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A Study on the Impact of Fiscal Decentralization on Regional Green Development: A Perspective Based on the Emphasis on Sports

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Abstract: From the perspective of institutional economics, we investigate the impact of fiscal decentralization on regional green development in China and its transmission mechanism through influencing sports fiscal expenditures on regional green development. Based on panel data of Chinese provincial regions from 2006 to 2017 in China, we use fixed effects models, two-stage least squares, and mediating effects models to find that fiscal decentralization accelerates regional green sustainability. Fiscal decentralization can enhance the government's emphasis on sports and promote the smart and intelligent development of the sports and health industry, thus contributing to the improvement of green and sustainable development. There is regional heterogeneity in the effect of the governmental emphasis on sports, and the mediating effect of the degree of emphasis on sports is more obvious in the eastern region. We verify the possibility that the government can accelerate economic green sustainability by raising the importance of the sports and health industry development and promoting the intelligent infrastructure of sports and enrich the theoretical study of the ecological effect of fiscal decentralization from the perspective of sports economic development.

Keywords: economic green sustainability; fiscal decentralization; government emphasis on sports; the intelligent development of sports; mediating effect

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1. Introduction

The essence of human society's advancement is in the history of the evolution of the relation between human beings and nature [1]. While industrial civilization has created a huge material civilization for human society, it has also intensified the conflict between man and nature. The key to human survival and development lies not only in our own institutional arrangements and technological innovations, but also in how to live in harmonious coexistence with the Earth through the construction of a reasonable circular economy system to achieve green and sustainable development, which has become a problem that needs to be solved by all mankind. The United Nations Environment Programme (UNEP) has provided an important interpretation of sustainable development. They emphasize the importance of green and sustainable development in science and technology innovation, economic development, social peace and ecological environment construction [2,3]. With China's rapid economic growth, its carbon emissions have grown at a high rate of speed and have surpassed those of America to become the top carbon producer, and the pressure on its ecological environment is increasing daily, which has severely tested the regional environmental bearing capacity [4]. In a reality where technologies such as the Internet of Things are booming and ecological pressures are gradually increasing, a circular economic development approach is more in line with the goal of sustainable economic development in each country than the traditional economic model. Therefore, what should we do to

build a rational circular economy system that will improve economic sustainability? This is the focus of our study.

As the policy designer of economic development, the leader of green transformation and the builder of an ecological civilization society, the government is of great importance in promoting regional green sustainable development. Fiscal expenditure, as one of the main means of government participation in regional construction [5], is the key to promoting regional green sustainable development. Fiscal decentralization is an institutional arrangement that involves the transfer of fiscal powers from the central government to local governments. It aims to achieve a dispersion of political power at the national level and empower local governments with autonomy and responsibility in fiscal matters, enabling them to cater to diverse local needs and characteristics [6]. Fiscal decentralization is an essential element affecting regional government fiscal spending [7] and has a crucial effect on regional green sustainable development [8].

Some studies have demonstrated that fiscal decentralization can impede green sustainable development in the region. Kunce (2007) [9] found that governments with higher fiscal autonomy can engage in "bottom-by-bottom competition", leading regional governments to automatically lower environmental criteria, thereby increasing environmental pollution and creating serious ecological problems. Zeng et al. (2020) [10] showed that fiscal decentralization affects regional ecotourism development, which hinders the improvement of regional green sustainable development. Some studies point out the lack of correlation between fiscal decentralization and regional green sustainability. Wu (2014) [11] found that fiscal decentralization is not important among the factors affecting the degree of green sustainable development in central districts and western districts. In addition, its role is extremely limited, which may be caused by its geographical location and economic development level. Xue and Pan (2012) [12] explored the relation between the scale of local environmental pollutant emissions in China and fiscal decentralization and found that the relation between fiscal revenue decentralization and emissions of environmental pollutants was not clear. Some studies also suggest that fiscal decentralization may have an inverted U-shaped relationship with green sustainable development in the region due to the existence of the complex behavioral motivations of local governments [13].

Obviously, studies on the impact of fiscal decentralization on green sustainability have yielded conflicting results. Zhang (2018) [14] argues that environmental issues stem from the economic development model, not fiscal decentralization. The imperfect incentive mechanism under fiscal decentralization leads to biased choices in environmental governance. Fiscal decentralization, as an institutional arrangement, gives regional governments a strong incentive to develop their economies and can encourage regional governments to aim for a high degree of integration between environmental protection and economic development under the premise of clear direction in policy documents, thus promoting green sustainable development in the region [15]. Similarly, some scholars have concluded that fiscal decentralization has an important effect in promoting regional ecological optimization and green transformation [16]. Fiscal decentralization has been widely studied in the context of its impact on regional development and governance [6,17]. It is understood that delegating fiscal responsibilities to sub-national governments can enhance local decision-making and resource allocation, potentially leading to more effective and sustainable development strategies [18]. In recent years, there has been a growing body of research examining the relationship between fiscal decentralization and the promotion of green development [19,20].

The government's attention to green sustainable economic and social development is increasing, yet it still does not pay enough attention to the ecological effects of sports and the sports industry [21,22]. Researchers and policy-makers have also ignored the ecological effects of the sport and health business. In recent years, the concept of local government support for sports and health industries and thus the promotion of green sustainable development has gradually gained attention [23,24], and carrying out the concept of green sustainable development and expanding channels of green sustainable

development to enhance the quality of regional development is important. Concomitantly, sports have been recognized as playing a significant role in regional development, with various studies highlighting the positive socio-economic impacts of hosting sports events and investing in sports infrastructure [25]. Sports events and facilities can attract tourists, boost local economies, and contribute to urban regeneration and community cohesion [26]. Furthermore, sports can serve as a platform for promoting environmental awareness and sustainable practices [27].

Existing studies examine the impact of governmental sports fiscal expenditure on regional sustainable development [1] and carbon emissions [28]. However, few studies focus on the relationship between fiscal decentralization, sports fiscal expenditure, and regional green development in sports economic development. To bridge this gap, our study aims to investigate the relationship between fiscal decentralization, financial expenditures on sports, and regional green development in China's provinces. By integrating insights from previous research on fiscal decentralization, green development, and sports economics, our research seeks to shed light on how fiscal decentralization affects regional green sustainability, and whether it influences the extent of regional green sustainability by changing the government's emphasis on sports development.

The Chinese-style fiscal system is an important institution that changes the level of support for sports and influences regional green sustainable development [29,30]. On the basis of the above analysis, we effectively expand the study on the ecological effects of fiscal decentralization. Our study's marginal contributions are primarily as follows. First, our investigation of the ecological effects of fiscal decentralization is based on the perspective of sports development. With the concept of "Green Olympics" for the Beijing Winter Olympics, green sports have gradually gained popularity, and sports and the green economy have been closely linked [31]. It is not only appropriate but also necessary to explore fiscal decentralization's ecological effects from the standpoint of sports development. We explore the influence of fiscal decentralization on green sustainable development from the standpoint of government support for sports, which can enrich the research on the ecological effects of fiscal decentralization. Second, since the fiscal revenues of local governments have an important influence on fiscal expenditure behavior [32,33], we use fiscal revenue decentralization to evaluate the level of local government fiscal decentralization, which can better reflect the degree of regional fiscal autonomous rights. Third, we further analyze the regional variability of the mediating effect of the government's emphasis on sports based on the validation of the ecological effects of fiscal decentralization. Thus, our study enriches the research related to the ecological effects of fiscal decentralization from the perspective of sports development and provides a strong empirical basis for local governments to support the development of sports.

We explore the relationship between fiscal decentralization, the degree of governmental emphasis on sports, and regional green sustainability building using Chinese provincial panel data. China is chosen as the study subject mainly because of the following considerations. China is the largest developing country in the world and has significantly improved its economic development level; yet, similar to other developing countries, it has accumulated many ecological problems under its long-term growth-first development strategy. The need for improving China's economic system, the strategic arrangement for high-quality development of the sports economy and the ecological and environmental pressures faced provide realistic conditions for our study. Therefore, our study based on the Chinese sample can not only enrich the theoretical analysis of fiscal decentralization's ecological effects from the perspective of institutional economics, but also clarify the possibilities of local governments to accelerate green sustainable development by supporting sports and health industries.

2. Theoretical Framework

Building a suitable circular economy system and promoting the development of a green and healthy economy is an indispensable way to achieve carbon neutrality and carbon

peaking, which is also an inevitable choice for sustainable economic development. The fiscal decentralization system is an important system that influences government behavior, which profoundly affects sustainable green development. The assumption is that constitutional asymmetry may put at risk equality, cohesion, and transparency and therefore undermine the legitimacy and stability of a system. This leads us to a valid research objective, which is to provide a legal analysis of whether constitutional asymmetry is a condition for or a threat to equality in contemporary decentralized systems. Therefore, according to the first-generation theory of fiscal federalism, when local governments gain fiscal autonomy through fiscal decentralization, they may take advantage of information to form a strong link with the preferences of local residents and optimize government spending under fiscal constraints, which can maximize the welfare of regional voters [20,34,35]. As China enters a new stage of development, residents are increasingly focused on cultural and spiritual pursuits, which have driven a green and healthy economy to emerge swiftly. To meet the needs of residents, local governments change their preferences for fiscal expenditure, thus affecting regional green sustainability. On the grounds of the second-generation theory of fiscal federal government, with increased fiscal autonomy, local governments actively provide public services under the tax incentive target. This is because the improved quality of public services promotes market development, which in turn promotes more prosperous economic activities that generate greater tax revenues and thus a sustainable regional economic development [1,36]. According to the demand effect, the government may change the structure of fiscal expenditure, thus promoting public service development in the area of green health. Under the Chinese-style system, fiscal decentralization with the characteristics of political centralization can effectively enhance local government incentives to develop the economy [37], and the use of information advantages enables the development of institutional arrangements coordinated with regional green sustainable development and promotes institutional innovation among governments, thus achieving successful regional green sustainable development and economic system reform.

According to the theory related to fiscal decentralization, the effects of fiscal decentralization on green sustainable development are reflected in the following two aspects. Due to the continuous optimization of the promotion mechanism for government officials, the main responsibility of local governments to realize ecological civilization construction and green sustainable development is significantly strengthened under the fiscal decentralization system. The emphasis on green infrastructure and public service system construction increases, and the fiscal support for green economic development increases, which may effectively improve green total factor productivity (gtfp) and thus promote regional green sustainable development. Therefore, we propose the following hypothesis:

Hypothesis 1. *Fiscal decentralization can promote regional green sustainable development.*

The vigorous development of sports business is closely related to the green development of the region. From the supply side, the government increases fiscal support for sports; on the one hand, it could develop intelligent manufacturing and green materials [38] and integrate green concepts into the whole process of production, transportation and sales of sports manufacturing enterprises, which in turn could effectively enhance the green development of the region. On the other hand, it could explore the development of green fitness and the leisure industry and create green fitness and leisure demonstration areas and new models [39], which is conducive to promoting the green development of the region. From the demand side, the government could hold large-scale sports events through fiscal support, guide the public to change their lifestyles, pay attention to cultivating resident sports health and wellness habits, and advocate green and low-carbon living, thus promoting regional green development [40].

Stability is an indispensable prerequisite for reform and development, which also provides a solid foundation for social stability and long-term national security [41]. In June 2016, the Chinese government issued a document clearly proposing to implement the

National Fitness Plan (2016–2020), requiring increasing the investment of relevant funds and establishing a diversified fund-raising mechanism. In addition, local governments above the county level should include funds related to the work of national fitness in the fiscal budget and gradually increase investment in national fitness as the national economy continues to develop (http://www.gov.cn/gongbao/content/2016/content_5088765.htm, accessed on 2 May 2023). In 2019, China's State General Administration of Sports and China's Economic Development and Reform Commission further released the "Action Plan to Further Promote Sports Consumption (2019–2020)" document which clearly states that governments at all levels are expected to contribute to promoting the development of national fitness wisdom. It is believed that local governments should enhance the importance of sports and develop diversified and intelligent sports products by combining wearable devices, virtual reality technology and Internet of Things management platforms to achieve high-quality development of sports and health. Currently, under the strategic goals of pursuing "carbon neutrality", "carbon peak" and building a sports power, it is important to properly address the relationship among the improvement of the fiscal decentralization system, sports development and regional green sustainable development. The sports industry contains a variety of green development factors that are associated with regional green sustainability. Green and healthy sports activity attributes profoundly affect green sustainable development [42]. When the government increases fiscal support for sports, the green industry of the region is developed under the policy incentive, thus achieving the goal of sustainable development [1]. At this time, the ecological effect of sports development is fully reflected. From the supply perspective, the government's increasing attention and fiscal support for sports efficaciously achieve green sustainability in the region. The government can support industrial integration and integrate the green low-carbon concept into the whole process of production, transportation and sales of sports manufacturing enterprises to produce low-carbon sports clothing, shoes, hats and equipment, thus realizing green sustainable development. From the demand perspective, governments may accelerate regional green sustainability by fiscal support for organizing extensive sports events after raising the importance of sports, guiding residents to transform their way of life, attaching attention to forming the sports health and wellness customs of the residents, and advocating low-carbon living for residents. In summary, we propose the following hypothesis:

Hypothesis 2. *Fiscal decentralization tends to promote green sustainable regional development by increasing the government's emphasis on sports.*

In the process of fiscal decentralization to enhance regional green sustainable development, there are differences in the importance of local governments' emphasis on sports in different regions.

On the one hand, from the statistics of historical development, the higher the level of economic development of a region, the more important the sports industry in the regional economy [1], and the better the effect of fiscal support for sports in that region. The eastern area has a higher quality of economic development, and regional residents may place higher importance and demand on physical and mental health as well as physical activity. Due to the difference in consumer demand effects, the impact of fiscal support differs from region to region, making the transmission path of fiscal decentralization through supporting sports development and thus influencing regional green sustainable development significantly different. On the other hand, the optimization path of the economic structure is mainly to increase the ratio of tertiary industry. Regions with a higher level of economic development also tend to have more mature service industry development [43], and sports industries, as an important component of service industries, play an integral part in the optimization of the economic structure in the region. Under the premise of increased fiscal autonomy, local governments may be more willing to strengthen their fiscal support for sports and health, effectively promoting the optimization of economic structure in the region and

thus achieving green sustainable development. In summary, we propose the following hypothesis:

Hypothesis 3. *There is regional heterogeneity in the mediating effect of governmental emphasis on sports when fiscal decentralization affects regional green sustainable development through governmental emphasis on sports.*

3. Methodology

3.1. Data

We search for the relationship among fiscal decentralization, emphasis on sports, and regional green sustainable development on the basis of relevant data from provincial areas in China. We exclude some regions, including Tibet and Hong Kong, Macao and Taiwan, which are mainly limited by the lack of completeness of publicly available data for some regions. On the one hand, our data start in 2006 mainly because the Chinese government's fiscal and taxation statistics have been reformed since 2006, and this approach allows us the guarantee of the uniformity in the statistical caliber of the study sample. Moreover, the Chinese government's 11th Five-Year Plan of 2006 clearly states that economic development should emphasize sustainability and that energy saving and emission reduction are crucial goals for social development. On the other hand, we obtained data on fixed asset investment in sports through 2017 by requesting it via official channels. To ensure the completeness of the data and the smoothness of the research process, we used data related to provincial areas from 2006 to 2017.

In addition, there are four main sources of data that we use in the research process of this paper. The first is the data related to green total factor productivity (gtfp). The original data come from the China Energy Statistical Yearbook and China Environmental Statistical Yearbook, which are officially disclosed by China. The second is data related to fixed asset investment in sports, mainly from the China Fixed Asset Investment Yearbook. The third is the raw data related to fiscal decentralization and control variables, which we compiled on account of the data published by China's National Bureau of Statistics and the statistical yearbooks of each provincial region (if you have questions about the data, you can contact us.).

3.2. Variable Description

3.2.1. Dependent Variable

Green total factor productivity (gtfp) takes environmental factors into account and is able to measure the relationship between economic growth and environmental protection. It can assess the environmental impact and efficiency of resource use while achieving economic growth in a region, which enables a better assessment of the region's overall performance in terms of sustainable development [44,45]. Therefore, we use *gtfp* to characterize the level of regional green sustainable development. We use the extended model of the data envelopment approach (DEA) and the Malmquist Index to measure *gtfp*. For indicator selection and treatment, we draw on the specific input–output indicators and treatment from Feng and Zhang (2017) [46], as shown in Table 1.

First, we assume the existence of j provinces, each with input–output variables denoted as (x_j, y_j, u_j), $j = 1,\ldots, n$, where $x_j = (x_{1j}\ldots, x_{ij}\ldots, x_{mj})$ is the input vector, $y_j = (y_{ij}\ldots, y_{rj}\ldots, y_{sj})$ is the desired output vector, and $u_j = (u_{1j}\ldots, u_{wj}\ldots, u_{vj})$ is the undesired output vector. The assumption of strong disposability of inputs means that all producers want to emit fewer pollutants and can be expressed as $(x,y) \in T$, and there exists $(\overline{x}, y)$, where $\overline{x}$ satisfies $\overline{x}_i \geq x_i$ and $\overline{x}_m = x_m$, $m \neq s$, then $(x,y) \in T$. Then, the mathematical expression of the production possibility set is written as T_s:

$$T_s = \begin{cases} y_{r0} \le \sum_{j=1}^{n} y_{rj}\lambda_j, \ r = 1, \ldots, s \\ u_{v0} \ge \sum_{j=1}^{n} u_{wj}\lambda_j, \ w = 1, \ldots, v \\ x_{i0} \ge \sum_{j=1}^{n} x_{ij}\lambda_j, \ i = 1, \ldots, m \\ \lambda_j \ge 0, \ j = 1, \ldots, n \end{cases} \quad (1)$$

Second, the slack problem occurs after we fully consider the possible excess of specific inputs and the possible insufficiency of outputs. We refer to SBM put forward by Tone (2001) [47] under the assumption of strong disposability to measure the *gtfp* of a region.

$$S_0(x_0, y_0, u_0) = \min \frac{1 - \frac{1}{m}\sum_{i=1}^{m} \frac{S_i^x}{x_{i0}}}{1 + \frac{1}{s+v}\left(\sum_{r=1}^{s} \frac{S_r^y}{y_{r0}} + \sum_{w=1}^{v} \frac{S_w^u}{u_{w0}}\right)} \quad (2)$$

Among them, S_i, S_r and S_w represent the slacks of input, expected output and unexpected output, respectively.

Third, we use the Malmquist Index to calculate the index of *gtfp*, as shown in Equation (3):

$$ML_0 = \left[\frac{\theta_0^t(x_0^t, y_0^t)}{\theta_0^t(x_0^{t+1}, y_0^{t+1})} \times \frac{\theta_0^{t+1}(x_0^t, y_0^t)}{\theta_0^{t+1}(x_0^{t+1}, y_0^{t+1})}\right]^{\frac{1}{2}} \quad (3)$$

Table 1. Input–output variables for calculating green total factor productivity (*gtfp*).

	Variables	**Notes**
Input variables	Labor inputs	Number of employed persons at year-end (10,000)
	Capital inputs	Stock of fixed capital (100 million)
	Energy inputs	Energy consumption (10,000 tons of standard coal)
Expected output variables	Regional economic development Levels	Actual GDP (100 million)
Non-desired output variables	Pollutant emissions	Chemical oxygen demand in industrial wastewater (10,000 tons) SO_2 emissions in industrial waste gas (10,000 tons)

3.2.2. Independent Variable

Existing studies have mostly measured fiscal decentralization in the form of fiscal expenditure decentralization, while revenue distribution is what affects the extent of fiscal autonomy of local governments. As a consequence, we take a more appropriate revenue decentralization to characterize the extent of fiscal decentralization. In the process of exploring Chinese-style fiscal decentralization, we should construct suitable fiscal decentralization indicators. Although Lin and Liu (2000) [48] use the marginal share of government revenue to measure the level of fiscal decentralization, this index lacks the effect of measuring the time dimension. We refined it according to Zhu et al. (2020) [49] by constructing fiscal decentralization indicators as shown in Equation (4):

$$fd\_rev = \frac{\frac{FR_i}{POP_i}}{\frac{FR_i}{POP_i} + \frac{FR_c}{POP_n}} \times \left(1 - \frac{GDP_i}{GDP_n}\right) \quad (4)$$

where n, c, and i indicate the national, central, and provincial indicators, respectively. *fd_rev* indicates the degree of fiscal revenue decentralization. *FR* indicates the government's general budget revenue. *POP* indicates the regional population size. *GDP* indicates the

gross regional product. *fd_rev* represents fiscal decentralization, and a larger value of *fd_rev* indicates a higher level of fiscal decentralization, which indicates that local governments also have more fiscal autonomy.

3.2.3. Mediating Variables

When we measure the degree of emphasis on sports by the government (*sports_focus*), we propose to use the amount of investment or fiscal expenditure to measure it. Drawing on the measurement method of sports fiscal expenditure of Wang et al. (2022) [1], we use the amount of investment in fixed assets in sports to characterize the importance of sports. We take 2006 as the initial year of data processing. When calculating the stock of investment in fixed assets in sports, we use the perpetual inventory method and take logarithms.

3.2.4. Control Variables

In addition, we control the variables that may affect regional green sustainable development. First, we argue that gross regional product per capita (*gdp*) is a control variable that cannot be ignored. This is because as the income level of residents rises and the technology level improves, the lifestyle of residents may develop in the green direction. Therefore, the *gdp* is an important indicator of the progress of regional green development, which we express in terms of real GDP per capita. Second, the degree of foreign openness (*fdi*) may favor the development of the renewable energy industry [50], and the behavior of foreign investment may also promote the development of the energy industry and thus influence the green development of the region. Therefore, we use the quantity of real foreign direct investment per capita to express it. The third is regional R&D expenditure (*r&d*), which can promote local science and technology innovation and thus significantly influence the green development level [51]. We measure it by the ratio of change in regional R&D expenditure. The fourth is regional population density (*upd*), a vital factor affecting the regional ecological environment, and we use the regional urban population density to represent it. The fifth is the consumption level (*consump*). The consumption level of regional residents has an important impact on the lifestyle of residents and the development of regional industries, thus affecting regional green sustainability [28]. We measure it by the regional per capita consumption level of residents. Moreover, to avoid errors caused by extreme values, we perform a one-sided 1% tail reduction on the data. The descriptive statistics of the variables involved in the research process of this paper are shown in Table 2.

Table 2. Descriptive statistics of variables.

Variables	N	Mean	Median	Std. Dev	Min. Value	Max. Value
gtfp	360	1.245	1.154	0.295	0.823	2.476
fd_rev	360	0.469	0.446	0.128	0.260	0.788
fd_exp	360	0.804	0.804	0.065	0.632	0.933
sports_focus	360	12.993	13.070	1.321	8.711	15.262
gdp	360	4.053	3.569	2.389	0.579	11.820
fdi	360	0.108	0.069	0.130	0.001	0.708
r&d	360	2.028	−0.196	6.627	−0.946	40.760
upd	360	0.279	0.256	0.123	0.060	0.594
consump	360	0.786	0.607	0.445	0.380	2.478

4. Regression Analysis

4.1. Baseline Regression Analysis

To test Hypothesis 1, which demonstrates the effects of fiscal decentralization on the green sustainable development of regions, we set the basic regression model,

$$gtfp_{it} = \beta_0 + \beta_1 fd\_rev_{it} + \sum_{j=2}^{6} \beta_j X_{it} + \varepsilon_{it} \quad (5)$$

where *gtfp* represents the level of green sustainable development of regions, *fd_rev* represents the level of fiscal decentralization, and its coefficient β_1 is our focus. *X* represents the collection of control variables. β_0 is a constant term, and ε_{it} is a random interference term.

We estimate Equation (5) using a two-way fixed effects model, and Regression (1) to Regression (6) are validated by gradually adding control variables. As shown in Table 3, the estimated coefficients of fiscal decentralization (*fd_rev*) on regional green sustainability are all significantly positive and statistically significant at the 5% level. The value of *adj.* R^2 increases continuously from 0.777 to 0.836 during the gradual inclusion of control variables, which indicates a good and increasing model fit. According to the regression results, it can be seen that in the process of increasing the degree of fiscal decentralization, the fiscal autonomy of local governments is significantly increased, and they may pay more attention to regional sustainable development goals, adjust the direction of fiscal expenditures, and increase fiscal support for enhancing ecological and environment-related fields, which promotes green development enhancement and regional green development. This is consistent with the results of Zhang and Wang (2021) [52] and Xia et al. (2021) [16].

Table 3. Baseline regression result.

	(1) *gtfp*	(2) *gtfp*	(3) *gtfp*	(4) *gtfp*	(5) *gtfp*	(6) *gtfp*
fd_rev	0.658 **	0.755 ***	0.749 ***	0.847 ***	0.999 ***	1.322 ***
	(0.283)	(0.255)	(0.259)	(0.265)	(0.263)	(0.265)
gdp		0.109 ***	0.108 ***	0.105 ***	0.101 ***	0.073 ***
		(0.013)	(0.014)	(0.014)	(0.013)	(0.015)
fdi			0.022	−0.023	−0.028	−0.162
			(0.161)	(0.163)	(0.160)	(0.158)
r&d				−0.010 *	−0.010 *	0.001
				(0.006)	(0.006)	(0.006)
upd					0.529 ***	0.534 ***
					(0.145)	(0.141)
consump						0.727 ***
						(0.163)
constant	0.936 ***	0.451 ***	0.454 ***	0.444 ***	0.241 *	−0.379 *
	(0.133)	(0.132)	(0.135)	(0.134)	(0.143)	(0.196)
Province	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
N	360	360	360	360	360	360
adj. R^2	0.777	0.819	0.818	0.819	0.826	0.836

Notes: The values in brackets are standard deviations. ***, ** and * indicate that the estimated coefficients are significant at the confidence levels of 1%, 5% and 10%, respectively.

4.2. Robustness Checks

To check the robustness of the effectiveness of fiscal decentralization on the level of regional green sustainability, this paper adopts the following approach for robustness checks, as shown in Table 4. First, we do not include the economic growth rate and industrial structure as control variables in the baseline regression. Obviously, regional green sustainable development is closely related to factors such as the rate of economic growth and the level of rationalization of the regional industrial structure. On the one hand, when local economic development focuses more on the economic growth rate, an excessively fast growth rate can cause economic actors to neglect the maintenance of the regional ecological environment. On the other hand, the process of rationalization of industrial structure focuses more on the ecological effects of economic development. Therefore, we further introduce the economic growth rate and the level of rationalization of the regional industrial structure as control variables for robustness checks. The economic growth rate is expressed as the nominal GDP growth rate, while the degree of industrial structure rationalization is borrowed from Wang et al. (2022) [1]. To intuitively express the correlation, we perform reciprocal processing. Data for the above variables are obtained

from the Chinese National Bureau of Statistics. The results of the regression are shown in Model (1). After controlling for the economic growth rate and the level of rationalization of the regional industrial structure, it is statistically significant at the 1% level, which indicates that fiscal decentralization can facilitate green sustainability in the region.

Table 4. Robustness checks.

	(1) Add Control Variables	(2) Replace Independent Variable	(3) Adjust Sample Size
fd_rev	1.264 ***		1.457 ***
	(0.273)		(0.303)
fd_exp		3.813 ***	
		(0.505)	
gdp	0.073 ***	0.096 ***	0.098 ***
	(0.015)	(0.014)	(0.016)
fdi	−0.153	−0.152	−0.690 ***
	(0.158)	(0.149)	(0.172)
r&d	0.002	0.002	0.002
	(0.006)	(0.006)	(0.003)
upd	0.548 ***	0.500 ***	0.584 ***
	(0.142)	(0.134)	(0.159)
consump	0.794 ***	0.913 ***	0.981 ***
	(0.172)	(0.159)	(0.174)
rationalize	−0.003		
	(0.002)		
gdpr	−0.076		
	(0.243)		
constant	−0.381 *	−3.057 ***	−0.697 ***
	(0.197)	(0.472)	(0.215)
Province	YES	YES	YES
Year	YES	YES	YES
N	360	360	360
adj. *R* *	0.836	0.850	0.814

Notes: The values in brackets are standard deviations. *** and * indicate that the estimated coefficients are significant at the confidence levels of 1% and 10%, respectively.

Second, in consideration of the important impact of income distribution on regional expenditure autonomy, we use fiscal revenue decentralization to estimate the degree of fiscal decentralization in the baseline regression. Undeniably, fiscal expenditure decentralization can also indicate the level of fiscal decentralization. Therefore, we establish the fiscal expenditure decentralization index to explore the impact of fiscal decentralization on regional green sustainability by replacing the data related to fiscal revenue with fiscal expenditure according to Equation (4). The regression results are shown in Model (2). The estimated coefficient of fiscal decentralization remains significantly positive and statistically significant at the 1% level, which indicates that fiscal decentralization can enhance regional green sustainability.

Third, in the baseline regression, we apply a one-sided 1% tail shrinkage to all variables to avoid possible estimation bias. However, this treatment may obscure some important data. Therefore, we perform a re-estimation using the full sample data, and the regression results are shown in Model (3). The estimated coefficient of fiscal decentralization on the dependent variable is still significantly positive and statistically significant at the 1% level, further confirming the conclusion that fiscal decentralization can enhance regional green sustainable development.

4.3. Addressing Endogeneity Problems

In addition, there are many factors affecting the extent of regional green sustainability, and the lack of statistical data means that some potential influencing factors cannot be quantified, which inevitably generates omitted variables and thus leads to endogeneity problems. On the other hand, the existing statistical data may have errors leading to endogeneity problems. To alleviate the impact of endogeneity problems on the paper, we use lagged one-period fiscal decentralization (*L.fd_rev*) as the instrumental variable and perform further analysis using two-stage least squares regression (*2SLS*) and iterative GMM estimation (*igmm*). The estimated results are shown in Table 5.

Table 5. Estimation of instrumental variables.

	(1) **Phase 1** ***fd_rev***		**(2)** **Phase 2** ***gtfp***	**(3)** ***gtfp***
fd_rev			1.302 ***	1.302 ***
			(0.332)	(0.332)
iv	0.816 ***			
	(0.037)			
gdp	−0.003		0.075 ***	0.075 ***
	(0.002)		(0.018)	(0.018)
fdi	0.083 **		−0.241	−0.241
	(0.036)		(0.257)	(0.212)
r&d	0.002		0.003	0.003
	(0.001)		(0.008)	(0.008)
upd	0.004		0.514 **	0.514 **
	(0.022)		(0.223)	(0.227)
consump	−0.022		0.785 ***	0.785 ***
	(0.021)		(0.227)	(0.227)
constant	0.044		−0.823	−0.823
	(0.049)		(0.413)	(0.413)
Province	YES		YES	YES
Year	YES		YES	YES
Shea's adj. partial R^2		0.635		
Robust F		502.976 (p = 0.000)		
Minimum eigenvalue statistic		622.94		
N	330		330	330
adj. R^2	0.989		0.871	0.871

Notes: The values in brackets are standard deviations. *** and ** indicate that the estimated coefficients are significant at the confidence levels of 5% and 10%, respectively.

For the question of whether there is a weak IV, we judge it based on the relevant indicators. The *p*-value of the F test is 0.000, and the value of the minimum eigenvalue statistic (622.94) is far more than 10, which indicates that there is no weak instrumental variable. Model (1) and Model (2) are the results of the first-stage and second-stage estimation of the least squares method, respectively. From the first-stage regression results, the estimated coefficient of the instrumental variable on fiscal decentralization is significantly positive and statistically significant at the 1% level, indicating that the level of fiscal decentralization in the previous period has an inertial effect on fiscal decentralization in the subsequent period; that is, it has continuity. From the second-stage regression results, the estimated coefficients of fiscal decentralization on regional green sustainability are all positive and statistically significant at the 1% level, showing that the increase in fiscal decentralization can promote the improvement of regional green sustainability. Model (3) is an iterative GMM model, and it is clear that the effect of fiscal decentralization on regional green sustainability is also significantly positive, which is generally consistent with the estimation results of the two-stage least squares regression (*2SLS*). In summary, Hypothesis 1 is

verified. This result strongly suggests that when sub-national governments have control over financial resources, they are more likely to invest in environmentally friendly projects, such as those related to renewable energy, waste management, and ecological conservation, thereby fostering regional green development.

In addition, we further investigate whether the effects of fiscal decentralization on regional green sustainability are regionally heterogeneous. We divided the sample regions according to the principle of administrative division, mainly including eastern and non-eastern regions. The estimated results are shown in Table 6. On the one hand, the estimated coefficients of fiscal decentralization on green sustainability are found to be significantly positive and statistically significant at the 5% level in both eastern and non-eastern regions. This provides robust evidence supporting the positive ecological effects of fiscal decentralization systems, confirming their universality across regions. On the other hand, from the regression coefficient of fiscal decentralization, the effect is higher in eastern regions than in non-eastern regions. This suggests that local governments in economically prosperous areas are more attentive to the ecological impacts of their actions, likely due to higher awareness of environmental issues and greater resources available for environmentally friendly initiatives. In relatively economically underdeveloped regions, the correlation between local governments' actions and regional green sustainable development is less pronounced. This indicates that there is room for improvement in these regions to strengthen the link between fiscal decentralization measures and sustainable green development outcomes. Therefore, the results of the regional heterogeneity analysis show that the effectiveness of fiscal decentralization on regional green development has regional heterogeneity.

Table 6. Analysis of regional heterogeneity.

	(1) **The Eastern** ***gtfp***	**(2)** **The Non-Eastern** ***gtfp***
fd_rev	1.371 **	1.215 ***
	(0.566)	(0.357)
gdp	0.191 ***	0.033
	(0.026)	(0.023)
fdi	−1.329 ***	1.227 ***
	(0.215)	(0.402)
r&d	0.007 *	0.021 *
	(0.004)	(0.012)
upd	0.665	0.517 ***
	(0.545)	(0.130)
consump	1.471 ***	−0.617 **
	(0.233)	(0.266)
constant	−1.745 ***	0.622 ***
	(0.448)	(0.193)
Province	YES	YES
Year	YES	YES
N	132	228
adj. R^2	0.799	0.790

Notes: The values in brackets are standard deviations. ***, ** and * indicate that the estimated coefficients are significant at the confidence levels of 1%, 5% and 10%, respectively.

4.4. Analysis of the Transmission Mechanism

To test whether fiscal decentralization affects regional green sustainability by changing the level of government expenditure on sports, that is, to test Hypotheses 2 and 3, we construct a mediating effect model according to the method of Baron and Kenny (1986) [53],

as shown in Equations (6) and (7), to prove the mediating effect of the government's emphasis on sports, where *sports_fis* indicates the local government's emphasis on sports.

$$sports\_fis_{it} = \gamma_0 + \gamma_1 fd\_rev_{it} + \sum_{j=2}^{6} \gamma_j control_{jit} + \varepsilon_{it}, \quad (6)$$

$$gtfp_{it} = \varphi_0 + \varphi_1 fd\_rev_{it} + \varphi_2 sports\_fis_{it} + \sum_{j=3}^{7} \varphi_j control_{jit} + \varepsilon_{it}. \quad (7)$$

Based on the baseline regression analysis, we examined the mediating effect of the government's emphasis on sports by regressing Equations (6) and (7), and the results are presented in Table 7. Model (2) demonstrates that the estimated coefficient of the influence of fiscal decentralization on the emphasis of government support for sports is positive and statistically significant at the 1% level. This suggests that fiscal decentralization plays a role in positively guiding and supporting regional sports and health development by increasing the emphasis on government sports initiatives. In Model (3), the estimated coefficients of the effects of fiscal decentralization on regional green sustainability and the emphasis on the government's sports business on regional green sustainability are both positive and statistically significant at the 5% level. This indicates that fiscal decentralization not only directly contributes to regional green sustainability, but also has an additional positive impact when it actively guides and supports regional sports and health development through increased emphasis on government sports. The mediating effect of the emphasis on government sports is calculated to be 0.272 (5.141 × 0.053), indicating that approximately 27.2% of the total effect of fiscal decentralization on regional green sustainability is mediated through the government's emphasis on sports. To verify the mediating effect of the government's emphasis on sports, we conducted the Sobel test and employed the Bootstrap sampling method. The mediating effect value of the emphasis on sports was found to be 0.273, which confirms the mediating effect. Therefore, the empirical analysis results support Hypothesis 2, demonstrating that fiscal decentralization positively influences regional green sustainability by actively promoting regional sports and health development through increased emphasis on government sports initiatives.

Table 7. The regression result of the mediating effect.

	(1) ***gtfp***	**(2)** **Sportscl**	**(3)** ***gtfp***
fd_rev	1.322 ***	5.141 ***	1.184 ***
	(0.265)	(0.676)	(0.328)
sports_focus			0.053 **
			(0.025)
constant	−0.379 *	11.668 ***	−1.316 ***
	(0.196)	(0.480)	(0.364)
CV	YES	YES	YES
Province	YES	YES	YES
Year	YES	YES	YES
N	360	360	360
adj. R^2	0.836	0.947	0.816
Sobel Test		0.273 ** (p = 0.042 z = 2.029)	
Bootstrap Test		0.273 * (p = 0.081 z = 1.74)	

Notes: The values in brackets are standard deviations. ***, ** and * indicate that the estimated coefficients are significant at the confidence levels of 1%, 5% and 10%, respectively.

We examine regional heterogeneity in the mediating effect of the governmental importance of sports to test Hypothesis 3. To do so, we divide the sample regions based on the administrative division of China and the degree of economic development, and estimate the regressions accordingly. The estimation results are presented in Table 8. Combining the results of the Sobel estimation and the Bootstrap sampling method, the mediating effect of the government's emphasis on sports in the eastern region is 0.833, which is statistically significant at the 1% level, while the mediating effect of the government's emphasis on sports in the non-eastern region is 0.307, which is statistically significant at the 1% level. The estimation results suggest that there is regional heterogeneity in the mediating effect of governmental emphasis on sports when fiscal decentralization enhances regional green sustainability by increasing governmental emphasis on sports. This is manifested by the more significant effect of the eastern region in influencing regional green sustainability through fiscal support for sports. Obviously, the analysis supports Hypothesis 3, confirming the existence of regional heterogeneity in the mediating effect of the government's emphasis on sports. This implies that the impact of fiscal decentralization on regional green sustainability, facilitated by increased government support for sports, varies across regions in China, depending on their economic development levels and administrative divisions.

Table 8. The regression result of the regional heterogeneity analysis of the mediating effect.

	(1)	(2)	(3)	(4)
	The Eastern		The Non-Eastern	
	sports_focus	***gtfp***	***sports_focus***	***gtfp***
fd_rev	6.140 ***	0.539	4.857 ***	0.908 **
	(1.305)	(0.595)	(0.937)	(0.377)
sports_focus		0.136 ***		0.063 **
		(0.041)		(0.027)
constant	9.915 ***	−3.089 ***	9.436 ***	0.025
	(1.032)	(0.587)	(0.506)	(0.320)
CV	YES	YES	YES	YES
Province	YES	YES	YES	YES
Year	YES	YES	YES	YES
N	132	132	228	228
adj. R^2	0.848	0.817	0.928	0.794
Sobel Test		0.833 ***		0.307 **
		(p = 0.006		(p = 0.034
		z = 2.273)		z = 2.121)
Bootstrap Test		0.833 ***		0.307 **
		(p = 0.007		(p = 0.027
		z = 2.68)		z = 2.21)

Notes: The values in brackets are standard deviations. *** and ** indicate that the estimated coefficients are significant at the confidence levels of 5% and 10%, respectively.

5. Conclusions and Policy Implications

As a guide during the economic transition, the government's fiscal support behavior plays a pivotal part in the process of improving the green circular economy and promoting regional green sustainable development. Different from previous studies that focus on the economic effects of fiscal decentralization, we focus on the study of the factors influencing fiscal decentralization on regional green sustainability and explore the ecological effects of the fiscal decentralization system. We further explore the mediating effects of fiscal decentralization on regional green sustainable development by increasing the emphasis on the development and intelligent transformation of sports. We discuss the relationship between them on the basis of Chinese provincial panel data. Our study has policy implications for the improvement of fiscal regimes and the development and intelligent transformation of the sports and health business in transition economies.

We use *gtfp* to measure the level of regional green sustainability and select fiscal revenue decentralization as the indicator of the extent of fiscal decentralization. We theoret-

ically analyze and empirically test the relationship among fiscal decentralization, the degree of emphasis on sports and regional green sustainable development. We obtain the following conclusions. First, fiscal decentralization can promote regional green development, further confirming Hypothesis 1 by robustness tests in various ways and by addressing endogeneity issues. Second, fiscal decentralization can enhance regional green development by increasing the importance of government sports, which verifies Hypothesis 2. Third, there is regional heterogeneity in the effect of the degree of importance of government sports in the process of fiscal decentralization affecting regional green development. The transmission effect of fiscal decentralization affecting regional green development through sports development in the eastern region is better than that in the non-eastern region; that is, there are regional differences in the mediating effect of the government's emphasis on sports. Our study confirms the ecological effects of fiscal decentralization system optimization and verifies that the increase in local governments' emphasis on sports is beneficial to regional economic and green sustainability.

Based on the conclusions of our study, we have several policy implications. First, authorities should provide full play to the comparative advantages of local governments and implement the main role of local governments in the process of regional sustainable development. A greater share of tax revenues should be allocated to local governments and more control over their budget allocations should be granted. This will empower them to prioritize sustainable development projects and implement policies that align with local environmental needs, which can promote the government's active role in the process of promoting green and sustainable development. Second, while optimizing the fiscal decentralization system, authorities should pay more attention to establishing partnerships between local governments, sports organizations, and technology companies to create smart sports infrastructure. This measure can make full use of the digital economy and digital technology to provide full play to the potential ecological effects of sports development and guide the development of the regional green circular economy. Third, authorities should further improve the transmission mechanism of fiscal decentralization in less economically developed regions through fiscal support for sports. Specific funding should be allocated for sports infrastructure, training programs, and sports events in less economically developed regions. Public–private partnerships should be encouraged to leverage additional resources and expertise in promoting sports-based initiatives that have positive environmental and economic impacts.

We explored the impact of fiscal decentralization on regional green development and its mechanism of action from the perspective of institutional economics, which enriches the theoretical study of the ecological effects of fiscal decentralization from the perspective of sports business development. However, since the data related to sports fiscal expenditures are only available at the provincial administrative level, this limits our research on exploring the ecological effects of sports economic development from the perspective of cities or counties. In the future, we will use big data platforms, data from listed companies, and data mining techniques to obtain micro-level data for more in-depth research.

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