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Industrial Linkages Analysis of China's Information Industry

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Abstract

This paper takes China's eight input-output tables from 2002 to 2018 as the research data, introduces the influence coefficient, sensitivity coefficient and corresponding weighted linkages to measure the national economic impact of the information industry, and empirically explores the development of the information industry. It also analyzes the skewness, kurtosis and change trend of weighted and unweighted industrial linkages. Finally, it compares the impact of competitive model and non competitive model on the measurement of information industry linkages.

Keywords

Information industry, Industry linkages, Weight, Skewness, Kurtosis, Non competitive model.

1. Introduction

As a strategic, basic and leading pillar industry of a country, information industry has high added value, high linkages and obvious market-oriented characteristics. Under the background of economic globalization, the rapid technological innovation of the information industry and the wide integration promote it to play a more and more important role in the national economy and even the world economy. The Information industry plays a key role in promoting the rapid development of national economy, improving people's life, making it more intelligent, and enhancing international competitiveness.

Information industry refers to the industry specializing in the production, collection, sorting and transmission of information and the manufacture of various information equipment. In this paper, the information industry is classified in a narrow sense, which refers to the Electronic product manufacturing industry and information service industry.

Compared with other developed countries, the development of information technology in China started late, but in recent years, with the continuous breakthrough of scientific research and technology, China ranks among the forefront of the world. According to the statistics of *the 2018 China* Internet *industry development report*, the scale of China's information consumption reached 5 trillion yuan in 2018, with a year-on-year increase of 11%, and the proportion in GDP increased to 6%. In 2018, the consumption scale of Information services exceeded that of Electronic products for the first time, indicating a structural change in China's information consumption market. The information industry will maintain the growth trend in the future. It is of great significance to study the development trend and characteristics of its industrial linkages. Input-output analysis is usually used to study industrial linkages.

The input-output method was first proposed by the American economist Leontief in 1936. It is a method to describe the quantitative dependence between various sectors of the national economy through a system of linear equations based on the general equilibrium theory [1]. Rasmussen (1956)

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proposed industrial linkages measurement method based on Leontief inverse matrix [2]. However, he only considered the demand relationship in the input-output table. Subsequently, Augustinovics (1970) introduced the Ghosh inverse matrix into the measurement of industrial association to make up for the gap of measuring industrial linkages based on supply relationship. [3] The above only considers the industrial linkages measurement does not include the impact of economic scale on the industry. By comparing the weighted and unweighted results, Hazari(1970) empirically analyzed the need to select appropriate measurement methods for different analysis purposes [4]. Laumas (1976) believes that unweighted is too ideal for showing the influence of industry in the national economy, and factors such as industrial scale should be added to the model [5]. In addition to the above classical industrial association methods, there are also some more complex methods, such as hypothetical extractions method (Strasrert, 1968, Dietzenbacher, Van Burken, Kondo, 2019), eigenvector method (Dietzenbacher, 1988), etc. In terms of wide application, classical methods have been widely used [6-8].

After analyzing the industrial linkages under different calculation methods, Yang & Zheng (2014) found that although each result has a reasonable interpretation direction [9]. Wen (2013), after measuring the backward industrial linkages based on demand in 2007, pointed out that when judging the importance of the industrial sector in the national economy, we should not simply look at the scale weighting, but also consider the characteristics of the industry itself [10]. Xu (2018) discussed the impact of weighted and unweighted on industrial linkages measurement from the perspective of demand and supply, and systematically analyzed the results of each measurement method [11]. Yang (2019) quantified the impact of the industry on other industries from the direct linkages coefficient, influence coefficient and induction coefficient [12]. Zang (2018) studied the economic linkages between industries from the perspective of three industries [13]. Gong et al.(2019) proposed a new model when identifying the key industries in the input-output table, that is, to measure the importance of the industry by the impact on the total output when the industry exits the input-output network [14]. Zhu et al. (2014) quantitatively evaluated the economic impact of China's remanufacturing industry on other related sectors [15]. Li (2020) uses the industry added value as the measurement index and uses the hypothetical extractions method to measure the total effect, backward effect and forward effect, so as to analyze the industrial importance [16]. Shi and Liu (2020) used the directional characteristics of grey relational analysis (GRA) and combined with the data of industrial development to calculate the industrial influence coefficient and industrial sensitivity coefficient, which solved the difficulty of using the industrial linkages research method based on input-output table When the table is not available [17].

At the national level, the indicators of information industry’s linkages are still influence coefficient and induction coefficient, which can be used to judge the status of information industry in the national economy. The general conclusion is that the industrial linkage of electronic products manufacturing industry is strong and that of Information service industry is weak (Wei et al., 2010) [18]. At the regional level, the conclusions obtained are not significantly different from those at the national level (Rong et al. 2013; Zhou, 2016) [19, 20].

There are four deficiencies in the research on China's information industry’s linkages. First, there is a lack of dynamic change analysis of information industry’ linkages. Second, there is a lack of weighted analysis of information industry linkages. Third, the impact of weighted and unweighted on the distribution of industrial linkages is not clear. Fourth, what is the impact of competitive and non competitive models on the industrial linkages ranking of the information industry. In terms of analyzing the information industry, on the one hand, weighted linkages can make us better understand the position of the information industry in the economy. On the other hand, time-series industrial linkages can reflect the annual changes in the influence and sensitivity of the information industry, which is of reference significance for formulating information industry development policies. There are differences between weighted and unweighted industrial linkages measures, which are reflected not only in the size of linkages, but also in the distribution of linkages coefficients. Due to the factors of imported products, it is often exaggerated to use competitive model to measure industrial linkages.

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Therefore, excluding imported products, using non competitive model to measure Information industry association has higher reliability

After a brief literature review, we introduce the theory of industrial linkages in the second part. We not only analyze the unweighter indicators of industrial linkages, but also use weighted indicators to measure industrial linkages from two aspects of efficiency and scale, which has a richer explanation for the analysis of the position and role of information industry in the national economy. In the third part, the empirical analysis includes four aspects: Firstly, the industrial linkage of each industry is measured by using the input-output table in 2018. Secondly, using input-output tables of 8 years, this paper analyzes the development and change of industrial linkages of information industry. Thirdly, we analysis the impact of weighted and unweighted cases on the distribution of industrial linkages. Fourth, the results of linkages measurement of competitive model and non competitive model are compared. The last part is the conclusion.

2. Theoretical Model and Data

2.1 Theoretical model

Demand driven Leontief Model Based on the horizontal balance relationship of input-output table

$$X = (I - A)^{-1} \cdot Y \tag{1}$$

The Leontief inverse matrix is $(I - A)^{-1}$, record as L. l_{ij} indicates that the output of the ith sector is required for each additional unit of the final demand of the jth sector.

The Ghosh inverse matrix measures the relationship between initial input and total input. Starting from the vertical balance relationship of input-output table, the supply driven Ghosh model is obtained through output coeficient matrix *B*:

$$X^T = V(I - B)^{-1} \tag{2}$$

The Ghosh inverse matrix is $(I - B)^{-1}$, which is recorded as G, g_{ij} represents the supply to the jth sector for each additional initial input of the ith sector.

In terms of calculation connotation, influence coefficient and sensitivity coefficient have shortcomings. But they are still widely used to measure the importance of industry in the national economy.

The influence coefficient can be obtained by summing and normalizing the columns of Leontief inverse matrix. The influence coefficient reflects the final demand of an additional unit in an sector and its impact on the product demand of all sectors. When the influence coefficient is greater than 1, it indicates that its demand influence is greater than the average level of all sectors. On the contrary, the influence is less than the average.

$$BL_j = \frac{\sum_{i=1}^{n} l_{ij}}{\frac{1}{n}\sum_{j=1}^{n}\left(\sum_{i=1}^{n} l_{ij}\right)}, \ j = 1, 2, \cdots, n \tag{3}$$

In formula (3), the numerator of influence coefficient is the sum of columns of Leontief inverse matrix, which represents the total consumption of products of all sectors by adding one unit of final consumption to the sector, so as to measure the demand pulling effect of the sector. The denominator represents the average demand pulling effect of all sectorts. The influence coefficient is dimensionless, and the influence coefficient between each sector is comparable. For example, the influence coefficient of one sector is twice that of another sector, indicating that the output all sectors produce in order to meet the final demand of a unit of the former is twice that of the latter.

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Scale is added to the formula as a weight. Referring to the method of Yang and Zheng (2014), the final demand is used as the weight to define the weighted influence coefficient based on demand pull.

$$WBL_j = \frac{\sum_{i=1}^{n} l_{ij} y_j}{\frac{1}{n}\sum_{j=1}^{n}\left(\sum_{i=1}^{n} l_{ij} y_j\right)}, j = 1, 2, \cdots, n \tag{4}$$

Weighted influence coefficient WBL_j, whose numerator reflects the pull of product demand for all sectors when the sector's final demand increases y_j units.

With the help of the distribution and use of products, Ghosh inverse matrix reflects the driving effect of initial input on the supply. The supply driven sensitivity coefficient is the ratio of the row sum of the Ghosh inverse matrix to the row average. If the sensitivity coefficient is greater than 1, it indicates that the supply driven sensitivity of the sector is greater than the average level, otherwise, it is less than the average level.

$$FL_i = \frac{\sum_{j=1}^{n} g_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\left(\sum_{j=1}^{n} g_{ij}\right)}, i = 1, 2, \cdots, n \tag{5}$$

In formula (5), the numerator of sensitivity coefficient is the row sum of Ghosh inverse matrix, which represents the output sum of the all industries under the initial input of the industry. The denominator is the average of the row sum of the Ghosh inverse matrix.

The sensitivity coefficient can be weighted by the added value. The numerator of the weighted sensitivity coefficient reflects the supply driving effect on all industrial sectors when the sector increases the initial input.

$$WFL_i = \frac{\sum_{j=1}^{n} g_{ij} v_i}{\frac{1}{n}\sum_{i=1}^{n}\left(\sum_{j=1}^{n} g_{ij} v_i\right)}, i = 1, 2, \cdots, n \tag{6}$$

2.2 Data

The preparation rule of China's input-output table is to prepare the input-output table every "2" and every "7". After industry segmentation, more than 100 industries will be roughly divided, and the extension table will be prepared every "0" and every "5". In order to make a unified analysis, the input-output tables need to be aggregated. The processing method of this paper is to unify the industries into 41 or 42 industries. Note that there are separate statistical items in each input-output table for the subdivided Electronic product manufacturing industry and information service industry in information industry, and the statistical division of other industries in different years is not uniform. Huang (2018) adopted the proportional "value added rate method" to separate industries [21]. Since there is no unclear statistical distinction in the main information industry of this study, there is no need to refer to this operation. At the same time, in order to ensure the preciseness of the analysis, it still has high comparability when most industries are the same and a few are different.

Table 1. Aggregation of sectors of input-output tables

Year	Number of sectors	Number after aggregation	Category name
2002	122	41	Category 1
2005	42	42	Category 2

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2007	135	41	Category 1
2010	41	41	Category 3
2012	139	42	Category 4
2015	42	42	Category 4
2017	149	42	Category 4
2018	153	42	Category 4

Note: due to the differences in the industrial order compiled in the input-output table, there are four categories of industry names, 40 industries in the main body are the same, and only the statistical caliber of individual industries is inconsistent.

3. Information Industrial Linkages Analysis

3.1 Linkages analysis based on 2018 input-output table

At present, the latest input-output table in China is the 2018 table. Analyzing the development of various industries in the national economy, using the 2018 data can more effectively reflect the current situation of industrial development in recent years, which is time-effective.

The top ten industries with unweighted influence coefficient in 2018 are: electronic product, electrical machinery, clothing, shoes and hats, transportation equipmen, instruments and apparatuses, general equipment, equipment repair services, textile, special equipment, other manufactured products. It can be seen that the top ten industries with influence are basically manufacturing. The top ten industries weighted by final demand are construction, transportation equipmen, food and tobacco, public administration, health and social work, electronic product, real estate, wholesale and retail, clothing, shoes and hats, education. They involve half of the manufacturing industry and half of the service industry.

Most of the top ten industries with unweighted sensitivity coefficient are resource industries, respectively: oil and gas, metal ore, waste products, coal, non metallic ore, supply of electricity and heat, petroleum, instruments and apparatuses, chemical products, metal smelting products. The top ten industries in the weighted sensitivity coefficient are: wholesale and retail, agriculture, finance, transportation and post, real estate, chemical products, metal smelting products, leasing and business, oil and gas, supply of electricity and heat.

In 2018, the influence coefficient and sensitivity coefficient of the electronic product manufacturing industry were 1.475 and 1.092 respectively, which were greater than 1, indicating that the influence and sensitivity of the electronic product manufacturing industry were higher than the average level of the all industries. From the ranking, it can be seen that the influence of the Electronic product manufacturing industry ranked first and the sensitivity ranked 12th. It can be seen that the electronic product manufacturing industry plays a huge pulling role in the national economy. From the weighted calculation results, after considering the scale, the weighted influence coefficient and sensitivity coefficient of the Electronic product manufacturing industry were 1.592 and 0.929, which falled to the 6th and 16th places, and the influence and sensitivity coefficients showed a certain degree of decline.

The influence coefficient and sensitivity coefficient of information service industry are 0.856 and 0.731 respectively, which are less than 1, ranking 31th and 30th. The impact of information service industry on the national economy is less than the average level. After weighting, the influence and sensitivity of the information service industry are 1.187 and 1.327 respectively, which are greater than 1, and the ranking also rises to varying degrees, ranking 12th and 11th respectively, indicating that under the influence of scale factors, the role of the information service industry in the national economy is significantly improved.

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Table 2. Influence coefficient and sensitivity coefficient in 2018

Industry	Noweighting				Weighting			
	BL	Rank	FL	Rank	WBL	Rank	WFL	Rank
Agriculture	0.730	37	0.957	18	0.922	17	3.444	2
Coal	0.835	33	1.655	4	-0.060	39	1.060	14
Oil and gas	0.675	39	3.173	1	-0.520	42	1.508	9
Metal ore	0.906	28	2.699	2	-0.389	41	0.735	19
Non metallic ore	0.940	26	1.533	5	-0.018	37	0.352	31
Food and tobacco	1.027	20	0.768	28	2.487	3	1.108	13
Textile	1.241	8	1.015	15	0.361	26	0.363	30
Clothing, shoes and hats	1.294	3	0.63	36	1.299	9	0.235	36
Wood products and furniture	1.189	11	0.799	27	0.436	21	0.237	35
Paper and cultural products	1.156	15	1.070	13	0.406	24	0.563	27
Petroleum	0.947	25	1.266	7	0.163	30	0.729	20
Chemical products	1.170	13	1.224	9	0.366	25	2.363	6
Non metallic mineral products	1.067	17	0.836	24	0.150	31	1.005	15
Metal smelting products	1.104	16	1.196	10	-0.156	40	1.762	7
Metalware	1.174	12	0.946	19	0.422	22	0.589	24
General equipment	1.25	6	0.830	25	1.107	14	0.492	29
Special equipment	1.228	9	0.726	31	1.073	15	0.335	32
Transportation equipment	1.283	4	0.724	32	2.59	2	0.723	21
Electrical machinery	1.295	2	0.881	22	1.176	13	0.565	26
Electronic product	1.475	1	1.092	12	1.592	6	0.929	16
Instruments and Apparatuses	1.273	5	1.23	8	0.008	36	0.157	37
Other manufactured products	1.196	10	0.925	21	0.069	33	0.048	41
Waste products	0.475	42	1.687	3	-0.026	38	0.641	23
Equipment repair services	1.242	7	1.047	14	0.024	35	0.024	42
Supply of electricity and heat	1.049	18	1.321	6	0.281	28	1.421	10
Gas supply	0.962	23	0.93	20	0.093	32	0.069	39
Water supply	0.892	29	0.752	29	0.057	34	0.059	40
Construction	1.160	14	0.342	40	13.297	1	1.174	12
Wholesale and retail	0.680	38	0.873	23	1.357	8	4.036	1
Transportation and post	0.891	30	1.004	16	0.957	16	2.706	4
Accommodation and catering	0.96	24	0.822	26	0.726	19	0.696	22
Information service	0.856	31	0.731	30	1.187	12	1.327	11
Finance	0.749	36	0.973	17	0.911	18	3.133	3
Real estate	0.593	41	0.669	34	1.425	7	2.402	5
Leasing and business	1.033	19	1.108	11	0.353	27	1.605	8

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Scientific research	1.004	22	0.641	35	1.203	11	0.829	17
Water conservancy	0.932	27	0.629	37	0.236	29	0.119	38
Resident services	0.839	32	0.678	33	0.537	20	0.512	28
Education	0.642	40	0.351	39	1.231	10	0.585	25
Health and social work	1.004	21	0.337	42	1.875	5	0.306	33
Culture and entertainment	0.835	34	0.593	38	0.407	23	0.268	34
Public administration	0.750	35	0.340	41	2.390	4	0.788	18

3.2 Analysis on the change of linkages of Information industry

After aggregating, the 8-year industrial linkages are calculated respectively, and then the influence coefficient and induction coefficient of Electronic products are listed in Table 3, and the linkages of information service industry are listed in Table 4, the numbers in parentheses are sorted accordingly.

Table 3. Linkages of Electronic products in 8 years

Year	Noweighting		Weighting	
	BL	FL	WBL	WFL
2002	1.385 (1)	1.124 (15)	1.666 (7)	1.121 (9)
2005	1.403 (1)	0.912 (19)	2.979 (2)	1.020 (14)
2007	1.408 (1)	0.979 (18)	2.397 (4)	1.112 (11)
2010	1.394 (1)	0.909 (22)	2.282 (6)	0.874 (17)
2012	1.375 (1)	0.999 (14)	1.733 (8)	0.977 (15)
2015	1.288 (2)	1.031 (15)	1.452 (9)	1.133 (11)
2017	1.454 (1)	1.088 (13)	1.634 (6)	0.998 (15)
2018	1.475 (1)	1.092 (12)	1.592 (6)	0.929 (16)

Table 3 shows the measurement values of influence coefficient and sensitivity coefficient of electronic products year by year. It can be seen that the influence coefficient of electronic products ranks first in all statistical years except 2015. It shows that increasing the final demand of a unit by the electronic products itself requires the output of all industries, which are greater than the general level. The electronic products industry has an important impact on the driving development of the national economy. After the final demand weighting, the influence coefficient of the electronic products manufacturing industry has decreased, and the ranking basically fluctuates within 5-10. Although it has decreased, the influence is still at the medium and upper level. The sensitivity coefficient ranking of electronic products manufacturing industry is basically about 20-35, and the coefficient is generally less than 1. After weighting with initial input, the sensitivity coefficient increases in most cases.

Table 4. Linkages of Information service in 8 years

Year	Noweighting		Weighting	
	BL	FL	WBL	WFL
2002	0.947 (24)	0.745 (29)	1.142 (13)	0.788 (19)
2005	0.946 (27)	0.892 (21)	0.544 (20)	1.05 (13)
2007	0.908 (27)	0.762 (27)	0.804 (19)	0.708 (21)

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2010	0.821 (34)	0.695 (34)	0.675 (15)	0.682 (22)
2012	0.884 (29)	0.602 (35)	0.962 (15)	0.630 (21)
2015	0.818 (33)	0.615 (35)	1.037 (13)	0.819 (17)
2017	0.821 (34)	0.679 (33)	1.182 (11)	1.178 (12)
2018	0.856 (31)	0.731 (30)	1.187 (12)	1.327 (11)

Table 4 shows the calculation results of influence coefficient and sensitivity coefficient of Information service industry year by year. The ranking of influence coefficient of information service industry is basically between 25 and 35, and the influence coefficient is less than 1. The sensitivity coefficient ranks between 20 and 35 and is also less than 1, indicating that when the information service industry increases the final demand of a unit, the output growth of all industries is less than the average level, and the information service industry has less impact on the national economy. From the weighted coefficient measurement results, both influence coefficient and sensitivity coefficient rank 10-20, and the scale factor of information service industry improves its linkages effect in the national economy.

3.3 Effect of weighted and unweighted on distribution of industrial linkages

Here, the 2018 input-output table is used to measure the impact of weighted and unweighted on the distribution of influence coefficient and induction coefficient, including skewness and kurtosis.

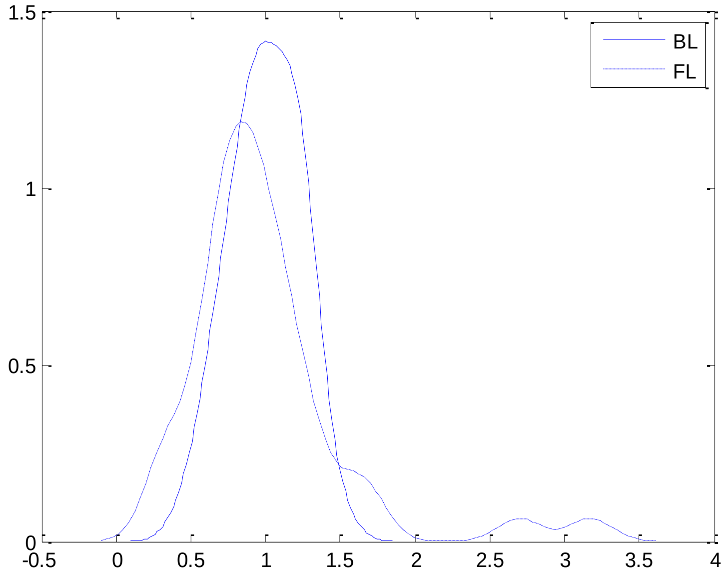

Figure 1. Distribution of influence coefficient and sensitivity coefficient in 2018

The distribution curve of influence coefficient and sensitivity coefficient are shown in Figure 1. The skewness of influence coefficient is -0.232, the kurtosis is -0.519, the skewness of induction coefficient is 2.293, and the kurtosis is 7.040. Therefore, relative to the influence coefficient, the sensitivity coefficient is right biased and thick tailed. The right deviation of the sensitivity coefficient indicates that some industries in the economic system are particularly forward related. Careful inspection shows that these industries are resource-based industries and bottleneck industries, which have a great restrictive effect on economic development. The thick tail distribution indicates that the supply constraints are significantly different for some industries: some industries have strong constraints on the economy, such as resource industries, while others have weak supply constraints on the economy, such as final demand industries. The existence of these two industries makes the induction coefficient present a thick tail distribution.

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The distribution curves of unweighted and weighted influence coefficients are shown in Figure 2 respectively. The skewness of the weighted influence coefficient is 5.229 and the kurtosis is 30.966. The skewness of the weighted influence coefficient increases and obviously deviates to the right. The kurtosis increased and thick tail distribution. The reason for the right deviation is that the final demand of some industries increases rapidly, the final demand scale is large, and the influence of these industries exceeds the average level, resulting in a large weighted influence coefficient, such as the construction industry, which makes the weighted influence coefficient to the right. Due to the factors of the final demand difference of various industries, the weighting makes this difference more significant. For example, the final demand difference between the construction industry and the resource industry is huge, resulting in a thick tail in the distribution of the weighted influence coefficient.

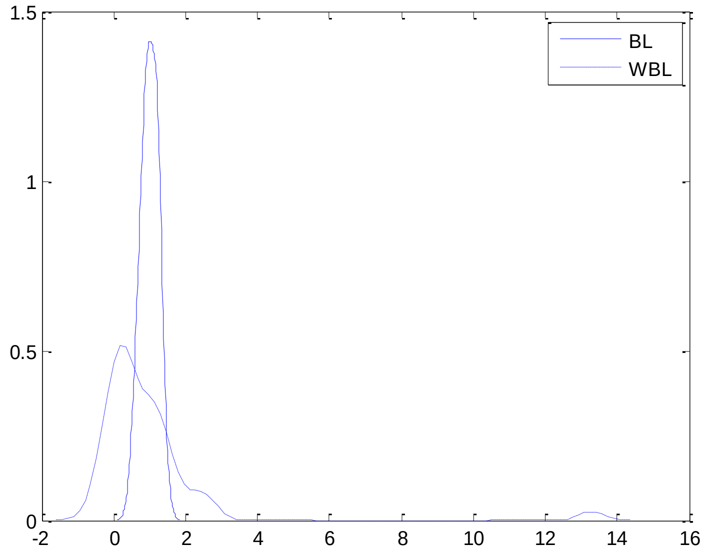

Figure 2. Distribution of influence coefficient and weighted influence coefficient in 2018

The distribution curves of unweighted and weighted induction force coefficients are shown in Figure 3. The skewness of the weighted induced force coefficient is 1.5768 and the kurtosis is 2.078. Therefore, compared with the unweighted induction force coefficient, the weighted case weakens the right deviation and the thick tail. This situation is due to the limited scale of resource industries themselves, while resource industries are often small, which makes the scale factor often offset, resulting in the weakening of the right deviation. Large scale industries are often final demand industries, and the sensitivity coefficient is small. Smaller scale industries are often resource industries, and the sensitivity is large, so the scale and efficiency often offset each other. The extreme value of weighted sensitivity coefficient is not as common as the extreme value of sensitivity coefficient, and the thick tail weakens.

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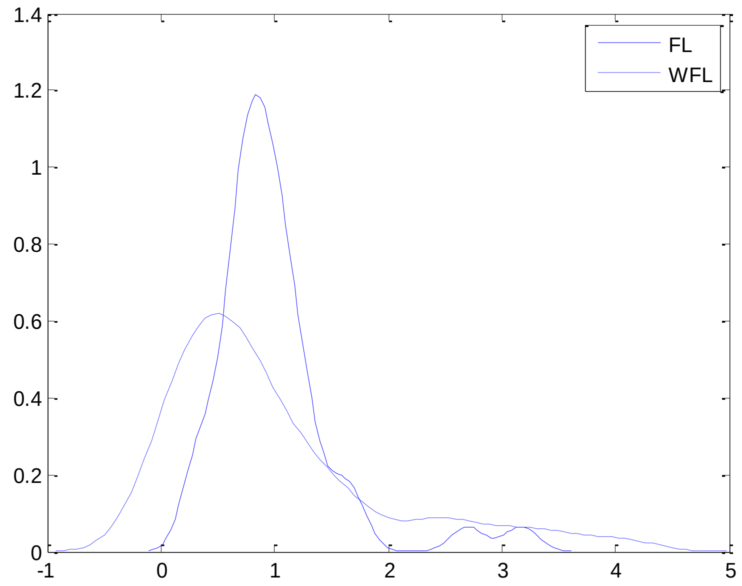

Figure 3. Distribution of sensitivity coefficient and weighted sensitivity coefficient in 2018

Then the skewness and kurtosis of the linkages coefficient over the years are listed in Table 5. It can be seen from this table that the distribution of the industrial linkages coefficient over the years shows a considerable degree of stability. For example, the skewness range of the influence coefficient fluctuates between -0.889 and -0.232, slightly to the left, and the weighted skewness range fluctuates between 3.669 and 5.2292, showing an obvious right deviation. The coefficient shows an obvious thick tail after weighting. The average skewness of the sensitivity coefficient is 1.705, showing a right deviation. In the weighted case, the average skewness is 1.763, the skewness changes little, and the kurtosis remains generally stable after being weighted.

Table 5. Distribution of linkages over the years

Year	Skewness				Kurtosis			
	Noweighting		Weighting		Noweighting		Weighting	
	BL	FL	WBL	WFL	BL	FL	WBL	WFL
2002	-0.585	0.825	4.311	2.051	0.582	0.954	22.708	4.806
2005	-0.889	1.612	3.669	1.83	1.303	2.977	17.928	4.179
2007	-0.451	1.424	4.181	1.591	-0.373	2.565	22.092	2.428
2010	-0.248	1.779	3.994	1.588	-0.72	4.731	20.012	2.912
2012	-0.347	1.897	4.435	1.655	-0.872	4.664	24.17	2.508
2015	-0.629	1.923	5.193	2.172	-0.581	5.8	30.608	4.648
2017	-0.272	1.883	5.029	1.64	-0.62	4.867	29.095	2.24
2018	-0.232	2.293	5.229	1.577	-0.519	7.04	30.966	2.078
mean	-0.457	1.705	4.505	1.763	-0.225	4.200	24.697	3.225

3.4 The impact of competitive model and non competitive model on the rank of linkages of Information industry

The empirical part above is calculated by using the competitive input-output table, and the following will be calculated by using the non competitive input-output table. The difference between the two

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models lies in the different treatment of imported items. Although both intermediate flow and final demand contain import items, the import part of intermediate flow and final demand needs to be excluded in the non competitive model. Therefore, the linkages measured by the two models are different. Similarly, the weighted correlation coefficient measured by the two models is also different. Due to space constraints, only non competitive models are listed here to measure industrial linkages, and the impact of the two models on weighted industrial linkages is not discussed here.

Table 6. Linkages based on non competitive model

Year	Electronic products		Information service	
	BL	FL	BL	FL
2002	1.141 (13)	0.887 (26)	1.016 (19)	0.831 (28)
2005	1.160 (7)	0.762 (32)	0.895 (33)	1.004 (18)
2007	1.136 (14)	0.792 (31)	0.986 (23)	0.852 (25)
2010	1.174 (11)	0.788 (31)	0.832 (34)	0.786 (32)
2012	1.144 (15)	0.836 (29)	0.880 (29)	0.706 (34)
2015	1.096 (17)	0.858 (30)	0.812 (34)	0.694 (35)
2017	1.216 (6)	0.917 (25)	0.844 (33)	0.767 (33)
2018	1.229 (6)	0.922 (24)	0.878 (30)	0.831 (30)

The influence coefficient, sensitivity coefficient and ranking of the information industry are calculated by using the non competitive model, as shown in Table 6. The influence coefficient of Electronic product manufacturing exceeds the average level, greater than 1, and fluctuates around 10. At this time, it is significantly lower than the competitive model. The sensitivity coefficient is lower than the average level, less than 1, fluctuates around 30, and is also significantly lower than the competitive model. For the information service, there is no obvious difference in the industrial linkages calculated by using the competitive model or the non competitive model. The Electronic product manufacturing industry has a long industrial chain, its intermediate input comes directly or indirectly from imports, and a large part of its output is exported abroad. Therefore, the industrial linkages are often exaggerated by using the competitive input-output model. The information service industry has a short industrial chain and few product transactions with foreign countries. Therefore, the measurements of linkages of information service industry of the two models are relatively consistent.

4. Conclusion

From the perspective of linkages measurement, the role of electronic products and information service industry in the national economic industry is very different. Specifically, the influence and sensitivity of Electronic products on the national economy are higher than that of information service industry. Taking the measurement data of 2018 as an example, in 2018, the influence and sensitivity of information manufacturing industry reached the first and 12th positions respectively in the ranking of 42 includes, and also ranked the sixth and 16th after scale weighting. As for the information service industry, the influence coefficient and sensitivity coefficient rank 31st and 30th, basically at the lower middle level. The impact of the information service industry on the national economy is far less than that of the manufacturing industry, but after weighting, the influence coefficient and sensitivity coefficient rise by leaps and bounds, ranking 12th and 11th, ranking among the upper middle level.

From the calculation results of time series input-output table, the influence coefficient and sensitivity coefficient of information industry show a high degree of stability, and the pulling force and driving force of information industry in the economic system have not changed significantly. The influence

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coefficient of Electronic products industry is at the forefront of all industries, and the sensitivity coefficient is at the upper middle level. The industrial linkages effect of information service industry in the economic system has always been at a low level, which has not undergone a breakthrough change over time.

Although weighted or unweighted has a great impact on the industrial correlation ranking of the information industry, the distribution of industrial linkages coefficient over the years shows a considerable degree of stability for the economy as a whole. The skewness of the influence coefficient is slightly left, the weighted case shows a more obvious right deviation, and after weighting, it shows a more obvious thick tail distribution. For the sensitivity coefficient, it shows a right deviation, the skewness changes little in the case of weighting, and the kurtosis remains generally stable after weighting.

The measurement of linkages between competitive model and non competitive model varies with different industries. The use of competitive model often exaggerates the industrial linkages effect on Electronic product manufacturing. For the linkages of information service the measurement results of the two models are relatively consistent.

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