



Coupling and Coordination Research on Green Finance and Ecological Civilization Construction in Xinjiang

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Abstract: Since the national proposal to construct a green financial system, Xinjiang has three pilot areas for green finance. The connotation of green finance shares similarities with the basic requirements of ecological civilization construction. This paper analyzes the coupling mechanism between green finance and ecological civilization construction, and conducts research based on the coupling coordination model. Through the study, it is found that the ecological civilization construction in Xinjiang is improving year by year, while the development of green finance fluctuates significantly. However, the overall trend of both tends to be of high-quality coordinated development. Green finance and ecological civilization construction can promote each other, fundamentally being a complementary relationship. Therefore, from the perspective of promoting the development of green finance, it is believed that Xinjiang should promote the development of green finance from three dimensions: broadening the sources of green finance funds, improving the mechanism of matching supply and demand of funds, and enhancing the efficiency of fund allocation.

Keywords: green finance, ecological civilization, entropy method, coupling coordination model

1. Introduction

To support the construction of ecological environment civilization, relying solely on financial investment often yields little result, requiring financial support to provide funds for projects or enterprises that can generate positive externalities for the environment. In recent years, the emergence of green finance meets this requirement perfectly, as its basic connotation aligns well with the requirements of ecological civilization construction. Particularly, Xinjiang has three pilot areas for green finance, which can provide impetus for the ecological civilization construction in Xinjiang. This paper constructs a comprehensive evaluation index system and uses the entropy method to comprehensively evaluate the green finance and ecological civilization in Xinjiang from 2011 to 2020. With the help of the coupling coordination model, the relationship between the development of green finance and the construction of ecological civilization in Xinjiang is analyzed, providing decision-making basis for vigorously developing green finance to support ecological civilization construction in Xinjiang.

2. Green Finance and the Coupling Mechanism Analysis of Ecological Environment Construction

2.1 Green Finance Support for Ecological Environment Construction

Optimization of Resource Allocation. Green finance can encourage the development of capital-intensive projects and energy-saving and environmental protection enterprises, achieving a shift of resources towards green industries and further optimizing resource allocation. Through differentiated financial policies, the financing costs and difficulty of financing in “two highs and one surplus” industries can be increased, guiding resources towards intensive industries and achieving optimized resource allocation.

In terms of information resources, green finance can leverage its information advantage to identify investment projects that meet green, low-carbon, and environmental protection conditions. According to the efficient market theory, security prices can reflect the value of investments in green industries and projects, further guiding the flow of capital, technology, and talent towards environmental protection, new energy, and other green industries, forming a virtuous cycle and further promoting ecological efficiency improvement.

Regarding technological innovation, based on Schumpeter’s theory of technological innovation, green innovation projects also face drawbacks such as high risk, high failure rates, and long funding cycles. The funding term of green finance aligns perfectly with the cycle of enterprise green technological innovation activities, providing assurance for enterprise green technological innovation activities and improving regional ecological efficiency.

2.2 Promotion of Green Finance Innovation by Ecological Environment Construction

As ecological environment construction continues to advance, the demand for green finance is increasing. Traditional forms of credit and bonds are no longer sufficient to meet the capital needs of enterprises. However, the higher investment return rates in green industries can promote innovation in green finance products. This continual improvement in green finance policy systems facilitates the optimization and development of green finance.

3. Model Construction and Data Source

3.1 Model Construction

3.1.1 Entropy Method

Due to the problem of different dimensions and magnitudes among various indicators, it is necessary to standardize the data. In this paper, Max-Min normalization is chosen to standardize the data of the ecological civilization construction indicator system.

$$Y_{ij} = \begin{cases} \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})} & \text{When } X_{ij} \text{ is a positive indicator} \\ \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_{ij})} & \text{When } X_{ij} \text{ is a negative indicator} \end{cases}$$

Specific steps are as follows:

(1) Calculate the entropy E_{ij} of each indicator.

$$E_{ij} = -\frac{1}{\ln(n)} \sum_{i=1}^n [(Y_{ij} / \sum_{i=1}^n Y_{ij}) \ln(Y_{ij} / \sum_{i=1}^n Y_{ij})]$$

(2) Calculate the weight W_{ij} of each indicator.

$$W_{ij} = \frac{1 - E_{ij}}{\sum_{j=1}^k (1 - E_{ij})}$$

(3) Calculate the scores S_{ij} of each dimension based on the calculated weights.

$$S_{ij} = W_{ij} * Y_{ij}$$

3.1.2 Coupling Coordination Model

This paper constructs the following coupling coordination model:

$$C = \left\{ (GF \times EC) / [GF / 2 + EC / 2]^2 \right\}^n$$

$$T = \alpha GF + \beta EC$$

$$D = \sqrt{C \times T}$$

Among them, C represents the coupling degree, D represents the coordination degree (Table 1), GF represents the level of green finance development, EC represents the level of ecological civilization construction, and T represents the comprehensive evaluation level, used to reflect the overall level of ecological civilization construction and green finance. The coefficients α and β are undetermined weight factors, and their sum is 1. Here, $\alpha = \beta = 0.5$ is taken.

Table 1. Division of Coupling Degree

Negative Coupling (Disequilibrium Development)		Positive Coupling (Coordinated Development)	
D	Types:	D	Types:
0.00-0.09	Extreme Disequilibrium Recession	0.50-0.59	Barely Coordinated Development
0.10-0.19	Severe Disequilibrium Recession	0.60-0.69	Primary Coordinated Development
0.20-0.29	Moderate Disequilibrium Recession	0.70-0.79	Intermediate Coordinated Development
0.30-0.39	Mild Disequilibrium Recession	0.80-0.89	Good Coordinated Development
0.40-0.49	Imminent Disequilibrium Recession	0.90-1.00	High-Quality Coordinated Development

3.2 Data Sources and Variable Descriptions

3.2.1 Ecological Civilization Construction Indicator System

This article draws on relevant research by existing scholars to construct the level of ecological civilization construction in Xinjiang from three dimensions: economic development, social progress, and ecological environment (Table 2).

Table 2. Three Dimensions of Xinjiang’s Ecological Civilization Construction Level

Subsystem	Evaluation Indicator	Indicator Attribute
Economic Development	Per Capita GDP	+
	Contribution Rate of the Tertiary Industry	+
	Total Import and Export Volume	+
	Total Retail Sales of Consumer Goods	+
	Total Amount of Wastewater Discharge	-
Ecological Environment	Comprehensive Utilization Rate of Industrial Solid Waste	+
	Forest Coverage Rate	+
	Sulfur Dioxide Emissions	-
	Nitrogen Oxide Emissions	-
Social Progress	Proportion of Scientific and Technological Expenditure to Total Expenditure	+
	Proportion of Educational Expenditure to Total Expenditure	+
	Urbanization Rate	-

3.2.2 Green Finance Indicator System

Based on the basic connotations of green finance and data availability, in this article, Xinjiang’s level of green finance development is calculated only from four dimensions: green credit, green insurance, green investment, and carbon finance (Table 3).

Table 3. Four Dimensions of Green Finance Development Level in Xinjiang

Secondary Indicators:	Measurement Methods of Indicators:	Explanation
Green Credit	Proportion of Interest Expenses of High-Energy-Consumption Industries	Interest Expenses of Six High-Energy-Consumption Industries / Total Interest Expenses of Industrial Sector
Green Insurance	Proportion of Agricultural Insurance Scale	Agricultural Insurance Expenses / Total Insurance Expenses
Green Investment	Proportion of Energy Conservation and Environmental Protection Expenditure	Environmental Protection Fiscal Expenditure / Total Fiscal Expenditure
Carbon Finance	Carbon Dioxide Emission Intensity	Total Carbon Dioxide Emissions / GDP

4. Empirical Results Analysis

4.1 Analysis of Xinjiang’s Ecological Civilization Construction Level

Since 2010, the level of ecological civilization construction in Xinjiang has shown a steady upward trend amid

fluctuations (Figure 1).

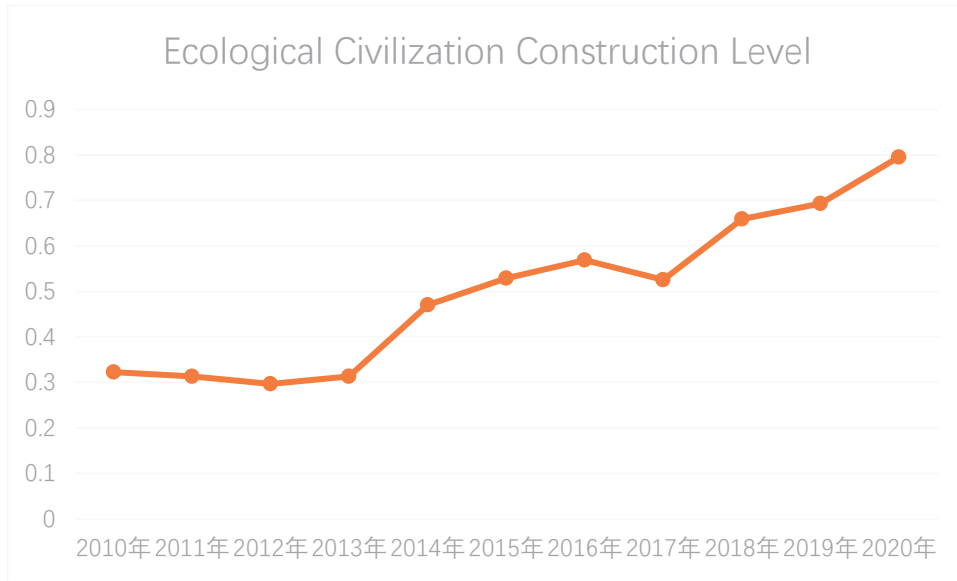


Figure 1. Ecological Civilization Construction Level in Xinjiang

4.2 Analysis of Green Finance Development Level

From the perspective of the development level of green finance in Xinjiang, it can be observed that there is significant fluctuation without a clear upward trend. Upon analysis, it is noted that before 2016, the development of green finance in Xinjiang was primarily government-led. Although after 2016, green finance gradually shifted towards market dominance, it still heavily relies on the support of green credit. The development of green insurance and carbon finance remains relatively weak (Figure 2).

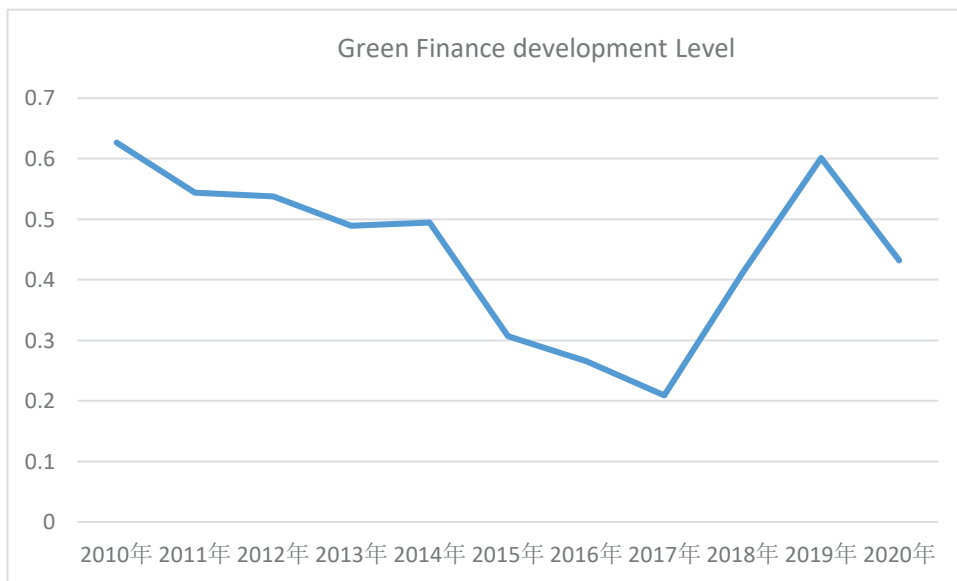


Figure 2. Green Finance Development Level in Xinjiang

4.3 Coupling and Coordination Analysis of Ecological Civilization Construction and Green Finance in Xinjiang

Based on the results of the coupling and coordination analysis, the degree of coupling and coordination between

ecological civilization construction and green finance in Xinjiang has gradually shifted from being on the verge of imbalance to entering a phase of good coordination. Influenced by different economic events and levels of development in different years, the coupling degree, coordination index, and coupling coordination degree all exhibit certain fluctuations. However, the development of green finance in Xinjiang can indeed promote ecological civilization construction.

From the perspective of the coupling degree between green finance and ecological civilization construction, the coupling degree has increased from 0.464 to 0.954. This increase indicates that the coupling degree between the two systems has improved and is gradually moving towards a high coupling phase. Overall, it suggests that the connotation of green finance aligns with the basic requirements of ecological civilization construction, and the development of green finance and ecological civilization are interrelated.

In terms of the coordination degree between green finance and ecological civilization construction, the coordination degree has increased from 0.525 to 0.761, shifting from a moderate coordination phase to a high coordination phase. This overall trend indicates a positive mutual influence between ecological civilization construction and the development of green finance (Table 4).

Table 4. Calculation Results of Coupling Coordination Degree

Time	Coupling Degree (C Value)	Coordination Index (T Value)	Coupling Coordination Degree (D Value)	Coupling Coordination Degree
2010	0.464	0.525	0.494	On the Verge of Imbalance
2011	0.442	0.420	0.431	On the Verge of Imbalance
2012	0.223	0.396	0.297	Moderate Imbalance
2013	0.476	0.355	0.411	On the Verge of Imbalance
2014	0.948	0.516	0.699	Primary Coordination
2015	0.946	0.353	0.578	Barely Coordination
2016	0.812	0.343	0.528	Barely Coordination
2017	0.289	0.235	0.260	Moderate Imbalance
2018	0.981	0.604	0.770	Intermediate Coordination
2019	0.997	0.860	0.926	High-Quality Coordination
2020	0.954	0.761	0.852	Good Coordination

5. Conclusion and Recommendations

5.1 Conclusion

Through the calculation of the development levels of green finance and ecological civilization construction, it is evident that the ecological civilization construction level in Xinjiang is gradually improving. This progress is attributed to Xinjiang's consistent emphasis on the "Two Mountains" concept and active promotion of ecological civilization construction. However, the development of green finance in Xinjiang exhibits significant fluctuations, mainly influenced by changes in economic development strategies and ideologies. According to the coupling coordination model, the development of green finance and ecological civilization construction in Xinjiang is complementary.

5.2 Recommendations

5.2.1 Expand the Sources of Green Finance Funding

Compared to inland and coastal regions, Xinjiang's financial industry is relatively underdeveloped and still relies on the financial sector to bridge funding gaps. The government should actively encourage financial institutions to expand the sources of green finance funding and increase its scale. Incentives such as external subsidies should be provided to encourage local financial institutions to actively develop green finance. The government should take proactive measures such as fiscal interest subsidies and credit incentives to encourage financial institutions to vigorously develop green finance businesses.

5.2.2 Improve the Mechanism for Matching Funds Supply and Demand

Xinjiang should establish its own platform for green projects to help financiers find investors that match their funding needs and risk preferences, thereby improving the efficiency of fund utilization. On the other hand, the project repository can reduce investors' search costs, further attracting more social capital. The government should take the lead in building a green finance project repository to enhance investor confidence and achieve effective fund transfer. By establishing a large environmental information database and improving policies related to environmental information disclosure, environmental

information can be readily available, reducing the risk caused by information asymmetry, enhancing the willingness of financial institutions to invest in enterprises and green projects, and achieving matching of funds supply and demand for green projects.

5.2.3 Utilize Financial Technology to Improve Fund Allocation Efficiency

Financial technology, utilizing technologies such as cloud computing and big data, can improve fund allocation efficiency and the capital utilization efficiency of the banking industry. Financial technology should be used to enhance the management efficiency of green credit and ensure that credit funds flow to the green sector. Full use should be made of artificial intelligence technology in financial technology to set criteria for green project entry independently, thus reducing corresponding labor costs. By using technologies such as big data and machine learning, green projects similar to investor preferences can be automatically matched, allowing investors to make choices. This can shorten the waiting time for green projects and the search time for investors, further enhancing fund allocation efficiency through appropriate capital matching.

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