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The comparison of regional logistics systems based on the logistics equilibrium

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ABSTRACT

With the deep attention to the logistics by our government, Each local governments have enacted lots of policies to accelerate the process of modernization of logistics. Although these measures more or less have promoted the development of the logistics industry, The phenomena of over-investment which has led to a waste of regional resources have emerged in some areas because of the lack of rational understanding of balanced development and equilibrium situation and level of their own logistics system. For this, the paper applies equilibrium ideology which comes from economics to logistics system and presents a new theory which named Logistics equilibrium. According to this theory, the comparative indicators of regional logistics system are constructed from three aspects: regional logistics system equilibrium posture indicators, equilibrium level indicators and equilibrium running results indicators. Furthermore, the method of TOPSIS is introduced to form a complete compare model with the comparative indicators above. Finally, an example is used to verify the model above. This paper aims to provide a basis for some places which could recognize the shortcomings of their own logistics system by comparison and then put forward some practical policies and measures.

KEYWORDS

Regional logistics system; Logistics equilibrium; Comparative indicators.

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INTRODUCTION

Regional logistics system is a logistics activity for adapting to regional economic development. It will be beneficial to the social production and circulation if the regional logistics system could operate efficiently and stability. So it plays a crucial role to plan and build a regional logistics system adapted to economic development.

Logistics has appeared along with the production and circulation. It is the bridge connecting requirement and supply. Balanced development of regional logistics should not only meet the needs of logistics under certain conditions of supply, but also should avoid waste caused by excessive investment. Therefore it is essential to make some effective recommendations by comparing operating conditions between different regional logistics systems from the angle of logistics equilibrium.

RESEARCH SUMMARY ABOUT THE COMPARISON OF REGIONAL LOGISTICS SYSTEMS

Regional logistics system is a comprehensive system for the purpose of meeting the needs of regional logistics market and promoting the development of regional economy. Many domestic and foreign scholars have studied the comparative aspects of regional logistics system and made lots of fruition.

Generally, foreign related research can be divided into two areas:1) Overall comparison of regional logistics system. There are many representative scholars, such as Coia, Anthony, Ruth, James and Chris[1-3] etc. Among them, James and Chris had compared the logistics development environment between Europe and Asia, and also gave a series of indicators to evaluate the logistics system, which had given an impetus to logistics system;2) A single aspect comparison of regional logistics system. The representative scholars are named Julia Devlin, Peter Yee, Jan Havenga and Teodor Gabriel Crainic[4-6] etc. Julia Devlin and Peter Yee had gave some suggestions which could improve the efficiency and competitiveness of regional logistics after they contrasted the transportation cost in North Africa and Middle East.

As for domestic scholars, on the one hand, their study focused on the comparison with developed countries. For example, Yuanhong Zheng[7] pointed out that the development of Chinese agricultural cold chain logistics must be combined with the actual situation by comparing with US. On the other hand, some scholars such as Linbang Fan, Dehua Wang, Jing Ye and Qiming Chen[8-10] etc. paid attention to logistics in different regions of China. Among them, Linbang Fan calculated Elasticity Coefficient of logistics and economy through empirical analysis of Sichuan and Jiangsu Province.

THE OVERVIEW OF LOGISTICS EQUILIBRIUM THEORY

Logistics equilibrium theory is developed from the idea of a balanced. Balancing, a relatively stable state, has been widely used in economics and game. Generally, balancing can be divided into static equilibrium and dynamic equilibrium. Both of them can examine whether the system balance or not. The difference is, the static equilibrium treats system from a relative static angle, while the dynamic equilibrium injects the concept of time on this basis. This paper puts forward to the concept of logistics equilibrium by incorporating the idea of a balanced into logistics system. This concept can be defined as follows: Under the current logistics technological level, logistics supply and requirement achieve a relatively stable status in three dimensions: quantity, structure and time, so that a certain investment can get the maximum benefits. The following aspects should be noticed to understand the logistics equilibrium theory properly:

1) Logistics equilibrium which can achieve a balanced state in quantity, structure and time refers to logistics static equilibrium. These three aspects constitute the three-dimensional structure of logistics

static equilibrium which can examine the extent of balance under certain technical level by interlinkages and interaction.

2) In addition to, logistics equilibrium is a dynamic process in which needs to evolve towards a higher balanced level constantly. The logistics technologies, such as information technology and equipment technology, are all important factors which can affect the equilibrium level of logistics system.

3)Logistics equilibrium ensures the stable operation of logistics system. Planning and developing rationally can reduce logistics costs and contribute to regional economic. For this purpose, we study and apply this theory.

THE CONSTRUCTION OF REGIONAL LOGISTICS SYSTEM BALANCED COMPARATIVE INDICATORS

This paper designs a series of regional logistics system balanced comparative indicators. The purpose can be summarized as:1)to grasp the balanced status of its own regional logistics system and identify the factors that influence regional logistics system to run balanced in a period of time.2)to analysis of the pros and cons by comparing different regional logistics system, and then learn from each other, so that provide some effective recommendations.

Depending on the content of logistics equilibrium theory, this paper designs a comparative indicator in three areas: equilibrium posture indicators, equilibrium level indicators and equilibrium running results indicators, which is shown in TABLE 1.

TABLE 1 : Comparative indicators of regional logistics system equilibrium

Comparative indicators of regional logistics system equilibrium	Regional logistics System Equilibrium posture indicators	Regional logistics quantity equilibrium (I_1)
		Regional logistics structural equilibrium (I_2)
		Regional logistics time equilibrium (I_3)
	Regional logistics system equilibrium level indicators (Logistics technology indicators)	Regional logistics technology and equipment level indicators (I_4)
		Regional logistics information development indicators (I_5)
		Regional logistics standardized indicators (I_6)
	Regional logistics system equilibrium Running results indicators (Cost-Earning indicators)	Regional logistics social benefits indicators (I_7)
		Regional logistics economic benefits indicators (I_8)
		Regional logistics environmental benefits indicators (I_9)

Construction and analysis of equilibrium posture indicators

The regional logistics system equilibrium posture indicators should be Chosen mainly based on the three-dimensional structure of logistics static equilibrium, which are called logistics quantity equilibrium, logistics structural equilibrium and logistics time equilibrium. The details are as follows:

1) Regional logistics quantity equilibrium.

It mainly measure the balanced extent of logistics required quantity and supplied quantity (r_1). Now using v to represent logistics workload of supply and demand, and w represents value quantity, then:

Logistics required quantity=f (w_1,v_1) Logistics supplied quantity=f (w_2,v_2)

r_1= Logistics required quantity/ Logistics supplied quantity

r_1: the closer to 1 the better

2) Regional logistics structural equilibrium.

The quantitative indicator is the balanced extent of supply and demand structure among each industry (r_2). The specific contents are as follows:

r_{21}= The proportion of agricultural logistics requires/The proportion of agricultural logistics supplies

r_{21}= The proportion of industrial logistics requires/The proportion of industrial logistics supplies

$r_2=1/2(r_{21}+r_{22})$

r_2: the closer to 1 the better

3) Regional logistics time equilibrium.

It mainly measures the connected extent of regional logistics supply and demand. Now using α to represent timely rate of logistics supply, then: α = (The number of timely delivery / The total number of delivery)×100%.

Construction and analysis of equilibrium level indicators

Through the analysis above, logistics technology is the crucial driving force from the perspective of logistics equilibrium theory. Therefore, this paper will treat logistics technology as the key indicators to measure the level of regional logistics system equilibrium. The logistics technology will be elaborated in following three areas.

1) Regional logistics technology and equipment level indicators.

The rate of logistics technology and equipment represented by t1 will be tested to calculate the level. It can be defined as follow.

t1= The net output of Machinery equipment per year/The number of employees

2) Regional logistics information development indicators.

The rate of information application coverage will be assessed. Now using t_2 to represent. Then, the meaning is:

t_2= The number of enterprise applied logistics information technology/ The number of logistics enterprises in the area

3) Regional logistics standardized indicators.

It mainly checks the implemented extent of standardization. The concept that indicated by t_3 can be explained as follow.

t_3= The number of enterprise applied logistics standardization / The number of logistics enterprises in the area

Construction and analysis of equilibrium running results indicators

The running results aims at assessing the benefits produced by balanced operation. The indicators can be articulated in following three dimensions.

1) Regional logistics social benefits indicators.

The rate of logistics employment represented by p_1 will be tested to calculate the worth, then:

p_1 = The number of employees within the region's logistics industry/ The number of employees throughout the region

2) Regional logistics economic benefits indicators.

It mainly examines the contribution to regional economy of logistics. The concept that indicated by p_2 can be named as logistics demand coefficient.

p_2 = The total value of regional logistics/ regional logistics GDP

3) Regional logistics environmental benefits indicators.

The degree of processing waste will be calculated. Now using p_3 to represent the reduction rate of litter, then:

p_3 = (The amount of waste generated by the pre - The amount of waste generated in a period)/ The amount of waste generated by the pre

THE COMPARISON OF REGIONAL LOGISTICS SYSTEM BALANCED RUNNING

The option of comparative method

There are Several features should be elaborated according to this comparison:1)The circumstance that incomprehensive index will be possibility appeared because of the complex running system;2)The balanced running of regional logistics system is not absolute but relative;3) For comparison of Logistics system, the situation of comprehensive equilibrium should be taken into account.

Based on the analysis above, The method called TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is good at comparing the merits and shortcomings between different objects. So the paper will be taken into account. The specific reasons are:1) It can also be used for similar comparison due to its flexibility if the contents of index is modified;2)It describes relative result by sorting compared object and has no specific evaluated criteria;3)The best result is closest to the positive idea and farthest from negative idea. This method takes both two sides into account, so that can make overall comparison.

The basic steps of comparison

The principle of TOPSIS can be described as follows[11]: Firstly, choose a positive idea and a negative idea respectively among these objects. Then calculate the distance. If the compared object is closest to the positive idea and farthest from negative idea, it is the best, otherwise, the worst. The details are as follows:

1) Constructing the original data matrix. Suppose there are m comparative regions: A_1, A_2,.. A_m. And n comparative indicators: I_1, I_2,…I_m. Then x_{ij} is the i-th compared region and the j-th index value. The original matrix has been formed as $X=(x_{ij})_{m\times n}$;

2) Processing the original index data, including two sides: harmonization and dimensionless. Then the standardized matrix is generated: $R=(r_{ij})_{m\times n}$. The process is:

For harmonization, generally, turning the cost-based and moderate-based indicators into earning-based indicators[12]. The transformation method is shown in equation (1).

$$\mathbf{y_{ij}=\frac{1}{x_{ij}}\ y_{ij}=\frac{1}{|x_{ij}-k|}\quad (k:\ the\ best\ vlue)} \tag{1}$$

For dimensionless, suppose r_{ij} is the index value of nondimensionalized and m is the number of compared objects. The transformed formula is illustrated as (2).

$$r_{ij}=\frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}} \tag{2}$$

3) To determine the positive idea A^+ and negative idea A^-.

$$A^+=\{r_1^+, r_2^+, \ldots r_n^+\} \qquad A^-=\{r_1^-, r_2^-, \ldots r_n^-\}$$

Of which:

$$r_j^+=\max\{r_{ij}\} \qquad r_j^-=\min\{r_{ij}\}$$

4) Calculating the distance (referred as D_i^+ and D_i^-) between each compared object A_i to A^+ and A^- respectively.

$$D_i^+ = \sqrt{\sum_{j=1}^{n} \left(r_{ij} - r_j^+\right)^2} \qquad D_i^- = \sqrt{\sum_{j=1}^{n} \left(r_{ij} - r_j^-\right)^2}$$

5) Calculate the relative closeness degree C_i of each compared object A_i. And arranged C_i by descending. If A_i is closer to A^+, then C_i is closer to 1,which can show that this region logistics system is more balanced. Conversely the more worse, of which:

$$\mathbf{C_i = \frac{D_i^-}{D_i^+ + D_i^-}}$$

EXAMPLE OF APPLICATION

This paper attempts to establish comparative indicators from the point of equilibrium theory. Now applying an

Example to verify this model. Suppose there are three areas M,N and P, which have similar economic and geographical environment. Now using TOPSIS to make a comparison for the above nine indicators.

1) Establishing original data matrix of regional logistics system balanced running:

$$\mathbf{X} = \begin{array}{c} \\ \mathbf{A_1} \\ \mathbf{A_2} \\ \mathbf{A_3} \end{array} \begin{array}{c} \begin{array}{ccccccccc} \mathbf{I_1} & \mathbf{I_2} & \mathbf{I_3} & \mathbf{I_4} & \mathbf{I_5} & \mathbf{I_6} & \mathbf{I_7} & \mathbf{I_8} & \mathbf{I_9} \end{array} \\ \begin{bmatrix} \mathbf{0.80} & \mathbf{0.76} & \mathbf{0.90} & \mathbf{56} & \mathbf{0.65} & \mathbf{0.75} & \mathbf{0.05} & \mathbf{3.1} & \mathbf{0.08} \\ \mathbf{0.78} & \mathbf{0.82} & \mathbf{0.85} & \mathbf{62} & \mathbf{0.60} & \mathbf{0.80} & \mathbf{0.04} & \mathbf{3.3} & \mathbf{0.09} \\ \mathbf{0.82} & \mathbf{0.80} & \mathbf{0.88} & \mathbf{68} & \mathbf{0.70} & \mathbf{0.72} & \mathbf{0.05} & \mathbf{3.4} & \mathbf{0.07} \end{bmatrix} \end{array}$$

I_1,I_2 and I_3 are the moderate-based indicators, others are the earning-based indicators.

2) Processing the original index data by using formula (1) and (2),including two sides: harmonization and dimensionless. Then we can get the standardized matrix R:

$$\mathbf{R} = \begin{bmatrix} \mathbf{0.333} & \mathbf{0.319} & \mathbf{0.342} & \mathbf{0.301} & \mathbf{0.333} & \mathbf{0.330} & \mathbf{0.357} & \mathbf{0.316} & \mathbf{0.333} \\ \mathbf{0.325} & \mathbf{0.345} & \mathbf{0.323} & \mathbf{0.333} & \mathbf{0.308} & \mathbf{0.353} & \mathbf{0.286} & \mathbf{0.337} & \mathbf{0.375} \\ \mathbf{0.342} & \mathbf{0.336} & \mathbf{0.335} & \mathbf{0.366} & \mathbf{0.359} & \mathbf{0.317} & \mathbf{0.357} & \mathbf{0.347} & \mathbf{0.292} \end{bmatrix}$$

3) To determine the positive idea A^+ and negative idea A^- according to the selected criterion.

$$A^+ = \begin{bmatrix} 0.342 & 0.345 & 0.342 & 0.366 & 0.359 & 0.353 & 0.357 & 0.347 & 0.375 \end{bmatrix}$$

$$A^- = \begin{bmatrix} 0.325 & 0.319 & 0.323 & 0.301 & 0.308 & 0.317 & 0.286 & 0.316 & 0.292 \end{bmatrix}$$

4) Calculating the distance referred as D+ and D– between the compared value of area M, N and P to A+ and A- respectively.

$$\mathbf{D^-} = \begin{array}{c} \begin{array}{ccc} \mathbf{A_1} & \mathbf{A_2} & \mathbf{A_3} \end{array} \\ \begin{bmatrix} \mathbf{0.089} & \mathbf{0.102} & \mathbf{0.116} \end{bmatrix} \end{array} \qquad \mathbf{D^+} = \begin{array}{c} \begin{array}{ccc} \mathbf{A_1} & \mathbf{A_2} & \mathbf{A_3} \end{array} \\ \begin{bmatrix} \mathbf{0.094} & \mathbf{0.097} & \mathbf{0.091} \end{bmatrix} \end{array}$$

5) At last, calculate the relative closeness degree C_i of area M,N and P.

$$\begin{matrix} & \mathbf{A}_1 & \mathbf{A}_2 & \mathbf{A}_3 \\ \mathbf{C} = & [\mathbf{0.486} & \mathbf{0.513} & \mathbf{0.560}] \end{matrix} \qquad \mathbf{C}_3 \succ \mathbf{C}_2 \succ \mathbf{C}_1$$

So the situation that logistics balanced operation of area M,N and P can be shown as follow: area P is the best; then area N; area M is the last. Furthermore, we can also compare the three aspects of logistics equilibrium theory and identify gaps existed of their own logistics system. And then put forward to some practical policies and measures. Here, This paper will not repeat the comparison.

CONCLUSION

Running smoothly of regional logistics system is conducive to the steady growth of regional economy. So it is necessary to compare different regional logistics system from the perspective of Equilibrium. The mainly Conclusions of the study is divided into two aspects:1) The paper proposed logistics equilibrium theory and constructed comparative indicators composite of logistics system equilibrium posture indicators, equilibrium level indicators and equilibrium running results indicators; 2) Based on the indicators system above, the paper made a comparison among three areas who have the similar economic and geographical environment by the method of TOPSIS, which to further verify the theory.

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