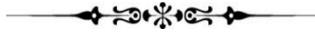


# CONFUCIAN CULTURE AND GREEN INNOVATION OF ENTERPRISE TECHNOLOGY



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## Abstract

The rapid growth of China's economy often comes at the cost of damaging the ecological environment. To effectively solve the problem of ecological deterioration, it is necessary to rely on technological progress, especially innovation-oriented green technology. Based on the sample of A-share listed companies in Shenzhen and Shanghai from 2008 to 2022, this article manually collected and sorted out Confucian culture data, and empirically tested the impact of Confucian culture on corporate green technology innovation from the perspective of informal institutions. The results show that Confucian culture has a significant effect on corporate green technology innovation. The greater the degree to which a company is influenced by Confucian culture, the higher the level of its green technology innovation. Furthermore, combined with the context of overseas cultural shock, this article also found that overseas cultural shock will weaken the impact of local Confucian traditions on corporate green technology innovation. This article enriches the research on the influencing factors of corporate green technology innovation, supplements the literature on the economic consequences of Confucian culture, and also provides strong support for promoting China's excellent traditional culture.

**Keywords:** Confucianism, Green Technology Innovation, Informal Institutions

## Introduction

While reform and opening up have brought rapid economic development, they have also brought severe challenges to the ecological environment. The extensive economic development model has led to many problems such as environmental pollution, ecological imbalance, and resource depletion. Faced with the tense situation of severe environmental damage and increasingly degraded ecology, the Party Central Committee and the State Council attach great importance to ecological environmental protection, and policy systems such as carbon peak and carbon neutrality "1+N" have been introduced one after another. In his report at the 20th National Congress of the Communist Party of China, President Xi Jinping mentioned that "Chinese-style modernization is the modernization of harmonious coexistence between man and nature", and regarded it as one of the missions and tasks of the Communist Party of China in the new era and new journey, and regarded "widely forming a green

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production and lifestyle, carbon emissions peaking and then steadily declining, the ecological environment fundamentally improved, and the goal of a beautiful China achieved" as one of the overall goals of my country's next development. Faced with the new era, new challenges, and new requirements, green technology innovation has become an inevitable choice for enterprises to break through development bottlenecks and achieve high-quality development.

Most existing studies have analyzed the key factors of corporate green technology innovation from the perspectives of environmental regulation (Li et al., 2023; Wang Z.Y et al., 2020), environmental tax (Yu L.C et al., 2019), government subsidies (Gorg & Strobl, 2007; Ma G.H & Xia J.L, 2020; Yang X.H & You D.M, 2021) and board governance (Wang F.Z& Chen F.Y 2018). Zhao H. & Li W.F (2022) explained that Confucian culture can improve the accounting information quality and decision-making efficiency of enterprises; Confucian culture can alleviate the agency conflict between controlling shareholders and minority shareholders, inhibit the hollowing out of major shareholders (Du, 2015), prevent the risk of stock price collapse (Xu X.X et al., 2020; Bashir & Yu, 2020), promote accounting conservatism, and affect accounting robustness (Du et al., 2022). This series of studies shows that in addition to formal institutions such as laws and regulations, informal institutions represented by social culture also have an important impact on economic activities. Culture has a profound impact on people's values and corporate decision-making and management models in a subtle way (Zhao L.Q., 2022).

Xi Jinping's ecological civilization thought is the inheritance and development of the idea of "Unity of Heaven and Man" advocated in Confucian culture, and points the way for the modernization process of harmonious coexistence between man and nature. In addition, Confucius believed that "The Master used a fishing rod to fish instead of a net; he used bow and arrow to catch prey, but he never shot birds or animals that were resting." (The Analects of Confucius), Wang Yangming pointed out that "The great personage can treat the universe as a whole, not because they do it intentionally, but because the benevolence in their hearts is like this. This benevolence is a whole with the universe." (The Great Learning), all of which depict the Confucian vision of ecological civilization that respects, conforms to, and protects nature, and outlines a beautiful blueprint for harmonious coexistence between man and nature. Corporate green technology innovation is an important foundation for sustainable economic development and green transformation. Can the cultural imprint of Confucian tradition further reflect and influence the daily business activities of micro-enterprises and improve their green technology innovation performance?

## Literature Review

Confucianism: In terms of respecting nature, Kongzi, the founder of Confucianism, mentioned in "The Analects", Chapter on Yang Huo, "What can Heaven say? The four seasons of spring, summer, autumn and winter are constantly changing, and all kinds of things grow and multiply accordingly. What can Heaven say? Heaven is just letting all things in nature grow and change according to certain laws.", which describes the regular operation of the four seasons and the regular development of all things, and reflects Confucius' awe of the laws of nature. Confucianism believes that humans and nature coexist harmoniously and are essentially the same. The cultural imprint of Confucian traditional ecological awareness will have an important impact on the green technology innovation of enterprises at the micro-enterprise level. This concept of people-oriented, respect for nature, and harmony between man and nature will have a positive guiding effect on the behavior of corporate economic decision-makers, allowing enterprises to abandon the extensive development model in the process of development, and instead continuously improve the level of green technology innovation of enterprises to achieve green and sustainable development of enterprises.

"Don't be hasty, don't see small profits. If you have too much haste, you won't achieve your goal. If you see small profits, you won't achieve great things" (On the Analects of Confucius Zilu) indicates that when doing things, you can't blindly pursue speed and

immediate progress, you can't be eager for quick success and instant benefits, and you need to accumulate a lot before you can make a breakthrough. Enterprise green technology innovation is an economic activity with a long cycle. In the short term, the large amount of funds consumed by technological innovation will bring financial risks to enterprises, and its future benefits are uncertain. Therefore, many managers are unwilling to take green technology innovation behaviors. However, the idea of focusing on long-term development and overcoming quick success and instant benefits advocated in Confucian culture will subtly affect the economic activities of enterprises. Enterprises deeply influenced by Confucian culture have stronger endogenous motivation to carry out green technology innovation.

Third, in terms of alleviating the agency problem, due to the agency problem, enterprise management is often unwilling to take risks to carry out green technology innovation, resulting in the phenomenon of "As an official, he is not active in governing and is lazy and negligent in handling government affairs." "Government officials are neglectful of their duties". The Confucian tradition believes that people's pursuit of material wealth is a reasonable phenomenon, but "taking something that is not yours is unrighteous." ("Mencius complete-heart"). Under the influence of Confucian culture "The concept of righteousness and profit" and the concept of loyalty and trustworthiness", corporate managers are willing to take the initiative to take responsibility and do "Even when others cannot see or hear him, or when things are trivial, a gentleman should remain cautious and self-disciplined, and not relax his requirements on himself." ("The Book of Rites: Doctrine of the Mean"), and set higher moral standards for themselves. When making economic decisions, they can improve the social ecology through corporate green technology innovation. Based on the above analysis, this article proposes the following research hypotheses:

H1: Confucian culture promotes corporate green technology innovation.

## Research Design

### 1. Sample selection and data sources

This article uses the data of A-share listed companies in Shanghai and Shenzhen from 2008 to 2022 as the initial sample, and screens the sample according to the following criteria: (1) exclude ST or PT listed companies; (2) exclude sample companies in the financial sector; (3) exclude sample companies with missing data on research variables. The final sample includes data from 3,205 companies, which generated 27,677 valid observations from 2007 to 2021. Confucian culture data were collected and sorted manually, company patent data came from the State Intellectual Property Office of the People's Republic of China, and company financial and governance data came from the RESSET and CSMAR databases. To eliminate the adverse effects of extreme values on the research conclusions, all continuous variables were Winsorized at the top and bottom 1% levels of each distribution.

### 2. Variables

Explained variable: Green technology innovation (Green). Referring to the existing literature (Li W.J & Zheng M.N, 2016; Qi S.Z et al., 2018; Xu J. & Cui J.B, 2020; Wang Xin and Wang Ying, 2021), this article mainly measures the green technology innovation of enterprises by the number of green patent applications of listed companies. Specifically, the green technology innovation variable (Green) is measured by taking the natural logarithm of the number of green patents applied for by listed companies in that year plus 1. The larger the value, the higher the level of green technology innovation of the company. For the screening of green patents of listed companies, this article uses the "International Patent Classification Green List" launched by the World Intellectual Property Organization (WIPO) in 2010, combined with the international patent classification number to identify and extract the green patent data of sample listed companies. The green list is generated according to the classification standards of green patents in the United Nations Framework Convention on Climate Change, including seven major categories: transportation, waste management, energy conservation, alternative energy production, administrative supervision and design, agriculture

and forestry, and nuclear power.

Explanatory variable: Confucian culture (Confu). Referring to existing studies (Du, 2015; Gu Z.H, 2015; Xu X.X & Li W.L, 2019), this article measures the intensity of Confucian culture based on the distance model and the distribution density of Confucian academies recorded in historical books. First, based on the records of China Local Chronicles and Chinese Academy Dictionary, the author manually collected and sorted out the names and addresses of Confucian academies in prefectures, states and counties within the jurisdiction of provincial administrative regions from the Tang Dynasty to the Qing Dynasty. Secondly, the longitude and latitude coordinates of each academy and the registered place of listed companies were determined by Google Maps search, and the geographical distance between the two was calculated based on the longitude and latitude. Finally, the number of Confucian academies distributed within a certain radius of the registered place of each listed company was counted. The greater the distribution density of Confucian academies, the deeper the influence of Confucian culture on the listed company. In order to enhance the robustness of the empirical conclusions, the distribution density of Confucian academies within a radius of 100/200/300 kilometers of the company's registered place was used as a proxy variable for the intensity of Confucian culture. Since the value of this indicator is large and not in the same order of magnitude as other variable indicators in the model, in order to make the regression coefficient readable, the value is divided by 1000.

Control variables. Referring to existing studies (Du, 2015; Kang and Kim, 2020; Gu Z.H, 2015; Li W.J & Zheng M.N, 2016; Xu J. & Cui J.B, 2020), this article incorporates a series of control variables into the model, including: enterprise size (Size), enterprise age (Age), financial leverage ratio (Lev), profitability level (Roe), growth ability (Growth), equity concentration (Own1), board size (Board), independent director ratio (Indratio) and dual-position (Dual). The specific variable definitions are shown in Table 1.

Table 1 Variable definitions

Variable Name	Variable Symbols	Variable definitions
Confucianism	<i>Confu100</i>	Number of Confucian academies within a 100-kilometer radius of the company's registered location/1000
	<i>Confu200</i>	Number of Confucian academies within a 200km radius of the company's registered location/1000
	<i>Confu300</i>	Number of Confucian academies within a 300-kilometer radius of the company's registered location/1000
Green Technology Innovation	<i>Green</i>	The number of green patents applied by the company in the current year is added by 1 and the natural logarithm is taken
Enterprise scale	<i>Size</i>	The natural logarithm of the total assets of the enterprise
Company age	<i>Age</i>	The natural logarithm of the company's listing time plus 1
Financial Leverage	<i>Lev</i>	Debt-to-asset ratio, which represents the ratio of total liabilities to total assets
Profitability	<i>Roe</i>	Roe
Growth Capacity	<i>Growth</i>	Operating income growth rate
Equity Concentration	<i>Own1</i>	Shareholding ratio of the largest shareholder
Board size	<i>Board</i>	The natural logarithm of the total number of directors
Proportion of independent directors	<i>Indratio</i>	Ratio of independent directors to total number of directors
Two jobs in one	<i>Dual</i>	If the general manager and the chairman are the same person, the value is 1, otherwise it is 0

This article organically links Confucian culture with corporate green technology innovation and examines the impact and internal mechanism of Confucian culture on corporate green technology innovation from the perspective of informal institutions. The A-share listed companies in Shenzhen and Shanghai from 2008 to 2022 were selected as samples, and the number of Confucius temples within a certain radius of the company was used as a proxy variable for the intensity of Confucian cultural influence. The empirical study found that

Confucian culture will have a positive effect on corporate green technology innovation. The greater the degree of influence of Confucian culture on the company, the higher the level of its green technology innovation. At the same time, for those companies that are less affected by foreign culture, the influence of Confucian culture on them is more significant.

### 3. Research model

Drawing on the research of Xu X.X & Li W.L (2019) and Wang X.& Wang Y. (2022), this article constructs the following multiple regression model to verify the impact of Confucian culture on corporate green technology innovation:

$$Green_{i,t} = \alpha_0 + \alpha_1 Confu_{i,t} + \alpha_2 Controls_{i,t} + \sum Ind + \sum Year + \varepsilon_{i,t}$$

Among them, Green represents corporate green technology innovation, Confucian represents Confucian culture, Controls represents a set of control variables,  $\sum Ind$  and  $\sum Year$  represent dummy variables of industry and year respectively,  $\varepsilon$  is a random error, and  $i$  and  $t$  represent company and year respectively. If the regression coefficient  $\alpha_1$  of Confucian culture (Confu) is significantly positive, it means that Confucian culture significantly promotes corporate green technology innovation, and the research hypothesis of this article will be verified.

## Research Result

### 1. Descriptive Statistics

According to the descriptive statistics in Table 2, the mean of the explained variable corporate green technology innovation (Green) is 0.1898, and the standard deviation is 0.5317, indicating that there are large differences in green technology innovation among different companies. The minimum values of the explanatory variables Confucian culture Confu100, Confu200, and Confu300 are all 0, and the maximum values are 2.5649, 3.5553, and 4.2195, respectively. There is a large gap between the minimum and maximum values, which indicates that there is a large gap in the degree of influence of Confucian culture on different companies. The distribution of other control variables is consistent with existing research, and the distribution is within a reasonable range.

Table 2 Descriptive Statistics

variable	Mean	median	Standard Deviation	Minimum	Maximum	Number of samples
<i>Green</i>	0.1898	0.0000	0.5317	0.0000	2.8332	27500
<i>Confu100</i>	1.6415	1.7918	0.7029	0.0000	2.5649	27500
<i>Confu200</i>	2.5090	2.6391	0.7651	0.0000	3.5553	27500
<i>Confu300</i>	3.0904	3.2581	0.7664	0.0000	4.2195	27500
<i>Size</i>	21.9501	21.7773	1.2720	19.5394	25.9293	27500
<i>Ageb</i>	1.2883	1.6094	1.1672	0.0000	2.8904	27500
<i>Lev</i>	0.4384	0.4377	0.2072	0.0510	0.8895	27500
<i>Roe</i>	0.0637	0.0702	0.1216	0.6659	0.3326	27500
<i>Growth</i>	0.4451	0.132	1.3328	0.7004	10.0174	27500
<i>Ownl</i>	35.8378	33.8800	15.1203	8.8600	74.9600	27500
<i>Board</i>	2.1566	2.1972	0.2020	1.6094	2.7081	27500
<i>Indratio</i>	0.3697	0.3333	0.0523	0.2857	0.5714	27500
<i>Dual</i>	0.2354	0.0000	0.4243	0.0000	1.0000	27500

## 2. Correlation analysis

The results of the Pearson correlation coefficient analysis of the main variables are shown in Table 3. The results show that the correlation coefficients of Confu100, Confu200, Confu300 and corporate green technology innovation Green are 0.024, 0.035, and 0.046, respectively, and are all significant at the 1% level, which indicates that without considering other influencing factors, Confucian culture is significantly positively correlated with corporate green technology innovation, that is, the greater the impact of Confucian culture on the company, the higher the level of green technology innovation, which preliminarily supports the research hypothesis of this article. In addition, the correlation coefficients between other control variables are relatively small, which indicates that putting them into the regression model for empirical testing will not cause multicollinearity problems.

## 3. The impact of Confucian culture on corporate green technology innovation

Table 4 reports the empirical regression results of Confucian culture on corporate green technology innovation. In the regression models of columns (1) to (3), the regression coefficients of the explanatory variables Confucian culture (Confu100, Confu200, Confu300) are 0.0281, 0.0323, and 0.0385, respectively, and are all significantly positive at least at the 5% level. From an economic point of view, for every increase in the standard deviation of the variable Confu100 (Confu200, Confu300), the corporate green technology innovation level increases by 10.41% (13.02%, 15.55%). The above results show that the stronger the influence of Confucian culture on a company, the higher its green technology innovation level. The research hypothesis of this article is supported by empirical evidence.

The regression results of the control variables show that the regression coefficients of enterprise scale, enterprise age, financial leverage, and independent director ratio are significantly positive, indicating that the larger the scale, the longer the establishment period, the higher the debt-to-asset ratio, and the larger the proportion of independent directors, the higher the level of green technology innovation of enterprises; secondly, the regression coefficients of equity concentration and the combination of two positions are significantly negative, indicating that the higher the shareholding ratio of the largest shareholder, the greater the power of the chairman and general manager, and the lower the level of green technology innovation of the enterprise. This is consistent with the research results of existing literature (Wang F.Z et al., 2018; Geng H.J, 2020; Li, 2022;).

## 4. Robustness Test

To improve the reliability of the empirical results, this study draws on the practices of Cheng Bo et al. (2016), Xu X.X. et al. (2020), and Yan et al. (2021), and further uses the distribution density of Confucius Temples within 100 kilometers (Lnrujia100), 200 kilometers (Lnrujia200), and 300 kilometers (Lnrujia300) of the company's registered place to measure and re-measure Confucian culture, and test the impact of Confucian culture on corporate green technology innovation. The regression results are shown in Table 5, and it is found that the estimated coefficients of the independent variable Confucian culture are significantly positive at the 1% level, indicating that Confucian culture can significantly promote corporate green technology innovation, which is consistent with the previous empirical conclusions.

## Conclusion

Green development is the development that achieves harmonious coexistence between man and nature. The report of the 20th National Congress of the Communist Party of China pointed out that we should develop green and low-carbon industries and accelerate the green transformation of development methods. The white article "China's Green Development in the New Era" issued by the Information Office of the State Council mentioned that the concept of green development should be integrated into all aspects of development, and the innovation of standards and models should be vigorously promoted to guide enterprises to carry out green product design and low-carbon environmental protection process innovation, to improve the green level of traditional industries comprehensively. However, the

transformation and upgrading of green development methods not only require the support and macro-control of the state but also require enterprises to continuously transform their development concepts and carry out green technology innovation. Enterprise green technology innovation is an important foundation for sustainable economic development and green transformation. This article empirically examines the impact of Confucian culture on enterprise green technology innovation from the perspective of informal institutions. Using the data of listed companies in Shenzhen and Shanghai from 2008 to 2022, it is empirically found that Confucian culture has a significant promoting effect on enterprise green technology innovation. The greater the degree to which an enterprise is influenced by Confucian culture, the higher the level of its green technology innovation. The respect for nature, long-term development orientation, "the concept of righteousness and profit" and the concept of loyalty and trustworthiness contained in Confucian culture can reflect and influence the daily business activities of micro-enterprises and improve the green technology innovation performance of enterprises.

The findings of this study provide the following practical implications. First, given the impact of Confucian culture on green innovation, enterprises need to consider the cultivation of a Confucian cultural atmosphere in their daily operations and ensure that they are driven by good values (green awareness and innovation awareness) when making decisions. Specifically, if an enterprise is under pressure from environmental pollution risks, the influence of Confucian culture may be an effective way to promote necessary strategic changes in the enterprise. In this case, the findings of this study are beneficial for companies that emphasize green innovation. This study shows that Confucian culture may be beneficial from an environmental and innovation perspective, especially in terms of green innovation, an area considered important for corporate strategy (Arena et al., 2018). Second, our research shows that the impact of Confucian culture on corporate green innovation faces challenges from different categories of informal institutions, and foreign culture can weaken the role of local Confucian culture in promoting green innovation. Therefore, to promote corporate green innovation, it is necessary to consider setting the best scenario for Confucian culture to promote green innovation in combination with different categories of informal institutions.

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