Analysis of the Industrial Correlation Effect of Digital Economy in Heilongjiang Province - Based on the input-output Method

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Abstract. This article is based on the 2017 input-output table of Heilongjiang Province, and uses an input-output model to study the correlation and spillover effects between the digital economy industry and various sectors of the national economy. The research results indicate that the digital economy industry in Heilongjiang Province is closely related to manufacturing and productive service industries, while the correlation with the primary industry is relatively low; The impact coefficient and sensitivity coefficient of the digital economy manufacturing industry are higher than those of the digital economy service industry, but the scale is much smaller than the latter, and it is necessary to cultivate pillars.

Keywords: digital economy industry; Industry correlation analysis; Input output analysis; Digital construction

1 Introduction

In recent years, China's digital economy has developed rapidly and has become an important driving force for the development of the national economy. At present, the development of the digital economy industry in Heilongjiang Province is severely constrained. Therefore, this article takes the digital economy industry in Heilongjiang Province as the research object, and based on the latest published input-output table of Heilongjiang Province in 2017, scientifically calculates the correlation and spillover effects between the digital economy industry in Heilongjiang Province and other industries, providing theoretical basis and policy reference for the development of China's digital economy industry.

2 Literate Review

The relevant research on the digital economy industry mainly focuses on the definition of connotation, industry classification, and economic impact. This article elaborates on the above three aspects.

The term 'digital economy' was first proposed by Tapscott Don[1]. Lane summarizes the digital economy as a collection of information technology and computer networks[2]. Scholars generally believe that the digital economy is a new type of economic form, and its development requires the use of digital information to achieve deep integration with the real economy (Tian

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Jinfang et al., 2022)[3]. And with the development of technology, the digital economy has shown strong characteristics such as virtuality, permeability, and spillover. Under the combined action of these characteristics, the digital economy has been able to achieve rapid development(Tong Feng et al., 2020)[4].

In 1962, Mahlup was the first to propose knowledge industries other than the three major industries (Machlup, 1962)[5]. The communication equipment, computer and other electronic equipment, information transmission, software, and information technology services in the national economic industry classification of multiple mathematicians in China are classified as the digital economy department, which are respectively referred to as the digital product manufacturing department and the digital technology application department (Shen Xiaoping, 2022)[6]. The current digital economy industry in China can be divided into: digital product trade industry, digital driven industry, digital technology service industry, digital equipment manufacturing industry, digital content industry, e-commerce industry, digital finance industry, and other digital industries (Fu Ying, 2021)[7].

The digital economy industry has a high degree of integration with other industries, which has a strong boosting effect on China's economic development (Zhang Xinhong, 2016)[8]. On the one hand, the digital economy has continuously widened and extended the boundaries of traditional industrial technological innovation, further promoting the adjustment and upgrading of industrial structure (Ding Zhifan, 2020)[9]; On the other hand, the digital economy can stimulate production vitality and ensure stable and high-quality economic development (Jiang Xiaojuan, 2017)[10]. The digital economy industry provides greater support to downstream industries than to upstream industries, and is a factor driven industry (Tian Jinfang et al., 2022)[3]. At the same time, the digital economy industry has a significant indirect contribution to manufacturing production, playing a stronger driving role than a driving role in the development of the manufacturing industry (Wu Xiaoting et al., 2021)[11].

3 Method

This article is based on the input-output table and selects the following indicator coefficients to study the correlation and impact between the elderly care digital economy industry and various sectors of the national economy in Heilongjiang Province.

(1)Direct consumption coefficient: reflects the direct consumption degree of the digital economy industry towards various forward related industries in the national economy, and the calculation formula is:

$$a_{ij} = \frac{x_{ij}}{X_j}(i, j = 1, 2, \cdots n)$$

(2)Complete consumption coefficient: Reflects the degree of complete consumption of the digital economy industry towards various forward related industries in the national economy, expressed as a matrix:

$$B = \left(I - A\right)^{-1} - I$$

(3) Direct distribution coefficient: reflects the direct distribution degree of the digital economy industry to various backward related industries in the national economy, and the calculation formula is: $r_{ij} = \frac{x_{ij}}{X_i}$

(4)Complete distribution coefficient: reflects the degree of complete distribution of digital economy industries to various backward related industries in the national economy, and its calculation formula is: $W = \left(I - R\right)^{-1} - I$

(5) Influence coefficient: Reflects the degree of demand spillover to other departments when each department in the digital economy industry increases the production of one unit of final product. The calculation formula is: $T_j = \frac{\sum_{i=1}^{n} A_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} A_{ij}}$

(6)Sensitivity coefficient: Reflects the degree of demand induction received by various departments of the digital economy industry when another department increases the production of one unit of final product. The calculation formula is: $S_i = \frac{\sum_{j=1}^{n} D_{ij}}{\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n} D_{ij}}$

4 Empirical analysis

4.1 The Backward Correlation Effect of the Digital Economy Industry

4.1.1Direct consumption coefficient.

According to formula (1), the direct consumption coefficient can be calculated (as shown in Table 1). According to the calculation results, there are differences in the direct backward correlation characteristics between two departments of the digital economy industry and other industrial sectors, as follows:

Table 1. Direct Consumption Coefficient Sorting

Sort	Digital Economy Manufacturing Industry	Digital Economy Service Industry
1	Communication equipment and other electronic devices 0.3426	Information transmission and information technology services 0.1181
2	Wholesale and Retail 0.1591	Communication equipment and other electronic devices 0.1340
3	Coal mining and selection products 0.1355	Wholesale and Retail 0.0934

Through calculation, it is found that the manufacturing industry in the digital economy has a high degree of product consumption and dependence on the secondary industry; The direct inputs required by the digital economy service industry in the production process mainly come from the tertiary industry.

4.1.2Total Input Coefficient.

According to formula (2), the complete consumption coefficient can be calculated (as shown in Table 2), as follows:

Table 2. Ranking of Complete Consumption Coefficients

Sort	Digital Economy Manufacturing Industry	Digital Economy Service Industry
1	Communication equipment and other electronic devices 0.5303	Information transmission and information technology services 0.1396
2	Wholesale and Retail 0.1591	Communication equipment and other electronic devices 0.1340
3	Coal mining and selection products 0.1355	Wholesale and Retail 0.0934

Overall, the manufacturing industry in the digital economy consumes a significant portion of the primary and tertiary industries; The development of the digital economy service industry has a strong dependence on the second and third industries.

4.2 The Forward Correlation Effect of the Digital Economy Industry

4.2.1Direct distribution coefficient

According to formula (3), the direct distribution coefficient can be calculated (as shown in Table 3). The direct distribution coefficient of the digital economy industry to most sectors of the national economy is greater than zero, and the specific characteristics are as follows:

Table 3. Direct Distribution Coefficient Sorting

Sort	Digital Economy Manufacturing Industry	Digital Economy Service Industry
1	Information transmission and information technology services 2.1116	Information transmission and information technology services 0.1181
2	Leasing and Business Services 0.7483	Finance 0.1146
3	Communication equipment and other electronic devices 0.3426	Wholesale and Retail 0.0387

The products of the digital economy manufacturing industry mainly flow to the tertiary industry, which has a strong direct driving effect on the development of the tertiary industry; The direct distribution coefficient of the digital economy service industry to itself is the highest, indicating that the digital economy service industry provides a large amount of resource support to the tertiary industry, greatly promoting its industrial development.

4.2.2Complete distribution coefficient.

According to formula (4), the complete distribution coefficient can be calculated (as shown in Table 4). The complete distribution coefficient of the two sectors of the digital economy industry to most sectors of the national economy is greater than zero. The specific characteristics of the complete forward correlation are as follows:

Table 4. Ranking of Complete Distribution Coefficients

Sort	Digital Economy Manufacturing Industry		Digital Economy Service Industry	
1	Information transmission and information technology services	3.7029	Finance	0.1534
2	Construction business	1.8688	Information transmission and information technology services	0.1396
3	Wholesale and Retail	1.3278	Wholesale and Retail	0.0918

The forward relationship between digital economy manufacturing and manufacturing, as well as leasing and business services, is relatively close; The digital economy service industry has a strong driving effect on the development of the tertiary industry.

4.3 The ripple effects of the digital economy industry.

The analysis of correlation effects in the previous text indicates that the digital economy industry is closely related to various industries in the national economy, but it is still impossible to comprehensively determine the degree of impact and induction of the digital economy industry on the overall output of the national economy. Therefore, it is necessary to analyze the ripple effects of the digital economy industry.

4.3.1Influence coefficient.

The influence coefficients of various departments in the national economy can be calculated using formula (5). From the calculation results(as shown in Table 5), it can be seen that the influence coefficient of the digital economy manufacturing industry is greater than 1, indicating that the digital economy manufacturing industry has a strong driving effect on other sectors. The influence coefficient of the digital economy service industry is less than 1, ranking at the bottom, indicating that its driving effect on other departments is lower than the average level of each department.

Table 5. Impact coefficient of digital economy industry

Sort	Department	Influence coefficient
1	Metal products	1.3630
2	Metal smelting and rolling products	1.3357
3	Instrumentation	1.2858
16	Communication equipment, computers, and other electronic devices	1.1232
29	Information transmission, software, and information technology services	0.8312

4.3.2Sensitivity coefficient.

The sensitivity coefficients of various departments in the national economy can be obtained by using formula (6). According to the calculation results(as shown in Table 6), the sensitivity coefficient of the digital economy manufacturing industry is 0.0376, ranking third, indicating that the industry has a strong forward driving effect on the national economy, while the sensitivity coefficient of the digital economy service industry is 0.2859, located at the end, reflecting a weak forward driving effect on the national economy.

Table 6. Sensitivity coefficient of digital economy industry

Sort	Department	Sensitivity coefficient
1	Metal products	21.4278
2	Communication equipment, computers, and other electronic devices	3.0376
3	Metal smelting and rolling products	1.3582
4	Other manufacturing products and waste materials	1.2508
30	Information transmission, software, and information technology services	0.2859

5 Conclusion

From the perspective of backward correlation, the digital economy manufacturing industry has a strong demand driving effect on the manufacturing industry; From the perspective of forward correlation, the manufacturing, leasing, and business service industries are closely related to the digital economy industry, making them the main battlefield for the development of the digital economy. From the perspective of spillover effects, the digital economy service industry has a strong supply driving effect on the national economy. However, from the perspective of total input-output, the scale of the digital economy manufacturing industry is far smaller than that of the digital economy service industry, indicating that its pillar role still needs to be cultivated.

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