Academic Journal of Management and Social Sciences
ISSN: 2958-4396 | Vol. 5, No. 2, 2023

Research on the Measurement and Coupling Coordination of the Development Level of Material Civilization and Spiritual Civilization under the Background of Chinese path to modernization

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Abstract: The modernization of material civilization and spiritual civilization is an important feature of Chinese path to modernization. It is difficult for a nation without spiritual strength to stand on its own, and it is difficult for a cause without cultural support to last for a long time. Based on the background of Chinese path to modernization, this paper will build two subsystems of material civilization development level and spiritual civilization development level. Based on the panel data of the Yangtze River Delta urban agglomeration from 2006 to 2021, the two subsystems will be measured by entropy method, and then the coupling coordination degree model will be introduced to measure the two subsystems. Finally, the dynamic evolution of coupled scheduling for the development level of material civilization and spiritual civilization is studied through kernel density estimation method, combined with Gini coefficient and decomposition method Differential analysis of spatial regions. The study found that the overall evaluation value of the development level of material and spiritual civilization in the Yangtze River Delta region h as increased, and the gap between cities is significant. The coupling coordination degree of the two subsystems of material civilization and spiritual civilization development level is constantly rising, but the overall average value is low, with significant regional differences, and there is still great potential for development.

Keywords: Level of Material and Spiritual Civilization Development; Entropy Method; Coupling Coordination Degree.

1. Introduction

Modernization is a social comprehensive reform in the course of the development of human civilization. Its essence is to realize the modernization of human beings. Compared with other developed countries, China is a late-developing country with a long history and a huge population. Therefore, the development path of China's modernization is more complex and more challenging. The Communist Party of China (CPC) has united and led all the Chinese people in exploring a Chinese-style path of modernization in the developing country with the largest population in the world.

The modernization in harmony between material civilization and spiritual civilization is an important feature of Chinese modernization. Material wealth and spiritual wealth are the basic requirements of socialist modernization. Material poverty is not socialism, spiritual poverty is not socialism. In promoting socialist modernization, we should not only focus on the construction of material civilization, but also pay attention to the construction of spiritual civilization. While promoting high-quality economic development and upgrading the industrial structure to make the people rich, we must also pay attention to ideological and moral development and the development of science and culture. We will vigorously promote core socialist values, carry forward the fine traditional Chinese culture, and strive to achieve all-round material and human enrichment for the people.

Focusing on Chinese-style modernization, domestic scholars have carried out rich research on material civilization and spiritual civilization. At present, the material civilization and spirit of Chinese modernization mainly remain in theoretical research.Liu Panhong et al. studied the coordinated development of material civilization and spiritual civilization from the three dimensions of Marxist spirit, the leadership of the Communist Party of China and the excellent traditional culture of China. [1] Hao Lixin combined with the characteristics of harmony between material civilization and spiritual civilization in the process of Chinese style modernization, expounds the understanding of enriching people's spiritual world. [2] The scholar of Qin made a systematic analysis of the elements of the construction of spiritual civilization, expounded the dialectical relationship between material civilization and spiritual civilization, and put forward the general idea of how to strengthen the construction of spiritual civilization. Because of the unbalanced development level, there are regional differences in the development level of Chinese-style modernization. [3] Liao Yanbin, by combing the problems of spiritual civilization construction existing in the process of rural construction, put forward countermeasures such as strengthening ideological guidance, perfecting institutional security, and innovating practical activities, so as to strengthen the construction of rural spiritual civilization and assist the all-round development of rural areas. [4]

Some scholars carry out research from the perspective of river basins, mainly the Yangtze River basin and the Yellow River basin economic belt.Li Haiyang took the cities in the Yangtze River Basin as samples, constructed a Chinese-style modernization evaluation index system, studied the evolution dynamics and regional differences, and analyzed the convergence characteristics of the coupling and coordination of the modernization development in the Yangtze River Basin. [5] Feng Xiaohua et al. measured the high-quality development level of cities in the Yangtze River Delta under the background of modernization from the perspective of green productivity of cities in the Yangtze River Delta based on spatio-temporal spillover effect. [6] Li Feifei constructed

a comprehensive index system of high-quality development, measured the high-quality development level of the Yangtze River Delta urban agglomeration and the trend of coupling and coordination of subsystems, drew conclusions and pointed out the development path. [7] The above studies are all coordinated research on the overall development of urban agglomerations, ignoring the development of spiritual civilization.

Based on the background of Chinese-style modernization, this paper will construct two subsystems: the development level of material civilization and the development level of spiritual civilization. Based on the panel data of urban agglomeration in the Yangtze River Delta in 2015-2021444, the entropy method of the two subsystems is measured. The coupling coordination degree model is introduced to measure the coupling coordination degree of the two subsystems. Finally, the dynamic evolution of coupled write scheduling of material civilization and spiritual civilization development level was studied by kernel density estimation method, and the difference analysis of spatial regions was carried out by combining Dagum Gini coefficient and decomposition method.

2. Evaluation System and Research Method

2.1. The Evaluation Index System of the Development Level of Material and Spiritual Civilization

At present, scholars' evaluation of modernization is mainly divided into two criteria: qualitative and quantitative. From the qualitative point of view, Dong Fangfang and Liu Aijun [8] adhere to the socialist market economy with Chinese characteristics, adhere to the socialist democratic politics with Chinese characteristics, adhere to the unification of cultural modernization and democracy, adhere to the coordinated development of society and common prosperity to achieve substantial progress, adhere to the harmonious coexistence and sustainable development of man and nature. From the quantitative point of view, foreign scholars mainly use "Black standard", "Ingels standard" and joint Human Development index to measure the modernization level of a country or a region. At home, based on the underlying logic of Chinese-style modernization development, Ren Baoping and Zhang Qian establish indicators from five dimensions: economy, society, urban-rural development, ecological civilization and governance capacity. [9]

Table 1. Evaluation index system of development level of material civilization and spiritual civilization

Basic dimension	Sub-item dimension	Basic indicators	Unit	Character
Level of material civilization development	Economic scale	GDP	rmb	+
		Regional GDP growth rate	%	+
	Industrial structure	Proportion of secondary and tertiary industries in regional GDP	%	+
		The ratio of output value of tertiary industry to output value of secondary industry	%	+
	Income and consumption	Average wage of employees on the job	rmb	+
		Total retail sales of consumer goods	rmb	+
	Infrastructure construction	Number of people covered by basic old-age insurance for urban workers	pax	+
		Urban road area per capita municipal district	m^2	+
		Number of hospital beds per capita in the city	pcs	+
		Green coverage rate of built-up area Municipal area	%	+
Level of development of spiritual civilization	Scientific innovation	RD internal expenditure	rmb	+
		Number of patents granted	pcs	+
	Construction of education	Education expenditure	rmb	+
		Number of students enrolled in ordinary institutions of higher learning	pax	+
	Culture construction	Number of employees in culture, sports and entertainment in the tertiary industry	pax	+
		Number of sports venues	pcs	+
		There are books in public libraries for every 100 people	pcs	+
		Number of museums	pcs	+

Based on the review of previous literature and the understanding of the background of Chinese-style modernization, this paper constructs two subsystems from the perspectives of the development of material civilization and

the development level of spiritual civilization. Material civilization is the synthesis of material achievements made by human beings in transforming the natural world, and it is also the organic unity of progress in material production and improvement of material life. This paper selects 10 indicators from four aspects, such as economic scale, industrial structure, income and consumption, and infrastructure, to measure the level of material civilization development of a region. Spiritual civilization is the state of progress and enlightenment of the spiritual life of human society, and it is also the sum of the positive results of human spiritual life. Due to the limitation of data collection and the difficulty of quantifying the ideological and moral style, this paper selects eight indicators from three aspects of scientific innovation, education construction and cultural construction to measure the level of spiritual civilization development in a region.

2.2. Research Approach

2.2.1. TOPSIS

There are many indicators involved in the construction of performance evaluation index system, and the key is to empower each indicator to carry out comprehensive measurement. At present, the main methods to determine the indicators in the evaluation system include subjective weighting methods such as AHP and ANP, and objective weighting methods such as principal component analysis and entropy weight method.

As an objective weighting method, TOPSIS can calculate the corresponding information entropy according to the relative variation range of each index value, and then give different weights to the evaluation index to reflect the role of this index in the evaluation system, which provides a basis for the multi-index evaluation system. Based on the actual development situation of the Yangtze River Delta region, this paper uses the entropy weight method to weight indicators, eliminates the influence of indicators with serious missing data, and retains the information of all collected original indicators. The specific operation steps are as follows:

(1) Standardization deals with raw data

For positive indicators:

$$Z_{ij} = \frac{x_{ij} - min(x_j)}{max(x_j) - min(x_j)} \quad (1)$$

For the backward indicators:

$$Z_{ij} = \frac{max(x_j) - x_{ij}}{max(x_j) - min(x_j)} \quad (2)$$

(2) Calculate the proportion of each specific index: calculate the proportion of the ith sample under the JTH index, and regard it as the probability used in the calculation process of relative entropy. Calculate the probability matrix P, where each element of p_{ij} is calculated as follows:

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}} \quad (3)$$

(3) The information entropy of each component is calculated according to the specific gravity.

For the JTH index, the information entropy is calculated as follows:

$$e_j = -\frac{1}{\ln n}\sum_{i=1}^{n} \ln(p_{ij}), j=1,...,m \quad (4)$$

Definition of information utility value:

$$d_j = 1 - e_j \quad (5)$$

(4) The entropy value of each index is calculated

The entropy value of each index is obtained by normalizing the information utility value:

$$W_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \quad (6)$$

(5) Calculate the composite score

$$U_i = \sum_{j=1}^{n} W_j z_{ij} \quad (7)$$

2.2.2. Coupled Coordination Model

The degree of coupling and coordination is an index to measure the relationship between two subsystems and their closeness. It describes the phenomenon that two or more subsystems in a system interact, influence and promote each other based on certain characteristics, so as to coevolve. Coupling degree measures the degree of interdependence and mutual restriction of system elements, and coordination degree refers to the coordination relationship of the correlation between two subsystems. If the coupling relationship is high but the coordination relationship is poor, the result will be that the more development the two systems have, the worse the coordination degree will be. Similarly, if the coupling relationship between the two is high and the coordination relationship is good, it indicates that the more developed the two are, the better the coordination degree will be.

By referring to relevant research results and combining with the actual situation, the coupling degree measurement model of spiritual civilization, material civilization and the development degree of material civilization is constructed, and the calculation formula is as follows:

$$C = \frac{U_1 \times U_2}{[\{U_1 \times U_2\} \div 2]^{\frac{1}{2}}} \quad (8)$$

Among them, C represents the coupling degree, U_1 an U_2 represents the comprehensive score of the development degree of material civilization and the development degree of spiritual civilization. After calculating the coupling degree of the two, the coupling coordination degree model is established to study the interactive relationship and coordinated development among the dimensions. The calculation formula is as follows:

$$T(U_1, U_2) = \beta_1 U_1 + \beta_2 U_2 \quad (9)$$

$$D(U_1, U_2) = \sqrt{C(U_1, U_2) \times T(U_1, U_2)} \quad (10)$$

Where, T represents the comprehensive contribution index among the composite dimensions; D represents the coupling coordination degree; β is the coefficient to be determined, which is the weight of the coordination index and represents the mutual compensation between the composite dimensions. Based on the existing research results and the actual situation of this study, the coupling coordination degree is divided into the following ten types, and Table 2 below shows the criteria for determining the coupling coordination degree.

Table 2. Evaluation criteria of coupling coordination degree

Type	Extreme dissonance	Serious dissonance	Moderate dissonance	Mild disorder	On the verge of disorder	Barely in tune	Primary coordination	Intermediate level coordination	Good coordination	Quality coordination
Scope	(0.0~0.1)	[0.1~0.2)	[0.2~0.3)	[0.3~0.4)	[0.4~0.5)	[0.5~0.6)	[0.6~0.7)	[0.7~0.8)	[0.8~0.9)	[0.9~1.0)

2.2.3. Kernel Density Estimation

Kernel density estimation method is a common non-parametric estimation method that uses continuous density function curve to describe the distribution form of random variables, which is more and more applied in the related research of regional differences and their dynamic evolution. The density function of variable X is assumed to be:

$$f(x) = \frac{1}{Nh}\sum_{i=1}^{N} K(\frac{X_I - X}{h}) \quad (11)$$

Where K is the Kernel function, N is the number of observations, represents the observed value, x is the average value, h is the window width, and the kernel function is a smooth transformation function or weighting function, which must meet the following conditions:

$$\begin{cases} \lim\limits_{x\to} K(x)\cdot x = 0 \\ K(x) \geq 0; \int_{-\infty}^{+\infty} K(x)dx = 1 \\ sup < +\infty; \int_{-\infty}^{+\infty} K^2(x)dx < +\infty \end{cases} \quad (12)$$

2.2.4. Gini Coefficient

This paper mainly focuses on the Gini coefficient method proposed by Dagum, which was originally used to measure the income gap between regions. The biggest advantage of Gini coefficient and its decomposition method is that the overall difference (G) is further divided into three parts, namely, the intra-regional difference, the inter-regional difference and the hypervariable density, so as to effectively solve the problem of the source of regional difference. Different from other indexes that measure regional development differences, the Gini coefficient makes up for the problem of ignoring the overlapping part of different intervals by identifying the hypervariable density, so as to completely identify the contribution of overall regional disparities. The calculation formula is as follows:

$$G=\frac{\sum_{j=1}^{k}\sum_{h=1}^{k}\sum_{i=1}^{n_1}\sum_{r=1}^{n_k}|y_{ji}-y_{hr}|}{2n^2\bar{y}} \quad (13)$$

$$G_w = \sum_{j=1}^{k} G_{jj}P_jS_j \quad (14)$$

$$G_{nb} = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(p_js_h + p_hs_j)\,D_{jh} \quad (15)$$

$$G_t = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jk}(p_js_k + p_ks_j)(1 - D_{jk}) \quad (16)$$

3. Research Objects and Data Sources

In view of the fact that the Yangtze River Delta urban agglomeration has gradually expanded since the 21st century, this paper combs the policy documents of the administrative division adjustment in the Yangtze River Delta region in recent years. On May 22, 2016, The State Council issued the Reply of The State Council on the Development Plan of Urban Agglomeration in the Yangtze River Delta (Guo Han {2016} No. 87). It points out that the urban planning scope of the Yangtze River Delta includes 41 cities, including Shanghai, Nanjing, Wuxi, Changzhou, Suzhou, Nantong, Yancheng, Yangzhou, Zhenjiang, Taizhou, Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoxing, Jinhua, Zhoushan, Taizhou, Hefei, Wuhu, Ma 'anshan, Tongling, Anqing, Chuzhou, Chizhou and Xuancheng. This paper takes a total of 41 cities in three provinces and one city in the Yangtze River Delta region as the research sample to study the development level of material civilization and spiritual civilization in these cities and the regional differences among provinces.

The data in this paper come from China City Statistical Yearbook, China Energy Statistical Yearbook, China Environment Statistical Yearbook, Statistical yearbooks of provinces and cities in the Yangtze River Delta, China Research Network database and CEIC database. Partial missing data were supplemented by linear interpolation.

4. Measurement and Coupling Coordination Degree of Development Level of Spiritual Civilization and Material Civilization in Urban Agglomeration of Yangtze River Delta Region

4.1. Index Weights and Measure Scores

This paper uses the entropy method to measure the development levels of material civilization and spiritual civilization in the three provinces of the Yangtze River Delta and Shanghai, and obtains the index weights of the development levels of material civilization and spiritual civilization (see Table 3). The indicator that best represents the development level of material civilization in the Yangtze River Delta is GDP, with a weight of 29.09%, followed by the average wage of employees on duty; The indicator that best represents the level of spiritual civilization development in the Yangtze River Delta is the number of books in public libraries, followed by the number of employees in the tertiary industry-culture, sports and recreation. Chinese modernization is a multi-dimensional social development process. People pay more and more attention to the spiritual world and the all-round development of people while paying attention to the material world and material abundance.

4.2. Comprehensive Ranking

On the basis of the above, the comprehensive evaluation value of the development level of material and spiritual civilization in the Yangtze River Delta region from 2005 to 2021 is calculated (see Table 4). The results show that the evaluation value of the overall development level of material civilization and spiritual civilization in the Yangtze River Delta region is increasing. The top five cities in the comprehensive evaluation value of material civilization development level in 2021 are Shanghai, Hangzhou, Suzhou, Nanjing and Hefei. These five cities are mainly municipalities directly under the Central Government and the capital cities of Jiangsu, Zhejiang and Anhui provinces. Suzhou is a super-large city and a city close to Shanghai. The comprehensive evaluation value of Shanghai's material civilization development level reached 0.912, 0.5 higher than the second place Nanjing; Shanghai, Nanjing, Suzhou, Hangzhou and Wuxi ranked the top five in terms of comprehensive evaluation value of spiritual civilization development level in 2021.

Table 3. Weight of indicators of material civilization and spiritual civilization development level

Basic dimension	Basic indicators	Information entropy value e	The utility value of information d	Weight coefficient w
Level of material civilization development	GDP	0.8952	0.1048	29.09%
	Regional GDP growth rate	0.9874	0.0126	0.035
	Proportion of secondary and tertiary industries in regional GDP	0.9969	0.0031	0.0087
	The ratio of output value of tertiary industry to output value of secondary industry	0.9818	0.0182	0.0506
	Average wage of employees on the job	0.9739	0.0261	0.0725
	Total retail sales of consumer goods	0.9236	0.0764	0.212
	Number of people covered by basic old-age insurance for urban workers	0.9191	0.0809	0.2247
	Urban road area per capita municipal district	0.9813	0.0187	0.0519
	Number of hospital beds per capita in the city	0.9826	0.0174	0.0482
	Green coverage rate of built-up area Municipal area	0.998	0.002	0.0055
Level of development of spiritual civilization	RD internal expenditure	0.9251	0.0749	9.89%
	Number of patents granted	0.9263	0.0737	9.74%
	Education expenditure	0.8869	0.1131	14.95%
	Number of students enrolled in ordinary institutions of higher learning	0.9111	0.0889	11.75%
	Number of employees in culture, sports and entertainment in the tertiary industry	0.8767	0.1233	16.30%
	Number of sports venues	0.9463	0.0537	7.09%
	There are books in public libraries for every 100 people	0.8444	0.1556	20.56%
	Number of museums	0.9266	0.0734	9.70%

The comprehensive evaluation value of Shanghai's spiritual civilization development level is still at the first level of 0.930, and it is worth noting that the comprehensive evaluation value of Wuxi's spiritual civilization development level of 0.113 has reached the fifth place. The comprehensive evaluation value of the development level of spiritual civilization and material civilization in Wuxi city is in the forefront. It gives full play to the advantages of being close to Shanghai and is the beneficiary of the dividend release of the regional integration of the Yangtze River Delta. From the provincial level, Shanghai has an absolute advantage in the development level of material civilization and spiritual civilization. The overall development level of material civilization and spiritual civilization in Jiangsu Province is slightly higher than that in Zhejiang Province. Except Hefei, the capital city of Anhui Province, the development level of material civilization and spiritual civilization of other cities in Anhui Province is in the middle and lower reaches of the Yangtze River Delta cities, and its potential still needs to be tapped.

4.3. Coupling Coordination Measurement Results

The coordination degrees of the development levels of spiritual civilization and material civilization in the Yangtze River Delta urban agglomeration are shown in Table 5 below. As can be seen from the following results:

The coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta urban agglomeration has been improved on the whole, but there are obvious differences among cities. In 2005, the coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta urban agglomeration was between 0.142 and 0.609, and the overall average level was 0.24, which was in a state of moderate imbalance and the coordinated development level was not high. Most of the cities are in the state of moderate incoordination and serious incoordination, among which Shanghai is the best and reaches the state of primary coordination. Three cities are on the brink of imbalance: Nanjing, Hangzhou and Changzhou; There are six cities with mild disorders, 13 with moderate disorders, and 18 with severe disorders. In 2021, the coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta urban agglomeration has been improved on the whole, with the average value rising to 0.33. Although the coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta urban agglomeration is constantly improving, the coordinated development of most cities is still at a low level, and there is still a long way to go to achieve the coordinated development of material civilization and spiritual civilization.

Table 4. Evaluation value of material civilization and spiritual civilization development level in the Yangtze River Delta region from 2006 to 2021

	2006		2011		2016		2021	
	material civilization	spiritual civilization	material civilization	spiritual civilization	material civilization	spiritual civilization	material civilization	spiritual civilization
Shanghai	0.280	0.463	0.437	0.566	0.665	0.679	0.920	0.912
Nanjing	0.150	0.300	0.202	0.304	0.308	0.365	0.395	0.457
wuxi	0.123	0.113	0.178	0.121	0.237	0.135	0.260	0.246
xuzhou	0.097	0.123	0.112	0.125	0.167	0.118	0.189	0.128
Changzhou	0.150	0.199	0.128	0.163	0.191	0.138	0.209	0.148
suzhou	0.134	0.123	0.216	0.147	0.322	0.189	0.404	0.269
Nantong	0.089	0.057	0.122	0.076	0.181	0.092	0.210	0.129
Lianyun gang	0.098	0.063	0.090	0.056	0.108	0.053	0.111	0.060
Huai'an	0.061	0.066	0.080	0.066	0.119	0.063	0.130	0.082
Yancheng	0.066	0.054	0.090	0.063	0.130	0.073	0.151	0.080
Yangzhou	0.074	0.077	0.097	0.070	0.135	0.063	0.141	0.068
Zhenjiang	0.082	0.061	0.104	0.076	0.142	0.086	0.143	0.090
taizhou	0.069	0.032	0.098	0.038	0.129	0.046	0.142	0.061
Suqian	0.113	0.137	0.065	0.087	0.096	0.038	0.113	0.039
Taizhou	0.162	0.198	0.208	0.241	0.327	0.272	0.428	0.267
Ningbo	0.116	0.102	0.167	0.126	0.238	0.139	0.286	0.206
Wenzhou	0.104	0.080	0.133	0.086	0.190	0.088	0.215	0.115
Shaoxing	0.090	0.053	0.117	0.058	0.149	0.073	0.174	0.095
Huzhou	0.087	0.058	0.094	0.051	0.133	0.043	0.153	0.059
Jiaxing	0.088	0.054	0.112	0.060	0.162	0.061	0.182	0.070
Jinhua	0.078	0.032	0.106	0.039	0.159	0.047	0.182	0.060
Quzhou	0.061	0.027	0.076	0.029	0.121	0.032	0.127	0.033
Zhoushan	0.080	0.053	0.084	0.046	0.120	0.045	0.116	0.032
Taizhou	0.073	0.031	0.102	0.041	0.145	0.055	0.161	0.069
Lishui	0.092	0.108	0.109	0.071	0.131	0.032	0.148	0.032
Hefei	0.097	0.136	0.143	0.184	0.204	0.203	0.292	0.165
Wuhu	0.070	0.056	0.100	0.060	0.133	0.065	0.155	0.122
Ma'anshan	0.061	0.032	0.080	0.035	0.104	0.038	0.123	0.057
Tongling	0.061	0.021	0.075	0.023	0.097	0.027	0.101	0.037
Chizhou	0.048	0.031	0.060	0.029	0.083	0.022	0.085	0.022
Anqing	0.060	0.028	0.077	0.030	0.112	0.031	0.157	0.036
Xuancheng	0.043	0.028	0.059	0.027	0.082	0.024	0.089	0.029
chuzhou	0.053	0.029	0.079	0.025	0.122	0.020	0.151	0.033
Bengbu	0.068	0.028	0.086	0.029	0.114	0.031	0.139	0.036
Huaibei	0.060	0.027	0.076	0.026	0.086	0.025	0.101	0.030
Huainan	0.058	0.031	0.071	0.035	0.096	0.035	0.107	0.034
suzhou	0.046	0.030	0.052	0.027	0.085	0.026	0.100	0.035
fuyang	0.047	0.022	0.060	0.024	0.090	0.023	0.122	0.037
bozhou	0.048	0.024	0.052	0.023	0.079	0.021	0.092	0.028
Lu'an	0.043	0.034	0.052	0.036	0.081	0.029	0.092	0.036
Huangshan	0.063	0.031	0.080	0.031	0.116	0.033	0.127	0.037

Table 5. Calculation results of coupling coordination degree of Yangtze River Delta urban agglomeration

City	2006 Year				2021 Year			
	Coupling degree C value	Coupling coordination degree D value	Level of coordination	Degree of coupling coordination	Coupling degree C value	Coupling coordination degree D value	Level of coordination	Quality coordination
shanghai	0.958	0.609	7	Primary coordination	1	0.995	10	Primary coordination
nanjing	0.908	0.452	5	On the verge of disorder	0.995	0.667	7	Barely in tune
hangzhou	0.984	0.416	5	On the verge of disorder	0.976	0.594	6	Barely in tune
suzhou	0.999	0.345	4	Mild disorder	0.983	0.586	6	Barely in tune
wuxi	0.998	0.327	4	Mild disorder	1	0.507	6	On the verge of disorder
ningbo	0.999	0.312	4	Mild disorder	0.991	0.497	5	On the verge of disorder
hefei	0.947	0.316	4	Mild disorder	0.967	0.472	5	On the verge of disorder
changzhou	0.973	0.406	5	On the verge of disorder	0.992	0.416	5	On the verge of disorder
nantong	0.996	0.24	3	Moderate dissonance	0.98	0.402	5	Mild disorder
wenzhou	1	0.28	3	Moderate dissonance	0.962	0.392	4	Mild disorder
xuzhou	0.962	0.307	4	Mild disorder	0.99	0.388	4	Mild disorder
wuhu	0.994	0.215	3	Moderate dissonance	0.999	0.36	4	Mild disorder
shaoxing	0.991	0.235	3	Moderate dissonance	0.968	0.349	4	Mild disorder
jiaxing	0.994	0.235	3	Moderate dissonance	0.905	0.325	4	Mild disorder
zhenjiang	1	0.236	3	Moderate dissonance	0.987	0.323	4	Mild disorder
yancheng	0.989	0.207	3	Moderate dissonance	0.967	0.318	4	Mild disorder
jinhua	0.944	0.189	2	Serious dissonance	0.868	0.311	4	Mild disorder
taizhou	0.955	0.181	2	Serious dissonance	0.93	0.311	4	Mild disorder
huai'an	0.942	0.21	3	Moderate dissonance	0.989	0.305	4	Moderate dissonance
yangzhou	0.971	0.242	3	Moderate dissonance	0.954	0.297	3	Moderate dissonance
huzhou	0.998	0.239	3	Moderate dissonance	0.908	0.293	3	Moderate dissonance
taizhou	0.974	0.179	2	Serious dissonance	0.933	0.289	3	Moderate dissonance
ma'an shan	0.995	0.168	2	Serious dissonance	0.95	0.27	3	Moderate dissonance
lianyungang	0.995	0.256	3	Moderate dissonance	0.976	0.264	3	Moderate dissonance
anqing	0.984	0.158	2	Serious dissonance	0.763	0.253	3	Moderate dissonance
bengbu	0.954	0.169	2	Serious dissonance	0.801	0.244	3	Moderate dissonance
cuzhou	1	0.149	2	Serious dissonance	0.746	0.243	3	Moderate dissonance
lishui	0.969	0.291	3	Moderate dissonance	0.742	0.239	3	Moderate dissonance
huangshan	0.987	0.169	2	Serious dissonance	0.838	0.238	3	Moderate dissonance
fuyang	0.999	0.122	2	Serious dissonance	0.85	0.235	3	Moderate dissonance
suqian	0.975	0.335	4	Mild disorder	0.888	0.233	3	Moderate dissonance
quzhou	0.975	0.158	2	Serious dissonance	0.802	0.229	3	Moderate dissonance
zhoushan	0.999	0.224	3	Moderate dissonance	0.822	0.22	3	Moderate dissonance
tongling	0.915	0.143	2	Serious dissonance	0.907	0.22	3	Moderate dissonance
huai'an	0.998	0.161	2	Serious dissonance	0.866	0.218	3	Moderate dissonance
suzhou	0.973	0.135	2	Serious dissonance	0.895	0.215	3	Moderate dissonance
liu'an	0.905	0.132	2	Serious dissonance	0.926	0.21	3	Moderate dissonance
huaibei	0.979	0.156	2	Serious dissonance	0.847	0.205	3	Serious dissonance
xuancheng	0.952	0.124	2	Serious dissonance	0.878	0.193	2	Serious dissonance
haozhou	1	0.129	2	Serious dissonance	0.856	0.193	2	Serious dissonance
chizhou	0.983	0.142	2	Serious dissonance	0.798	0.17	2	Serious dissonance
average value	0.98	0.24			0.91	0.33		

4.4. Dynamic Evolution of System Coupling and Coordination

The stata software is used to estimate the kernel density of the coupling coordination degree of the two subsystems of the development level of material civilization and the development level of spiritual civilization in the Yangtze River Delta region from 2006 to 2021, and to describe the overall form and dynamic evolution law of its distribution, as shown in the figure below:

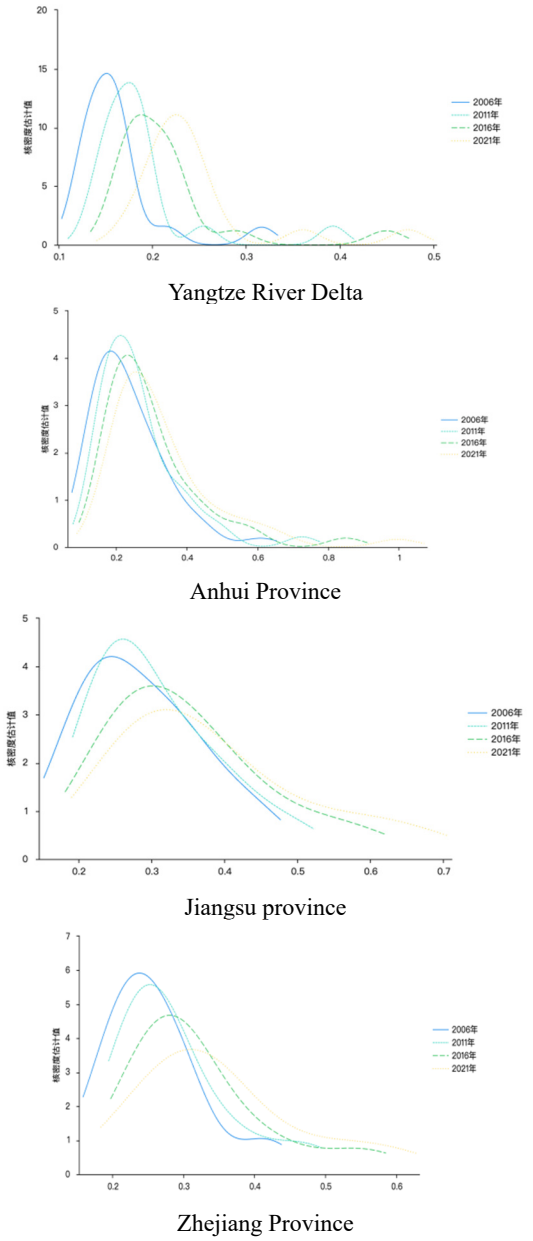

Figure 1. The kernel density of the coupling coordination degree between the development level of material civilization and the development level of spiritual civilization in the Yangtze River Delta region from 2006 to 2021 is estimated

Through the trend map of kernel density of urban agglomerations in the Yangtze River Delta region, it can be obtained that: (1) As time goes by, the kernel density curve of cities in the Yangtze River Delta region keeps moving to the right, which reflects that the coupling and coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta region is in a continuous development trend. 2) The peak value of the kernel density curve of the cities in the Yangtze River Delta region shows a decreasing trend, and the kurtosis changes from a sharp kurtosis to a relatively wide kurtosis. 3) The peak value of the kernel density curve of the cities in the Yangtze River Delta region shows a trend of rising and then falling, and there is an obvious left-tailing phenomenon. (4) According to the analysis of the number of peaks in the two-dimensional diagram of the kernel density curve of the urban agglomeration in the Yangtze River Delta region, it shows a trend of multiple peaks, which indicates that it is facing a trend of multi-polar differentiation in the development process. (5) There are differences among different provinces. The kurtosis of Jiangsu Province is smaller than that of other provinces on the whole, and the peak value is also smaller than that of Zhejiang Province and Anhui Province, which indicates that the internal difference of Jiangsu province is greater than that of other provinces.

4.5. Overall Regional Differences

The following figure reflects the evolution trend of the overall regional differences in the coupling and coordination degrees of the development of spiritual and material civilization in the Yangtze River Delta. From the perspective of the evolution process, the Gini coefficient of coupling and coordination degree shows obvious fluctuations. In general, the fluctuation range of the difference of the coupling and coordination degree between the development of spiritual civilization and material civilization from 2005 to 2021 is 0.214-0.230, and from 2016 to 2018, the difference decreases significantly from 0.230 to 0.214. In 2018-2021, it shows an upward trend, from 0.214 to 0.227.

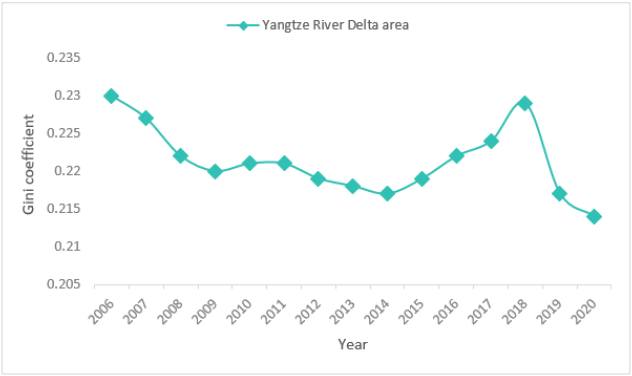

Figure 2. Overall Gini coefficient in the Yangtze River Delta

4.6. Regional Differences within Provinces

It can be seen from the figure below that the difference of coupling coordination degree between the development of spiritual civilization and material civilization in Jiangsu Province is higher than that in Anhui Province and Jiangsu Province. The within-province differences of Jiangsu and Zhejiang provinces show an upward trend, with the Gini coefficient of Jiangsu Province from the lowest 10.14 to the highest 0.176, and the Gini coefficient of Zhejiang Province from the lowest 0.129 to the highest 0. 164. The reason may be that the rapid economic development of Jiangsu Province and Zhejiang Province and the rapid improvement of the development level of material civilization make it difficult to take into account the construction of spiritual civilization. The intra-provincial difference of Anhui Province fluctuates slightly, and has decreased significantly since 2017, from 0.146 to 0.129. The reason is that the overall economic

development speed of Anwei Province is slow, and it has the guarantee of basic spiritual civilization construction, and the difference of development range within the province is small. The state has precisely controlled the major problems facing society and vigorously promoted coordinated development.

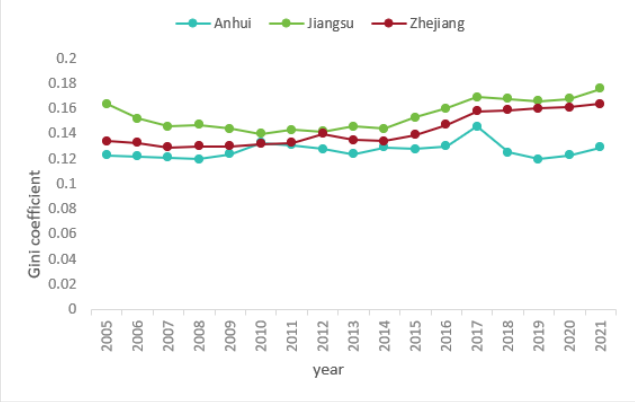

Figure 3. Regional differences within provinces

4.7. Regional Differences in Different Provinces

The following figure reflects the interval difference values of the coupling coordination degrees of the development of spiritual and material civilization in Anhui Province, Jiangsu Province, Zhejiang Province and Shanghai. On the whole, the regional differences of Shanghai-Anhui Province, Shanghai-Jiangsu Province, and Shanghai-Zhejiang Province show an upward trend, and the difference value is constantly expanding. Among them, the regional difference between Shanghai and Anhui Province has always been at the highest level, with an average value of 0.58. The reason is that most cities in Anhui Province still have great potential for the development level of spiritual and material civilization, while Hefei, its central city, has little influence. Both Jiangsu and Zhejiang provinces are close to Shanghai and have been exposed to the radiation effect of Shanghai, the central city. It also belongs to the eastern coastal region, with rapid economic development, strong support from the development policy of the free trade zone, and a key pilot area of ideological and cultural construction, so the regional difference with Shanghai is relatively small.

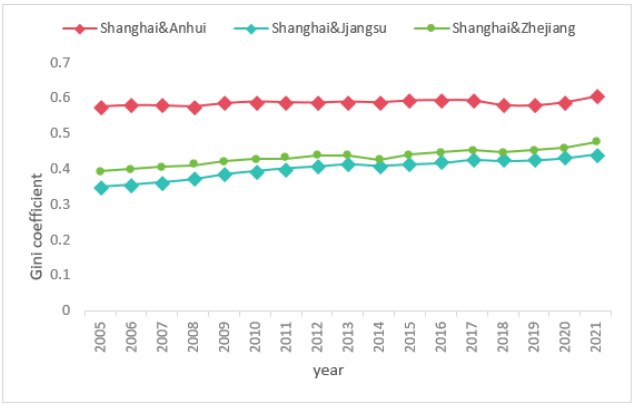

Figure 4. Regional differences in different provinces

5. Research Conclusion

Based on the background of Chinese-style modernization, this paper will build two subsystems of material civilization development level and spiritual civilization development level, and measure the two subsystems by the silkworm entropy method based on the panel data of the Yangtze River Delta urban agglomeration from 2005 to 2020. Finally, the kernel density estimation method is used to study the dynamic evolution of the coupled writing schedule of the development level of material civilization and spiritual civilization, and the Dagum Gini coefficient and decomposition method are used to analyze the difference of spatial regions. Specific conclusions are as follows:

First, the entropy method is used to measure the development levels of material civilization and spiritual civilization in the three provinces of the Yangtze River Delta and Shanghai, and the index weights of the two subsystems of material civilization and spiritual civilization development are obtained. Among them, the indicator that best represents the development level of material civilization in the Yangtze River Delta is regional GDP, with a weight of 29.09%, followed by the average wage of employees; The indicator that best represents the level of spiritual civilization development in the Yangtze River Delta is the number of books in public libraries, followed by the number of employees in the tertiary industry-culture, sports and recreation.

Second, by calculating the evaluation value of the development level of material civilization and spiritual civilization in the Yangtze River Delta region from 20006 to 2021, the results show that the evaluation value of the overall development level of material civilization and spiritual civilization in the Yangtze River Delta region is on the rise. The top five cities in terms of comprehensive evaluation value of material civilization development level in 2021 are Shanghai, Hangzhou, Suzhou, Nanjing and Hefei, and the top five cities in terms of comprehensive evaluation value of spiritual civilization development level are Shanghai, Nanjing, Suzhou, Hangzhou and Wuxi.

Thirdly, according to the coupling coordination degree model, the coupling coordination of the two subsystems of the development level of material civilization and spiritual civilization in the Yangtze River Delta urban agglomeration is calculated, and the differences between cities are obvious. The coupling coordination degree is constantly rising, indicating that the development level of coupling coordination is constantly improving. The coupling coordination degree of Shanghai is the highest, reaching high-quality coordination, but there are obvious differences within the region, and the mean value of the whole region is only 0.33, indicating that there is still a large space for coordinated development.

Fourthly, it can be obtained from the kernel density trend map of urban agglomerations in the Yangtze River Delta region that the coupling and coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta region is in a trend of continuous development. While the coupling and coordination degree of the development level of spiritual civilization and material civilization in the Yangtze River Delta region is constantly improving, the difference within the region shows a trend of expanding. However, the differences between regions have a trend of expanding, and they are facing the trend of multi-polar differentiation in the process of development.

6. Development Proposals

Based on the above conclusions, some suggestions are put forward:

First, there are differences in the level of material civilization development in the Yangtze River Delta region, so the flow of factors should be strengthened to improve the degree of regional integration. Taking advantage of regional advantages, we will strengthen infrastructure construction, especially the construction of transportation facilities such as high-speed rail and high-speed; Clarify the industrial division of labor, transfer labor-intensive industries from developed areas to less developed areas, optimize the industrial layout, and improve the efficiency of resource allocation; Strengthen cooperation and exchange of talents, establish scientific and technological synergy centers, promote scientific and technological cooperation with central cities, and use new and high technologies to promote the increase of industrial energy and production; Seize the policy opportunity, give play to the radiation and driving role of central cities, and join the urban development economic circle. In northern Jiangsu and Anhui, the mechanism of free trade zones will be applied and promoted to promote high-quality development in the region.

Second, there are differences in the level of spiritual civilization development in the Yangtze River Delta region, and efforts should be made to solve the problem of imbalance and inadequacy in the construction of spiritual civilization. Strengthen the Party's ideological construction, give full play to the Party's leading role, and comprehensively strengthen the education of ideals and beliefs and socialist values; We should attach great importance to and vigorously develop education, provide all-round education for young students, strengthen cooperation and exchanges within the education system, cooperate and share educational resources, and comprehensively raise the level of education and the penetration rate of higher education and vocational education. We should strengthen cultural confidence and strive to promote the development of various cultural undertakings. The government should attach importance to the inheritance and development of traditional culture, attach importance to the development of cultural characteristic industries, play a guiding role, and monitor the development of the market.

References

[1] Liu Pan red. The coordinated development of material civilization and spiritual civilization triple dimensions [N]. China social proceedings, 2023-04-13 (008). DOI: 10.28131 / n.c. Nki NCSHK. 2023.001416.

[2] Hao Lixin. Casting the cultural form of Chinese Style Modernization in "Two Combination" [N]. Chinese Journal of Social Sciences,2023-06-07(002).

[3] Qin Shusheng, Sun Meixiao. The implementation and application of the system concept in the fight against epidemic [J]. Party Literature,2021,No.206(02):38-45.

[4] Liao Yanbin. Rural revitalization of the horizon, the rural spiritual civilization construction path analysis [J]. Journal of intelligent agriculture Tribune, 2023, 3 (18) : 181-184. The DOI: 10.20028 / j.z hnydk. 2023.18.045. Feng Xiaohua, QIU Siyuan. Yangtze river delta city economic development level of high quality measure and convergence study [J]. Journal of east China economic management, 2022, 4 (11) : 28-43. DOI: 10.19629 / j.carol carroll nki. 34-1014 / f, 220524008.

[5] Li Haiyang, XU Yuchen, Chai Zhengmeng. Measure and coupling coordination level of the Yangtze river economic belt modernization analysis [J]. Journal of statistics and decision, 2023, 33 (09) 6:74-79. The DOI: 10.13546 / j.carol carroll nki tjyjc. 2023.09.013.

[6] Feng Xiaohua, QIU Siyuan. Yangtze river delta city economic development level of high quality measure and convergence study [J]. Journal of east China economic management, 2022, 4 (11) : 28-43. DOI: 10.19629 / j.carol carroll nki. 34-1014 / f, 220524008.

[7] Li F F. Measurement of high-quality development level of urban agglomerations in the Yangtze River Delta and its coupling coordination evolution analysis [J]. Journal of jianghan university (social science edition), 2023, 40 (5) : 78-91 + 127. DOI: 10.16387 / j.carol carroll nki. 42-1867 / c. 2023.05.008.

[8] Dong Fangfang, LIU Aijun. Identification of the connotation of the New Road of Chinese-style Modernization [J]. Learning and Exploration,2022(07):9-19.

[9] REN Baoping, Zhang Qian. Construction of scientific and reasonable evaluation index system of Chinese style modernization [J]. Academia,2022,No.289(06):33-42.