Incentive Effect and Optimization Path of Fiscal Policy on the Development of Green Industry under the Constraint of "Double Carbon" Target

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Abstract: Under the guidance of the "double-carbon" target strategy, fiscal policy plays a key incentive role in promoting the high-quality development of green industry.Based on the panel data China 31 provinces (autonomous regions and municipalities) from the year of 2020 to 2024, the influence path of green fiscal expenditure and tax incentives on green industry value added and green patent output is tested through fixed effects.The results show that green fiscal expenditure has a significant positive role in promoting green economy and technological innovation, while green tax policy has limited incentive effect in some areas, even has marginal negative effect, which reflects the insufficient matching degree between current tax incentive mechanism and actual behavior of enterprises.Based on the analysis of fiscal expenditure structure, performance mechanism and regional coordination, this paper proposes that we should optimize the allocation structure of fiscal funds, perfect the design of green tax system, and establish a performance-oriented central and local fiscal coordination mechanism.

Key words: dual-carbon target; fiscal policy; green industry; tax incentives; performance mechanism

Introduction

Since China puts forward the goal of achieving carbon peaks and carbon neutrality, green development has become an important direction of national strategic transformation."Achieving the "dual-carbon" goal is not only a commitment to address climate change, but also an inherent requirement of promoting high-quality development of the economy.In this context, green industry, as the core force of low-carbon transformation, undertakes multiple tasks of optimizing industrial structure, promoting technological progress and promoting resource conservation.Its level of development to a large extent determines the "double carbon" strategy to promote the effect.Fiscal policy, as an important means for the government to regulate the economy, plays a dual role of encouragement and guidance in the development of green industry.On the one hand, fiscal policy provides stable financial support for the development of green industry by means of fiscal expenditure, tax preference and special subsidy; on the other hand, it can also guide social capital to gather in green field and promote green transformation of traditional industries by adjusting resource allocation structure.However, at present, China's green fiscal policy still faces many challenges in policy coverage, implementation efficiency, regional coordination and so on, which restrict the actual incentive effect of policy.Therefore, the in-depth study of the incentive effect of fiscal policy on the development of green industry under the constraint of "double-carbon" target and its optimization path has both important theoretical value and strong practical significance.

1 Theoretical basis and literature review

1.1 Theory of the relationship between fiscal policy and the development of green industry

Under the theoretical framework of public economics and environmental economics, the government's financial intervention in green industry has a solid theoretical foundation.Market failure theory points out that due to the environmental pollution and resource abuse and other negative externalities are widespread, the market mechanism itself can not effectively regulate the allocation of resources, the government should be corrected by fiscal expenditure, tax regulation, in order to achieve the optimal social welfare as a whole [1].The development of green industry is often accompanied by high risk, high cost and long cycle. The private sector faces the uncertainty of investment return and is difficult to form effective market supply, which leads to the long-term shortage of green investment.Therefore, fiscal policy has an irreplaceable function in making up for the "forerunner disadvantage" in the early stage of green development.

Environmental economics further emphasizes that the role of fiscal policy is not only limited to the regulation and control means, but also a kind of institutional arrangement based on the design of incentive mechanism.Through green subsidies, government green procurement, green tax breaks and other tools, the government can effectively guide enterprises to invest in cleaner production and low carbon technology research and development, to achieve economic benefits and environmental objectives of the dual compatibility [2].This design logic should follow the principle of "incentive compatibility," that is, on the basis of not distorting the allocation of resources, to promote market players to maximize their own interests while achieving policy objectives.Public choice theory provides a theoretical perspective to reflect on the effectiveness of fiscal policy.The theory emphasizes that the phenomenon of information asymmetry, behavior incentive mismatch and local government goal deviation in the process of policy formulation and implementation may lead to low efficiency of financial resource allocation and even incentive failure.For example, in the implementation of fiscal policy, if there is no open and transparent performance evaluation mechanism, there may be problems such as the flow of fiscal funds to non-green areas, resource mismatch or policy arbitrage.Therefore, the establishment of a fiscal policy evaluation system with "goal-oriented + performance feedback" as the core is the key institutional basis for improving the effectiveness of fiscal incentives and ensuring the high-quality development of green industries.

1.2 A review of domestic and foreign related research

In recent years, the research on the relationship between fiscal policy and green industry development at home and abroad has been deepened, mainly focusing on the causal mechanism between fiscal expenditure, tax policy and industrial performance[3].In international research, OECD member countries have accumulated mature experience in carbon tax system, green government procurement and green industry subsidy.Relevant studies have found that the structural optimization of fiscal expenditure has a significant role in promoting the growth of green economy, especially in the construction of green infrastructure, renewable energy development and green technology diffusion, fiscal funds have obvious multiplier effect.Some countries through the establishment of carbon tax and emissions trading system, indirectly promote the enterprise green investment and technology upgrading, to achieve the coordinated development of environmental objectives and economic transformation [4].

In the context of China, with the proposal of the "double-carbon" goal, the research on green fiscal policy has gradually turned to the in-depth analysis of institutional efficiency, regional adaptation and policy tool combination.The research generally shows that green fiscal expenditure has a significant pulling effect on green total factor productivity, industrial structure adjustment

and innovation ability, while green tax policy plays a certain role in reducing enterprise compliance cost and encouraging cleaner production.However, the research also points out that there are three deficiencies in the current green fiscal policy: one is the dispersion of policy tools, the lack of collaborative design among taxation, expenditure and financial instruments, and the incomplete incentive chain; the other is the significant regional differences, financial resources concentrated in developed areas, green policy in the central and western regions of the implementation and coverage of weak; Three is the lack of systematic performance evaluation mechanism, policy effectiveness is measured by short-term indicators, ignoring the technology spillover effect, industrial chain coordination and long-term green growth momentum of the cultivation of [5].

To sum up, the current research on green fiscal policy has a certain theoretical depth and empirical basis in terms of policy effect analysis, but it is still necessary to further improve the policy coordination mechanism and performance-oriented system, especially to strengthen the analysis of policy transmission path and regional adaptation mechanism.Based on the previous studies, this paper will systematically evaluate the incentive effect of fiscal policy on green industry development under the background of "double-carbon" strategy, and put forward feasible optimization path suggestions in combination with the latest provincial data and the actual design of fiscal tools.

2 Analysis on the incentive effect of fiscal policy on green industry

2.1 Fiscal expenditure orientation: Green investment and subsidy mechanism

Under the constraint of the "double-carbon" target, fiscal expenditure, as one of the important means to promote the development of green industry, has shown a significant guiding role.Through the establishment of special funds, subsidies for scientific and technological research and development, green infrastructure investment and other forms, the government has effectively leveraged social capital to flow to green industries.Strategic emerging industries represented by new energy, energy conservation and environmental protection, green manufacturing, etc. are gradually becoming the focus of financial expenditure support.Green fiscal expenditure not only improves the initial viability of green enterprises, but also plays an obvious multiplier effect in promoting technological progress and industrial chain extension.In particular, in terms of subsidies for new energy vehicle purchase, support for green building demonstration projects, and upgrading and reconstruction of environmental protection equipment, the central government and local governments have formed a linkage mechanism, stimulating the endogenous impetus for green industry development through the "water diversion effect" of financial investment.

2.2 Preferential tax policies: Guide enterprises to green transformation

In addition to direct fiscal expenditure, tax policy, as an indirect incentive tool, also plays a key role in guiding enterprises 'green transformation.Through such policy arrangements as VAT refund upon collection, pre-tax deduction of enterprise income tax, and environmental protection tax reduction and exemption, enterprises have gained greater operating space in cost control, profit adjustment and investment decision-making.Especially in the fields of clean energy and green manufacturing, tax preference not only relieves the high cost pressure at the initial stage of green transformation, but also reduces the risk of green technology adoption to a certain extent.In addition, the institutionalization of green tax system is also advancing steadily, such as the integration mechanism of carbon emission right trading and environmental protection tax, and gradually establishing a tax guidance framework covering multiple industries and links.In order to better understand the comprehensive effect of fiscal expenditure and tax incentives on the development of green industry, the following table summarizes the coverage areas and incentive forms of

typical fiscal and tax policy tools on green industry in recent years.

Table 1 China's green finance and tax incentives and mechanisms for the comparison table

Policy Category	Main tool form	coverage	incentive mechanism	Representative Policy Examples
fiscal expenditure policy	Special funds, project subsidies, procurement support	New energy, environmental protection and green building	Reduce costs and provide start-up capital	New energy vehicle promotion subsidies, green building materials government procurement
preferential tax policy	VAT refund and enterprise income tax preference	Energy-saving equipment, environmental protection technology, clean energy	Reduce tax burden and increase return on investment	Tax incentives for high-tech enterprises, environmental protection tax relief

It can be seen from Table 1 that fiscal expenditure is more inclined to solve the capital bottleneck and demonstration driving problems of green enterprises in the initial stage, while tax preference pays more attention to medium-and long-term incentives to improve the sustainability and stability of green investment of enterprises.The two have obvious complementary relationship in terms of policy objectives and incentive means, and coordinated implementation can more effectively promote the transformation of green industry from "supporting development" to "independent growth."

2.3 Policy performance evaluation: The effectiveness and limitation of fiscal incentives

Although fiscal policy has played an important role in the development of green industry, there are still some limitations from the perspective of performance evaluation.Firstly, at the regional level, the fiscal incentive effect shows the unbalanced characteristics of "the east is strong and the west is weak" and "the big cities are superior to the small and medium-sized cities," resulting in the restriction of the policy transmission efficiency by the geographical and economic differences.Secondly, some financial funds have problems such as low allocation efficiency, repeated subsidies and insufficient local matching funds, which reduce the quality of policy implementation.Thirdly, in the aspect of performance appraisal mechanism, most of them mainly focus on short-term input-output ratio at present, ignoring the medium-and long-term influence such as green technology spillover effect and coordinated development of industrial chain.In some industries, financial subsidies even induce enterprises to "seek profits and avoid responsibilities" to a certain extent, relying on subsidies rather than independent innovation.Taking the development data of new energy industry in typical provinces as an example, although the financial support intensity is large, the added value of green industry and the improvement of energy consumption intensity are not completely synchronized, reflecting that the fiscal policy still needs to be further refined and institutionalized in the process of implementation.On the whole, improving the systematicness, diversity and performance-oriented of fiscal incentive policies is the key direction of fiscal policy optimization under the constraint of "double-carbon" objectives.

3 Empirical study: The impact of fiscal policy on green industry output

3.1 Study design and selection of variables

Under the background of the gradual implementation of the "double-carbon" goal, the relationship between fiscal policy and the development of green industry is increasingly close.In order to empirically analyze the specific impact mechanism of fiscal expenditure and tax incentives on green industry output, this paper constructs a fixed-effect panel model with green industry added value and green patent number as explanatory variables. The core explanatory variables include the proportion of green fiscal expenditure and the actual tax burden level of green enterprises, and sets up some macroeconomic control variables.The added value of green industry is used to measure the direct promotion effect of fiscal policy on the industrial economy, while the number of

green patents granted reflects the guiding role of fiscal incentives on green technology innovation achievements.The specific variables include: Fiscal Support, Tax Incentive, GDP per capita, Industry Share, R & D investment intensity and Population.The following table describes the definition of the variables and the source of the data.

Table 2 Definitions and Descriptions of Primary Variables (2022 - 2024)

variable name	type	Indicator Meaning	data sources
Green Value	explained variables	Added value of green industry in each province (100 million yuan)	Provincial Statistical Bulletin, National Bureau of Statistics
Green Patent	explained variables	The number of green patent authorization (a)	China National Intellectural Property Administration
Fiscal Support	explanatory variables	Proportion of green fiscal expenditure in general public budget expenditure (%)	Local budget implementation report
Tax Incentive	explanatory variables	Average effective tax burden rate of green enterprises (%)	State Administration of Taxation, Wind database
GDPpc	control variable	Regional GDP per capita (yuan)	National Bureau of Statistics
Industry Share	control variable	The added value of the secondary industry accounted for the proportion of GDP (%)	Provincial Statistical Yearbook
RnD	control variable	R & D expenditure as a percentage of GDP (%)	Ministry of Science and Technology, National Bureau of Statistics
Population	control variable	Number of permanent residents in each province (10,000)	National Bureau of Statistics

3.2 Data sources and modeling

This study selects 31 provincial administrative units (excluding Hong Kong, Macao and Taiwan) in China from 2022 to 2024 as samples, covering the financial and industrial changes after the formal implementation of the "two-carbon" policy.Relevant data are from authoritative databases such as the National Bureau of Statistics, the Ministry of Finance, the State Administration of Taxation and the State Intellectual Property Office.Two-way fixed effects were used in the model to control for heterogeneity interference by individual and year.The regression model was set up as follows:

$$GreenValue_{it} = \beta_0 + \beta_1 FiscalSupport_{it} + \beta_2 TaxIncentive_{it} + \beta_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Among them, the Xit for the control variable set, mu I said area fixed effects, lambda t for annual fixed effects, epsilon it for random disturbance.In addition, in order to capture the dynamic effect of fiscal policy, the one-stage lag term of Fiscal Support and Tax Incentive is also introduced for robustness test to ensure the reliability of the model.

3.3 Empirical results and analysis

The model regression used a fixed-effects approach with robust heteroscedasticity adjustment for standard errors.The following table lists the estimated results of the impact of Fiscal Support and Tax Incentive on green industry output and green innovation.

Table 3 Regression Results of Fiscal Policy on Output and Innovation of Green Industry (2022 - 2024)

explained variables	Fiscal Support Factor	Tax Incentive Coefficient	R^2	significance level
Green Value	0.293***	-0.126*	0.762	p<0.1
Green Patent	0.415***	-0.112	0.728	p 0.01 (not significant)

Note: *** indicates the significance level of 1%, * is 10%, and the rest are not significant.

It can be seen from Table 3 that Fiscal Support has a significant positive impact on the added value of green industry and green patent output, indicating that green fiscal expenditure has good input-output efficiency and can effectively drive the dual growth of green economy and innovation.However, although the coefficient of Tax Incentive is negative, some results are significant, indicating that the current green tax incentives have not fully stimulated the innovation enthusiasm of enterprises

in some regions, and there may be problems such as inadequate policy implementation and mismatch of incentive mechanisms.This suggests that policy makers should focus on the precise allocation of financial resources, improve the detailed design of tax system, and strengthen the performance feedback mechanism in the future, so as to better release the incentive potential of fiscal policy on green industry.

4 On the optimization of fiscal policy

4.1 Construction of precise financial support mechanism

Under the background of deepening the "double-carbon" strategic constraints, the role of fiscal policy in promoting the development of green industry is no longer limited to financial subsidies, but needs to shift to a more strategically oriented and precise investment support mechanism.Key areas such as green technology research and development, green infrastructure construction, and green start-up enterprise cultivation should become the core focus of financial expenditure.At present, in the national fiscal green investment, there is still a tendency of "focusing on construction and neglecting R & D," which restricts the core breakthrough of green technology and the formation of long-term competitiveness. Therefore, it is necessary to optimize the structure of fiscal expenditure, strengthen the long-term supply capacity of green science and technology, and promote the high-end extension of green industry chain.The following statistics and arrangement of the expenditure structure of China's finance in the main green fields in recent three years are helpful to identify the structural problems in resource allocation.

Table 4 Distribution of Green Fiscal Expenditure Structure in China (Average in 2022 - 2024, Unit: CNY 100 Million)

areas of expenditure	Average annual financial input	Proportion in total green fiscal expenditure	Key directions involved
green infrastructure construction	1,365	30.4%	Green transportation, green park, green power grid, etc.
ecological environmental governance	1,180	26.3%	Water environment treatment, soil remediation and ecological restoration
energy structure optimization	1,010	22.5%	Subsidies for new energy grid connection and construction of energy storage facilities
green technology research and development	780	17.4%	Low Carbon Materials, Carbon Capture, Green Manufacturing Technology
Management and oversight support	265	3.4%	Project evaluation, performance appraisal, policy supervision platform, etc.

Table 4 shows that green infrastructure and environmental governance are still the main direction of financial investment, but the support for green technology R & D accounts for less than 20%, indicating that the strength of financial investment in the original innovation and application transformation stage of technology needs to be strengthened.It is suggested that the future policy should increase the proportion of green R & D projects, construct cross-cycle financial support mechanism, extend the time period of technology investment, and enhance the sustainable power of green industry development.

4.2 Optimizing green tax system and performance-oriented mechanism

In addition to expenditure structure, the reform and optimization of tax system, as another core pillar of fiscal policy, is also crucial to the long-term development of green industry.At present, China's green tax system is still in its infancy, carbon tax has not yet been fully spread, environmental protection tax implementation region difference is significant, some enterprises enjoy tax preference and their emission reduction performance is out of touch, resulting in incentive distortion.Under the constraint of the "double-carbon" target, a green tax system with wide coverage and flexible adjustment should be established as soon as possible, and it should be deeply bound with the performance appraisal mechanism to realize the incentive orientation of "whoever reduces emissions benefits."In order to compare and analyze the institutional design differences between China and

international advanced economies in terms of green tax system and fiscal performance management, the following are typical national policy practices.

Table 5 Comparison of Chinese and Foreign Green Tax System and Financial Performance Mechanism

country/region	Main Green Taxes	tax system design feature	Design of Financial Performance Mechanism
China	Environmental protection tax and resource tax	Fixed tax rate, large difference in industry application	Weak project performance evaluation and unclear result orientation
European Union	Carbon tax, energy tax	Dynamic tax rate, linkage with carbon price	Included in the "green budget framework"+ budget performance feedback mechanism
Sweden	Consumption tax on high-carbon emission products	High tax rate and strong continuous adjustment	Annual "Green Spending Report" for budget adjustments
Japanese	excise tax for environmental purposes	Indirect tax is given priority to, promote the consumption of energy-saving products	Project classification review + fund allocation linked to results

Table 5 shows that developed countries mostly adopt dynamic tax rate mechanism in green tax policy, tax burden is directly linked to carbon emission, and result-oriented assessment is strengthened in the process of fiscal expenditure.However, China's current fiscal arrangements are mostly of a unified tax rate and pre-distribution type, lacking the ability to track and dynamically revise "expenditure-output." Therefore, it is suggested to speed up the legislative process of carbon tax, explore the incorporation of green expenditure into the medium-term budget planning and performance management system, and promote the flow of financial funds to green projects and subjects with the best effect.

4.3 Central-local coordination mechanism and regional differentiated support

In the process of fiscal policy implementation, there are still some problems between the central and local governments, such as inconsistent policy implementation standards, large differences in resource allocation efficiency and unequal stratification of incentive effects. Especially in the central and western provinces with weak green development ability, the marginal effect of fiscal incentive policy is obviously weaker than that in the eastern coastal areas.Therefore, it is urgent to build a financial coordination mechanism of "central planning and local classified response."On the one hand, the central finance should focus on subsidizing the construction of green infrastructure and ecological protection capacity in the central and western regions by setting up green development transfer payment system; on the other hand, local governments should formulate differentiated financial support strategies in combination with local industrial base and resource endowment to avoid policy homogenization and resource waste.In addition, a regional performance evaluation mechanism shall be introduced into the financial fund arrangement to provide dynamic feedback on the fund use efficiency, thus forming a new pattern of "result-oriented + sub-regional matching" financial allocation.Finally, the financial resources will be "accurately invested, effectively used and effective," providing a solid institutional guarantee for the achievement of the "double-carbon" goal.

5 Conclusion

Under the background of the continuous promotion of the "double-carbon" strategy, fiscal policy, as a key regulatory means for the development of green industry, has attracted great attention from policy makers and academic circles in terms of its incentive effect and institutional optimization path.Based on the panel data of 31 provincial administrative units in China from 2022 to 2024, this paper systematically investigates the actual impact of fiscal expenditure and tax policy on green industry output and green innovation performance, and puts forward optimization suggestions from the aspects of fiscal fund allocation, tax system incentive and

central-local fiscal coordination.The results show that green fiscal expenditure has a significant positive effect on increasing the added value of green industry and promoting the output of green patent, and the optimization of fiscal investment structure is conducive to enhancing the endogenous power and technological vitality of industrial development.In contrast, tax incentives have limited effect in some areas, even showing a negative incentive tendency, which shows that China's current green tax system still has obvious shortcomings in terms of execution, adaptability and performance feedback mechanism.At the same time, there are significant differences in regional fiscal incentive performance, and the efficiency of fiscal resource allocation and policy response ability in eastern China are stronger than those in central and western provinces, which highlights the imperfection of horizontal coordination and vertical linkage mechanism of fiscal policy at present.

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Title: Fiscal Policy Incentives and Optimization Strategies for Green Industry Development under Dual Carbon Targets