WEP Warwick Evans Publishing

International Journal of Global Economics and Management

ISSN: 3005-9690 (Print), ISSN: 3005-8090 (Online) | Volume 2, Number 3, Year 2024
DOI: https://doi.org/10.62051/IJGEM.v2n3.68
Journal homepage: https://wepub.org/index.php/IJGEM/index

Analysis of the Coupling and Coordinated Development of Green Investment and Low Carbon Economy

——Taking 16 Cities in the Yangtze River Delta Region as an Example

Nan Yu [1], Feng He [1, a], Maimaiti Amanguli [1], Xinyi Zhang [1, b, *], Zejiong Zhou [2]

[1] School of Finance, Anhui University of Finance and Economics, Bengbu, Anhui, 233030
[2] School of Economics, Anhui University of Finance and Economics, Bengbu, Anhui, 233030
*Corresponding Author: [a] ynymf2023@163.com, [b, *] ynymf2023@163.com

ABSTRACT

Firstly, based on the review of domestic and foreign scholars' research on green investment and low-carbon economy, this article explores the coupling mechanism between green investment and low-carbon economy. Secondly, based on panel data from 16 cities in the Yangtze River Delta Economic Zone from 2015 to 2021, a comprehensive evaluation index system for green investment and low-carbon economy is constructed using five indicators: "low-carbon output indicator, low-carbon consumption indicator, low-carbon resource indicator, low-carbon environment indicator, and development capacity indicator." Furthermore, the entropy method is used to determine the weights of various indicators for green investment and low-carbon economy, calculate the comprehensive evaluation index for green investment and low-carbon economy in 16 cities in the Yangtze River Delta Economic Zone, and make a theoretical analysis of the development level of green investment and low-carbon economy in each region. At the same time, a coupling coordination model is used to explore the coupling degree and coupling between green investment and low-carbon economy index in 16 cities in the Yangtze River Delta Economic Zone from 2015 to 2021. Co scheduling. Finally, from the perspectives of time and space, in order to promote the coordinated development of green investment and low-carbon economy in the Yangtze River Delta Economic Zone, targeted policy recommendations are proposed for the government, enterprises, and the general public, with the aim of making theoretical contributions to the coordinated development of green investment and low-carbon economy, as well as the construction of ecological civilization in China.

KEYWORDS

Green investment; Low carbon economy; Coupling coordination

1. INTRODUCTION

With the proposal of China's "dual carbon" goals and the deepening of high-quality economic development, there is a strong demand for green investment in China, and low-carbon economy is receiving attention. It is necessary to study the coupling and coordination relationship between green investment and low-carbon economy in order to promote the development of green and low-carbon economy. This article takes the representative region of China's most active economic development, the Yangtze River Delta Economic Zone, as an example to explore the coupling and coordination relationship between green investment and low-carbon economy.

By studying relevant literature, this paper summarizes some research by foreign scholars on green investment and low-carbon economy. Luc Eyraud et al. analyzed the trends and determinants of investment in 35 developed and emerging countries over the past decade, and found that green investment has become a key driving force in the energy industry, with its rapid growth now mainly driven by China. Li Zheng Zheng et al. used the cross-sectional augmented autoregressive distribution lag method to estimate the elasticity of green investment and other key macroeconomic aggregates in carbon reduction in 30 provinces of China from 1995 to 2017. The results showed that investing in green projects was seen as reducing short-term and long-term carbon emissions levels.

In recent years, domestic scholars have paid considerable attention to the development of green investment and low-carbon economy. Cheng Lin and others studied the "the Belt and Road" green investment under carbon neutrality, pointing out that financial institutions need to actively study and judge the possible climate risks and transformation risks of the "the Belt and Road" construction, reduce investment in high carbon industries, grasp the opportunities of low-carbon transformation, and increase investment in green projects; Wang Jiaqing established a green investment portfolio under the low-carbon concept through the mean variance method, in order to provide a basis for financial institutions to launch low-carbon concept wealth management products or securities markets to launch low-carbon indices in the future; Zeng Sheng et al. used a spatial econometric model to test the nonlinear relationship between green investment, carbon emission intensity, and high-quality economic development, and concluded that the increase in financing for green enterprises has a more significant effect on high-quality economic development and carbon reduction.

2. ANALYSIS OF THE COUPLING MECHANISM BETWEEN GREEN INVESTMENT AND LOW-CARBON ECONOMY

Currently, in the context of high-quality development, the trend of green and low-carbon development in China's economy is evident, and the integration of green investment and low-carbon economy is strengthening. The triple profit principle of green investment is highly consistent with the sustainable development concept of low-carbon economy in terms of spiritual connotation. Based on the theories of sustainable development economy, ecological economics, market failure, and Coase property rights theory, this article establishes a theoretical analysis framework for the coupling mechanism of green investment and low-carbon economy.

2.1. The Development of Low-Carbon Economy Requires the Support of Green Investment

At present, China's energy consumption structure is based on fossil fuels, and the high carbon emission characteristics of the energy structure are significant. On this basis, China's economy also has high carbon emission characteristics. The high carbon emission of the energy structure has become one of the key factors hindering the development of China's low-carbon economy. Although green investment cannot directly reverse the situation where China's energy structure is mainly based on fossil fuels in the short term, green investment itself follows the "triple profit principle". Under the green investment model, it can guide producers to unify environmental protection and product production, pay attention to resource conservation and scientific utilization, and balance utilization and maintenance, thereby promoting the optimization of resource structure and to some extent reducing the resistance to China's low-carbon economic development.

While pursuing the speed of economic development in the long term, a high carbon lifestyle has also become one of the factors restricting the development of China's low-carbon economy. Green investment adheres to the concept of ecological environment, allowing people to assume social responsibility while engaging in investment behavior, effectively transforming people's consumption patterns and habits of high energy consumption, high emissions, and high pollution, promoting the

unity of production investment and environmental pollution prevention, and promoting the low-carbon transformation of the entire society.

Green production enterprises are the main body of technological innovation. To develop a low-carbon economy, it is necessary to continuously innovate low-carbon technologies in their production and operation processes. By improving new energy technologies, comprehensive resource utilization, and environmental protection technologies closely related to the green industry, the goal of improving resource utilization efficiency can be achieved. In addition to providing direct financial support for the green industry, green investment can also drive other production factors to flow towards the green industry, effectively supporting the research and development of low-carbon new technologies and methods, promoting their massive emergence and transformation into green productivity, improving the efficiency of China's low energy consuming primary and tertiary industries, helping to improve the industrial structure dominated by high energy consuming secondary industries, and promoting the long-term development of China's low-carbon economy.

2.2. The Development of Low-Carbon Economy Promotes the Improvement and Upgrading of Green Investment

Currently, the public's awareness of environmental issues is not strong, and the prices of green products are generally higher than those of non green products. Chinese consumers have relatively weak awareness of green consumption, which hinders the buying and selling of green products and is not conducive to the development of green investment. As an economic form that has grown up in China's sustainable development strategy, the low-carbon economy has been highly recognized by the public and is also an inevitable trend for enterprise development. With the strengthening of the low-carbon development trend of Chinese enterprises, low-carbon production and consumption forms continue to emerge. Green investment, which shares the goal of pursuing green GDP with the low-carbon economy, will also be increasingly favored by investors, thereby promoting the expansion of green investment scale and the on-demand improvement and upgrading of green investment strategies.

During the 14th Five Year Plan period, China's energy development has entered a new stage, and the weight of the safe, clean, low-carbon, and efficient transformation of the low-carbon economic energy system in China's development will significantly increase. This will promote the construction of green electricity, the improvement of carbon emissions trading markets, new energy transportation, and urban construction, all of which have created a good social environment for the deep expansion of green investment. The development of low-carbon economy has, in a sense, boosted the investment confidence of green investors, reduced the market trading risks of green investment products to a certain extent, and promoted the efficiency of green investment, accelerating the development of green investment.

The construction of low-carbon economy involves many aspects such as population, resources, environment, and social development, and requires effective integration and coordinated allocation of various factors. With the further improvement of the status and role of green investment, the coupling and coordinated development of low-carbon economy and green investment will become more prominent.

3. RESEARCH ON THE COUPLING AND COORDINATED DEVELOPMENT LEVEL OF GREEN INVESTMENT AND LOW-CARBON ECONOMY

3.1. Construction of Data Sources and Indicator Systems

This article selects the statistical yearbooks of 16 cities in the Yangtze River Delta region from 2015 to 2021, collects data on green investment and low-carbon economic evaluation indicators, and constructs a comprehensive evaluation index system as shown in Table 1.

Due to the lack of unified standards for the definition and calculation of green investment in China, in order to comprehensively reflect the status of green investment under the new development concept, based on the principles of operability, objectivity, and data availability, and drawing on the methods of Zeng Sheng et al. (2021), Liao Xianchun et al. (2020), and Zhang Lili (2018), this article measures the ecological benefits of green investment through environmental protection investment (output value of "three wastes" comprehensive utilization products); Measure the social benefits of green investment through productive green investment (i.e. water conservancy construction investment and afforestation construction investment); The economic benefits of green investment are measured by the annual average scale of financing for 8 sector enterprises related to the concept of green environmental protection, which is the sum of long-term and short-term loans, IPO raised funds, rights issues and additional issuance amounts, and long-term bonds payable by the enterprise. Finally, select five indicators: low-carbon output indicator, low-carbon consumption indicator, low-carbon resource indicator, low-carbon environment indicator, and development capacity indicator to construct a comprehensive evaluation system for low-carbon economy. The specific indicators are shown in the table below.

Table 1. Comprehensive evaluation index system

System name	Primary indicators	Secondary indicators
Green investment system	Environmental investment	The output value of comprehensive utilization products of "three wastes"
	Productive green investment	Water conservancy construction investment
		Forest construction investment
	Enterprise Green Investment	Financing scale of green enterprises
Low carbon economic system	Low carbon output indicators	Carbon productivity
		gdp energy intensity
	Low carbon consumption indicators	Per capita carbon emissions
		Per capita living consumption carbon emissions
	Low carbon resource indicators	Unit energy carbon emission intensity
		Coal proportion
	Low carbon environmental indicators	Forest coverage rate
		Per capita green space area
	Development capability indicators	Per capita GDP
		Engel's coefficient
		Per capita public transportation operations
		Urbanization rate
		The proportion of population with high school education or above to the total population

3.2. Comprehensive Evaluation of Green Investment and Low-Carbon Economic Development

We use the entropy method to measure the indicator weights of green investment and low-carbon economy, in order to objectively reflect the importance of different indicators in the constructed comprehensive indicator evaluation system. The specific method is to use the entropy method to calculate the comprehensive evaluation index of green investment and low-carbon economy for 16 cities in the Yangtze River Delta region from 2015 to 2021, and then calculate the average values for ranking. Finally, based on two comprehensive evaluation index tables, a theoretical analysis is made on the development level of green investment and low-carbon economy in each region. The process of determining weights is as follows:

Step 1: In order to eliminate the impact of dimensional inconsistency among various indicators, we perform dimensionless processing and overall translation processing on the data, and use the formula: $b_{ij} = \frac{a_{ij}^{"}}{\sum_{i=1}^{m} a_{ij}^{"}}$ to calculate the proportion of indicator a_{ij}, b_{ij}.

Step 2: Use formula: $d_j = -\frac{1}{\ln n}\sum_{i=1}^{m} b_{ij} \ln b_{ij}$ to calculate the entropy value of the jth indicator.

Step 3: Use formula: $e_j = 1 - d_j$ to calculate the coefficient of difference for the jth indicator. (Where j=1, 2, ..., p).

Step 4: Use formula: $f_j = \frac{e_j}{\sum_{j=1}^{n} e_j}$ to calculate the weight of the jth indicator.

Step 5: Use formula $g_j = \sum_{j=1}^{n} f_j a_{ij}^{'}$ to obtain the comprehensive score for each indicator.

3.3. Analysis of the Coupled Development of Green Investment and Low Carbon Economy

3.3.1. Coupling degree model

The concept of coupling refers to the phenomenon of mutual relationships, influences, and constraints between two or more systems, factors, or variables. This relationship can be positive correlation, negative correlation, or no correlation, depending on the specific form and degree of connection between them. In economics, coupling refers to the existence of a certain correlation between two or more economic variables, and their changes will affect each other. This coupling relationship has wide applications in fields such as macroeconomics, international trade, and financial markets.

Based on the empirical experience of coupling models, we construct a model between green investment and low-carbon economy in the Yangtze River Delta region:

$$C = \frac{\sqrt{GI \cdot LCE}}{GI + LCE} \tag{1}$$

Among them, C represents the coupling degree between green investment and low-carbon economy in the Yangtze River Delta region, and the value range of C is (0,1). The closer C is to 1, the higher the coupling degree and coordination between green investment and low-carbon economy; The closer C is to 0, the lower and more uncoordinated the coupling between green investment and low-carbon economy. GI represents the level of green investment, LCE represents the comprehensive index of low-carbon economy.

3.3.2. Coupling coordination model

This section considers the limitation of coupling degree only reflecting the degree of mutual influence between two systems. To avoid falling into the "low development trap" of "low development level but high system collaborative development level", we introduce a coupling coordination degree model to measure the degree of benign coupling between the two systems. The coupling coordination model used in this section:

$$D = \sqrt{C \cdot T} \tag{2}$$

$$T = \alpha \cdot LCE + \beta \cdot GI \tag{3}$$

Among them, D represents the coupling and co scheduling between the green investment system and the low-carbon economic system, with a value range of (0,1); C represents the coupling degree between green investment and low-carbon economy; T is the comprehensive development level of green investment system and low-carbon economic system. In this study, the importance of green investment is the same as that of low-carbon economy, hence : $\alpha = \beta = 0.5$

3.3.3. Classification criteria for coupling degree and coupling coordination degree

Due to the lack of unified standards in the academic community for the division of coupling degree and coupling coordination degree, combined with the actual situation in the Yangtze River Delta region and existing research results, we have classified the coupling degree and coupling coordination degree levels of green investment and low-carbon economy as shown in Table 2.

Table 2. Coupling Levels of Green Investment and Low Carbon Economy

Coupling degree value	Coupling level	Coupling coordination value	Coordination level
$0 < C < 0.2$	Extremely low coupling	$0 < C < 0.2$	Extremely low coordination
$0.2 \leq C < 0.4$	Primary coupling	$0.2 \leq C < 0.4$	Primary coordination
$0.4 \leq C < 0.6$	Moderate coupling	$0.4 \leq C < 0.6$	Moderate coordination
$0.6 \leq C < 0.8$	Highly coupled	$0.6 \leq C < 0.8$	Highly coordinated
$0.8 \leq C < 1$	Extremely high coupling	$0.8 \leq C < 1$	Extremely coordinated

4. CONCLUSIONS AND SUGGESTIONS

4.1. Conclusion

In recent years, the Yangtze River Delta region has made significant progress in green investment and low-carbon economy. However, with the acceleration of urbanization and the continuous expansion of population, the pressure on resources and environment is increasing day by day. The development of green investment and low-carbon economy still faces many challenges. At the same time, there are differences in the level of development between different cities, and it is necessary to strengthen coordination and balance in the time dimension.

In terms of spatial dimension, the level of coordinated development between green investment and low-carbon economy among cities in the Yangtze River Delta region varies. Some cities have achieved significant results in areas such as green industries and clean energy, while others are

relatively lagging behind. In addition, the uneven distribution of environmental resources within the region also requires strengthening the optimization and coordination of spatial layout.

4.2. Suggestions

4.2.1. Government level

(1) Develop a unified plan and strengthen spatiotemporal collaboration. The government should formulate a unified development plan for green investment and low-carbon economy in the Yangtze River Delta region, clarifying the goals and paths of spatiotemporal coordinated development. Set development goals in stages over time to ensure effective coordination of tasks across different stages; In terms of space, optimize resource allocation and promote the coordinated development of green industries between cities.

(2) Improve the policy system and increase support efforts. The government should further improve the policy system for green investment and low-carbon economy, including fiscal subsidies, tax incentives, financial support, and other aspects. At the same time, we will increase the research and promotion of low-carbon technologies, and encourage enterprises and the public to participate in green investment.

(3) Strengthen supervision and evaluation to ensure implementation effectiveness. The government should establish a sound regulatory and evaluation mechanism for green investment and low-carbon economy, and regularly inspect and evaluate the implementation of relevant policies. For regions with weak policy implementation or problems, timely adjustments and optimizations should be made.

4.2.2. Enterprise level

(1) Enhance environmental awareness and practice the concept of green development. Enterprises should actively respond to the government's call, raise environmental awareness, and integrate the concept of green development into their development strategies. Through technological innovation and industrial upgrading, reduce energy consumption and emissions, and achieve green production and operation.

(2) Strengthen cooperation and exchange, and promote coordinated development of industries. Enterprises should strengthen cooperation and communication with enterprises in other cities in the Yangtze River Delta region, and jointly promote the coordinated development of green industries. By integrating the industrial chain and sharing resources, we can achieve complementary advantages and mutual benefit.

(3) Fulfill social responsibilities and actively participate in public welfare activities. Enterprises should actively fulfill their social responsibilities and participate in public welfare activities related to green investment and low-carbon economy. Contribute to regional green development through donations, volunteer services, and other means.

4.2.3. At the public level

(1) Enhance environmental awareness and promote a green lifestyle. The public should raise environmental awareness and actively promote green lifestyles. Contribute to regional green development by reducing energy consumption, carbon emissions, and garbage classification.

(2) Strengthen supervision and feedback to promote policy implementation. The public should strengthen supervision and feedback on green investment and low-carbon economic behavior of governments and enterprises. For the phenomenon of ineffective policy implementation or problems, timely reporting and suggestions should be made to relevant departments.

(3) Participate in public welfare activities and promote the concept of green development. The public should actively participate in public welfare activities related to green investment and low-carbon

economy, disseminate the concept of green development through publicity, education, and other means, and improve the environmental awareness of the whole society.

ACKNOWLEDGMENTS

This work was funded by the National Innovation Training Program of Anhui University of Finance and Economics, titled "Analysis of Coordinated Development of Green Investment and Low Carbon Economy Coupling-Taking 16 Cities in the Yangtze River Delta Economic Zone as Examples" (Project Number: 202210378126).

REFERENCES

[1] Zeng Sheng, Zhang Minglong. Green investment, carbon emission intensity, and high-quality economic development: non-linear relationship testing using spatial econometric models [J]. Western Forum, 2021, 31 (05): 69-84.

[2] Kang Xiaohong, Zhao Lijuan, Honghua, Xiao Yaxing Analysis of the Coupled and Coordinated Development of Green Investment and Circular Economy - Taking Inner Mongolia as an Example [J] Friends of Accounting, 2022, (02): 70-75.

[3] Zhu Jianhua, Wang Hongji, Zheng Peng Research on the Coordinated Development of Circular Economy and Green Finance in Guizhou Province [J] Economic Geography, 2019, 39 (12): 119-128.

[4] Cheng Lin, Chen Yunhan Carbon neutral "the Belt and Road" green investment [J] China Finance, 2021, (22): 29-30.

[5] Wang Jiaqing Green investment portfolio under low-carbon economy [J] Journal of Harbin Institute of Technology, 2011, 16 (01): 128-131.

[6] Liao Xianchun, Li Xiaohui, Shi Xunpeng. Research on the Impact Mechanism of Green Investment on Green Welfare [J]. China Population, Resources and Environment, 2020,30 (02): 148-157.

[7] Zhang Lili, Xiao Liming, Gao Junfeng Measurement and Comparison of the Development Level and Efficiency of Green Finance in China: Based on Micro Data from 1040 Public Companies [J] China Science and Technology Forum, 2018, (09): 100-112+120.

[8] Zheng Shihua Construction and Empirical Study of Evaluation Index System for Provincial Low Carbon Economic Development [J] Urban Issues, 2013, (11): 61-66.

[9] Xu Wei The construction of a low-carbon economic evaluation index system in Jiangsu Province [J] Journal of Nantong University (Social Sciences Edition), 2014,30 (04): 18-23.

[10] EYRAUD L, Clements B, WANE A. Green investment: trends and determinants [J] Energy Policy, 2013,60:852-865.

[11] LI Z Z, LI R Y M, MALIK M Y, et al. Determinants of carbon emission in China: How good is green investment? [J] . Sustainable Production and Consumption, 2021,27 (6): 392-401.

[12] Wei Ping, Shu Hao Research on Carbon Performance of Securities Investment Portfolios Based on EIO-LCA Method [J] Management Review, 2021,33 (04): 24-39.

[13] Guo Zhaohui, Ma Yuqi, Fan Chao Assessment of green development level of regions along the "the Belt and Road" [J] Fujian Forum (Humanities and Social Sciences Edition), 2017, (09): 25-31.

[14] Wu Caixia A Study on the Synergistic Effects of Low Carbon Economic Development in China [J] Managing the World, 2021, 37 (08): 105-117.

[15] Shi Shuai, Zang Faxia, Chi Jia Opportunities and challenges faced by China's low-carbon economic development in the new era Theoretical Exploration, 2021, (02): 115-119.