

Studies on Improving the Performance of Small and Micro Enterprises through Green Innovation

Badania nad poprawą wyników małych i mikroprzedsiębiorstw poprzez stosowanie zielonych innowacji

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Abstract

It is an important goal of China's 2025 Strategy to build an environmental governance system with the government as the leading role, enterprises as the main body, and social organizations and the public all participate actively. In this context, whether and how small and micro enterprises, as a force of rejuvenating the country through science and technology, participate in the construction of environmental governance system is discussed in this paper. This study uses the 12th China small and micro enterprise survey database to deeply analyze the direct and indirect effects between green innovation and small and micro enterprise performance, and finds that: in the direct effect analysis, the direct promotion effect of green innovation on the financial performance of small and micro enterprises is related to the development stage of small and micro enterprises, which is significant in the initial stage and mature stage, but not significant in the growth stage; in the indirect effect analysis, green innovation can indirectly improve the overall performance of small and micro enterprises by improving their environmental and social responsibility performance. At the same time, green innovation can amplify the role of other factors in promoting the overall performance. This study not only enriches the research scope of green innovation theory from the subdivision dimension, provides a new perspective for the integration of green innovation and social responsibility theory, it also provides theoretical reference and guidance for the green innovation practice of small and micro enterprises.

Key words: green innovation, environmental and social responsibility, performance of small and micro enterprises

Streszczenie

Ważnym celem chińskiej Strategii 2025 jest zbudowanie systemu zarządzania środowiskowego, z rządem odgrywającym wiodącą rolę, przedsiębiorstwami jako głównym organem i aktywnie uczestniczącymi organizacjami społecznymi i społeczeństwem. W niniejszym artykule omówiono, czy i w jaki sposób małe i mikroprzedsiębiorstwa, uczestniczą w budowie systemu zarządzania środowiskiem. W badaniu wykorzystano 12. bazę danych ankietowych małych i mikroprzedsiębiorstw w Chinach, aby dogłębnie przeanalizować bezpośrednio i pośrednio

zależności między zielonymi innowacjami a wynikami małych i mikroprzedsiębiorstw. Stwierdzono, że: w analizie skutków bezpośrednich bezpośredni wpływ promocji zielonych innowacji na finanse wyniki małych i mikroprzedsiębiorstw jest związany z fazą rozwoju małych i mikroprzedsiębiorstw, jest ona istotna w fazie początkowej i dojrzałej, ale nieistotna w fazie wzrostu; w analizie skutków pośrednich zielone innowacje mogą pośrednio poprawić ogólne wyniki małych i mikroprzedsiębiorstw poprzez poprawę ich wyników w zakresie odpowiedzialności środowiskowej i społecznej. Jednocześnie ekologiczne innowacje mogą wzmocnić rolę innych czynników w promowaniu ogólnej wydajności. Niniejszy artykuł nie tylko wzbogaca zakres badawczy teorii zielonych innowacji z wymiaru poddziałowego, zapewnia nową perspektywę integracji zielonych innowacji i teorii odpowiedzialności społecznej, ale także dostarcza teoretycznego odniesienia i wskazówek dla praktyki zielonych innowacji małych i mikroprzedsiębiorstw.

Słowa kluczowe: zielone innowacje, środowiskowa i społeczna odpowiedzialność, wydajność małych i mikroprzedsiębiorstw

1. Introduction

Statistics from the *Analysis and Prospects: Report on the Survival and Development of China's Small and Micro Enterprises* show that the total number of small and micro enterprises in China in 2019 be about 100 million. The 2014 European Commission report showed that small and micro enterprises accounted for 98.7% of the total number of enterprises, and employees accounted for 50.2% of the total number of employees (Targoutzidis et al., 2014). In 2018, the US Census Bureau showed that small and micro enterprises accounted for 95% of the total number of enterprises (US Census Bureau, 2018). Small and micro enterprises continue to develop on a global scale, their economic development mode is changing rapidly, and their employment absorption capacity is strong. They have become a propeller of regional growth and a regulator of social stability. Small and micro enterprises not only provide more jobs for the society, but also practice most of the innovation of technology and management and promote the development of economy. According to the national statistical yearbook of China, the final product and service value of small and micro enterprises accounted for more than 43% of GDP in 2018, and the tax payment accounted for more than 47%. In addition, about 50% of China's patent invention rights and 42% of new product development came from small and micro enterprises. Small and micro enterprises have become an important pillar of national economy and an important driving force of social development and play a pivotal role in social economy. Under the background of global high concern for sustainable development, China is also actively building the environmental governance system based on sustainable development. Because a large part of pollution in China comes from enterprises, enterprises play an important role in environmental governance practice, and small and micro enterprises are a force that cannot be ignored. As one of the sources of pollution, small and micro enterprises are not only the key monitoring objects of pollution prevention and control, but also an important carrier to promote green innovation and green production mode. Traditional view is that compared with large

and medium-sized enterprises, small and micro enterprises are often relatively conservative due to the restrictions of various resources and have high organizational commitment to traditional products. When facing risks, especially when their own survival and control rights are threatened, they are more willing to adopt the attitude of avoiding rather than preference, and then the willingness to innovate is lower (Cao et al., 2017; Chen et al., 2017). The green innovation that this research focuses on refers to the activities of small and micro enterprises to reduce environmental pollution through technological and product innovations to create new market opportunities to improve the overall performance of the enterprise. This activity has the dual attributes of environmental protection and innovation. In the process of implementing green innovation strategy, small and micro enterprises will face the dual pressure of environmental protection and innovation. Can they show stronger green innovation willingness than large and medium-sized enterprises? What are the specific driving factors? How to choose the path? The research on this issue is not only related to the sustainable development of small and micro enterprises, but also related to the sustainable development of China's economic and social environment.

This research can bring the following contributions. (1) By focusing on the subdivision dimension of green innovation, this paper reveals the impact of different indicators of green innovation on the sustainable development performance of small and micro enterprises, and deepens the existing green innovation theory; (2) By introducing the intermediary model and interaction model, this paper tests the indirect effect of green innovation on the sustainable development performance of small and micro enterprises, expands the channels for green innovation to play its value, and reveals the path of action between green innovation and the performance of small and micro enterprises; (3) It not only provides the possibility for small and micro enterprises to bring green innovation, corporate environmental social responsibility performance and corporate financial performance into the overall framework for systematic management, but also improves the theoretical extension of the impact process of green innovation on

corporate performance, and opens up new ideas for effectively improving the performance of small and micro enterprises and promoting the sustainable development of small and micro enterprises.

The research content of this paper is arranged as follows: the second section, literature review, to understand the impact of green innovation on enterprise performance and the role and motivation of green innovation of small and micro enterprises; the third section is the research design, select of green innovation indicators and corporate environmental and social responsibility measurement indicators, construct an analysis model of the direct and indirect effects of green innovation on the performance of small and micro enterprises; the fourth section analyzes the path of green innovation on the performance of small and micro enterprises; the fifth section is the conclusion.

2. Literature review

(1) Green innovation and corporate performance

Green innovation is an innovation composed of new or complete technologies, products, processes, services, and management concepts. It can not only realize value-added for enterprises, but also significantly reduce the adverse impact on the environment (Arfi, 2017). Green innovation is increasingly regarded as an important strategy for enterprises to obtain sustainable competitive advantage in the new arena (Chan, 2016), whose purpose is to make enterprises produce good environmental benefits, not just to reduce the pressure from the environment (Chen et al., 2018). Green innovation can effectively improve energy utilization using alternative energy, improvement of process and resource recycling, and promote cost minimization by reducing resource use, to ensure that the production and manufacturing processes of enterprises comply with environmental regulations and avoid environmental pollution penalties (Craig et al., 2006; Dangelico et al., 2019). As a forward-looking strategy to fundamentally solve environmental problems, green technology innovation can be reflected in the establishment of technical barriers and cultivation of long-term competitive advantages of enterprises through the dual value effect on environment and finance, it is the key factor for enterprises to occupy the market and realize sustainable operation (Chen et al., 2018; Calabrò et al., 2019). Green innovation can be divided into green process innovation and green product innovation (Fernando et al., 2019; Fu et al., 2019), green process innovation includes clean production technology innovation and end treatment technology innovation, which aims to reduce harmful substances, reduce pollutant emissions and improve energy efficiency by improving existing production processes or developing new processes (Gemechu et al., 2016).

The environmental characteristics of green product innovation can help enterprises to build differentiated competitive advantages (Ioannou et al, 2012), including establishing a good green image and improving social trust in the environmental performance of enterprises. At the same time, the differentiated advantages brought by green product innovation can help enterprises obtain environmental premium, thereby improving corporate financial performance (Jiang et al., 2016).

(2) The role and motivation of green innovation in small and micro enterprises

Most small and micro enterprises will face difficulties in financing, rising operating costs, and greater pressure on survival in the process of growth. Innovation can alleviate the degree of energy constraints and improve the performance of small and micro enterprises (TU et al., 2014). Compared with large enterprises, small and micro enterprises lacking resources and political influence are more dependent on favorable entrepreneurial environment, to continuously improve their ability to obtain external resources and survival opportunities, therefore, the innovation of external environment and internal operation is the key to improve the performance of small and micro enterprises at this stage (Li et al., 2015). Enterprises are deeply embedded in the external institutional environment, especially small and micro enterprises. In addition to being driven by internal profit creation, their strategic decisions will also be constrained by external institutional pressure. As far as the current external institutional pressure is concerned, small and micro enterprises mainly face the pressure from external stakeholders on natural environment protection and green mode of production, to achieve sustainable development, it is necessary to adopt green innovation strategies to respond to these institutional pressures and obtain the necessary legitimacy (Cao et al., 2017). Through a questionnaire survey on owners and managers of 211 small and micro enterprises, this paper explores the growth mechanism of small and micro enterprises from the perspective of resources, financing, learning and other innovation, and finds that the improvement of small and micro enterprises' performance should not only focus on the internal structure and policies, but also consider the external environment (Gemechu et al., 2016). Innovation input ability, innovation management ability, R&D and manufacturing ability, innovation output ability and innovation external environment all have a certain impact on the overall performance of small and micro enterprises (Jiang et al., 2016). The network membership of China's SME Industry Association will have an impact on innovation and enterprise performance, at the same time, innovation has a positive impact on the overall performance of small and micro enterprises (Qiao et al., 2014).

(3) Review of existing research

Existing studies have shown the importance of green innovation in improving the performance of small and micro enterprises, but there are also some shortcomings. First, green innovation can promote the performance of small and micro enterprises, but the existing studies only show whether it can improve the performance, and the implementation of green innovation will convey to the outside world the willingness of small and micro enterprises to actively abide by environmental regulations and meet green needs, however, there is a lack of research on how green innovation affects the sustainable development of small and micro enterprises. In practice, due to the different roles of environmental responsibility, enterprises will show different degrees of green innovation behavior. How small and micro enterprises should carry out green innovation and how to set more efficient innovation path need further analysis. Second, many scholars have studied the effect of green innovation on the performance of small and micro enterprises, but the existing literature mainly uses the resource-based view to analyze the impact of green innovation on corporate financial performance or environmental performance. However, under the background of global emphasis on the construction of environmental governance system, the coordinated development of financial performance and environmental performance can better evaluate whether small and micro enterprises can meet the requirements of sustainable development. For small and micro enterprises, they need to create the best financial performance to ensure their long-term viability in the market, it also requires the ability to provide products or services based on technologies that reduce environmental burdens and even generate environmental benefits. Therefore, this paper uses both financial performance and environmental social responsibility performance to comprehensively measure the sustainable development performance of small and micro enterprises. Third, although the existing studies agree that green innovation has a certain effect on the performance improvement of small and micro enterprises, there is a lack of quantitative research on the contribution. In view of the above shortcomings, this paper studies the path of green innovation promoting the performance of small and micro enterprises based on quantitative effect.

3. Research design

In order to ensure the scientific of the indicators and the availability of relevant data, we determine the indicators of green innovation based on *Corporate Social Responsibility Report* and *Annual Financial Report of Small and Micro Enterprises*, and analyze the indicators closely related to green innovation in the corporate social responsibility report and the annual financial report of small and micro enterprises, establish the green innovation evaluation index system

closely related to the performance of small and micro enterprises. Based on *Environmental Protection Corporate Social Responsibility Guidelines*, an index system of environmental social responsibility closely related to the performance of small and micro enterprises is established. In the aspect of performance measurement of small and micro enterprises, the return on total assets (%) in the annual financial report of small and micro enterprises is taken as the performance measurement index of small and micro enterprises. The research process includes three steps: first, selecting green innovation indicators, based on the *Fourteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China and Outline of Vision Goals for 2035*, using literature analysis and factor analysis to analyze the elements related to green innovation; secondly, based on the *Environmental Protection Corporate Social Responsibility Guide*, the paper analyzes the elements related to the environmental social responsibility of small and micro enterprises by literature analysis and factor analysis; thirdly, analyze the direct effect of green innovation on the performance improvement of small and micro enterprises; fourth, analyze the indirect effect of green innovation on the performance improvement of small and micro enterprises.

3.1. Evaluation index of green innovation

According to the research viewpoints of Chen (2017), Chiou (2011) and Xie (2021), based on the comprehensive discussion of experts, this study subdivides green innovation into 12 indicators to measure. In addition, quoting the coding criteria of Mallin (2013) and Xie (2021) using content analysis to quantify environmental information, the evaluation methods of green innovation indicators are as follows: if the CSR report has a text description of the relevant indicators, the score is 1; if quantitative or detailed description is involved, the score is 2; if there is no description, the score is 0; The final value is the sum of the scores of all indicators.

The selected 12 green innovation evaluation indicators are shown in Table 1. Factor analysis is used to verify the correctness of index selection. The total variance explanation of the output results of factor analysis of 12 green innovation indicators shows that the first principal component is 80.63%. Kmo and Bartlett test results show that the green innovation system Kmo sampling appropriateness quantity is 0.892, and Bartlett sphericity test significance is 0. The data shows that the accuracy and consistency of index selection can be used for subsequent analysis and application.

3.2. Environmental social responsibility indicators of small and micro enterprises

In order to guide enterprises to fulfill their environmental protection social responsibility, promote the standardization and promotion of their social respon-

Table 1. Green innovation indicator settings and data sources

	Indicator	Literature sources	Data Sources
Green innovation	Green R&D investment/sales	Chen et al., 2001; Edwards, 2007; Chiou et al., 2011; Block, 2012; Aghion, 2017; Dangelico, 2019; Xie, 2021;	2014-2019 Corporate Social Responsibility Report
	End technology R&D investment/sales		
	Green technological transformation investment/sales		
	Green innovation auxiliary system investment/sales		
	Number of green innovation patents approved in recent five years		
	Impact of green process innovation on reducing environmental pollution		
	The impact of green innovation on reducing raw materials and operating costs		
	The influence of green innovation on the improvement of product performance and quality		
	Sales revenue of green new products / total sales revenue in recent 5 years		
	The market share of new green products for enterprises		
	Number of green products with green certification		
	Environmental friendliness of green products		

Table 2. Indicator setting and data sources of environmental social responsibility of small and micro enterprises

Indicator	Measurement method	Literature sources	Data Sources
Environmental costs	Percentage of pollution treatment fee in total product cost	Chen et al., 2001; Edwards, 2007; Chiou et al., 2011; Block, 2012; Aghion, 2017; Dangelico, 2019; Xie, 2021	2014-2019 Corporate Social Responsibility Report
Ecological compensation	Percentage of ecological compensation fee in total product cost		
Environmental organization Awards	Award level of world / national / local environmental protection organizations		
Certification	Years of ISO9000 and ISO14000 series certification		
Energy consumption	Energy consumption per unit value		
Environmental education and training	Percentage of environmental education and training cost in total training cost		
Green consciousness	The degree of understanding efforts of enterprises in guiding green consumption		
Green culture	The degree of green recognition in corporate culture		
Green personnel input	The number of green management personnel		

sibility behaviors, and promote the sustainable development of China's environmental protection enterprises, China Environmental Protection Industry Association organized 13 units to compile the first group standard on environmental protection enterprises' social responsibility in 2019: *Corporate Social Responsibility Guidelines for Environmental Protection*. According to the characteristics of the production and operation activities of environmental protection enterprises, there are 11 specific issues of environmental corporate social responsibility and their implementation suggestions were given as the core content, including: the enterprise decision-making and measures, undertaking public environmental responsibility, biodiversity protection, integrity and fair operation, NIMBY effect response, consumer service, cleaner production, occupational health and safety, innovation and application, supply chain management and information disclosure. Based on the analysis of specific issues and implementation suggestions of corporate social responsibility in the

corporate social responsibility guidelines for environmental protection, and referring to the studies of Christian (1997), Chen (2001), Ilias et al. (2018), this study selects 8 evaluation indicators of green innovation as shown in Table 2.

3.3. Sample selection and data sources

The data of this study mainly comes from the small and micro enterprises in the small and micro enterprise directory system. In view of the lack of a unified paradigm for the disclosure of environmental information by small and micro enterprises in China, we should learn from the existing research methods on enterprise environmental information disclosure (Albertini, 2014; Mallin et al., 2013), in addition to the second-hand data from wind and other databases, this paper mainly uses content analysis method to mine the CSR reports of heavy pollution small and micro enterprises from 2014 to 2019. In order to obtain reliable and comprehensive data, this study screened the research objects through the following

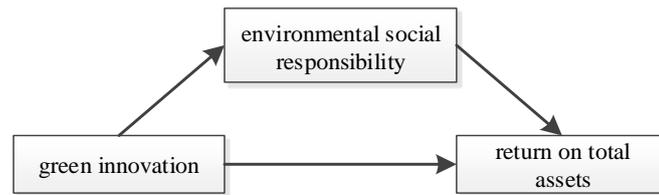


Figure 1. The mediating effect model of green innovation on return on total assets of small and micro enterprises

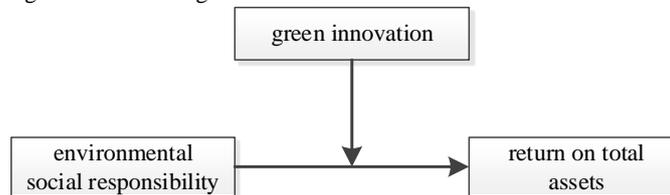


Figure 2. Interaction effect model of green innovation on return on total assets of small and micro enterprises

steps: (1) collected 1900 small and micro enterprises which were recorded in wind database and small and micro enterprise directory system; (2) according to the Environmental Protection Verification Industry Classified Management Directory (HBH [2008] No. 373), 890 small and micro enterprises with heavy pollution were further screened out; (3) delete the small and micro enterprises that did not publish the CSR report from 2014 to 2019; Finally, the research data of 211 small and micro enterprises were obtained. Including metal and nonmetal industry, petrochemical and plastic industry, pharmaceutical manufacturing industry, textile and clothing industry, food manufacturing, agricultural and sideline products processing industry, paper and paper products industry, etc. Nevertheless, there are still 62 small and micro enterprises with missing data. In order to ensure the sample size, this study uses the regression interpolation method to fill in the missing values, and finally obtains the balanced panel data composed of a total of 1266 research samples of 211 small and micro enterprises from 2014 to 2019.

3.4. Analysis method of action path

According to the mutual influence and intermediary effect model of multiple factors proposed by Miller et al. (2014), this study first uses regression analysis model to analyze the direct effect of green innovation on the performance of small and micro enterprises; then, the intermediary model and interaction model are established to analyze the interaction of small and micro enterprises' environmental social responsibility index, green innovation index and small and micro enterprises' performance index.

Direct action model. In order to analyze the direct relationship between green innovation and the performance of small and micro enterprises, this paper takes the return on total assets (%) as the evaluation of the performance of small and micro enterprises and establishes a regression analysis model of the two. The life cycle stage of small and micro enterprises is considered in the analysis process. According to the enterprise life cycle and model of enterprise life cycle revised by Li (2015), 211 small and

micro enterprises are divided into three categories according to their life cycle stages: start-up small and micro enterprises (68 in total, with a duration of 0-2 years), growth small and micro enterprises (61 in total, with a duration of 2-4 years) and mature small and micro enterprises (82 in total, with a duration of 4-6 years).

Indirect action model. Based on the research of Edwards & Lisas (2007), Preacher & Hayes (2008), Jin & Liu (2021), this paper constructs the mediating effect model and interaction effect model respectively to analyze the interaction effect among environmental social responsibility index, green innovation index and performance index of small and micro enterprises. The model is shown in Figure 1 and Figure 2. Figure 1 is the mediating effect analysis model based on the indicators of environmental social responsibility of small and micro enterprises, in which green innovation is the independent variable, environmental social responsibility is the mediating variable, and the return on total assets of small and micro enterprises is the dependent variable. The percentile bootstrap method recommended by Zhang et al. (2016) and Hayes et al. (2013) will be used to test the mediating effect. Figure 2 shows the interaction effect model of green innovation on the return on total assets of small and micro enterprises, in which the environmental social responsibility index of small and micro enterprises is taken as the independent variable, the green innovation index is taken as the interactive variable, and the return on total assets is taken as the dependent variable. The study will use the SPSS macro (process) compiled by Hayes (2013) to verify the interaction.

4. Analysis of action path

4.1. Analysis of the direct effect of green innovation on the performance of small and micro enterprises

The bivariate correlation analysis results of green innovation index and return on total assets of small and micro enterprises show that they are significantly correlated at the level of $P=0.01$. A linear regression analysis was performed on the green innovation in-

dicators and the return on total assets of small and micro enterprises, and the path coefficient was 0.698.

In order to analyze whether there are significant differences in the relationship between green innovation index and small and micro enterprise performance in different life cycle stages of small and micro enterprises, the contribution value of green innovation index to the total return on assets of small and micro enterprises is constructed, which is defined as green innovation/total return on assets of small and micro enterprises. The discriminant function could explain 100% of the variance, and the correlation was significant at the level of $P=0.01$. The results show that the contribution value of green innovation to the total return on assets of small and micro enterprises has significant differences among the three stages, so it is necessary to carry out regression analysis for the three stages. The results of bivariate correlation analysis of green innovation and return on total assets of small and micro enterprises in the three stages are shown in Table 3.

Table 3. Correlation analysis of green innovation and return on total assets

Variable	Initial stage	Growth period	Mature period
Pearson correlation	0.298	-0.203	0.815**
Sig.	0.081	0.187	0
Number of cases	68	61	82

The regression results show that the green innovation in the start-up period is weakly correlated with the return on total assets at the P value of 0.01, and the linear regression path coefficient is 0.298, indicating that in the start-up period, the increase in green innovation has a certain degree of improvement in the performance of small and micro enterprises. Green innovation in the mature period is significantly related to the return on total assets at the P value of 0.01, and the linear regression path coefficient is 0.815, the improvement of green innovation has the most obvious effect on the performance of small and micro enterprises. The correlation between the two variables in the growing period is not significant, and the linear regression path coefficient is -0.203, indicating that the degree of effect in the growing period is not significant.

This phenomenon can be explained by the characteristics of the development stage of small and micro enterprises in China. In the early stage of small and micro enterprises, the company has fewer personnel, and the operation right and ownership are often concentrated on the entrepreneurs. The entrepreneurs have clear strategic ideas, have high enthusiasm for entrepreneurial prospects, and are willing to invest more time and money in improving the quantity of green process innovation and the performance and quality of products, which will slowly improve the performance of small and micro enterprises. In the growth period, 67% of small and micro enterprises

in China go bankrupt. At this stage, they will encounter two problems. One is that the enterprise has a certain turnover and scale and enters the preliminary standardized management. However, many management decisions still need the participation of the boss. If the management right and ownership are not separated, they will encounter management crisis. The other problem is that the boss's strategy is very scientific, however, the ability of employees cannot keep up, and the return on investment of green innovation may be extremely low. It takes a long time and high investment to reflect the performance of small and micro enterprises. Many of these problems make entrepreneurs doubt and even retreat from green innovation.

In the mature period, the enthusiasm of employees, the self-cultivation of leaders, and the core competitiveness of enterprises have reached a relatively perfect state. The innovation speed of green products, the number of patents approved for green products, and the sales revenue of green new products have enhanced and magnified other aspects of small and micro enterprises, showing the characteristics of high investment and high return, so as to efficiently produce the chain reaction of sustainable development.

4.2. Analysis of the indirect effect of green innovation on the performance of small and micro enterprises

The analysis of the correlation between the environmental and social responsibility indicators of small and micro enterprises, green innovation, and return on total assets respectively shows that there are 8 significantly related indicators under the condition of a P value of 0.05. There is only one index, green personnel input, which has no significant correlation with green innovation and return on total assets.

(1) Analysis of mediation model validation

Taking environmental cost as an example, this paper constructs the intermediary model between environmental cost and green innovation and small and micro enterprise performance, and the results are shown in Table 3. The total effect is the effect of green innovation on the performance of small and micro enterprises, which is significant at the level of $P=0.05$, and the path coefficient is 0.7813. It can be seen that improving the level of green innovation can directly affect the performance of small and micro enterprises. Taking the environmental cost as an example to construct the mediating model, the indirect effect of mediating variable is 0.3391, and the bootstrap 95% confidence interval of the mediating effect test of environmental cost does not contain 0, which indicates that the mediating effect of environmental cost between green innovation and small and micro enterprise performance is significant. The contribution of mediators to the total indirect effect was 43.40%. The mechanism by which green innovation affects the performance of small and micro enterpri-

Table 4. The mediating effect of green innovation on the performance of small and micro enterprises

Path	Effect value	Bootstrap Standard error	Bootstrap95% CI		Proportion of relative mediating effect
			Lower limit	Upper limit	
Total effect	0.7813	0.0654	0.6387	0.9791	
Direct effect	0.4087	0.1193	0.2035	0.7084	
Indirect effect (Environmental costs)	0.3391	0.1981	0.1099	0.6121	43.40%
Total effect	0.7918	0.0654	0.6312	0.9436	
Direct effect	0.5143	0.1082	0.3154	0.7874	
Indirect effect (Environmental organization Awards)	0.2361	0.1157	0.0465	0.4965	29.81%
Total effect	0.7873	0.0724	0.6132	0.9532	
Direct effect	0.4452	0.0912	0.2643	0.6564	
Indirect effect (Certification)	0.3236	0.0653	0.1886	0.4527	41.10%
Total effect	0.7922	0.0724	0.6251	0.9569	
Direct effect	0.6012	0.0989	0.4087	0.8326	
Indirect effect (Environmental education and training)	0.1564	0.0542	0.0539	0.2543	19.74%

Table 5. Results of interaction effect of environmental social responsibility, green innovation and small and micro enterprises performance

Interactive path	Coefficient	Standard error	t	p	Interaction effect
Environmental cost * Green Innovation	0.1902	0.0793	2.4734	0.0152	0.3591
Ecological compensation*Green Innovation	0.1718	0.0654	2.5682	0.0094	0.3216
Environmental protection organization award * Green Innovation	0.2325	0.0712	2.8843	0.0045	0.4356
Certification * Green Innovation	0.2852	0.0883	3.1571	0.0198	0.5345
Energy consumption * Green Innovation	0.2107	0.0802	3.0162	0.0185	0.3916
Environmental education and training * Green Innovation	0.1865	0.0794	2.1365	0.0099	0.3431
Green consciousness * Green Innovation	0.1906	0.0713	2.0441	0.0083	0.3014
Green culture * Green Innovation	0.1638	0.0709	1.9512	0.0076	0.3122
Green personnel * Green Innovation	0.1927	0.0658	1.2508	0.0054	Nix

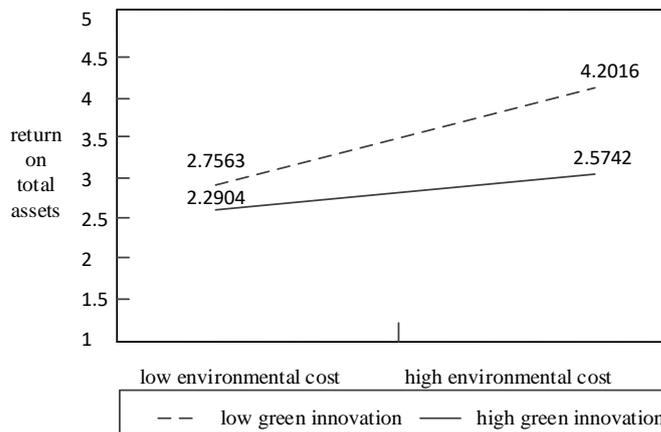


Figure 3. Relationship among environmental social responsibility (independent variable), green innovation (interactive variable) and small and micro enterprise performance (dependent variable)

ses through environmental costs is that as the level of green innovation increases, pollution treatment fees are reduced, and at the same time, corporate products meet environmental protection requirements and service satisfaction increases, which will expand the overall market for small and micro enterprises. Both of these aspects will affect its return on total assets.

Similar analysis is applied to other indicators of environmental social responsibility of small and micro enterprises. The results show that green innovation can indirectly promote the performance of small and micro enterprises through variables such as environmental cost, environmental organization reward, qualification certification, environmental education and training, as shown in Table 4.

(2) Interactive model validation analysis

The results of interactive model analysis are shown in Table 5. The results show that green innovation is an interactive variable that affects the relationship between environmental cost, ecological compensation, environmental organization reward, qualification certification, energy consumption, environmental education and training, green awareness, green culture and small and micro enterprise performance. Taking environmental cost as examples, in order to intuitively illustrate how interaction variables affect independent variables and dependent variables, we use the slope diagram of $M \pm 1SD$ for comparison (see Figure 3).

The simple slope plot of $M \pm 1SD$ shows that each pair of variables is an enhancement. The indirect effect analysis results show that green innovation has amplification effect, and green innovation is not a single factor to promote the performance improvement of small and micro enterprises, but a unified whole is formed by relying on environmental and social responsibility indicators and mutual conditions. Therefore, it can be said that green innovation enhances the impact of environmental social responsibility on the performance of small and micro enterprises, and the interaction effects are 0.5 and 0.5216 respectively. The interaction effect is calculated by the method in Reference Jin (2021) and Zhang (2016). The results are shown in Table 4. It can be seen from table 4 that the factors that green innovation has amplification effect on the environmental social responsibility performance of small and micro enterprises include environmental cost, ecological compensation, etc., while the indicator *green personnel* do not show amplification effect.

From the perspective of the relationship between environmental and social responsibility indicators and green innovation, at the micro level within small and micro enterprises, the increase in environmental costs is on the one hand the result of corporate environmental awareness, on the other hand, it is promoted by the improvement of the level of green innovation. Changes in environmental costs will significantly affect the resource allocation methods of small and micro enterprises. Increasing environmental costs is an inevitable requirement for improving the competitiveness of small and micro enterprises. At the macro level of society, the development of green innovation needs the improvement and implementation of government rules and regulations, education and incentive measures. In the process of economic development, China has been learning from foreign advanced production development and innovation systems, and has entered the society of green production. Green innovation means that green involves all aspects of the development of small and micro enterprises. The interaction between environmental social responsibility indicators and green innovation can be understood from the perspective of sustainable

development. With the active implementation of sustainable development strategy, green innovation emphasizes harmonious coexistence, and the improvement of green innovation level means that small and micro enterprises can maintain the stability of green and survival, ensure the green quality of products and services, form a virtuous cycle process, and produce spillover effects. Therefore, it can be said that green innovation is the only way for small and micro enterprises to obtain market leading advantages.

5. Discussion and conclusion

Due to the epidemic, most small and micro enterprises are currently experiencing serious declines in operating income and tight cash flow. According to a joint survey of 995 small enterprises conducted by Tsinghua University and Peking University, in 2020, 29.6% of small businesses' operating income dropped by more than 50%, 58% of small enterprises' business income dropped by more than 20%, and only 4% of small enterprises business income dropped by less than 10%. In addition, about 50% of small and micro enterprises in China are in the growth stage, and the effect of green innovation on improving performance may not be very significant at this stage. In this complex environment, whether small and micro enterprises should become more active green innovation promoters, and how to solve the problem of *harmonious coexistence* have become the most concerned issues of current managers.

When facing environmental pollution problems, the government's environmental regulations are important, but more importantly, it is to actively guide all kinds of enterprises to become active promoters of environmental protection, not just passive responders to environmental pressures. Therefore, how to effectively guide them to environmental protection and green innovation is a subject of both theoretical and practical significance. This study provides some support for small and micro enterprises to firmly follow the green innovation route. The study found that green innovation can directly improve the performance of small and micro enterprises, and there is a life cycle phenomenon in the direct promotion effect of green innovation on the performance of small and micro enterprises. When the development of small and micro enterprises is in the initial stage and mature stage, the direct effect of green innovation investment on the performance of small and micro enterprises is very significant; In the growth period, the direct effect is not significant. In addition, there is a significant interaction between green innovation and environmental social responsibility indicators of small and micro enterprises, which can enhance and enlarge the performance of small and micro enterprises, at the same time, it has amplification

effect on 8 indicators of environmental social responsibility of small and micro enterprises. These indicators provide clear guidance for the green innovation practice of small and micro enterprises. Combined with the conclusion of this paper, this paper mainly puts forward two policy suggestions. First, the incentive and qualification certification of environmental protection organizations present a strong indirect effect, indicating that the government can guide small and micro enterprises to carry out more green innovation activities through government regulation. Therefore, it is of positive practical significance to continue to adhere to and improve the formulation and implementation of green environmental protection systems and rules, which can not only enhance the long-term competitive advantage of small and micro enterprises, at the same time, it is also conducive to play the main role of small and micro enterprises in the process of building environmental governance system. Secondly, in addition to environmental costs and ecological compensation, environmental education and training, green awareness and green culture also show strong indirect effects, which shows that small and micro enterprises not only need to actively integrate green development concept into process improvement and product design process, and constantly improve green production process and green product quality. In addition, small and micro enterprises should also fully realize the scientific nature of incorporating green innovation, green awareness, green culture, and sustainable development performance into the corporate performance management framework, and actively establish a good corporate image. In order to build a trustworthy relationship network, strive to identify the cognitive requirements and expectations of social participants for the sustainable development of small and micro enterprises, and strive to integrate the *harmonious symbiosis* culture into the corporate green culture.

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