

Measurement and Analysis of Rural Revitalization Level in the Yangtze River Delta Region

Yue Jiang^{1, a}, Yuemin Xing², Menghan Tang³, Ling Jiang^{4, b, *}

¹School of Management Science and Engineering, Anhui University of Finance and Economics, Bengbu, China

²School of Accountancy, Anhui University of Finance and Economics, Bengbu, China

³School of Statistics and Applied mathematics, Anhui University of Finance and Economics, Bengbu, China

⁴School of Economics, Anhui University of Finance and Economics, Bengbu, China

^a1596156138@qq.com, ^{b, *}jl567@sina.com.cn

Abstract

Promoting the integration strategy of the Yangtze River Delta is a major strategic measure to lead the high-quality development of the national economy. This paper focuses on how to further reveal the regional differences and sources of the overall and various subsystems on the basis of scientific and accurate measurement of rural revitalization and the level of each subsystem, so as to provide value for comprehensively promoting rural revitalization and promoting common prosperity. This article summarizes the research methods of numerous scholars in the existing field, constructs a rural revitalization evaluation index system from five aspects: industrial prosperity, ecological livability, rural civilization, effective governance, and affluent living. The entropy method is used to calculate the comprehensive index of rural revitalization level and various subsystem indices in the Yangtze River Delta region, and the Dagum Gini coefficient and quadratic weighted dynamic method are used to evaluate regional differences.

Keywords

Rural Revitalization; Horizontal Measurement; Regional Differences.

1. Introduction

In the process of urbanization, as cheap rural labor, capital and other production factors continue to gather in cities and towns, the hollowing out of villages and the deterioration of rural production and living environment are particularly prominent, leading to a clear gap in economic development, medical security, education and other aspects between urban and rural areas. At present, the imbalance between urban and rural development, as well as insufficient rural development, cannot meet people's needs for a better life, and has become the main contradiction restricting economic and social development. Therefore, on the basis of summarizing past policy experience, the 20th National Congress of the Communist Party of China made a major deployment to implement the rural revitalization strategy, and affirmed the importance of "agriculture, rural areas, and farmers" work from the perspective of national strategy. Therefore, in the first year of comprehensively promoting rural revitalization, we should build an indicator system aimed at objectively evaluating the implementation effect of rural revitalization, measure the current real level of rural revitalization in various provinces, clarify the spatial differences and sources of rural revitalization, and analyze the distribution dynamics and evolution laws of rural revitalization, which has important reference value and

guiding significance for comprehensively promoting rural revitalization and promoting common prosperity.

In this context, rural revitalization strategy has become a hot topic of academic research, with existing achievements mainly focusing on three aspects: the theoretical origin and connotation of rural revitalization, the organic connection between rural revitalization and poverty alleviation, and the measurement of rural revitalization level. One is the theoretical origin and connotation of rural revitalization. The strategic thought of rural revitalization has a profound theoretical foundation, among which the rural development thought of Marx and Engels is the theoretical cornerstone of the strategic thought of rural revitalization (Zhang Haipeng et al., 2018; Chen Long, 2018; Xu Cailing and Li Jianjian, 2019), and the rural regional system theory of geography is the basic basis for understanding rural revitalization (Liu Yansui, 2018; He Renwei, 2018). The second is the organic connection between rural revitalization and poverty alleviation. At present, the organic connection between rural revitalization and poverty alleviation is mainly concentrated.

2. Measurement of Rural Revitalization Level

Table 1. Evaluation Index System for Rural Revitalization in China

Primary indicators	Secondary indicators	Third level indicators	Unit	Indicator attribute
Rural Revitalization	Industrial prosperity	Added value of agriculture, forestry, animal husbandry, and fishery	RMB100mn	+
		Fixed assets investment of rural households	RMB100mn	+
		Retail sales of rural consumer goods	RMB100mn	+
		Total power of agricultural machinery	10000 kilowatts	+
		Per capita electricity consumption of rural residents	KWh/person	+
	Ecological livability	Rural built-up area	hectare	+
		Per capita park green area in rural areas	Square meter/person	+
		Harmless treatment rate of rural household waste	%	+
		Number of rural bridges	Seat	+
		Rural gas penetration rate	%	+
		Number of rural health technical personnel	people	+
	Rural civilization	Total expenditure of education funds for rural schools at all levels	Thousand yuan	+
		Per capita education years for rural population aged 6 and above	Year/person	+
		Per capita expenditure on culture, education, and entertainment for rural residents	Yuan/person	+
		Number of township cultural stations	individual	+
	Effective governance	Number of village committees	individual	+
		Number of rural residents providing five guarantees	ten thousand people	+
		Degree of aging population in rural areas	%	-
		Effective irrigation rate	%	+
		Rural sewage treatment rate	%	+
		Number of rural public toilets	individual	+
	Life in affluence	Per capita net income of farmers	Yuan/person	-
		Engel's coefficient of rural households	%	+
		Per capita expenditure on daily necessities and services for rural residents	Yuan/person	+
		Per capita transportation and communication consumption expenditure of rural residents	Yuan/person	+
Total dependency ratio of rural population		%	-	

2.1. Indicator System for Measuring the Level of Rural Revitalization

Based on the above explanation of the connotation of rural revitalization, the scientific and effective construction of the system, and the previous research foundation, and following the principles of scientificity, feasibility, measurability, and data accessibility, this article selects 26 indicators from five aspects: industrial prosperity, ecological livability, rural civilization, effective governance, and affluent life to construct an evaluation index system for the level of rural revitalization in China, as shown in Table 1.

2.2. Data Description

This article uses 26 specific indicators to calculate the comprehensive index and five subsystem indices of rural revitalization level in 27 central cities of the Yangtze River Delta Economic Belt from 2011 to 2019. All raw data in the indicator system mainly comes from the "China Urban Rural Construction Statistical Yearbook", "China Education Statistical Yearbook", "China Urban Rural Statistical Yearbook", as well as provincial statistical yearbooks, Wind database, and China Economic and Social Big Data Research Platform.

2.3. Measurement Methods

This article adopts the entropy method to measure and evaluate the comprehensive index of rural revitalization and various subsystem indices in China. The reason is that the entropy method has the advantage of objective weighting, which can avoid the subjectivity of expert weighting and reflect the importance of each indicator in the comprehensive index in a practical and truthful manner [9].

(1) Consider that the measurement units of each indicator are not uniform. Before calculating, it is necessary to first standardize each indicator. To avoid the meaningless logarithmic calculation when calculating entropy, the positive and negative indicators are treated as non negative, with a unified addition of 0.01. The specific method is as follows:

Negative indicator:

$$X'_{ij} = \left[\frac{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - X_{ij}}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} \right] + 0.01 \tag{1}$$

Positive indicators:

$$X'_{ij} = \left[\frac{X_{ij} - \min(X_{1j}, X_{2j}, \dots, X_{nj})}{\max(X_{1j}, X_{2j}, \dots, X_{nj}) - \min(X_{1j}, X_{2j}, \dots, X_{nj})} \right] + 0.01 \tag{2}$$

Whers, X'_{ij} is the value of the j th indicator in the i -th city after processing. $i=1,2,3,\dots, n$; $j=1,2,3,\dots,m$.

(2) Calculate the proportion of the i -th city to the j th indicator.

$$P_{ij} = X'_{ij} / \sum_{i=1}^n X'_{ij} \tag{3}$$

(3) Calculate the entropy value of the j th indicator.

$$e_j = -1 / \ln(n) \sum_{i=1}^n p_{ij} \ln(p_{ij}) \quad 0 \leq e_j \leq 1 \tag{4}$$

(4) Calculate the coefficient of difference for the j th indicator.

$$g_j = 1 - e_j \quad 0 \leq g_j \leq 1 \tag{5}$$

(5) Calculate the weight of the j th indicator to all indicators.

$$w_j = g_j / \sum_{j=1}^m g_j \tag{6}$$

(6) Calculate the comprehensive score for each city.

$$s_i = \sum_{j=1}^m w_j X'_{ij} \quad (7)$$

3. Analysis of the Calculation Results of Rural Revitalization Level

3.1. Comprehensive Index and Subsystem Index Characteristics of Rural Revitalization Level in the Yangtze River Delta Region

According to the calculation results, the comprehensive index of rural revitalization level in China has the following characteristics: firstly, the comprehensive index of rural revitalization level is relatively small, with a maximum of only 0.384 in 2019, indicating that the level of rural revitalization in China is relatively low and there is significant room for improvement. Therefore, in 2021, the Central Government's "No.1 Document" proposed to comprehensively promote rural revitalization and issued and implemented the "Rural Revitalization Promotion Law", which means that China will continue to expand the depth and breadth of rural revitalization, and effectively ensure that the goals and tasks of rural revitalization are achieved as scheduled. Secondly, the comprehensive index of rural revitalization level shows an overall growth trend, increasing from 0.329 in 2011 to 0.384 in 2019, with a growth rate of 16.717%. Thirdly, there was a significant increase in the comprehensive index of rural revitalization level from 2018 to 2019, with a growth rate of 1.604%. The reason is that the "No.1 Document" of the central government in 2018 comprehensively deployed the implementation of the rural revitalization strategy, marking the beginning of the rural revitalization strategy and enabling the rapid improvement of the rural revitalization level.

From the measurement results of the five subsystems of industrial prosperity, ecological livability, rural civilization, effective governance, and prosperity, it can be seen that: firstly, the industrial prosperity index fluctuated slightly, but overall showed a stable upward trend, with a significant upward trend from 2018 to 2019, with a growth rate of up to 6.95%; Secondly, the ecological livability index shows an increasing trend year by year, with an average annual growth rate of 6.693%, with the most significant growth rate from 2017 to 2019, with an average annual growth rate of 11.385%; Thirdly, the rural civilization index shows a slow upward trend, with an average annual growth rate of 1.164% during the research period, and a significant increase after 2018; Fourthly, the fluctuation range of the governance effectiveness index is relatively large, but overall it shows an upward trend, with an average annual growth rate of 3.714%; Fifth, the index of affluence in daily life has shown a steady upward trend, increasing from 0.332 in 2011 to 0.402 in 2019, with an average annual growth rate of 2.343%. Overall, the five subsystem indices have shown significant growth since 2018, with the largest increase in ecological livability. This is mainly due to the implementation of rural revitalization, and indicates that the country has achieved significant results in improving rural living environment, strengthening rural ecological protection and restoration construction. Among the five subsystems, the rural civilization index is the highest, which means that the level of rural civilization construction in China is constantly strengthening, the scientific and cultural literacy of farmers and the level of rural civilization are gradually improving, and the industrial prosperity index is the lowest. This indicates that the current rural industry in China is a weakness in the implementation of rural revitalization, and the level of industrial prosperity urgently needs to be improved. Therefore, it is necessary to adapt to local conditions, respect agricultural characteristics, and develop characteristic agriculture. Cultivate emerging industries and expand the agricultural industry chain, promote the diversified development of rural industries, and accelerate the realization of a new pattern of integrated development of rural primary, secondary, and tertiary industries.

3.2. Comprehensive Index and Subsystem Index Characteristics of Rural Revitalization in Various Cities of the Yangtze River Delta Region

Given that the implementation of the rural revitalization strategy started only in 2018 and there is a certain lag in its effectiveness, this article takes 2019 as an example to further analyze the level of rural revitalization and the development differences of various subsystems in 27 cities in the Yangtze River Delta region.

The average comprehensive index of rural revitalization level in the Yangtze River Delta region in 2019 was 0.384, with a total of 11 cities exceeding the average, accounting for 35.48% of the total cities. These 11 cities are Shanghai, Suzhou, Nanjing, Yangzhou, Jiaxing, Shaoxing, Huzhou, Jinhua, Ningbo, Tongling, and Chizhou. There are differences in the dominant factors that lead to higher than average rural revitalization levels among these 11 cities. Shanghai, Suzhou, Nanjing, and Yangzhou are mainly attributed to ecological livability, rural civilization, effective governance, and relatively high levels of living prosperity; Jiaxing, Shaoxing, Huzhou, Jinhua, and Ningbo are mainly influenced by the level of industrial prosperity; Tongling and Chizhou are mainly affected by effective governance. There are a total of 15 cities below the average, and these cities may have lower levels of rural revitalization due to low levels of various subsystems or poor performance in some aspects.

Further analysis of the various subsystem indices of rural revitalization in 27 cities can reveal the strengths and weaknesses of each city in implementing rural revitalization, providing a scientific basis for comprehensively promoting rural revitalization. The average subsystem index of national industrial prosperity in 2019 was 0.323, with a total of 13 cities exceeding the average. These cities, with their unique advantages in climate, water source, soil, and population, have achieved stable growth in grain production. They also focus on optimizing and adjusting agricultural structures, vigorously developing new industries such as agricultural product processing, leisure agriculture, and tourism agriculture, thus becoming the "vanguard" of agricultural development in the Yangtze River Delta urban belt. Cities with high levels of ecological livability can fully utilize their economic advantages, increase efforts in rural living environment governance and rural ecological environment protection and restoration, thereby promoting the overall improvement of ecological livability. The average rural civilization index is 0.506, with 16 cities below the average, accounting for 51.61% of the total cities, indicating the rural civilization in most provinces. The problems of low level, low cultural literacy of farmers, and poor communication channels of civilization are particularly prominent. The average effective governance index is 0.463, with 12 cities higher than the average, accounting for 38.71% of the total cities. There are 15 cities below the average, indicating that the level of rural governance in most cities is low and the governance effect is poor. Therefore, it is necessary to further improve the rural governance system and strengthen the effectiveness and sustainability of governance behavior. The average life prosperity index is 0.402, with 11 cities higher than the average, accounting for 64.52% of the total number of provinces in China. This indicates that the level of rural prosperity in most provinces is relatively low. Therefore, these cities should take rural revitalization as an opportunity to continuously increase farmers' income, improve their living conditions, gradually narrow the urban-rural gap, and increase farmers' satisfaction through various means such as developing collective economy, increasing property income, and strengthening infrastructure construction. A sense of gain and happiness.

4. Distribution Dynamics and Evolution of Rural Revitalization Level

In order to deeply analyze the characteristics of the absolute difference in the level of rural revitalization, this paper uses kernel density estimation to reflect the absolute difference in the level of rural revitalization in China and the Yangtze River Delta region, the change trend,

extensibility and polarization trend of the absolute difference, in order to reveal the size and source of the regional differences in the level of rural revitalization.

4.1. Research Methods

Kernel estimation uses continuous density curves to estimate the probability density of random variables. Compared with other estimates, its model dependence is weak and robustness is strong [11]. Assuming it is the density function of a random variable, the formula is expressed as:

$$f(x) = \frac{1}{Nh} \sum_{i=1}^N K\left(\frac{X_i - \bar{x}}{h}\right) \quad (8)$$

Among them, N is the total number of observation values, X_i is the observation values with independent and identically distributed characteristics, \bar{x} represents all observation values, $K(x)$ is the kernel density function, h is the bandwidth. If the bandwidth is larger, the density function image is smoother, indicating lower estimation accuracy. On the contrary, if the bandwidth is smaller, the density function is less smooth, and its accuracy is higher. This article uses Gaussian kernel to estimate the dynamic evolution of rural revitalization across the country and four major regions.

$$K(x) = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{x^2}{2}\right) \quad (9)$$

4.2. Analysis of the Distribution Dynamics and Evolution of the Five Subsystem Indices

From the perspective of peak morphology, the evolution trend of the nuclear density curve peak morphology between industrial prosperity and ecological livability is basically consistent, showing a trend of continuous rightward shift of the peak, continuous decrease of the peak height, and continuous expansion of the peak width. This indicates that the level of industrial prosperity and ecological livability has improved, and the absolute difference continues to expand. The peak of the nuclear density curve of rural civilization level continuously shifts to the right, and the peak height shows a trend of first decreasing and then increasing. The peak width also shows an evolutionary process of first expanding and then decreasing. The overall performance is an increase in height and a decrease in width, indicating a continuous improvement in the level of rural civilization and a decrease in absolute differences. From 2011 to 2017, the peak height of the nuclear density curve for effective governance levels continued to decrease and its width continued to expand. In 2019, the peak height significantly increased and the slope became steeper, indicating that the implementation of the rural revitalization strategy has to some extent narrowed the spatial gap for effective governance. The peak of the nuclear density curve of the level of living affluence continues to shift to the right, and the height of the peak undergoes a "rise decrease" process. Overall, it shows a trend of increasing height and decreasing width, indicating that the level of living affluence continues to improve and the absolute difference has a decreasing trend. From the perspective of distribution extensibility, the extensibility of all five subsystems shows a convergence trend. Except for the phenomenon of left and right trailing in the level of rural civilization, the other four subsystems all have obvious right trailing phenomenon, indicating that provinces with high levels of industrial prosperity, ecological livability, effective governance, and living prosperity exist, while provinces with both high and low levels of rural civilization exist. From the perspective of polarization, the development level distribution of the five subsystems is basically composed of one main peak and one side peak. Among them, the peak values of the side peaks for industrial prosperity and effective governance are relatively high and arranged in a stepped pattern, indicating a significant gradient effect of industrial prosperity and effective governance. The

peak values of the side peaks for ecological livability, rural civilization, and affluent life are relatively low, indicating ecological livability. There is a slight polarization trend between rural civilization and prosperity in life.

5. Conclusion and Suggestions

5.1. Conclusion

This article summarizes the research methods of numerous scholars in the existing field, constructs a rural revitalization evaluation index system from five aspects: industrial prosperity, ecological livability, rural civilization, effective governance, and affluent living. The entropy method is used to calculate the comprehensive index of rural revitalization level and various subsystem indices in the Yangtze River Delta region, and the Dagum Gini coefficient and quadratic weighted dynamic method are used to evaluate regional differences. The following conclusions were obtained through research:

Firstly, overall, the level of rural revitalization in the Yangtze River Delta region is relatively low, but it has shown a growth trend during the research period, and there are significant regional differences in the level of rural revitalization among cities. However, the growth rate of rural revitalization in underdeveloped areas is relatively fast, so the regional differences in China's rural revitalization level are gradually narrowing. From the perspective of subsystems, the development status of each subsystem varies, with the highest rural civilization index and the lowest industrial prosperity index, but all showing a stable growth trend.

Secondly, overall, the regional differences in the level of rural revitalization in the Yangtze River Delta region are steadily decreasing, with inter regional differences being the main source of overall differences in rural revitalization, followed by intra regional differences. In terms of regional differences, the regional differences in all cities have shown a steady downward trend, and the regional differences in rural revitalization level have gradually narrowed. From the perspective of subsystems, the regional differences of all five subsystems show a downward trend.

Thirdly, overall, although there are cities with high levels of rural revitalization, the absolute difference in rural revitalization level shows a significant narrowing trend. From the perspective of subsystems, the evolution trend of the peak shape of the nuclear density curve for industrial prosperity, ecological livability, and effective governance level is basically consistent, showing a trend of continuous rightward shift, continuous decrease in height, and continuous expansion of width. The peak of the nuclear density curve for rural civilization and living prosperity level is constantly rightward shift, with fluctuations in peak height. Overall, the height increases, while the width decreases, and all five subsystems have a right tail phenomenon. The peak values of industrial prosperity and effective governance are relatively high and arranged in a stepped pattern, while the peak values of ecological livability, rural civilization, and affluent living are relatively low.

5.2. Suggestions

Based on the above research conclusions, suggestions for promoting rural revitalization and development should be based on two points: firstly, to stimulate the endogenous driving force of rural revitalization. The second is to narrow the regional differences in the level of rural revitalization and actively promote the coordinated development of regional rural revitalization. In view of this, this article proposes the following suggestions:

(1) Fully activate various elements. The key to implementing rural revitalization is to grasp the three factors of "people, land, and money". Talents are the key to rural revitalization. To stimulate farmers' endogenous power, we should fully respect farmers' wishes, take open promotion as the breakthrough, and take common prosperity as the foothold; By unblocking

channels for collecting opinions and expressing demands, we carefully understand the needs of farmers, listen to their opinions, and promote open and transparent decision-making and participatory governance; Improve farmers' right to know and participate by timely announcing project construction plans, content, and capital investment. By establishing incentive funds, entrepreneurship funds, and other interest driven mechanisms, we aim to activate the motivation for returning to rural areas for entrepreneurship and employment, and fully tap and cultivate local talents in rural areas. Land is the largest resource for rural revitalization, and land elements should be fully activated by improving the rural land property rights transfer system, liberating land management rights, revitalizing collective construction land assets, and deepening the reform of the homestead system. Capital is the "blood" of rural revitalization. To activate capital elements, it is necessary to establish a mechanism for integrating fiscal agricultural funds and effective social capital incentive mechanisms to stimulate the enthusiasm of social capital and financial systems to support rural revitalization.

(2) Actively promote the coordinated development of regional rural revitalization level. There are significant intra regional and inter regional differences in the current level of rural revitalization, and regional differences are the main source of regional differences in rural revitalization. Therefore, reducing regional differences is a key link in promoting coordinated development of rural revitalization and improving the level of rural revitalization. Governments at all levels should conduct in-depth analysis of the driving mechanism of regional rural revitalization, identify the entry point and driving force, adjust measures to local conditions, and construct the implementation path of rural revitalization. Rural areas in urban suburbs should make full use of their distance advantages, focus on developing industries and new types of agriculture that are highly sensitive to transportation costs, such as vegetable planting bases, smart agriculture, sightseeing agriculture, and leisure industries, while efficiently and intensively utilizing land, strengthening rural infrastructure and public service construction. Efforts should also be made to undertake and utilize urban spillover resources, such as attracting investment and intelligence to rural areas Agricultural enterprise integration, etc; Rural areas in characteristic resource distribution areas should focus on resource characteristics, refine and refine industries, improve industrial supporting services, extend industrial chains, and achieve the transformation of resources into product advantages and product advantages into industrial advantages. Rural areas in plain areas should fully utilize the advantages of economies of scale, encourage the transfer of agricultural land management rights to new agricultural management entities on the basis of the "separation of three rights", further improve agricultural water conservancy facilities, reduce agricultural production costs, improve agricultural production efficiency, support employment and entrepreneurship of rural surplus labor, and continue to train and improve farmers' scientific and technological literacy, strengthen rural social, cultural, and infrastructure construction.

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