

Coordination Development of Regional Urbanization Process and Logistics Industry Based on Composite System

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Abstract Urbanization is one of the most important economic and social phenomena in the world. The process of urbanization is closely related to the development of the logistics industry. Firstly, a coordinated development evaluation index system of regional logistics industry and urbanization composite system is established by the application of collaboration theory. Secondly, a coordination degree model is constructed of urbanization and logistics industry composite system. At last, the paper carries on an empirical study with Chongqing. The result shows that, the logistics industry development level and the urbanization process in Chongqing tends to be coordinated, but the coordination degree should be improved in the future.

Keywords Coordination development • Composite system • Logistics industry • Urbanization process

1 Introduction

Since the reform and opening up, China's urbanization process has entered the stage of rapid development. The urbanization process not only accelerated economic development, push forward social progress, but promote population, space, and lifestyle changes also. The process of urbanization is closely linked with the development of related industries, in particular, is closely linked with the development of supply chain and logistics industry. As an important support of the urbanization

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process, logistics industry support transfer of industries, promote economic integration, improve urban and regional core competitiveness. The establishment of urban logistics system has become an important measure of reducing traffic congestion and emissions, building harmonious city, happiness city and sustainable city (Fan Gang 2011). Modern logistics industry has become a comprehensive services industry supported by modern technology, modern management concepts and information technology. Its contribution to the urban system has been widely recognized. Modern logistics industry promote the urban group coordinated development by affecting the labor growth, capital, natural resources, technological progress, industrial structure, infrastructure and other economic factors (Zhang Zhigang 2006).

2 Coordination Degree Model

2.1 The Meaning of Coordination

There has been a lot of relative research recent years. For example, one of the researchers has established the coordination degree model based on the implication of coordination development between industrialization and urbanization (Liu Yaobin and Wang Qifang 2004). An article discusses the gap between China's and international urbanization through analyzing the change of China's economic development, industries structure and employment structure (Feng Jun 2002). Some researchers have proposed that the significant raise of urbanization level is the inevitable reflection of the change of regional industrial structure (Liu Xuegong and Fan Mingzhi 2011). One of the researchers utilizes system theory to set up a dynamic coupling model for the harmonious development between urbanization and eco-environment and argue that the harmonious development system of the urbanization and eco-environment would go through four phases (Qiao Biao and Fang Chuanglin 2005). With the application of synergetic theory, a paper studied urban energy infrastructure economy society environment composite system's harmonious development deeply (Wan Dongjun et al. 2007). The other papers aim at establishing two mutualistic symbiosis models for both coordinated and non-coordinated developments of logistics industries and regional economies by adopting the symbiosis theories and through analysis of their symbiotic relationships (Zhangmei Qing et al. 2012), calculates the degree of order of logistics industrial subsystem and economic subsystem in 30 provinces in China, based on which gets the coordinating degree of three areas and the whole country and the coordinating degree of most developed areas (Zhang Yi and Chen Qi 2010).

Based on the existing literature, we think that coordination refers to harmony between systems or elements of system components in the process of evolution. To achieve the harmony of the system, a number of regulation and control activities imposed on the system are called coordinating role, all possible regulation and

control activities (coordinating role) and the appropriate procedures and rules are known as coordination mechanism. The degree of coherence between systems or system elements in the process of evolution is called coordination degree.

2.2 Composite System Coordination Degree Model

First, the concept of order degree is given, considering the subsystem $S_j, j \in [1, k]$, the order parameter variable in the course of its development is $e_j = (e_{j1}, e_{j2}, \dots, e_{jn})$, $n \geq 1, \alpha_{ji} \leq e_{ji} \leq \beta_{ji}, i \in [1, n]$. Without loss of generality, we assumed that the larger the value of $e_{j1}, e_{j2}, \dots, e_{jl_1}$, the higher the order degree of the system. The smaller the value, the lower the order degree of the system. Assumed that the greater the value of $e_{jl_1+1}, \dots, e_{jn}$, the lower the order degree of the system, the smaller the value, the higher the order degree of the system. The system order degree of order parameter component e_{ji} can be defined by following formula:

$$u_j(e_{ji}) = \begin{cases} \frac{e_{ji} - \beta_{ji}}{\alpha_{ji} - \beta_{ji}}, & i \in [1, l_1] \\ \frac{\alpha_{ji} - e_{ji}}{\alpha_{ji} - \beta_{ji}}, & i \in [l_1 + 1, n] \end{cases} \tag{1}$$

As defined above, $u_j(e_{ji}) \in [0, 1]$, the greater the value, the greater the contribution of $u_j(e_{ji})$. Overall, the “total contribution” of the order parameter variable e_{ji} to the ordering degree of system S_j can be achieved by integrated. For the sake of simplicity, we used the geometric mean method to integrate in this paper, that is,

$$u_j(e_j) = \sqrt[n]{\prod_{i=1}^n u_j(e_{ji})} \tag{2}$$

As defined above, $u_j(e_j)$ is called system order degree of order parameter variable e_{ji} , $u_j(e_j) \in [0, 1]$, the larger the value of $u_j(e_j)$, the higher the order degree of the system, and vice versa lower.

Given initial time t_0 , set system order degree of every subsystem order parameter as $u_j^0(e_j), j = 1, 2, \dots, k$. So in the overall development and evolution process of the composite system at any moment t , if the system order degree of every subsystem order parameter is $u_j^t(e_j), j = 1, 2, \dots, k$, composite system coordination degree can be defined as cm :

$$cm = \theta^k \sqrt[k]{\prod_{j=1}^k [u_j^t(e_j) - u_j^0(e_j)]} \tag{3}$$

$$\theta = \frac{\min [u_j^t (e_j) - u_j^0 (e_j) \neq 0]}{\left| \min [u_j^t (e_j) - u_j^0 (e_j) \neq 0] \right|}, j = 1, 2, \dots, k$$

1. Thus, $cm \in [-1, 1]$, the greater its value, the higher the coordinated development degree of the composite system, otherwise lower.
2. The role of the parameter θ lies in the composite system, if and only if the following equation is true, have a positive coordination degree

$$u_j^t (e_j) - u_j^0 (e_j) > 0, \forall j \in [1, k]$$

3. If the order degree of one subsystem improves larger, yet the order degree of other subsystems improves smaller or even decreases, thus the whole system cannot be in better coordinated state or simply lack of coordination, $cm \in [-1, 0]$.
4. The use of coordination degree model can test the characteristics and trends of the coordination degree of the composite system relative to the base period (Meng Qingsong and Han Wenxiu 2000).

3 Coordination Development Indicators System

Take logistics industry – urbanization as a composite system, the coordination development of the logistics industry and urbanization means, in the evolutionary process to achieve the common goals of the system, under the action of certain control activities or restraint mechanisms, a virtuous cycle trend of collaborate, cooperate with each other between the logistics industry subsystem and urbanization subsystem or subsystem internal elements.

Based on existing literature, the development level of logistics industry subsystem could be measured from such three aspects as logistics industry investment, operation and output of 8 order parameters, sees the table below (Table 1)

Table 1 The index system of logistics industry subsystem

Item	Order parameter	Code
1.	The amount of investment in fixed assets of the logistics industry (100 million yuan)	X1
2.	The proportion of investment in fixed assets of the logistics industry (%)	X2
3.	The number of practitioners of the logistics industry (10,000 persons)	X3
4.	Freight traffic (100 million tons)	X4
5.	Cargo Ton-kilometers (billion ton-km)	X5
6.	Freight Ton-kilometers by growth rate (%)	X6
7.	Logistics industry output value (100 million yuan)	X7
8.	Logistics industry output value accounted for the proportion of GDP (%)	X8

Table 2 The index system of urbanization subsystem

Item	Order parameter	Code
1.	Proportion of urban population (%)	Y1
2.	Non-farm proportion of employees (%)	Y2
3.	GDP (million)	Y3
4.	Per capita GDP (yuan/person)	Y4
5.	Urban households Engel coefficient (%)	Y5
6.	Per capita road area (sq. m/person)	Y6
7.	Urban built-up area (sq. km)	Y7
8.	Per capita living space (sq. m/person)	Y8

The urbanization process is not only a transfer process of an area population from rural to urban, but also a change process of regional economic, social, lifestyle, geographical environment and other aspects. Consolidated existing literature, the urbanization level includes four aspects, that is population urbanization, economic urbanization, social urbanization and spatial urbanization, total 8 order parameters, sees the table above (Table 2).

4 Empirical Study

Let’s take Chongqing for example to carry on an empirical study, all data is selected from “Chongqing Statistical Yearbook (2000–2012)”, “Chongqing Economic and Social Development 12th Five-Year Plan” and “Chongqing Twelfth Five logistics and security planning”.

Some of the data is repaired by interpolation method because of missing in the existing statistics. Sometimes, the upper limit of the order parameter can be calculated based on the future planning objectives, the lower limit value can be determined based on the history of the actual value. In this paper, the extreme values need to be adjusted properly in order to avoid the emergence of the order parameter 0 and 1. The maximum value is enlarged, while the minimum value is reduced, enlarged or reduced by 1 % in both extreme values in this article. The calculation results of urbanization subsystem order degree and logistics industry subsystem order degree is shown below (Fig. 1).

It can be found from the calculation results that, in the 2001–2011 periods, the order degree of Chongqing logistics industry subsystem and urbanization subsystem continues to rise, it means good coordination between order parameters of two subsystems, leading to continued rise of the coordination degree of the composite system. The calculation result of Composite system coordination degree is shown below (Fig. 2).

The coordination degree between Chongqing logistics industry development and urbanization shows a gradual upward trend. The development of the logistics industry contributes more to coordination degree of the composite system than

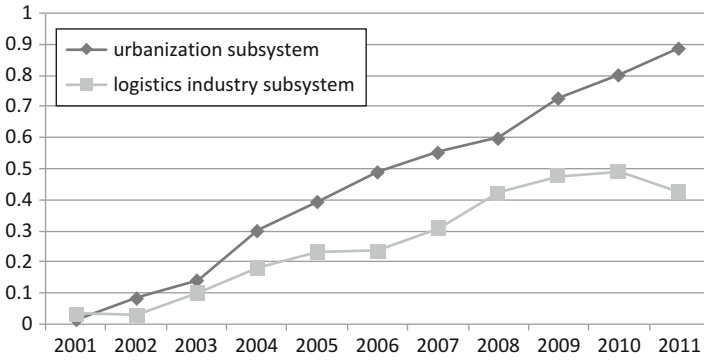


Fig. 1 Order degree of urbanization subsystem and logistics industry subsystem

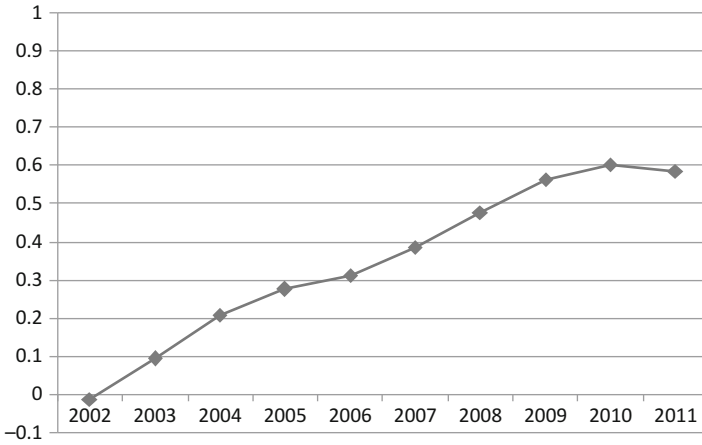


Fig. 2 Composite system coordination degree

urbanization in the period 2002–2005. However, the urbanization process contributes more to coordination degree of the composite system than the development of logistics industry in the period 2009–2011.

The result is inseparable from the efforts of Chongqing that pays more attention to regional sustainable and coordinated development during the “10th Five-Year Plan” and the “11th Five-Year Plan”. But the maximum coordination degree is not very high, indicating the coordination degree of the logistics industry and urbanization need to be further improved.

First of all, the development of the logistics industry is conducive to promoting the process of urbanization, the logistics industry enhancements, directly and indirectly, to promote economic development, in order to advance the process

of urbanization, to improve the level of urbanization. Modern logistics industry has become a comprehensive services industry supported by modern technology, modern management concepts and information technology. On the contrary, become the bottleneck of urbanization.

Secondly, the process of urbanization is accelerating the development of the logistics industry, the enhancement of urbanization level means strengthening of economic activity and increase in logistics, information flow, will lead to the growth of the logistics industry needs. Urbanization process could attract more money into the construction of urban infrastructure, increase the logistics industry infrastructure investment. So the entire logistics economic function of the system will be further strengthened. At the same time, the urbanization process can also continuously improve the technology level of logistics industry, make management system more perfect, and thus further enhance the logistics supply capacity. On the contrary, the process of urbanization becomes constraints of logistics industry development if it lags behind the development of the logistics industry.

5 Conclusion and Policy Recommendations

Using the collaboration theory, this paper constructs a coordination degree model of urbanization and logistics industry composite system, and establishes a coordinated development evaluation index system of regional logistics industry and urbanization composite system. By carrying on an empirical study with Chongqing, the result shows that, the process of urbanization is closely related to the development of the logistics industry, the logistics industry development level and the urbanization process in Chongqing tends to be coordinated.

This indicates that, on the one hand, in the “10th Five-Year Plan” and the “11th Five-Year Plan” period, as a municipality of urban and rural coordinating development, Chongqing seize the historic opportunity to construct the urban and rural comprehensive reform pilot area, fully implement the scientific development concept, accelerate the process of industrialization, urbanization and integration of urban and rural areas, properly deal with the adverse effects of the international financial crisis and major natural disasters, effectively suppress the unstable and unhealthy factors in the economic operation, and actively promote the coordinated development of the logistics industry and urbanization.

On the other hand, there is still further upside for the coordination degree of the composite system. Chongqing should improve the input-output efficiency of the logistics industry to enhance the coordination level of the logistics industry and urbanization through connotative development.

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