

An Evaluation of the Correlation between the Regional Economic Development Capability and the Human Resources Development*

----A Case Study on Henan Province of China

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Abstract - In order to analyze the correlation between the regional economic development capability and the human resources development, the authors establish an evaluation index system of the correlation degree between a region's economic development capability and its human resources development. With the application of the Grey Relational Analysis method, the authors set up a model for evaluation of the correlation degree between the regional economic development capability and the human resources development, and use this model to evaluate the correlation degree between Henan province's economic development capability and its human resources development. The result of the evaluation shows that there is a medium to high correlation between the province's economic development capability and its human resources development and that their relation needs to be further improved.

Index Terms - regional economic development capability, human resources development, correlation degree, evaluation index system

1. Introduction

Resources are sources of social wealth. Human resources are the most active, extensive and penetrating resources[1]. With the development of history, human resources have changed constantly its role played in the productivity towards increasing its importance in the composition of productivity, and become the most strategic resource or the "first resource" [2]. A region's economic development needs certain quantity and quality of population, and the labor supply situation of the region is an important condition which will influence the development and distribution of the productivity of such region[3]. Economic development of a region requires not only sufficient labor force, but also qualified talents.

In recent years, various academic disciplines in China have achieved sustained development. However, there is lack of systematic and in-depth studies on the relation between the regional economic development capability and the human resources development. Most of the existing studies on this issue are qualitative research, and quantitative research is quite few. Related research achievements mainly concentrated in the studies of the regional economic development theories [4], the regional economic growth space [5], the coordinated development of the regional economy [6], the sustainable development of the regional economy [7], the human resources

development and management in the regional economic development[8], etc.. Therefore, certain quantitative index for measurement of the relation between the regional economic development capability and the human resources development needs to be introduced. Such index is the "correlation degree between a region's economic development capability and its human resources development", which can reflect the interactions of the regional economic development capability and the human resources development, and their strength and contribution to the regional economic growth. Because of this, this paper attempts to set up a model for evaluation of the correlation degree between the regional economic development capability and the human resources development, so as to provide an effective way of evaluating the complicated system of the regional economic development. This model is also applied in this paper to evaluate the correlation degree between Henan Province's economic development capability and its human resources development.

2. Establishment of the Correlation degree Evaluation Index System

A scientific Evaluation Index System of the correlation degree between a region's economic development capability and its human resources development shall be able to accurately, comprehensively and systematically reflect the main characteristics, the structure, the functions and the trend of the two objects of the research, and shall follow the principles of being goal-oriented, quantitative, structural and easy to operate. After review of reference articles related to the regional economic development level[9], the regional innovation capability[10], the regional culture[11] and the regional human resources development[12], and after lots of statistics and observation work, detailed analysis of information and data related to the regional economic development capability and the regional human resources development, and primary selection of the indexes that may be used for the correlation analysis, taking into account the special requirements of the study hereof, a correlation degree evaluation index system to applied in the paper is finally established. Then, based on such evaluation index system and

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after checking the availability of annual statistic data of the primarily-selected indexes and making necessary adjustment, a full set of quantitative indexes are finally selected.

The evaluation index system of the correlation degree

between a region’s economic development capability and its human resources development established in this paper is shown in Table 1 below:

TABLE 1 The Evaluation Index System of the Correlation Degree between the Regional Economic Development Capability and the Regional Human Resources Development

First-Level Indexes	Second-Level Indexes	Third-Level Indexes	Fourth-Level Indexes
comprehensive evaluation index system	index system of the regional economic development Level A	national economic accounting A ₁	GDP per capita (RMB yuan)X ₁
		population A ₂	consumption per capita (RMB Yuan)X ₂
		foreign tradeA ₃	annual average population(ten thousand)X ₃
		employed population A ₄	total import and export volume(ten thousand US dollars)X ₄
			actual overseas investment (ten thousand US dollars)X ₅
		financial revenue & expenditure A ₅	persons employed in urban units (ten thousand)X ₆
		people’s living standards A ₆	public fiscal budget income per capita (RMB yuan)X ₇
			public fiscal budget expenditure per capita (RMB yuan)X ₈
		industries A ₇	Engel coefficient of urban residents(%)X ₉
		construction industry A ₈	annual net income of rural residents per capita (RMB yuan)X ₁₀
			industrial added value per capita (RMB yuan)X ₁₁
	finance A ₉	construction industry labor productivity per capita (RMB yuan per capita)X ₁₂	
	postal services A ₁₀	balance of Savings deposits of urban residents at the end of a year (hundred million RMB yuan)X ₁₃	
	tourism A ₁₁	post and telecommunications services per capita (RMB yuan per capita)X ₁₄	
		inbound tourists (person-time)X ₁₅	
		domestic tourism income (hundred million RMB yuan)X ₁₆	
		investment in talent development B ₁	investment in fixed assets for social education (hundred million RMB yuan), new statistics standard Y ₁
			investment in fixed assets for scientific research, technical service and geological prospecting survey (hundred million RMB yuan)Y ₂
	fiscal expenditure on education per capita (RMB yuan)Y ₃		
	fiscal expenditure on science and technology per capita (RMB yuan)Y ₄		
	fiscal expenditure on culture and media per capita (RMB yuan)Y ₅		
	public library (number of libraries)Y ₆		
	quality education of talents B ₂		college and university graduates (ten thousand)Y ₇
		technical schools graduates (ten thousand)Y ₈	
		percentage of the illiterate population in the population aged 15 and above (%)Y ₉	
	benefits of talent development B ₃	urban unemployment rate (%)Y ₁₀	
number of occupational (assistant) physicians each then thousand people Y ₁₁			
structure of talents B ₄	fertility rate (%)Y ₁₂		
	employment in urban units of professional and technical services (ten thousand)Y ₁₃		
	ratio of the employment of primary industries in the total employment (%)Y ₁₄		
	ratio of the employment of second industries in the total employment (%)Y ₁₅		
		ratio of the employment of third industries in the total employment (%)Y ₁₆	

3. Establishment of the Correlation Degree Evaluation Model

Grey Relational Analysis (“GRA”) is a method of quantitative description and comparison of the development tendency of a system, whose basic thinking is to judge whether there is a close correlation between certain comparative data sequence and the reference data sequence through comparison of their geometry similarity, which reflects the correlation degree between the curve of the comparative data sequence and the curve of the reference data sequence[13]. In this paper the correlation analysis method is applied to evaluate the effect of correlation between the regional economic development capability and the regional human resources development, and thus a model for evaluating the correlation degree between the regional economic development capability and the regional human resources development is established and applied for the evaluation. The process of setting up the model is as follows:

(1) Dimensionless Quantization of Data

Sequences usually consist of various indexes calculated in different units, which makes it impossible to compare such original data. Therefore, dimensionless quantization of original data is required. There are various methods of dimensionless quantization and in this paper the method of calculating the arithmetic mean of the data is applied. This method can be explained as follows:

Suppose there is the original (n+1) sequences:

$$\{x_i^0(k)\}(i = 0, 1, \dots, n; k = 1, 2, \dots, m)$$

After the mean calculation process, we can get the new sequences $\{x_i^{(1)}(k)\}$, which are:

$$x_i^{(1)}(k) = \frac{x_i^0(k)}{\bar{x}_i} \quad (1)$$

where, \bar{x}_i is the mean value of the No. i sequence. The formula

for calculation of \bar{x}_i is as follows:

$$\bar{x}_i = \frac{\sum_{k=1}^m x_i^{(0)}(k)}{m} \quad (2)$$

There are also two types of indexes required to be standardized. For example, there are maximum indexes (whose characteristics is the higher the better) and minimum indexes (whose characteristics is the lower the better), among the indexes of the regional economic development capability.

The mean calculation process of the indexes of the regional human resources development is similar to that of the indexes of the regional economic development capability.

(2) Calculation of the Correlation Coefficient

Correlation coefficient is the basis for consideration of the geometry differences of the respective curves of various data sequences, and evaluation of the correlation between such data sequences based on the spread between such curves.

$$F_{oi}(k) = \frac{\min_i \min_k |x_0^{(1)}(k) - x_i^{(1)}(k)| + \varepsilon \max_i \max_k |x_0^{(1)}(k) - x_i^{(1)}(k)|}{|x_0^{(1)}(k) - x_i^{(1)}(k)| + \varepsilon \max_i \max_k |x_0^{(1)}(k) - x_i^{(1)}(k)|} \quad (3)$$

Where, $x_0^{(1)}(k)$ and $x_i^{(1)}(k)$ mean the respective standardized value of the regional economic development capability indexes and the regional human resources development indexes at the k moment; ε means the identification coefficient whose value falls within $[0,1]$ and is usually equal to 0.5; $\min_i \min_k |x_0^{(1)}(k) - x_i^{(1)}(k)|$ represents the range minimum of Henan province's regional economic development capability and the province's regional human resources development; $\max_i \max_k |x_0^{(1)}(k) - x_i^{(1)}(k)|$ represents the range maximum of Henan province's regional economic development capability and the province's regional human resources development; and $F_{oi}(k)$ means the correlation coefficient at the k moment.

(3) Calculation of Correlation degree

It is inconvenient to analyze correlation coefficient sequences, as it involves quite complex data and scattered information. Therefore, it is necessary to centralize correlation coefficients at various moments as a value. According to the evaluation index system of the correlation degree between a region's economic development capability and its human resources development established in this paper, we can apply the formula (3) to calculate the correlation coefficient $F_{oi}(k)$ and get a correlation degree matrix $R = a \times b$, where a and b represent the respective values of the regional economic development capability indexes and the regional human resources development indexes. Such matrix R reflects the interactions of the regional economic development capability and the human resources development, and their strength and contribution to the regional economic growth. By comparing the value of the respective correlation degrees r_{ij} , it can be analyzed which factor of the regional economic development capability plays a bigger role in the regional human resources development, and which factor plays a smaller role in the regional human resources development, or whose role needs to be further strengthened. In case the value of r_{ij} equals 1, the maximum of correlation degree, it shows that the relevant

index of the regional economic development level of Henan province has a very close correlation with the relevant index of the human resources development of Henan province, and the two indexes have similar change trend and best interaction with each other. In case the value of r_{ij} is lower than 1 but higher than 0, it shows that there is certain correlation between the relevant index of the regional economic development level of Henan province and the relevant index of the human resources development of Henan province, and the higher the value, the closer the correlation. In general, in case $0 < r_{ij} \leq 0.40$, it shows that there is very low correlation between the two relevant indexes and their interaction is weak; in case $0.40 < r_{ij} \leq 0.8$, it shows that the correlation between the two relevant indexes is moderate; if $0.8 < r_{ij} \leq 1$, it shows that there is high correlation and strong interaction between the two relevant indexes [14].

4. Application of the Correlation Degree Evaluation Model

Taking Henan province as a study case, the correlation between the province's economic development capability and its human resources development is evaluated and analyzed by using the above-mentioned correlation degree evaluation model, so that on one hand we can achieve better understanding of the practical application of the model for evaluating the correlation degree between the regional economic development capability and the regional human resources development, and on the other hand, we can learn quantitatively the correlation between the economic development of Henan province and the province's human resources development.

A. Production of the Basis Data of the Relevant Indexes

In this paper, the annual data of Henan province for the period from 2007 to 2011 is applied. Such data is stable, reflects the actual situation of the economic development level of Henan province, and shows its development trend to some extent, and therefore has a relatively strong explanation ability. The data sources are mainly the Henan Statistics Yearbook 2008-2012, and the National Bureau of Statistics of the People's Republic of China. The original data of the relevant indexes of Henan province for the period from 2007 to 2011 is put through the mean calculation process in accordance with the above-mentioned formulae (1) and (2) to produce the basic data of the relevant indexes. As to the maximum indexes and minimum indexes, the highest value of the maximum index data of Henan province during the period from 2007 to 2011 is taken as the optimal value for such maximum index, while the lowest value of the minimum index data of Henan province during the period from 2007 to 2011 is taken as the optimal value for such minimum index. The detailed basic data for each year of the period from 2007 to 2011 is shown in Table 2 and Table 3 below:

B. Results of the Grey Relational Analysis

The correlation degree of the indexes of Henan province's economic development capability and the indexes of the province's human resources development will be produced by putting the standardized values of the basic data

in Table 2 and Table 3 into the above-mentioned formula (3).

The detailed calculation results are shown in Table 4 below:

TABLE 2 Regional Economic Development Index Statistics

Indexes	2007	2008	2009	2010	2011	optimal value
X ₁	0.74	0.88	0.95	1.12	1.32	1.32
X ₂	0.74	0.85	0.95	1.13	1.32	1.32
X ₃	0.98	0.98	0.99	1.01	1.04	1.04
X ₄	0.79	1.08	0.83	1.1	1.19	1.19
X ₅	0.47	0.88	0.81	0.8	2.03	2.03
X ₆	0.97	0.98	1	1.01	1.04	1.04
X ₇	0.73	0.85	0.94	1.11	1.37	1.37
X ₈	0.66	0.8	1.01	1.13	1.4	1.4
X ₉	1.01	1.02	1	0.97	1	0.97
X ₁₀	0.76	0.88	0.95	1.09	1.31	1.31
X ₁₁	0.66	0.89	0.94	1.14	1.37	1.37
X ₁₂	0.74	0.84	0.98	1.1	1.34	1.34
X ₁₃	0.7	0.85	1	1.15	1.31	1.31
X ₁₄	0.88	1.05	1.21	1.34	0.52	1.21
X ₁₅	0.7	0.82	0.99	1.16	1.33	1.33
X ₁₆	0.67	0.79	1	1.15	1.39	1.39

TABLE 3 Regional Economic Development Index Statistics

Indexes	2007	2008	2009	2010	2011	optimal value
Y ₁	0.76	0.82	1.19	1.06	1.17	1.19
Y ₂	0.57	0.71	1.22	1.28	1.22	1.28
Y ₃	0.68	0.81	0.96	1.06	1.49	1.49
Y ₄	0.68	0.81	0.94	1.13	1.43	1.43
Y ₅	0.7	0.86	1.22	1.09	1.13	1.22
Y ₆	0.96	0.99	0.99	0.99	1.06	1.06
Y ₇	0.78	0.88	0.97	1.11	1.26	1.26
Y ₈	0.83	0.92	0.99	1.11	1.15	1.15
Y ₉	1.26	1.17	1.05	0.67	0.86	0.67
Y ₁₀	0.99	0.99	1.02	0.99	0.99	0.99
Y ₁₁	0.83	0.85	0.99	1.17	1.17	1.17
Y ₁₂	0.99	1	1	1.01	1.01	1.01
Y ₁₃	0.95	0.97	0.96	1.01	1.11	1.11
Y ₁₄	1.08	1.04	0.99	0.96	0.92	1.08
Y ₁₅	0.92	0.96	1.01	1.04	1.07	1.07
Y ₁₆	0.93	0.96	1	1.03	1.07	1.07

TABLE 4 The Correlation Degree of Henan Province’s Economic Development Level and the Province’s Human Resources Development

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆
Y ₁	0.74	0.76	0.62	0.73	0.66	0.62	0.75	0.62	0.58	0.76	0.71	0.78	0.75	0.71	0.76	0.72
Y ₂	0.61	0.62	0.46	0.56	0.64	0.47	0.60	0.56	0.46	0.57	0.66	0.61	0.67	0.70	0.67	0.69
Y ₃	0.80	0.81	0.61	0.64	0.73	0.61	0.84	0.71	0.57	0.78	0.85	0.84	0.82	0.61	0.84	0.86
Y ₄	0.86	0.87	0.57	0.66	0.72	0.57	0.89	0.74	0.55	0.85	0.92	0.86	0.86	0.62	0.88	0.91
Y ₅	0.76	0.75	0.61	0.70	0.67	0.62	0.76	0.63	0.58	0.78	0.76	0.77	0.79	0.72	0.76	0.73
Y ₆	0.65	0.64	0.95	0.67	0.66	0.95	0.64	0.55	0.88	0.64	0.66	0.67	0.66	0.71	0.65	0.64
Y ₇	0.91	0.89	0.67	0.80	0.71	0.67	0.87	0.67	0.63	0.85	0.86	0.90	0.87	0.67	0.84	0.80
Y ₈	0.81	0.79	0.75	0.80	0.68	0.76	0.78	0.64	0.70	0.81	0.79	0.80	0.79	0.71	0.77	0.75
Y ₉	0.45	0.45	0.55	0.49	0.60	0.55	0.45	0.41	0.61	0.44	0.48	0.46	0.48	0.63	0.47	0.48
Y ₁₀	0.62	0.61	0.90	0.63	0.65	0.90	0.61	0.54	0.93	0.61	0.63	0.63	0.64	0.71	0.62	0.61
Y ₁₁	0.80	0.83	0.69	0.77	0.68	0.69	0.79	0.67	0.65	0.74	0.80	0.83	0.85	0.70	0.84	0.80
Y ₁₂	0.64	0.62	0.95	0.65	0.65	0.95	0.62	0.55	0.93	0.65	0.65	0.65	0.66	0.71	0.64	0.63
Y ₁₃	0.70	0.69	0.90	0.70	0.67	0.91	0.68	0.54	0.81	0.77	0.70	0.69	0.67	0.69	0.66	0.64
Y ₁₄	0.58	0.57	0.79	0.62	0.64	0.78	0.57	0.51	0.88	0.62	0.60	0.60	0.60	0.71	0.59	0.59
Y ₁₅	0.69	0.67	0.88	0.69	0.66	0.90	0.67	0.59	0.81	0.69	0.69	0.70	0.70	0.72	0.68	0.67
Y ₁₆	0.68	0.67	0.91	0.69	0.66	0.93	0.67	0.58	0.83	0.76	0.69	0.69	0.70	0.71	0.68	0.67

Among the indexes of Henan province’s economic development capability, the Engel coefficient of urban residents is an economic cost index, whose value follows the principle of “the lower the better”, while the other indexes of Henan province’s economic development capability are economic revenue indexes, whose value follows the principle of “the higher the better”. In the indexes of the human resource development in the province, the value of the percentage of the illiterate population in the population aged 15 and above, and the value of the urban unemployment rate follow the principle of “the lower the better”, while the value of the other indexes follows the principle of “the higher the better”. The detailed analysis is as follows:

(1) Overall, in the correlation degree matrix, no correlation degree of any two indexes is less than 0.4; the correlation degrees higher than 0.6 account for more than 85.5%; the correlation degrees over 0.8 account for about 23%. It means there is a medium to high correlation between Henan province’s economic development capability and its human resources development, and more than 50% of the indexes show a positive correlation.

(2) The correlation degrees between each of the indexes Y₁, Y₂ and Y₅ and the relevant indexes of the regional economic development capability of Henan province are mild, and the human resources development of Henan province is faster than that of the province’s regional economic development capability. Therefore, the province’s regional economic development capability can provide good, but not the best, conditions for the province’s human resources development, and thus there is space for further improvement.

(3) More than 50% of the indexes of the regional economic development capability of Henan province have a correlation degree exceeding 0.8 with the indexes Y₃ and Y₄, which shows an ideal correlation between them. It should be noted that the correlation degree between X₁₆ and Y₄ is as high as 0.91, which reflects a very strong correlation between the index of the domestic tourism income and the index of the fiscal expenditure on science and technology per capita in Henan province. It means that such index related to the human resources development may have a relatively strong influence on the regional economic growth of Henan province.

(4) The correlation degree between each of the indexes

X_3, X_6, X_9 and each of the indexes $Y_6, Y_{10}, Y_{12}, Y_{13}, Y_{15}, Y_{16}$ range from 0.81 to 0.95, which shows that there is quite a strong correlation between the three indexes of Henan province's economic development capability, i.e. the annual average population, the persons employed in urban units, and the Engel coefficient of urban residents, and the six indexes of the province's human resources development, including the public library, the urban unemployment rate, the fertility rate, the employment in urban units of professional and technical services, the ratio of the employment of second industries in the total employment, and the ratio of the employment of third industries in the total employment. Therefore, the human resources develop along with the growth of the regional economy, and they promote each other to achieve continuous development, resulting in the fast growth of economy of Henan province.

(5) The correlation degree between Y_9 and all of the indexes of the regional economic development capability of Henan province are around 0.5 on average, which means that the impact of the index of percentage of the illiterate population in the population aged 15 and above on the indexes of the regional economic development capability does not increase with the growth of the economic indexes.

(6) The correlation degree between each of the indexes Y_7 and Y_8 and each of the indexes X_1, X_4, X_{10} are higher than 0.8, but the correlation degree between each of the Y_7, Y_8 and each of the other indexes of the regional economic development capability are lower than 0.8, which shows the correlation between the economic revenue indexes, such as the actual overseas investment, the public fiscal budget expenditure per capita and the post and telecommunications services per capita, and the indexes of the human resources development of Henan province are relatively weaker.

(7) The correlation degree between the index Y_{14} and the index X_9 are higher than 0.8, but the correlation degree between the index Y_{14} and each of the other indexes of the regional economic development capability are lower, which shows that the correlation between the indexes of the regional economic development capability, such as GDP per capita, the construction industry labor productivity per capita, the balance of savings deposits of urban residents at the end of a year, and the indexes of the human resources development are relatively weak.

5. Conclusions

Due to the complex of the regional economic development system, it is very complicate to evaluate the effect of the regional economic development. In this paper, the correlation between the regional economic development capability and the human resources development is chosen as the characteristic variables of the evaluation, an evaluation index system of the correlation degree between a region's economic development capability and such region's human resources development is set up, and the Grey Relational Analysis method is applied, and a model for evaluation of the correlation degree between the regional economic development capability and the human resources development

is developed. It provides an effective method for evaluation of the complicated system of the regional economic development. Then, this correlation degree evaluation model is applied to research the correlation degree between the regional economic development capability and the human resources development in Henan province. The result of the research shows there is a medium to high correlation between Henan province's economic development capability and its human resources development and that the relation between the two needs to be further improved and coordinated on the whole, so that the human resources development can play a key role to accelerate the economic development of Henan province. Such research result confirms theoretically the correlation between Henan province's economic development capability and the province's human resources development, and provides reference to the establishment of an evaluation index system of the correlation degree between a region's economic development capability and its human resources development, and provides a theoretical basis for improvement and promotion of the regional economic development capability and human resources development system and for facilitating better and faster development of the regional development.

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