

# *Research on Green Finance Promoting the Optimization of Industrial Structure*

—An Empirical Analysis Based on Guizhou Province

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**Abstract**—With the rapid development of China's economy and the deepening of sustainable development, the adjustment of China's industrial structure has been put on the agenda. The proposal of green finance not only helps to alleviate a series of environmental problems but also limits the expansion of high energy consumption and high pollution industries and promotes the adjustment of industrial structure. Based on the research on the mechanism of green finance promoting the adjustment of industrial structure, this paper makes an empirical analysis on the relationship between the development of green finance and the third industrial structure in Guizhou Province by using the grey relational analysis method. Under the condition of excluding the influence of the initial value of index sequence, it shows that the ratio of green credit ratio in Guizhou Province to the proportion of tertiary industry in GDP is the largest, followed by the second industry, and the correlation between the first industry is the weakest. Finally, combined with the actual situation of green finance development in Guizhou Province, the corresponding countermeasures and suggestions are put forward to promote the optimization of industrial structure in Guizhou Province.

**Keywords**—green finance; industrial structure; green-credit policy; Grey correlation analysis

## I. INTRODUCTION

In recent years, with the problems of excessive energy consumption, global warming and deterioration of ecological environment, the sustainable development of economy has been put on the agenda, and an innovative financial system-green finance has been put forward. The construction and perfection of green financial system is conducive to promoting the adjustment and optimization of industrial structure, so green finance should play an active role in the rationalization of the third industrial structure. This paper gives a brief overview of the development status of green finance and industrial structure in Guizhou Province, and sorts out the promotion mechanism of green finance to industrial structure optimization. It uses gray correlation theory and model to analyze the relationship between green finance development and three industries in Guizhou Province in recent years, and

make targeted recommendations.

## II. JOURNALS REVIEWED

Before foreign scholars studied the relationship between green finance and industrial structure, the initial focus was on the relationship between financial development and economic growth. However, when studying economic growth, it faced a very difficult resource and environmental problem, so the scholars turned to the research of sustainable development, then realized that the adjustment of industrial structure is a necessary condition for achieving sustainable economic development.[1]Goldsmith(1969)was the first one to study the relationship between financial structure and industrial structure transformation and upgrading.[2]Jose Salazar (1998)believes allocate resources scientifically and effectively, and play a guiding role to promote capital flow to green industries and achieve optimal adjustment of industrial structure.[3]Aintablian, McGraw, and Roberts (2007) found that in the process of bank lending, high-interest loans to high-pollution corporate loans that are not conducive to environmental protection are subject to high interest rates or direct cancellation of loan funds, thereby controlling environmental risks from banks.

Domestic scholars have made systematic research on the optimization of green finance and industrial structure from the perspective of empirical research.[4]Tan Chunlan(2013) used gray correlation degree to conclude that green finance can promote the optimization and upgrading of marine industry structure, transforming its structure more highly and rationalized.[5]Wang Ligu(2015)used VAR model to analyze that the structure of financial development, scale and rationalization of industrial structure were positively related.[6]Tang Yong(2018)believes that the impact of green finance on industrial structure upgrading is not obvious in the short term, but it has a positive pulling effect in the long run.

From the results of the existing research, foreign scholars mainly emphasized the importance of promoting green credit and the construction of industrial structure theory from the perspective of "sustainable finance", and more emphasized on theoretical research. While most domestic scholars focused on financial development and industrial structure optimization.

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Due to the short time for implementing green credit in China, there is little literature to study the relationship between green finance and industrial structure. Although some scholars have empirically analyzed the relationship between the two. However, the existing literature on the selection of green finance indicators is relatively simple. In addition, in view of the differences between the development of green finance and the industrial structure in various provinces in China, this paper selects more comprehensive indicators and takes Guizhou Province as an example to further study the promotion of green finance to optimize the industrial structure.

### III. THE STATUS OF GREEN FINANCE DEVELOPMENT AND INDUSTRIAL STRUCTURE IN GUIZHOU PROVINCE

#### A. Development Status of Green Finance

At present, China's green credit consists of two parts: one is to support energy-saving and environmental protection, the use of new energy and other strategic emerging technology industries loans; the second is to support energy-saving environmental protection projects and service loans. Between December 2013 and June 2017, the country's 21 major banks increased their green credit by nearly 3 trillion Yuan. Among them, energy conservation and environmental protection projects and services loans doubled. The balance of emerging technology industry loans such as energy conservation and environmental protection and new energy technologies increased from 1.51 trillion Yuan to 1.69 trillion Yuan (data from the China Banking Regulatory Commission). This shows that the scale of China's green credit has maintained steady growth (see Table 1).

TABLE I. 2014-2016 ENERGY CONSERVATION AND ENVIRONMENTAL PROTECTION AND GREEN CREDIT BALANCE FLUCTUATIONS

PROJECT	2013	2014	2015	2016
Balance of loan for energy saving and environmental protection projects / 100 million RMB	36853.49	44363.86	53201.57	58090.34
Balance of Green Credit in Banking institutions / 100 million RMB	51983.09	60128.29	70066.13	75046.87

<sup>a</sup>. Source: 2013-2016 Social Responsibility Report

In 2016, the total GDP of Guizhou Province was 1,17,776.73 billion Yuan, ranking 25th in the country. The added value of the financial industry was 68.940 billion Yuan, ranking 24th in the country, accounting for 1.59% and 1.13% of the national total. It is worth noting that Guizhou Province ranks relatively low in the economic status of the provinces and the development of the financial industry in the whole country. The above data shows that in the case of Guizhou Province's promotion of gross national product, the financial industry also needs to adapt to the new situation, and the financial industry is matched with the real-time economic development through reforms. In addition, the development of green finance needs not only perfect market structure, but also perfect legal system, which is the premise and foundation to expand the scale of green finance and promote the realization of its function.

#### B. Present Situation of Industrial Structure

The GDP of Guizhou Province has increased from 288.411 billion Yuan in 2007 to 117.763 billion Yuan in 2016. During this decade, the overall economic operation trend is considerable. At the same time, the proportion of the three major industries in GDP can reflect the overall trend of the industrial structure in the region. Specifically, the trend of the proportion of the primary industry in GDP (AGR) in Guizhou Province is "U" shaped first and then rising, accounting for the proportion 15.5% to 15.7% eventually stabilized; the secondary industry's share of the province's gross domestic product (IGR) rose from 39.0% to 39.7%; the tertiary industry (SGR) fell from 45.5% to 44.6%. It can be seen that the industrial structure of Guizhou Province is similar to that of the whole country. The tertiary industry is in a dominant position, followed by the secondary industry and finally the primary industry. From 2007 to 2016, the gross domestic product increased from 270,232.3 billion Yuan to 743,585.5 billion Yuan. Compared with the added value of the three major industries in Guizhou Province, China's primary industry's share of the total industry (AGR) fell rapidly to 8.6% in 2016; The data show that in 2012, the proportion of the tertiary industry in the country and the proportion of the secondary industry has been completely equal. Then in 2016, the proportion of China's tertiary industry in the total industry surpassed the secondary industry, exceeding 11.7 percentage points, reaching 51.6%. (See Table 2).

TABLE II. VALUE ADDED OF VARIOUS INDUSTRIES IN CHINA AND GUIZHOU PROVINCE FROM 2007 TO 2016

Indicator	Added value of various industries throughout the country (%)			Added value of various Industries in Guizhou Province (%)		
	Primary industry	Secondary industry	Tertiary industry	Primary industry	Secondary industry	Tertiary industry
2016	8.6	39.9	51.6	15.7	39.7	44.6
2015	8.8	40.9	50.2	15.6	39.6	44.8
2014	9.1	43.1	47.8	13.8	41.7	44.5
2013	9.3	44.0	46.7	12.3	40.6	47.1
2012	9.4	45.3	45.3	13.0	39.2	47.8
2011	9.4	46.4	44.2	12.7	38.5	48.8
2010	9.5	46.4	44.1	13.4	39.1	47.3
2009	9.8	45.9	44.3	14.1	37.7	48.2
2008	10.3	46.9	42.8	15.1	38.5	46.4
2007	10.3	46.9	42.9	15.5	39.0	45.5

<sup>b</sup>. Source: State Statistical Bureau

Although Guizhou Province still maintains the "three-two-one" industrial structure, the gap with the whole country has not been fundamentally improved, and even the difference has increased. The situation of unreasonable industrial structure still cannot be obtained by simply reversed. China's industrial structure has been gradually adjusted and optimized from "two-three-one" to "three-two-one". Guizhou Province cannot take off the hat of poor provinces only by relying on the development of planting and animal husbandry, and if it cannot make effective adjustments, this will lead to the imbalance of the economic structure and even lead to the unsound development of the economy. Therefore, the industrial structure of Guizhou also needs to be adjusted and gradually optimized under the original "three-two-one" mode,

so as to increase the proportion of the tertiary industry while developing the primary industry. Take into account the internal elements of the industry coordinated and sustained development.

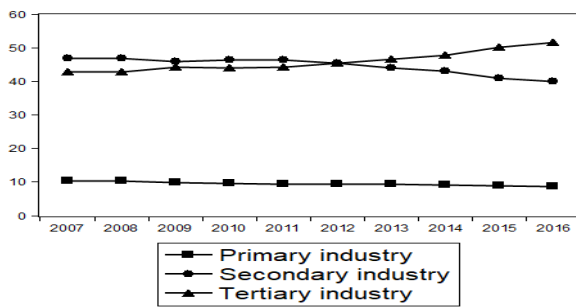


Fig. 1. Trends of the proportion of China's three industries from 2007 to 2016

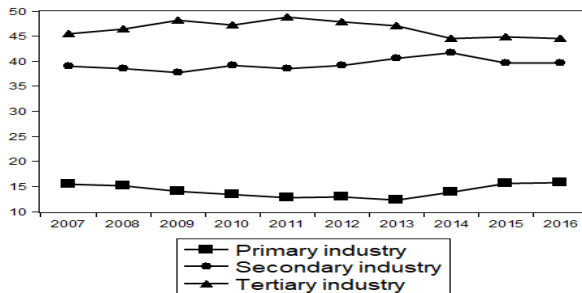


Fig. 2. Trends of the proportion of the three industries in Guizhou Province from 2007 to 2016

#### IV. AN EMPIRICAL ANALYSIS OF GREEN FINANCE AND INDUSTRIAL STRUCTURE IN GUIZHOU PROVINCE

##### A. Model and Indicator Selection

###### 1) Grey correlation Model

In this paper, four sample sizes from 2014 to 2017 are selected as the sample space. If the regression analysis method is used in the case of small sample size of time series data, the phenomenon that the model freedom is too small and "pseudo-regression" will occur. The grey relational analysis method is carried out by analyzing and determining the degree of influence between factors or the contribution of factors to the main behavior. It is possible to study the problem of insufficient sample information. In the case that the time series data sample quantity is small, and the analysis object does not need to have a typical distribution law, the ideal analysis result can still be obtained.

###### 2) Selection of indicators and data sources

We choose green credit as an indicator to replace the development degree of green finance. Through the comprehensive analysis of grey correlation degree, we can explore the impact of the development of green finance in Guizhou Province on the three industries from 2014 to 2017 from a macro perspective. Since the beginning of 2014, the former China Banking Regulatory Commission has established a statistical system for energy conservation and environmental protection projects and service loans. Therefore, only the loan balance from 2014 has been collected. The data comes from

the Guizhou Provincial Banking Regulatory Bureau from 2014 to 2017.

In the industrial structure index of Guizhou Province, this paper selects the proportion of the added value of the first, second and third industries to the total output value of Guizhou Province as the measurement index. The data comes from the work report of the National Bureau of Statistics and the Guizhou Provincial Government in 2014-2017.

The following are the figures for the ratio of green credit and the proportion of the three major industries in Guizhou:

TABLE III. GREEN CREDIT AND THE PROPORTION OF THE THREE MAJOR INDUSTRIES IN GDP

PROJECT/YEAR	2014	2015	2016	2017
green-credit policy(GLR)	1079.82	1322.81	1400.85	1808.82
AGR	13.8	15.6	15.7	16.7
IGR	41.7	39.6	39.7	44.6
SGR	44.5	44.8	44.6	49.2

Note:  
AGE: The share of primary industry in GDP;  
IGR: The share of secondary industry in GDP;  
SGR: The proportion of Tertiary Industry to GDP(SGR)

##### B. Analysis of empirical results

This paper discusses the relationship between green credit and industrial structure in Guizhou province based on grey relational degree analysis method. The steps for calculating grey correlation are as follows:

The first step is to build a time series based on the dependent and independent variables. Set the parent factor time series and the child factor time series respectively:  $X_0(k) = \{x_0(1), x_0(2), \dots, x_0(n)\}$   $X_i(k) = \{x_i(1), x_i(2), \dots, x_i(n)\}$ , Where 0 and i represent sequences and k represents years.

$$X_{01} = (0.77, 0.94, 1.00, 1.29)$$

$$X_1 = (0.89, 1.01, 1.02, 1.08)$$

$$X_2 = (1.01, 0.96, 0.96, 1.08)$$

$$X_3 = (0.97, 0.98, 0.97, 1.07)$$

After homogenization:

The second step is to find the difference column and the maximum difference and the minimum difference between the two poles:

$$\Delta_i(k) = |x'_0(k) - x'_i(k)|$$

$$\Delta_j = [\Delta_i(1), \Delta_i(2), \dots, \Delta_i(n)]$$

$$M = \max_i \max_k \Delta_i(k), m = \min_i \min_k \Delta_i(k)$$

TABLE IV. DIFFERENCE ABSOLUTE VALUE

Difference absolute value			$\Delta_{\max}$ and $\Delta_{\min}$		
0.12	0.24	0.20	0.21	0.24	0.21
0.07	0.01	0.04			
0.02	0.04	0.02	0.02	0.01	0.02
0.21	0.21	0.21			

The third step is to calculate the correlation coefficient. The calculation formula is:

$$\xi_{0i}(k) = \frac{\min_k |X_0(k) - X_i(k)| + \zeta \max_k |X_0(k) - X_i(k)|}{|X_0(k) - X_i(k)| + \zeta \max_k |X_0(k) - X_i(k)|}$$

TABLE V. CORRELATION COEFFICIENT

0.54	0.57	0.92
0.71	0.77	1.01
1.00	0.75	1.07
0.39	1.08	1.20

The fourth step is to calculate the correlation synthesis degree:

$$\gamma_{0i} = \frac{1}{n} \sum_{t=1}^n \delta_{0i}(t)$$

Among,  $\gamma_{0i}$  is the correlation degree between mother sequence 0 and subsequence  $i$ ,  $n$  is the year, the time series.

According to the upper formula, grey comprehensive correlation degree:

$$\gamma_{01} = 0.66, \gamma_{02} = 0.79, \gamma_{03} = 1.05, \lambda_{03} > \lambda_{02} > \lambda_{01}.$$

## V. CONCLUSIONS AND POLICY RECOMMENDATIONS

### A. Conclusions

It shows that the ratio of green credit ratio in Guizhou Province to the proportion of tertiary industry in GDP is the largest, followed by the second industry, and the correlation between the first industry is the weakest. In other words, the lending situation of the green loan project in Guizhou Province currently has a greater impact on the enterprises related to the secondary and tertiary industries, which is second to the primary industry. This is in line with the actual situation, most industries involved in green finance belong to the second and third industries, namely energy-saving and environmentally-friendly and technologically innovative industries. Through analysis, it can be concluded that green finance plays an important role in promoting the adjustment of industrial structure. Industrial restructuring can not be separated from the strong financial support; green finance is just for the development of these industries to provide a source of water.

### B. Policy Recommendations

(1) Optimize resource allocation and support industrial restructuring. At the same time, the government should give full play to the function of management and regulation. In guiding financial institutions to invest, we should give energy conservation and environmental protection industry key support, vigorously support the development of green finance, and promote the transformation and development of industrial structure, also encourage financial institutions to vigorously develop green credit, innovative financing model. The government should introduce green funds into the environmental protection industry, adjust and encourage banks to develop green credit, and draw on the Equator Principles to

establish a standardized and standard operating system for green credit. At the same time, the government should actively promote the bank's research and development of rich green credit products; increase the proportion of investment in environmental protection, low-cost, energy-saving industries, so that the industrial structure is optimized. When lending money to financial institutions, environmental risk is taken as a standard in the risk assessment of customers. The "two high" project enterprises are given a quota, and the government imposes certain penalties and rectification on such enterprises.

(2) Strengthen the disclosure of green data; improve the construction of information platform. At present, China still lacks a platform for green financial information disclosure. It is very difficult to collect relevant data, which in turn leads to problems in financial institutions' redistribution of investment risks. Therefore, it is necessary to establish and improve relevant systems for green financial data disclosure and improve the information sharing system. A good information sharing platform can enhance the efficiency of communication and collaboration between government and financial institutions. On the other hand, it also creates new channels for understanding green finance.

(3) Set up the idea of green environmental protection; increase the propaganda of green development. Through the implementation of higher standards of social and environmental risk review, enterprises can better reduce the environmental risk. More enterprises realize the necessity, urgency and usefulness of green development by the promotion of banks. For the enterprise itself, establish consumer concepts and investment concepts related to green finance and environmental protection, and keep consistent with the national industrial policy in action, and invest funds in energy conservation and environmental protection projects. Actively organize training related to green finance and industrial transformation. While introducing professional talents, we will introduce advanced technologies, establish a sound green credit evaluation system, and integrate corporate culture with environmental protection.

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