Research on Anhui Information Manufacturing Industry Based on Average Influence Distance

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Abstract

With the transformation and upgrading of Anhui economy and the acceleration of industrialization, the role of information manufacturing industry in the process of economic development is becoming more and more important. Based on the data processing of input-output table of Anhui Province in 2012, this paper introduces the average communication length (APLS) Matrix among different departments, and combines the theory of economic distance, industrial association and minimum support tree to analyze the information manufacturing industry chain of Anhui Province in a more comprehensive and multi-dimensional way. After calculating the economic distance, it is found that most of the economic distance between industries is two-step dependence, and the distance between industries is far. The calculation of the minimum support tree shows that scientific research and technical services are in a special position in the information manufacturing industry chain. Finally, we put forward countermeasures and suggestions to improve the competitiveness of the whole industry chain of information manufacturing industry in Anhui Province.

Keywords

Information manufacturing industry; Input-output table; Average economic distance; Minimum support tree.

1. Introduction

With the acceleration of industrialization and industrial informatization in China, information manufacturing plays an increasingly important role in economic development.With the implementation of innovation driven strategy in Anhui Province, information manufacturing industry has become an important engine for the implementation of innovation driven, manufacturing province construction, transformation and upgrading development in Anhui Province. The electronic information industry in Anhui Province is in the period of high-speed growth and rising. It is facing not only the development opportunities brought by the new generation of information technology revolution and industrial reform, but also the challenges of complex and changeable external environment and economic situation, and increasingly fierce regional competition. Domestic scholars use a variety of measurement and statistical methods to analyze the information manufacturing industry chain in China. According to China Statistical Yearbook 2018 and Statistical yearbook of anhui province 2018, In 2018, the industrial added value of the scale of electronic information manufacturing industry in anhui province increased by 22.2%, higher than that of the whole province and the same industry in the whole country by 12.9 percentage points and 9.1 percentage points, and its proportion in the whole province increased by 0.3 percentage points compared with the previous year,which was 12.9 and 9.1 percentage points higher than the industry of the whole province and the same industry of the whole country, accounting for 0.3 percentage point higher than that of the previous year.

Sun Jiuyu (2019) [1] calculated 42 industrial sectors in the 2012 input-output table of Hebei Province and the 2012 national input-output table, calculated the influence coefficient, sensitivity coefficient and other indicators, and compared the factors of the whole country and Hebei Province, and comprehensively analyzed the current situation of the integration of equipment manufacturing

industry, science and technology industry and information industry in Hebei Province was analyzed, and some suggestions were put forward to solve the problems existing in the integration of industry in Hebei Province, in order to provide help for the deep integration of equipment manufacturing industry in 2012 of Hebei Province with high technology such as Internet, big data and artificial intelligence.Van ke, Liu Yaobin, et al. (2019) [2] studied the coordinated development of the new generation of information technology industry in the industrial chain of Hubei, Hunan and Jiangxi. Using the input-output model of Leontief, the paper first analyzed the backward (forward) direction of the new generation of information technology industry. The direct and indirect related industries are analyzed quantitatively to build the industrial chain of the new generation of information technology industry, and the main related departments of the new generation of information technology industry chain are obtained. Then, by calculating the average value matrix F of Ghosh inverse matrix and Leontief inverse matrix, we measure the cost driving effect and demand pulling effect among the main related departments of the industrial chain in Hubei, Hunan and Jiangxi. Song Gang, Tang Lingyun, etc. (2018) [3] Based on the input-output tables of Liaoning Province in 2002 and 2007, a comprehensive and detailed analysis was made on the relationship between the equipment manufacturing industry and the producer service industry in Liaoning Province as well as the ripple effect. Ni Hongfu and Ji Cheng [4] (2020) used China's input-output table data to conduct an in-depth analysis of the changes and development trend of consumption structure, and mainly compared the consumption structure data in the input-output tables of China and the United States from 1971 to 2017, from the perspective of the per capita GDP of 10000 US dollars in the United States. This paper analyzes the upgrading direction and potential of the consumption structure of Chinese Residents Based on the consumption structure and trend.

To sum up, domestic scholars mainly use input-output model to study the development of information manufacturing industry chain from the simple correlation level. Few scholars introduce the dimension of "economic distance" to study the information manufacturing industry chain from the regional level. In this paper, the input-output method is used to fully consider the economic impact of various departments, and through the economic distance to form a complete information manufacturing industry chain to study the current situation and existing problems of the development of information manufacturing industry in Anhui Province, and based on this, relevant policy recommendations are put forward.

2. Research Objects and Methods

2.1 Research Object

This paper studies the development of information manufacturing industry and its related industries from the basic industry chain and extended industry chain of information manufacturing industry. Compared with other related industries, this paper studies the development of information manufacturing industry chain from three aspects: the intensity of Industry Association, the economic distance between industries, and the minimum support tree of agricultural industry chain. Due to the time lag in the preparation of input-output table, this paper analyzes the input-output table of Anhui Province in 2012.

2.2 Research methods

Input-output analysis is a quantitative method to study the interdependence between industries, which can well show the correlation between industries, and has a unique role in the study of industrial chain.[5] Because this paper focuses on the study of inter regional information manufacturing industry chain, it only analyzes the information manufacturing industry chain of Anhui Province, and the lag of the preparation time. Based on the input-output table of Anhui Province in 2012, it analyzes the information manufacturing industry chain of Anhui Province in 2012.According to the difference between demand driven and supply driven, input-output model includes Leontief Model and Ghosh model. Leontief Model reflects the relationship between total output and final demand. Leontief's model is as follows:

$$X = (I - A)^{-1} f \quad (1)$$

In formula (1), X is the total output column vector of each department; a is the input coefficient matrix, also known as the direct consumption coefficient matrix f is the final demand column vector; (I-A) - 1 is the famous Leontief inverse matrix, recorded as l, its I j element indicates that the final demand of the j department increases by one unit, and the output change of the I department changes.

The Ghosh model reflects the relationship between total output and initial input. The model is as follows:

$$X^{'} = v(I-B)^{-1} \quad (2)$$

In formula (2), V is the initial input row vector of each department; B is the output coefficient matrix, also known as the direct distribution coefficient matrix, (I-B) - 1 is the Ghosh inverse matrix, which is recorded as G, and the i and j element indicates the initial input of the I Department is increased by one unit, and the output of the j department is increased. The l-matrix and G-matrix reflect the size of complete industrial association, including both direct association and indirect association, but the position of direct association and indirect association in the total association is not considered. Taking the demand driven model as an example, this paper illustrates how the pull effect between industries accumulates into a complete effect. The cumulative effect is represented by the cumulative step size, which is also called the economic distance.

$$v_{ij} = \{1A_{ij} + 2[A^{2}]ij + 3[A^{3}]_{ij} + ...\} / \{A_{ij} + [A^{2}]_{ij} + [A^{3}]_{ij} + ...\} \quad (3)$$

Formula (3) shows the economic distance between the final demand of J industry and the total output of I industry. Obviously, $v_{ij} \geq 1$. A large economic distance means that the relationship between the two departments is dominated by indirect relationship, whereas the direct impact is dominant.The left side of formula (3) is the ij element of the following distance matrix v.

$$V = L(L-I)/(L-I) = G(G-I)/(G-I) \quad (4)$$

In formula (4), I is the unit matrix, which can also be defined by the Ghosh inverse matrix. At this time, the I j element represents the influence distance of the cost change of I industry on the cost of J industry. In addition to the economic distance matrix, we need to define an industry correlation matrix F:

$$F = [(L-I) + (G-I)]/2 \quad (5)$$

In formula (5), the f matrix includes Leontief inverse matrix and Ghosh inverse matrix, indicating that the industry association includes both demand and supply sides.Unit matrix I is subtracted from both matrices to eliminate the effect of initial injection.Another threshold is introduced, which can eliminate the connection between industries with small total correlation effect. On this basis, a matrix s is constructed, and the ij element of the matrix is:

$$S_{ij} = \text{int}(V_{ij}) f_{ij} \geq a$$

$$0 < f_{ij} < a \quad (6)$$

In formula (6), int is the rounding symbol, which can be rounded. In this study, int is rounded down; a is the threshold value.

3. Empirical Results and Analysis

The input-output table of Anhui Province in 2012 is selected from the statistical yearbook of Anhui Province. The table is collectively called the input-output table of 42 departments, which is used for analysis. The economic distance between departments is calculated by formula (3) and formula (4), and the result is shown in Table 1.

Table.1 average influence distance and S matrix of seven departments in Anhui Province (in brackets)

project	Paper printing and cultural and sports goods	Chemical products	Electrical machinery and equipment	Information manufacturing	Instruments and Apparatuses	Information transmission, software and information technology services	Scientific research and technical services	Row averaging
Paper printing and cultural and sports goods	1.43(1)	1.63(2)	1.57(2)	1.84(2)	1.86(0)	1.48(0)	1.02(1)	1.55
Chemical products	1.63(2)	2.01(1)	1.48(2)	1.97(2)	2.22(0)	2.03(0)	1.85(0)	1.88
Electrical machinery and equipment	1.57(0)	1.89(0)	2.23(1)	2.16(0)	2.07(0)	1.89(0)	1.94(0)	1.96
Information manufacturing	2.01(0)	1.78(0)	2.21(2)	1.98(1)	1.79(1)	2.20(1)	2.15(1)	2.02
Instruments and Apparatuses	1.67(0)	2.01(0)	1.98(0)	2.13(1)	2.04(0)	1.67(0)	1.95(0)	1.92
Information transmission, software and information technology services	1.59(0)	1.73(0)	1.82(0)	2.01(0)	2.08(0)	1.98(1)	1.79(0)	1.86
Scientific research and technical services	1.89(0)	1.91(0)	2.11(0)	2.17(0)	1.79(0)	1.87(0)	1.96(0)	1.97
Column averaging	1.68	1.85	1.91	2.04	1.98	1.87	1.53	

It can be seen from table 1 that: first, of the 49 economic distances, 34 are less than 2, accounting for 69.39%, indicating that interdepartmental dependence is mainly direct dependence, and the economic distance of the Department itself is also mainly direct dependence. Second, the economic distance of the information manufacturing industry is 1.98, which indicates that the information manufacturing industry itself is mainly directly related. The information manufacturing industry not only affects the industry through the feedback of other industries, but also has a direct impact on the industry through its own development. Thirdly, the economic distance between paper printing, cultural and sporting goods and chemical products is less than 2.0, which shows that the feedback effect between paper printing, cultural and sporting goods and chemical products through other industries is lower than the multiplier effect within the industry.[6]

The longest forward economic distance of information manufacturing industry mainly includes the following departments, from information manufacturing industry to information transmission, software and information technology service industry, from information manufacturing industry to electrical machinery and equipment; the longest backward economic distance of information manufacturing industry mainly includes the following departments, from information manufacturing industry to electrical machinery and equipment, from information manufacturing industry to scientific research and technical services. The role of each department is determined by the average number of rows and columns. The average number of rows represents the average number of forward economic distance of each row. The average number of information manufacturing industry is the largest, followed by scientific research and technical services. This shows that information manufacturing industry and scientific research and technical services are located at the first end of regional economic production chain, and the forward direction of information manufacturing industry and scientific research and technical servicesThe dependence of association is mainly indirect. Among the column average of backward economic distance of each department, the largest is information manufacturing industry and instrument industry, and the dependence of backward correlation between information manufacturing industry and instrument industry is also indirect.

In order to make the inter industry information more detailed, this paper calculates the F, V and s matrices respectively through formulas (4), (5) and (6), and draws the industrial chain diagram of information manufacturing industry. Firstly, the F and V matrices of 42 × 42 are calculated. Then, the threshold a = 1 / 21 is introduced to calculate the S matrix. Third, mark the i-th element in the first row and column as 0.Finally, delete row I and column I to get the matrix.

According to the S matrix, draw a detailed industrial chain diagram of information manufacturing industry, as shown in Figure 1.In order to study the position of information manufacturing industry in the whole industrial chain and the relationship between agriculture and other industries in detail, this paper only retains the relationship between information manufacturing industry and other industries, neglecting the relationship between other industries, and does not mark the direction and arrow between other industries in the industrial chain diagram.

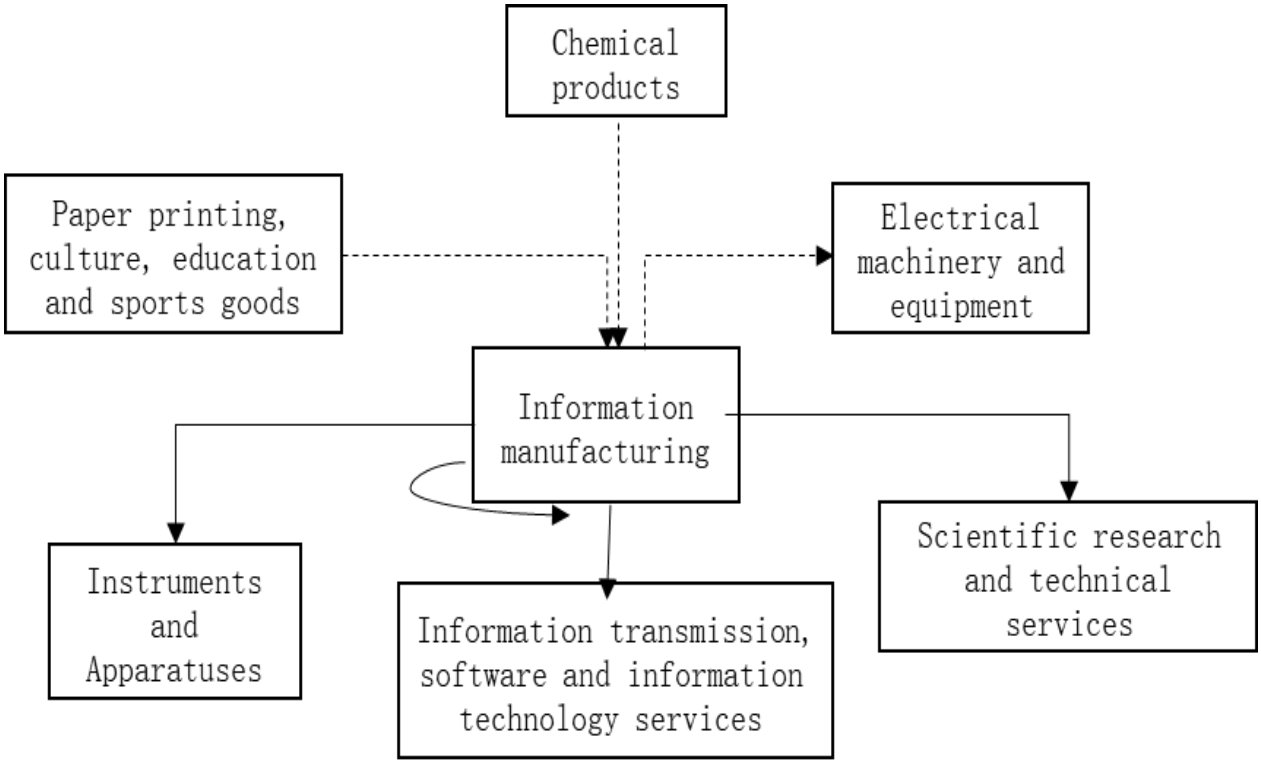

Fig.1 industrial chain diagram of information manufacturing industry

It can be seen from the figure that: first, the economic distance between the industries of information manufacturing amateur chemical products, paper printing, cultural and sports goods, electrical machinery and equipment is greater than 2.0, indicating that the multiplier effect within the industry is less than the feedback effect. The economic distance between information manufacturing industry and other industries is less than 2.0, which means that the multiplier effect in the industry is greater than the feedback effect in the industry. Secondly, the economic distance between information manufacturing industry and itself is less than 2.0, which shows that its development has a direct impact on itself. Third, chemical products, paper printing, culture, education and sports goods are forward related industries in the information manufacturing industry, while electrical machinery and equipment, instruments and meters, information transmission, software and information technology services, scientific research and technology services are backward related industries in the information manufacturing industry.

In order to make the industrial chain of information manufacturing industry clearer and find the position of other industries in the industrial chain of information manufacturing industry, use matlab to calculate the minimum support tree of information manufacturing industry and get Figure 2.As can be seen from Figure 2, the industry has been extended due to electrical machinery and equipment.

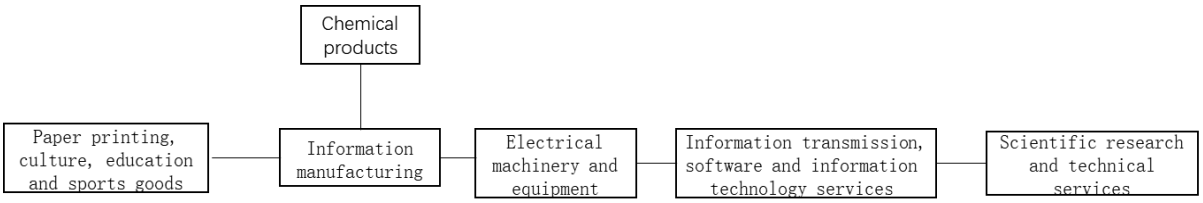

Fig. 2 minimum support tree of information manufacturing industry in Anhui Province

4. Conclusions and Suggestions

4.1 Conclusion

Through the identification of the information manufacturing industry chain in Anhui Province, we can see that the economic distance between departments, industrial association and the minimum support tree all play an important role. In order to have a clear understanding of the industrial chain of information manufacturing industry in Anhui Province, this paper analyzes the input-output table of Anhui Province in 2012, and finds that the economic distance between information manufacturing industry and other industries is mostly 1, which has a direct impact on each other, that is, the cumulative effect of industrial association is faster. Through the analysis of the input-output table of 42 departments, there are three forms of industrial association, namely forward dependence, backward dependence and interdependence. The forward dependent industries of information manufacturing industry are paper printing, cultural and educational sports goods and chemical products. The backward dependent industries of agriculture are electrical machinery and equipment, information transmission, software and information technology services, scientific research and technical services. Information manufacturing industry extends the industrial chain through electrical machinery and equipment, and promotes the rapid development of scientific research and technical service industry.

4.2 Suggestions

According to the above research results and conclusions, the following policies and suggestions are put forward: first, increase the investment in paper printing, culture, education and sports goods. The influence of paper printing and cultural, educational and sports goods on the information manufacturing industry is indirect. Through the increase of investment, it can not only promote the rapid development of education, but also promote the development of information manufacturing industry. Second, accelerate the integration and development of chemical products, information manufacturing, electrical machinery and equipment. The impact between chemical products, electrical machinery and equipment is direct. Accelerating the integration of the three can not only enhance the influence of information manufacturing industry itself, but also provide better support for scientific research and technical services. Third, we should implement different industrial agglomeration policies for different industries. For industries with an economic distance of less than 2.0, they can develop cooperatively through the policy of agglomeration industry; for industries with an economic distance of more than 2.0, they should implement the policy of decentralization industry, so that they can drive the industrial development of the whole region from multiple levels and angles.

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