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Research on the Carbon Emission Reduction Effect of Green Taxation under China's Fiscal Decentralization

Wei Dong [1], Xiaomi Hou [1] and Guowei Qin [2,*]

[1] School of Economics, Anhui University, Hefei 230093, China
[2] Anhui Forestry Bureau, Hefei 340000, China
* Correspondence: ahqinguowei@163.com; Tel.: +86-15156053795

Abstract: Using the spatial Durbin model, this study investigates, systematically, the link between green taxes and carbon emissions and the influence of green taxation on carbon emissions under fiscal decentralization in the context of the shift in performance evaluation of the local government. The results demonstrate a positive correlation at different stages of the performance appraisal. Fiscal expenditure has dual effects on carbon emissions at different stages of environmental assessments. It additionally strengthens the positive effects of green taxation on carbon emissions, with improvements in economic development. Further analysis demonstrates an interaction between fiscal decentralization and environmental taxes and fees, effectively reducing carbon emissions. The interaction between fiscal decentralization and other green taxes, except the environmental bonded tax, has no significant impact on emissions. This study finally proposes a series of policy recommendations to reduce carbon dioxide from the perspective of reasonable green tax formulation and fiscal decentralization. These include: increasing environmental taxes, modifying present resource and environmental protection taxes, adopting new environmental taxes gradually, enhancing the current tax system, and enhancing the "greening" of tax income. In addition, this study proposes reforms to the performance evaluation method within the present fiscal decentralization framework.

Keywords: green tax system; fiscal decentralization; carbon emission space; Durbin model

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1. Introduction

Facing the aggravation of the global climate problem, the need to mitigate climate change and reduce carbon dioxide emissions has increased globally [1]. Reducing carbon emissions and achieving green development have become the goal of global consensus. It is, therefore, vital to expand the methods, mechanisms, and policies of carbon emission reduction. The central government has been increasing its efforts to assess the local environment in the context of emphasizing high-quality economic development. Green taxation, as one of the government's means to protect the environment, can effectively control pollution emissions and regulate the mode of economic development. Fiscal decentralization, as an important part of China's economic system reform, is an important system to ensure sustained and rapid economic development. Therefore, exploring changes in Chinese-style fiscal decentralization is critical to assessing the impact of green taxes on CO_2 emissions. How to formulate an appropriate green tax system according to the current situation of China-style fiscal decentralization, while taking into account the growth of economic benefits and environmental performance, these environmental issues have brought new challenges to China's development.

There is a great deal of debate about whether the implementation of green taxes will benefit the improvement of environmental pollution. Lawton (2016) introduced the theory of green taxation into the practice of carbon emission reform, arguing that taxation can promote carbon emission reform [2]. Cui Yafei and Huang Shaoan (2019) constructed the index of green sensitivity, classifying the degree of greening of the tax system into four quadrants—dark gray-green, light gray-green, light green, and dark green—which increases the green incentive impact of the related environmental tax. According to an empirical examination, the degree of greening of China's taxation system is low, only occurring in the light gray-green area of the first quadrant, and the environmental protection effect is weak [3]. Zheng Guohong (2017) developed a Real Business Cycle (RBC) model, utilizing goods tax, carbon tax, and other taxes to explore the green effect of various taxes. The findings indicate that taxes influence carbon emissions by influencing the allocation of labor and capital, while the carbon tax rate has a direct impact on energy savings and emission reduction in enterprise production and activities [4]. Fan Dan (2018) pointed out that environmental taxes and fees have double dividends, playing a strong role in promoting the improvement of green technological innovation while reducing pollution. Environmental regulations that are sensible and stringent can encourage technological advancement and have positive effects on the economy and the environment [5]. Fu Sha and Wang Jun (2018) examined the economic growth situation of 30 provinces in China from 2001 to 2015 and presented narrow and wide indicators of the "green tax system". The results revealed a U-shaped association between the severity of the environmental tax and China's carbon dioxide emissions [6]. Some scholars have studied the effect of a green tax on carbon emissions in different ways. For example, Zhou Di (2021) integrated green tax, industrial structure, and carbon emissions into a unified research framework. The green tax has a threshold effect between industrial structure and carbon emissions [7]. Zhang Hua (2014) presented a "U-inverted" curve to represent the direct relationship between environmental legislation and carbon emissions. In the transition from weak to robust environmental regulation, the effect changes from "green paradox" to "forced emission reduction" [8]. Previous research on the effects of fiscal decentralization on environmental deterioration has been based on different research perspectives or different statistical indicators of fiscal decentralization, with the conclusions drawn by scholars also being diversified. Most researchers believe that fiscal decentralization will lead to increased environmental pollution. The traditional environmental federalism school, represented by Oates (2002) [9], believes that the decentralized regulatory environment will produce the phenomenon of "competition to the end" under the system of fiscal decentralization. To retain promising enterprises, local governments will usually relax environmental regulatory standards and plan for enterprises that discharge pollutants, resulting in the further deterioration of environmental quality. Domestic scholars, such as Li Yanhong (2020) [10], believe that enhancing the fiscal sovereignty of local governments is not beneficial to lowering carbon emissions. As a result of the domestic fiscal decentralization system and the mechanism for promoting government officials, local governments sacrifice public goods with positive environmental externalities to support the development of high-carbon industries with higher economic benefits when the degree of local fiscal autonomy increases. Tan Zhixiong and Zhang Yangyang (2015) [11] found a substantial negative association between fiscal decentralization and environmental pollutant emissions using the input-output model. Current research on the influence of green tax income on our carbon emissions is fairly limited from the standpoint of fiscal decentralization; the majority of the study depends on government action. Zhang Pingping (2018) [12] emphasized that, under the framework of China's fiscal decentralization system, the fundamental effect of fiscal decentralization on pollutants is contingent on whether local governments can continue to safeguard the environment, which supplements the existing research on fiscal decentralization and pollution emissions. To sum up, most scholars, at home and abroad, hold a positive attitude toward the role of the green tax in pollution reduction and agree with the necessity of levying the green tax. Numerous empirical studies on the environmental effect of green taxes have been done by scholars. Some empirical results demonstrate that green taxes do indeed play a role in pollution reduction [13,14].

However, some investigations show that the environmental protection tax's influence on decreasing environmental pollution is insignificant and has not achieved the desired results, and that its impact on reducing emissions needs to be further studied [15]. The majority of the discussion about green taxes and carbon emissions has focused on environmental regulation or government competition, as well as the medium through which green taxes affect carbon emissions [16]. However, there are few studies on the impact of green taxes on the fiscal decentralization of carbon emissions, and there is a lack of a comprehensive overview of the relationship between fiscal decentralization, green taxes, and carbon emission governance, as well as the joint impact of green taxes and fiscal decentralization on carbon emission reduction. In addition, the definition of "green taxes" has been very controversial, and this paper redefines "green taxes" according to the specificity of the research object of carbon emissions. The paper's potential marginal contributions may be explained as follows:

The taxation system is a manifestation of fiscal decentralization, particularly in China's current political context. Since carbon emissions are closely related to government regulation, most previous studies on green taxation and carbon emissions have explored the impact on carbon emissions of different kinds of green taxation from the perspective of environmental regulation or government competition, and very little literature has explored the relationship between green taxation and carbon emissions from the perspective of fiscal decentralization, in which the moderating role of fiscal decentralization, in this regard, deserves attention. In this paper, we try to investigate whether central government fiscal decentralization has an interactive relationship with green taxation of carbon emissions. Therefore, based on theories such as "double dividend", "green paradox", and "mandatory emission reduction", this study uses the spatial Durbin model to investigate the interference of the level of economic development on the deviation of local governments from environmental protection, to reveal the interaction between fiscal decentralization and green taxation on carbon emissions, and to propose innovative countermeasures to reduce carbon emissions, in combination with empirical analysis. Most of the existing studies on the impact of taxation on carbon emissions start with a single environmental protection tax, a carbon tax, or the whole green taxation system [17]. This paper is based on the existing green taxes related to carbon emissions. The eight green taxes are divided into two categories, according to the way they directly or indirectly affect carbon emissions, and the effects of the two types of green taxes on carbon emissions are discussed separately. The quantitative arguments are enhanced based on the large amount of data obtained.

The rest of the paper is structured as follows: Section 2 presents the theoretical analysis and research hypotheses. Section 3 develops the model and describes the variables, and Section 4 presents the research methodology and findings. Section 5 provides a discussion and outlook for the study results. Section 6 provides conclusions and future policy recommendations.

2. Theoretical Analysis and Research Hypothesis

2.1. The Impact of Tax System Greening on Carbon Emissions

A green tax is indispensable for supporting carbon emission reduction in enterprises and achieving environmental goals. Based on the externality theory, Pigou (1877), a British economist, proposed to internalize external costs through taxation or subsidies to reduce pollution emissions [18]. According to Porter's hypothesis, environmental protection policies will promote enterprises to carry out technological innovation or adopt innovative technologies, which can not only restrain the total amount of emissions, but also improve the motivation of enterprises to independently reduce emissions. Through the collection of taxes and fees on sewage, waste gas, and solid waste discharged by sewage enterprises through green taxation, the "negative external cost" is internalized, and pollutant discharge is limited. This is because the environment is a public product, and the private marginal cost is less than the social marginal cost when enterprises discharge pollutants, resulting in more serious pollution. Through the "internalization of negative external costs", the private marginal cost is equal to, or greater than, the social marginal cost, which restricts the emission behavior of enterprises. However, the green tax does not always reduce carbon emissions. If the tax burden is too heavy, it will affect the enthusiasm of enterprises and negatively affect production and operation capacity. This may ultimately lead to enterprises having to struggle for survival and being unable to carry out green technology innovation [19]. In addition, Krass et al. (2013) analyzed the technology options of carbon tax regulations to reduce carbon emissions and found that extremely high carbon tax rates may have a negative impact on the adoption of green technologies. They further demonstrated that lower carbon taxes could motivate manufacturers to adopt green products [20]. Carbon emissions cannot be curbed, suggesting that green taxes need to be modest; otherwise, the loss outweighs the gain. It may be observed that a green tax is an additional burden in the process of production and operation of enterprises—it is too low to reduce the carbon emission effect and too high to dampen the enthusiasm of enterprises.

Hypothesis 1. *The increase in the greening degree of the tax system has an inhibitory effect on carbon emissions.*

2.2. The Impact of Fiscal Decentralization on Carbon Emissions

The government's preference for environmental pollution governance is the key to determining whether fiscal decentralization can play a role in carbon emission pollution governance. However, the government's preference for environmental governance is subjective and affected by the central government's performance appraisal at all stages. Governments may make different choices when it comes to balancing the interests of economic growth with environmental protection [21]. Following the 1994 tax allocation system reform, the local fiscal authority and the administrative authority are now separated. The effect of the tax allocation system is to enhance the state's financial capacity. However, it also results in an imbalance between local financial and administrative authorities. The incentives and restrictions imposed by the federal government on local authorities have a considerable effect on the management of the environment, causing dislocation in the choice of economic development and environmental protection, making it easy for local governments to ignore regional comparative advantages and sustainable development, and blindly encourage and develop the second industry [22] that can produce a star effect. On the other hand, to attract new businesses and provide employment possibilities, local authorities will loosen environmental laws, resulting in a "race to the bottom" that ultimately leads to excessive deterioration of the environment [23].

The central government requires local governments to set corresponding carbon emission targets, and continuously increases the "carbon assessment" and environmental accountability to local governments, which makes local governments pay more attention to regional carbon emission problems and increase the intensity of environmental regulation [24,25], forcing enterprises with substandard carbon emissions and high treatment costs to move outside their jurisdictions. Fiscal policies, such as fiscal transfer payments and green purchasing by the government, encourage local governments to take an active role in governing the environment, and also encourage businesses to make products that are better for the environment. Through preferential tax policies, enterprises can reduce production costs, enhance their competitiveness, optimize the distribution and use of environmental production factors, improve the utilization rate, and encourage measures to improve ecological quality. Yet, the government's preference for environmental governance will be affected by the structure and level of local economic development, no matter what stage the environmental assessment is at. When local fiscal revenues are insufficient to support a series of local environmental governance and development strategies for emerging industries, local governments must finance the increased expenditure. Considering that the local government cannot decide on the size of the central transfer payment, there are two primary financing channels: one is to attract capital inflows and expand the tax base, thereby prompting local governments to reduce environmental governance standards; the other is to issue government bonds, where the accumulation of local government debt will further encourage seeking rapid economic growth and stimulate carbon dioxide emissions, and local governments will further reduce spending on tackling carbon emissions.

Hypothesis 2. *Improving fiscal decentralization does not help to curb carbon dioxide emissions. However, the improvement in decentralization of fiscal power will curb carbon emissions after the "one-vote veto system" of environmental assessment is included in the assessment criteria of local governments.*

Hypothesis 3. *The negative effect of decentralization of fiscal power on carbon dioxide emissions will be weakened with economic improvement.*

2.3. The Impact of Green Taxation on Carbon Emissions under Fiscal Decentralization

In the present scenario, in which the gap between local fiscal revenues and expenditures produced by the tax-sharing system and fiscal pressure is growing, the steady expansion of fiscal revenue decentralization would strengthen the autonomy of local government revenues. Local governments are more inclined to cultivate more tax sources, such as VAT (Value-added tax) and enterprise income tax, which are divided into their budgets. In terms of green taxation (generally a central tax or only a small portion of this revenue owned by local governments, such as consumption tax in the current tax system), little attention will be paid to tax source cultivation. The restrictive effect of these green taxes on environmental pollution is thereby affected. The improvement of fiscal revenue decentralization will, therefore, render a medium caliber green tax unable to play the role of reducing carbon.

In addition, in the case of a high degree of fiscal decentralization, the central government's financial resources will not be able to continuously maintain the balance of fiscal expenditure structure in all regions. Additionally, it cannot cover the expenditures and subsidies of all regions of environmental conservation. Due to the pressure of environmental protection, the central government will, therefore, delegate the responsibility of environmental protection to local governments. This will urge local governments to adjust their financial expenditure structure and strengthen environmental control accordingly, raise the standard of environmental protection tax collection for sewage enterprises, and increase the share of fiscal funds paid to environmental protection, while reducing the proportion allocated to economic construction.

Hypothesis 4. *In a situation of constant fiscal spending, the greater the degree of fiscal decentralization, the greater the carbon emission-inhibiting effect of a small-bore green tax.*

3. Model Design and Variable Explanation

3.1. Model Design

Carbon emissions have a strong spatial correlation and negative externality. The spatial correlation is caused by two mechanisms—the spillover effect, and the externality of local areas. Both are prevalent regional variables [26]. Carbon emission is not only influenced by local variables, but also by the surrounding environment; a generic static regression cannot accurately describe its spatial feature; therefore, the spatial Durbin model, with high universality, is selected for this work. The spatial Durbin model (SDM) is capable of obtaining unbiased estimates and resolving the endogenous issue of variables [27]. This study adopts the spatial Durbin model to construct the subsequent model:

$$\begin{aligned}\ln pce_{i,t} = \alpha_i + \rho w \ln pce_{i,t} + \beta_0 agtc_{i,t} + \beta_1 fdsz_{i,t} + \beta_2 fdsz^2{}_{i,t} + \beta_3 wagtc_{i,t} \\ + \beta_4 wfdsz^2{}_{i,t} + \beta_5 wfdsz^2{}_{i,t} + \beta_6 wx_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t}\end{aligned} \quad (1)$$

$$\begin{aligned}\ln pce_{i,t} = \alpha_i + \rho w \ln pce_{i,t} + \beta_0 bgtc_{i,t} + \beta_1 fdsz_{i,t} + \beta_2 fdsz^2{}_{i,t} + \beta_3 wbgtc_{i,t} \\ + \beta_4 wfdsz^2{}_{i,t} + \beta_5 wfdsz^2{}_{i,t} + \beta_6 wx_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t}\end{aligned} \quad (2)$$

In the theoretical analysis, fiscal flexibility may impact the effect of a green tax on carbon dioxide reduction. Using carbon dioxide emissions as the explained variable, and keeping narrow and medium green taxation as the explanatory variable, the interaction between fiscal decentralization and green taxation is introduced to verify the correctness of the hypothesis. The model is constructed as follows:

$$\begin{aligned} \ln pce_{i,t} = \alpha_i + \rho w \ln pce_{i,t} + \beta_0 agtc_{i,t} + \beta_1 fdsz_{i,t} + \beta_2 fdsz^2{}_{i,t} + \beta_3 wagtc_{i,t} \\ + \beta_4 wfdsz_{i,t} + \beta_5 wfdsz^2{}_{i,t} + \beta_6 agtc_{i,t} \times fdsz_{i,t} \\ + \beta_7 wagtc_{i,t} \times fdsz_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \end{aligned} \quad (3)$$

$$\begin{aligned} \ln pce_{i,t} = \alpha_i + \rho w \ln pce_{i,t} + \beta_0 bgtc_{i,t} + \beta_1 fdsz_{i,t} + \beta_2 fdsz^2{}_{i,t} + \beta_3 wbgtc_{i,t} \\ + \beta_4 wfdsz_{i,t} + \beta_5 wfdsz^2{}_{i,t} + \beta_6 bgtc_{i,t} \times fdsz_{i,t} \\ + \beta_7 wbgtc_{i,t} \times fdsz_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \end{aligned} \quad (4)$$

$$\begin{aligned} \ln pce_{i,t} = \mathrm{K}_i + \delta w \ln pce_{i,t} + \lambda_0 pgdp_{i,t} + \lambda_1 fdsz_{i,t} + \lambda_2 wpgdp_{i,t} \\ + \lambda_3 wfdsz_{i,t} + \lambda_4 pgdp_{i,t} \times fdsz_{i,t} + \lambda_5 wpgdp_{i,t} \times fdsz_{i,t} \\ + \lambda_6 wx_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \end{aligned} \quad (5)$$

where i and t refer to the ith province (city, autonomous region) and year t, respectively; $\ln pce_{i,t}$ represents the logarithm of carbon emissions per capita, $agtc_{i,t}$ and $bgtc_{i,t}$ represent the greening degree of medium caliber and small caliber tax systems, respectively, and represent the interaction term between per capita Gross Domestic Product and fiscal decentralization; $\rho, \delta, \beta, \lambda$ are the regression coefficients to be estimated; μ_i and φ_t represent the residual term for the space-specific and the time-specific effect, respectively; $\varepsilon_{i,t}$ is a general term for control variables.

3.2. Characterization of Variables

3.2.1. Explained Variables

Carbon emissions per capita (Inpce) use measurements provided by the 2006 IPCC (Intergovernmental Panel on Climate Change) guidelines. Using the IPCC-recommended energy-to-standard coal coefficient [28] and the final consumption statistics of each province from the statistical yearbook [29], this is translated into the carbon dioxide emissions of each province, which are then computed logarithmically. In this paper, eight types of fuels (*the eight fuels are coal, coke, crude oil, gasoline, kerosene, diesel, fuel oil, and natural gas*) are selected to measure the carbon emissions of each province. $\mathtt{C}_{it} = \sum_{j=1}^{n} \gamma_{i,t} E_{ijt} U_j$, where $\mathtt{C}_{it}$ represents the province i's carbon emissions in year t. $\gamma_{i,t}$ is the standard coal coefficient that has been discounted for the jth energy source, E_{ijt} represents the quantity of the jth energy source that province i consumed in year t, and U_j is the emission coefficient of the jth energy source.

3.2.2. Core Explanatory Variables

Tax system greenness (gtc): Referring to Zhu Zunhong and Huang Shasha (2018) [30], small-bore green taxation (bgtc) = $(\sum_{n=1}^{8} btax_{i,t}) /\ tax_{i,t}$, where $\sum_{n=1}^{8} btax_{i,t}$ denotes the sum of environmental protection tax (emission fee) in province t in the year i. Considering no environmental protection tax was introduced before 2018, the emission fee with greenness is used instead. The green tax policy, in a narrow sense, is only aimed at curbing environmental pollution, and taxes the emission of pollutants by enterprises and individuals. It plays a role in curbing environmental pollution by taxing emissions or gases with polluting nature. Green tax policy is the tax that has the strongest function to improve environmental protection, directly reducing environmental pollution by imposing penalties on polluting behaviors.

Green taxation in the medium sense (agtc) = $(\sum_{n=1}^{8} atax_{i,t}) /\ tax_{i,t}$, where $\sum_{n=1}^{8} atax_{i,t}$, indicates the total revenue of eight taxes with greening nature in province t in the year i. The "green tax" in the middle sense is based on the "green tax" in the narrow sense, i.e., the environmental protection tax, and other environmental protection-related levies and resource conservation, are also included. In China, this is represented by the resource tax, vehicle tax, urban maintenance tax, construction tax, urban land use tax, vehicle purchase tax, arable land occupation tax, and consumption tax. A consumption tax [31] is imposed on the manufacture of carbon-emitting fuel, as well as small cars, motorcycles, and refined oil products. Recycled oil products, such as waste mineral oil, are exempt from consumption tax benefits. A resource tax [32] is levied on fossil fuels that produce greenhouse gases, such as crude oil, natural gas, and coal. The implementation of a vehicle purchase tax encourages residents to purchase new energy vehicles and reduces the consumption of fuel vehicles. Similar to the car purchase tax, the vehicle and watercraft tax is halved for fuel-efficient automobiles and boats. Those employing new energy are exempt from this tax. The consumption tax collection strategy, the vehicle purchase tax, and the vehicle and boat tax are all favorable to influencing the behavior of producers and consumers towards energy conservation and emission reduction. The urban maintenance and construction tax is primarily used to improve environmental quality and maintain basic public facilities for centralized heating and a clean fuel supply.

Carbon emissions resulting from building energy use have gradually become the main source of carbon emissions from construction land [33].

To limit carbon emissions from harmful construction processes, an urban land usage tax and an arable land occupation tax are imposed on building land. In contrast, a "green tax" in the broad sense includes all tax and fee policy tools that can improve the environment and protect resources, such as penalties and tax concessions, to prevent polluting behaviors [34], similar to China's corporate income tax and VAT to encourage enterprises to invest in products and services for comprehensive resource utilization, energy conservation, and environmental protection. However, these taxes are paid primarily in the form of corresponding tax incentives, which cannot be measured precisely in terms of tax revenue. Green taxes of small and medium caliber are selected for the study considering the availability of data; $tax_{i,t}$ refers to the entire amount of local taxes collected by the local tax department of province t in year i. Local taxation departments collect business tax, enterprise income tax, individual income tax, resource tax, urban maintenance and construction tax, property tax, stamp duty, urban land use tax, land value-added tax, vehicle and vessel tax, vehicle purchase tax, customs duty, land occupation tax, deed tax, and tobacco tax.

3.2.3. Moderating Variables

Fiscal decentralization (fdsz): Fiscal decentralization is the capacity of local governments to autonomously allocate financial resources. Academics often use the ratio of central to local revenues and expenditures to quantify fiscal decentralization, since the degree of decentralization correlates with the degree of financial autonomy of local governments. Chen Shuo and Gao Lin (2012) [35] believe that, when the data structure is panel data, the financial autonomy index should be prioritized, due to regional differences. Therefore, this paper adopts the ratio of regional budget fiscal revenue to regional budget fiscal expenditure to measure financial flexibility.

3.2.4. Control Variables

GDP per capita (pgdp): This examines the degree of influence of economic growth on carbon emissions.

Foreign direct investment (infdi): This study uses the annual average RMB to USD exchange rate to calculate the logarithm of foreign direct investment.

R&D investment (rd) is calculated by dividing internal research expenditures and experimental development funds by GDP. The greater an enterprise's R&D investment, the lower its pollution emissions.

Urbanization rate (ul): Accelerating urbanization results in a rise in urban population, which has an effect on carbon emissions. In this study, the rate of urbanization was used to figure out how much of each province's total population lived in cities.

Capital (Incap): Utilizing the perpetual inventory approach, capital stock data is calculated as follows: $cap_{i,t} = I_{i,t} + (1 - \sigma_{i,t})cap_{i,t-1}$, where I and σ are the present-value investment volume and the capital depreciation rate, respectively, expressed as the logarithm [36,37].

Labor (Inlab): The logarithm is used to indicate the quantity of employment at the conclusion of each year in each region.

Table 1 below shows the descriptive statistics of all variables.

Table 1. Statistical descriptions of primary variables.

	Variable	N	Mean	p50	sd	Min	Max
Carbon emissions per capita takes logarithm	Inpce	420	9.945	7.518	6.941	2.288	43.601
Medium-caliber green tax	agtc	420	0.743	0.400	0.847	0.027	4.560
Small-bore green taxation	bgtc	420	0.007	0.004	0.008	0.000	0.067
Fiscal decentralization	fdsz	420	0.508	0.454	0.195	0.148	0.951
GDP per capita	pgdp	420	2.880	2.420	1.709	0.510	10.660
Foreign direct investment takes logarithm	infdi	420	5.293	5.615	1.648	1.220	7.722
R&D investment	rd	420	0.015	0.012	0.011	0.002	0.063
Urbanization rate	u1	420	0.551	0.533	0.138	0.275	0.896
Capital takes logarithm	Incap	420	10.372	10.475	0.950	7.659	12.340
Labor takes logarithm	Inlab	420	7.617	7.637	0.797	5.684	8.875

Table Source: based on data generated by stata16.0.

3.2.5. Construction of Spatial Weight Matrix

In terms of matrix selection, most of the spatial weights used in the literature are selected from three matrixes—the geographic proximity matrix, the geographic distance matrix, and the economic matrix. It was found through the empirical study that the economic matrix is not suitable for this study, i.e., the economic matrix is not significant when measured using the economic matrix in the empirical evidence of spatial correlation. The first two weight matrices were, therefore, selected for this study.

(1) Geographic adjacency weight matrix (W_1). A neighboring spatial weight matrix of 30 provinces (considering the desirability and coherence of the data, excluding Tibet, Hong Kong, Macao, and Taiwan) was constructed, where W_{ij} is 1 if each province is neighboring, and W_{ij} is 0 if each province is not neighboring.

$$W_{ij}\begin{cases} 1, & \text{Region } i \text{ is adjacent to region } j \\ 0, & \text{Region } i \text{ is not adjacent to region } j \end{cases} \tag{6}$$

(2) Geographic distance weight matrix (W_2). For the systematic analysis of carbon emissions, this paper also constructed the geographic distance matrix in addition to the geographic proximity matrix. The W_{ij} element in the geographic distance matrix was calculated based on the real geographic location, where this matrix is more rigorous compared with the proximity matrix. Here, d is considered as 1 or 2.

$$W_{ij} = \exp\left(-\gamma d_{ij}\right) \tag{7}$$

$$W_{ij} = \begin{cases} \frac{1}{d_{ij}}, & i \neq j \\ 0, & i = j \end{cases} \tag{8}$$

(3) Data description

Taking into account the availability of data, panel data for 30 provincial-level areas in China (excluding Hong Kong, Macau, Taiwan, the South China Sea islands, and Tibet) from 2006 to 2020 were selected. All the variables were logarithmized to eliminate heteroskedasticity among variables, while the indicators that include price factors were adjusted to constant prices with 2006 as the base period.

4. Empirical Study

4.1. Spatial Correlation Analysis

Before conducting an empirical analysis, it is important to confirm the geographical connection of carbon emissions. The Moran index of carbon emissions is displayed in Table 2, according to the regional adjacency weight matrix. Under the geographical adjacency weight matrix, the Moran index was found to be larger than 0 and satisfied the 1% significance test, indicating that carbon emissions are spatially correlated and should be analyzed using a spatial econometric model. The adjacency matrix was selected to apply ArcMap 10.8 (excluding Tibet, Hong Kong, Macao, Taiwan, the South China Sea islands, and other regions) to draw the local indicators of spatial autocorrelation (LISA) agglomeration map for 2006 and 2019, as presented in Figures 1 and 2.

Overall, the carbon emissions of China were found to be significant in terms of positive spatial correlation. The low-low-type carbon emission areas were primarily concentrated in regions such as East China and South China, and the high-high-type carbon emission areas were concentrated in North China, such as Shanxi and Hebei Province, and Northeast China, such as Heilongjiang and Liaoning Province. From the data, it may be observed that Beijing, Shanghai, and Jiangsu Province exhibited high-high type emissions in 2019, which have now transformed into low-high type carbon emissions. Inner Mongolia, Ningxia, Shanxi Province, and Liaoning Province have exhibited high levels of carbon emissions. Considering these provinces rely on traditional energy industries, it is difficult to improve the environment and achieve green economic development at this stage. These provinces need to focus on emission reduction without impacting the surrounding provinces.

Table 2. Carbon Emissions Moran's I and Geary's C Index, 2006–2019.

Matrix	W1				W2			
Year	Moran's I	*p*-Value *	Geary's c	*p*-Value *	Moran's I	*p*-Value *	Geary's c	*p*-Value *
2006	0.389	0.000	0.682	0.031	0.130	0.000	0.854	0.004
2007	0.399	0.000	0.589	0.004	0.135	0.000	0.856	0.002
2008	0.432	0.000	0.623	0.008	0.133	0.000	0.846	0.001
2009	0.416	0.000	0.664	0.021	0.125	0.000	0.847	0.002
2010	0.406	0.000	0.666	0.022	0.111	0.000	0.858	0.004
2011	0.390	0.000	0.703	0.052	0.092	0.000	0.871	0.017
2012	0.392	0.000	0.693	0.044	0.092	0.000	0.867	0.013
2013	0.377	0.000	0.670	0.027	0.090	0.000	0.865	0.009
2014	0.372	0.001	0.679	0.032	0.088	0.000	0.861	0.007
2015	0.357	0.001	0.688	0.038	0.082	0.001	0.866	0.011
2016	0.357	0.001	0.698	0.044	0.082	0.001	0.863	0.008
2017	0.329	0.002	0.675	0.033	0.074	0.001	0.876	0.020
2018	0.320	0.002	0.702	0.054	0.074	0.001	0.881	0.029
2019	0.322	0.002	0.720	0.073	0.069	0.002	0.886	0.039

Table Source: based on data generated by stata16.0. * $p < 0.1$.

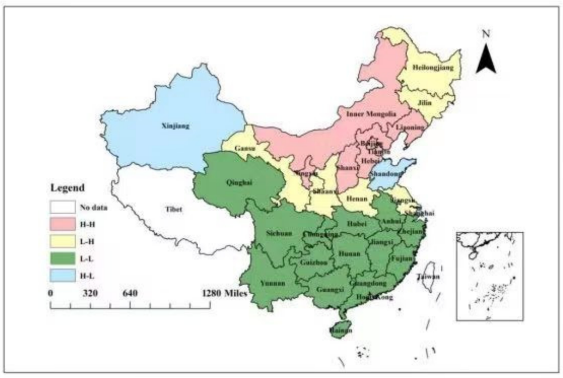

Figure 1. Thirty provinces and municipalities' carbon dioxide emissions LISA agglomeration map in 2006.

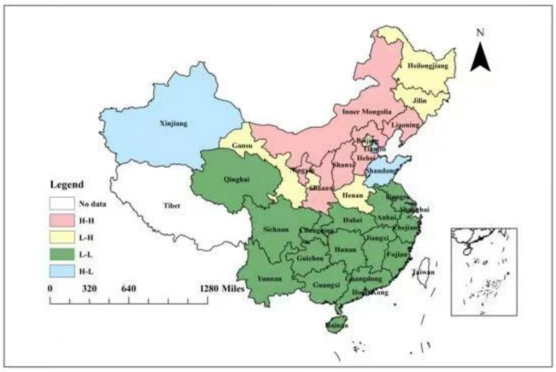

Figure 2. Thirty provinces and municipalities' carbon dioxide emissions LISA agglomeration map in 2019.

4.2. Analysis of the Spatial Spillover Effect of Tax Greenness on Carbon Emissions

The spatial regression model needs to be diagnosed and selected before conducting the analysis. In this paper, LM-lag and LM-error were first measured to select the spatial lag model (SAR) and the spatial error model (SEM). LM-lag, LM-error, robust LM-error, and robust LM-lag all passed the 1% significance level test, implying that the non-spatial model should be rejected. In this paper, the Wald-SAR and Wald-SEM tests were found to pass the significance test. Therefore, the spatial Durbin model (SDM) was deemed the superior model. Concerning explanatory variables, the lag period of CO_2 emissions was significantly positive at the level of 1%, suggesting a considerable spatial and temporal lag impact for CO_2 emissions, where there is a "snowball" effect of CO_2 emissions in space and time. The pollutants left in the early period may have an impact on the ecological environment in the later period. At the 1% significance level, the CO_2 emissions correlation coefficient was considerably positive, showing a significant inter-regional interaction of CO_2 emissions. Additionally, the rise in local pollutants will have an effect on environmental contamination in nearby places.

In Tables 3 and 4, the direct impact of green taxes on carbon emissions at various levels is presented. The geographic autocorrelation coefficient under the W1 matrix is substantial at 1%, showing a positive spatial correlation between carbon emissions in each location. This indicates that a region's carbon emissions are influenced in the same way as those of its neighbors. In accordance with the adjacency and geographic matrix, the medium-scale green tax has a stimulating influence on regional carbon emissions, but it has an inhibiting effect on carbon emissions in neighboring regions. Both small- and medium-caliber green taxes promote carbon emissions. Hypothesis 1 is therefore not valid, indicating that relatively green taxes that have been introduced, such as resource taxes and environmental protection taxes, contribute insufficiently to carbon emissions in each location. This may be because the majority of China's carbon emissions originate from fossil fuels and automobile exhaust, and the existing environmental protection tax or other taxes do not directly target carbon emissions [38]. This may be because local governments do not invest enough or exist only in a formal way for the control of environmental pollution.

Table 3. Spatial regression results of medium-caliber green taxes on carbon emissions.

Variables	**W1**		**W2**	
	Main	**Wx**	**Main**	**Wx**
agtc	0.117 ***	−0.124	0.130 ***	−1.176 ***
	(2.86)	(−1.35)	(3.10)	(−3.70)
fdsz	2.957 ***	−2.689 *	2.945 ***	2.411
	(3.26)	(−1.68)	(3.19)	(0.46)
$fdsz^2$	−0.200 ***	0.269 **	−0.143 *	0.277
	(−2.71)	(2.20)	(−1.90)	(0.66)

Table 3. *Cont.*

Variables	W1		W2	
	Main	**Wx**	**Main**	**Wx**
pgdp	0.200	−0.592	−0.518	−10.10 ***
	(0.53)	(−0.71)	(−1.27)	(−3.81)
infdi	−0.373 *	−0.333	−0.254	0.687
	(−1.75)	(−0.79)	(−1.20)	(0.47)
rd	−1.550 **	−2.200 **	−2.428 ***	−5.606
	(−2.52)	(−2.08)	(−3.95)	(−1.53)
ul	4.978 ***	−0.397	5.952 ***	0.689
	(6.12)	(−0.23)	(7.36)	(0.13)
cap	−4.196 ***	−0.468	−6.697 ***	−11.55
	(−3.49)	(−0.21)	(−5.95)	(−1.56)
lab	12.91 ***	−4.771	12.47 ***	37.98 **
	(6.26)	(−1.06)	(6.71)	(2.47)
Spatial				
rho	0.381 ***		−0.0489	
	(5.91)		(−0.25)	
Variance				
sigma2_e	2.867 ***		3.039 ***	
	(14.21)		(14.49)	
N	420		420	
R2	0.078		0.088	

Table Source: based on data generated by stata16.0. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Spatial regression results of small-scale green taxes on carbon emissions.

Variables	W1		W2	
	Main	**Wx**	**Main**	**Wx**
bgtc	0.171 ***	0.106 ***	0.160 ***	0.370 **
	(7.92)	(2.71)	(6.56)	(2.21)
fdsz	1.664 **	−1.963	1.631 *	−0.777
	(1.96)	(−1.34)	(1.81)	(−0.15)
$fdsz^2$	−0.104	0.153	−0.0570	0.285
	(−1.55)	(1.41)	(−0.81)	(0.72)
pgdp	0.314	0.629	−0.236	−3.311
	(0.92)	(0.78)	(−0.59)	(−1.24)
infdi	−0.427 **	−0.377	−0.311	−0.309
	(−2.15)	(−0.99)	(−1.50)	(−0.22)
rd	−1.421 **	−1.142	−1.926 ***	−7.441 **
	(−2.49)	(−1.14)	(−3.24)	(−2.13)
ul	3.690 ***	−0.434	4.399 ***	−7.146
	(4.71)	(−0.27)	(5.36)	(−1.40)
cap	−2.044 *	2.234	−4.752 ***	−9.713
	(−1.80)	(1.10)	(−4.24)	(−1.42)
lab	13.36 ***	−5.617	10.66 ***	2.389
	(6.93)	(−1.33)	(5.86)	(0.15)
Spatial				
rho	0.341 ***		−0.200	
	(5.19)		(−0.96)	
Variance				
sigma2_e	2.530 ***		2.889 ***	
	(14.27)		(14.47)	
N	420		420	
R2	0.002		0.094	

Table Source: based on data generated by stata16.0. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In addition, as presented in Table 5, the estimated coefficient of GDP per capita was considerably positive at the 1% level. When economic growth and development are poor, the government may decide to compromise the environment for the sake of the gross domestic product. People may raise their demand for environmental quality as economic growth improves, resulting in a progressive increase in demand elasticity. When the elasticity is greater than 1, people may choose to forgo part of their income in exchange for the improvement in environmental quality. Therefore, as the income elasticity of people's demand for environmental quality changes, an inverted U-shaped relationship in the environmental Kuznets curve is observed [39], linking carbon emissions and GDP.

Table 5. Effects of Financial Decentralization and Economic Growth on Carbon Emissions.

Variables	**W1**		**W2**	
	Main	**Wx**	**Main**	**Wx**
fdsz	0.812 **	0.542	1.568 ***	5.010 **
	(2.42)	(0.77)	(4.45)	(2.23)
pgdp	0.240	1.319	0.386	0.153
	(0.59)	(1.44)	(0.91)	(0.04)
pgdp × fdsz	−0.156	−0.560 ***	−0.471 ***	−1.757 **
	(−1.64)	(−2.87)	(−5.18)	(−2.28)
infdi	−0.290	0.0613	−0.0152	2.122
	(−1.36)	(0.15)	(−0.07)	(1.38)
rd	−0.420	−0.110	−0.500	−1.337
	(−0.66)	(−0.08)	(−0.74)	(−0.33)
ul	5.202 ***	1.224	6.005 ***	3.400
	(6.39)	(0.70)	(7.47)	(0.64)
cap	−4.575 ***	−3.239	−7.806 ***	−29.59 ***
	(−3.70)	(−1.47)	(−6.68)	(−4.19)
lab	16.31 ***	−0.473	16.98 ***	65.35 ***
	(7.66)	(−0.10)	(8.17)	(3.80)
Spatial				
rho	0.276 ***		−0.136	
	(3.89)		(−0.67)	
Variance				
sigma2_e	2.922 ***		3.033 ***	
	(14.33)		(14.46)	
N	420		420	
R2	0.076		0.139	

Table Source: based on data generated by stata16.0. ** $p < 0.05$, *** $p < 0.01$.

The computed coefficient of the fiscal freedom indicator was found to be considerably positive, indicating a strong association between fiscal decentralization and per capita carbon emissions. Improving fiscal freedom is not counterproductive to lowering carbon emissions, but rather promotes carbon emissions. Additionally, the coefficient of the squared term of fiscal decentralization was negative. This indicates that a further degree of fiscal decentralization may enhance the impact of suppressing carbon emissions. This verifies the validity of Hypothesis 2 and further reflects the initial success of China's environmental assessment system. Secondly, the co-efficient of the cross-term between the degree of fiscal freedom and GDP per capita was found to be significantly negative. This indicates that there will be more financial resources to tackle pollution when there are sufficient local funds. However, regions with low fiscal decentralization tend to attract more polluting industries, due to the lack of financial resources. This situation corresponds to the fact that the regions mentioned in the above theoretical analysis prefer to give priority to economic development in order to seek economic growth. Industrial pollution may become more serious in the absence of sufficient funds to combat pollution, which also indicates the need for sufficient financial support to mitigate carbon emissions.

As shown in Table 6, under the combination of fiscal decentralization and green taxation, the impact of small-scale green taxes on carbon emissions has increased. However, moderate green taxes do not necessarily affect carbon emissions through the moderating impact of fiscal liberty. Due to the deepening degree of fiscal decentralization, local governments will focus on cultivating main taxes with rich tax sources and large tax bases with various incentives from the central government, while neglecting to cultivate resource taxes, vehicle taxes, and consumption taxes that prioritize environmental preservation and energy conservation. The central tax has the highest consumption tax in the green taxation system of medium size. The consumption tax has fewer tax items, specifically for environmental pollution, due to its narrow tax scope. This is similar to the environmental tax and cannot play the role of "prohibiting but not levying" on enterprise emissions. The most intuitive means is to internalize the negative externalities of environmental pollution into the production and operation costs of taxpayers by levying more environmental taxes and giving taxpayers financial subsidies to control their emission choices and motivate them to introduce energy-saving and environmental protection technologies, thus improving environmental quality. Thus, with the interference of environmental decentralization, small-bore green taxes are determined to be better at reducing carbon dioxide emissions than medium-bore green taxes. Overall, the policies of the current green taxation system of local governments have been determined to have a negative overall inhibitory effect on carbon dioxide reduction. It also simultaneously confirms that there is a need to improve the green taxation policy system implemented by states to minimize carbon dioxide emissions.

Table 6. Impact of fiscal decentralization and green tax interaction term on carbon emissions.

Variables	**W1**		**W2**	
Main				
bgtc	0.171 ***	0.239 ***	0.124 ***	0.185 ***
	(6.80)	(4.67)	(4.33)	(3.17)
agtc × fdsz	-	0.0696 ***	-	0.0141
	-	(4.51)	-	(0.82)
bgtc × fdsz	−0.000394	-	−0.0330 **	-
	(−0.03)	-	(−2.12)	-
fdsz	1.705 **	2.631 ***	2.085 **	3.054 ***
	(1.98)	(2.99)	(2.28)	(3.27)
$fdsz^2$	−0.108	−0.143 **	−0.105	−0.143 *
	(−1.55)	(−1.97)	(−1.43)	(−1.86)
pgdp	0.328	−0.184	−0.122	−0.635
	(0.93)	(−0.49)	(−0.31)	(−1.54)
infdi	−0.408 **	−0.382 *	−0.298	−0.367 *
	(−2.02)	(−1.84)	(−1.42)	(−1.67)
rd	−1.408 **	−1.972 ***	−1.817 ***	−2.660 ***
	(−2.46)	(−3.24)	(−3.06)	(−4.12)
ul	3.634 ***	4.709 ***	4.642 ***	5.913 ***
	(4.58)	(5.93)	(5.68)	(7.32)
cap	−2.056 *	−4.163 ***	−4.773 ***	−7.151 ***
	(−1.81)	(−3.58)	(−4.30)	(−6.23)
lab	13.24 ***	12.17 ***	10.33 ***	12.48 ***
	(6.75)	(6.01)	(5.60)	(6.74)
Wx				
bgtc	0.0971 **	−0.145	0.500 ***	−0.595
	(2.23)	(−1.15)	(2.84)	(−1.32)
bgtc × fdsz	−0.0134	−0.0621 **	0.214 **	0.174
	(−0.49)	(−2.28)	(2.32)	(1.61)
fdsz	−1.808	−2.174	−1.606	1.512
	(−1.21)	(−1.40)	(−0.31)	(0.29)
$fdsz^2$	0.134	0.175	0.466	0.427
	(1.17)	(1.44)	(1.13)	(1.00)
pgdp	0.743	−0.0966	−6.876 **	−12.79 ***
	(0.89)	(−0.11)	(−2.32)	(−3.98)
infdi	−0.317	−0.371	−0.108	−0.148
	(−0.80)	(−0.88)	(−0.07)	(−0.09)

Table 6. *Cont.*

Variables	**W1**		**W2**	
Main				
rd	−1.056	−1.781	−7.378 **	−8.463 **
	(−1.04)	(−1.54)	(−2.10)	(−2.13)
ul	−0.533	−0.593	−7.041	1.956
	(−0.32)	(−0.35)	(−1.33)	(0.36)
cap	2.310	−0.941	−12.06 *	−21.23 **
	(1.13)	(−0.40)	(−1.74)	(−2.34)
lab	−5.902	−2.611	8.137	44.17 ***
	(−1.37)	(−0.57)	(0.50)	(2.82)
Spatial				
rho	0.340 ***	0.425 ***	−0.221	−0.0239
	(5.16)	(6.79)	(−1.05)	(−0.12)
Variance				
sigma2_e	2.529 ***	2.681 ***	2.829 ***	3.015 ***
	(14.27)	(14.14)	(14.46)	(14.49)
N	420	420	420	420
R2	0.001	0.099	0.087	0.088

Table Source: based on data generated by stata16.0. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

From the perspective of control variables, a huge environmental cost is paid, considering China's industries are still the leading factors promoting the country's economic growth. The impact of increased foreign investment on carbon emissions is negligible, possibly because it brings pollution from industries while simultaneously introducing environmentally friendly emission reduction technologies. R&D investments are significantly negative, indicating that a growth in R&D investment promotes the decrease of carbon dioxide in the region and nearby areas. The acceleration of urbanization will significantly promote carbon emissions, while the enhancement of environmental control and the increase in capital stock can replace existing traditional energy sources, effectively reducing carbon emissions. The population employment structure reflects the fact that the majority of the population works in the secondary industry. Therefore, the rise in the employed population results in an increase in carbon emissions.

5. Discussion

Will fiscal decentralization, which has led to the use of different tools to regulate the environment and fight pollution, change how green taxes affect carbon emissions? Will fiscal decentralization be influenced by economic development in order to reduce carbon emissions? Based on the analysis in the previous section, it is clear that whether the level of fiscal decentralization affects the local government's environmental decisions is partially dependent on the dynamics of the local economic development level and that fiscal decentralization itself must reach a certain peak in order to stimulate carbon emission reduction, which is consistent with the study by Chen X [40]. Both types of green taxes are ineffective at reducing carbon emissions, confirming the "green paradox" effect [41] observed by a few researchers. The interaction between fiscal decentralization and environmental protection taxes can effectively reduce carbon emissions; however, other green taxes do not have a positive effect on carbon emission reduction with fiscal decentralization, demonstrating that different fiscal policies must be formulated for different types of green taxes to achieve carbon emission reduction from fiscal decentralization.

(1) Concerning the impact of green taxes on carbon emissions, we discovered that green taxes do not have the effect of "forcing emission reduction", despite the belief that strict green tax levies on polluting enterprises can achieve low-carbon emission reduction by imposing constraints on high-polluting and energy-consuming industries and businesses [8,42–44]. To encourage technological innovation, R&D expenses are allowed to be deducted at 100%, and if they form intangible assets, they can be amortized at 200% [45].

Such tax incentives can reduce the burden of technological innovation and R&D for businesses. In turn, this can motivate businesses to transform and upgrade their industrial structures. According to the manner in which the tax burden is transferred, the two types of green taxes can be classified as either direct taxes or indirect taxes. The small-caliber tax described in this paper is the environmental protection tax, which belongs to the category of direct tax. However, the actual tax burden of this direct tax may be transferred to consumers through the price mechanism. From the perspective of the taxpayer, the producer and operator of pollutants have a strong incentive to add the increase in operating costs caused by the environmental tax to the selling price of the product, thereby shifting the tax burden to the downstream enterprises via the price mechanism, which is ultimately borne by the consumers. This is the same as indirect taxes, such as the consumption tax or resource tax and the urban maintenance and construction tax, which are designed to help businesses reduce their emissions costs. Without more substantial tax incentives for companies and the imposition of penalties, efforts to reduce carbon emissions will not be sustainable.

(2) This study disproves the theory that fiscal decentralization increases greenhouse gas emissions [46–48]. We propose that the relationship between fiscal decentralization and carbon emissions is "inverted U-shaped", as the majority of previous studies were based on the assessment mechanism of the government's pursuit of GDP growth. As a result of the modification of the mechanism for promoting political competition, local governments will prioritize the high-quality development of the local economy and increase the local green GDP in pursuit of sustainable development. Local governments will focus more on the issue of polluting businesses, and reduce carbon emissions to a certain degree. In addition, the majority of prior research has utilized fiscal expenditure decentralization and fiscal revenue decentralization to examine the association between fiscal decentralization and environmental pollution. Comparatively to cross-sectional or panel data with regional differences, the fiscal revenue and expenditure indicators utilized in this study are more appropriate for time series data with time period changes.

(3) In terms of the interaction between fiscal decentralization and green taxes affecting carbon emissions, green taxes can reduce carbon emissions via capital factor flows, technological advancements, environmental expenditures, and environmental regulation [49], and are also likely to be influenced by factors related to fiscal decentralization. In the course of central fiscal decentralization, localities have favored strengthening the cultivation of tax sources, such as corporate income tax, value-added tax, urban maintenance and construction tax, and resource tax, which are central-local shared taxes and increase the proportion of local revenue sharing, whereas the majority of green taxes are either local or central taxes. Urban maintenance and construction taxes and resource taxes represent a small portion of central and local shared taxes, so fiscal decentralization and its interactions have a negligible effect on carbon emission reduction. The decentralization of fiscal power enables local governments to strengthen environmental control [50] and, assuming other conditions such as capital, technology, and foreign investment remain unchanged, on the one hand, the government will implement R&D subsidies within the industry to increase the use of new energy research and development, and on the other hand, the relevant industries will be subject to price control and compensation for long-cycle transition industries. For long-term growth, local businesses typically internalize external costs. In addition, the interaction between environmental taxes and fiscal decentralization has a significant impact on carbon emissions because local governments have the authority to set local tax regulations, environmental taxes can be levied at the discretion of local governments, and local governments are more involved in improving activities with strong negative externalities by investing environmental tax funds and central transfer payments to reduce carbon emissions.

In conclusion, all the research hypotheses proposed in this paper are verified, except Hypothesis 1. The intervention of fiscal decentralization has a positive effect on the implementation of an environmental protection tax to reduce carbon emissions. Since carbon emissions are affected by regional heterogeneity, spatial and temporal lags, environmental regulations, consumption structure, and other complex factors and governmental behavior is subjective; there are games and strategic interactions between upper, lower, and peer governments in environmental decision-making. The question of whether green taxes can reduce carbon emissions needs to be further investigated. On the basis of this study, refining the research area into national prefecture-level cities to study carbon emissions, and analyzing the impact of green taxation on carbon emissions under the game strategy of interaction behavior between central and local governments, can be the next research direction of this paper.

6. Conclusions and Recommendations Concerning Policy

This article integrates tax greenness, carbon emissions, and fiscal decentralization into the same research paradigm, using panel data for 30 Chinese provinces and cities during 2006 to 2019. We constructed a spatial Durbin model (SDM) and examined the relationship between the positive spatial spillover impact of carbon emissions and tax greenness. The findings demonstrated: (1) Carbon emissions have a positive spatial spillover impact, and both degrees of tax greenness are positively correlated with carbon emissions, i.e., carbon emissions grow as the degree of tax greenness increases. This negative effect of encouraging carbon emissions is particularly visible in the low-level of green taxes and fees; (2) Increased fiscal decentralization will result in an increase in carbon dioxide. Pollution caused by profit-driven fiscal decentralization cannot suppress carbon emissions at this stage of local government development. As the economy enters a high-level development stage, each local government focuses on environmental protection while pursuing economic development. The impact of fiscal decentralization on the reduction of carbon emissions thus begins to appear; (3) Depending on the expansion of local fiscal freedom, the effect of "green taxation" in the narrow sense is more significant in reducing carbon emissions. The regulation of fiscal decentralization and green taxation in the middle sense was not observed to be strong. However, both fail to contribute positively to carbon dioxide reduction.

In order to fulfill the dual objectives of reducing carbon dioxide emissions and promoting low-carbon agriculture, the following recommendations are made: First, the environmental tax rate should be increased, and the supervision of funds dedicated to environmental protection should be strengthened to ensure that they are reasonably earmarked for environmental treatment. The current environmental protection tax rate is low, which can improve the acceptance of enterprises, reduce the resistance and impact on enterprises, and support the stable growth of the economy throughout the initial phase of the tax. The low tax rate cannot produce strong constraints on polluting enterprises, and may not be effective enough to control pollution. Increasing the tax rate can, therefore, make the environmental protection tax fully reflect the polluter pays principle—more emissions, more tax; fewer emissions, less tax; no emissions, no tax. If the tax rate to protect the environment is higher than the marginal cost of technical facilities used by taxpayers, it may also encourage businesses to enhance their investments in environmental preservation. The tax burden may be continuously increased to improve the flexibility of the tax rate, as per the increase in emissions of pollutants. If the enterprise pollutant emissions are higher than the previous year, the tax rate in the next year will be increased by an appropriate amount, which can have a strong restraining effect, but also encourage the pollution control work to be more active and achieve good results in the enterprise, increasing tax cuts to encourage pollution control.

Secondly, a development-oriented performance-appraisal system should be built. The weight of environmental indicators in the government performance appraisal should be increased, and the economic appraisal indicators should be weakened to expand the positive spillover effect, thereby forming an effective radiation to the surrounding improvement of eco-efficiency. This may also effectively curb the local government's blind pursuit of disordered economic growth and the resultant environmental pollution.

Third, there should be restructuring of the existing taxes related to resources and environmental protection. Currently, the resource tax, consumption tax, vehicle and vessel tax, and other taxes related to energy conservation and emission reduction should be appropriately adjusted, and new taxes should be introduced to effectively play the role of tax incentives and constraints, in order to improve the function of taxation in environmental protection. For instance, to address the issue of severe pollution brought on by rural businesses using outdated production technology during the industrialization process, we can scientifically and reasonably design targeted tax incentives for VAT and corporate income tax and help, and encourage rural enterprises to carry out technological transformation through various tax incentives, such as accelerated depreciation, pre-tax credits, and lower tax rates, so as to guide these enterprises to take a low-carbon sustainable development path. In light of the severe degradation of water and soil resources in rural regions and the progressive decline in air quality, we should broaden the scope of resource tax and consumption tax collection in order to effectively preserve resources and the environment, increasing the tax rate and changing existing unreasonable taxation methods (e.g., resource tax should be changed from quantitative to ad valorem).

Finally, it is suggested to include carbon dioxide in the tax items of the environmental protection tax system, which is currently narrow. Further high-energy-consuming and high-polluting products and behaviors may be covered, such as taxation for carbon dioxide. In addition, given the reality that rural enterprises mostly belong to the urban elimination of high-carbon industries, we may also consider new taxes, such as carbon taxes, to curb the development of these high-energy-consuming, high-emission, and high-polluting enterprises, so that the development of agriculture and the rural economy may be changed into a low-carbon economy by reducing energy use, emissions, and pollution.

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