

Research on Coupling and Coordinated Development of High-Tech Service Industry and Manufacturing Industry Based on Big Data Analysis

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Abstract. The deep integration of high-tech service industry and manufacturing industry is an important trend of modern economic growth and industrial development. At the same time, with the step into the information society, the application of big data and information technology is gradually extensive. To investigate the coupling degree of high-tech service industry and manufacturing industry in Liaoning Province, this paper analyzes the panel data of Liaoning Province from 2013 to 2019 through big data and information technology, constructs the evaluation index system of the two industries, and evaluates it through entropy weight method. Secondly, the coupling coordination degree model is established, and the integration degree index and grade of high-tech service industry and manufacturing industry are analyzed. The empirical results show that there is integration between high-tech service industry and manufacturing industry in Liaoning Province, but the coordination level is not stable. Finally, combined with the empirical research results, this paper puts forward some policy suggestions to improve the integrated development level of high-tech service industry and manufacturing industry.

Keywords: Information Technology; high-tech service industry; Manufacturing; Industrial convergence

1 Introduction

Information technology is an important product of modern science and technology. Using computer technology to process information data has become an important technical means. ^[1] With the continuous improvement of our industrial level, the social drive of economic structure transformation is forming. The service-oriented economic structure has become the significant economic feature of the developed province, and the expansion of service demand and modern manufacturing industry put forward higher requirements. ^[2] Therefore, the big data information technology should be used to analyze the industry, to enable the coordinated and efficient development of manufacturing industry and service industry.

Therefore, based on information technology, this paper adopts coupling coordination degree model and econometric analysis method to evaluate the collaborative development of high-tech service industry and manufacturing industry in Liaoning Province, and analyzes the coupling and coordinated development of the two systems, so as to provide decision-making reference for promoting industrial transformation and upgrading of Liaoning Province and high-quality economic development.

2 Evaluation on the development level of high-tech service industry in Liaoning Province

2.1 Construction of index system

Based on following the principles of integrity, simplicity, hierarchy, comparability and dynamics of the index system, this paper refers to the evaluation index system of high-tech service industry established by Fu Weizhong et al. (2017) and Li Pan (2020).^[3]

2.2 Evaluation on the development level of high-tech service industry in Liaoning Province

This paper uses entropy weight method to analyze and evaluate the high-tech service industry in Liaoning Province.

2.2.1 Comprehensive evaluation of the development level of high-tech service industry in Liaoning Province

Based on the calculation of entropy and weight, the development evaluation value of high-tech service industry in Liaoning Province is calculated, and the comprehensive development score of high-tech service industry in Liaoning Province is obtained, as shown in Table 1

Table 1. Comprehensive score (owner-draw)

Year	Score	Year	Score
2013	0.609	2017	0.367
2014	0.437	2018	0.555
2015	0.384	2019	0.379
2016	0.339		

In general, the highest score from 2013 to 2019 was in 2013, and the lowest score was in 2016, indicating that the development of high-tech service industry in Liaoning Province was still in a downturn stage at the present stage.

3 The symbiotic relationship between high-tech service industry and equipment manufacturing industry in Liaoning Province

3.1 Construction of evaluation index system

Based on the evaluation index of high-tech service industry, this paper establishes the evaluation index system of high-tech service industry and manufacturing industry and calculates the comprehensive evaluation of high-tech service industry and manufacturing industry in Liaoning Province.

3.2 Construction of coupling coordination degree model

(1) The comprehensive score of manufacturing industry $f(x)$ and high-tech service industry $g(y)$ of Liaoning Province were calculated respectively. The calculation formula is as follows:

$$f(x) = \sum_{i=1}^5 \omega_i \bullet x_{ij} \quad (1)$$

$$g(x) = \sum_{i=1}^4 \omega_i \bullet y_{ij} \quad (2)$$

(2) Establish the coupling degree model. The coupling function expression of the manufacturing evaluation system and the high-tech service evaluation system is as follows:

$$C = 2 \sqrt{\frac{f(x) \times g(y)}{(f(x) + g(y))^2}} \quad (3)$$

Where $f(x)$ and $g(y)$ are the score values of the manufacturing evaluation system and the high-tech service evaluation system respectively, and C is the coupling degree.

(3) Construct the coupling coordination degree model of high-tech service industry system and manufacturing industry system of Liaoning Province:

$$D = \sqrt{C \times T} \quad (4)$$

$$T = \alpha f(x) + \beta g(y) \quad (\alpha = 0.5, \beta = 0.5) \quad (5)$$

(4) The coupling coordination degree is divided into different intervals, which can be used as the evaluation criteria of different coupling coordination degrees.

Table 2. The criterion of coupling coordinated development (owner-draw)

Zone of coordinated development	Coupling coordination type
$0 \leq D < 0.2$	Extreme imbalance
$0.2 \leq D < 0.3$	Moderate disorders
$0.3 \leq D < 0.4$	Mild disorder
$0.4 \leq D < 0.5$	On the verge of disorder
$0.5 \leq D < 0.6$	The basic coordinate
$0.6 \leq D < 0.7$	Primary coordination
$0.7 \leq D \leq 1.0$	High coordination

3.3 Evaluation on the integration degree of high-tech service industry and manufacturing industry in Liaoning Province

On the whole, we measure the coupling and coordination degree of China's high-tech service industry and manufacturing industry. The high-tech service industry and manufacturing industry in Liaoning Province are integrated, but the coordination level is not stable.^[4] The coupling degree between manufacturing industry and high-tech services will remain around 0.5 and 0.6 after 2015. Further analysis of the coupling and coordination degree of the industry shows that the highest coupling degree was 0.85 in 2013 and the lowest was 0.533 in 19, which means that the highly coordinated state gradually declined to the basic coordinated state.

Table 3. Integration degree of high-tech service industry and manufacturing (owner-draw)

Year	The coupling of C	Coupling coordination degree D	Coordination level
2013	0.990	0.839	High coordination
2014	0.987	0.717	High coordination
2015	0.995	0.590	The basic coordinate
2016	0.959	0.503	The basic coordinate
2017	0.985	0.554	The basic coordinate
2018	0.951	0.635	Primary coordination
2019	0.988	0.569	The basic coordinate

From the perspective of manufacturing industry, from 2013 to 2019, the petroleum processing, coking and nuclear fuel processing industries and high-tech service industries reached a primary coordination state for seven consecutive years. The weakest integration is metal products, machinery and equipment repair industry and chemical fiber manufacturing industry, which need to be further improved through integration with high-tech service industry.

Table 4. Integration index and level of high-tech service and manufacturing (owner-draw)

year	Petroleum processing, coking and nuclear fuel processing industries	Automobile Manufacturing Industry	Printing and recording media reproduction	Metalwork, machinery and equipment repair industry
2013	0.628●	0.556◆	0.347^	0.364^
2014	0.629●	0.565◆	0.335^	0.322^
2015	0.649●	0.562◆	0.323^	0.300^
2016	0.660●	0.571◆	0.286★	0.354^
2017	0.661●	0.579◆	0.307^	0.309^
2018	0.675●	0.567◆	0.306^	0.308^
2019	0.682●	0.583◆	0.311^	0.316^
year	Cultural education, industrial art, sports and entertainment manufacturing	Chemical fiber manufacturing	Ferrous metal smelting and calendaring industry	Food manufacturing Industry
2013	0.360^	0.317^	0.644●	0.409※
2014	0.359^	0.313^	0.641●	0.405※
2015	0.330^	0.311^	0.614●	0.383^
2016	0.278★	0.305^	0.583◆	0.366^
2017	0.296★	0.313^	0.573◆	0.359^
2018	0.303^	0.304^	0.556◆	0.362^
2019	0.308^	0.314^	0.569◆	0.362^

★ Moderate disorders ^ Mild disorder ※ On the verge of disorder ◆ The basic coordinate ● Primary coordination

4 Policy Suggestions

(1) Promoting technological innovation and industrial integration. We should take technological innovation as the core driving force for industrial development, establish a technological innovation system, and accelerate the application of scientific and technological achievements.

(2) We will relax government regulation and create an environment for industrial integration. The country should improve the market access mechanism and create a good macro environment for industrial integration.

(3) To lead industrial agglomeration and build high-tech service industry agglomeration area. Relying on the advantages of Liaoning, we will cultivate a number of high-tech service industry clusters with strong innovation ability.

5 Conclusions

By establishing the index system and the coupling degree evaluation model, this paper measures the development level of high-tech service industry and its integration with manufacturing industry in Liaoning Province. The main conclusions are as follows: In recent years, the number of high-tech service enterprises in Liaoning Province has decreased significantly, and the development of high-tech service enterprises has entered a bottleneck period.^[5] At the same time, the high-tech service industry and manufacturing industry in Liaoning Province are integrated, but the coordination level is not stable. Therefore, in the future work, how to integrate the high-tech service industry into the manufacturing industry to drive the economic development of Liaoning is an important task of economic development.

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