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Comparative Study on the Digital Economy Development Based on TOPSIS Comprehensive Evaluation: A Case Study of the Middle and Lower Reaches of the Yangtze River

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Abstract. Promoting the digital economy in the middle and lower reaches of the Yangtze River can not only boost the development of e-commerce, energy science and technology and other industries, but also pave the theoretical way for the digital economy development in various regions, so as to further provide an important practical basis for achieving high-quality economic growth. In this paper, seven provinces in the middle and lower reaches of the Yangtze River are taken as the research objects. Meanwhile, the development and different trends of the digital economy in each region are quantitatively analyzed and compared to propose suggestions for better development of the digital economy in the middle and lower reaches of the Yangtze River. On this basis, this paper first constructs the evaluation and measurement model of the digital economy development, and then gives the weights to the relevant indices through the analytic hierarchy process. After that, the regions in the middle and lower reaches of the Yangtze River are scored and compared via the TOPSIS comprehensive evaluation, which identifies that the mobile phone penetration, the number of Internet broadband access ports and the telecom business income are vital indices to accelerate the digital economy development. Finally, this paper argues that governments should increase investment in digital infrastructure construction and promote the deep integration of digital technology and industry.

Keywords: Digital Economy; Analytic Hierarchy Process; TOPSIS Comprehensive Evaluation; Influencing Factors; Middle and Lower Reaches of the Yangtze River.

1. Introduction

The digital economy is booming and integrated into all aspects of economic and social development, which has become a significant means to stimulate economic growth, ease the downward pressure on the economy, and drive economic recovery. According to *The White Paper on the Digital Economy Development and Employment in China* (2023), the scale of digital industrialization and industrial digitalization in China reached 9.2 trillion yuan and 41 trillion yuan respectively in 2022, accounting for 18.3% and 81.7% of the digital economy respectively. In addition, President Xi presided over the symposium on further promoting the high-quality development of the Yangtze River Economic Belt, stressing that "it is necessary to enhance the high-quality development of the Yangtze River Economic Belt to better support and serve Chinese modernization". The middle and lower reaches of the Yangtze River have good natural conditions and a complete foundation of heavy industry and manufacturing industry, which is an economic region with outstanding comprehensive strength and a critical supporting role in China. However, the improvement of infrastructure in the middle and lower reaches of the Yangtze River is still insufficient, with its ecological construction not suitable for development. Besides, there are great differences in resource endowments and development conditions in various regions. The government has not yet formed a universal binding incentive mechanism and coordinated development norms in the middle and lower reaches of the Yangtze River. Therefore, to give full play to the leading role of the digital economy and promote the construction of a new development pattern, it is of extreme importance to evaluate the digital economy development in the middle and lower reaches of the Yangtze River and calculate the influencing factors.

On this basis, this paper first constructs 4 secondary indices and 16 tertiary indices of the digital economy before using the analytic hierarchy process to give weight to each index. Finally, TOPSIS comprehensive evaluation is used to make a comparative study on the total scores of the digital economy in the middle and lower reaches of the Yangtze River, including Zhejiang, Jiangsu, Shanghai, Hunan, Hubei, Anhui and Jiangxi provinces, which obtains the differences in the digital economy development to make suggestions for the government.

2. Literature Review

2.1. Research on Influencing Factors of the Digital Economy

According to Muhammad, Dominic, Naseebullah et al.[1], information and communication technology (ICT) and technology infrastructure are vital factors affecting e-commerce development in the digital economy. Billon and Lera-Lopez [2] using factor analysis and the MDA model found that ICT level is related to GDP and knowledge-intensive activities in this region. Broekel, Brenner and Bürger [3] pointed out that innovation is affected by capital investment and other factors, and proposed inter-regional cooperation should be strengthened. Vujica and Tamara [4] held that the penetration rate of broadband Internet is an important influencing factor and appealed to strengthen the construction of basic communication facilities. According to Richter, Kraus, Brem, et al. [5], the digital economy promoted the emergence of the sharing economy by means of semi-structured interviews, and they created an innovative model mechanism of the sharing economy. Jiao and Sun [6] used the SDM spatial econometric model to measure digital economy development and analyzed factors such as human capital and government behavior to effectively improve digital economy development. Cai, Hong and Zhang [7] found that the optimization of industrial structure provided positive guidance for the digital economy development through the entropy weight method. Du and Long [8] used the entropy weight-TOPSIS model to analyze the influencing factors of the digital economy in Hunan Province, which found that digital industrialization and digital infrastructure construction are vital influencing factors. Nie [9] selected 30 provinces in China and adopted typicality analysis to conclude that road infrastructure and human capital are vital factors affecting the digital economy development.

2.2. Research on the Measurement of Digital Economy

At present, the research on measuring digital economy development is mostly based on the construction of relevant comprehensive index systems. Corrocher and Ordanini [10] put six digitization factors into a composite index called the digitization composite index. Zhao, Wallis and Singh [11] analyzed the relevant data from 64 countries and regions with the help of the technology acceptance model, which concluded that there is a significant positive correlation between e-government development and the digital economy. According to Itkonen and Juha [12], GDP and other indices should be included in the measurement indices of the digital economy. Zhang and Shen [13] used factor analysis to measure the readiness of digital economy development in different countries, and they believed that there were great differences in the digital economy development in various countries. Liu and Jiang [14] used the entropy weight-TOPSIS method to measure the digital economy development of each province. In addition, they held that GDP should be included in the digital economy measurement index.

2.3. Literature Review

To sum up, foreign research on the influencing factors of the digital economy development is mainly based on infrastructure, communication technology, government systems and related economic measurement indices, while Chinese scholars pay more attention to the influencing factors such as industrial structure, technology advancement, capital investment and human resources. The above research at home and abroad has great reference value for this paper, but there are still the following shortcomings. Few scholars evaluate the regional differences in the digital economy, and the scale measurement of international organizations and related institutions tends to compare between countries, which is not applicable to provinces and regions in China. Nowadays, few studies are about the digital economy development in local areas, most of which focus on the digital economy development in China. The timeliness of data is not long, and most of the applied methods are time series regression, so it is impossible to intuitively see the degree of digital economic development index in each region. On this basis, this paper first normalizes the data and gives the index weight through the entropy weight method. Finally, it evaluates the digital economy development in the middle and lower reaches of the Yangtze River by using TOPSIS comprehensive evaluation, so as to explore the differences in the development of different regions. This paper focuses on the middle and lower reaches of the Yangtze River as the research object, which analyzes the influencing factors of the digital economy development and finds out the development differences of various regions in the middle and lower reaches of the Yangtze River. Meanwhile, more targeted suggestions are proposed to fully play the engine role of the whole Yangtze River Economic Belt in building a new development pattern in China.

3. Analytic Hierarchy Process

3.1. Initial Screening of Indices and Data Sources

Table 1. Index of Influencing Factors of Digital Economy

Primary Index	Secondary Index	Tertiary Index
	Digital Infrastructure	Mobile Phone Penetration (ministry/100 people)
		Fixed Telephone Penetration (ministry/100 people)
	Digital Industrialization	Number of Internet Broadband Access Ports (10,000)
Digital Economy Development		Fixed Internet Broadband Access Users (10,000 households)
	Digitalization of the Industry	Total Telecommunication Business (100 million yuan)
		Number of Internet-related Employees (10,000)
		Number of Companies in ICT Industry
	Digital Innovation Capabilities	Revenue from Internet Technology Services (100 million yuan)
		E-commerce Transaction Volume (100 million yuan)
		Percentage of Businesses with E-commerce Activities (%)
		Number of Websites per 100 Businesses
		Number of Computers Used per 100 People (Sets)
		R&D Spending as a Percentage to GDP (%)
		Number of R&D Personnel (person/year)
		Inventive Patent Application
		Number of Colleges and Universities

By consulting relevant literature, this paper constructs the primary, secondary and tertiary indices that affect the digital economy development, including 4 secondary indices and 16 tertiary indices. The construction system and explanation of each index are shown in Table 1.

The data in the above index system are all from the *China Statistical Yearbook* (www.stats.gov.cn), the CSMAR database (www.data.csmar.com) and the EPS database (www.epsnet.com), with 2022 as the cross-sectional data year.

3.2. AHP Index Construction Weight

AHP (Analytic Hierarchy Process), referred AHP, was put forward by T.L. Saaty, a management scientist at the University of Pittsburgh in the United States, to study "power distribution according to the contribution of various industrial departments to national welfare". It is a hierarchical weight decision analysis based on network system theory and a multi-objective comprehensive evaluation model.

3.2.1. Establishment of Hierarchical Analysis Model

AHP decomposes the problem into different factors according to its essence and research objectives, which aggregates and combines them at different levels according to the correlation and membership degree among the factors, thus forming a multi-hierarchy analysis structure model. It finally makes the problem down to the determination of relative important weights or the arrangement of relative advantages and disadvantages of the lowest level (schemes and measures for decision-making, etc.) relative to the highest level (general objectives).

In this paper, the analytic hierarchy process is applied to the comprehensive evaluation model of the digital economy in the middle and lower reaches of the Yangtze River, which is a major innovation of this paper.

According to Figure 1, this paper constructs the hierarchical structure analysis model of digital economy development through 4 secondary indices and 16 tertiary indices.

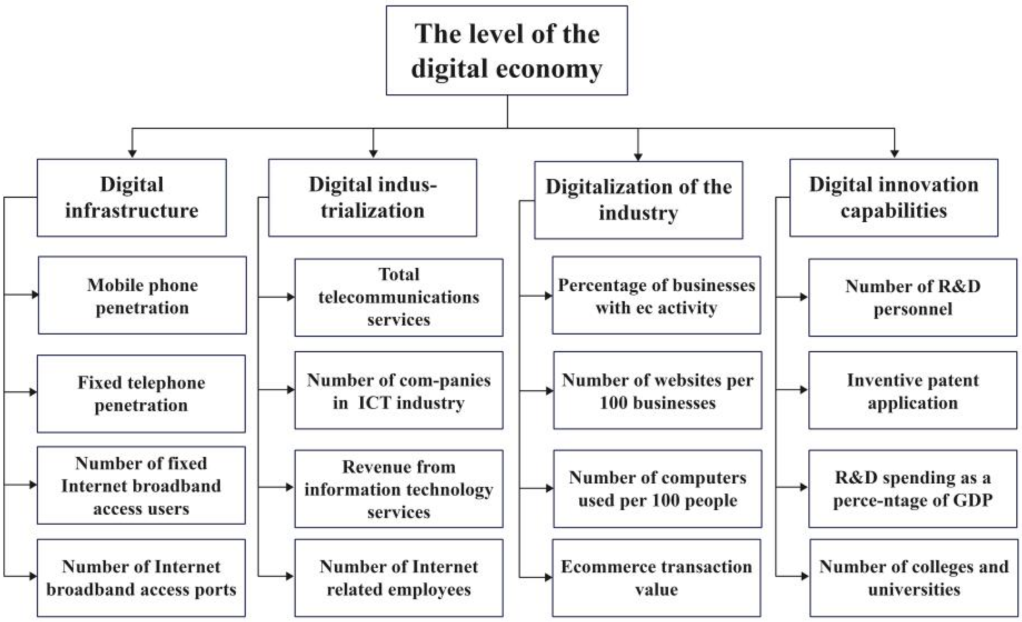

Figure 1. Hierarchical Analysis Structure Model of Digital Economy Development

3.2.2. Construction of Judgment Matrix

AHP calculates according to the judgment matrix. The size of each element in the judgment matrix reflects people's understanding of its relative importance, which is directly related to the decision-making results. Generally, the element size of the matrix is judged by the scaling method of 1 ~ 9 and its reciprocal. Each scale and its meaning are shown in the following table.

Table 2. Scaling Method of Judgment Matrix Elements

Scale	Meaning
1	Two factors are equally important compared
3	One is slightly more important than the other
5	One is obviously more important than the other
7	One is more important than the other
9	One is more important than the other
2, 4, 6 and 8	Median values of the two adjacent judgments
Reciprocal	If the factor i is compared with j to determine B_{ij}, then the factor j is ompared with i to determine $B_{ij}=1/B_{ij}$

3.2.3. Hierarchical Single Ordering

Hierarchical single ordering refers to comparing a certain element in the upper layer with all the elements in this layer in pairs to obtain the importance order. It is represented by the eigenvector of the judgment matrix, and the specific calculation can be conducted according to the judgment matrix A. For example, the solution vector W of the characteristic problem $AW = \lambda_{max}W$ of the judgment matrix A is the ordering weight of the relative importance of elements in the same level to an element in the previous level after normalization. This process is called hierarchical single ordering.

To ensure the credibility of hierarchical single ordering, it is necessary to test the consistency of the judgment matrix, that is, to calculate the random consistency ratio.

Consistency index:

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{1}$$

λ_{max} is the maximum eigenvalue of A.

Random consistency indices are shown in the following table.

Table 3. Random Consistency Index of Judgment Matrix

Order n of judgment matrix	1	2	3	5	6	7	8	9	10
RI	0	0	0.58	1.12	1.24	1.32	1.41	1.45	1.49

Consistency ratio:

$$CR = \frac{CI}{RI} = \frac{\lambda_{max} - n}{RI \cdot (n-1)} \tag{2}$$

Only when CR<0.1, the result of hierarchical single ordering is credible; otherwise, the values of each element of the judgment matrix should be readjusted.

3.2.4. Hierarchical Total Ordering and Consistency Test

Hierarchical total ordering is to calculate the weight value of the relative importance of all elements in the same hierarchy to the total goal, with the calculation conducted from the top layer to the bottom layer.

In the whole process of AHP, not only the consistency test of each judgment matrix is needed, but also the combination consistency test is needed, which can be carried out layer by layer.

Then, the combined consistency ratio of layer p to layer 1 is:

$$CR^{(P)} = CR^{(P-1)} + \frac{CI^{(P)}}{RI^{(P)}}, \quad p = 3,4,\cdots,s \tag{3}$$

When CR＜0.1, the results of hierarchical total ordering have good consistency; otherwise, it is necessary to readjust the element values of the judgment matrix. Based on the model, CR=0. 073956<0.1 shows that the model is reasonable.

3.3. Index Weight Table

The index weight table obtained based on the AHP structure model constructed above is shown in the following table.

Table 4. Index Weight Table of Digital Economy Development

Primary Index	Secondary Index	Tertiary Index	Tertiary Index Weight	Index Ordering
Digital Economy Development	Digital Infrastructure	Mobile Phone Penetration	0.2628	1
		Fixed Telephone Penetration	0.1336	2
		Number of Internet Broadband Access Ports	0.0771	4
		Number of Fixed Internet Broadband Access Users	0.0392	6
	Digital Industrialization	Total Telecommunication Service	0.1336	2
		Number of Internet-related Employees	0.0679	5
		Number of Companies in ICT Industry	0.0392	6
		Revenue from Internet Technology Services	0.0199	8
	Digitalization of the Industry	E-commerce Transaction Volume	0.0189	9
		Percentage of Businesses with E-Commerce Activities	0.0109	11
		Number of Websites per 100 Businesses	0.0373	7
		Number of Computers Used per 100 people	0.0833	3
	Digital Innovation Capabilities	R&D Spending as a Percentage of GDP	0.0392	6
		Number of R&D Personnel	0.0115	10
		Inventive Patent Application	0.0058	12
		Number of Colleges and Universities	0.0199	8

The AHP index weight chart is shown in Figure 2 below.

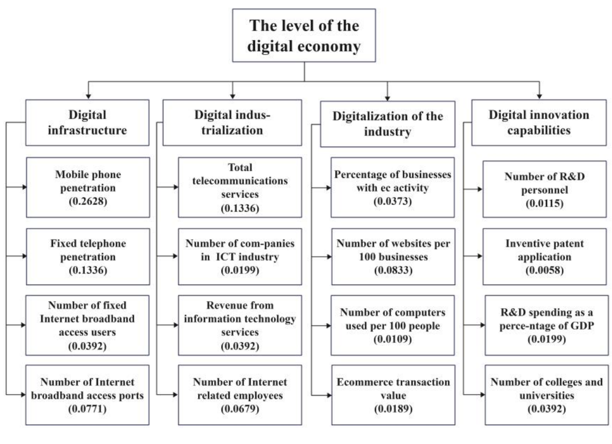

Figure 2. Index Weight Chart of Digital Economy Development

4. TOPSIS Comprehensive Evaluation

TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) is a commonly used comprehensive evaluation. According to the limited original data, it reflects the gap between the evaluation object and the ideal target for ordering. It is an evaluation of the relative advantages and disadvantages of the existing evaluation objects. The rule of scheme ordering is to compare each solution with the best and the worst. If one is close to the best and far away from the worst, it is the best scheme.

4.1. Construction of the Decision Matrix

A decision matrix $A=(aij)_{mxn}$ is constructed. Each column of the matrix represents an evaluation index, with each row as a different evaluation scheme.

To remove the influence of dimensions and facilitate comparison, this paper uses the range transformation method to normalize the decision matrix A, which obtains $B=(bij)_{mxn}$, where

1) If the data is with a very large attribute:

$$b_{ij} = \frac{a_{ij} - a_j^{min}}{a_j^{max} - a_j^{min}} \tag{4}$$

2) If the data is with a very small attribute:

$$b_{ij} = \frac{a_j^{max} - a_{ij}}{a_j^{max} - a_j^{min}} \tag{5}$$

4.2. Index Weight Assignment

Weight assignment is an important step in the TOPSIS comprehensive evaluation. According to the different contribution degrees of indices to the evaluation object, different weights are assigned. In this paper, AHP is used to establish the AHP structure model and the weight matrix w, and then the weighted canonical matrix $C=(cij)_{mxn}$ is obtained.

4.3. Determination of Positive and Negative Ideal Solutions

Determine positive and negative ideal solutions:

$$C^+ = [c_1^+, c_2^+, \ldots, c_n^+]; \tag{6}$$

$$C^- = [c_1^-, c_2^-, \ldots, c_n^-]; \tag{7}$$

Positive ideal solution:

$$c_j^+ = \begin{cases} \max c_{ij}, j & \text{Is a very large attribute} \\ \min c_{ij}, j & \text{Is a very small attribute} \end{cases} \qquad j = 1, 2, \ldots, n \tag{8}$$

Negative ideal solution:

$$c_j^- = \begin{cases} \min c_{ij}, j & \text{Is a very large attribute} \\ \max c_{ij}, j & \text{Is a very small attribute} \end{cases} \qquad j = 1, 2, \ldots, n \tag{9}$$

4.4. Calculation of the Distance from the Scheme to the Positive and Negative Ideal Solutions

The distance from the scheme to be evaluated ai to the positive ideal solution:

$$d_i^* = \sqrt{\sum_{j=1}^{n}\left(c_{ij} - c_j^+\right)^2} \quad i = 1, 2, \dots, m; \tag{10}$$

The distance from the scheme to be evaluated ai to the negative ideal solution:

$$d_i^0 = \sqrt{\sum_{j=1}^{n}\left(c_{ij} - c_j^-\right)^2} \quad i = 1, 2, \dots, m; \tag{11}$$

4.5. Calculation of Relative Closeness

Calculate the relative closeness of each scheme to be evaluated:

$$f_i = \frac{d_i^0}{d_i^0 + d_i^*} \quad i = 1, 2, \dots, m; \tag{12}$$

Then arrange from big to small to get the relative advantages and disadvantages of each scheme.

4.6. TOPSIS Empirical Analysis

Python3.11.5 is used to establish the model by adopting the above-mentioned related formulas, with the evaluation scores of the provinces in the middle and lower reaches of the Yangtze River shown in the following Table 5.

Table 5. Evaluation Scores of Provinces in the Middle and Lower Reaches of the Yangtze River

Province	Score	Ordering
Zhejiang Province	0.5202	2
Jiangsu Province	0.4680	3
Shanghai	0.6770	1
Anhui Province	0.1276	6
Hunan Province	0.1341	4
Hubei Province	0.1333	5
Jiangxi Province	0.0551	7

5. Conclusion

(1) Shanghai has the highest digital economy development with an evaluation score of 0.6770

First of all, Shanghai has invested a lot of money and resources in digital infrastructure construction. At present, a total of 88,000 5G base stations have been built and used in the city, and the construction density of 5G base stations ranks first in the country. Nowadays, the 5G network basically covers the whole city of Shanghai, and the Gigabit optical network can reach thousands of households in Shanghai. Secondly, in terms of digitalization of the industry, Shanghai vigorously carries out digital transformation and encourages enterprises to conduct e-commerce transactions. In 2022, Shanghai will speed up the construction of 25 digital life benchmark scenes, build 40 smart factories, and set up the digital assets section of the Shanghai Data Exchange [15]. Thus, the proportion of enterprises with e-commerce activities and e-commerce transaction volume in Shanghai is ahead of other regions in the middle and lower reaches of the Yangtze River. Finally, as a new industry, the Shanghai Municipal Government has already taken various measures to promote digital industry development and provided employment guidance and skills training. In 2022, the number of digital core enterprises in Shanghai exceeded 1,200, the scale of core industries was nearly 340 billion yuan, and the number of Internet-related employees was 534,300, much higher than other areas in the middle and lower reaches of the Yangtze River. It can be seen that the construction of digital infrastructure, the number of digital core enterprises, and the cultivation of Internet talents are the main driving forces to promote the digital economy in Shanghai.

(2) The following regions with better digital economy development are Zhejiang and Jiangsu Provinces, with evaluation scores of 0.5202 and 0.4680 respectively

Zhejiang Province has implemented the in-depth co-construction of telecommunications, China Unicom, mobile, radio and television, and 5G networks, which has promoted its digital infrastructure construction to be in a leading position in China. Zhejiang Province insists on building a perfect digital economy industrial chain, which makes the number of ICT enterprises and the total amount of telecommunications services at a high level, effectively boosting its digital economy level. Finally, the digital economy industry in Zhejiang Province has invested heavily in scientific and technological innovation, and the number of inventive patent applications has steadily increased, which are inexhaustible sources of the rapid development of the digital economy. Jiangsu Province continues to exert its strength in the field of digital infrastructure. For example, relevant departments have formulated the *Implementation Plan for Accelerating Digital Economy in Jiangsu Province*. In 2022, Jiangsu Province has built a total of 187,000 5G base stations, ranking second in the country, with an average penetration rate of 124.1 mobile phones and 77.0496 million Internet broadband access ports. However, there are few leading enterprises in Jiangsu Province that guide and drive the development of other small and medium-sized enterprises [16]. Different from Jiangsu Province, Zhejiang Province has enterprises with annual operating income exceeding 100 billion, such as Alibaba (China) and Zhejiang Rong Sheng Holding Group, which lead and drive the development of other small and medium-sized enterprises in Zhejiang Province with their influence at home and abroad. Therefore, few influential leading enterprises in the digital economy in Jiangsu Province have become the weakness of its digital economy development.

(3) The provinces with medium digital economy development are Hunan, Hubei and Anhui Provinces, with evaluation scores of 0.1341, 0.1333 and 0.1276 respectively

In 2022, the number of ICT industry enterprises in Hunan Province reached 49,864, and the number of websites per 100 enterprises was 45.5, which indicated that the Hunan provincial government continued to promote the overall project and fund management, enhancing the steady growth of the digital economy. However, the digital economy development in Hunan Province still faces the problem that the independent innovation capabilities of enterprises are relatively weak, especially the number of inventive patent applications is small, only 43,973. This may be related to the shortage of ability to train high-level comprehensive talents and the low investment in innovation in Hunan Province. By building a trillion-dollar industrial cluster of digital product manufacturing industry, the Hubei provincial government has realized the quality improvement and multiplication of core industries of the digital economy and promoted the digital development of industries. Nevertheless, the shortage of digital talents in Hubei Province leads to the low level of R&D funds in GDP and the number of R&D personnel, which limits its digital economy development. The number and quality of advantageous enterprises in Anhui Province have improved in 2022. For example, during the 13th Five-Year Plan period, the annual operating income of iFlytek exceeded 10 billion yuan. However, the scale of the software and information technology service industry in Anhui Province is still small with a poor foundation. In 2022, the income of Internet service technology will only reach 26.44 billion yuan, which may be related to the lacking of supply of digital talents, its insufficient optimization of industrial structure and the large proportion of traditional industries.

(4) Jiangxi Province has the worst digital economy development, with an evaluation score of 0.0551

Although mobile phones and Internet-related facilities in Jiangxi Province have been widely used in various urban areas, the penetration of information network infrastructure such as 5G network is still not as good as that in rural or remote areas, which affects the popularization of digital services and the application of information infrastructure system. In addition, Jiangxi's financial strength is weak, its GDP is lower than the national average, which depends on the transfer payment of the central government, hindering the development of digital infrastructure construction in Jiangsu Province.

There are some shortcomings in the application of digital technology in Jiangxi Province. The number of ICT industry enterprises, e-commerce transaction volume and revenues of Internet technology services in Jiangxi Province are generally at a low level. This may be because although some enterprises and institutions have begun to try to use big data, artificial intelligence and other technologies, the overall application level is not high. Many enterprises and institutions still stay in the traditional data processing and analysis methods, short of understanding and mastery of the application of new technologies. This limits the speed and effect of digital transformation and upgrading in Jiangxi Province. Finally, its supply and demand capacity of digital talents is weak, which may be related to the shortage of comprehensive high-skilled digital talents who are proficient in digital technology, the small market share occupied by the core industries of the digital economy, and the lack of sufficient preferential policies to promote the digital transformation of enterprises and the high degree of aging.

6. Suggestions

6.1. All Provinces Should Focus on the Digital Infrastructure Development

China should increase infrastructure construction in ICT to lay a solid material foundation for the digital economy development. First of all, governments should broaden the sources of investment, not limited to the transfer payment of the central government to build digital infrastructure, but increase investment in digital infrastructure construction through a wide range of private capital and multiple channels. All kinds of explicit or implicit thresholds that restrict the entry of private enterprises in basic telecommunications operations should be removed. Besides, we should expand investment in information and communication infrastructure construction [17]. Secondly, governments should expand the penetration of 5G information networks and pay attention to the penetration rate of mobile phones in rural and remote areas. By increasing the capacity of mobile switches and metropolitan area networks, the construction of 5G and Gigabit optical networks can be steadily and orderly promoted, and the co-construction and sharing of networks can be deepened. Governments should also accelerate the construction of new infrastructure and digital transformation in various places, along with building a new information infrastructure with cloud network penetration as its core feature. For example, the "Smart Cloud Network" built by Shanghai can use independent and controllable new technologies such as software definition, artificial intelligence and cloud nativity to realize a comprehensive intelligent information infrastructure integrating "cloud network edge security" and further boost the digital transformation.

6.2. Optimize and Reform the Industrial Structure and Deeply Integrate Digital Technology and Industry

First of all, the government should actively guide the extensive participation of market forces by encouraging enterprises to hold shares, and form a benign interactive pattern of government, enterprises, industries and other multi-subjects [18]. Secondly, the digital transformation of traditional enterprises can be promoted by integrating high-tech with enterprise production. For example, the Zhejiang provincial government focuses on building a "future factory" with the goal of digital empowerment and digital innovation, which is committed to integrating high and new technology into traditional factories, and driving multiple robots for personalized customized production by one person. This measure has transformed many traditional workshops into intelligent, lean and digital modern new enterprises, and accelerated the deep integration of digital technology and industry. At the same time, governments have increased the use of high-tech in traditional industries such as energy and medical care, so as to accelerate the transformation and upgrading of production and operation modes in traditional industries. We should also pay attention to the cooperation between Internet enterprises and traditional industries, optimize the business model of traditional industries and promote the intelligence of traditional industries by taking advantage of the technology, traffic and data advantages of Internet enterprises. The country should also introduce relevant policies to encourage provinces to speed up the transformation and upgrading of traditional communication networks, and introduce cloud computing and the Internet of Things to meet the needs of large-scale data transmission and real-time interaction, while promoting the intelligentization of communication networks.

6.3. The Government Should Pay Attention to Digital Innovation Capability and Cooperation to Build Digital Core Enterprises

In addition to actively coordinating data resources, high-tech digital technologies and other elements, all provinces should help enterprises break through technical barriers by vigorously cultivating high-tech talents and studying at home and abroad, and focus on overcoming key core technical problems in superconducting chips, AI and other fields [19]. All provinces should actively build a characteristic gathering area of the "Digital Trade Demonstration Zone", cultivate strong IP and leading enterprises, and lead a number of major digital service projects with their own characteristics. For example, to give full play to the digital economy of Zhejiang Province, the Zhejiang Provincial Government has built a pioneering demonstration zone for digital trade in Zhejiang Province, which promoted the digital economy of Zhejiang Province by creating regional data center clusters and intelligent computing centers, exploring the co-construction and sharing mechanism of new facilities such as big data centers, and supporting cloud service enterprises to set up offshore cloud platforms in key markets. In addition, provinces can also carry out in-depth cooperation with other countries and regions in the world with the help of the Belt and Road Initiative and RCEP agreements, so as to play a greater role in enhancing their digital innovation capabilities. As for big data, "Internet Plus" and cloud computing, enterprises should also be encouraged to build core industrial clusters and improve industrial competitiveness by relying on industrial bases.

6.4. Pay Attention to Personnel Training and Introduction, and Promote the Deep Industry-University-Research Integration

First of all, the provincial governments should introduce outstanding talents with relevant management experience, including talents from home and abroad, to improve the overall quality and synergy of the industrial digital construction team and enhance the ability of industrial digital talents to serve the local area. Meanwhile, the government should not only take the initiative to take the lead and plan the cooperation between local resources and universities, combine local research and overall planning, but also attract external innovation resources to enter scientific research institutes and universities, and serve the innovation system with enterprises as the main body [20]. On top of responding to the talent policy promulgated by the government and providing more high-quality courses for Internet employees in various ways, enterprises should improve the professional quality of employees, realize the balance between supply and demand of Internet technicians, and enable employees to keep pace with the times in terms of their professional skills. The government should not only strengthen cooperation with universities and research institutes, but also use the Internet, artificial intelligence and other technologies to build targeted and intelligent digital talent training platforms, so as to provide talent guarantees for the digital management of enterprises and further enhance the quality and quantity of Internet-related employees in various provinces, achieving the in-depth industry-university-research integration.

References

[1] Muhammad, J., Dominic, P. D., Naseebullah, et al. (2011). Towards digital economy: The development of ICT and E-commerce in Malaysia. Modern Applied Science, 5(2), 23-34.

[2] Billon, M., Lera-Lopez, F. & Marco, R. (2016). ICT use by households and firms in the EU:links and determinants from a multivariate perspective. Review of World Economics, (4), 629-654.

[3] Broekel, T., Brenner, T. & Buerger, M. (2015). An investigation of the relation between cooperation intensity and the innovative success of German regions. Spatial Economic Analysis, 10(1), 52-78.

[4] Vujica, L. & Tamara, D. (2014). The digital economy in developing countries challenges and opportunities. International Convention on Information & Communication Technology. Electronics & Microelectronics, (37), 1580-1585.

[5] Richter, C., Kraus, S. & Brem, A. (2017). Digital entrepreneurship: Innovative business models for the sharing economy. Creativity and Innovation Management, 26(3), 300-310.

[6] Jiao, S. T. & Sun, Q. B. (2021). Research on the measurement and influencing factors of China's digital economy development. The World of Survey and Research, (07), 13-23.

[7] Cai, S. H., Gu, C. & Zhang, Z. J. (2022). Research on temporal and spatial characteristics and influencing factors of China's provincial digital economy. East China Economic Management, (07), 1-9.

[8] Du, G. F. & Long, Z. W. (2023). A comprehensive evaluation of digital economy development level in Hunan province based on TOPSIS-Entropy method. Mathematics in Practice and Theory, 53(9), 257-266.

[9] Nie, C. T. & Zhang, F. (2022). Regional differences and driving factors of the digital economy development level in China: An empirical analysis based on spatial panel model. Journal of Technical Economics & Management, (04), 105-110.

[10] Corrocher, N. & Ordanini, A. (2002). Measuring the digital divide:a framework for the analysis of cross-country differences. Journal of Information Technology, 17(1), 9-19.

[11] Zhao, F., Wallis, J. & Singh, M. (2015). E-government development and the digital economy: A reciprocal relationship. Internet Research, 25(5), 734-766.

[12] Juha, I. (2017). How can we measure the economy in the digital era? Economic Outlook, 3-13.

[13] Zhang, B. C. & Shen, K. Y. (2018). Quantitative evaluation and characteristics of the development readiness in digital economy for the Belt and Road countries. Shanghai Journal of Economics, (1), 94-103.

[14] Liu, C. K., Jiang, Y., Zhang, Q. H. & Zhu, X. F. (2022). Research on statistical measure and spatiotemporal trend of the development level of digital economy. Journal of Industrial Technological Economics, 41(02), 129-136.

[15] Ruan, C. R. (2023). Analysis on the realistic foundation and path of new infrastructure leading the development of digital economy in Shanghai. Shanghai Business, (11), 10-12.

[16] Cao, X. L. Analysis and countermeasures of digital economy development in Jiangsu—Comparison with Guangdong and Zhejiang. Jiangnan Forum, (9), 18-22.

[17] Jiao, Y. X. Research on the development and influencing factors of digital economy in China. Hangzhou: Master's Dissertation of Hangzhou Dianzi University.

[18] Han, F. & Lang, Y. K. Factors influencing industries' digital transformation and paths of improving industries: An exploratory study based on industrial digitalization in Zhejiang Province. Big Data Time, (8), 38-46.

[19] Meng, J. Research on the strategies for empowering the transformation and upgrading of Anhui Province's manufacturing industry with the digital economy. Jiangsu Commercial Forum, (11), 108-111.

[20] Zhang, Z. H. & Chen, H. X. Research on the choice of industry-university-research cooperation mode in Jiangsu Province. Jiangsu Higher Education, (4), 48-50.