Fiscal Decentralization, Environmental Protection Investment and Regional Green Development

Changmin Li

School of Finance and Public Administration, Anhui University of Finance and Economics, Bengbu 233000, Anhui, China

Abstract

At present, China attaches unprecedented importance to green development.Based on the perspective of China's fiscal decentralization reform, the article uses the green total factor productivity of 251 cities to measure the status of regional green development, studies the impact of fiscal decentralization and environmental protection input on green total factor productivity.and constructs the impact of the interaction between the two on green total factor productivity. The following conclusions are drawn: First, from the perspective of the whole country, fiscal decentralization and environmental protection input have significant promotion effects on green total factor productivity, but regional differences are obvious; Second, the comprehensive role of fiscal decentralization and environmental protection input significantly promotes the improvement of green total factor productivity; Third, through the intermediary effect, it is found that part of the impact of fiscal decentralization on green total factor productivity comes from environmental protection input, that is, the transmission mechanism of fiscal decentralization → environmental protection input → green total factor productivity is verified. Based on the above conclusions, policy suggestions are put forward from the aspects of increasing environmental protection investment and optimizing the reform of the fiscal decentralization system.

Keywords

Fiscal Decentralization; Environmental Input; Green Total Factor Productivity.

1. Introduction

With the continuous development of China's economy, environmental problems have become increasingly prominent. How to promote high-quality economic development and green transformation and upgrading is a practical problem that China's green total factor productivity must solve. The state has put forward the concept of green development in the process of developing with the times. In recent years, China's absolute energy consumption and energy consumption per unit of GDP have shown a downward trend, but they are still higher than other developed countries in the world. The environmental quality in many parts of the country is still very poor, and environmental pollution problems such as smog are still serious. According to the 2021 Communiqué on the Status of China's Ecology and Environment, 121 of the 339 cities at the prefecture level and above exceeded the standard, accounting for 35.7%. Excluding the impact of sand and dust, this proportion rises to 43.1%. From the above data, we can see that although the environmental quality has improved compared with the past, the governance task is still relatively severe and has to attract our attention. In the report of the 20th National Congress of the Communist Party of China, General Secretary Xi Jinping once again emphasized the promotion of green development and the harmonious coexistence of man and nature. We must firmly establish and practice the concept that green waters and green mountains are golden mountains and silver mountains, and plan and develop from the perspective of harmonious coexistence between man and nature. From this, we can see that in the past, the

simple pursuit of economic development and ignoring environmental protection is inconsistent with today's development, so it is particularly urgent to further improve green total factor production (GTFP). This is what we need to work on next. Practice has proved that the fiscal decentralization system is one of the important driving forces for China's rapid economic development, but at the same time, it is also an inevitable and important factor in our promotion of green total factor productivity. Green development is inseparable from the overall leadership role of local governments. Environmental protection investment is an important manifestation of the responsibility of local governments to manage the environment, and it is crucial for regional green development. Therefore, it is of certain practical significance to explore the influence of environmental protection input on green total factor productivity under the background of fiscal decentralization. Provide decision-making reference for the high-quality development of the national economy in the new era. Therefore, it can better implement the green development concept proposed by the state.

2. Literature Review

2.1. Fiscal Decentralization and Green Total Factor Productivity

Scholars have done a lot of research on the relationship between the two, but the relationship between the two has not been conclusive so far. There are two views of domestic scholars: one view is that under China's current fiscal decentralization system, local governments at all levels can allocate resources reasonably and efficiently, thereby promoting the development of green total factor productivity. The main representatives of this view are Fan Ziying (2009) and others. [1]. Zhang Chang (2020) et al. also found a positive relationship between the two through research [2]. Zhang Rui et al. (2020) measured the green total factor productivity of the Yellow River Basin through models and found empirically that fiscal expenditure decentralization has a promoting effect on the green total factor productivity of cities along the Yellow River Basin, and fiscal expenditure decentralization promotes the high-quality development of the Yellow River Basin through the rational optimization of industrial structure[3]; Cheng Zhonghua et al. (2021) found through urban data that fiscal decentralization is conducive to the improvement of green total factor productivity, but the impact of different regions is obviously different. Moreover, further research found that there is a mediating effect, that is, fiscal decentralization affects green total factor productivity growth by affecting R&D investment and public infrastructure[4]. Contrary to the above view, some scholars believe that fiscal decentralization leads to a mismatch between local governments' powers and responsibilities, which will have a negative effect on green total factor productivity growth. For example, Li Bin et al. (2016) pointed out that fiscal decentralization is not conducive to the improvement of green technology efficiency, so it generally hinders the development of green total factor productivity [5]; Du Juntao et al. (2017) found that fiscal decentralization will lead to horizontal competition among local governments, so that local governments will simply pursue economic benefits at the cost of damaging the environment, and the result is that environmental governance is not timely and is not conducive to the development of green total factor productivity [6].

2.2. Environmental Protection Investment and Green Development

The impact of environmental protection investment on green development, most scholars at home and abroad believe that environmental protection investment improves environmental quality and promotes regional green development. Dungumaro and Madulu (2003) found that environmental pollution control requires reasonable financial support from the government based on the research perspective of water pollution [7]. Moretti (2004) pointed out that increasing environmental protection investment can effectively eliminate the negative externalities caused by environmental pollution. [8] Wang Yafei (2011) believes that on the

whole, public financial environmental protection investment has obvious effects on environmental pollution control in that year, and at the same time has a promoting and stimulating effect on the improvement of environmental quality in the previous year. From a local perspective, the role of financial environmental protection investment in improving environmental quality varies greatly among provinces, that is, measures should be adapted to local conditions [9]. Li Kaijie (2014) based on the empirical analysis of the two-period generation alternation model shows that the increase in government environmental expenditure can significantly promote regional green development [10]. Yang Zhi'an (2018) et al. argue that fiscal decentralization has an impact on environmental protection spending [11]. Jin Dianchen (2020) found that government environmental protection investment has a significant effect on improving regional environmental quality [12]. Hu Lina et al. (2022) believe that fiscal environmental protection expenditure has a significant positive incentive effect on green development [13]. Zhang Xuna et al. believe that (2022) by increasing environmental protection expenditure as an intermediary channel, it can indirectly promote the improvement of enterprises' green technology innovation [14].

A review of the literature shows that the existing studies have analyzed the impact on regional green development from the single aspect of fiscal decentralization or environmental protection input, and rarely consider the two together to analyze their common impact on regional green development, and relevant quantitative research methods are even more lacking. Moreover, most of the green development indicators used to study the impact of environmental protection input on green development are mostly air quality indicators, and the use of green total factor productivity as green development index to study the impact of environmental protection input on green development is one of the innovative points of this paper. In today's China, governments at all levels are striving to promote green development and build a beautiful China in an all-round way, so it is of great practical significance to study the relationship between China's system and green development and its shortcomings.

2.3. The Role Mechanism Analysis of Fiscal Decentralization, Environmental Protection Input and Green Development

One of the most obvious features of the reform of fiscal decentralization is the upward shift of financial power and the downward transfer of power. This is the trend of fiscal decentralization reform in modern China. From the perspective of expenditure, local governments have decentralized fiscal expenditure, which allows local governments to give full play to their advantages in information services and improve the efficiency of resource allocation. This reform will directly affect the behavior of local governments, which will consider the arrangement of fiscal expenditure and the selection and supply of public environmental goods under the guidance of central policies and the advantages of local information. Environmental protection financial investment is an indispensable part of fiscal expenditure, and the selection of environmental public goods requires environmental protection financial investment to provide necessary guarantees. Under the fiscal decentralization system, the local government has a greater right to control the wealth, there are enough environmental protection financial investment capital reserves, in the existing environmental protection fiscal expenditure areas, including pollution control, energy conservation and utilization, natural ecological protection and other fields, the improvement of investment level will also effectively promote the control of environmental pollution, improve the quality of the regional environment, and significantly promote regional green development.

In view of the above theoretical analysis, this paper puts forward the following hypotheses and tests them empirically:

Hypothesis 1: Fiscal decentralization can significantly promote the growth of urban green total factor productivity.

Hypothesis 2: Increasing environmental protection input can improve urban green total factor productivity.

Hypothesis 3: The contribution of fiscal decentralization to urban green total factor productivity is partly achieved by increasing environmental inputs.

3. Research Design

3.1. Model Setting

In order to study the impact of fiscal decentralization and environmental protection input on green total factor productivity, and the impact of the combined effect of the two on green total factor productivity, this paper adds the interaction terms between fiscal decentralization and environmental protection input in the model, and the specific measurement model is as follows:

$$GTFP_{it} = \alpha_0 + \alpha_1 FRE_{it} + \alpha_2 PRO_{it} + \alpha_3 FRE_{it} \times PRO_{it} + \beta X_{it} + \varepsilon_{it} \qquad (1)$$

where i represents the city and t represents the year. GTFP stands for Urban Green Total Factor Productivity; FRE stands for fiscal decentralization; PRO stands for Environmental Input; FRE × PRO represents the interaction of fiscal decentralization and environmental inputs; X represents the control variables, including government regulation (GOV), foreign investment (FDI), road area per capita (ROAD) and industrial structure (GI); Represents a random perturbation term.

3.2. Variable Selection and Data Description

3.2.1. The Variable Being Explained

The explanatory variable in this paper can be selected as green total factor productivity (GTFP). Using the SBM-Malmquist index, the green total factor productivity of 251 cities in China is calculated.

Input variables. The first is labor input, expressed by the number of employees at the end of each city. The second is capital investment, drawing on the method of Zhang Jun (2004) [15], using the perpetual inventory method, and using the price index to convert the constant price to 2010. The third is energy input, drawing on the method of Wu Jiansheng (2014) [16], and using the global stable luminous value fitting. The fourth is land input, which is expressed by the built-up area of the city.

Output variables. The first is the expected output, and this paper selects the GDP of each city to express and adjust GDP to the real value of constant prices in 2010. The second is undesired output, which unifies sulfur dioxide emissions, industrial wastewater emissions and industrial smoke emissions in the evaluation system of unintended outputs. Because the GML index is a month-on-month comparison between years, this paper draws on the practice of Wang Ping (2022) [17], sets the GTFP in 2010 to 1, and multiplies it with the GML index of each year, and finally obtains the green total factor productivity of each city for each year.

3.2.2. Core Explanatory Variables

Fiscal Decentralization (FRE). This paper selects fiscal expenditure decentralization as the measurement index of fiscal decentralization, refers to the practice of Dong Xiangshu et al. [18], and adopts the following calculation formula: fiscal expenditure decentralization (FRE) = per capita urban fiscal expenditure / (per capita urban fiscal expenditure + per capita provincial fiscal expenditure + per capita central fiscal expenditure). At the same time, the fiscal revenue decentralization index is used to test the robustness.

Environmental Inputs (PRO). For government environmental protection investment, this paper refers to the practice of Jin Dianchen et al. [11], using the level of energy conservation and

environmental protection expenditure to measure government environmental protection investment, and at the same time, due to the official change of name to energy conservation and environmental protection expenditure in China since 2007 and the limited availability of data in prefecture-level cities, the data in this article starts from 2011.

3.2.3. Control Variables

Referring to relevant studies and considering the availability of data in various cities, government regulation, foreign investment, industrial structure, and per capita road area were selected as control variables. Government Regulation (GOV). The degree of government regulation is measured by municipal district budget expenditure/GDP*100. Foreign investment (FDI) is measured by the proportion of FDI actually utilized by each city as a percentage of GDP. Industrial Structure (GI). Most of the secondary industry are high-pollution and high-energy-consuming enterprises, and this paper uses the output value of the tertiary industry to account for the output value of the secondary industry. Infrastructure construction affects green total factor productivity, so the per capita road area (ROAD) is selected as the indicator to measure infrastructure, and the total road area is divided by the total urban population.

3.2.4. Data Description

Considering the availability of data, this paper selects 251 cities in China as the research objects, deletes some cities with serious data deficiency, and analyzes the research objects based on the balance panel data. The data are mainly from the "China Cities Statistical Yearbook", "China Statistical Yearbook", "China Environment Yearbook", and the statistical yearbook of prefecture-level cities. At the same time, in order to avoid the influence of extreme values, the continuous variable is shrunk. Table 1 shows the statistical results.

Table 1. Descriptive statistical results of variables

symbol	Observations	mean	standard deviation	minimum	median	maximum
GTFP	2510	1.256	0.433	0.274	1.156	4.635
FRE	2510	0.409	0.098	0.149	0.390	0.896
PRO	2510	13.671	27.475	0.456	7.525	458.440
GOV	2510	0.176	0.110	0.010	0.156	2.702
FDI	2510	0.044	0.043	0.002	0.031	0.176
GI	2510	1.090	0.613	0.164	0.959	6.119
ROAD	2510	0.129	0.068	0.024	0.116	0.400

4. Empirical Analysis

4.1. Benchmarking

The models (1) and (2) in Table 3 are the baseline regression results including fiscal decentralization, energy conservation and environmental protection expenditure, in order to test the impact of fiscal decentralization and environmental protection input on green total factor productivity. From the table, we can conclude that the regression coefficient of fiscal decentralization (FRE) is positive and significant, and the regression coefficient of energy conservation and environmental protection expenditure (PRO) is the same result, indicating that fiscal decentralization promotes the development of green total factor productivity, and environmental protection input also has a positive impact on the growth of green total factor productivity. Hypotheses 1 and 2 are validated. (3) and (4) are the benchmark regression results of the interaction terms between fiscal decentralization and energy conservation and environmental protection expenditure, and the influence coefficient of the interaction terms is still significantly positive regardless of whether the control variables are considered, indicating that the comprehensive effect of the two has a significant promoting effect on green total factor

productivity. Research hypothesis 3 is valid. From the results of the control variables, the per capita road area (ROAD) and industrial structure (GI) were significantly negative, indicating that the per capita road area and industrial upgrading were not conducive to the development of green total factor productivity. A negative government intervention coefficient (GOV) indicates that the government's excessive control of the economy has further narrowed the investment space of other investment entities and made it inefficient in the social economy, which is not conducive to the growth of green total factor productivity. A negative foreign investment coefficient (FDI) may be due to the fact that most foreign investors are energy-intensive and polluting enterprises and lack high-quality foreign investors, which is not conducive to the improvement of green total factor productivity.

Table 2. Benchmark results

variable	(1)	(2)	(3)	(4)
FRE	0.3768*	0.7187***		
	(1.6694)	(3.2293)		
PRO	0.0015***	0.0013***		
	(3.4578)	(3.1205)		
FRE × PRO			0.0030***	0.0027***
			(4.1437)	(3.8266)
GOV		-0.4434***		-0.3880***
		(-5.1092)		(-4.5614)
ROAD		-1.9574***		-1.9194***
		(-8.5607)		(-8.3834)
FDI		-1.3226***		-1.3048***
		(-4.6338)		(-4.5676)
GI		-0.1080***		-0.1100***
		(-4.5627)		(-4.6406)
Urban fixed effect	control	control	control	control
Year fixed effect	control	control	control	control
Constant terms	0.8823***	1.1870***	1.0324***	1.4607***
	(9.6615)	(12.7401)	(54.7451)	(37.8405)
R^2	0.3094	0.3589	0.3100	0.3572
N	2510	2510	2510	2510

4.2. Heterogeneity Testing

In order to further study the development of the subregion, this paper divides the east, central and western regions for testing. As we can see from Table 3, there is significant regional heterogeneity in the results. The empirical results in the western region are as follows: the coefficient value of the fiscal decentralization index in model (1) is negative, and the impact of environmental protection expenditure on green total factor productivity is positive, but not significant. In model (2), although the interaction coefficient between fiscal decentralization and environmental protection expenditure is positive, it is not significant. From the perspective of cities in the western region, most of them are economically underdeveloped areas, and local governments have aggravated the deterioration of the local environment at the expense of the environment in order to promote local economic growth. The empirical results show that the model (3) has significant fiscal decentralization, indicating that fiscal decentralization in the central region positively affects the growth of green total factor productivity, while the expenditure on energy conservation and environmental protection is not significant. Model (4)

is the influence of the interaction terms on green total factor productivity, and it can be seen that the results are not significant. It shows that in central cities, local governments do not pay attention to the role of environmental protection input in promoting green total factor productivity. The empirical results in the eastern region show that the model (5) shows that fiscal decentralization is conducive to the improvement of green total factor productivity at a significant level of 5%, and environmental protection expenditure also has a significant role in promoting green total factor productivity at the level of 5%. Model (6) is the regression result of the interaction term, and it can be seen that it also has a significant promotion effect on green total factor productivity, and is significant at the level of 1%. This is because most of the eastern cities are more economically developed cities, and these areas have strong financial support and can invest more in environmental protection expenditure.

Table 3. Heterogeneity test results

variable	(1) westward	(2) westward	(3) Central	(4) Central	(5) eastern	(6) eastern
FRE	-0.0982		1.0967***		1.2124**	
	(-0.2731)		(3.3898)		(2.3732)	
PRO	0.0003		0.0010		0.0015**	
	(0.5215)		(0.7540)		(2.5220)	
FRE × PRO		0.0017		0.0036		0.0024***
		(0.9461)		(1.6206)		(2.6125)
GOV	-0.3652**	-0.3828**	-0.3555***	-0.2962***	-1.5109***	-1.3256***
	(-2.0039)	(-2.2484)	(-3.7570)	(-3.1713)	(-4.8495)	(-4.3819)
ROAD	0.0372	0.0475	-1.0998***	-1.0582***	-3.1664***	-3.1343***
	(0.0802)	(0.1025)	(-3.1913)	(-3.0562)	(-8.2668)	(-8.1540)
GI	-0.1516***	-0.1503***	-0.0984***	-0.0929***	-0.1177**	-0.1284**
	(-4.0653)	(-4.0581)	(-3.1974)	(-3.0062)	(-2.1373)	(-2.3334)
FDI	-1.9067***	-1.9204***	-2.6645***	-2.6165***	-0.4226	-0.3678
	(-2.8197)	(-2.8514)	(-5.5975)	(-5.4693)	(-0.8685)	(-0.7554)
Urban fixed effect	control	control	control	control	control	control
Year fixed effect	control	control	control	control	control	control
Constant terms	1.2916***	1.2545***	1.0141***	1.4137***	1.2806***	1.7695***
	(9.3406)	(20.8527)	(7.7915)	(24.9443)	(5.7512)	(20.8637)
R^2	0.4307	0.4314	0.3761	0.3688	0.3872	0.3834
N	520	520	1030	1030	960	960

4.3. Robustness Test

This paper makes the following robustness tests: First, replace the explanatory variables. The decomposition index of green total factor productivity is replaced by green total factor productivity for empirical testing, and the results are shown in Table 4 model (1)∼ model (2). The second is to reduce the sample space. This article deletes provincial capitals and municipalities. The relationship between fiscal decentralization, environmental protection input and green total factor productivity is reanalyzed, and the results are shown in Table 4 model (3) ∼ model (4). The third is to replace explanatory variables. An empirical test is carried out by replacing the decentralization of fiscal expenditure by decentralization of fiscal revenue. The results are shown in Table 4 Model (5) ∼ Model (6). From the above three regression test results, the impact on green total factor productivity is still significant, which is consistent with the overall conclusion. This further demonstrates that the benchmark conclusions in this paper are reliable.

Table 4. Robustness test results

variable	(1)	(2)	(3)	(4)	(5)	(6)
FRE	0.7549***		0.8858***		0.8681***	
	(3.3477)		(3.6727)		(4.5279)	
PRO	0.0012***		0.0025***		0.0012***	
	(2.9921)		(3.5354)		(2.9960)	
FRE × PRO		0.0025***		0.0058***		0.0030***
		(3.7286)		(4.9045)		(3.9106)
GOV	-0.4303***	-0.3739***	-0.4325***	-0.3683***	-0.3721***	-0.3828***
	(-5.2209)	(-4.6340)	(-5.0162)	(-4.3695)	(-4.4212)	(-4.5365)
ROAD	-1.9310***	-1.8917***	-1.8610***	-1.7924***	-1.9746***	-1.9050***
	(-8.9038)	(-8.7102)	(-7.9215)	(-7.6089)	(-8.7084)	(-8.3850)
GI	-0.1157***	-0.1183***	-0.1176***	-0.1176***	-0.0967***	-0.1092***
	(-5.1535)	(-5.2621)	(-4.7409)	(-4.7382)	(-4.1017)	(-4.6465)
FDI	-1.3169***	-1.2949***	-1.2819***	-1.2598***	-1.4649***	-1.3099***
	(-4.8643)	(-4.7788)	(-4.4596)	(-4.3825)	(-5.1479)	(-4.6219)
Urban fixed effect	control	control	control	control	control	control
Year fixed effect	control	control	control	control	control	control
Constant terms	1.1276***	1.4151***	1.1138***	1.4359***	1.2377***	1.4595***
	(12.0743)	(38.6482)	(11.4122)	(36.4090)	(20.0028)	(38.1412)
R^2	0.3696	0.3676	0.3439	0.3428	0.3630	0.3585
N	2510	2510	2250	2250	2510	2510

4.4. Intermediary Effect Test

The "interaction item" test of fiscal decentralization and energy conservation and environmental protection expenditure preliminarily explores and confirms the conclusion that fiscal decentralization affects green total factor productivity through environmental protection input. However, the significantly positive coefficient of the interaction term may also be due to a certain correlation between fiscal decentralization and energy conservation and environmental protection expenditure, so the conclusions drawn need to be further confirmed. Therefore, further tests are needed to prove the hypothesis3. In the research methods of reading the relevant literature, find a method suitable for further research confirmation. Therefore, this paper draws on the research ideas of Zheng Wei (2021) to further explore the transmission mechanism of fiscal decentralization→ environmental protection input → green total factor productivity by constructing a mediating effect model[19]. The specific steps are as follows:

The first step is to test whether fiscal decentralization (FRE) affects green total factor productivity (GTFP), and if β1 is significant in equation (2), it indicates that fiscal decentralization affects green total factor productivity.

$$GTFP_{it} = \beta_0 + \beta_1 FRE_{it} + \theta X_{it} + \varepsilon_{it} \tag{2}$$

The second step is to test whether fiscal decentralization (FRE) affects energy conservation and environmental protection expenditure (PRO). If it is significant in equation (3), it indicates that fiscal decentralization will affect energy conservation and environmental protection expenditure.

$$PRO_{it} = \gamma_0 + \gamma_1 PRE_{it} + \eta X_{it} + \varepsilon_{it} \tag{3}$$

Finally, include both models in the variables. If the sum in equation (4) is significant, and the absolute value of the regression coefficient is less than the absolute value, then part of the mediating effect, that is, the impact of fiscal decentralization on green total factor productivity, comes partly from the transmission of energy conservation and environmental protection expenditure.

$$GTFP_{it} = \alpha_0 + \alpha_1 FRE_{it} + \alpha_2 PRO_{it} + \lambda X_{it} + \varepsilon_{it} \tag{4}$$

The following table shows the results of the test. From the test results of column (1), the coefficient is significantly positive. In model (2), the regression coefficient is also significantly positive. In model (3), the regression coefficient is 1% significantly positive, and the regression coefficient is significantly positive. In addition, compared with the regression coefficient in model (1), the absolute value of the regression coefficient in model (3) decreased, indicating that part of the impact of fiscal decentralization on green total factor productivity is through the intermediate variable of environmental inputs. Therefore, the research hypothesis 3 is valid. Therefore, we can conclude that fiscal decentralization affects the improvement of green total factor productivity through investment in multiple environmental protection fields, thereby promoting regional green development.

Table 5. Mediation effect test results

variable	Step 1	Step 2	Step 3
	Variable: GTFP	Variable: PRO	Variable: GTFP
	(1)	(2)	(3)
FRE	0.7381***	24.3176**	0.7187***
	(3.3113)	(2.0426)	(3.2293)
PRO			0.0013***
			(3.1205)
ROAD	-2.0121***	-41.9525***	-1.9574***
	(-8.8089)	(-3.6714)	(-8.5607)
GOV	-0.4440***	-1.1276	-0.4434***
	(-5.1059)	(-0.2589)	(-5.1092)
GI	-0.1067***	0.9811	-0.1080***
	(-4.5021)	(0.8271)	(-4.5627)
FDI	-1.2957***	20.1128	-1.3226***
	(-4.5328)	(1.4064)	(-4.6338)
Urban fixed effect	control	control	control
Year fixed effect	control	control	control
Constant terms	1.1926***	0.6478	1.1870***
	(12.7783)	(0.1312)	(12.7401)
R^2	0.3561	0.1211	0.3589
N	2510	2510	2510

5. Research Conclusion and Policy Recommendations

5.1. Research Conclusion

Using the panel data of 251 prefecture-level cities in China from 2011 to 2020, this paper puts forward a research hypothesis that local governments promote green total factor productivity by increasing environmental protection investment under the fiscal decentralization system, and further empirically tests. The conclusions drawn from the results are as follows: first, the benchmark test shows that from a national perspective, fiscal decentralization reform and the increase in environmental protection input are conducive to the growth of green total factor productivity, but the regional differences are obvious; Second, by constructing interactive items, it can be found that the comprehensive effect of fiscal decentralization and environmental protection input also has a promoting effect on green total factor productivity, and fiscal decentralization promotes the improvement of green total factor productivity by increasing environmental protection input. Third, the intermediary effect test can further prove that environmental protection input is an important way for fiscal decentralization to affect the level of green total factor productivity.

5.2. Policy Recommendations

Based on the above conclusions, this paper puts forward the following policy recommendations:

First, It is necessary to further optimize the reform of fiscal decentralization to promote green development. First of all, the central government can continue to delegate financial power appropriately, so as to make full use of the information advantages held by local governments, so as to solve environmental protection problems in a targeted manner. Second, the central government should further improve the incentive mechanism for officials' performance appraisal. We should not simply take "GDP first" as the most important indicator for official promotion assessment, we must adhere to the equal emphasis on economic development and green development, and emphasize the importance of "green GDP" in promotion assessment. In this way, local governments pay more attention to environmental protection and green development.

Second,The optimization and reform of the fiscal decentralization system should fully consider regional differences, take into account the level of local economic development, and take narrowing the economic gap as one of the goals of reform. There cannot be a "one-size-fits-all" approach, as the impact of fiscal decentralization on green TFP growth varies widely across regions. For example, compared with the east, the western region has a lower economic aggregate base and economic development potential than the eastern region, so the western region is relatively weak in terms of industrial structure optimization, the introduction of high-quality FDI and innovation ability due to insufficient financial funds, which is not conducive to the growth of green total factor productivity.

Third,Increase financial investment in the field of environmental protection. Increase the scale of environmental protection expenditure and further make up for the shortcomings of fiscal decentralization in promoting regional green development. Further promote the reform of vertical leadership of environmental protection departments, so that environmental protection departments can have more autonomy. In addition, it can also attract many foreign investors through preferential tax incentives and other preferential policies, so that they can join the investment in the field of environmental protection, so that the development of the environmental protection industry has more financial support and promotes the dual development of the economy and the environment.

Finally,It is necessary to ensure the necessary intensity of environmental protection expenditure, but at the same time, it is necessary to continuously and dynamically optimize the expenditure structure, and ensure that the financial funds required for green development can

be used rationally and efficiently. At the same time, environmental protection investment should fully consider regional differences, because environmental protection investment has different effects on the green development of each region, therefore, for each place, it is not possible to increase environmental protection expenditure in one fell swoop, but to consider the current situation of regional economic development, targeted investment in the lack of environmental governance, optimize the environmental protection investment structure, and help improve the level of regional green total factor productivity.

References

[1] FAN Ziying, ZHANG Jun. Fiscal Decentralization and the Efficiency of China's Economic Growth: An Analysis Based on Undesired Output Model[J]. Management World,2009,(07):15-25+187.

[2] ZHANG Zhang,ZHENG Yanxi,LI Yujiao. Fiscal decentralization, government behavior and the growth of green total factor productivity[J]. Journal of Finance and Economics,2020,(03):22-33.

[3] ZHANG Rui,WANG Geyi,SUN Xialing. Financial decentralization, industrial structure and high-quality development of the Yellow River Basin[J]. Economic Issues,2020,(09):1-11.

[4] CHENG Zhonghua,JIN Wei. Does fiscal decentralization affect China's green economic growth? [J]. Journal of Finance and Trade,2021,32(03):69-84.

[5] LI Bin,QI Yuan,LI Qian. Fiscal Decentralization, FDI and Green Total Factor Productivity: An Empirical Test of Dynamic GMM Method Based on Panel Data [J]. Journal of International Trade, 2016,(07):119-129.

[6] XIA Liang,ZHU Lianmei,WANG Xiaodong. Environmental regulation, fiscal decentralization and green total factor productivity[J]. Statistics and Decision,2021,37(13):131-135.

[7] Esther W. Dungumaro,Ndalahwa F. Madulu. Public participation in integrated water resources management: the case of Tanzania[J]. Physics and Chemistry of the Earth,2003,28(20).

[8] MORETTI E. Workers'education, spillovers, and productivity: Evidence from plant-level production functions[J].American Economic Review, 2004, 94(3).

[9] Wang Yafei. Analysis of the impact of public financial environmental protection investment on environmental pollution[J]. Journal of Fiscal Research,2011,(02):38-42.

[10] Li Kaijie. Does Environmental Expenditure Promote Economic Growth?-- Research Based on Provincial Panel Data[J]. Journal of World Economy,2014,(12):77-83+86.

[11] YANG Zhi'an, WANG Jiaying. Fiscal Decentralization and Green Total Factor Productivity: A Test Based on Systematic GMM and Threshold Effect[J]. Ecological Economy,2018,34(11):132-139.

[12] Jin Dianchen, Chen Xin, Chen Xu. Fiscal Decentralization, Environmental Protection Investment and Environmental Governance: An Empirical Study Based on China's Provincial Panel[J]. Ningxia Social Sciences,2020,(04):77-85.

[13] HU Lina, XUE Yang. Fiscal environmental protection expenditure, fiscal pressure and green development[J]. Soft Sciences: 1-13.

[14] ZHANG Xuna, WU Jianluan, LU Shanbing. Has the Belt and Road Initiative Improved the Level of Green Technology Innovation of Chinese Enterprises[J]. Scientific and technological progress and countermeasures:1-12.

[15] ZHANG Jun, SHI Shaohua. Changes in Total Factor Productivity of China's Economy: 1952-1998[J]. World Economic Papers,2003,(02):17-24.

[16] WU Jiansheng, NIU Yan, PENG Jian, WANG Zheng, HUANG Xiulan. Energy consumption dynamics of prefecture-level cities in China from 1995 to 2009 based on DMSP/OLS night lighting data[J]. Geographical Research,2014,33(04):625-634.

[17] WANG Ping, CAI Ling. Export Product Quality and Development of China's Urban Green Transformation: A Study Based on Green Total Factor Productivity[J]. Ecological Economy,2022, 38(08):72-79.

[18] DONG Xiangshu, WEI Yuanyuan, XIAO Xiang. How does fiscal decentralization affect green innovation? Chinese Resources and Environment,2022,32(08):62-74.

[19] Zheng Wei, Lu Yuanquan. Fiscal pressure, technological innovation and green total factor productivity[J]. Journal of Guizhou University of Finance and Economics,2021,(04):101-110.