CONFUCIAN CULTURE AND CORPORATE GREEN TECHNOLOGICAL INNOVATION: AN EMPIRICAL TEST FROM THE PERSPECTIVE OF INFORMAL INSTITUTIONS

[1]Xiang Gao and [2]Liming Zhang

Panyapiwat Institute of Management, Thailand

9889303@qq.com

Received: October 18, 2024; **Revised** :November 10, 2024; **Accepted** :December 28,2024

Abstract

The rapid growth of China's economy often comes at the cost of damaging the ecological environment. To effectively solve the problem of environmental deterioration, we must 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 study manually collected and sorted Confucianism data, and empirically tested the impact of Confucianism on corporate green technology innovation from the perspective of informal institutions. The results show that Confucianism significantly affects corporate green technology innovation. The greater the degree to which a company is affected by Confucianism, the higher its green technology innovation level. This article enriches the research on the influencing factors of corporate green technology innovation, supplements the literature on the economic consequences of Confucianism, 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 increasing ecological degradation, the Party Central Committee and the State Council attach great importance to ecological environmental protection, and have successively introduced policy systems such as carbon emission peaking, carbon neutrality, and "1+N". In his report at the 20th National Congress of the Communist Party of China, President Jinping Xi 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 production and lifestyle, carbon emission reduction peaking and steady decline, fundamental improvement of the ecological environment, and achieving the goal of a beautiful China" as one of the 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 production

[1]Chinese Graduate School, Panyapiwat institute of Management, Thailand
[2]Chinese Graduate School, Panyapiwat institute of Management, Thailand

and lifestyle, carbon emission reduction peaking and steady decline, fundamental improvement of the ecological environment, and achieving the goal of a beautiful China" 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.H. 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). However, few scholars have paid attention to the impact of social culture, an invisible value norm, on corporate green technology innovation. Culture has a profound impact on people's values and corporate decision-making and management models in a subtle way. (Zhao L.Q, 2022). Existing studies have found that regional culture can alleviate agency conflicts between controlling shareholders and minority shareholders, prevent major shareholders from hollowing out (Du, 2015), guard against the risk of stock price collapse (Xu X.X et al., 2020; Bashir & Yu, 2020), promote accounting conservatism, and thus affect accounting robustness (Du et al., 2022).

The Chinese nation has a civilization history of more than 5,000 years and has nurtured many excellent traditional cultures. Among them, Confucianism, as the mainstream of Chinese traditional culture, has brought far-reaching influences to all aspects of Chinese society, politics, and economy. General Secretary Xi Jinping mentioned at the International Academic Symposium in Commemoration of the 2565th Anniversary of the Birth of Confucius: "China's excellent traditional culture, including Confucianism, contains important inspiration for solving the problems facing contemporary mankind." Among them, Xi Jinping's ecological civilization thought is the inheritance and development of the idea of "Harmony between Man and Nature" advocated by Confucianism and points out the way for the modernization process of harmonious coexistence between man and nature. In addition, Confucius believed that "When Confucius went fishing, he only used a fishing rod, not a large net; he used the arrows he brought with him to shoot birds, but he did not shoot birds returning to their nests." (The Analects), Wang Yangming pointed out that "A great man sees heaven, earth, and all things as one." (profound knowledge), all of which depict the Confucian vision of ecological civilization that respects, adapts 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 generated by the Confucian tradition further reflect and influence the daily business activities of micro-enterprises and improve their green technology innovation performance?

On this basis, this article organically links Confucianism with corporate green technology innovation and examines the impact and internal mechanism of Confucianism on corporate green technology innovation from the perspective of informal institutions. Selecting A-share listed companies in Shenzhen and Shanghai from 2008 to 2022 as samples, the number of Confucius temples within a certain radius of the company is used as a proxy variable for the intensity of Confucianism's influence. The empirical study finds that Confucianism will have a positive effect on corporate green technology innovation. The greater the degree to which a company is influenced by Confucianism, the higher its green technology innovation level.

This study may have the following contributions. First, this article broadens the research perspective of the factors affecting corporate green technology innovation. In recent years, corporate green technology innovation has been a hot topic in domestic and foreign academic circles for studying high-quality development of enterprises. At present, most of the research on corporate green technology innovation in my country focuses on environmental regulation, government subsidies, board governance, etc., but there are few research papers explaining corporate green technology innovation from the perspective of informal institutions,

and there are even fewer studies on the impact of Confucianism on corporate green technology innovation. This article starts from the perspective of Confucianism, an informal institution, to study the impact of Confucianism on corporate green technology innovation, which provides new ideas for studying corporate green technology innovation at the theoretical level and enriches the relevant research literature. Secondly, this study also enriches the relevant research on the economic consequences of Confucianism. As the mainstream of Chinese traditional culture, Confucianism has influenced Chinese society for more than two thousand years and plays an important role in maintaining social stability and shaping individual behavior. Under the influence of Confucianism, the behavioral decisions of enterprises will be affected to a certain extent. However, there are relatively few studies in domestic and foreign academic circles that link Confucianism with corporate behavior. This article selects Chinese-listed companies for empirical analysis. Studying the impact of Confucianism on corporate green technology innovation behavior supplements the relevant research literature on the economic consequences of Confucianism. Third, this article is also helpful in promoting the inheritance and innovation of China's excellent traditional culture. Inheriting and innovating China's excellent traditional culture will help promote the construction of a socialist cultural power and improve the country's cultural soft power. This article can not only correct the prejudice of domestic and foreign scholars against Chinese traditional culture, but also increase scholars' attention to China's excellent traditional culture, actively publicize and promote China's excellent traditional culture, and give play to the positive guiding role of excellent culture on economic behavior.

Research hypothesis

As an important part of China's excellent traditional culture, Confucianism has a profound impact on personal behavior and socio-economic behavior, and its impact will promote corporate green technology innovation. In general, the impact mechanism of Confucianism on corporate green technology innovation is reflected in the following aspects:

First, in terms of respect for nature, Confucius, the founder of Confucianism, mentioned in *the Analects of Confucius·Yanghuo* that "Heaven does not speak in words. It speaks through the rotation of four seasons and the growth of all living things.", describing the law of the four seasons and the law of the development of all things, reflecting Confucius' awe of the laws of nature. Confucianism believes that "Confucius fished with bamboo only rather than with net. He shoots flying birds only rather than the birds overnight." (*The Analects*), "There is heaven and earth, and then there are all things; There are all things, and then there are men and women" (Zhouyi: Xueguazhuan). In the view of Confucianism, man and nature coexist harmoniously, and the two are essentially the same. The cultural imprint of traditional Confucian ecological awareness will have an important impact on the green technological 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 role in the behavior of corporate economic decision-makers, enabling enterprises to abandon the extensive development model in the process of development and instead continuously improve the level of green technological innovation of enterprises to achieve green and sustainable development of enterprises.

Secondly, in terms of long-term development orientation, "Without desire for speed, without seeing small benefits. If one desires speed, they will not achieve success; if they see small benefits, they will not achieve great things" (*The Analects of Confucius: Zilu*) shows that we should not blindly pursue speed and immediate progress, and we should not rush for quick success and instant benefits. We need to accumulate a lot before we can achieve a lot. 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 Confucianism will subtly affect the economic activities of enterprises. Enterprises deeply influenced by Confucianism have stronger endogenous motivation to carry out green technology innovation.

Thirdly, 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 "Lazy government," "Being an official but not doing anything." Confucian tradition believes that people's pursuit of material wealth is a reasonable phenomenon, but they should "take what is not yours, which is not righteous" *(Mencius: Exerting One's Mind* (Part 1)). Under the influence of Confucianism's "The concept of righteousness and profit" and "the concept of loyalty and trustworthiness", corporate managers will be willing to take the initiative to take responsibility and be "A gentleman is cautious when he is alone. (*The Book of Rites: Doctrine of the Mean*), hold themselves to higher moral standards, and improve the social ecology through corporate green technology innovation when making economic decisions. Based on the above analysis, this article proposes the following research hypotheses:

Hypothesis 1: Confucianism promotes corporate green technology innovation.

Research design

Sample selection and data collection

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. Confucianism data was 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.

Variable settings

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 X. & Wang Y, 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: Confucianism (*Confu*). Referring to existing studies (Du, 2015; Gu Z.H, 2015; Xu X.X & Li W.L, 2019), this article measures the intensity of Confucianism 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 "*China Shuyuan 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, Google Maps was used to determine the longitude and latitude coordinates of each academy and the registered place of listed companies, 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 Confucianism on the listed company. 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 Confucianism. Since the value of this indicator is large and not in the same order of magnitude as other variable indicators in the model, to make the regression coefficient readable, the value is divided by 1000.

Control variables. Referring to existing studies (Du, 2015; Kang & Kim, 2020; Gu Zhihui, 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	*Confu*100	Number of Confucian academies within a 100-kilometer radius of the green technology innovation company's registered location /1000
	*Confu*200	Number of Confucian academies within a 200-kilometer radius of the green technology innovation company's registered location /1000
	*Confu*300	Number of Confucian academies within a 300-kilometer radius of the registered territory /1000
Green Technology Innovation	*Green*	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	*Size*	The natural logarithm of the total assets of the enterprise
Company age	*Age*	The natural logarithm of the company's listing time plus 1
Financial Leverage	*Lev*	Debt-to-asset ratio, which represents the ratio of total liabilities to total assets
Profitability	*Roe*	Roe
Growth Capacity	*Growth*	Operating income growth rate
Equity Concentration	*Own1*	Shareholding ratio of the largest shareholder
Board size	*Board*	The natural logarithm of the total number of board members
Proportion of independent directors	*Indratio*	Ratio of independent directors to total number of directors
Two jobs in one	*Dual*	If the general manager and the chairman are the same person, the value is 1, otherwise it is 0

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 multivariate regression model to verify the impact of Confucianism 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 Confucianism, Controls represents a set of control variables, ∑Ind and ∑Year represent dummy variables of industry and year respectively, ε is a random error, i and t

represent company and year respectively. If the regression coefficient α1 of Confucianism (*Confu*) is significantly positive, it means that Confucianism significantly promotes corporate green technology innovation, and the research hypothesis of this article will be verified.

Research result

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 ConfucianismConfu100, 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 Confucianism 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
Green	0.1898	0.0000	0.5317	0.0000	2.8332	27500
Confu100	1.6415	1.7918	0.7029	0.0000	2.5649	27500
Confu200	2.5090	2.6391	0.7651	0.0000	3.5553	27500
Confu300	3.0904	3.2581	0.7664	0.0000	4.2195	27500
Size	21.9501	21.7773	1.2720	19.5394	25.9293	27500
Ageb	1.2883	1.6094	1.1672	0.0000	2.8904	27500
Lev	0.4384	0.4377	0.2072	0.0510	0.8895	27500
Roe	0.0637	0.0702	0.1216	-0.6659	0.3326	27500
Growth	0.4451	0.1320	1.3328	-0.7004	10.0174	27500
Own1	35.8378	33.8800	15.1203	8.8600	74.9600	27500
Board	2.1566	2.1972	0.2020	1.6094	2.7081	27500
Indratio	0.3697	0.3333	0.0523	0.2857	0.5714	27500
Dual	0.2354	0.0000	0.4243	0.0000	1.0000	27500

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, Confucianism is significantly positively correlated with corporate green technology innovation, that is, the greater the impact of Confucianism on the company, the higher its level of green technology innovation, which preliminarily supports the research hypothesis of this paper. In addition, the correlation coefficients between other control variables are relatively small, which indicates that the subsequent empirical test of them in the regression model will not cause multicollinearity problems.

The impact of Confucian culture on corporate green technology innovation

reports the empirical regression results of Confucianism on corporate green technology innovation. In the regression models of columns (1) to (3), the regression coefficients of the explanatory variables Confucianism (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 level of corporate green technology innovation increases by 10.41% (13.02%, 15.55%). The above results show that the stronger the impact of

Confucianism on a company, the higher its level of green technology innovation. The research hypothesis of this paper 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;).

Robustness test

To improve the reliability of the empirical results, this study draws on the practices of Cheng B. et al. (2016), Xu X.X et al. (2020), & 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 Confucianism, and test the impact of Confucianism 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 Confucianism are significantly positive at the 1% level, indicating that Confucianism can significantly promote corporate green technology innovation, which is consistent with the previous empirical conclusions.

Table 3 Robustness test

Analysis conclusion

Green development is the development that realizes harmonious coexistence between man and nature. The report of the 20th CPC National Congress pointed out that we should develop green and low-carbon industries and accelerate the green transformation of development methods. The white paper "China's Green Development in the New Era" issued by the State Council Information Office mentioned that the concept of green development should be integrated into all aspects of development to guide enterprises to carry out green product design and low-carbon environmental protection process innovation. However, the transformation and upgrading of green development methods requires not only the support and macro-control of the state, but also the continuous transformation of development concepts and green technological innovation of enterprises. Green technological innovation of enterprises is an important foundation for sustainable economic development and green transformation. This paper empirically examines the impact of Confucianism on corporate green technological 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 Confucianism has a significant promoting effect on corporate green technological innovation. The greater the degree to which an enterprise is affected by Confucianism, the higher its green technological innovation level. The respect for nature, long-term development orientation, "righteousness and profit" and "loyalty" contained in Confucianism can reflect and influence the daily business activities of micro-enterprises and improve the green technological innovation performance of enterprises.

Considering the impact of Confucianism on green innovation, enterprises need to consider the cultivation of the Confucianism atmosphere in their daily operations and ensure that they are driven by good value orientation (green awareness and innovation awareness) when making decisions. If enterprises are under pressure from environmental pollution risks, under the influence of Confucianism, this may be a potential path to promote green strategic actions. The findings of this study are particularly helpful for companies that emphasize green innovation. This study shows that Confucianism may be beneficial from the perspective of

environment and innovation, especially in terms of green innovation, which is considered an important development dimension for enterprises to achieve sustainable growth.

References

Bashir, U., & Yu, Y. (2020). Do confucianism and political connections affect stock price crash risk: evidence from Chinese economy?. *Applied Economics Letters*, 27(7), 569-575.

Cheng Bo, Pan Fei, & Wang Jianling. (2016). Confucian culture, information environment and internal control. *Accounting Research*, (12), 79-84.

Du, X. (2015). Does Confucianism reduce minority shareholder expropriation? Evidence from China. *Journal of Business Ethics*, 132, 661-716.

Du, X., Xie, Y., Lai, S., & Zeng, Q. (2022). Confucian culture and accounting conservatism: evidence from China. China *Journal of Accounting Studies*, 10(4), 549-589.

Görg, H., & Strobl, E. (2007). The effect of R&D subsidies on private R&D. *Economica*, 74(294), 215-234.

Gu Zhihui. (2015). Confucian tradition and investor protection from the perspective of information disclosure of related-party transactions. *Economist Tea Party* (4), 5.

Li Wanli, & Xu Xixiong. (2020). Can collective decision-making improve the investment efficiency of state-owned enterprises? - A quasi-natural experiment based on the opinions on "three major issues". *Finance and Trade Research*, 31(2), 17.

Li Wenjing, & Zheng Manni. (2016). Air pollution governance mechanism and its effect - empirical data from prefecture-level cities. *China Industrial Economy* (4), 17.

Li, Z., Huang, Z., & Su, Y. (2023). New media environment, environmental regulation and corporate green technology innovation: Evidence from China. *Energy Economics*, 119, 106545.

Ma Guanghong, & Xia Jialei. (2020). Analysis of the evolutionary game of multi-agents in green product technology innovation under the background of environmental regulation. *Ecological Economy*, 36(5), 50-56.

Qi Shaozhou, & Xu Jia. (2018). Environmental regulation and low-carbon international competitiveness of manufacturing industry - a re-examination of the "Porter hypothesis" of the G20. Journal of Wuhan University: *Philosophy and Social Sciences*, 71(1), 13.

Wang Fengzheng, & Chen Fangyuan. (2018). Board governance, environmental regulation and green technology innovation - an empirical test based on listed companies in heavy pollution industries in my country. *Science of Science*, 36(2), 361-369.

Wang Xin, & Wang Ying. Research on the green innovation effect of environmental information disclosure - a quasi-natural experiment based on the "Ambient Air Quality Standards". *Financial Research*.

Wang Zhenyu, & Zhou Jiayu. (2020). Research on the cooperation mechanism of genetic resource protection between China and ASEAN under the "Belt and Road". *Modern Business* (9), 3.

Xu Jia, Cui Jingbo. (2020). Low-carbon cities and corporate green technology innovation. *China Industrial Economy* (12), 19.

Xu Xixiong, & Li Wanli. (2019). Confucian tradition and corporate innovation: the power of culture. *Financial Research*, 471(9), 112-130.

Yang Xiaohui, & You Daming. (2022). Research on corporate green technology innovation decision-making considering consumer environmental awareness and government subsidies. *Chinese Management Science*, 30(9), 263-274.

Yu Lianchao, Zhang Weiguo, & Bi Qian. (2019). Research on the forced effect of environmental tax on corporate green transformation. *China Population Resources and Environment*, 29(7), 112-120.

Zhao Lingqing, 2022. Research on the impact of Confucian culture on entrepreneurial strategic management. *Yunnan Finance*.