ISSN : 0974 - 7435 Volume 10 Issue 24

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(24), 2014 [15215-15219]

# Analysis of the impact Chongqing industry structure on transport

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## ABSTRACT

The development of transport is closely related with the changes of industries structure. Different industry structure and product structure ask different demand for traffic from the viewpoint of quantity and quality. In this paper, we will begin with the current situation of Chongqing industrial structure, combined with structural changes of transportation in recent years, and then use gray correlation theory to quantify and analyze the impact of Chongqing industry structure on transport. Take the passenger volume and freight volume as referring sequences and the three industries comparing sequences, we obtain the correlation coefficients and analyze the detailed impact.

## KEYWORDS

Industrial structure; Transportation structure; Grey system correlation method.



## LITERATURE REVIEW

The traffic growth mainly comes from the development of national economy. Different industry structure and product structure ask different demand for traffic from the viewpoint of quantity and quality. Due to the economic and technical characteristics of each transport and the fact that the traffic demands vary from industries. In recent years, Chongqing has gained rapid economic and social development. In 2013 the city's GDP reached up to 1.265669 trillion yuan, with an increase speed of 12.3%. Among them primary industry output is 100.268 billion, secondary industry 639.792 billion, and the tertiary industry value 525.609 billion. And the development of transport keeps pace with the development of three industries. Wang Yueping analyzed the impact of industrial structure changes on transport through input-output model and regression analysis [1]. Peng Xiangtao discusses the relationship between transportation and industrial structure adjustment through qualitative analysis, and points out that transportation is the foundation of national economic development. And the influences changes according to economy and society [2]. Li Chongliang explores the impact of industrial structure changes theoretically using correlation analysis method and gray relational analysis theory. Furthermore takes empirical analysis in Xining City for both qualitative and quantitative research [3]. Nie Zhengying builds the complete decomposition model to analyze and predict the influences that industrial structure yield to transportation structure [4]. Chu Kebo preliminarily analyzed the correlation relationship between the development of Sichuan passenger and freight transport and industrial structure changes from gray system association mode [5]. Feng Xunjie etc use the co-integration theory to study the long-term equilibrium relationship between passenger and freight traffic and the three industries [6]. Wu Feng analyzes such relationship by examining the entropy causality of industrial structure and transportation structure [7]. Baiding Hu and Michael McAleer took the transport into consideration to analyze the industry structure [8]. In this paper, we will begin with the current situation of Chongqing industrial structure, combined with structural changes of transportation in recent years, and then use gray correlation theory to quantify and analyze the influences.

## THE EVOLUTION AND SITUATION ANALYSIS OF CHONGQING INDUSTRY STRUCTURE

The general characteristics of three industries in Chongqing among 1978 and 2012 were unbalanced increasing on the whole. The proportion of first industry keeps decreasing and on the contrary the tertiary industry remains growing. The percentage of secondary industry varies from 40% to 55% and even upgrades to some extent. According to the actual situation, the industry structure of Chongqing needs to be further adjusted and improved. The detailed output value and proportion changes are shown in figure 1 and figure 2.

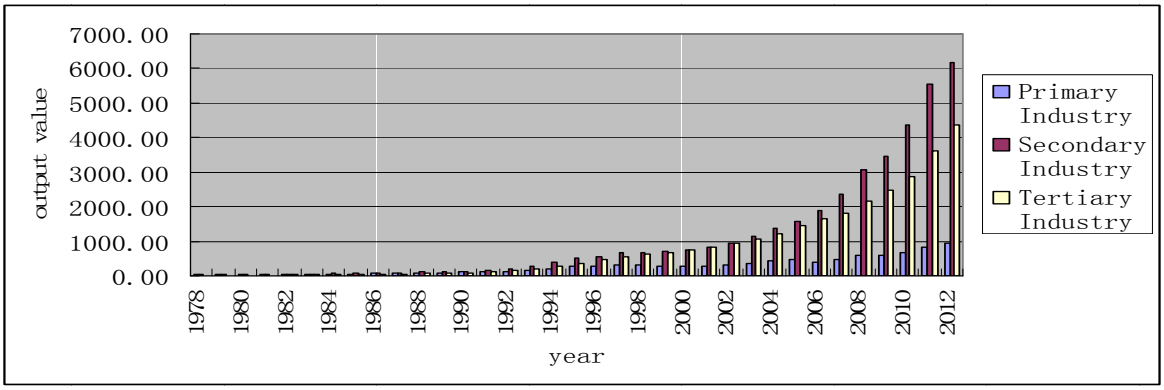


**Figure1 The output value of Chongqing three industries in 1978-2012**

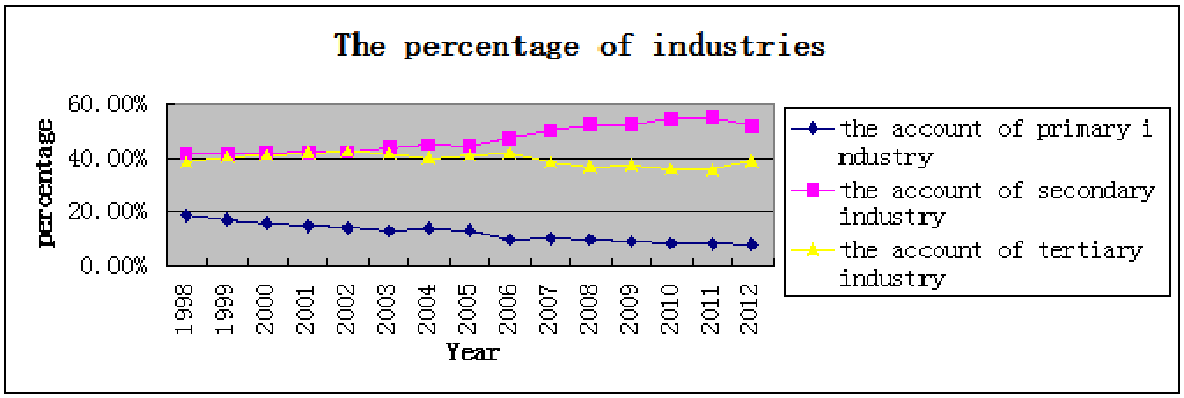


**Figure 2 The percentage of three industries in Chongqing**

## THE GREY SYSTEM CORRELATION MODEL

The grey system correlation analysis method is essentially the analysis of correlation coefficient. Firstly we calculate the correlation coefficient of dependent variable indexes and the corresponding independent variable indexes, and then obtain the correlation degree. Through ranking and analyzing the above correlation degree, we can draw the conclusion. Such method is superior to the classical exact mathematical methods. With the intentions, opinions and demands conceptualizing and modeling, the grey system becomes clearer in structure, model and relationship and easier to describe and deal quantitatively and mathematically. As to these partly-known grey systems, we can use the grey system correlation method to discuss and analyze, and furthermore use correlation degree to describe the correlation sequences of various information.

The transport and industry structure are closely related. We use grey system correlation method to analyze such relationship, and to seek the inherent pattern between transport and industrial structure.

**The standardization processing of the data**

Due to the different physical meaning of various factors in the system, the data is not necessarily using the same dimension, which leads the sequences hard to compare or get the correct conclusion. In order to ensure comparability of the same and similar factors, the original data should be non-dimensional normalized using the equation (3.1). Equation (3.1) applies to these indexes the larger value the higher utility.

$$x_i(k) = \frac{x_i(k) - \min x_i(k)}{\max x_i(k) - \min x_i(k)} \quad (3.1)$$

**The calculation of grey correlation coefficient and correlation degree**

In essence the correlation is the difference of the curve geometry. Then we use the difference value to measure the correlation degree.

(1) the calculation equation of grey correlation coefficient:

$$\xi_i(k) = \frac{\min\limits_i \min\limits_k \left|x_0(k)\right| + \rho \max\limits_i \max\limits_k \left|x_0(k) - x_i(k)\right|}{\left|x_0(k) - x_i(k)\right| + \rho \max\limits_i \max\limits_k \left|x_0(k) - x_i(k)\right|} \quad (3.2)$$

($\rho$ means the resolution coefficient, used to equal 0.5)

(2) the calculation equation of correlation degree

Through the equation (3.2) we can calculate the correlation coefficients of referring sequence and comparing sequence. Considering that there are a series of correlation coefficients and the scattered information is inconvenient to compare, so it is necessary to focus on these correlation coefficient of different time point. We calculate the mean value to present the correlation. And the correlation calculated as follows:

$$r_i = \frac{1}{N}\sum_{k-1}^{N} \xi_i(k) \quad (3.3)$$

**Analysis of Chongqing industry structure**

**(1) Establish the referring sequence and comparing sequence**

Use the passenger volume and freight volume establish the referring sequences $\{C^*\} = [C_1^*, C_2^*, ...C_n^*]$, and then treat the first, secondary and tertiary industry as comparing sequences $\{C\} = [C_1^i, C_2^i, ...C_n^i]$.

**(2)The standardization processing of the data**

The data is not necessarily using the same dimension. In order to ensure comparability of the same and similar factors, the original data should be non-dimensional normalized using the equation (3.1). The calculation results are shown in table1

**(3) the grey correlation coefficients of referring sequences and comparing sequences**

With the data standardized, treating Chongqing passenger volume and freight volume as the referring sequences and the first, secondary and tertiary industry as comparing sequences, we can calculate the correlation coefficients through the equation (3.2). The detailed results are shown in table2.

**Table1 the standardization data of Chongqing industry structure and transport**

| Year | GDP（100 mm） | First industry | Second ary industry | Tertiary industry | Freight volume（10kton） | Railway freight volume | Road freight volume | Waterway freight volume | Passenger volume（10k p-t） | Railway Passenger volume | Road Passenger volume | Waterway Passenger volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.06 | 0 | 0.02 | 0.07 | 0.02 | 0 |
| 2004 | 0.08 | 0.14 | 0.11 | 0.13 | 0.15 | 0 | 0 | 0.13 | 0 | 0 | 0 | 0.10 |
| 2005 | 0.19 | 0.23 | 0.36 | 0.22 | 0.25 | 0.17 | 0.16 | 0.23 | 0.18 | 0.14 | 0.21 | 0.12 |
| 2006 | 0.27 | 0.37 | 0.46 | 0.30 | 0.36 | 0.32 | 0.29 | 0.34 | 0.29 | 0.22 | 0.38 | 0.24 |
| 2007 | 0.39 | 0.45 | 0.52 | 0.40 | 0.43 | 0.51 | 0.43 | 0.57 | 0.36 | 0.47 | 0.49 | 0.38 |
| 2008 | 0.52 | 0.55 | 0.54 | 0.53 | 0.58 | 0.65 | 0.54 | 0.71 | 0.52 | 0.59 | 0.57 | 0.57 |
| 2009 | 0.65 | 0.73 | 0.69 | 0.70 | 0.73 | 0.80 | 0.77 | 0.79 | 0.59 | 0.72 | 0.75 | 0.65 |
| 2010 | 0.70 | 0.87 | 0.84 | 0.86 | 0.90 | 0.90 | 0.95 | 0.86 | 0.74 | 0.81 | 0.82 | 0.87 |
| 2011 | 0.90 | 0.94 | 0.92 | 0.94 | 0.96 | 1.00 | 1.00 | 0.97 | 0.87 | 0.89 | 0.91 | 0.94 |
| 2012 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.93 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

**Table2 the grey correlation coefficients of Chongqing three industries**

| Year | Freight volume | | | Passenger volume | | |
|---|---|---|---|---|---|---|
| | First industry | Secondary industry | Tertiary industry | First industry | Secondary industry | Tertiary industry |
| 2003 | 0.43 | 0.43 | 0.43 | 0.63 | 0.33 | 0.33 |
| 2004 | 0.45 | 0.43 | 0.48 | 0.72 | 0.33 | 0.44 |
| 2005 | 0.45 | 0.44 | 0.50 | 0.89 | 0.39 | 0.63 |
| 2006 | 0.43 | 0.44 | 0.50 | 1.00 | 0.45 | 0.80 |
| 2007 | 0.38 | 0.41 | 0.45 | 0.94 | 0.45 | 0.75 |
| 2008 | 0.38 | 0.43 | 0.45 | 0.94 | 0.56 | 0.86 |
| 2009 | 0.36 | 0.46 | 0.46 | 0.76 | 0.7 | 0.92 |
| 2010 | 0.61 | 0.66 | 0.65 | 0.66 | 0.78 | 0.71 |

**(4) The grey correlation degree**

For there are so many correlation coefficients of referring sequences and comparing sequences, and the calculation results are too scattered to compare. We focus and average the correlation coefficients of different time point, then obtain the grey correlation degree.

According to the correlation coefficients of different time point in table2, we can calculate the correlation degree of Chongqing industry structure and passenger volume, freight volume. The results are shown in table3.

Table3 the correlation degree of Chongqing industry structure and passenger volume, freight volume

| Correlation degree | Freight volume | Passenger volume |
|---|---|---|
| First industry | 0.60 | 0.67 |
| Second industry | 0.78 | 0.64 |
| Tertiary industry | 0.66 | 0.74 |

From the table3, we can figure out that as to the freight volume, the most related is secondary industry, and the correlation degree is 0.78; then the tertiary industry 0.66, and last the first industry 0.60. As to the passenger volume, the tertiary industry is the most related one, and the correlation degree is 0.74; then the first industry 0.67, and last the second industry 0.64.

## CONCLUSION

The revolution of Chongqing secondary industry has a greater influence on the changes of freight volume, and the tertiary and first industry are smaller. The large freight volume industries remain dominant within the secondary industry. As to the passenger volume, the tertiary industry is the most related, then the first industry and last the secondary industry.

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