Research and Analysis of the Synergy Degree of Regional Economy and Regional Labor Force Based on AHP-EWM Coupling Perspective

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Abstract. To measure the coordinated development level of regional economy and regional labor force, on the basis of the analysis of the regional economy and regional labor force development coordination effect, select 11 representative regional economic subsystem of order parameters and 9 representative regional labor force subsystem of order parameters. The weight is calculated by AHP-EWM coupling method to evaluate the level of coordinated development of regional economy and regional labor force. In this paper, the order parameter method of measuring system synergy degree is used to construct a synergy degree evaluation model of regional economy and regional labor force development, and the model is applied to measure the level of regional economy and regional labor force synergy development in Zhoushan city, an archipelago tourism city in China. The results indicate that the synergy degree of regional economy and regional labor force in Zhoushan city shows an M-shaped development trend of alternating increase and decrease, and the overall synergy degree is in a low level state.

Keywords: Regional economy, regional labor force, coupling perspective, collaborative analysis.

1. Introduction

Since the reform and opening up, China's economy has developed rapidly and occupies a pivotal position in the world economic system. However, there is a serious imbalance between China's regional economic growth and regional labor force growth. Sun [1] conducted a static and comparative static analysis of the economic spillover effects of the three growth poles and the Chengdu-Chongqing economic circle through the input-output model of the four regions, and concluded that within the Pearl River Delta economic circle. The strength of industrial linkages is the weakest, the economic spillover effect of the Yangtze River Delta economic circle is the highest, and the economy of the Chengdu-Chongqing economic circle has the strongest ability to be driven, and there are certain differences between regions. Fu Linghui, a spokesman for China's National Bureau of Statistics, said at a press conference held by the State Council Information Office that China's labor resources are still relatively abundant, and there are huge advantages in terms of both the total labor force and the quality of the labor force. From an economic point of view, labor is an important factor input for economic development. In addition, China has relied on a large number of low-cost labor input to promote economic growth in the past. In the future, it will turn more to improving technology and promote economic growth through technological progress. It can be seen that the research on regional economy and regional labor synergy is of great practical significance. At present, there are many researches in this area.

In the field of regional economy, Liu [2] summed up the existing theoretical research on regional economy. By comparing the regional economic theories at home and abroad, he analyzed the regional economic theory from five aspects: regional economic theory, regional economic market structure, spatial pattern, regional relationship, and regional policy. Economic characteristics are summarized. On the theoretical basis of regional economy, Yu [3] used EWM and TOPSIS methods to study the

economic development of the north and south regions, and selected the northeast and the Yangtze River Delta as the regional research objects and found that the two regions are increasingly unbalanced, and the regional integrity is not uniform. Equality is also increasing. Combining the empirical analysis of the development of the circulation industry and the regional economic gap, Dong [4] took a comparative study of the economic gap between the east, the central and the west regions, and believed that the provinces with relatively backward economies should speed up the creation of a more dynamic economic environment and improve the innovation ability of circulation. In the research and analysis of the regional labor force, Xiu [5] studied the impact of labor force scale and regional trade circulation through the Hodrick-Prescott method, and learned that the continuous expansion of the labor force structure and the improvement of quality will help to improve the overall regional economic level, to promote the coordinated development of the whole region. Zhou [6] compared the labor and industrial data in Shanghai, Jiangsu Province, Zhejiang Province, and Anhui Province, and conducted research on the development of labor market integration in the Yangtze River Delta region, and found that there is a larger economy in regional development. The level of development is different, and the industrial structure is irrational. Chen [7] studied the absolute average gap of labor wage levels by analyzing the characteristics of time series data, and selected the Beijing-Tianjin-Hebei region as the main research object, and believed that the degree of labor market integration in the Beijing-Tianjin-Hebei region showed a downward trend.

Under the research mechanism of perspective, Cheng [8] based on different ownership perspectives, and found that the level of labor market integration in the Beijing-Tianjin-Hebei region presents an inverted "U"-shaped nonlinear characteristic; Liu [9] took the Chengdu-Chongqing economic circle as an example, through the Empirical analysis proves that the stronger the mobility of labor factors in productive and non-productive service industries, the more integrated the labor market will be.

From the reading of the literature, it can be seen that there are relatively more studies on regional economy and regional labor development by scholars, but there are few related studies on the coordinated development between the two, and the existing related literature has some limitations:

a. Part of the research lacks empirical analysis, and only a small amount of literature focuses on the analysis of the coordinated development of regional economy and regional labor within urban agglomerations, and has not been involved in the topic of regional coordinated development.

b. The research perspective is mostly static analysis, and there is no dynamic research on the coordinated development of regional economy and regional labor force in a certain region. Therefore, this paper will use time series analysis to select indicators to measure different aspects of regional economy and regional labor force, construct coupled weighted model and regional collaborative model through coupled weight calculation and regional collaborative analysis, and apply the model to Zhoushan City in 2011 Measure the level of coordinated development of regional economy and regional labor force by 2020. and make evaluations and recommendations accordingly.

2. Construction of regional economy subsystem and regional labor subsystem

2.1. Construction of regional economic subsystem

Since the reform and opening up in 1978, the Chinese economic growth has grown by leaps and bounds, making it unique in the world economic system. Under the background of high-quality development in the new era, China's regional economic development pattern has presented a series of new changes: a regional circular pattern of interconnection and complementary advantages has begun to form, the digital and intelligent regional economic spatial structure has been continuously optimized, and a comprehensive regional economic structure has been established. A directional, multi-level and diversified high-level regional economic opening pattern [15] Regional economy is a production complex produced by the interaction of internal factors and external conditions of economic development in a certain region. It reflects the current situation and problems of regional resource development and utilization, especially the rational utilization of mineral resources, land

resources, human resources and biological resources, which is mainly reflected in the scientific and economical distribution of regional productivity.

2.2. Construction of regional labor subsystem

There are broad and narrow senses of labor. The labor force in a broad sense refers to the entire population. The labor force in the narrow sense refers to the population with labor ability. In actual statistics, the indicators that consider the two factors of working age and working capacity are the working-age population and the total number of social labor resources. In economics, labor is usually considered to be a special commodity whose value and use value are different from ordinary commodities.

Based on the theory of synergy and following the principles of systematization, scientific, comprehensiveness and operability, the paper finally determines the order parameters of regional economy and regional labor force. Among them, the regional economic subsystem is 11 order parameters reflecting economic structure, level and trade; the regional labor subsystem is 9 order parameters reporting labor force population and resources as shown in Figure 1and Table 1.

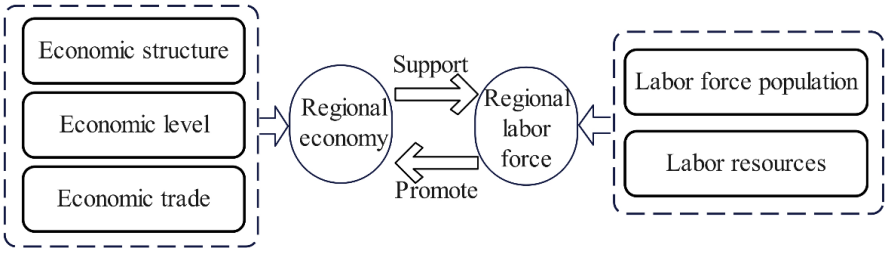

Figure 1. Regional economy and regional labor synergy diagram

Table 1. Index system of regional economy and regional labor force

Order parameter	Level indicators	The secondary indicators	Units	Types	Ref
Regional economy	Economic structure	Output value of primary industry	Ten thousand yuan	Positive	[13]
		Output value of secondary industry	Ten thousand yuan	Positive	
		Output value of tertiary industry	Ten thousand yuan	Positive	
	Economic level	GDP per capita	Yuan per person	Positive	[13]
		Urban per capita disposable income	Yuan per person	Positive	
		Fixed investment	Ten thousand yuan	Positive	
		Local financial revenue	Ten thousand yuan	Positive	
	Economic trade	Total import and export of goods	Ten thousand yuan	Positive	[14]
		Total foreign direct investment	Ten thousand dollars	Positive	
		Total retail sales of consumer goods	Ten thousand yuan	Positive	
		Total sales of commercial houses of real estate enterprises	Ten thousand yuan	Positive	
Regional labor force	Eabor force population	Total population	Ten thousand people	Positive	[10]
		Number of employed	Ten thousand people	Positive	
		Number of unemployed	Ten thousand people	Negative	
		Non-labor force population	Ten thousand people	Negative	
		Unemployment rate	Percent	Negative	
	labor resources	Total labor resource	Ten thousand people	Positive	[11][12]
		Total labor resource/Total population	Percent	Positive	
		Utilization rate of labor resources	Percent	Positive	
		labor productivity	Yuan per person	Positive	

3. Construction of coupling weighting model

3.1. AHP Method

Based on AHP (Analytic hierarchy process), we can combine both qualitative and quantitative aspects in this paper. We can make decisions by using people's experience and quantize subjective and objective factors for systematic analysis.

AHP steps are as follows:

Step1: Analyze the relationship of each element in the system, find the element association, and establish the relevant hierarchical structure for initial classification.

Step2: Compare the importance of elements of the same category in the initial classification and construct a new comparison matrix.

Step3: Judge the comparison matrix and give corresponding weights to the elements.

Step4: Check and judge the consistency of the comparison matrix.

Step5: Calculate the total ranking weight of the system in each level and conduct ranking processing.

Step6: Make a total weight ranking of the element targets in the overall scheme.

3.2. CRITIC Method

The CRITIC method determines the objective weight of indicators based on the discriminative power and conflict of evaluation indicators, which has more scientific reference significance compared with the simple subjective weight assignment method, and makes the analysis results more reasonable.

The steps are as follows:

Step1: Calculate the normalized matrix.

Step2: Calculate the coefficient of variation of the index.

Step3: Calculate the degree of independence between indicators.

Step4: Calculate the weight and evaluate it.

3.3. Lagrange multiplier method

In this paper, the Lagrange multiplier method is used for coupling to combine the subjective weight and objective weight, and the combined weight is obtained to analyze and judge the information. The formula is as follows:

$$w_j = \frac{(w_{1j}w_{2j})^{0.5}}{\sum_{j=1}^{n}(w_{1j}w_{2j})^{0.5}}, j = 1,2,\cdots,n \tag{1}$$

4. Construction of collaborative model

4.1. Construction of sub- collaboration model

From the composite system $E=\{E_1, E_2\}$ defined above, it can be seen that its subsystem is E_j (j = 1, 2), and let its order parameter is $e_j=(e_{j1}, e_{j2},\ldots, e_{jn})$, where $\beta_{ji} \le e_{ji} \le \alpha_{ji}$, $n \ge 1$, $i = 1,2,\cdots,n$, and α_{ji}, β_{ji} are respectively the critical values when the system is stable.

First, the order parameters of the subsystem E_j are normalized by Min-Max as follows, and the result is defined as the order degree $u_j(e_{ji})$.

$$u_j(e_{ji}) = \begin{cases} \dfrac{e_{ji}-\beta_{ji}}{\alpha_{ji}-\beta_{ji}}, e_{ji} \text{ is a positive indicator} \\ \dfrac{\alpha_{ji}-e_{ji}}{\alpha_{ji}-\beta_{ji}}, e_{ji} \text{ is a negative indicator} \end{cases} \tag{2}$$

Based on the synergetic theory, the contribution of order parameters to the system can be calculated by "integrating" each order parameter component. In this paper, the linear weighting method is used for integration, that is, the order degree of the order parameter variables $u_j(e_{ji})$ is:

$$u_j(e_{ji})=\sum_{j=1}^{n}\omega_j u_j(e_{ji}), w_j \geq 0, \sum_{j=1}^{n} w_j = 1 \tag{3}$$

In Equation (3), w_j is the coupling weight of each order parameter.

According to the AHP and EWM methods introduced above, the subjective weight w_{1j} and objective weight w_{2j} of order parameters are calculated respectively, which w_j should be as close as possible to w_{1j} and w_{2j}. According to the principle of minimum relative information entropy, the Lagrange multiplier method is used to optimize the coupling weight equation (1).

4.2. Collaborative system model construction

And the synergy degree of composite system of regional economy and regional labor force reflects the comprehensive coordination degree of regional economic system operation and regional labor force development. The synergy degree of the two is as follows.

$$\begin{aligned} U_{(t)} &= sig(\cdot)\sqrt{|U_1(t)-U_1(t-1)|\cdot|U_2(t)-U_2(t-1)|} \\ sig(\cdot) &= \begin{cases} 1, U_1(t)-U_1(t-1)\geq 0, U_2(t)-U_2(t-1)\geq 0 \\ 0, \text{else} \end{cases} \end{aligned} \tag{4}$$

Where, $U_1(t)$ refers to the ordered contribution degree of regional logistics subsystem at time t, and $U_2(t)$ is the ordered contribution degree of regional economic subsystem at time t. $U_{(t)} \in [-1,1]$. When $U_{(t)}$ tends to 1, it indicates that the greater the coordination degree of regional economy and regional labor force, the greater can be achieved between regional economic subsystem and regional labor subsystem or between internal factors. The smaller $U_{(t)}$ is, the smaller the degree of synergy between the two systems, and the regional economy subsystem and the regional labor subsystem are in a state of disorderly development.

5. Case Study

5.1. Region selection and data collection

Zhoushan City is the first prefecture-level city based on archipelagoes in China. Located in the southeast coast of China, Zhoushan City, with a total area of 22,200 square kilometers, is the largest archipelago and the first national strategic new area with Marine economy as its theme in China. With fascinating scenery and rich human resources, its main economic sources include Marine fishery, logistics industry, harbor industry, tourism industry and so on. In 2020, the GDP of Zhoushan City was 151.21 billion yuan, which ranked the last in Zhejiang Province in terms of total volume, not far from Lishui. However, considering that Zhoushan has only 1.15 million population, its per capita output value is very high. As the only archipelagic tourism city in China, it is of great significance to study the synergistic relationship between regional labor force and regional economy. The synergistic development of the two is not only the objective demand of regional economic and social development, but also an important way to enhance the competitiveness of archipelagic tourism city.

Therefore, this paper obtains relevant data from the official website of Zhoushan Bureau of Statistics based on network search and Python crawler technology. The main source of index data is Zhoushan Statistical Yearbook and its statistical bulletin, covering the period from 2011 to 2020. For the collected data, preprocessing is carried out first to facilitate the subsequent research and analysis. This article uses Python's Pandas library to find missing and outliers. If there are missing values, the samples or features with missing values can be deleted or the missing values can be filled in to ensure the integrity and accuracy of the data. The regional economy and regional labor force are regarded as a composite system $E=\{E_1, E_2\}$, where E_1 is the regional economic subsystem and E_2 is the regional labor force subsystem. Let E_{ji} denotes the value of the first-level index i under the subsystem j, e_{ji} denotes the value of the second-level index i under the subsystem j, where $j = 1$ denotes the regional

labor force subsystem and $j = 2$ denotes the regional economic subsystem, The results of descriptive statistics on the secondary indicators of regional economy and regional labor force are as shown in Table 2:

Table 2. Descriptive statistical table of secondary indicators of regional economy and regional labor force

Level indicators	The secondary indicators	Units	Max	Min	Average	Standard deviation
E_{11}	e_{11}	Ten thousand yuan	1529406.0	721475.0	1112209.0	91982.6
	e_{12}	Ten thousand yuan	5901513.0	2704098.0	3695498.0	313759.8
	e_{13}	Ten thousand yuan	7690158.0	3468922.0	5603647.0	474364.0
E_{12}	e_{14}	Yuan per person	130130.0	61056.0	89998.7	7154.5
	e_{15}	Yuan per person	63702.0	26984.0	46819.9	3791.2
	e_{16}	Ten thousand yuan	17866943.0	4760876.0	11879165.0	1536603.0
	e_{17}	Ten thousand yuan	2544983.0	1271752.0	1770518.0	140407.8
E_{13}	e_{18}	Ten thousand yuan	7859430.0	1170087.0	4235446.0	986949.9
	e_{19}	Ten thousand dollars	16673094.0	17467.0	4213278.0	2153672.0
	$e_{1,10}$	Ten thousand yuan	5533191.0	2429046.0	4042515.0	340497.2
	$e_{1,11}$	Ten thousand yuan	2858913.0	836252.0	1652466.0	225639.2
E_{21}	e_{21}	Ten thousand people	117.6	113.7	115.5	0.5
	e_{22}	Ten thousand people	72.1	64.8	69.8	0.7
	e_{23}	Ten thousand people	50.5	20.4	32.6	4.0
	e_{24}	Ten thousand people	26.5	18.6	22.4	0.7
	e_{25}	%	3.0	1.6	2.5	0.2
E_{22}	e_{26}	Ten thousand people	100.4	96.0	98.0	0.5
	e_{27}	%	86.6	84.2	84.9	0.2
	e_{28}	%	72.6	67.5	71.2	0.5
	e_{29}	Yuan per person	13195.9	6345.4	9607.9	763.1

5.2. Coupling weight calculation

Based on above method, according to the panel set the index weight ratio builds AHP judgment matrix, first of all, respectively, build the primary index of the subsystems of the judgment matrix, and then build a secondary index of judgment matrix. The proceeds of the secondary index weight multiplied by the corresponding weights of indicators is the final weight of secondary indicators.

The judgment matrix of the first-level indicators of regional economy E_1, and the judgment matrix of the second-level indicators corresponding to each first-level indicator E_{11}, E_{12}, E_{13} are respectively [16]:

$$E_1 = \begin{pmatrix} 1 & 2 & 4 \\ 1/2 & 1 & 2 \\ 1/4 & 1/2 & 1 \end{pmatrix}, \quad E_{11} = E_1, E_{12} = \begin{pmatrix} 1 & 2 & 5 & 4 \\ 1/2 & 1 & 5/2 & 2 \\ 1/5 & 2/5 & 1 & 4/5 \\ 1/5 & 1/2 & 5/4 & 1 \end{pmatrix}, E_{13} = \begin{pmatrix} 1 & 4 & 1/2 & 2 \\ 1/4 & 1 & 1/8 & 1/2 \\ 2 & 8 & 1 & 4 \\ 1/2 & 2 & 1/4 & 1 \end{pmatrix} \tag{5}$$

The first-level indicator of regional labor force is a second-order judgment matrix E_2, in which each element is 1. The judgment matrix of the second-level indicator corresponding to each first-level indicator E_{21}, E_{22} are:

$$E_{21}=\begin{pmatrix}1 & 1/3 & 1/2 & 1/2 & 1/2\\ 3 & 1 & 3/2 & 3/2 & 3/2\\ 2 & 2/3 & 1 & 1 & 1\\ 2 & 2/3 & 1 & 1 & 1\\ 2 & 2/3 & 1 & 1 & 1\end{pmatrix},\ E_{22}=\begin{pmatrix}1 & 1/2 & 1/2 & 1/3\\ 2 & 1 & 1 & 2/3\\ 2 & 1 & 1 & 2/3\\ 3 & 3/2 & 3/2 & 1\end{pmatrix} \tag{6}$$

Through the consistency test, the values of the above judgment matrices are all less than 0.1, indicating that the above matrices have relative consistency, and the calculated weights are valid. The calculation results of the weights of AHP, CRITIC and coupling weights are respectively calculated as shown in Table 3.

Weighting results by above knowable, for regional economy, the primary index of economic structure, economic level, trade and economic decline in order of importance. In the economic structure, the third industry production value occupies the main weight in the three kind of weights, indicating that it has the greatest impact on economic structure. In the economic level, the per capita GDP and fixed asset investment accounted for larger proportion. In economic trade, the total value of import and export of goods and the total value of foreign direct investment account for a relatively large proportion in the coupling weight, indicating that it has a significant impact on economic and trade. For the regional labor force, the weight of the first-level index is almost the same, while the second-level index, unemployment rate and labor productivity have a large weight, that is, they are the main factors affecting the labor force and population resources.

Table 3. Weight result table

The secondary indicators	AHP Method			CRITIC Method		AHP-CRITIC
	CI	CR	Weighting	Entropy	Weighting	
e_{11}	0.0000	0.0000	0.0817	0.9865	0.0172	0.0708
e_{12}			0.1632	0.9869	0.0167	0.0987
e_{13}			0.3265	0.9858	0.0182	0.1455
e_{14}	0.0000	0.0000	0.1465	0.9878	0.0156	0.0901
e_{15}			0.0733	0.9868	0.0169	0.0664
e_{16}			0.0293	0.9649	0.0449	0.0685
e_{17}			0.0366	0.9880	0.0153	0.0447
e_{18}	0.0000	0.0000	0.0381	0.8841	0.1483	0.1419
e_{19}			0.0095	0.4974	0.6434	0.1478
$e_{1,10}$			0.0762	0.9857	0.0182	0.0704
$e_{1,11}$			0.0190	0.9647	0.0452	0.0554
e_{21}	0.0000	0.0000	0.0500	1.0000	0.0001	0.0030
e_{22}			0.1500	0.9998	0.0005	0.0138
e_{23}			0.1000	0.8690	0.3008	0.2779
e_{24}			0.1000	0.9158	0.1933	0.2228
e_{25}			0.1000	0.7924	0.4766	0.3498
e_{26}	0.0000	0.0000	0.0625	1.0000	0.0001	0.0042
e_{27}			0.1250	1.0000	0.0000	0.0032
e_{28}			0.1250	0.9999	0.0002	0.0083
e_{29}			0.1875	0.9876	0.0284	0.1170

5.3. Regional collaboration analysis

According to equations (3) and (4), the changes of order degree and synergy degree of regional economy and regional labor force in Zhoushan City are drawn as shown in Figure 2.

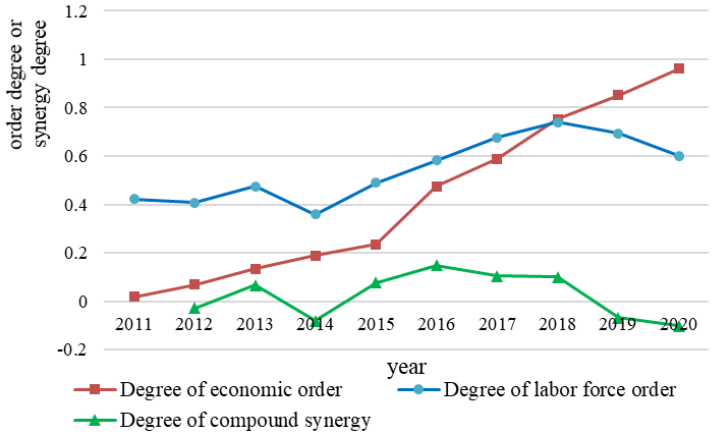

Figure 2. Order degree and synergy degree of regional economy and regional labor force in Zhoushan City from 2011 to 2020

As shown as Figure 2, the order degree of regional economy and regional labor subsystem in Zhoushan City show an overall upward trend, but the regional labor subsystem shows a downward trend in 2011-2012, 2013-2014 and 2018-2020. The order growth rate of regional economic subsystem was significantly higher than that of regional labor subsystem. The order degree of regional economic subsystem increased by 0.9427 from 0.0191003 in 2011 to 0.961750 in 2020, which was about 50 times of that in 2011, and the largest increase was achieved in 2015-2016, which was 0.2388 higher than that in the previous year. The order degree of the regional labor subsystem increased from 0.423038 in 2011 to 0.600487 in 2020, and the order degree of the regional labor subsystem reached the peak of 0.740314 in 2018, indicating that the contribution degree of the two subsystems to the composite system was constantly increasing.

By comparing the order degree of regional economic subsystem and regional labor subsystem, it can be seen that: from 2011 to 2017, the order degree of regional labor subsystem was significantly higher than that of regional economic subsystem, indicating that regional labor was leading regional economy and had a supporting and promoting effect on regional economy. However, after 2018, the order degree of the regional labor subsystem began to decline slowly, while the order degree of the regional economic subsystem still grew rapidly and exceeded the order degree of the regional labor subsystem.

As shown as Figure 2, The synergy degree of regional economy and regional labor force development in Zhoushan city shows an M-type development trend of alternating increase and decrease, and is generally in a low level of synergy state. The overall change trend of collaborative degree of composite system can be divided into five stages:

Stage 1: 2011~2012. The order degree of the regional labor subsystem showed a downward trend but was higher than that of the regional economic subsystem. The order degree of the regional economic subsystem showed an upward trend, indicating that the regional labor force was leading the regional economy. The composite synergy degree was negative, indicating that the development of the two subsystems was not coordinated.

Stage 2: 2013. In the stage from 2012 to 2013, order degree of regional economy and regional labor subsystem were on the rise. The order degree of regional labor subsystem was greater than the regional economy, indicated that regional labor led the region economy. The composite synergy degree was positive, showing two subsystems were in a state of synergy and maintained good development momentum.

Stage 3: 2014. From 2013 to 2014, order degree of regional labor subsystem decreased significantly, while the order degree of regional economic subsystem has remained stable growth as

the first two years of growth. The order degree of regional labor subsystem was still higher than that of regional economy and leading superiority was still remain, but synergy degree of composite systems declined. At this stage, a negative value indicates that the two subsystems were not in harmony.

Stage 4: 2015~2018. The order degree of regional economy and regional labor subsystem still showed an upward trend on the whole, but the growth rate gradually slowed down. The order degree of regional economic subsystem increased rapidly from 2015, and exceeded the order degree of regional labor subsystem for the first time in 2018. At this stage, the synergy degree of the composite system was always positive. From 2015 to 2016, the growth was maintained, and then it declined slowly, indicating that the two subsystems were relatively coordinated. However, since 2016, the degree of coordination began to decline, indicating a worrying development trend.

Stage 5: 2019~2020. The order degree of the regional economic subsystem continued to maintain a growth trend, reaching a peak of 0.961750 in 2020. The order degree of the regional labor subsystem seriously declined, decreasing by 0.1398 in two years, which widened a gap with the order degree of the regional economic subsystem, and the development of the regional economic subsystem was ahead of the regional labor subsystem. However, the degree of the composite system dropped seriously to negative value, and the two subsystems were in a dissonance state, unable to produce synergistic effect. Based on the actual situation, it can be speculated that the COVID-19 epidemic in 2020 had a great impact on the regional labor subsystem, which made the complex system dysfunctional.

6. Conclusion

(a) this paper selects 11 representative regional economic subsystem of order parameter reflecting the economic structure, economic level and economic trade and 9 representative regional labor force subsystem of order parameter reflecting the labor force and labor resources to evaluate the coordinated development levels of regional economy and regional labor.

(b) According to the construction principles of the order parameters of regional economy and regional labor system, determine the order parameters of regional economy and regional labor system, establish the evaluation model of the cooperation degree of regional economy and regional labor force, and determine the measurement method of the coordination level of regional economy and regional labor force.

(c) Taking Zhoushan City as an example, the model is applied to evaluate the synergy degree of Chinese archipelago tourism cities. The results indicate that the synergy degree of the composite system of regional economy and regional labor force in Zhoushan city shows an M-type development trend of alternating increase and decrease, and is generally in a low level of synergy stage.

Acknowledgements

The order of the author's name is in alphabetical order, and the workload of each author is equivalent.

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