

Empirical Analysis on the Development of Green Finance in the Yellow River Basin

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Abstract. Green finance is aimed at promoting green economic growth, using financial tools and other financial means to reduce the degree of environmental damage in the Yellow River Basin, improve the utilization of limited resources, and alleviate the contradiction between humans and ecology, in order to achieve healthy economic development to the greatest extent possible on the root issues. This article presents the current status of green finance in the Yellow River Basin from the perspectives of green credit and green investment, and uses entropy method to conduct empirical research on panel data. Through calculation and analysis, it was found that the overall development of the Yellow River Basin is better in the downstream than in the upstream, and both show a trend of growth over time.

Keywords: Yellow River Basin; Green Finance; Entropy Method.

1. Introduction

The Yellow River Basin has always relied on highly polluting non renewable resources such as coal and oil as energy support for industrial and economic development, and the pillar industries of multiple cities in the basin are concentrated in industries such as oil extraction and processing. Green finance is an emerging industry, but China's green finance has been growing rapidly and with high quality since its inception.

2. The Development Status of Green Finance in the Yellow River Basin

The Yellow River flows through 9 provinces (regions) from west to east, including Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan, and Shandong. The main function of green finance is to guide investment funds to flow as much as possible to low-carbon economic industries that are more eco-friendly, reduce the financing difficulty of green environmental protection industries, and thus promote green development of the economy.

(1) Green credit

Overall, except for Sichuan Province, the green credit scale in the eastern provinces and regions of the Yellow River Basin is slightly larger than that in the western region. The green upgrading of infrastructure and the clean energy industry are the main sources of funds, and they are gradually moving towards innovation. Chinese financial institutions have relied on the operating procedures of green credit finance statistical software to accelerate the development of higher precision green finance information sets. In the process of conducting regular big data quality risk detection and verification every year, it ensures a more accurate and dynamic systematization of green credit data analysis, thereby truly providing strong data foundation support for the dynamic digital risk management research in the field of national green finance. In the macro field of local finance, from the adjustment of Bank of China to the current launch of more than 60 new products such as "energy efficiency loans" and "contract energy management project loans", we will expand the supply of new credit and guarantees, and support the establishment of a new structural model for financing innovation service supply through PPP.

(2) Green bonds



Green bonds are special purpose bonds that raise funds to support environmental projects or organizations, offering a new option for sustainable development. Overall, in recent years, Bank of China has undertaken the listing, issuance and establishment of domestic bond varieties for many large and high-quality green enterprises in China, and has successfully organized and implemented the green energy creditor transfer guarantee business. In international business, the company fully relies on its professional advantages of industrial globalization and comprehensive services, increases its efforts to promote the innovation and expansion of green finance business, and successfully develops and launches various innovative guarantee financial products such as green asset income guarantee trust bonds.

(3) Green insurance

Environmental liability insurance is the most representative type of green insurance. Chinese financial institutions, on the other hand, adhere to the company's mission of strictly fulfilling customer public management responsibilities, strengthening social environmental research, and strengthening risk assessment and management services. They conscientiously establish evaluation and management standards for green environmental and social risks, and effectively integrate various green risk factors into the entire green insurance business process system.

Environmental liability insurance and forest insurance in various regions are almost essential types of insurance. Based on this, each region has creatively launched green insurance products that are more suitable for the green development of its own province, taking into account its own actual situation. The main purpose is to obtain a certain degree of protection in the event of natural disasters in agriculture and animal husbandry, in order to maintain the stability of agricultural and forestry development.

(4) Green investment

According to the 2021 completion of industrial pollution control investment in the China Statistical Yearbook, the current status of green investment is reflected. Inner Mongolia in the middle reaches of the river basin and Shandong in the lower reaches of the river basin have the highest investment in pollution control, with approximately 3.309 billion yuan and 3.769 billion yuan, respectively. Except for Qinghai Province, the investment amount in industrial pollution control in other provinces (regions) is not significantly different. In terms of investment in pollution control, the investment amount in the Yellow River Basin accounts for 33.86% of the national investment amount, indicating that the position of green investment in the Yellow River Basin in the development of green finance in the country cannot be underestimated.

3. Empirical Analysis on the Development of Green Finance in the Yellow River Basin

To use the entropy method for empirical analysis, it is first necessary to establish an indicator system. This article uses panel data from 9 provinces (regions) from 2008 to 2019 for analysis. The data is sourced from databases such as the China Statistical Yearbook, the Statistical Yearbook of various provinces, the National Bureau of Statistics, and the China Insurance Yearbook.

3.1. Selection of Indicators

Table 1. Green Finance Indicators

Indicator name	indicator description
Green credit	proportion of interest expenses on industrial loans with high energy consumption
Green investment	proportion of investment in environmental pollution control to GDP
Green insurance	agricultural insurance depth
Government support	proportion of environmental protection expenditure in finance

By drawing on the commonly used indicators by scholars and considering the actual situation of green finance in the Yellow River Basin, this article chooses to construct its indicator system from four perspectives: green credit, green insurance, green investment, and government support. The specific indicator system for green finance is shown in the table 1.

3.2. Data Processing and Model Establishment

This article uses entropy method to calculate indicators based on panel data from various provinces (regions) in the Yellow River Basin from 2008 to 2019. Generally speaking, entropy is used to determine the degree of discreteness of a system. The specific process of entropy method is as follows:

(1) Data standardization:

$$s_{ij} = \frac{x_{ij} - \min(x_i)}{\max(x_i) - \min(x_i)} ; \quad s_{ij} = \frac{\max(x_i) - x_{ij}}{\max(x_i) - \min(x_i)}$$

Among them, s_{ij} is the value after preliminary processing of the data, x_{ij} refers to the j indicator value of the i evaluation object, $\min(x_i)$ refers to the minimum value of the i evaluation object's indicator, and $\max(x_i)$ is the maximum value of the indicator.

(2) Calculate the proportion of each indicator value: Calculate the proportion of j indicator value in the evaluation object i :

$$y_{ij} = s_{ij} / \sum_{i=1}^m s_{ij}$$

(3) Calculate the entropy of each evaluation object:

$$p_i = -b \sum_{j=1}^m y_{ij} \ln y_{ij}, \text{ wherein, } b = 1/\ln m$$

(4) Calculate the weight of each evaluation object:

$$\sum w_i = (1-p_i) / \sum_{i=1}^n (1-p_i)$$

Finally, multiply the weights with the standardized values to obtain the total comprehensive index.

According to the calculation results of panel data using entropy method, the trend of comprehensive indicators of green finance in 9 provinces and regions is shown in Figure 1. Overall, the development of the lower reaches of the Yellow River is significantly better than that of the upper reaches, and shows a trend of steady and rapid growth over time. Among them, Shandong has the best development trend among all provinces (regions), and Ningxia Hui Autonomous Region still needs to increase its support and attention to green finance.

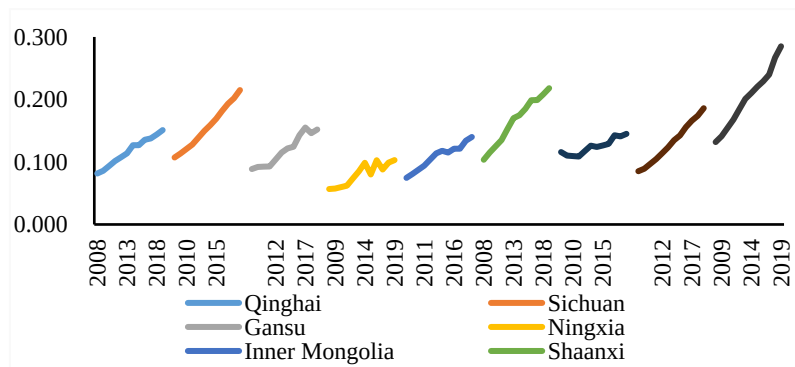


Figure 1. Comprehensive Indicators of Green Finance in Various Provinces (Districts) of the Yellow River Basin

4. Suggestions for the Development of Green Finance in the Yellow River Basin

(1) Combining government environmental financing with infrastructure financing. To carry out ecological security governance in the Yellow River Basin, regarding the need for the country to continue investing a large amount of funds in water conservancy infrastructure, it will undoubtedly bring a huge financing pressure to financial allocation departments at all levels. The most important function of the national green finance department is to effectively alleviate the supply and demand constraints on public project funds in the Yellow River governance construction and regional green transformation and development projects through market-oriented and diversified investment methods.

(2) Develop traditional agriculture by combining agricultural green credit. Due to the fact that the provinces in the upper reaches of the Yellow River have always been a vulnerable region with insufficient development speed of leading industries in China, the transformation, optimization, and upgrading of agricultural development in traditional regions are still lagging behind, and the driving force is still insufficient. Therefore, it is possible to choose to moderately increase the reasonable allocation of green credit assets for farmers, continuously and effectively improve advanced agricultural safety production prevention and control technologies, promote agricultural water resource conservation, and accelerate the construction of agricultural industry brand clusters. Increase the added value of efficient agricultural products, etc.

(3) Support the combination of green bond investment and green enterprise services. Guiding credit funds to actively flow into traditional green fields and supporting the rapid development of environmental and ecological industries are still several major reform topics that the green finance industry will face in the future. Timely and effective solutions, as well as clever solutions to the financing difficulties of small and micro enterprises in impoverished villages, remain the key to continuously stimulate regional economic vitality and win the precise poverty alleviation battle. Establish a sound and effective risk identification and disposal mechanism for green ecological enterprises, and help ecological enterprises effectively reduce the operating costs of corporate bond issuance.

(4) Continue to promote the water conservancy industry in the Yellow River Basin through technology, achieve overall transformation, optimization, and leapfrog upgrading, and provide strong support for accelerating the regional linkage and coordinated development strategy of promoting the layout of water conservancy projects in the Yellow River Basin in various provinces. As an organic whole, the Yellow River Basin should fully consider the differences between the upstream, middle, and downstream regions, and accelerate environmental governance, industrial transformation, etc., so that the upstream of the Yellow River Basin can drive win-win economic cooperation throughout the entire basin.

5. Conclusion

The overall differences among the three basins of the Yellow River Basin require the central and government to work together to improve the quality of economic development in the Yellow River Basin, so as to revitalize the governance of the original Yellow River Basin. At the same time, they will further point out a direction for the Bank of China's future comprehensive governance work. It is suggested that after the Bank of China, the Ministry of Water Resources will continue to strive to provide county-level governments with further investment policy support for some major green credit projects that can be independently operated and managed by diversified investment entities such as rural water conservancy business and PPP guided fund construction in accordance with the law. This can be beneficial for further promoting and strengthening the planning and construction of water conservancy infrastructure in key river basins during the Yellow River period. Promote the conservation and utilization of water resources in agricultural society, prevent or reduce the ecological risks of major sudden floods and environmental pollution in important small watersheds after the Yellow River in China. The Bank of China should continue to adhere to the concept of

protecting green waters and mountains, integrating mountain and water resources, and accelerate the promotion of green financial technology research and innovation towards strategic depth and development.

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