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"Carbon Spectacular" - Exploring the Path to Enhance the Precision of Fiscal and Tax Support for Innovative Technologies in Energy Conservation and Emission Reduction

Siyi Xu¹, Jiachen Shou², Qiuqin Yang³, Huaiwen Wang⁴, Shunan Sheng⁵, Weihua Gao⁶

^{1,2,3,4,5,6} Zhejiang University of Finance and Economics Dongfang College, Jiaxing, Zhejiang, China

Correspondence: Siyi Xu, Zhejiang University of Finance and Economics Dongfang College, Jiaxing, Zhejiang, China. Tel: 1360-051-0408. E-mail: 391134110@qq.com

Abstract

Since the 18th National Congress of the Communist Party of China, China has always placed technological innovation at the core of its development. In today's world, under the background of advocating "green manufacturing," energy conservation and emission reduction are the inevitable path to sustainable green development. This article primarily utilizes the method of data analysis to analyze the issues existing in fiscal and tax preferential policies in promoting technological innovation from the perspectives of literature review and tax preferential policy combing. These issues include the current fiscal and tax preferential policies leading enterprises to pursue the quantity rather than the quality of innovation, high policy thresholds, difficulties in expense allocation, limitations in tax incentives from multiple perspectives, and insufficient support for innovative talents in fiscal and tax policies. Based on these issues, a series of operable suggestions are proposed. It is hoped that this study can contribute to the revision and improvement of fiscal and tax preferential policies for technological innovation in energy conservation and emission reduction, providing effective theoretical references and inspirations.

Keywords: Energy Conservation and Emission Reduction, Fiscal and Tax Policies, Technological Innovation

1. Research Background and Purpose

Energy conservation and emission reduction have become the main theme in addressing global warming and energy shortages, representing the inevitable path towards sustainable development. In response, China has continuously promoted and implemented energy conservation, emission reduction, and green development. By 2023, China's energy consumption intensity has declined by 26.4% cumulatively, reducing carbon dioxide emissions by nearly 3 billion tons and emissions of sulfur dioxide and nitrogen oxides by over 10 million tons. However, industrial energy consumption, accounting for approximately 70% of the country's total social energy consumption, still faces issues such as low energy efficiency in many existing projects and insufficient energy-saving innovation technology in industrial parks.

Amid the rapid development of the internet, it is imperative to deepen the integration of manufacturing and the internet to implement "Made in China 2025", promoting the advancement, intelligence, greening, and servicing of the manufacturing industry. It is necessary to build a green manufacturing system, promote green management throughout the product's lifecycle, and continuously optimize the industrial product structure. This research focuses on technological innovation in energy conservation and emission reduction. Through literature analysis, it examines the incentivizing role of fiscal and taxation policies on energy conservation, emission reduction, and green development. By analyzing the existing fiscal and taxation policies for energy-saving technologies, it aims to address the lack of targeted policies and proposes feasible suggestions to further refine and enhance China's fiscal and taxation policies for encouraging technological innovation in energy conservation and emission reduction.

2. Literature Review

As a crucial economic regulation tool, fiscal and taxation policies play a significant role in resource allocation, enhancing technological innovation capabilities, promoting energy conservation and emission reduction, and driving economic development. To adapt to the development of the world economy and technological trends, China has continuously increased its investment in technological innovation for energy conservation and emission reduction since the reform and opening up, gradually intensifying fiscal and tax support measures. It utilizes fiscal subsidies, tax incentives, and other means to promote technological innovation in energy conservation and emission reduction, thus driving high-quality economic development in China. Existing relevant research primarily focuses on the following aspects:

2.1 Achievements and Deficiencies of China's Fiscal and Tax Policy System for Energy Conservation and Emission Reduction

The National Eleventh Five-Year Plan Outline and the "Several Opinions of the State Council on Accelerating the Development of Circular Economy" clearly stipulate specific goals for energy conservation and emission reduction from 2006 to 2010. Ma Haitao and Qiu Xiaojie (2010) analyzed fiscal and tax policies for encouraging energy conservation and emission reduction from the perspective of circular economy, thoroughly examining the achievements and deficiencies of fiscal and tax policies in this area. They proposed measures and suggestions suitable for China's national conditions at that time, such as establishing a green tax system, improving taxes and fees, and improving the trading of emission rights. Ma Haitao and Cheng Lan (2010) discussed fiscal and tax policies for promoting energy conservation and emission reduction by analyzing the practical pressures in achieving energy conservation and emission reduction in China. They specifically explored the relationship between energy conservation and emission reduction and fiscal policy, conducted in-depth research on fiscal and tax policies, and proposed existing defects. Zhang Xiaolong (2017) analyzed statistical bureau data and found issues in industrial development and defects in fiscal, tax, and financial policies during industrial upgrading under China's energy conservation and emission reduction trend. Wu Hong and Wang Hao (2023) explored the advantages and disadvantages of China's tax policies for energy conservation and emission reduction from the perspective of consumption tax. They proposed that to achieve the "dual carbon" goals, it is necessary to leverage the role of consumption tax in energy conservation and emission reduction, optimize the collection process, implement ad valorem taxation, and design tax rates that consider the application of energy-saving technologies.

2.2 Insights from Foreign Fiscal and Tax Policies for Promoting Energy Conservation and Emission Reduction

Song Xiaojing (2012) derived four insights by examining fiscal and tax policies of major foreign countries to promote energy conservation and emission reduction. For example, different reform models should be chosen based on national conditions, and fiscal and tax policies that emphasize both positive incentives and reverse constraints should be implemented. Jin Ying (2014) explored policies for promoting technological innovation in energy conservation and emission reduction in countries such as the Netherlands and Germany and found that developed countries would subsequently focus more on technological and policy innovations in this area. Liu Chanchan and Lan Jiajia (2022) listed relevant experiences in promoting technological innovation in green and low-carbon fiscal and tax policies in developed countries.

2.3 The Impact of Fiscal and Tax Incentive Policies on Enterprise Technological Innovation

Research conducted by Zeng Yifen (2023) has revealed that fiscal subsidies and tax incentives significantly motivate enterprises' R&D investments. Specifically, the incentive effect of fiscal and tax policies on non-state-owned enterprises' R&D investments is notably greater than that on state-owned enterprises. Additionally, the level of regional marketization can significantly enhance the incentive effect of fiscal and tax policies on R&D investments in high-tech enterprises. However, Si Jinmiao (2023) holds a different view, arguing that while appropriate fiscal subsidies can promote enterprise R&D investments and incentivize innovation, excessive fiscal subsidies may lead to a phenomenon of "the more subsidies, the greater losses." Furthermore, tax rate incentives can have an inhibitory effect on enterprise technological innovation. Guo Qing (2023) found through empirical research that fiscal subsidy policies have a more positive impact on promoting enterprise technological innovation compared to tax incentive policies. Specifically, fiscal subsidy policies have a stronger positive impact on technological innovation performance in state-owned military enterprises than in non-state-owned ones, while tax incentive policies have a stronger positive impact on technological innovation performance in non-state-owned military enterprises than in state-owned ones.

2.4 An Exploration of Fiscal and Tax Policies for Promoting Green Technological Innovation

From a circular economy perspective, Xu Jingting and Zhang Bing (2011) proposed that China should formulate fiscal and tax policies to promote green technological innovation and adjust and improve the current tax system to encourage enterprises' green technological innovation. Zhang Xiufeng, Jin Yingying, and Tang Haiyan (2023) found through their research on green technological innovation in photovoltaic enterprises that fiscal and tax incentive policies have a significant positive impact on green technological innovation in photovoltaic listed companies, with R&D investment playing a partial intermediary role. From the perspective of corporate internal governance, Ni Xinyu (2023) proposed that under the premise of good corporate governance, a fiscal and tax policy system should be actively constructed to support the achievement of green innovation performance goals. It is also necessary to establish a systematic fiscal and tax policy guidance plan to promote green R&D expenditures, further improve tax incentives for the new energy industry, and actively play the guiding role of corporate governance in the new energy industry.

By reviewing existing literature, we can observe that: firstly, there are still deficiencies in the design and implementation of fiscal and tax policies for energy conservation and emission reduction in China. Secondly, it is evident that developed countries are constantly innovating energy-saving and emission-reduction technologies, and research on fiscal and tax support policies for technological innovation in energy conservation and emission reduction has become a key area of their future research, highlighting the importance of exploring fiscal and tax policies for technological innovation in energy conservation and emission reduction. Thirdly, most of the current domestic research focuses on the impact of fiscal and tax policies on technological innovation in specific industries, while research on fiscal and tax support policies for green technological innovation in energy conservation and emission reduction is relatively scarce compared to the former. Based on the above, this paper will conduct an in-depth exploration of fiscal and tax policies for innovative technologies in energy conservation and emission reduction, analyze the existing problems in China's fiscal and tax incentives for promoting technological innovation in energy conservation and emission reduction, and propose relevant policy improvement suggestions.

3. Sorting out tax and fiscal incentives policies

3.1 Fiscal Subsidy Policy

Fiscal subsidies primarily provide enterprises with non-repayable financial support in the form of grants, loan interest subsidies, and other mechanisms, serving as a pre-emptive incentive policy. As a direct means of government support for enterprise research and development (R&D), fiscal subsidies aim to promote enterprises' willingness to invest in R&D while alleviating their financial burdens and reducing obstacles to their R&D efforts

(2024). In response to the "Opinions of the CPC Central Committee and the State Council on Comprehensively Implementing the New Development Philosophy to Achieve Carbon Peak and Carbon Neutrality," which calls for "increased fiscal support from all levels for energy conservation and emissions reduction, green and low-carbon industrial development, technological R&D, and other areas," various localities have successively introduced subsidy policies.

3.1.1 Policy subsidy review of certain regions

Policy implementation location	Policy content	Policy sources
Heilongjiang	On March 2, 2023, enterprises that meet the conditions for energy-saving renovation will be granted a reward of 1 million yuan. Enterprises that have been recognized as national-level green factories or green supply chain management enterprises in the previous year will be given a one-time reward of 1 million yuan. In the same year, the same enterprise is only allowed to apply for one reward fund specified in this guideline, and energy-saving renovation enterprises that have already received national or provincial financial support are not allowed to apply repeatedly.	Notice on Organizing the Application for Reward Funds for Energy Conservation, Carbon Reduction, and Green Transformation of Industrial Enterprises in 2023
Shenzhen Nanshan District	For enterprises that have obtained national green product certification, low-carbon product certification certificates, or certification certificates based on the "Nanshan District Green and Low-carbon Product Evaluation Rules," a reward of 100,000 yuan will be given for each certificate, with a maximum of 300,000 yuan for each enterprise. For enterprises that have obtained the "Carbon Neutral Enterprise" certification, a one-time reward of 100,000 yuan will be given. For enterprises that have set carbon neutral path goals and reduced their annual total carbon emissions by no less than 5% and carbon emission intensity by no less than 5%, a one-time reward of 300,000 yuan will be given.	Measures of the Nanshan District to Boost the High-Quality Development with the Assistance of Ecological Environment
Tianjin	1. Energy-saving technology renovation project: the investment amount of the project shall be no less than 2 million yuan, and the annual energy saving amount shall be no less than 1,000 tons of standard coal. According to the annual energy saving amount of the project, the energy-consuming unit shall be given a financial subsidy of 400 yuan per ton of standard coal. The subsidy shall not exceed 4 million yuan and 30% of the total investment of the project.	Notice on Applying for Subsidies of Special Fund for Energy Conservation and Carbon Reduction in Tianjin in 2023

	2. Low-carbon technology demonstration project: advanced and applicable technology demonstration projects such as low-carbon/zero-carbon smelting and full-process large-scale carbon capture, utilization, and storage (CCUS). The investment amount of the project shall be no less than 20 million yuan, and a subsidy of 10% of the investment amount shall be given. The subsidy shall not exceed 4 million yuan.	
Shanghai - Baoshan District	Enterprises that are supported to carry out green creation and are identified as national-level green factories will be awarded a one-time reward of 600,000 yuan; those identified as Shanghai green factories will be awarded a one-time reward of 300,000 yuan. (The Measures shall be implemented since January 1, 2020, and remain valid until December 31, 2024.)	Management Measures for the Use of Special Funds for Energy Conservation and Emission Reduction in Baoshan District

3.2 tax incentives

Tax incentives mainly reduce the tax burden of enterprises by directly reducing taxes or delaying the tax payment time, which is a kind of ex post incentive policy. Both fiscal subsidies as an ex ante incentive and tax incentives as an ex post incentive can be directly used for R&D investment to offset the risks and costs of R&D. Since the 18th CPC National Congress, China has actively promoted the green reform and transformation of the tax system, gradually built a green tax system with Chinese characteristics, and issued a series of tax and fee preferential policies to support green development in accordance with the strategic requirements of green development and ecological civilization construction.

3.2.1 Value-Added Tax

	Policy Content	Policy sources
exempt from VAT (Value-Added Tax)	1. Energy-saving service companies implementing eligible contract energy management projects that transfer value-added tax taxable goods to energy-consuming enterprises are temporarily exempt from value-added tax.	Finance and Taxation [2010] No. 110
	2. Major technological equipment within the scope of the import catalogue is exempt from value-added tax.	Finance and Tariff [2019] No. 38
	3. Full refund of VAT for domestic-funded R&D institutions and foreign R&D centers purchasing domestic equipment.	Announcement of the Ministry of Finance, Ministry of Commerce, and the State Taxation Administration [2023] No. 41

additional deduction for value-added tax	1. Taxpayers of productive service industries are allowed to offset the tax payable by adding 5% to the deductible input tax amount in the current period. Taxpayers of living service industries are allowed to offset the tax payable by adding 10% to the deductible input tax amount in the current period.	Announcement No. 87 of 2019 of the Ministry of Finance and the State Taxation Administration
	2. For the industrial machine tool enterprises that produce and sell advanced industrial machine tool mainframes, key functional components, and numerical control systems, a 15% additional deduction of the current deductible input tax is allowed for their taxable income	Tax and Taxation[2023] No. 25

3.2.2 Corporate Income Tax

	Policy Content	Policy sources
Additional deduction for research and development expenses	As for the actual R&D expenses incurred by enterprises during their R&D activities, if they do not form intangible assets and are included in the current profits and losses, on the basis of deducting them according to the regulations, starting from January 1, 2023, they can be further deducted before tax at 100% of the actual amount. If they form intangible assets, starting from January 1, 2023, they can be amortized before tax at 200% of the cost of intangible assets.	The Announcement of the Ministry of Finance and the State Taxation Administration No. 7, 2023
Accelerated Depreciation of Fixed Assets	For newly purchased equipment and instruments, if the unit value does not exceed 5 million yuan, they are allowed to be included in the current cost and expenses for deduction in calculating taxable income, without calculating depreciation year by year. If the unit value exceeds 5 million yuan, it shall still be subject to relevant regulations.	Announcement of the Ministry of Finance and the State Taxation Administration [2023] No. 37
Three-Year Tax Exemption Followed by Three-Year Half-Tax Reduction	1. As for the income from environmental protection and energy-saving water-saving projects that meet the conditions, it is exempt from enterprise income tax in the first three years since the first year in which the first production and operating income is generated. From the fourth to the sixth year, it shall be taxed at a rate reduced by half.	Finance and Taxation [2016] No. 131
	2. For the qualified energy-saving service companies implementing contract energy management projects in accordance with relevant provisions of the Enterprise Income Tax Law, from the tax year in which the project obtains the first production and operation income, the first to third years are exempted from the enterprise income tax, and the fourth to sixth years shall be taxed at half of the statutory tax rate of 25%.	Finance and Taxation [2010] No. 11

Tax rate concession	1. For high-tech enterprises which the country aims to give priority to in terms of support, the enterprise income tax will be levied at a reduced rate of 15%.	The Enterprise Income Tax Law of the People's Republic of China
	The enterprise income tax shall be levied at a reduced rate of 15% for the third-party enterprises engaged in pollution prevention and control that meet the requirements.	Announcement of the Ministry of Finance and the State Taxation Administration [2019] No. 60

3.2.3 personal income tax

The fiscal and tax incentives for technological innovation in terms of personal income tax mainly include the following two:

- (1) If an individual resident obtains stock options, stock appreciation rights, restricted stocks, equity incentives, etc., and meets relevant conditions, it will not be merged into the comprehensive income of the current year, and the individual income tax will be calculated and paid by applying the comprehensive income tax rate table in full and independently.
- (2) Since July 1, 2018, non-profit research and development institutions and universities approved by law, according to the Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements, can reduce the cash rewards given to scientific and technological personnel from the income of the transformation of scientific and technological achievements to 50% of the "salary and wage income" of the scientific and technological personnel in the current month, and pay individual income tax in accordance with the law.

3.2.4 other taxes

(1) Resource tax

To encourage the intensive exploitation and utilization of coal resources, from September 1, 2023 to December 31, 2027, the resource tax on coal replaced by backfill mining will be reduced by 50%.

(2) Real estate tax and urban land use tax

From January 1, 2024 to December 31, 2027, the real estate tax and urban land use tax will be exempted for the real estate and land used by national and provincial science and technology business incubators, university science parks, and national registered maker spaces, and the real estate and land provided to incubating objects through free or rental methods.

4. Problems in promoting fiscal and tax preferential policies for technological innovation in energy conservation and emission reduction

4.1 Preferential fiscal and tax policies lead enterprises to pursue the quantity rather than the quality of innovation

4.1.1 Preferential fiscal and tax policies have limitations of "true innovation" incentives

Preferential fiscal and tax policies are the main means of national macroeconomic regulation and control, mainly through fiscal subsidies, tax incentives, government procurement and other ways to achieve the purpose of benefiting enterprises and reducing the investment cost of enterprises to promote the development of enterprises. However, the current preferential fiscal and tax policies have the limitations of "true innovation" incentives. Today, with the rapid development of science and technology, the emergence of many strategic innovations has inhibited the process of "true innovation" to a certain extent. The 18th National Congress of the Communist Party of China proposed that scientific and technological innovation should be placed in the core position. The state provides many tax breaks, subsidies and interest-free policies to innovative technology enterprises in terms of investment and financing, technology development, enterprise growth and technology formation. However, in a society with poor information, many enterprises will exploit the "tax loophole" and innovate to enjoy preferential policies, which is not "true innovation." If they carry out the imitation innovation model, these enterprises will have a small amount of input, but there is no final output; Or they may increase a lot of non-high-quality research and development results in a period, but do not care about quality, just to enjoy tax incentives for their own enterprises to pay less tax innovation activities.

4.1.2 Preferential fiscal and tax policies are less favorable for enterprises in the start-up stage

An enterprise from the beginning to the final foothold, need to go through the initial stage, growth, maturity, decline and other processes. At present, most of the preferential policies introduced in China are aimed at those small and medium-sized enterprises that have been in the research and development link, more preferential policies for the growth period and mature period of enterprises, but for the start-up stage of the preferential policies involved less. Financing ability is often an important factor to promote the development of enterprises, small and medium-sized science and technology enterprises in the start-up is the need for a lot of capital, a lot of manpower, a lot of talent introduction of the period, and technology research and development of this high-tech industry, sufficient capital supply for technology research and development escort. At this stage, enterprises often face financing difficulties and other financial problems, but at this stage, the scale of enterprises is still small, direct and indirect financing difficulties, and the state only issued financial institutions to small and micro enterprises and individual industrial and commercial enterprises 10 million yuan and below small loans interest income from VAT exemption policies, preferential policies in the enterprise financing incentive range is small. Enterprises rely on external financing to obtain funds in the initial stage, which does not solve the problem of financing difficulties for enterprises in the initial stage to a certain extent and makes some people who want to start innovative enterprises discouraged.

Talent introduction is the foundation of innovation-oriented enterprises, but at present, there are few fiscal and tax preferential policies for technical personnel, which is very unfavorable to the cultivation and investment of talents. The preferential policies related to talent training are not strong enough. China only reduces or postpones the personal income tax of employees in enterprises according to a certain percentage or within a certain period, or makes enterprises enjoy a lower corporate income tax rate or reduce part of the corporate income tax within a certain period, or reduces the tax related to scientific research expenses, and carries out a certain subsidy or tax reduction for technological innovation projects. These preferential policies do not produce substantial incentives for talent training, enterprises did not increase investment in talent training, so the quality of talent training is not high in our country, the lack of high-quality talent resources, which also leads to the low level of enterprise innovation.

4.1.3 Preferential fiscal and tax policies have low efforts to transform innovative technological achievements

Patent is the core factor to measure the innovation ability of an enterprise the number of patent applications can reflect the innovation ability of an enterprise to some extent. The invention patent is an important symbol to measure the level of independent innovation ability of an enterprise. Invention patents are the patents with the highest technical content, internal value and research and development difficulty. At present, although the number of patents granted by Chinese enterprises shows an overall upward trend, the number of invention patents is far lower than that of utility model, design and other patents. Every year, about 40% of patents in China cannot pass the audit and certification due to technical substandard reasons. It shows that the quality of innovation patents in

China is not high. However, for small and medium-sized innovative enterprises, they would prefer to invest in technical achievements that meet customer needs, have a short cycle and a high conversion rate. However, at present, there are few relevant fiscal and tax preferential policies, which are not conducive to the achievements and outputs of small and medium-sized innovative enterprises. Therefore, not all the funds invested by these enterprises can be finally converted into output results. The preferential fiscal and tax policies for the transformation of technological achievements are mainly reduced and deferred tax on technology shares, but this preferential policy only makes the technology research and development personnel defer the tax payment to the transfer of equity, but extends the tax period, and does not substantially reduce the tax burden. The preferential intensity is small, and the scope of the preferential policy is not large. If the technical and innovative personnel get cash incentive rather than equity incentive, the tax burden will be heavier. This is because the bonus will be fully taxed as salary and salary in comprehensive income, and the tax rate may be as high as 45%, which is much higher than the 20% tax rate on property transfer as equity transfer.

4.2 The threshold of preferential fiscal and tax policies is high, and the collection of expenses is difficult

4.2.1 High policy threshold

For the current high-tech enterprises, if the enterprise wants to enjoy the "two exemptions and three halves" policy, the enterprise first needs to meet the relevant provisions of the "high-tech enterprise identification Management Measures", obtained the high-tech enterprise identification certificate, can enjoy the preferential treatment. However, if the enterprise wants to enjoy the preferential policy of tax reduction and exemption every year in the future, it needs to meet the identification conditions every year in the future. If the tax department finds during daily management that the high-tech enterprise does not meet the conditions of recognition in the process of recognition or during the preferential period, it shall request the recognition institution to recombine. After the review, it is determined that the enterprise does not meet the conditions, the qualification of new and high technology enterprises shall be cancelled, and the tax authorities shall be notified to recover the taxes that are not in conformity with the provisions but are underpaid while enjoying tax incentives, and the enterprises shall be notified to pay the taxes in arrearage.

For example, although China has given a large number of preferential policies to micro, small and medium-sized enterprises, there are strict conditions for the identification of small and micro enterprises: for industrial enterprises, the annual taxable income should not exceed 300,000 yuan, the number of employees should not exceed 100 people, and the total assets should not exceed 30 million yuan; For other enterprises, the annual taxable income should not exceed 300,000 yuan, the number of employees should not exceed 80 people, and the total assets should not exceed 10 million yuan. Another example is that for high-tech enterprises that need key support from the state, the enterprise income tax shall be levied at a reduced tax rate of 15%. For the "high-tech enterprises" mentioned in this preferential fiscal and tax policy, the tax law strictly stipulates that they must meet the following six conditions at the same time: (1) have core independent intellectual property rights; (2) the product (service) belongs to the scope stipulated in the "high-tech fields supported by the State"; (3) the proportion of research and development expenses in sales revenue shall not be less than the prescribed proportion; (4) the proportion of the revenue of high-tech products (services) in the total revenue of the enterprise shall not be less than the prescribed proportion; (5) the proportion of scientific research personnel in the total number of employees of the enterprise shall not be less than the prescribed proportion; (6) other conditions stipulated in the measures for the administration of the identification of new and high technology enterprises.

4.2.2 Difficulty in collecting expenses

Research and development expenses are the tax basis of enterprise income tax. If enterprises do not collect research and development expenses in a standardized way, it may make it difficult for enterprises to calculate the deduction of enterprise income tax research and development expenses. Some enterprises, due to less understanding of relevant preferential policies, may mistakenly list an expense that does not belong to the scope of R&D expenses in the collection of R&D expenses, resulting in the deduction of a part of the expense, reducing the tax payable by the enterprise. For example, travel expenses of research and development personnel not caused by research and

development projects do not belong to the category of research and development expenses, and should be excluded and included in research and development expenses. In addition, the financial personnel of some small enterprises still have some misunderstandings about the collection of R&D expenses due to their lack of professional knowledge. In addition, accounting and tax law for the deduction of the standard is not consistent, whether the financial personnel in the enterprise can distinguish correctly and other problems, also caused a certain difficulty to the collection of expenses.

4.3 There are limitations of tax incentives from multiple perspectives

4.3.1 Regional limitations

There are differences in the implementation of fiscal and tax preferential policies in different regions, resulting in an imbalance in the innovative development of energy conservation and emission reduction among regions. China is geographically broad, and the economic development level, industrial structure and environmental pressure of different regions are different. However, there are obvious regional differences in the implementation of the current preferential fiscal and tax policies on innovative technologies for energy conservation and emission reduction. For the developed eastern regions, due to their good economic foundation and strong ability to accept and apply innovative technologies, the corresponding preferential fiscal and tax policies may be larger; In the western underdeveloped regions, despite their urgent demand for energy saving and emission reduction technologies and significant potential benefits, the actual preferential fiscal and tax support may be relatively small. Fiscal and tax incentive policies have a significant positive promoting effect on the green technology innovation of photovoltaic enterprises in eastern and central China, while government subsidies have a negative but not significant effect on the green technology innovation of photovoltaic enterprises in western China. This regional difference leads to the imbalance of energy conservation and emission reduction innovation development among regions, which is not conducive to the overall promotion of energy conservation and emission reduction work nationwide.

4.3.2 Industry limitations

The current preferential tax policies do have obvious industry-oriented characteristics and are more inclined to specific industries such as clean energy manufacturing (such as photovoltaic industry), new energy vehicles, high-tech, photovoltaic, integrated circuits, advanced technology service industries, environmental protection, energy saving and water saving projects, which undoubtedly plays a positive role in promoting green technology innovation in these industries. For example, in the manufacturing photovoltaic industry, tax incentives provided by reducing tax rates, accelerating depreciation, additional deduction of research and development expenses, etc., have strongly stimulated the R&D investment and technological upgrading of enterprises, and promoted the rapid development of the entire industry and the improvement of emission reduction effect. However, this kind of targeted preferential policies in the non-manufacturing field, especially those who also shoulder the responsibility of energy conservation and emission reduction in the coverage of the enterprise is not sufficient. Non-manufacturing photovoltaic enterprises and other industries, such as building energy-saving transformation, industrial process optimization, agricultural water-saving irrigation, waste resource utilization and other fields, although they also play an important role in the overall energy conservation and emission reduction work, but due to the current preferential tax policies to their green technology innovation support is limited or insufficient applicability, Therefore, they fail to give full play to the potential energy saving and emission reduction efficiency of these industries.

4.3.3 Limited scale

At present, many preferential fiscal and tax policies have largely focused on large enterprises and their major energy conservation and emission reduction projects. Such enterprises have significant advantages in resources, technology and market influence. Policy support will help them rapidly expand the application scale of green technology innovation and have a positive impact on energy conservation and emission reduction of the whole society. However, at the same time, the attention and support for small and medium-sized enterprises in the process of policy design and implementation is relatively weak. Due to their small scale and limited capital strength, smes

have great vitality and potential in energy conservation and emission reduction technological innovation. They are not only more flexible in technology research and development and product innovation, but also can play a unique role in market segmentation and solving local environmental problems. However, the existing fiscal and tax preferential policies are not enough to reduce the cost burden of small and medium-sized enterprises in green technology research and development, equipment purchase, demonstration project promotion, etc., and it is difficult to fully mobilize the enthusiasm and initiative of small and medium-sized enterprises to participate in energy conservation and emission reduction innovation.

4.3.4 Limitation of the target

Current preferential tax policies mainly target state-owned enterprises and non-state-owned enterprises and fail to fully consider the needs and development of other innovative entities, such as scientific research institutions and individual innovators. In practice, due to the special status and policy inertia of state-owned business, the implementation of preferential tax policies tends to favor state-owned business, while non-state-owned business is relatively difficult to enjoy the same preferential treatment. However, in terms of the stimulus degree of fiscal and tax policies to stimulate technological innovation, the stimulus effect of non-state-owned enterprises is more significant. In the photovoltaic industry, a typical field of green technology, the study found that the existing fiscal and tax incentive policies did not significantly stimulate the green technology innovation of state-owned enterprises but had a significant positive effect on the green technology innovation of non-state-owned enterprises. The reasons are as follows:

First, the green industry, as an industry highly dependent on knowledge, technology and capital, has a more competitive market environment for non-state-owned enterprises. In this environment, non-state-owned enterprises must rely on strong core competitiveness to survive and develop. Therefore, they are more deeply aware that green technology innovation is the key to enhance the competitive advantage of enterprises and ensure sustainable development, so they are more willing to invest in and actively promote green technology innovation. Secondly, non-state-owned enterprises usually face more serious financing problems, which limits their ability to invest in green technology innovation. The government's fiscal and tax incentive policies have just eased the pressure on non-state-owned enterprises at the capital level, improved their cash flow through subsidies and tax incentives, reduced financial risks in the process of technological innovation, and enabled non-state-owned enterprises to cope with the massive investment required for transformation and upgrading.

Moreover, the signal transmission effect of fiscal and tax incentive policies on non-state-owned enterprises is particularly prominent. Market participants generally believe that non-state-owned enterprises receiving government subsidies mean that they have higher development potential and stronger innovation ability, which not only enhances the confidence of non-state-owned enterprises themselves, but also attracts more attention and support from external investors, thus improving the overall performance of non-state-owned enterprises in green technology innovation.

4.4 *Insufficient support for innovative talents from fiscal and taxation policies*

The lack of preferential policies for innovative talents is a problem worthy of attention in the current fiscal and tax support policies. In the process of promoting the development of innovative technologies for energy conservation and emission reduction, talent is a crucial factor. However, there are still some inadequacies in the current preferential fiscal and tax policies to support innovative talents, which restricts the development and role of innovative talents to a certain extent.

4.4.1 Limitations of the existing preferential policies for talents

At present, China's talent preferential policies in the field of energy conservation and emission reduction innovative technology research and development mainly focus on tax relief and research project funding, etc. These measures have stimulated the innovation vitality of talents to a certain extent. However, these policies also have some limitations, mainly reflected in the following aspects: First, the coverage of the policy is not extensive enough. The current preferential tax policies are mainly aimed at specific high-tech enterprises and scientific research institutions, while there is insufficient support for innovative talents in other fields and industries. Second,

the policies are not attractive enough for high-end talents. Although tax breaks and other measures can reduce the cost of enterprises, for high-end talents, they are more concerned about the benefits of career development, salary and other aspects. Therefore, the government needs to formulate more comprehensive preferential policies for talents to meet the needs of talents at different levels and in different fields. Finally, the role of policies in stimulating the vitality of talent innovation is limited. The current preferential tax policies are more about rewarding the innovation results that have been achieved and lack incentives for the innovation process.

4.4.2 The incentive mechanism design is not perfect

Policy design is the key factor affecting the implementation effect of preferential policies. If the policy design is not reasonable, no matter how much money and resources are invested, the expected effect cannot be achieved. Therefore, policy design needs to fully consider the characteristics and needs of innovative talents to ensure targeted and effective policies. There may be some imprecision in the design of incentive policies for innovative talents. For example, the matching degree between the reward standard and the actual contribution is not high, which cannot effectively stimulate the R&D enthusiasm and innovation potential of individuals or teams. In addition, the lack of differentiated support policies for different levels and types of innovative talents may lead to the loss of some key talents or the failure to give full play to innovation capabilities.

4.4.3 Talent training and introduction mechanisms lag behind

At present, there is a mismatch between China's talent training and introduction mechanism in the field of energy-saving and emission-reduction innovative technologies and fiscal and tax policies. First, there are relatively few preferential fiscal and tax policies for the research and application of energy-saving and emission-reduction technologies, which fail to effectively encourage personnel training and industry-university-research cooperation. Secondly, there is a lack of tax incentives for overseas high-level talents returning to China to engage in research and development and innovation of energy-saving and emission reduction technologies, which restricts the introduction of international advanced technologies to some extent. In addition, the existing fiscal and tax policies are not systematic and synergic in supporting industry-university-research cooperation and promoting technology transformation and personnel training and have failed to form an effective mechanism for personnel training and introduction.

4.4.4 Issues of policy implementation and enforcement

The existing preferential policies for innovative talents may have problems in practical operation such as difficulty in landing and inadequate implementation. For example, complicated approval process and information asymmetry lead to low awareness of the policies, which makes many preferential measures unable to truly benefit innovative talents. At present, the preferential policies for innovative talents may mainly focus on some specific fields or links, without forming a complete support system, and the policies remain in the theoretical stage and cannot be implemented. For example, there may be gaps or deficiencies in support for talent training, research and development funding, and results transformation, which may lead to policy bottlenecks in the process of development of innovative talents.

4.4.5 Insufficient financial support

In the preferential policies for innovative talents, apart from non-material support, such as training and project participation opportunities, financial support is also a crucial part. However, in practice, the problem of insufficient financial support often appears, which mainly stems from the limited financial budget and the uneven distribution of funds. Due to financial budget constraints, the government or enterprises may face a shortage of funds when supporting innovative talents. Limited funds make it difficult to provide all-round support for innovative talents, especially in research and development, project implementation and other aspects that require a lot of capital investment. This not only affects the development of individual innovative talents, but also restricts the innovation activities of the entire industry or region. In addition to budget constraints, the uneven distribution of funds is also an important reason for insufficient financial support. In some cases, funds may be allocated to projects or

individuals that do not have the greatest potential due to the lack of effective evaluation and screening mechanisms. This not only leads to a waste of resources, but may also produce the "Matthew effect", a phenomenon where the strong get stronger and the weak get weaker, further exacerbating the imbalance in financial support.

5. Suggestions on improving fiscal and tax preferential policies to promote technological innovation in energy conservation and emission reduction

5.1 Continue to optimize preferential tax policies and further promote "true innovation" in enterprises

Preferential tax policies can help improve the enthusiasm of enterprises for technological innovation, significantly improve the efficiency of enterprises' innovation output, and help enterprises' substantive innovation. The goal of relevant government departments to formulate and implement preferential tax policies is to stimulate the innovation enthusiasm of enterprises, help enterprises to innovate, and improve the market competitiveness of enterprises. However, many government departments do not find the right direction when formulating tax policies and take the number of enterprises benefiting from tax preferential policies as the assessment target, rarely considering the economic effects generated by tax preferential policies. The government should change its ideology, take whether the enterprise has implemented substantive innovation as the assessment objective, pay attention to the implementation benefits of the policy, and pay attention to the quality inspection of the enterprise's substantive innovation.

The relevant government departments should do a good job of comprehensive research before formulating the relevant system and policy of tax preferential policies. Government departments should strengthen supervision, establish and improve the evaluation mechanism of innovation achievements, assess the innovation benefits of enterprises, and inspect the technological innovation achievements of enterprises. After examining the actual development of domestic enterprises and the effective preferential tax policies identified by foreign enterprises involved in innovation of scientific and technological achievements, the draft shall be put forward to the National People's Congress and approved by the National People's Congress to form special tax laws and regulations. In the laws and regulations, it is necessary to strictly define the conditions, implementation methods, management rules and preferential scope of tax incentives for each manufacturing enterprise, specify the conditions for the identification of enterprise innovation, reasonably define strategic innovation and substantive innovation results, and provide more clear and different tax incentives for the two types of innovation of enterprises. Continue to refine the identification standards for tax incentives, to specific problem specific analysis, according to the different innovation results of enterprises, to give enterprises different tax incentives.

In the process of the implementation of tax laws and regulations, relevant government departments should perform their supervisory functions well, and various departments should supervise each other to ensure that the responsibility goes to the people and the power is locked into the cage of the system. Clearly define strategic innovative enterprises and substantive innovative enterprises, in the process of qualification examination of preferential tax policies, we should pay attention to the results of innovation output, strictly examine and approve the scientific and technological innovation achievements submitted by enterprises, and judge whether they match the national identification standards. Reasonable determination of strategic innovation results and substantive innovation results, for some attempts to use strategic innovation to defraud the state preferential tax subsidies enterprises to be severely cracked down on, ordered to correct; The majority of enterprises should constantly understand the various preferential tax policies issued by the state, pay special attention to the country's definition of substantive innovation results and strategic innovation results standards, and combine their own innovation results, carefully check whether it matches the national identification standards. Enterprises should declare their innovation achievements in strict accordance with the relevant national systems and refuse to use strategic innovation achievements to defraud the state's preferential tax policies.

The government should establish an evaluation system for the effect of fiscal and tax preferential support and conduct dynamic supervision of the special financial funds of enterprises involving tax preferential policies through the Internet, big data and artificial intelligence. In addition, the government will classify the fiscal expenditures involving tax incentives according to regions and industry categories, seek truth from facts,

constantly adjust the direction of tax incentives support, and improve the efficiency of the government's use of fiscal funds involving substantive innovation.

5.2 Lowering the threshold of preferential fiscal and tax policies to solve the problem of expense collection

Although the preferential tax policies are universal, the positive benefits brought by them are minimal for some start-up small and medium-sized technology-based enterprises. Many start-up science and technology enterprises are small in scale at the beginning of their establishment, with fewer patents and little eligibility for tax incentives, and are often rejected by a series of good policies. The development of small and medium-sized technology enterprises in their infancy cannot be separated from financial support. Therefore, the universality of the preferential tax policies is still lacking, and the preferential tax policies are often unitary. Therefore, for small and medium-sized enterprises of science and technology in different industries, specific problems should be analyzed. While grasping the universality of science and technology enterprises, it is not possible to ignore the differences between different industries, grasp its particularity and diversity, and use scientific and flexible tax preferential policies to help the development of enterprises.

In the actual financial business accounting process of many enterprises, because the accounting system implemented by the enterprises is not perfect, at the same time, the financial staff of the enterprises have not established a special "research and development expenditure" project to reasonably collect the research and development expenses of the enterprises, which leads to the phenomenon of incorrect and disorderly recording of research and development expenses. At the same time, enterprises cannot reasonably divide research and development expenses and production and operating expenses, which leads to enterprises to bear more tax risks. Enterprises should constantly improve the system of additional deduction of research and development expenses, carry out feasibility analysis of research and development projects, reasonably define the process and technology of research and development projects, and set up projects that meet the requirements. For R & D expenses accounting to implement the responsibility system, for each project to establish a financial accounting working group, accounting timeliness throughout the whole process of the project, the whole process of follow-up R & D projects, timely statistics of project consumption costs, accurate development of R & D expenses list. At the same time, the enterprise should also establish and improve the research and development expenses related to the system supervision system, in-depth supervision of the implementation of research and development projects of the standard degree, the enterprise should constantly improve the expenditure of research and development expenses, according to the financial accounting system, set up the corresponding accounting accounts for research expenses.

5.3 Increase tax incentives and ease the financing constraints of enterprises

In the current complex international economic situation, the competition between enterprises is becoming increasingly fierce, and enterprises should constantly improve the quality and quantity of innovation to ensure that they can win the first place in the brutal market competition. The technological innovation of enterprises is inseparable from the strong support of the government. A series of preferential tax policies of the government can help enterprises improve their innovation ability and accelerate the research and development of core technologies. By increasing tax incentives, enterprises can solve their financing dilemma and break through financing constraints. Because the current preferential tax policies play a promoting role in easing the financing constraints of enterprises, the following policy suggestions are put forward:

The government should continuously optimize tax reduction and fee reduction policies, reduce the tax burden of enterprises, and help enterprises achieve technological breakthroughs in innovation. China's private enterprises are faced with the problem of fewer tax incentives, private enterprises have tax incentives mainly include goods and labor tax threshold concessions, corporate income tax incentives, etc., and these relatively single policy support can be described as a drop in the water for private enterprises, and the incentive effect for private enterprises is weak. In this regard, the relevant government departments of our country need to increase the preferential tax support for private enterprises and change the relatively single problem of tax incentives. Government departments can adjust the policy of accelerated depreciation of fixed assets of private enterprises, the government can appropriately relax the restrictions on accelerated depreciation of fixed assets, increase the deductible amount of

tax, which can further increase the available funds of enterprises and help enterprises have more funds to invest in production and research and development. All in all, the government needs to use various fiscal methods to help small, medium and micro enterprises solve the financing problem, and continuously reduce taxes and fees to help private enterprises get rid of the shortage of research and development funds. As for state-owned enterprises, they have more sufficient technology research and development funds compared with private enterprises. Therefore, relevant departments of the Chinese government should strengthen the supervision of the use of subsidy funds for state-owned enterprises, reasonably evaluate the project performance of state-owned enterprises, and improve the utilization efficiency of funds.

5.4 Improve the individual income tax policy to encourage innovation of scientific and technological talents

Talents are the source and driving force for enterprises to promote scientific and technological innovation. We should increase support and subsidies for scientific and technological innovation talents, constantly improve the income distribution system related to the transformation of scientific and technological achievements and increase tax incentives for scientific and technological innovation talents. At present, there is a real problem of talent shortage in many fields in China, such as information technology industry, medical and health industry, new energy and environmental protection industry, Internet finance and manufacturing industry. In view of this problem, the government departments should pay more attention to it and solve the problem of talent shortage in various fields.

The government departments should consider the income problem of innovative talents, and constantly adjust and improve the individual income tax policy of talent equity incentive. To retain scientific and technologically innovative talents in enterprises, China can allow high-tech enterprises to implement the policy of tax deferral. Relevant government departments should clearly define the applicable conditions for tax deferral. One of the conditions for tax deferral is the expiration of 5 years from the date when employees hold equity. The enterprise may issue a certain share of the company to the scientific and technological innovation talents as an incentive, and stipulate that the tax time of the share is when the scientific and technological talents transfer the stock, and shall be calculated according to the difference of the stock transfer income less the cost of acquiring the stock, and shall be calculated according to the tax rate of 20% of the property transfer income.

For some industries that are in short supply of talents, the government departments may introduce a series of preferential tax policies. For example, when collecting individual income tax, the innovative talents will be subsidized by the government for the part of individual income tax exceeding 20%; In the process of transforming scientific and technological achievements, the relevant research team of the enterprise can give talents equity rewards in the form of equity distribution, and the equity rewards obtained by scientific and technological talents can be exempted from individual income tax; In the enterprise, if the scientific research talents have outstanding innovation achievements, the company may distribute cash rewards. For the cash rewards obtained by the scientific research talents, the tax department may levy individual income tax at a special rate of 10%.

Through continuous improvement of the individual income tax equity incentive policy, the scientific and technological talents and the company's equity interests are tightly tied together, improve the enthusiasm of scientific and technological innovation talents, help enterprises stabilize talents, obtain the source of innovation, promote the innovation of enterprise products and manufacturing process, help enterprises grow and accelerate the progress and development of society.

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