Technical Directors in the Process of Green Development in China: Distribution Characteristics and Enlightenment

Duan Ji[1,*] Di Zhao[2]

[1]School of Accounting, Shandong University of Finance and Economics, Ji'nan, Shandong 250014, China
[2]School of Business and Economics, Shandong University of Finance and Economics, Ji'nan, Shandong 271100, China
[*]*Corresponding author. Email: jiduan1989331@163.com*

ABSTRACT

As the concept of green development becomes more and more popular, the role of technical directors in promoting green technology innovation has gradually attracted the attention of many enterprises. In order to comprehensively understand the development trend and distribution characteristics of technical directors in the process of green development in China, this paper uses descriptive statistics to analyze the technical director data collected from 437 companies from 2006 to 2018. The main conclusions are as follows: in the process of green development in China, the participation of technical directors in the board of directors has shown a downward trend overall; technical directors have higher participation in Mining and Washing of Coal, Mining and Processing of Ferrous Metal Ores, Processing of Petroleum, Coking, Processing of Nuclear Fuel, Smelting and Pressing of Non-ferrous Metals, Manufacture of Rubber and Plastic, and have relatively low participation in Manufacture of Textile, Gas production and supply, Utilization of Waste Resources, Manufacture of Textile Wearing and Apparel, Manufacture of Railway, Shipbuilding, Aerospace and Other Transportation Equipment; the participation of technical directors in the eastern and western regions is significantly lower than that in the central region. During the sample period, the participation of technical directors in the eastern and western regions showed a downward trend, and the central region remained basically stable.

Keywords: *green development, technical director, distribution characteristic*

I. INTRODUCTION

The Fifth Plenary Session of the 18th CPC Central Committee put forward the new development concept including green development as an important concept of the 13th Five-Year Plan and even longer-term social development. Since then, the 19th National People's Congress of the Communist Party of China pointed out that China's economic development has shifted from high-speed development to high-quality development. To ensure the stable operation of high-quality economic development, environmental pollution and excessive consumption of resources must be effectively controlled and resolved. Enterprises are a vital force to promote economic development, but they are also the main source of the above problems. As the main way to improve quality and efficiency and save energy and reduce emissions (Wang Fengzheng and Chen Fangyuan, 2018), green technology innovation is undoubtedly the best choice for many enterprises.

Talents are an important guarantee for enterprises to promote green technology innovation. The board of directors is the maker of corporate strategic decisions, and the technical directors, as members of the board of directors with a technical professional background, can better identify whether the existing technology in the enterprise is "green", and at the same time, reduce the risk of corporate innovation and promote the improvement of efficiency of corporate green technology innovation by exercising supervision, advice and decision-making functions they have. In addition, in recent years, technical directors have gradually attracted the attention of academia. Many scholars have found that technical directors can improve corporate performance (Hu Yuanmu and Ji Duan, 2017) and promote the sustainable development of enterprises (Liu Zhongyan and Zhou Zejiang, 2019) by improving the innovation efficiency of enterprises (Hu Yuanmu, 2012), the technical efficiency of enterprises, and increasing the output of technical elements (Han Zhongxue, Cui Jianwei, and Wang Shan, 2014).

In summary, whether in practice or in theory, technical directors are playing an increasingly important role in promoting green technology innovation in enterprises. If so, has the distribution of technical directors changed due to changes in the macro environment? In this paper, through the CSMAR database, the data of 437 companies from 2006 to 2018 were selected. For research needs, the industries of the sample enterprises in this paper are mainly "two high" industries(industries with high energy consumption and high pollution emissions)and the related manufacturing industries that assist "two high" industries to achieve green technology innovation; According to the "List of Classified Management of Environmental Protection Industry of Listed Companies" issued by the Ministry of Environmental Protection (Environment Office Letter [2008] No. 373), in this paper, Thermal Power Industry, Steel Industry, Cement Industry, Electrolytic Aluminum Industry, Coal Industry, Metallurgy Industry, Building Materials Industry, Mining Industry, Chemical Industry, Petrochemical Industry, Pharmaceutical Industry, Light Industry (Brewing Industry, Papermaking Industry, Fermentation Industry), Textile Industry And Leather Industry are divided into "two high" industries. Based on the data of 437 companies, the author manually collects the data of technical directors, uses descriptive statistical methods to study the distribution characteristics of technical directors, and analyzes the reasons for their current status in order to comprehensively understand the distribution characteristics of technical directors in the process of green development in China.

II. LITERATURE REVIEW

The term "technical director" was first coined by the American economists Adler and Ferdows (1990), who defined the "technical director" as the chief technical officers in an enterprise who can provide technical guidance and possess management functions. Up to now, the research on technology directors at home and abroad is still in the exploratory stage. This paper reviews the research literature on the impact of technology directors on corporate innovation. Most scholars believe that the existence of technical directors has a significant positive effect on the technological innovation of an enterprise. By analyzing the impact of technical directors on corporate R & D investment, Dalziel et al. (2011) believed that financial and entrepreneurial financial experience of directors had no significant impact on corporate R & D investment, and external technical directors could significantly promote corporate R & D investment. After the research, Zhang Qin (2018) found that CEOs with technology background can effectively promote the technological innovation level of private high-tech enterprises, which was reflected in the increase of R&D investment and patent output. Xu Xiumei, Li Jingsuo and Wen Lin (2019) also found that technical directors had a significant driving effect on the growth of enterprises; technical directors had a certain amplification effect on the scale of technology resources and can improve the quality of technology resource allocation. Han Zhongxue, Cui Jianwei, and Wang Shan (2014) believed that technology executives had a significant role in improving the enterprise's technological efficiency, technology executives can improve technical efficiency of enterprises by increasing R & D investment, the proportion of technicians, the number of patents, and the output of technicians. However, Hu Yuanmu (2012) believed that the increase in R & D investment of listed companies in China had not brought about a significant increase in innovation level and he reckoned that companies that hired technical independent directors can indeed improve the efficiency of R & D output, and when listed companies had both technology executive directors and technology independent directors, R&D output efficiency is higher.

III. OVERVIEW OF THE DEVELOPMENT OF TECHNICAL DIRECTORS IN THE PROCESS OF GREEN DEVELOPMENT IN CHINA

A. The overall development trend of the annual average proportion of technical directors in enterprises

Since 2006, although the annual average of the proportion of technical directors has fluctuated slightly, the overall trend has shown a downward trend, as shown in "Fig. 1", the proportion of technical directors is the ratio of the number of technical directors to the total number of directors. As of 2018, the average proportion of technical directors has reached the minimum value of 0.298, which is 3.5 percentage points lower than that of 2006. It shows that many theoretical studies in academia have confirmed that the existence of technical directors has a positive role in promoting technological innovation in enterprises, and the government is constantly implementing new development concepts and encouraging enterprises to conduct green technological innovation, but the participation of technical directors in the board of directors has not only not been improved because of this, but shown a downward trend. From this point of view, the enterprise's understanding of the role of technology directors in promoting green technology innovation needs to be improved to effectively ensure that technology directors can play a full and effective role in enterprise green technology innovation.

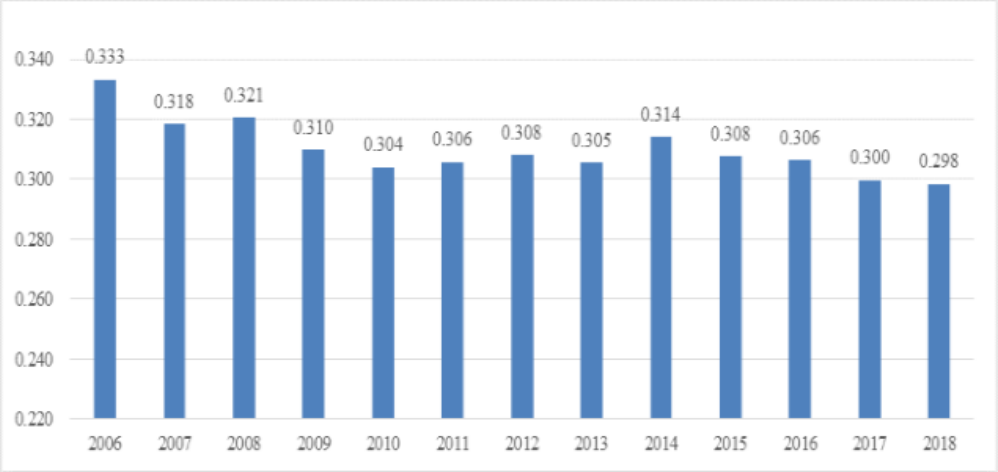

Fig. 1. Trend of annual average of technical directors.

B. Industry distribution of technical directors

According to the "Guidelines for the Industry Classification of Listed Companies" published by the CSRC in 2012, the entire sample is classified into different industries and the average value of the proportion of technical directors in each industry is calculated based on this, as shown in "Fig. 2". It can be seen from "Fig. 2" that in the entire sample, the top five industries with the average ratio of technical directors are Mining and Washing of Coal, Mining and Processing of Ferrous Metal Ores, Processing of Petroleum, Coking, Processing of Nuclear Fuel, Smelting and Pressing of Non-ferrous Metals, Manufacture of Rubber and Plastic, with the average between 0.397 and 0.476. The bottom five industries with the average ratio of technical directors are Manufacture of Textile, Gas production and supply, Utilization of Waste Resources, Manufacture of Textile Wearing and Apparel, Manufacture of Railway, Shipbuilding, Aerospace and Other Transportation Equipment, with the average between 0.076 and 0.175.

To sum up, first of all, there are technical directors in the industries included in the entire sample, but the average ratio of technical directors between different industries does have a large gap, which has a certain relationship with the nature of their industries. The top five industries are those with relatively large energy consumption and pollutant emissions among the "two high" industries. These industries have more urgent needs for green technology innovation. Therefore, the proportion of technical directors is relatively high. Secondly, in the bottom five industries, except for the textile industry, energy consumption and pollutant emissions are relatively small. The main direction of their demand for green technology innovation is to develop green processes and reduce energy waste. The demand for green technology innovation is relatively low, and it is reasonable to have a small average ratio of technical directors. However, Manufacture of Textile is one of the industries with relatively high energy consumption and more polluting industries in the "two high" industries. The mean value is in the bottom-fifth place, which is not good for Manufacture of Textile to better conduct green technology innovation. Finally, according to "Fig. 2" and comparing the average value of the technical director ratio of all industries in the entire sample of 0.310, it can be seen that the average ratio of technical directors in each industry below Manufacture of Medicines is lower than the full sample's, which indicates that a large part of "two high" companies in China and related manufacturing companies assisting them in realizing green technology innovation have not yet recognized the importance of technical directors to their green technology innovation, and the average ratio of technical directors is relatively low.

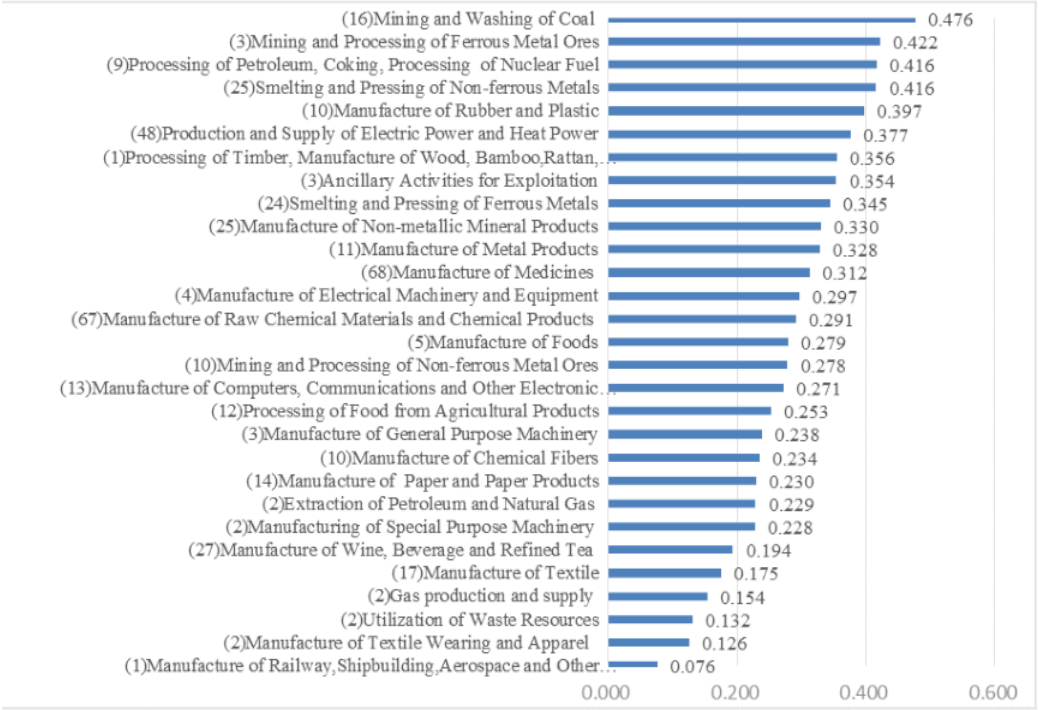

Fig. 2. Industry distribution statistics of the average ratio of technical directors.

[a.] The number in brackets on the ordinate indicates the number of samples

C. *The regional distribution and development trend of technical directors*

From the perspective of dynamic changes, it can be seen from "Fig. 3" that the average of the percentage of technical directors in the three regions from 2006 to 2018 has shown different trends. There is a certain similarity in the trend of the average of the percentage of technical directors in the eastern region and in the western region. The average of the percentage of technical directors in the two regions shows a downward trend as a whole. As of 2018, the average ratio of technical directors in the eastern region has decreased from 0.333 to 0.285, the western region has dropped from 0.326 to 0.284, the average proportion of technical directors has decreased by 4.8 percentage points in the eastern region, and has decreased by 4.2 percentage points in the western region; and the average percentage of technical directors in both regions has been significantly lower than that in the central region; in comparison, the average of the proportion of technical directors in the central region shows an increasing and decreasing trend, but the volatility is small. The average annual proportion from 2006 to 2018 is between 0.312 and 0.342.

In recent years, in order to narrow the huge economic development gap between the eastern and western regions, the government has issued a series of policies to promote the development of resources, infrastructure construction and talent team building in the western region, but the results have not been significant. At present, the economic strength and level of technological innovation (especially green technological innovation) in the western region are still lagging behind. The backward level of economic development has led many western companies to pursue low labor costs and not to incentivize skilled talents enough; conservative thinking and weak innovation consciousness have made western companies pay less attention to technological innovation, and the individual value of technical talents can't be well realized; coupled with relatively incomplete company management systems (Qian Li, Xiao Renqiao, and Chen Zhongwei, 2015), led to a large loss of technical talent in western enterprises, or even if they stay in the company, technical talent is difficult to enter at the top of the company, the average ratio of technical directors eventually declined. However, the author believes that although the trend of the average percentage of technical directors in the eastern region is similar to that in the western region, the reasons are not the same. The decline in the average percentage of technical directors in the eastern region may be affected by the global economic downturn. As we all know, the eastern region, as the frontier of China's reform and opening up, has participated in international division of labor and international market competition for a long time, and the degree of economic globalization and economic development are relatively high. Therefore, the eastern region was also hit hardest after the 2008 financial crisis, enterprises in the eastern region generally have low

profits, and some companies are even on the verge of bankruptcy. For the purpose of cost reduction, many eastern companies have compressed their labor costs, reduced employee compensation and the training and promotion of employee skills, and don't incentivize for employees enough. The average ratio of technical directors is on the decline, and the pace of green technology innovation in the eastern region has slowed down. As for the central region, the state has always attached great importance to the brain drain and green development in the central region. The Strategy of the Rise of the Central Region has been implemented in the central region, which has provided a certain guarantee for talents and strengthened its emphasis on green technology innovation. The local government has also attached great importance to the construction of local talent team, and gave preferential treatment to some core technical talents. The average proportion of technical directors of enterprises in the central region is considerable.

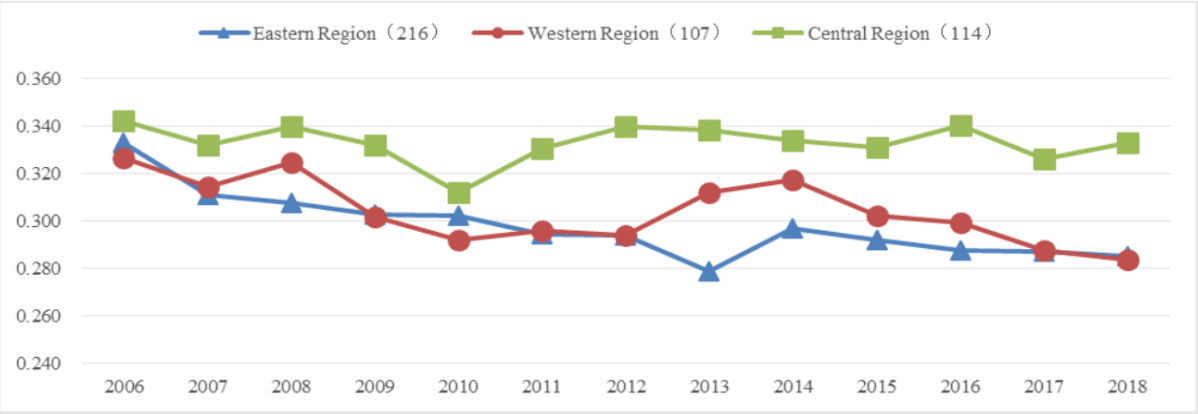

Fig. 3. Regional distribution statistics of the mean ratio of technical directors.

[a] The number in parentheses in the legend indicates the number of samples

IV. CONCLUSION

Through statistical analysis of the overall development trend, industry distribution, regional distribution of technical Directors in the Process of Green Development in China, the main conclusions are as follows.

First, from the perspective of the overall development trend, the average proportion of technical directors has shown a downward trend, and the participation of technical directors in the board of directors has declined. As of 2018, the proportion of technical directors has been less than 30%.

Second, from the perspective of industry, technical directors are more involved in Mining and Washing of Coal, Mining and Processing of Ferrous Metal Ores, Processing of Petroleum, Coking, Processing of Nuclear Fuel, Smelting and Pressing of Non-ferrous Metals, Manufacture of Rubber and Plastic. The participation of technical directors in Manufacture of Textile, Gas production and supply, Utilization of Waste Resources, Manufacture of Textile Wearing and Apparel, Manufacture of Railway, Shipbuilding, Aerospace and Other Transportation Equipment is relatively lower, these industries need to pay more attention to technical directors.

Third, from a regional perspective, first of all, the average ratio of technical directors in the eastern and western regions is significantly lower than in the central region. Secondly, the trend of the average percentage of technical directors in the eastern and western regions from 2006 to 2018 showed a downward trend, but for different reasons: the enterprises in the eastern region was mainly affected by the financial crisis and the global economic downturn, and the western region was mainly due to the poor economic foundation, inadequate management systems and the brain drain; with the support of national and local policies, the average ratio of technical directors in the central region is relatively stable overall.

According to the research in this paper, the following policy enlightenment can be drawn:

A. The "two high" industries should increase the emphasis on technical directors and improve the structure of the board of directors, thereby improving the level of green technology innovation in enterprises

"Two highs" industries are an important driving force for the country to achieve green development and an important subject for green technological innovation. Technical directors play an irreplaceable role in corporate green technology innovation. The "two high" industries should fully understand the key role of

technical directors in promoting corporate green technology innovation, achieving energy conservation and emission reduction, and promoting corporate green development, so as to increase the participation of technical directors in the board of directors.

B. Enhancing the strength of green technology in the western region, increasing the proportion of technical directors of enterprises, and accelerating the pace of green technology innovation of enterprises

The government should continue to promote the strategy for the large-scale development of the western region, help the western region get rid of resource dependence, strengthen the construction of technical personnel in the western region and its emphasis on green technological innovation, and strengthen the capability of green technological innovation in the western region; Enterprises in the western should increase their awareness of innovation, increase the participation of technical personnel in the board of directors, accelerate the pace of green technology innovation of enterprises and form a green production method.

C. Enterprises in the eastern region should do their best to meet the needs of the company's board of directors for core technical personnel, and further improve the efficiency of green technology innovation

Every coin has two sides. Although the global economic downturn has had a greater impact on the eastern region of China, the developed countries in Europe and the United States have been even more affected by it. The massive layoffs of many large multinational companies has also made it possible for the enterprises in eastern region of China to introduce global core technical personnel. Enterprises in the eastern region should seek and absorb high-end technical talents in the frequent international trade based on their own international advantages (Gao Chao, 2015); at the same time, for the high-end technical talents in the enterprise, the compensation given to them by the enterprise should be kept as stable as possible. Enterprises should strengthen their training and increase their participation in the board of directors, thereby improving the efficiency of green technology innovation.

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