RSR Method based Evaluation of City Digital Business Environment

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ABSTRACT

Using RSR method and SPSS software, this paper constructs a comprehensive evaluation system of digital business environment from six dimensions: public service, human resources, market environment, financial service, innovation environment and basic digital economy, and comprehensively evaluates the digital business environment of 16 prefecture level cities in Anhui Province of China. The results show that the development of digital business environment among regions in Anhui Province is unbalanced: Hefei and Wuhu have the best digital business environment and are at the leading level, followed by Chuzhou, Fuyang, Ma'anshan, Bengbu, Anqing, Lu'an, Suzhou, Huainan, Xuancheng, Bozhou, Tongling, Huaibei and Huangshan, Chizhou ranked last. It is concluded that the RSR method can scientifically evaluate the digital business environment. To set a first-class digital business environment, efforts need to be made to further optimize market environment, improve public services and increase human resources.

Keywords: Digital Business Environment, Comprehensive Evaluation, RSR Method

1. INTRODUCTION

With the rapid development of digital economy in the post-epidemic era, competition in digital transformation is intensifying among countries, optimizing the digital business environment has become an important measure to foster new drivers of China's economic growth. At the apec Economic Leaders' Meeting in 2021, President Xi Jinping stressed efforts to build an open, fair and non-discriminatory digital business environment, and put forward the concept of "digital business environment" for the first time on the international stage, pointing a new direction for unleashing the potential of digital economy and economic recovery. From a global perspective, the United Nations, the World Bank and other international organizations have taken the lead in launching comprehensive evaluation projects on the digital business environment. However, due to differences in national conditions and voices, the evaluation standards of the digital business environment developed by European and American countries are not suitable for the national conditions of all countries and cannot provide neutral and objective evaluation results. Therefore, China urgently needs to build a localized comprehensive evaluation system of digital business environment based on the traditional evaluation standard of business environment

according to the actual situation, and export "Chinese plan" to match the international standard[1].

In recent years, Anhui province's digital economy has developed rapidly, but the corresponding digital business environment construction and evaluation system needs to be strengthened. According to the "Business environment ranking of 26 cities in the Yangtze River Delta" released by the National Governance Institute of Tsinghua University, Anhui province ranks relatively low[2].Under the new round of regional competition promoted by digital economy, how to further evaluate and optimize the digital business environment of Anhui Province has become the key to promote the higher quality integrated development of Yangtze River Delta. Therefore, on the basis of traditional business environment evaluation indexes, this paper constructed Anhui province digital business environment comprehensive evaluation index system from six dimensions such as public service, classified and comprehensively evaluated the digital business environment of 16 prefecture-level cities in Anhui province by RSR method, calculated the regression model, and obtained the key indicators affecting the digital business environment in Anhui Province, so as to provide reference for relevant departments.

2. LITERATURE REVIEW

There has been a long history of research on the evaluation of business environment at home and abroad. The most widely used is the comprehensive evaluation system constructed by the World Bank in the Doing Business Report, which evaluates the business environment of 190 economies in the world from ten indicators such as start-up business, property registration and credit access (World Bank, 2020)[3].In 2017, The United Nations Conference on Trade and Development (UNCTAD) put forward the concept of digital business for the first time and evaluated digital business from the two dimensions of digital start-ups and digital platforms[4].That same year, the world bank began to build a global digital business indicators (Digital Business Indicators) , and in the next few years, from the network connection, digital market regulation and other five aspects to measure hundreds of countries around the world[6].However, the digital business indicators mainly constructed by European and American countries also ignore the differences in national conditions of different countries, and the evaluation standards and results cannot objectively and neutralize the actual situation of each country (Mengzi Wang, Limei Yin, 2021) [7]. Therefore, the digital business environment evaluation index system urgently needs to be localized and offer a China evidence.

In recent years, Chinese scholars have constructed business environment comprehensive evaluation system based on localization from different angles. For example, the Guangdong-Hong Kong-Macao Greater Bay Area Research Institute builds a business environment evaluation system from six dimensions, including soft environment and business cost environment (Chenxing Chen, Yanbing Geng, 2017) [8];Zhijun Li, Yunzhou Du et al. comprehensively evaluated the business environment of different cities from the perspectives of public service, human resources, financial service, market environment and innovation environment (Zhijun Li, 2019[9];Yunzhou Du et al., 2020[10]). These index systems provide reference for building a comprehensive evaluation system of digital business environment in China.

To sum up, traditional business environment evaluation at home and abroad has achieved fruitful

results, but the design of digital business environment evaluation system is just at an initial stage. At present, there are few quantitative researches in this field, especially based on the urban level of Anhui Province. Furthermore, there is still a lack of unified and comprehensive evaluation system for the study of digital business environment in China. Therefore, this article, on the basis of the traditional business environment evaluation index, constructed the comprehensive evaluation system of digital business environment from six dimensions, namely public service, human resources, financial services, market environment, innovation environment, and basic digital economy. By using RSR rank method, the digital business environment of 16 prefecture-level cities in Anhui province is comprehensively evaluated. Through the innovation of evaluation method and evaluation index system, it contributes to the existing literature and provides policy reference through empirical analysis.

3. RESEARCH DESIGN

3.1. Construction of comprehensive evaluation indicators

Based on the traditional business environment evaluation system constructed by Zhijun Li (2019) [9], Yunzhou Du and other (2020) [10] scholars, the basic digital economy dimension of CCID China digital economy index system is introduced to construct the comprehensive evaluation index system of digital business environment in Anhui Province. According to the actual situation of the current economic development in Anhui province and the availability of data, this paper follows the principle of objectivity and comprehensiveness when constructing the evaluation index system. To ensure the representativeness and operability of the evaluation indicators, a digital business environment comprehensive evaluation system with six first-level indicators including public services, human resources, financial services, market environment, innovation environment and basic digital economy and 23 second-level indicators has been established. See Table 1 for detailed indicators.

Table 1. Digital business environment evaluation index system of prefecture-level cities in Anhui Province

Level indicators	Secondary indicators	Data source
	General budgetary expenditure (ten thousand yuan)	①
	Road Area per capita (m2 / person)	①
Public service	Water supply capacity (ten thousand tons)	②
	Gas supply capacity (10,000 m3)	①
	Power supply capacity (ten thousand KWH)	①

	Health services - Number of hospital beds (per 10,000 persons)	①
	Average wage level of employed staff and workers (YUAN)	①
Human Resources	Population with college education or above per 100,000 population (persons)	②
	College enrollment	①
	Number of Employees at year-end (ten thousand)	①
Financial services	Balance of various LOANS of financial institutions at year-end (ten thousand yuan)	①
	Balance of Various RMB deposits of financial institutions at year-end (ten thousand yuan)	①
	Total current Assets of Industrial enterprises above designated size (ten thousand yuan)	①
Market Environment	Total profit of industrial enterprises above designated size (ten thousand yuan)	①
	Per capita GDP (yuan)	①
	Total investment in fixed assets (ten thousand yuan)	①
	Actual amount of foreign capital used in that year (ten thousand yuan)	③
Innovation environment	Science and technology Expenditure (ten thousand yuan)	①
	Number of patents granted per 10,000 R&D personnel	①
	Total factor productivity	①
Basic digital economy	Telecom business income (ten thousand yuan)	①
	Year-end Mobile Phone Users (ten thousand)	①
	Internet Broadband Access users (10,000 households)	①

Note: Data sources ①China Urban Statistical Yearbook 2020; ②Anhui Provincial Bureau of Statistics; ③Statistical bulletin of each city.

3.2. Data sources

The data of this study mainly come from three sources: first, the index of "water supply capacity" in the public service part, and "population with college education or above per 100,000 population" in the human resources part come from Anhui Provincial Bureau of Statistics; Second, the "actual amount of foreign capital used in that year" in the market environment part comes from the statistical bulletin of Anhui province; Other indicators are from the statistical data of China Urban Statistical Yearbook 2020.

In order to ensure the comparability and comprehensiveness of the data, the single index is represented by the directly obtained statistical data of various prefecture-level cities in Anhui Province, and is processed dimensionless through the initial value method.

3.3. Evaluation methods

(1) RSR Rank-sum Ratio

The RSR rank sum ratio method proposed by Professor Fengdiao Tian was used to conduct statistical treatment and comprehensive evaluation for each parameter and non-parameter[11].This method combines the advantages of classical parametric statistics and modern nonparametric statistics, which can effectively eliminate the interference of outliers and make the results more accurate. At present, RSR is mainly applied to comprehensive evaluation in the medical field, but seldom applied in the field of digital business environment evaluation.

The first step is to list the original data table, assuming that there are n samples to be evaluated and p evaluation indexes, forming the original index data matrix.

$$X = \begin{pmatrix} X11 & \cdots & X1p \\ \vdots & \ddots & \vdots \\ Xn1 & \cdots & Xnp \end{pmatrix}$$

Where X represents the value of the JTH item evaluation index of the ith sample.

In the second step, rank R is obtained according to the rank value of each specific evaluation index. The original

evaluation index value is replaced by R, and the rank data matrix of each index is established according to the rank ranking results.

$$R = \begin{pmatrix} R11 & \cdots & R1p \\ \vdots & \ddots & \vdots \\ Rn1 & \cdots & Rnp \end{pmatrix}$$

R_{ij}: represents the rank of the JTH evaluation index of the ith sample.

In the third step, Rank and ratio of RSR of each evaluation object is calculated according to the ranking of each evaluation index, and the formula is as follows:

$$RSR = \frac{\sum_{j=1}^{m} Rij}{mn}$$

In the above formula, RSRi (I =1,2... N) represents the rank sum ratio of the ith object.

In the forthstep, rank the RSR values from small to large, compile the FREQUENCY distribution table of RSR, list the frequency F of each group and the cumulative frequency $\sum$ F of each group, and determine the rank range and average rank of each RSR. With Probit as independent variable and RSR as dependent variable, the linear regression equation with significant statistical significance was fitted (P <0.01):

$$RSR = A + B * Probit$$

The fifth step is to classify and sort according to Probit, which is generally divided into 3 to 5 grades. The variance of each grade is consistent, and there must be significant difference between each grade. The grading boundary value (that is, the predicted VALUE of RSR) was obtained according to the above regression equation, and then the RSR was sorted.

4. RESEARCH RESULTS

RSR rank-sum ratio method mainly carries out comprehensive evaluation through RSR value calculation, RSR distribution calculation, model construction fitting, grading sorting critical value and grading sorting results. First of all, in the comprehensive evaluation index system of digital business environment in Anhui Province, 23 second-level indicators are all high quality indicators. The RSR value of each indicator is calculated by using the whole method, and the RSR ranking is carried out. Then, the RSR values were combined to the RSR distribution values (from 0.269 to 0.9511), and the frequency, cumulative frequency and average rank value of each distribution value were calculated (as shown in Table 2).Based on the mean rank /n value, the Probit value of the probability distribution (ranging from 3.466 to 7.154) was calculated.

Table 2. RSR distribution table

RSR points value	Frequency f	Cumulative frequency Σ f	Average rank	Average rank /n*100%	Probit value
0.269	1	1	1	6.3	3.466
0.2772	1	2	2	12.5	3.85
0.3478	1	3	3	18.8	4.113
0.3614	1	4	4	25	4.326
0.4185	1	5	5	31.3	4.511
0.4429	1	6	6	37.5	4.681
0.4457	1	7	7	43.8	4.843
0.4592	1	8	8	50	5
0.5611	1	9	9	56.3	5.157
0.591	1	10	10	62.5	5.319
0.6141	1	11	11	68.8	5.489
0.6196	1	12	12	75	5.674
0.6332	1	13	13	81.3	5.887
0.6821	1	14	14	87.5	6.15
0.8261	1	15	15	93.8	6.534
0.9511	1	16	16	98.4	7.154

Note: The grey table is estimated by (1-1/4*n)

According to the data of regression model table (Table 3), the following linear regression equation can be obtained:

RSR=-0.437+0.987Y

Through variance analysis, F value is calculated to be 535.066, P value is less than 0.01, R2 is 0.975, indicating that the linear regression equation has significant statistical significance and the result is ideal.

Table 3. Regression model table

	Nonstandardized coefficient		Normalization coefficient	T	p	R²	Adjusted R²	F
	B	Standard error	Beta					
constant	-0.437	0.043	-	-10.26	0	0.975	0.973	F (1,14)=535.066,p=0.000
Probit value	0.189	0.008	0.987	23.131	0			

Note: dependent variable is the RSR distribution value

As shown in Table 4, the Probit critical value was substituted into the regression model and the RSR fitting value was calculated. According to RSR fitting value, Probit critical value and regression equation, the comprehensive index is divided into four grades by using the principle of optimal grading.

Table 4. Table of threshold values for classification sorting

Grade	Percentile threshold	Probit threshold	RSR threshold（fitting values）
First gear	< 6.681	< 4	< 0.223
Second gear	6.681 ~	4 ~	0.223 ~
Third gear	50.000 ~	5 ~	0.506 ~
Forth gear	93.319 ~	7 ~	0.789 ~

Finally, the grade level and ranking results are shown in Table 5. The higher the grade is, the better the effect is. It can be seen that Hefei has the highest RSR (0.953) and the best digital business environment, followed by Wuhu (0.831), and the two cities are in the fourth gear. Six cities were in the third gear, including Chuzhou, Fuyang, Ma 'anshan, Bengbu, Anqing and Lu 'an. There are seven cities in the second gear, including Suzhou, Huainan, Xuancheng, Bozhou, Tongling, Huaibei and Huangshan. Chizhou is in the first gear with the lowest RSR (0.273).

Table 5. Table of classification and sorting results

City	RSR value	RSR ranking	RSR fitting values	Divide class level
Hefei	0.953	1	0.914	4
Wuhu	0.831	2	0.797	4
Chuzhou	0.684	3	0.724	3
Fuyang	0.633	4	0.674	3
Ma 'anshan	0.628	5	0.634	3
Bengbu	0.618	6	0.598	3
Anqing	0.59	7	0.566	3
Lu 'an	0.552	8	0.536	3
Suzhou	0.46	9	0.506	2
Huainan	0.435	10	0.476	2
Xuancheng	0.432	11	0.445	2
Bozhou	0.415	12	0.413	2

Tongling	0.383	13	0.378	2
Huaibei	0.336	14	0.338	2
Huangshan	0.277	15	0.288	2
Chizhou	0.273	16	0.215	1

5. DISCUSSION

According to the above evaluation results, the characteristics and regional differences of digital business environment in Anhui province are demonstrated. It is obvious that, the regional economic development of Anhui is unbalanced, and the digital business environment gap is large. According to RSR rank sum method, Hefei and Wuhu are ranked fourth and have the best digital business environment. The reasons can be considered from the key dimensions of comprehensive evaluation. In recent years, the dividend of the integration of the Yangtze River Delta has brought more opportunities to Hefei and Wuhu in terms of industrial layout, scientific and technological development and talent attraction. Entering the digital era, Hefei gathers remarkable innovation resources. As a comprehensive national science and technology center, Hefei has giant high-tech enterprises represented by IFlytek and BOE, focusing on emerging fields such as artificial intelligence and new energy. And this rapidly developing city has also attracted various national laboratories and national major scientific installations, bringing abundant high-end human resources. Another city Wuhu takes the lead in the whole province in carrying out the system of "enterprise standard director", constantly promoting the reform of "delegating management and providing services", and improving the intelligent level of public services. As an important industrial town, Wuhu has been vigorously developing strategic emerging industries in recent years, promoting the demonstration construction of industrial Internet, exerting the agglomeration effect of the third generation semiconductor industry, and promoting quick development of Internet and online business industries. Industrial clusters such as Wuhu Robot Industrial Park have also taken over the industries of core cities such as Shanghai. The advantages of market environment, innovation environment and human resources have greatly promoted the development of digital business environment in Hefei and Wuhu, and also played an exemplary and leading role in other cities in Anhui Province.

The seven cities with the worst digital business environment include Suzhou, Huainan, Xuancheng, Bozhou, Tongling, Huaibei and Huangshan. On the one hand, due to objective reasons, such as the small size of the city, the location advantage is not obvious; On the other hand, due to the high proportion of traditional industries, the development of emerging industries is insufficient, and the "brain drain" has long bothered policymakers in these cities. Therefore, to improve the digital business environment, it is necessary to promote emerging industries and strengthen the infrastructure of the digital economy, such as 5G base station construction, big data center, artificial intelligence and industrial Internet. But what deserves more attention is to supply better public services and market environment, as well as to breed abundant human resources.

6. CONCLUSION

Combining traditional business environment evaluation index and digital economy evaluation index, this study innovatively constructed a digital business environment comprehensive evaluation system. In terms of research methods, this paper applies RSR method for evaluation of digital business environment, which enriches the research results of urban digital development. The results show that the development of digital business environment is unbalanced among regions in Anhui Province. To build a first-class digital business environment, Anhui province should not only strengthen the infrastructure of digital economy, but also pay attention to the improvement of market environment, human resources and public service level. Limited by the availability of data, this study only introduces basic digital economy indicators, subsequent studies can continue to enrich the content of the comprehensive evaluation system from the aspects of digital industry and digital governance.

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