

Analysis of Weak Links in E-commerce Logistics Industry Chain Based on DEA

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Abstract. According to the development status of e-commerce logistics industry in Yuhong District of Shenyang, this paper combines the components of e-commerce logistics industry chain and uses DEA (Data Envelopment Analysis) to develop the e-commerce logistics industry in Yuhong District and other districts and counties in Shenyang. The effectiveness of the industrial chain is judged and the weak links in the e-commerce logistics industry chain in Yuhong District is analyzed. Finally, the corresponding industrial chain improvement plan is proposed for the existing weak links.

Keywords: E-commerce; logistics; DEA; weak links; promotion.

1. Introduction

China attaches great importance to the development of e-commerce logistics. Since 2016, China has issued more than a dozen documents to encourage the development of e-commerce logistics industry. On March 17, 2016, the Ministry of Commerce issued the “National E-Commerce Logistics Development Special Plan (2016-2020)”. The “Planning” proposed seven main tasks and eight key projects. By 2020, it will basically form an e-commerce logistics system with “complete layout optimized structure, powerful functions, efficient operation and high-quality service”. And it will made significant progress in the development of informationization, standardization and intensification. However, in the process of e-commerce logistics development, there has been a blind expansion of the industrial scale, extensive introduction of enterprises, resulting in serious homogenization competition of e-commerce enterprises, the industrial chain has broken. How to rationally arrange related enterprises according to the existing e-commerce logistics industry, and make the input and output of the e-commerce logistics industry chain optimal has become an urgent problem to be solved.

2. Relevant Theoretical Analysis

Data envelopment analysis (DEA) is an efficient evaluation method for multiple decision-making units with multiple inputs and outputs. The model has been widely used in the fields of management science and systems engineering to study the relative effectiveness of productive sectors with multiple inputs and outputs. In this study, several districts of Shenyang with better development are selected for the e-commerce logistics industry chain, and make the selected districts together to constitute the DMU comparison set. After selecting the DMU, the output indicators of the industry chain are selected. The important links selected by e-commerce logistics industry chain are input and analyzed separately as input indicators. The output efficiency of each input index in the industrial chain of the Yuhong industry is analyzed, and then the direction to improve the industrial chain will be found.

In the analysis of e-commerce logistics industry chain, the $n-1$ districts and Yuhong District are decision-making units, then the industry chain supply and output rate model have a total of n decision-making units, recorded as $DMU_i, i=1, 2, \dots, n$. The J principal component indexes of the logistics supply resource of the i -th decision-making unit are input into the model as the input resource, and is denoted as $X_{ij} = [x_{i1}, x_{i2}, \dots, x_{ij}]^T$, where $i = 1, 2, \dots, n; j=1, 2, \dots, J$. The K principal component indexes of the logistics demand resource are selected as the output resource of the model, denoted by $Y_{ij} = [y_{i1}, y_{i2}, \dots, y_{ij}]^T$, where $i = 1, 2, \dots, m; k=1, 2, \dots, K$. The supply resource utilization rate of the r -th decision unit is denoted as θ'_s , then the solution model of θ'_s is:

$$\left\{ \begin{array}{l} \min(\theta'_s - \varepsilon(e_1^T s^- + e_2^T s^+)) \\ \sum_{j=1}^{10} X_j \lambda_j + s^- = \theta'_s X_r \\ \sum_{j=1}^{10} Y_j \lambda_j - s^+ = Y_r \\ \lambda \geq 0, j = 1, 2, \dots, n \\ s^- \geq 0; s^+ \geq 0 \end{array} \right.$$

If $\theta'_s < 1$, it means that there is a DMU, whose output is higher than the output of the i -th DMU, and the input is lower than the output of the i -th DMU. If $\theta'_s = 1$, then the size and technology of the i -th decision unit are valid at the same time.

3. Case Study

3.1 Introduction to the Scale of E-commerce Industry

In recent years, the development of e-commerce industry in Yuhong District is rapid. In 2016, the total volume of e-commerce transactions in Yuhong District was 3.6 billion yuan, with an annual growth of 42%, of which online shop sales were 680 million yuan, accounting for 18.9%. But the economic development of Yuhong District is at a medium level in Shenyang, it is estimated that the e-commerce transaction volume will reach 30.9 billion yuan in 2022, indicating that there is still room for the improvement in e-commerce of Yuhong District.

3.2 Analysis of the Weak Links in the Industrial Chain

In this paper, we chose another 9 districts of Shenyang to compare with Yuhong district. And seven input indicators and 2 output indicators were selected based on the availability of data. The data comes from the ICP code business directory provided by Shenyang Industrial and Commercial Bureau and the Shenyang Statistical Yearbook. The relevant data are shown in Table 1.

Table 1. DEA model input and output indicators list of E-commerce industry chain

Means Standard	Input indicators					Output indicators			
	Number of B2B companies	Number of B2C Enterprises	number of O2O shops	Number of third-party trading platforms	Number of online stores with ICP code	Number of Internet users	Number of mobile phone users at the end of the year	The added value of the tertiary industry	The total retail sales of social consumer goods
Yuhong	203	10	1860	10	137	69507	131207	1564025	1016564
Shenhe	196	14	7178	16	275	50953	328257	8056049	10417681
Heping	141	166	6686	50	301	46659	300595	6986883	7945314
Tiexi	230	18	5670	5	147	65051	419081	3234334	5831654
Huanggu	158	12	3726	14	84	58539	377127	3638855	3063729
Dadong	115	5	4233	0	102	48806	314426	2103053	2826994
Hunnan	73	28	2262	21	112	13045	114765	1497311	1721853
Sujiatun	37	7	782	1	54	55924	329153	1016793	1515957
Xinmin	17	6	3770	5	30	80100	487000	1034447	1323855
Liaozhong	22	1	3770	0	15	68421	332061	980038	1045834

The above indexes and related values were input into the DEA model for calculation. The evaluation results are shown in Table 2.

Table 2. DEA model evaluation results

County	θ'_s optimal value	Evaluation conclusion
Yuhong	0.749225	Non-DEA effective
Shenhe	1	DEA effective
Heping	1	DEA effective
Tiexi	1	DEA effective
Huanggu	1	DEA effective
Dadong	1	DEA effective
Hunnan	0.725965	Non-DEA effective
Sujiatun	1	DEA effective
Xinmin	1	DEA effective
Liaozhong	1	DEA effective

The evaluation results show that, except Yuhong District and Hunnan District, the e-commerce input and output of the other districts and counties in are all DEA effective. This reflects that there is an imbalance in the development of various links in the industrial chain in the development of e-commerce in the Yuhong District. Due to the low utilization rate of supply resources in the e-commerce industry chain, the actual input and output are not proportional.

The shadow price of DEA analysis results can indicate whether there is an additional investment value of an input resource. The shadow prices of three types of e-commerce enterprises in 10 districts and counties are shown in Table 3.

Table 3. DEA shadow price list of three types of e-commerce enterprises

County	Dual Price (B2B)	Dual Price (B2C)	Dual Price (O2O)
Yuhong	-0.02221688	0	-0.00053763
Shenhe	-0.00124496	0	-0.00001570
Heping	-0.00336632	0	-0.00001239
Tiexi	-0.00000548	0	-0.00002422
Huanggu	-0.00275621	0	-0.00003475
Dadong	0	0	-0.00009993
Hunnan	0	0	0
Sujiatun	-0.00330844	0	-0.00011502
Xinmin	-0.02167031	0	-0.00008215
Liaozhong	-0.01023375	0	-0.00012902

Table 3 shows that the shadow price of B2C enterprises in Yuhong District is 0, indicating that the number of B2C enterprises in Yuhong District type is near saturation, the potential of market to further expand is lower. And the shadow price of B2B business and O2O business in Yuhong District are both negative, , indicating that the increase in the number of B2B enterprises and O2O shops will make the overall output efficiency of e-commerce been improved in Yuhong District.

3.3 Improvement Plan

3.3.1 Focus on Attracting B2B Business Enterprises

The Yongan E-commerce Building and public service platform planning should be completed quickly and the construction speed should be improved. Special activities should be carried out to attract investments of large-scale B2B e-commerce enterprises . Investment promotion strategies and policies should be made to effectively attract enterprise to create quality integrated service capabilities and service environments. The introduction of large-scale electric business enterprises should be speeded up through the theme investment, exhibition investment and commissioned investment to build a B2B e-commerce platform operation and settlement center base in Shenyang and serves the Northeast of China.

3.3.2 Rapid Development of O2O E-commerce

The environmental attraction, policy guidance, administrative control and other comprehensive means should be used to support the existing e-commerce enterprise to become bigger and stronger through transformation and upgrading. The cooperation between the existing large-scale professional market, logistics and distribution enterprises and large-scale well-known domestic enterprises

should be promoted. The e-commerce transaction service projects should be introduced and developed independently to accelerate the transformation of e-commerce enterprises. The channels of the existing business platform should go down to link with the industry, while promoting the physical stores to transform and innovate the business model. The business pattern should be innovated to promote the omni-channel competition in advance, vigorously develop the online and offline interaction of O2O, and enhance the new impetus for economic development.

3.3.3 Vigorously Consolidate the Foundation of B2B2C E-commerce Logistics

The e-commerce application ratio of enterprises in Yongan New City should be improved, especially for small and medium enterprises. The development and application of e-commerce service industry should be promoted to guide the logistics and industrial SMEs in the market to apply e-commerce means to produce and operate, to break the time and space constraints between producers, sellers and consumers, and to realize online and offline distribution of information, goods, technology and services. The sharing of global supply and demand information resources between enterprises should be promoted to make direct supply and demand transactions between the supply and demand sides through “buy globally and sales globally”, reduce the comprehensive cost of advertising, procurement, marketing and other links, improve the scope and efficiency of transactions. Convenient and fast e-commerce logistics distribution system and safe and reliable electronic payment system should be utilized to complete goods-delivery, to reduce inventory, transportation and sales costs, and to promote enterprises to participate in fair competition to accelerate its development.

4. Summary

This paper uses DEA model and selects indicators to quantitatively analyze the weak links of e-commerce logistics industry chain in Yuhong District of Shenyang City. From the theoretical point of view, it is determined that the current e-commerce logistics industry chain is not DEA effective. And through DEA shadow price analysis it is found that, at present, the weak link in the logistics industry chain is a short of B2B enterprises and O2O enterprises, and finally the corresponding improvement plan is given. This method makes up for the lack of qualitative analysis, and is conducive to the rational introduction and allocation of resources by the government departments in the process of regional development to achieve coordinated development of the logistics industrial chain.

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