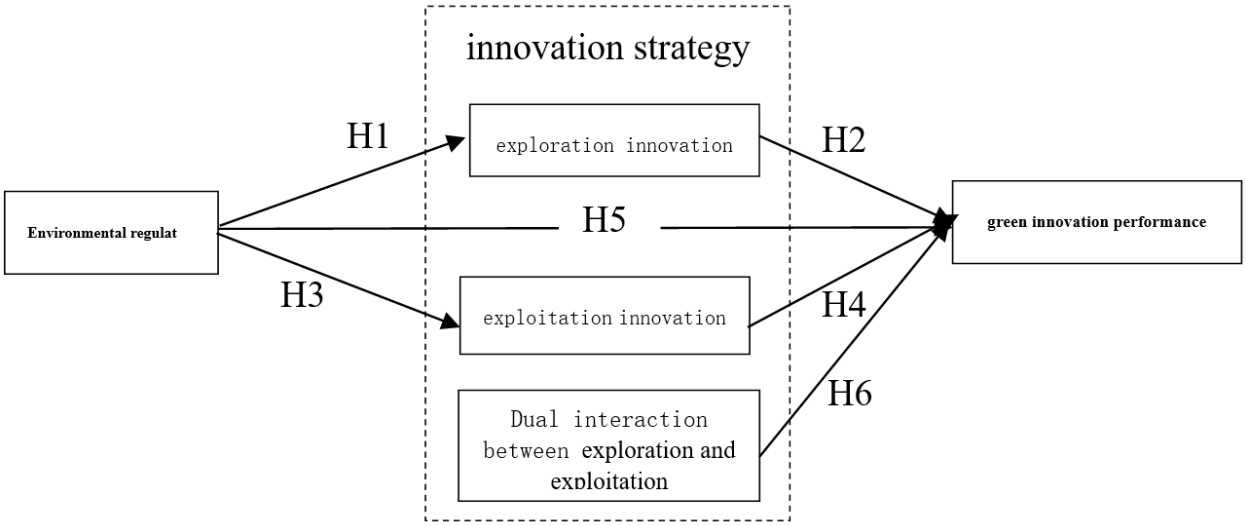

Fig. 1. Research model of the effect of environmental regulation on green innovation performance

In sum, it is proposed in this study that differences exist in the selection of innovation strategy in corporate environmental regulation. The relationship among environmental regulation, type of exploration innovation and exploitation innovation, and green innovation performance is therefore analyzed. The research architecture is shown in **Fig. 1**.

RESEARCH METHOD

Questionnaire Development and Variable Definition

The questionnaire items are referred to relevant international literatures. With strict translation and several times of item and syntax revision, the combination of environmental regulation in Shenzhen city and the actual situations of enterprises, and the pretest analysis of 50 middle and high-level professional managers, the accuracy, adaptability, and response convenience of the questionnaire items are ensured. Four constructs of environmental regulation, exploration innovation, exploitation innovation, and green innovation performance are included in the questionnaire. The operational definition and measurement are explained as below. Environmental regulation contains environmental policies, pollution control costs, pollution emission, direct grant, and indirect grant (Ma and Cha 2012), e.g. provision of subsidy for green products, sponsor of technology, R&D grant, tax preference, and talent awards. Examples of "the government provides interest-free or discounted loan", "the government gives subsidy for green products", and "the government provides environmental regulation tax preference" are included in the 9 items. Exploration innovation precedes disruptive innovation based on new knowledge and technology to create customer value (Jansen et al. 2006). Examples of "precede disruptive innovation" and "develop new market" are contained in the 5 items. Exploitation innovation precedes progressive innovation based on existing technology and products to satisfy customer and market demands (Jansen et al. 2006). Examples of "precede progressive innovation" and "improve existing product quality and production technology" are covered in the 4 items. The measuring indicators of green innovation performance at least contain green sales performance, green manufacturing performance, and green R&D performance (Bi et al. 2015). Examples of "green sales margin growth" and "green manufacturing performance enhancement" are included in the 10 items. Control variables cover type of industry, type of enterprise, enterprise age, and enterprise size. Likert 7-point scale is used for the questionnaire; the higher digit stands for better agreement with the item (1 stands for extremely disagree, 3 for ordinary, and 7 for extremely agree).

Data Collection

Green manufacturing enterprises is a factory that realizes intensive land use, harmless raw materials, cleaner production, resource utilization of waste and low-carbon energy. Green manufacturing enterprises in Pearl River Delta in China, as the research population, are randomly sampled. High and middle-level managers and innovation activity related personnel of enterprises are surveyed. Total 500 copies of questionnaire are distributed, and 282 copies are retrieved, with the retrieval rate 56.40%, among which 62 copies are eliminated due to incomplete information or invalid. Total 220 valid copies are confirmed. In the

Table 1. Sample characteristics (N=220)

	N	percentage
Industry		
advanced manufacturing	84	38.19%
electronic information	78	35.45%
traditional manufacturing	58	26.36%
type of enterprise		
state-own enterprise	16	07.27%
private enterprise	138	62.73%
foreign-owned enterprise	66	30.00%
enterprise age	4.3	
enterprise size		
S (1-50)	79	35.91%
M (51-1000)	95	43.18%
L (more than 1001)	46	20.91%

analysis of valid samples, type of industry contains 38.19% advanced manufacturing, 35.45 % electronic information, and 26.36 % traditional manufacturing; type of enterprise shows 7.27% state-own enterprise, 62.73% private enterprise, and 30.00% foreign-capital enterprises; enterprise size reveals 35.91% small, 43.18% medium, and 20.91% large; and, the average enterprise age is 4.3 years. In regard to the questionnaire, 62% participants are male and 38% female; education background reveals 5.45% doctorate, 51.73% master, 38.50% bachelor, and 4.32% under senior high school; 18% participants are chairman, 37% general (vice) manager, 34% department manager, and 11% other personnel; the average seniority in current company is 5.6 years; and, the average age is 37. The results are shown in **Table 1**.

Statistics Method

Structural Equation Model and Mplus7.8 are utilized in this study for testing the hypotheses. According to the suggestion of Anderson and Gerbing (1988), SPSS is first used for analyzing samples with Descriptive Statistics, Confirmatory Factor Analysis (CFA) is then applied to evaluate the reliability and validity of the measurement model, and latent variable path analysis is utilized for evaluating the structural model to test the research hypotheses.

EMPIRICAL ANALYSIS

Descriptive Statistics

According to the classification in **Table 1**, F test is first applied to test the equivalence of industry, type of enterprise, and enterprise size variance. The test shows insignificant results, industry ($F=0.79$, $p=0.45$), type of enterprise ($F=1.12$, $p=0.38$), and enterprise size ($F=0.96$, $p=0.41$), revealing equivalent variance of two samples. Meanwhile, the mean, standard deviation, and correlation coefficient of constructs are shown in **Table 2**, where the correlation coefficient between environmental regulation, exploration innovation, exploitation innovation and green innovation performance appears in 0.35-0.85, achieving the significance. It presents moderately positive correlations between constructs and green innovation performance.

CFA

Confirmatory Factor Analysis is utilized in this study for testing the reliability, convergent validity, and discriminant validity of the questionnaire. The CFA results show that the overall model fit index achieves the suggested standard ($\chi^2 = 782.27$, df = 431, cmin/df = $2.29 < 3$, $p = 0.000$; CFI = $0.94 > 0.90$; TLI = $0.93 > 0.90$; SRMR = $0.04 < 0.08$; RMSEA = $0.06 < 0.08$) (Hu and Bentler 1999), with favorable goodness of fit and measurement quality. Both Cronbach's α and composite reliability (CR) coefficient are above 0.9, conforming to the acceptable standard of α and composite reliability being higher than 0.7 (Nunally and Bernstein 1994). The standardized factor loadings of all items are above 0.65, higher than the acceptable standard of being higher than 0.5 (Anderson and Gerbing 1988). The average variance extracted in 0.08-0.89 is also higher than 0.5, showing good convergent validity of the scale (Fornell and Larcker 1981). Discriminant validity is tested with confidence interval. The test results reveal that the correlation coefficient between constructs does not cover 1 after adding and deducing two standard errors, conforming to the standard of good discriminant validity (Bogozzi and Yi 1988). Specific results are shown in **Table 2**.

Table 2. Mean, standard deviation, composite reliability, convergent validity, and correlation coefficient matrix

construct	mean	SD	CR	AVE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. environmental regulation	4.26	1.64	.96	.74	.87						
2. exploration innovation	4.68	1.43	.90	.65	.45	.80					
3. exploitation innovation	4.67	1.21	.95	.81	.45	.85	.89				
4. green innovation performance	5.26	1.26	.95	.80	.35	.71	.74	.89			
5. industry	2.01	0.71			.13	-.16	-.17	-.14	1		
6. type of enterprise	2.01	0.42			-.12	.02	.09	-.04	-.13	1	
7. enterprise size	2.03	0.63			.14	.06	.06	.05	.06	-.05	1

Remarks:
(1) N=220;
(2) Non-diagonal values stand for the correlation coefficient of dimension;
(3) Diagonal values represent the square root of the average variance extracted (AVE) of dimension

Table 3. Hypothesis testing and results

Hypothesis testing	Path coefficient	*t*	Result
H1: Environmental regulation presents positive relationship with exploration innovation.	0.68★★★	5.93	Accepted
H2: Exploration innovation shows positive relationship with green innovation performance.	0.53★★★	3.06	Accepted
H3: Environmental regulation reveals positive relationship with exploitation innovation.	0.37★★	2.47	Accepted
H4: Exploitation innovation appears positive relationship with green innovation performance.	0.72★★★	7.88	Accepted
H5: Environmental regulation presents positive relationship with green innovation performance.	-0.17	-0.79	Rejected
H6: Dual interaction between exploration and exploitation shows positive relationship with green innovation performance.	0.12★	1.47	Accepted

Remark: N=220; ★$p<.05$; ★★$p<.01$; ★★★$p<.005$.

Hypothesis Testing

The path relationship among constructs in this study is discussed with path analysis to test the research hypotheses. The path coefficient, *t*, and result are organized in **Table 3**. The model fit index and standardized path coefficient (χ^2=705.52, df=346, cmin/df=2.07, p=0.000; CFI=0.93; TLI=0.92; SRMR=0.06; RMSEA=0.07) show good goodness of fit between fit of structural model and observation data (Hu and Bentler 1999).

The relationship among environmental regulation, exploration innovation, and green innovation performance is first tested. Environmental regulation presents positive and notable effects on exploration innovation (β=0.68★★★, t=5.93) that H1 is supported. Exploration innovation shows positive and significant effects on green innovation performance (β=0.53★★★, t=3.06) that H2 is supported. It reveals that environmental regulation shows positive effects on the development of exploration innovation, and exploration innovation would result in better green innovation performance. The relationship among environmental regulation, exploitation innovation, and green innovation performance is further tested. Environmental regulation appears positive and remarkable effects on exploitation innovation (β=0.37★★, t=2.47) that H3 is supported. Exploitation innovation presents positive and notable effects on green innovation performance (β=0.72★★★, t=7.88) that H4 is supported. It reveals the positive effect of environmental regulation on the development of exploitation innovation, and exploitation innovation could enhance green innovation performance. Finally, environmental regulation does not appear remarkable effects on green innovation performance (β=-0.17, t=-0.79) that H5 is not supported. It reveals that environmental regulation would not directly affect green innovation performance, but promotes green technological innovation, through exploration innovation and exploitation innovation, to influence green innovation performance. Exploration innovation and exploitation innovation present mediation effects on environmental regulation and green innovation performance.

To further test the effect of dual interaction between exploration innovation and exploitation innovation on green innovation performance, SPSS23.0 and PROCESS, proposed by Hayes (2013), are applied to test the hypotheses. Dual interaction between exploration innovation and exploitation innovation shows positive and notable effects (β=0.12★, t=1.47) that H6 is supported. It reveals that enterprises could not concentrate on one of exploration innovation or exploitation innovation when making selection; dual interaction is necessary.

CONCLUSION AND SUGGESTION

Research Conclusion

The economy in China is currently slowing down the growth, adjusting the industrial structure, and encountering strict resource environmental regulation that the selection of innovation strategy is especially important for enterprises. The relationship among environmental regulation, innovation strategy, and

green innovation performance is discussed, effects of environmental regulation on exploration and exploitation innovation are tested, and green manufacturing enterprises in Pearl River Delta are surveyed to test the hypotheses in this study. Environmental regulation does not significantly affect green innovation performance, showing no direct effect of environmental regulation on green innovation performance. Although tax preference and green subsidy in environmental regulation are regarded as the extra income of an enterprise, it merely increases cash flow in short period. However, enterprises would regard it as the policy encouragement to invest in more capitals for the development of green innovation and realize green innovation performance through green products, green technology, and clean production.

Environmental regulation presents positive and notable effects on exploration innovation and green innovation performance, revealing that the environmental policies in environmental regulation would facilitate enterprises preceding green innovation, enhance the green technological innovation ability, and further promote the green innovation performance, where exploration innovation shows mediating effects. That is, an enterprise would develop innovation activity with internal and external resources to promote the green technological innovation ability. Besides, governmental innovation policy encourages enterprises investing in green product and technology R&D expenditure to enhance the learning ability and green innovation performance and further result in higher rewards to the society. Environmental regulation appears positive and significant effects on exploitation innovation and green innovation performance, revealing that environmental policies in environmental regulation would facilitate enterprises preceding green innovation to further promote the green innovation performance, where exploration innovation presents mediating effects. In other words, an enterprise with environmental regulation could enhance the technology innovation ability by researching and developing green products, introducing new technology, talent, equipment as well as organization and service innovation. Moreover, it could enhance the scale benefits and improve the green innovation performance by expanding the production scale and investment.

Exploration innovation requires more support of environmental regulation than exploitation innovation, while exploitation innovation presents better effects on green innovation performance than exploration innovation. It is because an enterprise with exploration innovation requires large amount of R&D expenditure, experiences high risks, and focuses on the organic integration of new knowledge, new technology, and market. The success of research and development could largely enhance the core competitiveness, explore new niche, and sustainably make profits. Exploitation innovation, on the other hand, stresses on learning and imitation for the improvement of existing technology, product, and workmanship, invests less in research and development, and shows lower risk coefficients.

Dual interaction between exploration and exploitation reveals positive and remarkable effects on green innovation performance. Apparently, an enterprise cannot concentrate on certain innovation strategy, but has to keep up with the time for the survival and competition. Different innovation strategy requires distinct knowledge, resource, structure, and ability. An enterprise therefore should deeply understand the difference between such two strategies, collect types of knowledge and resources, and match proper structure characteristics to further maximize the green innovation performance.

Management Inspiration

Environmental regulation policies do not directly affect green innovation performance, but realize green innovation performance by improving green products, green technology, clean production, and organization innovation. For this reason, environmental regulation policies should drive and induce enterprises preceding green innovation from supply and demand. In regard to supply, specific policies on green product R&D, green technological innovation, clean workmanship innovation, environmental regulation innovation, ecological organization innovation, and green system innovation are made. Green innovation requires the input of new production elements of ecological environment costs, data resources, information resources, intellectual resources, and new materials, clean energy, and renewable energy, the construction of green technological innovation new systems, the enhancement of green technological innovation standard, the increase in new-style production elements, and the promotion of ecological efficiency. It insists on regarding green development, loop development, and low-carbon development as the basic routes and requires the co-driving of the market and the government. Regarding demand, new technology products and green products should be the priority for governmental purchase and environmental regulation. With differential supervision system and tax, financial,

and governmental purchase policies, consumer needs for price priority, performance priority, and environment priority should be established. Meanwhile, industry and industrial characteristics should be considered in environmental regulation policies, environmental regulation styles should be innovated and enriched, and contents of subsidy policies should be broadened.

Innovation strategy is the most important business decision in the development process of an enterprise. An enterprise should make selection between exploration innovation and exploitation innovation, according to development scale, development stage, and management maturity. Besides, an enterprise cannot concentrate on a type of innovation, but should proceed with dual interaction. Both exploration and exploitation innovation strategies show certain risks. An enterprise needs environmental regulation policies for driving and guarantee and has to enhance the internal innovation ability. Exploitation innovation could be preceded in the exploration innovation process to rapidly adapt to the change in external environment. Preceding exploration innovation after acquiring certain outcomes and benefits in exploitation innovation process could establish self-owned product, technology, and brand to further construct core competitiveness. For instance, both mobile phone products of Huawei and automobiles of Yadi New Energy in Shenzhen start from learning and imitating, then precede exploitation innovation and then exploration innovation.

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