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Analysis of the Regional Competitiveness of the Telecommunications Industry

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This study presents the development status of the domestic telecommunications industry based on panel data from the 31 provinces in China, demonstrates the influence of the principal factors on the regional competitiveness of the industry by using the factor analysis method and calculates and ranks the comprehensive competitiveness of the industry in each province. Finally, the study determines the insufficiency of the regional development of the telecommunications industry and discusses some policy and regulation recommendations for healthy development of the industry.

Keywords: Telecommunications Industry; Regional Competitiveness; Factor Analysis

Introduction

Since the reform and opening-up of China, the telecommunications industry has experienced a process of rapid development in China, especially in the mobile phone market. In recent years, the development of the telecommunications industry has achieved a qualitative leap and has become the pillar industry of the national economic development. Because the government attaches significant importance to this industry, competition between regions is growing fiercer. Therefore, how to evaluate the advantages and disadvantages of the regional telecommunications industry development correctly and to foster core competitiveness of the regional telecommunications industry has become a hot topic in industrial and academic circles. Many scholars have analyzed the competitiveness of the telecommunications industry. Lars-Hendrik and Leonard built a model for the relationship between telecommunications investment and productivity[1]. They showed that telecommunications investment could improve the income of the telecommunications industry. Cieślik and Kaniewsk built a theoretical model for the relationship between the regional telecommunications industry infrastructure level and economic development[2]. They found a positive correlation. Susan and Siva researched disequilibrium of the regional telecommunications industry development and found that the economic gap between remote and rural areas and other regions widened because of poor telecommunications industry level[3]. Yan Ling Yu used model and data to show the competitiveness changes of Chinese telecommunications industry and its reasons before and after China's accession to the WTO[4]. Mu Qing and Keun Lee modified Lee and Lim's model of technological learning and catching-up and examined the growth of technological capability in the Chinese telecommunications industry. They found it was important for enhancing the competitiveness of Chinese telecommunications industry to improve technology[5]. Yue Liu and XinLin analyzed the competitiveness of Chinese telecommunications industry by using the data from 2004-2008. They found that the competitiveness of East is higher than in the West and Central area[6]. This study utilizes factor analysis to evaluate and analyze the telecommunications industry's competitiveness in the 31 provinces of China based on the theoretical framework of Porter's "diamond model".

Affecting Factors and Methods

Affecting Factors Selection

This study identifies the factors influencing the regional competitiveness of the telecommunications industry. Porter's "diamond model" is used to evaluate the competitiveness resources and the

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influencing factors of the industry of one country[7].This study uses research and development investment and the proportion of college students as the indicators of production factors, uses the consumption level of residents, the total number of regional telephone users, the number of regional mobile phone users, the number of internet broadband users, telecommunication income and the number of domain names as the indicators of Market demand, uses communication equipment manufacturing output and the number of communication equipment manufacturing investment as the indicators of regional telecommunications competitiveness, and uses the ratio of telecommunications investment in local telecommunications income and RPM as the indicators of enterprise strategies, structures and competitive forms.

Methods Selection

The factor analysis method is utilized to evaluate the regional telecommunications industry competitiveness. Thurston proposed the term "factor analysis" in 1931[8]. Factor analysis, a method of comprehensive evaluation, has a certain advantage when used for complex economic problems or when dealing with large amounts of data[9]. The calculation steps of factor analysis are as follows:

Set $x_1,\dots x_p$ as the problem evaluation index, and set sample observation matrix as X, which means that:

$$X = \begin{bmatrix} X_{11} & \dots & X_{1p} \\ X_{21} & \dots & X_{2p} \\ \dots & \dots & \dots \\ X_{n1} & \dots & X_{np} \end{bmatrix} \qquad \dots (1)$$

where P denotes the number of variables and n is the number of samples. Then, standardize the original sample data. The formula is:

$$Y_{ij} = \left[X_{ij} - \frac{\sum_{K=1}^{n} X_{kj}}{n} \Big/ \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(X_{kj} - \frac{\sum_{K=1}^{n} X_{kj}}{n}\right)^2} \right] \qquad \dots (2)$$

where X_{ij} is the j-th index value of the i-th sample, similarly to Y_{ij}. $(\sum^{n}_{k=1}X_{kj})/n$ is the average value of the j-th index in all samples. Use the Jacobi method to calculate the correlation coefficient matrix R of the standardized matrix Y and eigenvectors and eigenvalues of the coefficient matrix R. The eigenvalues satisfy $\lambda_1 \geq \lambda_2 » \dots » \lambda_n » 0$, and the eigenvector matrix is $U = (U_1, U_2, \dots, U_n)$. The main factor matrix is $F = U^T X = (F_1, F_2, \dots, F_n)$.On the basis of the principle of Kaiser, this study chooses factors whose eigenvalues are greater than 1. The cumulative variance percentage of these factors is equal to or greater than 0.8. The main factor matrix U is:

$$U_p \times_p = (U^{(1)}_{p\times m}\ U^{(2)}_{p\times(p-m)}) \qquad \dots (3)$$

$$F_p \times_n = \varepsilon \begin{vmatrix} F^{(1)}_{m\times n} \\ F^{(2)}_{(p-m)\times n} \end{vmatrix} \qquad \dots (4)$$

Then, $X=UF=U^{(1)}F^{(1)}+U^{(2)}F^{(2)}$. Make $U^{(2)}F^{(2)}$ as ε, so $X=U^{(1)}F^{(1)}+\varepsilon$. This formula is the factor analysis model. $U^{(1)}$ is the component matrix, and $F^{(1)}$ is a common factor. Finally, perform the orthogonal transformation on the factor loading matrix and calculate the points of common factors and total points of the sample.

Empirical analysis

This study chooses relevant telecommunications industry data from 31 provinces in China in 2011. The initial data are standardized. First, mark Z_i as the standardized variables. Then, check whether the factor analysis method is suitable for the data analysis in this study. The results of KMO and Bentley's ball test are in Table 1. The KMO of the samples is 0.698, which explains the significant correlation between the initial variables. The observation of Bentley's ball test is 599, and the corresponding P value is close to zero. Therefore, the null hypothesis is rejected, and the correlation coefficient matrix and identity matrix are significantly different. Therefore, the model is suitable for factor analysis.This study calculates the correlation coefficient matrix of the variable, extracts the common factor using the maximum variance method and extracts the number of common factors according to the ratio of the cumulated variance contribution. The cumulative variance of the three factors is more than 80% in table 2, so these three factors can reflect most information of the initial data.

Table 1—KMO and Bentley's ball test

Content	Value
KMO Measure of Sampling Adequacy	.698
Bentley's ball test of Sphericity Approx. Chi-Square	599.006
df	66
Sig.	.000

Table 2—Explanation of the total variance

Initial eigenvalues			Extracting and loading SOS			Rotating and loading SOS		
total	variance's	accumulation	total	variance's	accumulation	total	variance's	accumulation
6.792	56.598	56.598	6.792	56.598	56.598	6.118	50.987	50.987
2.023	16.860	73.458	2.023	16.860	73.458	2.086	17.385	68.372
1.277	10.638	84.096	1.277	10.638	84.098	1.887	15.724	84.096
.826	6.881	90.977						
.393	3.271	94.249						
.239	1.995	96.243						
.206	1.719	97.962						
.139	1.157	99.119						
.091	.758	99.876						
.010	.082	99.959						
.005	.039	99.998						
.000	.002	100.000						

Then, the factor loading matrix is obtained by the rotating factor by the largest variance orthogonal rotation method. The coefficients of variables that have larger absolute value in the first factor are V4, V5, V6, V7, V8, V9 and V10; the coefficients of variables that have larger absolute value in the second factor are V1 and V2; and the coefficients of variable that has larger absolute value in the third factor is V12. This study calculates the scores on every common factor of each province according to the factor score matrix.

The common factor score calculation is:

F1=0.011*V1-0.174*V2-0.005*V3+0.183*V4+…+0.011V12

F2=0.304*V1+0.574*V2-0.013*V3-0.086*V4+…-0.122V12

F3=-0.046*V1+0.041*V2-0.443*V3-0.056*V4+…+0.491V12

This study takes the contribution rate of the common factor variance as the weight to score the factors and obtain a comprehensive evaluation index ranking. The formula for calculating the comprehensive competitiveness of the telecommunications industry is:

ZF= (FI*50.99+F2*17.39+F3*15.72)/84.1

Result Analysis and Discussion

The scores of each province in the three common factors show the real condition of some factors that influence the local telecommunications industry. The first factor represents the demand and conditions of the related and supporting industries, the second represents the factor status in each province, and the third represents the impetus of promoting telecommunications industry competition in every province. The comprehensive evaluation score ranking represents the competitiveness power of the provincial telecommunications industry in the country.Table 4 shows the main development status of the telecommunications industry in China:

Table 3—Component score coefficient matrix

	Component		
	1	2	3
Zscore(V7)	.011	.304	-.046
Zscore(V4)	-.174	.574	.041
Zscore(V5)	-.005	-.013	-.443
Zscore(V6)	.183	-.086	-.056
Zscore(V9)	.186	-.098	-.053
Zscore(V8)	.170	-.047	-.032
Zscore(V10)	.177	-.066	.059
Zscore(V2)	.107	.041	.232
Zscore(V11)	.188	-.153	.113
Zscore(V1)	.105	.040	-.084
Zscore(V12)	.044	-.412	.151
Zscore(V3)	.011	-.122	.491

- There are many major provinces with high scores in table 3: Guangdong, Jiangsu, Zhejiang, Shandong, Shanghai, Beijing and Tianjin, which shows that the telecommunications industry of the southeast coastal area and the Beijing-Tianjin area is well-developed. The western area in China, such as Gansu, Qinghai, Ningxia, Guizhou and Chongqing, ranks at the bottom. The comprehensive evaluation scores of the western area in China are low, which indicates that the telecommunication industry of the western area is lagging. A lack of resources, lagging economic development, insufficient demand of the telecommunications industry and

Table 4—Comprehensive evaluation score of main districts

District	FAC1_1	FAC2_1	FAC3_1	Synthesis score	Ranking
Beijing	-0.32144	2.53162	2.37081	0.77	4
Tianjin	-0.89717	1.85937	0.70176	-0.03	12
Inner Mongolia	-0.43664	-1.0317	0.42124	-0.4	23
Shanghai	-0.00923	1.77068	1.66036	0.67	6
Jiangsu	2.15204	0.46211	-1.22099	1.17	2
Zhejiang	1.13104	0.44821	0.11548	0.8	3
Anhui	0.01101	0.22452	-1.58729	-0.24	18
Jiangxi	-0.38912	0.18896	-0.75873	-0.34	20
Shandong	1.2166	0.57049	-0.5513	0.75	5
Henan	0.57199	-0.52784	-0.33993	0.17	8
Hubei	-0.06842	0.83089	-0.88703	-0.04	14
Guangdong	3.89821	-0.97442	1.58614	2.46	1
Tibet	-0.81479	-2.07143	2.84692	-0.39	22
Qinghai	-0.70809	-1.77093	0.08292	-0.78	31
Xinjiang	-0.49749	-1.10641	-0.48026	-0.62	29

difficulty introducing telecommunications investment have prevented the development of telecommunications industry in the region.

- All three factors of the telecommunications industry competitiveness in the western area are generally lower than in the other regions, but the gap of the second factor score is particularly prominent, especially in Tibet, Qinghai, Xinjiang and Inner Mongolia. The second factor scores of the other areas in the west are almost all negative, which suggests that the western area in China is weak in production factors. The collated data show that advanced the factors of production in the west is particularly scarce.
- The regional telecommunications industry in Hunan, Hubei, Anhui and Jiangxi, which are located in the central part, is well-developed. The telecommunications industry in the central area has a middle ranking of competitiveness, but it cannot break through because of the lower third factor score, which affects overall competitiveness. This result reflects the insufficiency of enterprise competitiveness in the region, that is to say, the insufficiency of telecommunications investment.

Conclusion

This paper uses Porter's "diamond model" to systematically analyze the main factors influencing the development of the regional telecommunications industry and to evaluate the level of China's regional telecommunications industry competitiveness using factor analysis. From the analysis, this study shows that the telecommunications industry is developing rapidly overall in China, but the uneven development of the local telecommunications industry is the main factor restraining the development of the Chinese telecommunications industry. This study recommends focusing on advanced telecommunications personnel, telecommunications investment and technology to ensure the healthy development of the telecommunications industry.

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