

Study on the Impact of Main Functional Zoning Policies on the Economic Conversion Efficiency of Forest Ecological Capital in Hunan Province

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Abstract: In 2010, China promulgated the National Main Functional Area Planning (2010), marking the first national level of the national land space planning policy, the space planning is of great significance for optimizing the development model of forest ecosystems, improving the value transformation of forest ecological products, and is an important policy goal for the sustainable development of forest ecological resources. This paper analyzes the development status of the main functional zoning policy, and establishes a DID model to empirically analyze the implementation effect of the main functional zoning policy. The results show that the policy of main functional zoning will inhibit the increase of the economic conversion efficiency of forest ecological capital, and the policy effect is significant.

Keywords: Main functional zoning policy; economic conversion efficiency of forest ecological capital; Difference-in-difference model.

1. Introduction

Since the beginning of the 21st century, with the rapid development of urbanization, the land space is also facing multiple challenges, such as the imbalance of development pattern, ecosystem degradation, and the aggravation of resource waste, which makes the state pay more attention to the land space planning. (Godschalk, 2004; Bobylev, 2009; Persson, 2013). The main functional zoning policy is the most important part of the territorial spatial planning policy system, and the differentiated planning of land in different regions according to its different natural and social endowments (Brown and Glanz, 2018, Gong et al., 2018) is conducive to promoting resource coordination and land use diversification (Talen et al., 2016; Lu et al., 2015).

Forest ecosystems are an important component of natural ecosystems (Costanza, 1997), and ecologists will: The value of forest ecosystems is divided into four dimensions: ecological, social, economic and cultural (Faber et al, 2002; Howarth et al., 2002), the economic conversion efficiency of forest ecological capital, that is, the economic value realization efficiency of forest ecosystems (Kong et al, 2023), is the key to taking into account ecological protection and sustainable development.

In order to better optimize the layout of land use, in 2010, China promulgated the National Plan for Main Functional Zones (2010), which adjusted the land use structure of different regions (Fan et al., 2012), and divided different regions of Hunan Province into key development zones, main agricultural product producing areas and key ecological function zones. Among them, the key development zones take urbanization as the main purpose and mainly provide industrial products; The main production areas of agricultural products are mainly to improve the guarantee capacity of agricultural products, mainly providing agricultural products; The key ecological function zone takes the provision of ecological products and services as its main function, and mainly provides ecological products.

This paper mainly studies three questions: first, what is the impact of the main functional zoning policy on the economic conversion efficiency of forest ecological capital in Hunan Province? Second, what is the intermediary mechanism of the main functional zoning policy on the economic conversion efficiency of forest ecological capital in Hunan Province? Third, what kind of suggestions can be provided for the main functional zoning policy?

2. Literature Review

2.1. Zoning control of land use functions

The concept related to territorial spatial zoning can be traced back to 1898, when Howard first proposed the theory of "pastoral city", which believed that the rapid development of the economy would bring about the blind expansion of the city, followed by serious problems such as environmental pollution, and the countryside should be enclosed on the periphery of the city, so that the prosperity of the city and the green landscape of the countryside could be combined to form a complementary ecological and economic development of the city. The theory emphasizes the structural optimization of urban and rural layouts and the zoning and use of space. At the beginning of the 20th century, Saarinen proposed the "organic evacuation theory" based on the pastoral city theory, which believed that industry should be evacuated to the periphery of the city, and the vacant land in the center of the city should be used to increase the area of green space so that human beings can obtain a comfortable living environment. In the subsequent development of related theories, Germany has put forward a series of theories on agricultural location, industrial location and regional division of labor, which are intended to divide different functions into different regions and plan accordingly. In the 70s of the 20th century, the academic community put forward the theory of "urban growth boundary", which believes that the boundary between urban and rural areas should be delineated to prevent the environmental degradation caused by excessive urban sprawl,

and then, the academic community has carried out extensive research on the urban growth boundary, and Leroy (2003) has combed the urban sprawl mechanism based on the theory of urban growth boundary and carried out in-depth research, which is similar to the urban development boundary in China, and has a great reference role for China's territorial spatial planning.

2.2. Economic conversion efficiency of forest ecological capital

The concept is still in the preliminary stage of research in the academic circles at home and abroad, and Kong Fanbin et al. put forward the concept for the first time, and studied the impact of forestry on the income gap between urban and rural areas, the impact of digital economy on the value transformation of forest ecological products, and the influencing factors of the economic conversion efficiency of forest ecological capital by calculating the economic conversion efficiency of forest ecological capital. There is a lack of research on the impact of main functional zoning on the economic conversion efficiency of forest ecological capital. This paper will study the effect of the main functional zoning policy on the economic conversion efficiency of forest ecological capital in Hunan Province through the difference-in-difference model (DID model), and then put forward suggestions for the improvement of the economic conversion efficiency of forest ecological capital in Hunan Province.

2.3. Effects of land functional zoning on the economic conversion efficiency of forest ecological capital

Although foreign scholars have studied the relationship between land use and ecological environment, from the perspective of efficiency, the research on the relationship between land use and ecological efficiency is very limited. Foreign land use theory research focuses on the impact of ecological concepts or land use on the ecological environment. Marsh, in his book *Man and Nature*, a book on the ecology of land, mentions that land use and ecology are interdependent (Marsh, 1864). Marion. P studied the relationship between land use and ecological environment in the United Kingdom. Eco-efficiency is an integrated concept whose core is to improve production and land management through the efficient and sustainable use of resources, so as to achieve effective territorial spatial optimization (Marion.p., 2009). In order to improve eco-efficiency, measures can be taken, such as changing the management of individual crops and livestock enterprises or changing land-use systems. In addition, Reith has taken a number of measures to increase the eco-efficiency of land restoration (Reith, 2003). There are abundant studies and practices on land use and ecological efficiency in foreign countries, but at present, these studies are mainly focused on urban areas, and the research on the combination of the two is rarely mentioned, so it is necessary to explore the use efficiency of land resources and realize the optimization of land space from more perspectives and regions.

3. Theoretical Framework

This article believes that national spatial planning policies mainly affect the efficiency of forest ecological value transformation in various counties of Hunan Province through fiscal and industrial policies.

From the perspective of fiscal policy as an intermediary

mechanism, firstly, the national spatial planning policy has increased financial investment in various protected areas in Hunan Province and strengthened the protection of forest protected areas. This process has hindered the value transformation of forest ecosystems into ecological products, thereby reducing the efficiency of forest ecological product value transformation in various counties of Hunan Province; Secondly, the land spatial planning policy of Hunan Province has established a cross regional and regional ecological compensation mechanism, rewarding ecological functional areas with significant improvement in ecological environment and benefits. In this process, it has guided key ecological functional areas in Hunan Province to strengthen forest ecological construction and protection, which will have a certain impact on the forestry economic benefits output of unit forest ecological asset investment, further hindering the improvement of the efficiency of forest ecological product value transformation; Finally, through differentiated fiscal policies, we will increase financial support for environmental protection and energy conservation industries in key development zones, as well as agricultural technology enterprises in major agricultural product producing areas. Basic management fees and personnel expenses for key ecological function zones and nature reserves will be included in the fiscal budget, so as to maximize scientific ecological development according to the characteristics of different regions and protect forest ecosystems in different regions to the greatest extent possible. This also hinders the transformation of forest ecological resources into ecological product values to a certain extent.

From the perspective of industrial policy as an intermediary mechanism, firstly, the land spatial planning policy of Hunan Province further clarifies the industries that are restricted or prohibited, and strengthens the management of environmental pollution standards, thereby limiting the development of a large number of enterprises that cause pollution to the forest ecosystem, greatly avoiding damage to the forest ecosystem, reducing the level of forest development, and hindering the improvement of the efficiency of forest ecological product value transformation; Secondly, the national spatial planning policy has established a smooth policy for industry exit and transfer, promoting cross regional transfer or closure of industries through equipment depreciation subsidies, equipment loan guarantees, migration subsidies, land replacement and other means, promoting the scientific and green development of industrial structure, reducing the consumption of forest resources, lowering the output of forest ecological products, and thus reducing the efficiency of forest ecological product value transformation in Hunan Province; Finally, differentiated industrial policies have been adopted for different functional areas, such as developing ecological agriculture in the main agricultural production areas and prohibiting large-scale production and construction activities in key ecological functional areas. This has an impact on the local forest resource endowment and forest related industries, thereby affecting the supply capacity and consumption scale of forest ecological resources, affecting the economic benefits of converting forest ecological assets into forestry related assets in various regions, and further hindering the efficiency improvement of forest ecological product value transformation.

4. Methodology

4.1. Calculation of Economic Conversion Efficiency of Forest Ecological Capital

According to the principle of input-output analysis, this paper constructs the index system of forest ecological product value transformation efficiency in Hunan Province from two aspects: the input index of forest ecological product value transformation efficiency and the output index of forest ecological product value transformation efficiency, and measures the value transformation efficiency of forest ecological products with the help of SBM super-efficiency model and Dearun software.

Among them, the input indicators mainly include: (1) the value of forest ecological products, expressed by the total value of forest ecological products, which is composed of carbon sequestration and oxygen release value, water conservation value, sediment reduction value and soil

sequestration value. (2) Physical capital investment, expressed as investment in forestry fixed assets (Kong et al., 2023b). The investment of material capital in forestry has an impact on the level of forestry infrastructure, thereby affecting the realization of the value of forest ecological products. (3) Labor input. Expressed in terms of the number of effective labor force in forestry. The input of labor in forestry is conducive to cultivating forestry resources and improving the efficiency of forestry technology, which in turn affects the value of forest ecological products. (4) Forest land input, expressed in terms of forest land area. The area of forest land reflects the abundance of forest resources and the status of forest management, which affects the specific quality of forest ecosystems, thereby affecting the realization of the value of forest ecological products. The output indicators mainly include: the total output value of forestry (100 million yuan), including the total output value of the primary, secondary and tertiary industries of forestry.

Table 1.

	Primary indicators	Secondary indicators
input indicators	Value of forest ecological products	Carbon sequestration and oxygen release value (billion yuan)
		Value of water source conservation (billion yuan)
		Reduce the value of sediment deposition (billion yuan)
		Fixed soil value (billion yuan)
	Material capital investment	Forestry fixed assets investment (billion yuan)
	Labor input	Effective labor force in forestry (ten thousand yuan)
	Forest land investment	Forest area (hectares)
Output indicators	Forestry output value	Forestry primary industry output value (billion yuan)
		Output value of forestry secondary industry (billion yuan)
		The output value of the forestry tertiary industry (billion yuan)

4.2. Difference-in-differences model

The DID model is a policy evaluation tool commonly used to evaluate the specific implementation effects of a policy, and two key conditions need to be met before using the model. Firstly, the model needs to compare the gap between being impacted by policies and not being impacted by policies, so it is necessary to find the experimental and reference groups for policies based on this. The areas affected by the experiment are called the experimental group, while the areas not affected by the policy are called the reference group. Secondly, policy pilot programs require more than two years to demonstrate the scientific effectiveness of policy implementation. If implemented within two years, a short period of time can lead to significant errors.

The specific DID model set up in the article based on a large number of references is as follows:

$$Y_t = \alpha_0 + \alpha_1(D_i \times T_t) + \alpha_2 D_i + \alpha_3 T_t + U_t + V_t + \sum_j \lambda_j X_{it} + \varepsilon_{it}$$

Among them, Y represents the dependent variable, t represents the year, and D, T are dummy variables, It is an estimated coefficient for testing the effectiveness of policies, and represents the fixed effects of regions and years, respectively; X is the control variable and is the error term.

The selection of relevant variables is as follows:

(1) The dependent variable is the economic conversion efficiency of forest ecological capital (y), calculated using the SBM super efficiency model.

(2) Explanatory variable: interaction term, which is

obtained by multiplying the time dummy variable T with the regional dummy variable D. As shown in Table 1.

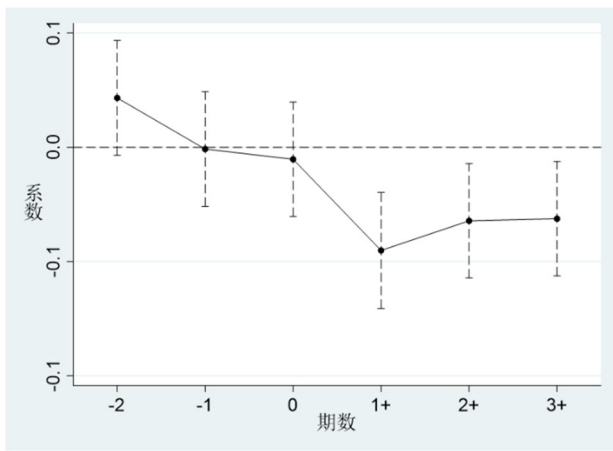
(3) Control variable: Economic development level X1, measured in per capita GDP (10000 yuan); The degree of industrial upgrading X2 is measured by the ratio of the added value of the tertiary industry to the added value of the industry; Population size X3, measured by the population of each city, district, and county in Hunan Province at the end of the year (in 10000 people); Urbanization level X4, measured by the ratio of urban population to total population; The scale of fixed assets investment is X5, measured by fixed assets investment (10000 yuan),

5. Results

5.1. Parallel trend test

The most important assumption of using the double difference method is to satisfy the parallel trend test, which means that there is no systematic difference in the conversion efficiency of forest ecological product values between the experimental group and the control group before national spatial planning, and even if there is a difference, the difference is fixed. This article sets the current planning period of the main functional area as the base period, and the null hypothesis that the estimated coefficients of each period before the implementation of land spatial planning in Hunan Province cannot be rejected is that counties and cities with significant differences after the main functional planning did not show systematic differences in the conversion efficiency of forest ecological products before the planning. After the implementation of land spatial planning in Hunan Province,

the estimated coefficients of each period changed from positive to negative, This indicates that the implementation of national spatial planning has a restraining effect on the efficiency of forest ecological product value transformation, meeting the parallel trend hypothesis.



5.2. The estimation results of the impact of main functional zoning on the efficiency of forest ecological capital economic transformation

This article uses the DID model as an empirical basis to analyze and predict the utility of calculating the main functional zoning on the economic conversion efficiency of forest ecological capital in Hunan Province. The regression results are shown in the table.

Table 2. Test results of policy effects of territorial spatial planning

	(1) Y	(2) Y
D*T	-0.018*** (0.006)	-0.015** (0.006)
x1		0.004* (0.002)
x2		0.001*** (0.000)
x3		0.003 (0.035)
x4		0.001 (0.000)
x5		-0.002 (0.002)
Constant	0.724*** (0.002)	0.679*** (0.037)
Regional effects	Yes	Yes
Time effect	Yes	Yes
Observations	1,220	1,220
R-squared	0.825	0.828

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

When controlling for regional fixed effects and time fixed effects, as well as without or with a series of control variables, the cross term coefficients were -0.018 and -0.015, respectively, but the significance decreased. After adding control variables, the significance decreased significantly from 1% to 5%, and the inhibitory effect of policies on the

economic conversion efficiency of forest ecological capital decreased.

The results show that the implementation of national spatial planning policies has a significant inhibitory effect on the conversion efficiency of forest ecological product mechanisms in various cities, districts and counties in Hunan Province as a whole, and the policies have reduced the average conversion efficiency of forest ecological products in key ecological functional areas by 1.8%; After policy implementation, the economic conversion efficiency of forest ecological capital in key ecological functional areas is lower than that in key development areas and agricultural main production areas; The negative control variable X5 indicates that an increase in the size of fixed assets represents a significant government investment in economic development, inevitably causing harm to the environment and leading to a decrease in the efficiency of forest ecological capital economic transformation.

5.3. Testing Results of Impact Mechanisms

The main policies implemented in the main functional zoning policy include fiscal, industrial, land, and population policies. Referring to the relevant documents of Hunan Province's land spatial planning, the main impact of the main functional zoning on the conversion efficiency of forest ecological products in key ecological functional areas mainly includes fiscal policies and industrial policies. The regression results of the mediation effect model show that there is a negative correlation between the planning of functional zoning and fiscal revenue, and a negative correlation with the added value of the tertiary industry. The main functional zoning policy focuses on the ecological protection of key ecological functional areas, which leads to a decrease in fiscal revenue and a decrease in the efficiency of forest ecological product value transformation in key ecological functional areas. The implementation of the main functional zoning policy has reduced the output value of the tertiary industry through ecological protection of key ecological functional areas, thereby reducing the efficiency of forest ecological product transformation.

Table 3. Test results of intermediary policy effects

Variable	Industrial policy		Fiscal policy	
	lnM1 (1)	Y (2)	M2 (3)	Y (4)
D*T	-0.023* (0.013)	-0.015** (0.006)	-0.354*** (0.054)	-0.013** (0.007)
lnM1		0.027* (0.015)		
M2				0.007** (0.004)
Control variable	Yes	Yes	Yes	Yes
Regional effects	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes
Observations	1,218	1,218	1,219	1,219
R-squared	0.991	0.828	0.893	0.828

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion and Policy Suggestions

By establishing a DID model, the article mainly draws the following conclusions: Firstly, the overall efficiency of economic transformation of forest ecological capital in Hunan Province is not high, and it shows a decreasing trend overall; Secondly, the policy of zoning the main functions will significantly inhibit the efficiency of economic transformation of forest ecological capital in Hunan Province,

indicating that the value transformation of forest ecological products in Hunan Province still needs to be improved; Thirdly, the policy of functional zoning affects the efficiency of economic transformation of forest ecological capital in Hunan Province through industrial and fiscal policies.

The value forwarding of forest ecological products in Hunan Province has not yet matured, and the existing main functional zoning policies have not promoted their efficient transformation. Therefore, this article proposes the following suggestions:

(1) Improve the green tax system and provide impetus for local fiscal revenue. One is to expand the scope of resource tax collection, increase tax rates, and include natural resources in the tax payment scope, in order to enhance the environmental awareness of enterprises and individuals, and force local enterprises to engage in green production. The second is to refine and optimize existing tax types, strengthen the incentive and constraint effect of green taxation on enterprises, and force non green production to transform through high tax burdens, production restrictions, and other means, thereby improving the efficiency of forest resource utilization and enhancing the efficiency of forest ecological capital economic transformation.

(2) Optimize industrial structure and improve the level of green technology. In the situation where industry inevitably produces pollutants, the focus of economic development should shift towards the tertiary industry. For enterprises and regions with backward technology, low production efficiency, and severe environmental pollution, they should actively industrialize and seek new economic growth points dominated by the tertiary industry.

(3) Establish ecological banks and expand financing channels for ecological compensation policies. At present, the only purchaser of forest ecosystem services in Hunan Province is the government, which uses taxation, subsidies, and other means of financing. According to existing literature review, the most fundamental way to address the externalities of public goods is to introduce market mechanisms to encourage other institutions or individuals to invest in forest ecological service systems, thereby expanding financing channels for ecological compensation policies [12].

(4) Standardize the order of spatial development, strengthen inter regional connections and sharing. Standardizing the development order for different types of main functional areas can optimize the spatial structure of the country, improve land use efficiency, solve the contradictions brought about by urbanization such as difficulties in urban land use and extensive development, effectively solve problems such as forest ecological resource occupation and forest ecological environment pollution, improve environmental governance capabilities, and thus improve the efficiency of forest ecological capital economic transformation.

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