Empirical Study of the Telecommunication Operation Performance Evaluation of Regional China

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Abstract—Based on the total assets and cost of main operations as input variables, the main business revenue and profit as the output variable in this paper, we build the operational performance evaluation model of China's telecom industry, based on DEA-CCR, and use the relevant data to measure the operational performance of different regions. The empirical results show that: the performance level of the telecom operators in China is relatively high and is not gathered, there is further room for improving telecom industry.

Keywords-DEA-CCR; telecom industry; operational performance

I.   MODEL CONSTRUCTION

Data Envelopment Analysis (DEA) is a method for evaluating the relative efficiency of the same type of multi index input and multi index output, as well as a powerful tool for multi-input multi-output function. In this paper, the DEA method is used to evaluate the performance of telecom industry in China.

Set up a total regions of n (n=30, excluding Tibet because of data problems), known as an evaluation unit of n (n=30). DMU_j ($j = 1, 2, \cdots, 30$), each evaluation unit has m (m=2) kinds of inputs, respectively, the total assets and the main business cost and has p (p=2) kinds of outputs, respectively, the main business revenue and total profit, so that there is an evaluation system of n unit for multi-index inputs and multi-index outputs, as shown in Fig. I[1-5].
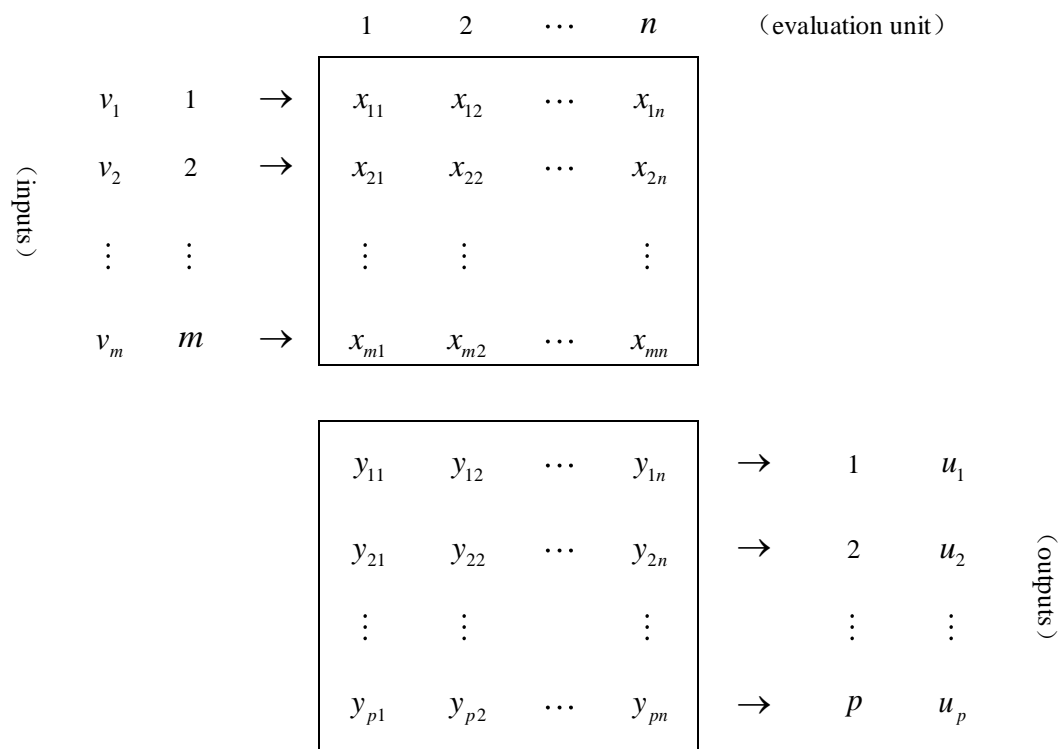

Figure 1. DEA evaluation system of telecom operators in China

In the figure, x_{ij} means the i (i=1, 2) kinds of evaluation of input indicators in DMU_j evaluation unit, the model is the total assets and the main business cost ($x_{ij} \succ 0$).

y_{rj} means the r(r=1, 2) kings of evaluation of output indicators in DMU_j evaluation unit, the model is the main business income and total profit ($x_{ij} \succ 0$).

v_i means the $i(i=1,2)$ kinds of weight coefficient of input index ($v_i \geq 0$).

u_r means the $r(r=1,2)$ kinds of weight coefficient of output indicator ($u_r \geq 0$).

x_{ij} and y_{rj} is the components of $x_j = (x_{1j}, x_{2j}, \cdots x_{mj})^T$ and $y_j = (y_{1j}, y_{2j}, \cdots y_{qj})^T$. The index data of this paper are derived from the "2012 China's third industry statistics yearbook".

In the evaluation system shown in Figure 1, the weight coefficient vector of the input index and output index in the model is $v = (v_1, v_2)^T$ and $u = (u_1, u_2)^T$ respectively.

For evaluation unit, the evaluation index is

$$h_j = \frac{\sum_{r=1}^{p} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \quad (j = 1, 2, \cdots, 30). \qquad (1)$$

defined

By this definition, first we can always appropriately select u and v and make $h_j \leq 1$. Second, roughly speaking, for the evaluation unit of DMU_{j_0}, the greater the h_{j_0}, the greater the use of relatively small input to get relatively more output [6-11].

To evaluate the relative effectiveness of the h_{j_0} evaluation unit, that is, if we want to understand this DMU_{j_0} in DMU with $n(n=30)$ is whether "optimal" or not, we shall establish CCR model evaluation system.

In the DEA-CCR evaluation model of Chinese telecom industry operators, to set up the input vector and output vector of the j_0 evaluation unit respectively as $x_0 = (x_{1j_0}, x_{2j})^T$ and $y_0 = (y_{1j_0}, y_{2j_0})^T$, and the operational performance index as $h_0 = h_{j_0}$. Under the condition of the operating performance evaluation index $h_j \leq 1$ $(j = 1, 2, \cdots, 30)$, to select the optimal weight coefficient u and v, and make h_0 reaches the maximum and establish optimization DEA-CCR model [12-15].

$$\begin{cases} \max h_0 = \dfrac{\sum_{r=1}^{p} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \\ s.t. \quad \dfrac{\sum_{r=1}^{p} u_r y_{rj_0}}{\sum_{i=1}^{m} v_i x_{ij_0}} \leq 1 \quad (j = 1, 2, \cdots, 30) \\ v_i \geq 0 \quad (i = 1, 2) \\ u_r \geq 0 \quad (r = 1, 2) \end{cases} \qquad (2)$$

II. EMPIRICAL ANALYSIS

A. Tobit model description

According to the above construction of China's regional telecom industry performance DEA-CCR evaluation model, can be obtained the corresponding operational performance measure values, specifically see tab. I.

TABLE I OPERATIONAL PERFORMANCE MEASURES OF THE TELECOM INDUSTRY IN CHINA (1)

DMU	Operational performance	Ranking
Beijing	0.9071	21
Tianjin	0.8559	28
Hebei	0.9314	19
Shanxi	0.9334	17
Inner Mongolia	0.9351	16
Liaoning	0.9528	11
Jilin	0.8465	29
Heilongjiang	0.8919	24
Shanghai	0.9618	9
Jiangsu	1	1

TABLE II Operational PERFORMANCE measures of the telecom industry in China (2)

DMU	Operational performance	Ranking
Zhejiang	0.9665	7
Anhui	0.9418	13
Fujian	0.9372	14
Jiangxi	0.9317	18
Shandong	0.9583	10
Henan	0.8643	27
Hubei	0.9309	20
Hunan	0.9652	8
Guangdong	1	1

	Guangxi	0.9825	6

TABLE III   Operational performance MEASURES of the telecom industry in China (3)

DMU	Operational performance	Ranking
Hainan	0.8782	26
Chongqing	0.986	5
Sichuan	0.9421	12
Guizhou	1	1
Yunnan	0.9356	15
Shanxi	0.9961	4
Gansu	0.8932	23
Qinghai	0.7559	30
Ningxia	0.8974	22
Xinjiang	0.8881	25

Through the above three tables, we can see that the different regions of China telecom industry operating performance is relatively good, 30 regions with an average of 0.9289, the lowest value of 0.7559 in Qinghai, and the rest of the operating performance values are more than 0.8. 0.9-1 of inter have 18 regions, there are eight regions between 0.8-0.9. Among them, Jiangsu, Guangdong and Guizhou, the three best performing regional telecom industry operators, are 1; Telecom industry operator performance of Qinghai, Jilin and Tianjin are the last three, respectively 0.7559, 0.8465, 0.8559. Shanxi, Chongqing, Guangxi, Zhejiang, Hunan, Shanghai and Shandong are the regions at the forefront. Liaoning, Sichuan, Anhui, Fujian, Yunnan, Inner Mongolia, Shanxi, Jiangxi, Hebei and Hubei are in the middle region. Beijing, Ningxia, Gansu, Heilongjiang, Xinjiang, Hainan and Henan are in relatively backward areas.

III. CONCLUSIONS

By constructing the performance evaluation model of China's telecom industry in China based on DEA-CCR, we can get the following conclusions.

First, the overall level of operational performance of China's telecommunications industry is relatively high. In the 30 regions, only Qinghai's telecom industry performance below 0.8 is 0.7559. Overall average of 0.9289, there are three areas of relative performance to 1. Thus, the overall development of China's telecommunications industry is good [16].

Second, there is no agglomeration state of the operational performance of the telecom industry [17]. Through the empirical results, we can see that there are some areas in the east, middle and west of the telecom industry with high performance, but also some areas of low performance. The top of the rankings does not drive the development of the telecom industry in the surrounding areas, and there is no obvious relationship between the level of economic development and the operation performance of the telecom industry. So it can be said that there is no obvious spillover effect on the operation performance of the telecom industry [18].

Third, the region's telecom industry has a further improvement of the space. In the 30 regions of China, only

three regions, the relative performance of the telecom industry operation level is 1, and the rest are to achieve the relative optimal state, there is 1 region below 0.8. There are 18 regions between 0.9-1, 8 regions between 0.8-0.9. Therefore, the regional telecom industry can also be further promoted, and the spillover effects of the telecom operators in the surrounding areas can also be utilized reasonably [19].

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