

Coupling Coordination Degree between Higher Vocational Education and Regional Advanced Industries--a Case Study of Hunan Province, China

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Abstract

Taking the education and economic statistics of 12 cities in Hunan province from 2008 to 2017 as the research object, this paper constructs the evaluation index system of higher vocational education and advanced industry coupled coordination, integrated use of entropy value method, coupling coordination model, analysis and research of higher vocational education and advanced industry coupled coordination evolution rule, using the ArcGIS to coupling coordination degree of spatial visualization expression, and puts forward related suggestions. The results show that: 1) from 2008 to 2017, the average coupling degree C of higher vocational education and advanced industries ranges from 0.4 to 0.5, and the coupling degree of the system as a whole belongs to the antagonistic stage. 2) the mean value of coupling coordination degree D is within the interval of [0.2, 0.3], which is lower than the coupling degree of the system on the whole, and in the stage of moderate disorder on the whole, and the mean value of both shows a certain upward trend. 3) it can be seen from the visual analysis of coupling coordination degree space that the coupling coordination degree between higher vocational education and advanced industries in 12 cities of Hunan province basically matches their actual situation, and the policy of "integration of industry and education" needs to be further promoted.

Keywords

Coupling Coordination Degree, Higher Vocational Education, Advanced Industries.

1. Introduction

The relationship between vocational education and advanced industries originates(HVEAI) from a classic topic, namely "the relationship between education and economy". In the 1960s, American economists Schultz and Becker founded the theory of human capital[1, 2]. In the 1980s, Romer and Lucas studied the role of knowledge and human capital investment in economic growth[3, 4]. In recent years, Hicks and Jacob et al. analyzed the contribution rate of education to economic growth in various countries[5, 6]. Education is regarded as a factor of production equal to land, capital, etc., taking labor productivity, education level, employment rate, unemployment rate, on-the-job training time, initial salary, labor income and other variables as the main indicators of research[7-9], it is proposed that education has a positive correlation with labor quality and regional industrial development level. Vocational education was born in the industrial production background in the 18th and 19th centuries, when the demand for skilled workers soared and traditional apprenticeships were no longer suitable for industrial development[10]. Since then, along with the upgrading of industrial structure,

technological innovation, and the change of market environment factors, the relationship between vocational education and the industry economy changes constantly adjust. Existing studies have shown that high quality of vocational education can provide regional enterprises with high-quality workforce, and can adapt to changing market conditions and technical change[11, 12], its graduates re-employment ability is stronger than the ordinary education students[13]. International organizations such as UNESCO, the organization for economic cooperation and development and the European Union have all given priority to vocational education reform and issued a series of important policy documents, which have to some extent improved the average quality of the labor force in various countries and promoted the global regional economic development [14].

In recent years, as China's economic development has entered a new normal, the transformation and upgrading of industrial structure has become the focus of regional economic development, and enterprises in the region are increasingly demanding high-quality and skilled personnel. Take Hunan province as an example. Hunan province's advanced industries have formed industrial clusters such as construction machinery based in Changsha and rail transit manufacturing based in Zhuzhou, and the overall industrial development ranks the first in China. However, there are still significant problems to be solved, such as lack of independent core technology and low overall technical level. Therefore, Hunan's high-end equipment industry is in urgent need of transformation and upgrading, which puts forward higher requirements for personnel training in Hunan's higher vocational colleges. In order to solve the above problems, the education department of Hunan province proposes to build "double first-class" colleges in the higher vocational education system, including the construction of "first-class vocational colleges and first-class professional groups" into the "double first-class" planning content of the province, so as to improve the quality of personnel training and meet the needs of regional economic growth. The deputy director of the education department pointed out that the "double first-class" professional setting must conform to the industry direction, the teaching staff structure must meet the market demand, the teaching system must meet the enterprise standard, and the ability and quality must be developed comprehensively. In view of this, this paper take 12 cities of Hunan province as the research object and constructs the coupling coordination degree index system of higher vocational education and advanced industry, hoping to provide beneficial reference for the integration development of higher vocational education and advanced industry in Hunan province.

2. Overview of Research Area

Hunan province, referred to as "xiang", is a provincial administrative region of the People's Republic of China, whose capital is changsha. Hunan is located in central China, between 24°38 '-30°08' north latitude and 108°47 '-114°15' east longitude. Its total area is 21,800 square kilometers. By the end of 2018, Hunan province had 13 prefecture-level cities and one autonomous prefecture under its jurisdiction. There are 18 county-level cities, 61 counties, 7 autonomous counties and 36 municipal districts. Hunan province has a permanent population of 68.988 million, a GDP of 3,642.58 billion yuan, a primary industry of 308.36 billion yuan, a secondary industry of 144.535 billion yuan, a tertiary industry of 1,888.87 billion yuan, and a per capita GDP of 52,949 yuan.

3. Data Sources and Research Methods

3.1. Data Sources

Analysis data were obtained from Hunan statistical yearbook, Hunan statistical database of economic and social development, and Hunan higher vocational colleges' data collection

platform from 2008 to 2017. Some missing data were calculated by difference compensation method.

3.2. Research Methods

3.2.1. Construction of Index System

In 2010, the Chinese government proposed to "incorporate vocational education into economic and social development and industrial development plans, so as to make the scale and specialty setting of vocational education meet the needs of economic and social development". In order to evaluate the interaction mechanism between the subsystem of higher vocational education and the subsystem of advanced industry more comprehensively, it is necessary to further subdivide its internal elements. This paper analyzes the degree of coordination between the components of higher vocational education structure at the macro level and the industrial structure, and the evaluation index system of coordinated development of higher vocational education and regional advanced industries is shown in table 1. The index system includes 2 subsystems of higher vocational education and regional advanced industries, divided into 6 criteria layers and 21 index factors[15-18].

Table 1. HVEAI Coupling Coordination Evaluation Index system

System Layer	Criteria Layer	Index Layer	Orientation
Subsystem of Higher Vocational Education	Education Funding	Government Education Funds	positive
		Income from Research and Social Services	positive
		Daily Teaching Fund	negative
		Other Expenditure	negative
	Education Assets	Educational Assets Per Student	positive
		Student-faculty Ratio	positive
		Books Per Student	positive
		Student-computer ratio	positive
	Education Output	Number of Students in School	positive
		Employment Rate	positive
		Number of Patents	positive
		Number of Subjects	positive
Subsystem of Regional Advanced Industrial	Industrial Output	Industrial Production	positive
		Industrial Profit	positive
		Sales Revenue	positive
	Industrial Assets	New Fixed Assets	positive
		Fixed Asset's Utilization Rate	positive
		Number of Employees	positive
	Research Funding	Number of Researchers	positive
		Scientific Research Expenditure	negative
		Expenditure on the Import of Industrial Technology	negative

3.2.2. Entropy Weight Method

Entropy weight method determines the weight according to the information abundance and correlation degree of the index, which avoids the deviation caused by subjective factors to some extent. The model is as follows:

1) Start Data Standardization

$$x'_{ij} = \begin{cases} \frac{x_{ij} - \min\{x_j\}}{\max\{x_j\} - \min\{x_j\}} & \text{(positive efficacy index)} \\ \frac{\max\{x_j\} - x_{ij}}{\max\{x_j\} - \min\{x_j\}} & \text{(negative efficacy index)} \end{cases} \quad (1)$$

Calculate Comprehensive Inex of Each System

$$u_i = \sum_{j=1}^n w_j R_{ij} \quad (2)$$

Where R_{ij} is the proportion of x'_{ij} and w_j is the weight of each index[19, 20].

3.2.3. Coupling Coordination Model

The concept of "coupling" originated from physics and refers to the phenomenon of interaction and mutual influence between two or more systems. The degree of coupling is used to describe the degree of mutual influence between systems. It is now widely used in the research of resources and environment, tourism economy and other aspects. The coupling of higher vocational education and advanced industrial system refers to the process of interaction, interweaving, gradual development from low-level coexistence to high-level sustainable and harmonious development. Coordination refers to the benign relationship between two or more systems with proper coordination and consistency. The degree of coordination measures the degree of harmony between the system or the internal elements of the system in the development process, which reflects the change trend of the system from disorder to order. In view of this, this paper defines the degree of interaction and coordinated development between higher vocational education and advanced industry as the coupling coordination degree between higher vocational education and advanced industry system to reflect the best state of dynamic and orderly development of 2 subsystems, and establishes the model and evaluation index system as follows:

$$C = \left(\frac{u_{1i} \times u_{2i}}{\left[\frac{u_{1i} + u_{2i}}{2} \right]} \right)^{\frac{1}{2}} \quad (3)$$

$$T = \alpha u_{1i} + \beta u_{2i} \quad (4)$$

$$D = \sqrt{C \times T} \quad (5)$$

In the formula: u_{1i} and u_{2i} are the comprehensive score values of higher vocational education subsystem and advanced industrial subsystem of city area I respectively; C is the degree of coupling; T is the comprehensive evaluation index of HVEAI coordinated development; D is coupling coordination degree; $\alpha, \beta \in (0,1)$ are undetermined coefficients and $\alpha + \beta = 1$. Values are determined by the average weight method. $C \in [0,1]$, the closer C is to 1, the greater the coupling

degree, indicating the higher the degree of orderly development of the system; On the contrary, the degree of orderly development is lower. The C value division, (0, 0.3] low coupling, (0.3, 0.5] antagonism stage, (0.5, 0.8] running-in stage, (0.8, 1] highly coupled. $D \in [0,1]$, when D is large, it indicates that HVEAI coupling coordination degree is high and the overall development degree is high, and vice versa. The evaluation standard of HVEAI coupling coordination degree, namely the classification level [21, 22], is shown in table 2:

Table 2. Classification of HVEAI Coupling Coordination

Number	Value	Type
1	0.00~0.19	Serious Discoordination
2	0.20~0.29	Moderate Discoordination
3	0.30~0.39	Mild Discoordination
4	0.40~0.49	Slightly Discoordination
5	0.50~0.59	Barely Coordination
6	0.60~0.69	Low Coordination
7	0.70~0.79	medium Coordination
8	0.80~1.00	Excellent Coordination

4. Empirical Analysis

4.1. Evolution Characteristics

According to figure 1, the average value of HVEAI coupling degree C in each city of Hunan province from 2008 to 2017 is within the range of [0.4~0.5], indicating that the HVEAI coupling degree is in the antagonistic stage and tends to be mildly coupled. The mean value of coupling coordination degree D is in [0.2~0.3], which is lower than the coupling degree on the whole and in the stage of moderate Discoordination. From 2008 to 2017, the mean values of coupling degree C and coupling coordination degree D of HVEAI showed a certain upward trend, indicating that the coordinated development level of higher vocational education and advanced industries in most cities of Hunan province has been improved.

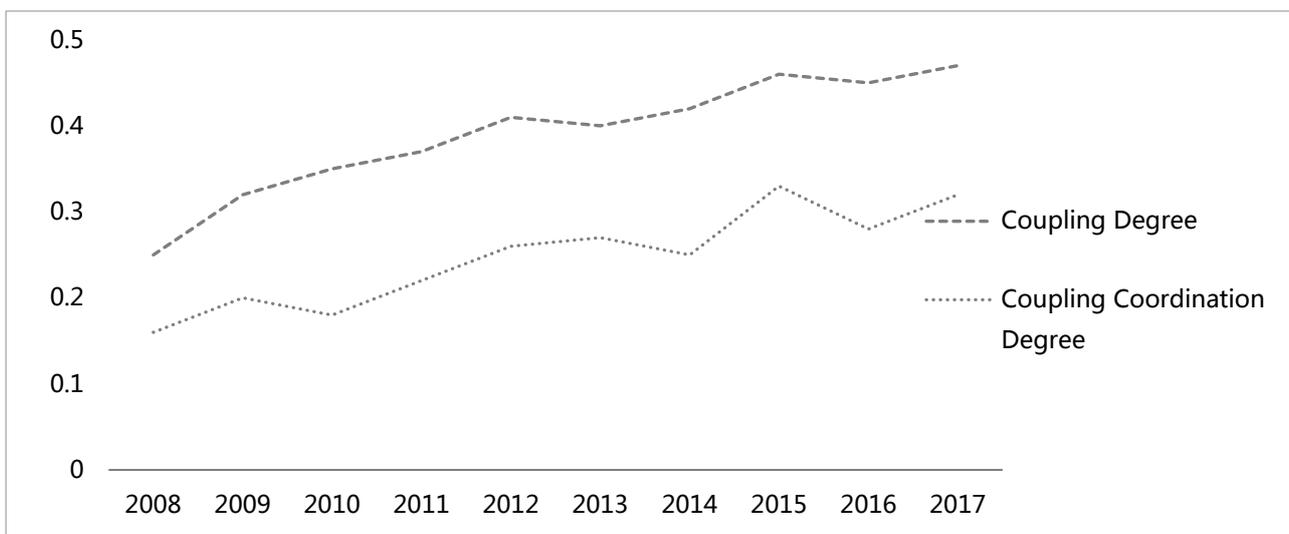


Fig 1. Average of Coupling Degree and Coupling Coordination Degree

Based on EXCEL software, the radar map of coupling coordination degree D of higher vocational education and advanced industry in each city of Hunan province in 2008, 2013 and 2017 was drawn (fig. 2).

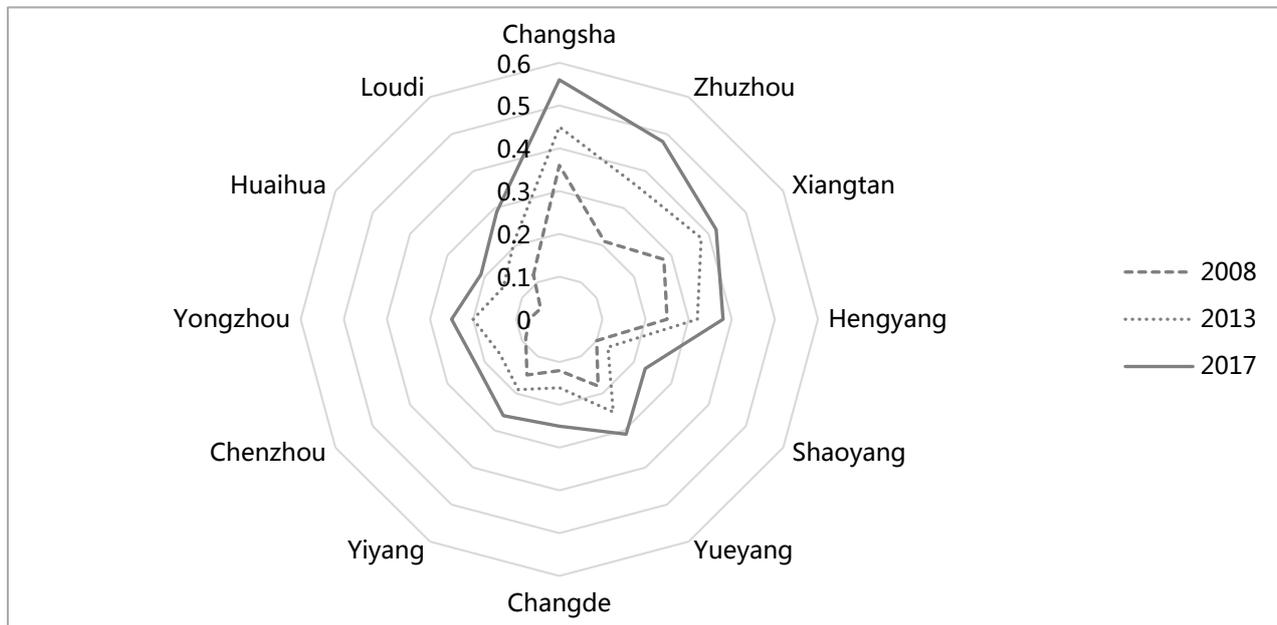


Fig 2. Radar Map of HVEAI Coupling Coordination Degree in Hunan

As can be seen from fig. 2:

Due to the rise of the concept of industry-education integration in higher vocational education, from 2008 to 2017, the coupling coordination degree of HVEAI in each city of Hunan province increased year by year, but the overall level was relatively low, which is in urgent need of further improvement.

From 2008 to 2017, the index of Changsha has been far higher than that of other cities, which indicates that Changsha is in an absolute leading position in Hunan province in terms of higher vocational education and advanced industry, and its HVEAI has reached a barely coordinated stage, forming a virtuous circle of mutual promotion.

The higher vocational education of Hunan province and advanced industrial concentrated in Changsha, Zhuzhou, Xiangtan, Hengyang, namely "Changzhutanheng area", at the end of 2016, national ministry on November 30, formal approval Changzhutanheng to carry out the "made in China 2025" pilot demonstration urban agglomeration is created, the next four regional higher vocational education teaching integration will accelerate the development of production, which will help to improve regional competitiveness of Hunan province, to speed up the pace of "central rise", more of the "made in China 2025" has profound role and significance.

Yueyang is the only bright spot outside the Changzhutanheng area. Its petrochemical industry has achieved certain achievements in cooperation with higher vocational colleges and enterprises, while the development of Shaoyang, Huaihua, Chenzhou and other cities is seriously inadequate, which is consistent with the overall layout of education and advanced industries in Hunan.

4.2. Regional Spatial Pattern

In order to understand more intuitively the spatial evolution of HVEAI coupling coordination degree in each city of Hunan province, this paper USES ArcGIS10.2 software to visualize the

above results according to the classification of coupling coordination degree (table 2), as shown in fig. 3.

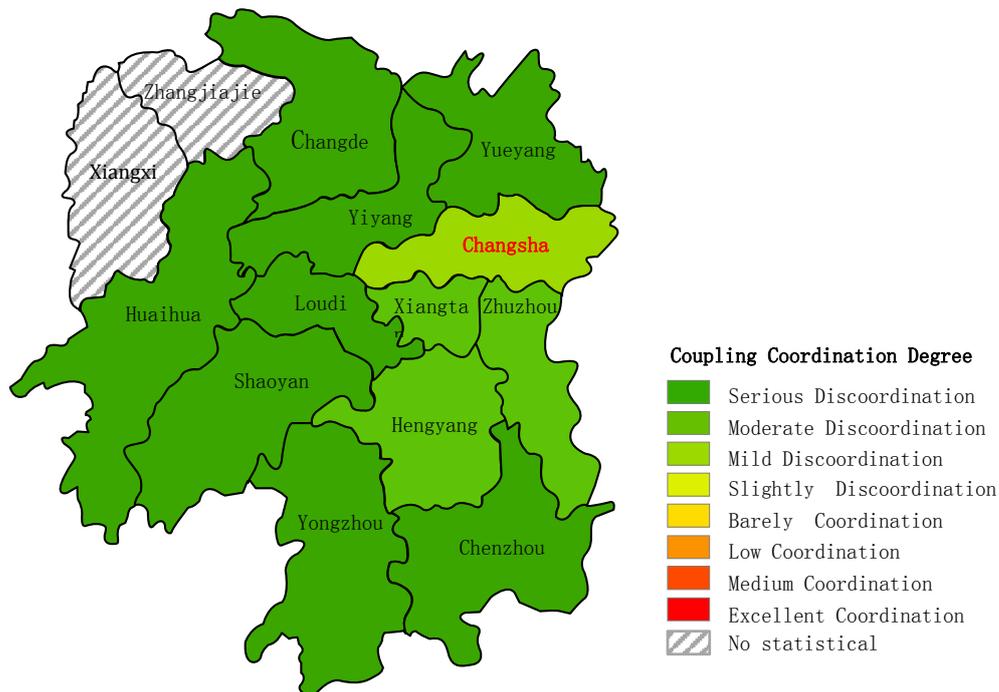


Fig 3(a). HVEAI Coupling Coordination Degree of Hunan in 2008

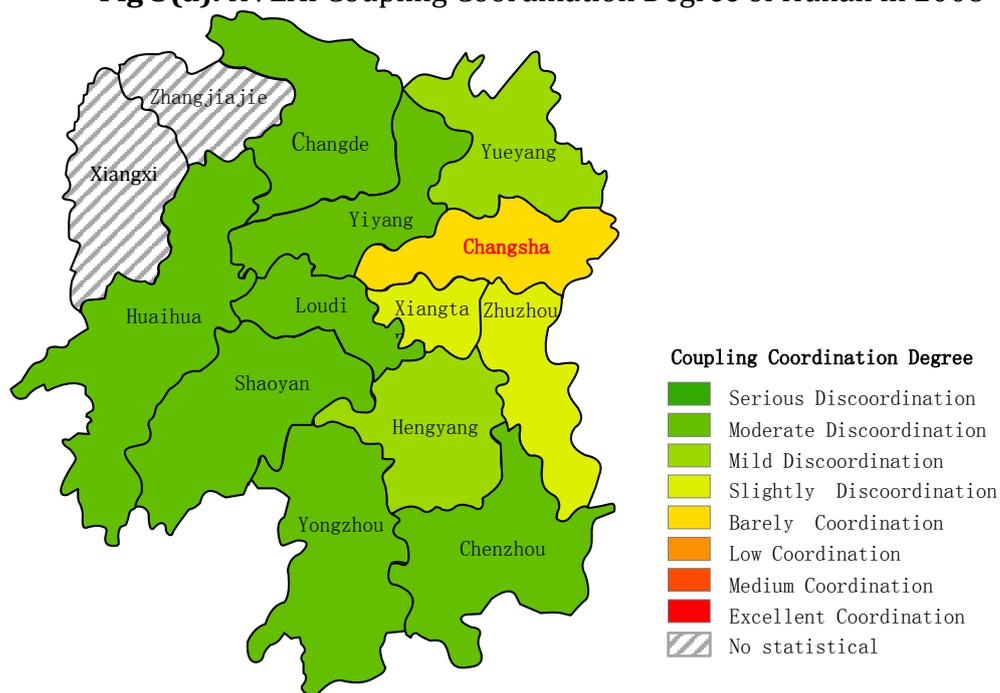


Fig 3(b). HVEAI Coupling Coordination Degree of Hunan in 2017

According to fig. 3(a) and fig. 3(b), the coupling coordination degree of higher vocational education and advanced industry in each city of Hunan province in 2008 is within the range of [0.12, 0.36], involving three levels. Among them, HVEAI in Changsha is in the stage of mild discoordination; In Zhuzhou, Xiangtan and Hengyang, HVEAI is moderate discoordination while other cities are serious discoordination. This shows that in 2008, the concept of "integration of industry and education" in higher vocational colleges is still in its infancy, and the development of advanced industries has not been widely paid attention to. However, in 2017, the coupling coordination degree of HVEAI in each city of Hunan province is within the range of [0.15, 0.56].

HVEAI in Changsha takes the lead to reach the barely coordinated stage, HVEAI in Xiangtan and Zhuzhou reaches the Slightly discoordination stage, and HVEAI in Yueyang and Hengyang is mildly discoordination. In addition, there are 7 cities' HVEAI are moderate discoordination, such as Changde, Yiyang, Yongzhou, Chenzhou, Loudi, Huaihua and Shaoyang.

5. Conclusion

Based on the data background from 2008 to 2017, this paper constructs the coupling coordination evaluation index system of higher vocational education and advanced industry by taking 12 cities of Hunan province as the research object. By comprehensively applying entropy value method and coupling coordination model, this paper analyzes the coupling coordination evolution law of higher vocational education and advanced industry in the research area, and draws the following conclusions:

According to the evaluation results of coupling coordination degree, the average coupling degree C between higher vocational education and advanced industries in 12 cities of Hunan province from 2008 to 2017 ranges from 0.4 to 0.5, and the coupling degree belongs to the antagonistic stage, which is still some distance from the ideal level.

From 2008 to 2017, the mean value of coupling coordination degree D between higher vocational education and advanced industries in 12 cities of Hunan is located in $[0.2, 0.3]$, which is lower than the coupling degree and in the stage of moderate discoordination on the whole. Moreover, from 2008 to 2017, the mean value of coupling degree C and coupling coordination degree D of the complex system show a certain upward trend. After ten years of evolution, the distribution of coupling coordination degree of 12 cities are more concentrated and basically lies in the stage of moderate discoordination.

According to the visual analysis of coupling coordination degree, HVEAI in 12 cities of Hunan province basically matches their actual situation, so "integration of industry and education" needs to be further improved.

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