

# Analysis of the synergistic benefits of regional green finance and the regional economy based on the CRITIC model

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**Abstract.** Green finance, which is a form of fusion of the financial and green industries, has a big influence on the economy, and it is vital to investigate both its impact mechanism and its synergistic mechanism. To analyse the synergistic benefits of both, this paper first collects evaluation index data related to green finance and the regional economy in the Xinjiang region of China from 2011 to 2020. Then, it calculates the index weights using the Criteria Importance Through Intercriteria Correlation (CRITIC) method. The findings indicate that although there is a positive trend between the two, the synergy between the regional green finance and economy of Xinjiang is generally at a low stage, and the development of the orderliness of the regional green finance and economy subsystems is unstable. However, the regional economy is less volatile than the regional green finance and has a good development trend.

**Keywords:** synergy model, regional green finance, regional economy, Xinjiang, CRITIC.

## 1. Introduction

"Green finance" refers to financial activities and services that aim to promote sustainable development. With the growing demand for industrial structure upgrades, high-quality regional economic development, and sustainable development in developing countries such as China, green finance as an emerging financial model has gradually gained widespread application. However, the current understanding of the mechanism of interaction between green finance and the regional economy is still at a relatively confusing stage, leading to certain problems in the coordinated development of the two. The synergistic development of green finance and regional economies is conducive to the innovation and environmental protection activities of regional enterprises and the sustainable development of regional economies, and there are many studies in this area.

In terms of the promotion effect of green finance on the regional economy:

LIU et al. [1] experimentally examined data from central China using a fixed-effects model and discovered that the stronger the industrial structure was in time and space, the greater the impact of green financing development on regional economic growth. To empirically examine the effects of green finance and R&D investment on regional economies, FU et al. [2] employed a panel threshold model and Chinese provincial panel data. They discovered that when the level of environmental pollution exceeds the threshold, the effect of green finance to promote sustainable economic growth is enhanced by an increase in R&D investment and technological progress. Based on provincial data in China, Li et al. [3] used a panel regression model to investigate the effects of green finance on energy use and economic growth. They discovered that, while there is spatial and temporal heterogeneity in this effect, green finance can significantly promote high-quality economic development and reduce energy consumption.

In terms of the application of comprehensive evaluation models:

Based on provincial panel data in China, Zhang et al. [4] used a highly effective SBM model to measure industrial eco-efficiency. The regression results revealed a "u-shaped" relationship between green finance and industrial eco-efficiency, illustrating the potential for green finance development

to enhance industrial eco-efficiency. Peng et al. [5] used the entropy value method to determine the green finance and regional environment scores of 30 provinces in China and created a coupled coordination model. LIU et al. [6] used a linear weighting method to determine the level of green finance and economic quality development by collecting provincial panel data in China. It is discovered that there is little coordination between regional environment and green finance, and their relationship is still in a state of disordered mutual restraint.

In terms of synergy model application:

In their analysis of the degree to which green finance and high-quality economic development are coupled, LIU et al. [5] discovered that, while there is a low degree of coordination between the two in China, the positive relationship is growing. Using the coupling coordination model, LIU et al. [7] concluded that there has been an improvement in the level of coordination between green finance and industrial structure each year and recommended that the beneficial interaction between green finance and industrial upgrading be directed.

The majority of studies have employed conventional regression models to investigate the two parties' potential for mutual promotion or to assess the degree of synergistic development using the coupling coordination degree. The purpose of this essay is to examine how green finance and local economies might work in harmony. First, based on the literature, a system of indicators for the interaction between green finance and regional economies is created, along with sequential covariates for evaluating green finance and regional economies. Next, the conventional synergistic system model is optimized using CRITIC, with the Chinese province of Xinjiang chosen as the research subject for empirical evidence. Finally, the synergistic model is calculated. Few academics have examined the relationship between the regional economy and green finance; thus, this study is helpful in investigating the relationship between the two in depth. This will allow for future reforms and optimization to support the coordinated growth of the two.

## **2. Regional Green Finance and Regional Economic System Construction**

### **2.1. Regional Green Financial System**

The term "green finance" describes financial actions used to combat climate change, support environmental improvement, and promote sustainable development. By raising money, green finance works to protect the environment and promotes the growth of green businesses like renewable energy, energy efficiency, environmental protection, and ecological building [7]. The People's Bank of China's Guidance on Building a Green Financial System categorizes the green finance business as primarily consisting of green securities, green credit, green insurance, green financing, carbon finance, and other components. Taking into account the green financial products currently available on the market, this paper upholds the principles of objectivity and accessibility in the selection of indicators and refers to pertinent studies [8, 9] to construct a green finance measurement index system. It then chooses five dimensions of green loans, green security, green insurance, green investment, and carbon finance to characterize the development level of green finance.

### **2.2. Regional Economic System**

The regional economy, which is defined by its regional and comprehensive nature, is the national economy that is divided up into different administrative regions as a result of the geographical division of labour. Studies comparing four dimensions of economic growth—material production, human capital investment, scientific and technological advancement, and industrial structure optimization—have examined variations in the degree of regional economic development. Researchers have also looked at five different aspects of the quality of regional economic development: innovation, coordination, sustainability, openness, and sharing. The degree of regional economic synergistic development has also been extensively studied from four perspectives: social, environmental, resource-based, and economic. In summary, drawing on relevant studies [10, 11], this paper selects 3 dimensions of economic growth, economic development, and economic progress to

measure the level of regional economic development. Economic growth is mainly portrayed by the total economic volume and innovation level; economic development mainly reflects the structural changes in the economy and the depth of professional division of labour and marketization; and economic progress is mainly related to social welfare, resources, and the environment.

In summary, the sequential covariates of regional green finance and regional economic systems constructed in this paper are shown in Table 1.

**Table 1.** Order parameters of regional green finance and regional economic system

System layer	First-order index	Secondary index	Order parameter	Unit	Property	Reference
Green finance	Typical green financial products	Green credit	The proportion of interest expenditure of high energy consumption industries ( $X_1$ )	%	-	[8]
		Green security	The market capitalization of energy-intensive industries ( $X_2$ )	%	-	[8]
		Green Insurance	Agricultural insurance rate ( $X_3$ )	%	+	[9]
	The proportion of agricultural insurance scale ( $X_4$ )		%	+	[9]	
	others	Green investment	The proportion of investment in environmental pollution control ( $X_5$ )	%	+	[9]
			The proportion of government expenditure on energy conservation and environmental protection ( $X_6$ )	%	+	[9]
		Carbon finance	Carbon intensity ( $X_7$ )	%	-	[9]
Regional economy	Economic growth	Economic aggregate	GDP( $Y_1$ )	hundred million yuan	+	[10]
			GDP per capita ( $Y_2$ )	RMB	+	[10]
		Innovation input	Percentage of R&D expenditure in GDP ( $Y_3$ )	%	+	[11]
			Proportion of R&D employees in employment ( $Y_4$ )	%	+	[11]
		Innovation output	Authorized Number of Domestic Patent Applications ( $Y_5$ )	a	+	[11]
	Total profits of high-tech industries ( $Y_6$ )		hundred million yuan	+	[11]	
	Economic development	Industrial structure	The proportion of secondary and tertiary industries in GDP ( $Y_7$ )	%	+	[11]
			The ratio of secondary and tertiary industries ( $Y_8$ )	%	+	[11]
			The proportion of employment in tertiary industry ( $Y_9$ )	%	+	[11]
		Urban-rural structure	The proportion of urban population ( $Y_{10}$ )	%	+	[11]
			Comparison of consumption level between urban and rural residents ( $Y_{11}$ )		+	[11]
	Degree of openness	Share of total imports and exports in GDP ( $Y_{12}$ )	%	+	[11]	
		Total foreign direct investment ( $Y_{13}$ )	ten thousand dollars	+	[11]	
	Economic progress	Resource consumption	Energy consumption per unit of GDP ( $Y_{14}$ )	tons of standard coal/ten thousand yuan	-	[11]
			Electricity consumption per unit of GDP ( $Y_{15}$ )	KWH/yuan	-	[11]
		Environmental pollution	Wastewater discharge per unit of gross domestic product ( $Y_{16}$ )	tons/yuan	-	[10]
			Emissions per unit of gross domestic product ( $Y_{17}$ )	standard cubic meters/yuan	-	[10]
		Social security	Proportion of urban and rural residents with basic medical Insurance ( $Y_{18}$ )	%	+	[11]
			The proportion of urban and rural basic endowment Insurance ( $Y_{19}$ )	%	+	[11]
		Social welfare	Per capita educational expenditure ( $Y_{20}$ )	RMB	+	[11]
	Number of beds in medical institutions per 10,000 people ( $Y_{21}$ )		a	+	[11]	

### 3. CRITIC Objective Empowerment Method

The Criteria Importance Though Intercriteria Correlation (CRITIC) method, proposed by Diakoulaki et al. in 1995, is an objective weighting method that combines the weights of indicators based on the strength of contrast and conflict between evaluation indicators [12]. This method is determined by two factors: the standard deviation and the correlation coefficient. The standard deviation reflects the volatility of the evaluation indicators, and the correlation coefficient reflects the conflict between the indicators. Compared with the entropy method and the standard deviation method, the CRITIC method takes into account the correlation between indicators while taking into account the differences between indicators, and obtains the weight values of indicators in an integrated manner, which helps to reduce the negative influence of the extreme values of individual data weights in the evaluation system. the steps of the CRITIC method to calculate the indicator weights are as follows.

STEP1: Data standardisation. Since the constructed indicators are composed of multiple evaluation indicators and the units of measurement of each indicator are not uniform, in order to eliminate the influence, the indicators are standardized. Assuming that there are  $h$  evaluation objects and  $q$  evaluation indicators, the positive and negative nature of the indicators are first distinguished, and the positive and negative indicators are processed according to equations (1~2) to obtain the standardisation matrix.

Of these, the positive indicators:

$$x'_{ij} = \frac{x_{ij} - x_{i-min}}{x_{i-max} - x_{i-min}}, i = 1, 2, \dots, h; j = 1, 2, \dots, q \quad (1)$$

Negative indicators:

$$x'_{ij} = \frac{x_{i-max} - x_{ij}}{x_{i-max} - x_{i-min}} \quad (2)$$

Determine the standard deviation of the indicator:

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^h (x_{ij} - \bar{x}_j)^2}{n-1}} \quad (3)$$

$$\bar{x}_j = \frac{1}{n} \sum_{i=1}^h x_{ij} \quad (4)$$

Where  $\bar{x}_j$  is the mean value of the  $j$  indicator and  $\sigma_j$  is the standard deviation of the  $j$  indicator. The larger the  $\sigma_j$  indicator, the greater the variation between objects and the greater the weight given to the indicator.

STEP2: Calculate the correlation coefficient of the evaluation indicators:

$$r_{ij} = \frac{\sum_{k=1}^h (x_{ki} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\sqrt{\sum_{k=1}^h (x_{ki} - \bar{x}_i)^2 \sum_{k=1}^h (x_{kj} - \bar{x}_j)^2}}, \quad i \neq j \quad (5)$$

Where  $x_{ki}$  and  $x_{kj}$  are the values of the  $i$  indicator and the  $j$  indicator of the  $k$  evaluation object, the  $\bar{x}_i$  and  $\bar{x}_j$  are the values of the  $h$  object of the  $i$  indicator and the  $j$  indicator of the  $k$  object, and  $r_{ij}$  is the correlation coefficient between the  $i$  indicator and the  $j$  indicator, and the closer it is to 1 means the greater the correlation between the two indicators.

STEP3: Calculating the amount of information in the indicator:

$$C_j = \sigma_j \sum_{i=1}^h (1 - r_{ij}), \quad i = j; j = 1, 2, \dots, h \quad (6)$$

Where  $(1 - r_{ij})$  reflecting the conflicting nature of the indicators, the  $C_j$  indicates the first The  $j$  larger the number of indicators, the more information it contains.

STEP4: Calculation of indicator weights:

$$w_j = \frac{C_j}{\sum_{j=1}^h C_j}, \quad j = 1, 2, \dots, h \quad (7)$$

Where  $w_j$  denotes the weight value of indicator  $j$ . The greater the amount of information contained, the greater the relative importance of indicator  $j$ , and the greater the weight.

## 4. Theoretical model construction of synergistic systems

### 4.1. Subsystem model construction

This paper defines regional green finance and regional economic systems, which interact to form a composite system. Define the composite system  $T = (T_1, T_2)$ , where  $T_1$  is the regional green financial system, and  $T_2$  is the regional economic system. Let the order parameter of the system be  $s_j = (s_{j1}, s_{j2}, \dots, s_{ji})$ , where  $\alpha_{ji} \leq s_{ji} \leq \beta_{ji} (i = 1, 2, 3, \dots, l)$  and  $n \geq 1$ , and  $l$  be the number of indicators affecting the operation of the system, and  $\alpha_{ji}$  and  $\beta_{ji}$  are the lower and upper limits, respectively, when the system is stable.  $s_{ji}$  are the lower and upper limits of the system when the system is stable.

When  $i \in (1, e)$ ,  $s_{ji}$  is positive, it is considered that the magnitude of its value would be positively connected with the level of orderliness; conversely, when  $i \in (e+1, l)$ ,  $s_{ji}$  is negative, it is assumed that the size of its value will be negatively correlated with the level of the orderliness of the system. As a result, the formula is used to determine the system orderliness of each indication of the subsystem:

$$u_j(s_{ji}) = \begin{cases} \frac{s_{ji} - \alpha_{ji}}{\beta_{ji} - \alpha_{ji}}, & i \in (1, e) \\ \frac{\beta_{ji} - s_{ji}}{\beta_{ji} - \alpha_{ji}}, & i \in (e+1, l) \end{cases} \quad (8)$$

For the system orderliness of the subsystem, this paper uses a linear weighting method, obtained by integrating the orderliness values of all indicators of the subsystem, with the following formula:

$$u_j(s_j) = \sum_{j=1}^e w_j u_j(s_{ji}) \quad (9)$$

Where  $w_j$  take the result of the 3-(7) calculation.

#### 4.2. Collaborative system model construction

The degree of synergy between regional green finance and the regional economic system is calculated based on the orderliness of each ordinal covariate, with the following formula:

$$O_{(t)} = \varpi \sqrt{|O_1(t) - O_1(t-1)| \cdot |O_2(t) - O_2(t-1)|} \quad (10)$$

Where  $\varpi = \begin{cases} 1, & O_1(t) - O_1(t-1) \geq 0, O_2(t) - O_2(t-1) \geq 0 \\ -1, & \text{else} \end{cases}$ .  $O_1(t)$  is the ordered contribution of the regional economic

subsystem at moment  $t$ , and  $O_2(t)$  is the ordered contribution of the regional economic subsystem at moment  $t$ . The degree of synergy  $O_{(t)} \in [-1, 1]$ , which takes a positive value, indicates that the composite system is in a synergistic state; on the contrary, it is in a non-synergistic state, and the more the value tends to 1, the greater the degree of synergy between regional green finance and the regional economy. The model can reflect the degree of comprehensive coordination between the development of regional green finance and the operation of the regional economic system. Referring to the research results of Wu C.X[13], the degree of the synergy of the composite system is divided, as shown in Table 2.

**Table 2.** Classification of the level of synergy of composite systems

Synergy	Level of synergy
$O_{(t)} \in [-1, -0.666)$	High degree of non-synergy
$O_{(t)} \in [-0.666, -0.333)$	Moderate non-synergy
$O_{(t)} \in [-0.333, 0)$	Mildly non-synergistic
$O_{(t)} \in [0, 0.333)$	Mild synergy
$O_{(t)} \in [0.333, 0.666)$	Moderate synergy
$O_{(t)} \in [0.666, 1]$	Highly synergistic

### 5. Empirical analysis

#### 5.1. Selection of study area

The study area of this paper is the Xinjiang Uyghur Autonomous Region (XUAR) in north-western China, covering an area of approximately 1.66 million square kilometres, with four prefectures, five regions, five autonomous prefectures, and eleven autonomous county-level cities, making it the largest province in China in terms of area. The overall volume of imports and exports from Xinjiang

increased from 139.8 billion RMB in 2016 to 156.9 billion RMB in 2021, and trade alliances were formed with more than 170 nations and regions. Reform and Innovation Pilot Zone, and as of June 2021, Xinjiang has issued a total of RMB 5 billion in green financial bonds, with a total of 1,715 projects included in the green project pool, with a total project investment of RMB 875.569 billion and financing needs of RMB 619.823 billion. In the same year, Xinjiang had a resident population of 25.85 million and a gross regional product of RMB 1,598.365 billion, an increase of 7.0% year-on-year. In its future planning, Xinjiang will stick to green and innovation-driven development and aggressively nurture fresh impetus for high-quality development and is therefore well represented.

**5.2. Data collection**

In this study, the two subsystems of green finance and regional economic development in Xinjiang from 2011 to 2020 were selected as the sample data. In order to ensure the reliability and authority of the sample data, the indicator data of the green financial system in this paper were obtained from the Wind database, EPS database, and the official website of the People's Bank of China, while the indicator data of the regional economic system were obtained from the Xinjiang Statistical Yearbook, in which some of the missing data were filled by modelling prediction and interpolation. Descriptive statistics for the ordinal covariates are shown in Table 3.

**Table 3.** Descriptive statistics for sequential parameters

Secondary indicators	Tertiary indicators (units)	Maximum value	Minimum value	Average	Median
Green Credit	X <sub>1</sub> (%)	0.7295	0.2001	0.6069	0.6505
Green Securities	X <sub>2</sub> (%)	0.2076	0.1060	0.1426	0.1355
Green Insurance	X <sub>3</sub> (%)	0.0034	0.0010	0.0016	0.0014
	X <sub>4</sub> (%)	0.0236	0.0118	0.0187	0.0188
Green Investment	X <sub>5</sub> (%)	3.2001	0.7814	1.7817	1.7094
	X <sub>6</sub> (%)	0.8645	0.5354	0.7381	0.7322
Carbon finance	X <sub>7</sub> (%)	0.0450	0.0385	0.0412	0.0406
Total economy	Y <sub>1</sub> (hundred million yuan)	13797.5800	6532.0300	10190.2630	9468.8550
	Y <sub>2</sub> (RMB)	53593.0000	29624.0000	42329.7000	40106.5000
Innovation input	Y <sub>3</sub> (%)	0.1613	0.1256	0.1466	0.1463
	Y <sub>4</sub> (%)	0.0578	0.0465	0.0514	0.0500
Industrial	Y <sub>5</sub> (a)	12763.0000	2642.0000	7136.2000	7605.0000
	Y <sub>6</sub> (hundred million yuan)	28.3000	0.7300	10.4535	6.9900
Industrial structure	Y <sub>7</sub> (%)	91.0000	82.0000	88.6800	88.9500
	Y <sub>8</sub> (%)	1.4906	0.7731	1.2086	1.3186
	Y <sub>9</sub> (%)	0.5199	0.2756	0.3916	0.3902
Urban and rural structure	Y <sub>10</sub> (%)	56.5300	43.7300	49.6830	49.6000
	Y <sub>11</sub> (%)	46.9589	37.1456	40.0352	39.0206
Degree of openness	Y <sub>12</sub> (%)	0.0023	0.0010	0.0015	0.0013
	Y <sub>13</sub> (ten thousand dollars)	48102.0000	19613.0000	34428.1000	36780.5000
Resource consumption	Y <sub>14</sub> (tons of standard coal/ten thousand yuan)	1.6927	1.3598	1.5260	1.5408
	Y <sub>15</sub> (kWh/yuan)	0.2456	0.1013	0.2037	0.2204
Environmental pollution	Y <sub>16</sub> (tons/yuan)	0.0004	0.0001	0.0002	0.0002
	Y <sub>17</sub> (standard cubic metres/yuan)	2.4660	1.3131	1.8655	1.8414
Social Security	Y <sub>18</sub> (%)	61.8004	11.7572	31.7988	12.7368
	Y <sub>19</sub> (%)	28.3008	22.2232	24.4458	23.3425
Social Welfare	Y <sub>20</sub> (RMB)	20369.6599	11248.6506	16691.0352	17136.8466
	Y <sub>21</sub> (a)	71.1000	56.9300	64.9310	64.9500

The results in Table 3 show that green credit, green investment, social economy, and social security in Xinjiang have developed rapidly between 2011 and 2020, reflecting the effectiveness of green financial reform, the increasing improvement of the social security system, and the rising standard of living of the people, but there is still no very significant improvement in environmental pollution.

### 5.3. Calculation of weights

In this paper, using MATLAB software, the indicator data collected for the two subsystems in 5.2 were brought in and the CRITIC calculations were carried out in conjunction with equations (1) to (7) in Chapter 3 to derive the conflicting, contradictory, information carrying capacity and final weight values for each indicator, as shown in Table 4.

**Table 4.** Green finance and regional economic system order covariate weights

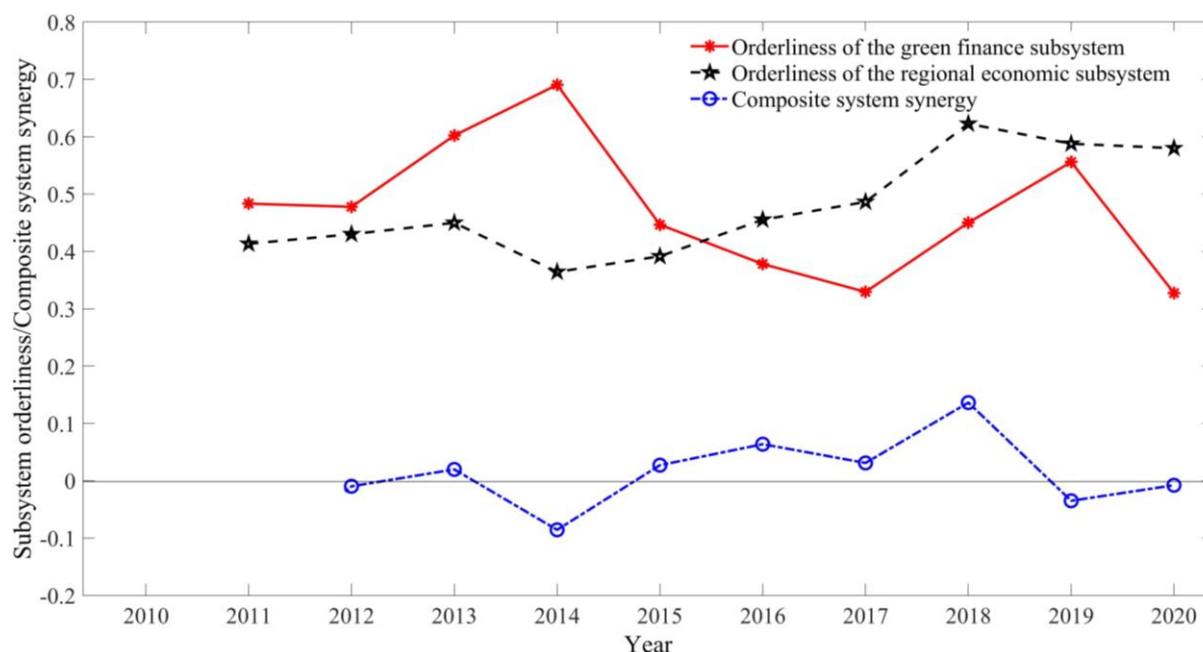
Tertiary indicators	Volatility	Conflictual	Information carrying capacity	Weights
X <sub>1</sub>	0.2875	5.8722	1.6885	0.1318
X <sub>2</sub>	0.3072	6.0345	1.8540	0.1448
X <sub>3</sub>	0.3217	4.8916	1.5736	0.1229
X <sub>4</sub>	0.3393	4.8745	1.6537	0.1291
X <sub>5</sub>	0.2855	5.6627	1.6166	0.1262
X <sub>6</sub>	0.3191	7.1825	2.2920	0.1790
X <sub>7</sub>	0.3226	6.5980	2.1287	0.1662
Y <sub>1</sub>	0.3515	12.3560	4.3433	0.0340
Y <sub>2</sub>	0.3504	12.4638	4.3669	0.0341
Y <sub>3</sub>	0.3086	22.8242	7.0428	0.0551
Y <sub>4</sub>	0.3802	27.0824	10.2964	0.0805
Y <sub>5</sub>	0.3053	13.0929	3.9968	0.0313
Y <sub>6</sub>	0.3440	13.5367	4.6572	0.0364
Y <sub>7</sub>	0.2852	25.6369	7.3116	0.0572
Y <sub>8</sub>	0.3598	13.0882	4.7097	0.0368
Y <sub>9</sub>	0.3402	12.4733	4.2430	0.0332
Y <sub>10</sub>	0.3701	12.3002	4.5523	0.0356
Y <sub>11</sub>	0.2949	17.1952	5.0716	0.0397
Y <sub>12</sub>	0.3861	28.9464	11.1753	0.0874
Y <sub>13</sub>	0.3716	27.7695	10.3183	0.0807
Y <sub>14</sub>	0.3843	15.4236	5.9272	0.0463
Y <sub>15</sub>	0.3081	26.4418	8.1465	0.0637
Y <sub>16</sub>	0.4114	12.4229	5.1102	0.0400
Y <sub>17</sub>	0.3741	14.5065	5.4263	0.0424
Y <sub>18</sub>	0.4998	12.7389	6.3675	0.0498
Y <sub>19</sub>	0.4229	13.0098	5.5023	0.0430
Y <sub>20</sub>	0.3296	12.6553	4.1706	0.0326
Y <sub>21</sub>	0.3675	14.0068	5.1481	0.0403

According to the three characteristics of CRITIC, namely volatility, conflict, and information-carrying capacity, the results in Table 4 show that, among the green financial system (X), the percentage of financial expenditure on energy saving and environmental protection (X<sub>6</sub>) has the highest weight of 0.179, indicating that this indicator itself has a strong evaluation intensity and is the most important within the green financial system, which can reflect more information and needs to be focused on. The agricultural insurance payout rate (X<sub>3</sub>) has the lowest weight of 0.1229, which has little impact on the evaluation of the green financial system. In addition, carbon finance and green securities, represented by X<sub>7</sub> and X<sub>2</sub>, also have a high degree of influence on the subsystem, and account for greater weight. In the regional economic system (Y), total imports and exports as a share of GDP (Y<sub>12</sub>) has the largest weight of 0.0878, followed by total foreign direct investment (Y<sub>13</sub>) with a weight of 0.0807, indicating that the degree of openness has a significant impact on the regional

economic system as a whole. The number of domestic patent applications granted ( $Y_5$ ) has the lowest weight of 0.313 and the lowest volatility of 0.3053, so it is of low importance and evaluation intensity in the subsystem of the regional economy and cannot reflect more information of the subsystem.

#### 5.4. Co-calculation and analysis

The weights of 5.3 are calculated by bringing in the collected data and using MATLAB software to calculate the degree of order of the green finance subsystem, the degree of order of the regional economic subsystem, and the synergy degree of the composite system of green finance and regional economy in Xinjiang in conjunction with equations (8) to (10) in Chapter 4. The calculated synergy degrees are shown in Figure 1.



**Figure 1.** Changes in the orderliness and synergy between green finance and the regional economy

##### 5.4.1. Subsystem orderliness analysis

As can be seen from Figure 1, from 2011 to 2020, the orderliness of the green financial subsystem and the regional economic subsystem in the XUAR fluctuates up and down over time, with the overall fluctuation of the green financial subsystem being larger and the overall fluctuation of the regional economy being more stable, and there is an obvious crossover phenomenon in the orderliness of the two, which can be divided into four stages according to this trend.

Phase 1 (2011~2014): the orderliness of the green finance subsystem has been higher than that of the regional economic subsystem, and it rapidly grew to the maximum value of 0.6905 after a year of stagnation and began to decline after 2014; the orderliness of the regional economic subsystem was in a negative and slow growth stage, during which it dropped to the lowest point of 0.3643 in 2014, indicating that the economic development of Xinjiang at that time was slow. The level was not high, and green finance was driving social and economic growth while entering a critical period of economic restructuring and development mode transformation.

Phase 2 (2015~2016): The regional economic subsystem is gradually more ordered than the green financial subsystem; the orderliness of the regional economic subsystem is slowly increasing, while the orderliness of the green financial subsystem is significantly decreasing when Xinjiang focuses on developing its social economy and increasing its gross product.

Phase 3 (2017-2018): The orderliness of the green finance subsystem grows in tandem with the orderliness of the regional economic subsystem; the regional economy develops and supports green finance, while green finance continues to develop as green finance reform measures are implemented in Xinjiang.

Phase 4 (2019~2020): The orderliness of both the green financial subsystem and the regional economic subsystem are declining; the orderliness of the green financial subsystem fell to the lowest point of 0.58, indicating that at that time, Xinjiang's economic development rate dropped due to the epidemic and green finance was hit hard.

#### 5.4.2. Analysis of the degree of synergy in composite systems

As can be seen from Figure 1, the degree of synergy between green finance and the regional economy in the Xinjiang Uygur Autonomous Region has developed in a wavy pattern and is generally at a low level of synergy. The overall trend in the degree of the synergy of the composite system can be divided into four stages.

Phase 1 (2011~2012): the orderliness of the green finance subsystem declined slightly, the orderliness of the regional economy subsystem increased slightly, the orderliness of green finance was slightly higher than that of the regional economy subsystem, and its development was ahead of that of the regional economy subsystem; the synergy of the composite system was negative at this time, so the two subsystems showed a mildly non-synergistic development phenomenon.

Phase 2 (2013~2014): green finance rises rapidly, the regional economy rises slowly and then declines slightly, during which the orderliness of the green finance subsystem is always higher than that of the regional economy subsystem, indicating that it is still green finance that leads the regional economic system; the synergy of the composite system is first positively promoted and then negatively antagonised in this phase, indicating that when the orderliness of both rises at the same time, the two subsystems are in a synergistic state. In contrast, the two subsystems are in an uncoordinated state of development when their orderliness rises and falls at the same stage.

Phase 3 (2015~2018): the orderliness of the green financial subsystem first declines and then rises, the orderliness of the regional economic subsystem slowly and continuously grows, the regional economic orderliness exceeds the green financial system, and the regional economic subsystem begins to lead the green financial subsystem; the synergy of the composite system has been in a positive value at this stage, indicating that the two subsystems have been in a mildly synergistic state and have produced synergistic benefits.

Phase 4 (2019~2020): The orderliness of the green finance subsystem shows a serious decline, the orderliness of the regional economic subsystem slightly declines and then rises, and the regional economic subsystem is still ahead of the green finance subsystem; the synergy of the composite system at this stage has been in a negative value, indicating that the two subsystems are seriously dysfunctional and unable to produce synergistic benefits, and timely adjustment is needed.

## 6. Conclusion

This paper builds a theoretical model for optimising synergistic systems based on the objective weighting of evaluation indicators using the CRITIC method. It then uses data on regional green finance and the regional economy from 2011 to 2020 in Xinjiang, China, to measure the level of synergy between regional green finance and the regional economy through the model. Following are the conclusions.

(1) In Xinjiang, the regional economy and regional green finance typically had low levels of synergy over the period under consideration. Between 2015 and 2018, regional green finance and the regional economy showed a sluggish synergy, with a major fall caused by a modest decline in the regional economy and the impact of the outbreak, and then an upward trend, demonstrating that the synergy between the two is progressing favourably.

(2) The Xinjiang regional green financial subsystem and regional economic subsystem orderliness generally show upward and downward fluctuations, but the latter is less volatile than the former. Among them, the green financial orderliness was higher than the socioeconomic orderliness before 2015, and the socioeconomic orderliness began to be higher than the green financial orderliness after 2015. During the synergistic development process, Xinjiang's social economy has had a stable upward trend, and although it has slightly decreased but is still at a high level overall.

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