

# Research on the Relationship between Logistics Industry and Regional Economy in the Western Region of China

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**Abstract** This paper discusses the relationship between logistics industry and regional economy with quantitative analysis. By using the multivariate linear regression model, this paper shows the interactive relationship between them. On the one hand the result is that the development of logistics industry can promote the growth of regional economy, but the development of logistics industry in the western region of China was delayed, so the effect of promotion is limited. On the other hand, the economic growth has promoted the development of logistics industry. Because the development of tertiary industry is slow, the effect of promotion to logistics industry is not obvious. Finally, this paper gives the recommendation for the development of logistics industry in the western region of China.

**Key words** Logistics; Regional economy; Western region; Multivariate linear regression model

## 1 Introduction

In regional economic development, the logistics industry as a basis for regional economic structure-based industries has become an important component of the system; its level of development has greatly affected the regional economy.

The Structure-Conduct-Performance (SCP) paradigm (Mason, 1949; Bain, 1951, 1956) was the dominant framework for empirical research in industrial organization. In economic development, 'big-push' theory (Paul Rosenstein-Rodan, 1961), theory of balanced growth (Ragnar Nurkse, 1964), theory of stages of growth (W.W. Rostow, 1960), etc. were important theories. Based on these theories, China scholars began to study on logistics industry. These studies mainly concentrated on economic methods related to the logistics industry (Zhang Guorong, 2004), competitive advantages of logistics industry to achieve leaping development, the reason of developing regional logistics system, etc.

The development of logistics industry can bring about business flow, capital flow, information flow, technology flow aggregation. It can change regional economic growth mode from extensive type to an intensive one. It can promote the city as the regional market center and accelerate regional economic spatial structure. From the regional economic development point of view, promote the role of the logistics industry is obvious. Western development strategy of China has accelerated the construction of infrastructure investment, integrated and optimized the traditional logistics industry and improved the concentration of regional logistics industry.

Studying on the relationship between logistics industry and regional economy in the western region of China has an important significance.

## 2 Correlation Model for Logistics Industry and Regional Economy

This paper discusses econometrics model in the empirical analysis of the relationship between logistics industry and regional economy.

### 2.1 Model setup

#### 2.1.1 Index Selection

This paper selected macro-economic statistical data with taking into account the data availability and quality. Logistics industry will use the following indicators to measure the volume and scale of logistics: freight turnover  $x_1$ , length of railways and highways  $x_2$ , total retail sales of consumer goods  $x_3$ , number of civil vehicles  $x_4$  and business volume of post  $x_5$ .

Main indicators of economic development are: GDP  $y_1$ , GDP growth rate  $y_2$ , output value of primary industry  $y_3$ , output value of secondary industry  $y_4$  and output value of tertiary industry  $y_5$ .

#### 2.1.2 Data processing

West region of China includes Inner Mongolia, Xinjiang, Ningxia, Shanxi, Gansu, Qinghai, Tibet, Sichuan, Guizhou, Yunnan, Chongqing, Guangxi, twelve provinces, autonomous region and municipalities. China has started to carry out the strategy of large-scale development of the western region to accelerate its development and narrow the gap in development between regions since 1999. West region has

stepped up the development of major projects that strengthen economic and long-term development and accelerate construction of important infrastructure projects such as energy production bases, trunk rail lines and national trunk highways. This paper depends on the publication data from China Statistical Yearbook issues from 1999 to 2009. It is shown in Table 1.

**Table 1 Main Indicators of Logistics Industry and Economic Development**

Time <i>i</i>	Freight turnover (billion ton-km) $x_{i1}$	Length of Railways and Highways (km) $x_{i2}$	Total Retail Sales of Consumer Goods (billion yuan) $x_{i3}$	Number of Civil Vehicles (ten thousand) $x_{i4}$	Business Volume of Post (billion yuan) $x_{i5}$	GDP (billion yuan) $y_{i1}$	GDP growth rate (%) $y_{i2}$	Primary Industry (billion yuan) $y_{i3}$	Secondary Industry (billion yuan) $y_{i4}$	Tertiary Industry (billion yuan) $y_{i5}$
1999	5065.10	553996.80	5454.30	1870.33	528.58	15545.23	7.56	3698.01	6375.66	5472.08
2000	5423.20	575983.40	5997.20	167.75	632.99	16968.54	8.47	3776.65	7043.55	6148.34
2001	5862.50	724809.30	6591.40	182.90	793.52	18297.84	9.57	3843.64	7451.07	7004.05
2002	6385.90	752443.70	7239.80	186.67	1074.80	20559.57	12.15	4044.30	8332.98	7796.11
2003	6939.10	766235.30	7783.01	200.06	1318.23	23496.59	15.79	4412.86	9753.22	8595.11
2004	7899.30	784320.00	8908.24	209.79	1843.36	25776.75	13.65	5138.44	11705.20	9557.86
2005	8666.23	807933.30	11580.50	230.38	2351.44	31063.43	24.36	5590.15	13522.52	12489.76
2006	9580.90	1290026.10	13335.90	234.65	3000.42	36631.22	17.92	5932.36	16583.35	14145.72
2007	10867.69	1368830.00	15730.70	257.71	3977.43	42100.57	21.19	6724.40	19501.97	15873.58
2008	16402.94	1452610.22	19239.00	285.61	4897.29	47869.01	21.71	7448.75	23022.67	17397.58
2009	17043.12	1463878.42	22769.69	304.79	9901.04	51917.21	14.83	7138.91	24727.09	20029.74

The indices of  $y_1, y_3, y_4, y_5$  in Table 1 are calculated at comparable prices. Comparable Prices refers to prices that are used to remove the factors of price change in calculating economic aggregates, so as to facilitate comparison of aggregates over time. The base year for the computation of data in comparable prices is the previous year. The base year for calculations of consumer price indices in constant prices is 1998. Then this paper uses a continuous iterative method to calculate CPI

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2.1.3 Variable selection

Correlation analysis is related in the sense that deals with relationships among variables. The correlation coefficient is a measure of linear association between two variables.

The formula for computing correlation coefficient  $r$  is:

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 (y_i - \bar{y})^2}}$$

Values of the correlation coefficient are always between -1 and +1. If  $|r|=1$ , then perfect correlation. If  $0.8 \leq |r| \leq 1$ , then strong correlation. If  $0.5 \leq |r| \leq 0.8$ , then fair correlation. If  $0 \leq |r| \leq 0.5$ , then weak correlation. If  $|r|=0$ , then no correlation.

Data were managed and analyzed using SPSS17. Correlation coefficients of independent variables  $y_2$  were not highly correlated, so remove the variable  $y_2$ .

#### 2.1.4 Establishing multiple linear regression models

A multiple linear regression model is a hypothetical relationship such as described below.

$$y = \varepsilon + \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_px_p$$

In the equation  $\beta_0, \beta_1, \beta_2, \dots, \beta_p$  are called the constant term and regression coefficients.  $\varepsilon$  is a random error term.

This paper established two regression equations.

Regression equation 1 is on behalf of the logistics industry to promote regional economic development.

$$E(y_i) = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5$$

Regression equation 2 is on behalf of the regional economic development to promote logistics industry.

$$E(x_i) = \beta_6 + \beta_7y_1 + \beta_8y_3 + \beta_9y_4 + \beta_{10}y_5$$

#### 2.2 Parameter estimate

Linear regression analysis was conducted with SPSS 17. In the parameter estimation analysis, it involves goodness of fit  $R^2$  test and regression coefficient significance  $t$  tests.

In regression equations 1,  $x_1, x_2, x_3, x_4, x_5$  correlation coefficients are:

$$r_{12} = 0.919 \quad r_{13} = 0.993 \quad r_{14} = 0.984 \quad r_{15} = 0.988 \quad r_{23} = 0.945$$

$$r_{24} = 0.940 \quad r_{25} = 0.956 \quad r_{34} = 0.990 \quad r_{35} = 0.997 \quad r_{45} = 0.993$$

It is obviously that two explanatory variables in a multiple regression model are highly correlated. It can lead to inaccurate parameter estimation. In order to check multicollinearity, stepwise regression analysis program was used.

For every combination of values of  $x_1, x_2, x_3, x_4, x_5$ , the values of the response variable varies with a certain standard deviation.

$$y_1 = 378.222 + 3.336x_1$$

Standard deviation (2364.934) (0.247)  $R^2 = 0.993$   $t = 26.519$

$$y_1 = 13054.058 + 7.160x_2$$

Standard deviation (3138.353) (0.003)  $R^2 = 0.934$   $t = 11.288$

$$y_1 = 5153.802 + 2.195x_3$$

Standard deviation (1265.138) (0.100)  $R^2 = 0.982$   $t = 21.878$

$$y_1 = -29975.815 + 272.184x_4$$

Standard deviation (2397.966) (10.661)  $R^2 = 0.986$   $t = 25.531$

$$y_1 = 13054.058 + 7.160x_5$$

Standard deviation (599.254) (0.205)  $R^2 = 0.981$   $t = 24.897$

Based on the above results,  $x_1$  is the most important explanatory variable. So  $x_1$  will be the first variable entering into the model.

Adding explanatory variables  $x_2$  in linear regression models.

$$y_1 = -2572.506 + 1.937x_1 + 0.016x_2$$

Standard deviation (1658.246) (0.391) (0.004)

$$R^2 = 0.984 \quad t = 4.953 \quad t = 3.892$$

It can be seen that  $R^2$  is closer to 1,  $x_1, x_2$  coefficients are significant. So keep  $x_2$  in models.

Adding explanatory variables  $x_3$  in linear regression models.

$$y_1 = 3479.582 - 0.655x_1 + 0.009x_2 + 2.091x_3$$

Standard deviation (2907.272) (2.515) (0.775) (0.924)

$$R^2 = 0.991 \quad t = 0.551 \quad t = 1.983 \quad t = 2.264$$

$R^2$  is closer to 1, but  $x_1$ ,  $x_2$  coefficients are not significant. So  $x_3$  can not enter into models. Similarly,  $x_4$ ,  $x_5$  can not enter into models.

Finally, keep the variables  $x_1$  and  $x_2$  in the model, the regression equation 1 is as follows:

$$y_1 = -2572.506 + 1.937x_1 + 0.016x_2$$

$$R^2 = 0.984 \quad t = 4.953 \quad t = 3.892$$

Similarly, the regression equations 2 are as follows:

$$x_1 = 1356.344 + 0.559y_4$$

$$R^2 = 0.961 \quad t = 14.834$$

Various tests are then employed to determine if the model is satisfactory. There are three main testing, including economic rationality testing, classical statistical testing and econometric testing. Classical statistical test which includes simulation level testing, individual significance testing and overall significance testing. Econometric testing includes multicollinearity testing, heteroskedasticity testing and autocorrelation testing.

These models passed testing and were deemed satisfactory. The regression equation can be used to predict the value of the dependent variable given values for the independent variables.

### 3 Results

Elasticity is measure of sensitivity of one variable to another. The coefficients of the explanatory variables in logarithms were thus the "elasticities" (percentage change in the dependent variable resulting from a 1% change in the independent variables). Using SPSS17 can obtain the double logarithmic regression equation.

$$\ln y_1 = 0.604 \ln x_1 + 0.487 \ln x_2 - 1.903$$

$$R^2 = 0.987 \quad t = 3.553 \quad t = 2.539$$

$$\ln x_1 = 0.79 \ln y_4 + 1.596$$

$$R^2 = 0.969 \quad t = 16.744$$

Elasticity Coefficients of double logarithmic regression equation 1 is 0.604、0.487. If freight turnover change 1%, then GDP change 0.604%, showing weak elasticity. If length of railways and highways change 1%, then GDP change 0.487%, showing weak elasticity.

Elasticity Coefficients of double logarithmic regression equation 2 is 0.79. If output value of secondary industry change 1%, then freight turnover change 0.79%, showing weak elasticity.

Elasticity Coefficients is less than 1, it shows that economy growth boosts logistics demand. Its GDP growth mainly comes from secondary industries, the tertiary industry makes little contribution for economic growth.

### 4 Conclusions

This paper established correlation model for logistics industry and regional economy. Freight turnover and the length of railways and highways give the significant contribution to the growth of economy. Secondary industries promote logistics industry significant, but tertiary industry started late.

West region needs to make and follow comprehensive and well-considered plans, give full play to local strengths and carry out related government policies to promote balanced development among all regions. It will conscientiously implement the Eleventh Five-Year Plan for the Large-Scale Development of the Western Region, focusing on strengthening infrastructure, developing science, technology and education, and developing industries that take advantage of local strengths.

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