

Comprehensive Measurement of Digital Economy in Anhui Province

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Abstract: Digital economy is an emerging economic development mode, which has brought new vitality to the development of social real economy and promoted the development of regional economy. In this context, Anhui Province also put great efforts into the construction of digital economy, made great efforts to break through the core technology of digital economy, and constantly expanded the scale of digital economy, achieving remarkable results. Taking Anhui Province as the research object, this paper constructs a comprehensive evaluation index system of digital economy development from three aspects: digital infrastructure, digital industry development and digital development environment, and uses entropy method to measure the overall development level of digital economy in each city and Anhui province. The study found that there are still big differences in the level of digital development among different cities, but most cities have large space for digital economy development and good prospects. Anhui's overall digital economy development tends to balance, the comprehensive level has also achieved a great leap. Finally, according to the evaluation results, combined with the development advantages and characteristics of Anhui digital economy, put forward operational suggestions.

Keywords: Digital economy, Digital industry development, Entropy method.

1. Introduction

The term "digital economy" was first put forward by Don Tapscott, and later domestic scholars have gradually diversified descriptions of the concept of digital economy. Although there are differences in language descriptions, almost all indicate that digital economy is a new economic form with the Internet and digital technology as the medium and driving force[1], which can integrate with the development of traditional industries and is the key driving force to promote the real economic growth. In the context of rapid economic development, the development of digital technologies has injected new impetus into China's economic development. The proportion of digital economy in GDP has been adjusted from 36.2 percent in 2019 to 38.6 percent in 2020, and the scale of digital economy has been further expanded, boosting regional economic development. As an emerging economic development mode, the digital economy, based on the application of big data and the Internet, continues to develop innovatively, injecting fresh vitality into the development of the real economy.

With the advent of the information age, domestic scholars' research on the development of digital economy has been gradually reduced to provincial research. The core issue is to study the development of digital economy in provinces and put forward measures. In the post-pandemic era, digital economy plays an important role in transforming the global economy and will also promote the development of regional digital economy. In recent years, Anhui Province has also invested in the construction of digital economy, striving to break through the core technology of digital economy, constantly expanding the scale of digital economy, and has achieved remarkable results. In 2020, the total scale of Anhui's digital economy reached 1.1 trillion yuan, an increase of about 11% compared with 2019. The development trend is good, which is of significance for in-depth study and evaluation. On the basis of clarifying the concept and significance of digital economy, this study conducted a

comprehensive measurement of prefecture-level cities and the overall digital economy of Anhui province by constructing a scientific evaluation index system for the development level of digital economy, so as to explore the development status of Anhui digital economy and put forward suggestions for the subsequent development. To promote the overall high-quality economic development of Anhui Province under the new situation.

2. Index Selection

Different scholars construct index systems and adopt different methods to study the development of digital economy from different angles and regions. Taking 31 provincial administrative regions as research objects, Liu Yu[2] studied the development of China's provincial digital economy by introducing time development factors, constructing dynamic evaluation models and conducting cluster analysis. Li Yingjie[3] used the entropy method to measure the development trend of the digital economy in the sample years and built a gray prediction model to predict the future trend of China's digital economy. Huang Xinhuan[4] constructed Fujian Province's digital economy development index evaluation system from five aspects, and adopted the improved G1 algorithm based on grey relational degree to evaluate the development status of digital economy in 2021.

On the basis of fully understanding the connotation of digital economy, this paper comprehensively considers the existing research on digital economy, and according to the principles of correlation, representativeness and availability of indicators, constructs an indicator system for measuring the development level of Anhui digital economy from three dimensions: digital infrastructure, digital industry development and digital development environment, as shown in Table 1. Among them, digital infrastructure includes the length of optical cable lines, the total amount of telecommunications services, mobile broadband penetration rate three secondary indicators; The development of digital industry includes three secondary indexes: software business

income, technical contract transaction amount and new product sales income of industrial enterprises. The digital development environment includes three secondary indexes: per capita GDP, the number of RD workers, industrial power consumption, and the number of patent applications authorized. The selected data are all from the official data of Anhui Provincial Department of Science and Technology, Anhui Provincial Bureau of Statistics website and Ministry of Industry and Information Technology website.

Table 1. Measure index

Category	Indicator name and unit of measurement
Digital infrastructure	cable line length (10,000 km)
	Total telecommunications business (ten thousand yuan)
	Mobile broadband penetration (%)
Digital industry development	software business revenue (ten thousand yuan)
	Technical contract transaction amount (RMB 100 million)
	Sales revenue of new products of industrial enterprises (ten thousand Yuan)
Digital development environment	Number of RD personnel (persons)
	Industrial electricity consumption (billion KWH)
	Number of valid invention patents (items)

3. Measure the Development Level of Digital Economy

3.1. Entropy method

Index weight is used to evaluate the importance of indicators. In this paper, entropy method is used to determine the weight of nine measurement indicators of the development level of digital economy. The specific steps are as follows:

Step1: All indicators in the index system are standardized and dimensionless. Since all indicators in this paper are positive indicators, there are:

$$Z_{ijk} = \frac{X_{ijk} - \min(X_{ijk})}{\max(X_{ijk}) - \min(X_{ijk})} \quad (1)$$

Where, i represents the year ($i = 1, 2, 3, 4, 5, 6$); j represent all indicators ($j = 1, 2, 3, \dots, 9$); k represents prefecture-level cities in Anhui Province ($k = 1, 2, 3, \dots, 16$); X_{ijk} is the original data; $\max(X_{ijk})$ and $\min(X_{ijk})$ are the maximum and minimum values of each index value in each city over the years, and Z_{ijk} is the standardized value.

Step2: Calculate the proportion of the value of the i -th index under the k -th index:

$$P_{ijk} = \frac{Z_{ijk}}{\sum_{i=1}^6 \sum_{k=1}^{16} Z_{ijk}} \quad (2)$$

Step3: Calculate the entropy value of the j -th index:

$$H_j = -K \sum_{i=1}^6 \sum_{k=1}^{16} P_{ijk} \ln P_{ijk} \quad (3)$$

where the adjustment coefficient $K=1/\ln(6 \times 16)$

Step4: Calculate the difference coefficient of the j -th index:

$$g_i = 1 - H_j \quad (4)$$

Step5: Calculate the weight of each indicator:

$$W_j = \frac{g_i}{\sum_{i=1}^{12} g_i} \quad (5)$$

Step6: Calculate the comprehensive score:

$$S_{ik} = W_j Z_{ijk} \quad (6)$$

Obviously, the larger the value of S_{ik} , the higher the development level of digital economy of the city in this year.

3.2. Result analysis

Through calculation by the above method, the comprehensive score of digital economy development of prefecture-level cities in Anhui Province from 2015 to 2020 is finally obtained. Based on this, the average value of comprehensive level of all prefecture-level cities in each year and the average annual growth rate of digital economy development of each prefecture-level city are obtained, as shown in Table 2.

According to the table, in terms of the comprehensive level of digital economy, Hefei and Wuhu are the two cities with the highest level of development. Among them, Hefei ranks the top. Thanks to good development conditions and many resources, its development level is far higher than the average development level of Anhui cities, and has opened a big gap with other prefecture-level cities, becoming the most developed city in Anhui Province. Less developed cities include Huaibei, Huainan, Tongling, Chizhou and Huangshan. Bengbu, Fuyang Maanshan and Xuancheng have a medium level of digital economy development.

In-depth analysis shows that although the digital economy level of cities such as Huaibei and Huainan is relatively low, the average annual growth rate still reaches more than 15%. The main reason is that these cities start from a low point. In the initial stage of development, due to backward infrastructure, many projects cannot be implemented, the development environment is poor, and the development of digital economy is at a low level. However, in recent years, due to the improvement of infrastructure, the construction of these cities in all aspects has been greatly boosted, and the digital economy has been developing at a faster pace and with a strong momentum of development, there is great room for future growth.

It is worth noting that the digital economy level of Hefei City made a big leap in 2017, but showed a backward phenomenon in 2018, and developed steadily in the following two years. In 2017, Hefei officially established the Bureau of Digital Resources, and held the Digital Economy Summit

continuously since that year, which promoted the release of a number of excellent results. These measures helped Hefei's digital economy develop rapidly in 2017. Although there was a brief regression after the rapid development, the digital this year, and also injected new momentum into the development of Anhui digital economy.

economy returned to the right track and continued to develop steadily in the following two years, which is normal. On the whole, a series of measures made the digital economy level of Hefei reached a new level after

Table 2. Digital economy development level comprehensive score

Year City	2015	2016	2017	2018	2019	2020	Average annual growth rate
Hefei	0.0401	0.0475	0.0695	0.0672	0.0762	0.0863	16.53%
Huabei	0.0020	0.0020	0.0022	0.0028	0.0038	0.0047	18.30%
Bozhou	0.0017	0.0020	0.0025	0.0040	0.0053	0.0069	32.62%
Suzhou	0.0029	0.0034	0.0039	0.0049	0.0059	0.0078	21.73%
Bengbu	0.0051	0.0061	0.0079	0.0113	0.0131	0.0180	28.72%
Fuyang	0.0038	0.0049	0.0055	0.0083	0.0110	0.0137	29.57%
Huainan	0.0024	0.0027	0.0033	0.0038	0.0041	0.0050	15.85%
Chuzhou	0.0051	0.0054	0.0058	0.0078	0.0106	0.0157	25.41%
Luan	0.0031	0.0036	0.0035	0.0047	0.0061	0.0092	24.28%
Maanshan	0.0055	0.0060	0.0065	0.0079	0.0091	0.0130	18.82%
Wuhu	0.0122	0.0138	0.0165	0.0209	0.0254	0.0293	19.16%
Xuancheng	0.0030	0.0034	0.0037	0.0048	0.0059	0.0106	28.39%
Tongling	0.0025	0.0030	0.0034	0.0038	0.0038	0.0051	15.06%
Chizhou	0.0010	0.0011	0.0013	0.0017	0.0024	0.0032	25.61%
Anqing	0.0050	0.0053	0.0058	0.0092	0.0122	0.0139	22.72%
Huangshan	0.0011	0.0012	0.0014	0.0020	0.0025	0.0030	22.22%
Average value	0.0060	0.0070	0.0089	0.0103	0.0123	0.0153	

Based on the above evaluation methods, this paper measures the overall digital economy development of Anhui

Province from 2015 to 2020, and the measurement results are shown in Table 3.

Table 3. Three-dimensional scores of Anhui's overall digital economy level from 2015 to 2020

Year	Digital infrastructure	Digital industry development	Digital development environment	Total score
2015	0.0001	0.0003	0.0025	0.0029
2016	0.0329	0.0435	0.0371	0.1135
2017	0.1016	0.0867	0.0723	0.2606
2018	0.1790	0.1476	0.1851	0.5117
2019	0.2645	0.2316	0.2550	0.7511
2020	0.3272	0.3810	0.4240	1.1322

In terms of dimensions, in 2015, the digital development environment index was much larger than the other two dimensions, contributing the most to the digital economy, while the digital infrastructure and digital industrialization level had a smaller index and a very low contribution rate. It can be concluded that the development of Anhui digital economy is unbalanced. Moreover, due to unbalanced development, the comprehensive level of digital economy is also low. In recent years, the level of digital infrastructure and digital industrialization has developed rapidly, and the three dimensional indexes have been steadily improved, and the difference of index size has gradually weakened. Anhui digital economy has embarked on the road of comprehensive development, and thus, the comprehensive level has achieved a great leap. In the future, with the development of science and technology, Anhui's digital infrastructure will continue to improve. Under the guidance of the "Internet +" strategy and

the multi-wheel drive of digital industrialization and industrial digitalization, it is expected that the three-dimension index will continue to improve steadily in the next few years, and Anhui's digital economy will develop in a sustainable and balanced way.

4. Conclusion and Recommendations

Since 2015, Anhui digital economy development has been growing, among all cities in the province, Hefei digital economy development level is in a leading position, the overall level of digital economy in the province in digital industrialization and its development environment growth is obvious, the provincial government encourages and supports digital technology innovation, supports the construction of digital economy industrial parks, and boosts the development of digital industrialization. Inject new vitality into the economic development of Anhui Province. The average

annual growth rate of all prefecture-level cities is at a high level, and the economic development situation has been greatly improved. Digital development has become the key factor of provincial economic growth. However, the digital development level of different cities is still different, and the regional digital economy has not coordinated development. In addition, the level of digital economy infrastructure construction is slightly low, which fails to fully meet the needs of regional development.

Anhui Province needs to strengthen the construction of digital infrastructure, optimize the development environment of digital economy, promote the deep integration of Internet, cloud computing and other digital technologies, improve the coverage level of digital infrastructure, increase investment in digital infrastructure construction, and promote the high-quality development of digital economy in the province. In the case of vigorously promoting the construction and development of digital infrastructure, Anhui Province should also encourage digital technology innovation and talent introduction to adapt to the development and change of the future data era. Support the development and construction of digital technology, so that data resources can be safely shared and utilized, invest a large amount of capital in digital technology innovation, and increase the introduction of digital technology talents, narrow the differences in the development of digital economy within the province, and further improve the efficiency of digital economy development; Actively cooperate with universities and research institutes to carry out digital talent exchange and new ideas of digital technology innovation, and encourage personnel to make multi-dimensional innovation in digital technology. In addition, Anhui Province can learn from the experience of digital economy development in high-development areas, activate the new impetus of digital economy development in low-development areas, and

promote the coordinated development of digital economy in the whole province.

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