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Empirical analysis on regional logistics capacity and regional economic development based on the panel data

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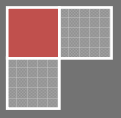
ABSTRACT

Regional logistics capacity is closely related to regional economic development and the former can reflect the basic status and development trend of the latter. This paper first describes in detail regional logistics capacity and discusses the main parts contained in regional logistics capacity based on specific results of domestic relevant literature research. In this paper, the principal component analysis (PCA) is used to calculate all the reflective indexes so that the further study on the main contents and the influences of regional logistics capacity can be conducted and the scientific calculation towards it can be made; this paper next discusses regional economic development and enumerates main factors that may influence its development, thus playing the security role in the improvement of the regional logistics capacity; the effective method of multivariate statistics and analysis is used in this paper to identify the relationship between two sets of variables based on the canonical correlation analysis on regional logistics capacity and regional economic development, so that the existent correlation can be fully reflected and the inherent relationship between them can be further discussed. The above information introduces the main idea of this paper and also fully expounds the main research field in this paper. This paper further summarizes that the advancement of regional logistics capacity can promote the sound and rapid economic growth.

KEYWORDS

Panel data; Regional logistics capacity; Regional economic development; Empirical analysis.



INTRODUCTION

From a development perspective, the economic development is a fundamental factor to measure the social great development, while regional logistics capacity is the representative factor of regional economic development. This paper gives a specific description of regional logistics capacity and regional economic development respectively. Moreover, the correlations between the two are discussed based on the canonical correlation analysis on regional logistics capacity and regional economic development, and it thus embodies that the rapid improvement of regional logistics capacity can boost the development of regional economy. However, regional economic development does not necessarily mean that the regional logistics capacity is developed well. This reflects the dialectical relationship between regional economic development and regional logistics capacity.

REGIONAL LOGISTICS CAPACITY

Compared with other relevant researches, the analysis of the logistics capacity was conducted a little later in China. However, the initial logistics capacity was put forward to direct at the definition designed for the competition of logistics enterprises. And its main operational process focuses on the specific research of the services provided by logistics enterprises. This process mainly aims at four factors including orientation, integration, quickness, and measurement, but these four factors alone cannot guarantee the good adaptability of the regional logistics capacity analysis. In his research on the regional logistics capacity, Yuefeng Wang puts forward the definition of regional logistics capacity based on relevant literature, and the generic terms are specifically used to mean the effective support and the logistics service capability provided by the logistics department. But in the specific research on the regional logistics capacity conducted by Qingmei Tan, he defines the cargo turnover and passenger turnover as logistics equivalents, which accordingly reflects the regional logistics capability of a country or a specific region. Xiuxia Yan conducts the regression analysis on three factors including logistics equivalents, warehousing, and the trade volume of wholesale and retail. These factors are regarded as the specific indexes of logistic equivalents, so that the regional logistics capacity can get better described. Huazhen Feng specifically discusses main characteristics of the regional logistics development and establishes the corresponding evaluation system of the logistics capability based on the analyses and summary of six reflective indicators. Moreover, the principal component analysis and the evaluation system are used together to calculate the valid composite scores of the logistics capability towards some provinces in 2006, making the research on the regional logistics capacity more effective. In the research and exploration, relevant literature information about the regional logistics capacity cannot be used to describe the single turnover and evaluate the capacity. In response to the situation, the detailed research and discussion is conducted in this paper, and the indicator system of the regional logistics capacity is effectively established based on indicators including economic output, the specific scale of the logistics industry, and logistics infrastructure, as is shown in TABLE 1.

TABLE 1 : Indicator system of regional logistics capacity and regional economic development

Subject	Index dimensions
regional logistics capacity	Production value x1(100 million yuan), freight volume x2(10,000 ton), cargo turnover x3(10,000 ton km),truck holdings x4 (pc),the investment amount of fixed assets projects x5 (10,000 yuan), employee ratio x6 (percentage), inland railway mileage x7 (km), highway mileage x8 (km)
regional economic development	GDP y1(100 million yuan), agricultural GDP y2, industrial GDP y3, gross retail sales of consumer goods y4 (100 million yuan), per capita GDP y5, people's consumption level y6 (100 million yuan), the social investment amount of fixed assets projects y7 (100 million yuan)

In accordance with *Classification of National Economic Industries GB-T4754-2002,* the output of the logistics economy is determined by the sum of the added value from the wholesale and retail industry and that from transportation, post and telecommunications. The evaluation indexes are made up of freight volume, cargo turnover, and truck holdings etc. Among these indexes, the statistics is conducted about the value of transportation and warehousing staff as well as regional staff to calculate the ratio of logistics based on a smaller proportion of wholesale and retail staff participating in logistics activities. The logistics infrastructure mainly consists of total railway mileage, total highway mileage, and total shipping mileage. The basic geographical features of a specific province and annual turnover of highway and railway cargoes are considered as the specific indexes in the logistics infrastructure. The information construction is not integrated in the index system, because the information platform not only provides supports for the logistics service industry but also plays an important role in other industries. Considering the feasibility of the acquired data, the information data are not classified between industries in terms of the logistics capacity, and the impact of the information level over regional logistics capacity will not be analyzed concretely.

REGIONAL ECONOMIC DEVELOPMENT

The so-called regional economic development mainly means the complex of the regional production based on the interplay between internal factors and external conditions existent in the economic development of a specified region, and the interplay could make regional production more competitive. The industrial GDP alone cannot be used for the evaluation and analysis of regional economic development. In the process of research and discussion, the index system of regional economic development comprises GDP from regional economic output, agricultural GDP, industrial GDP, residents' consumption level for the boost of logistics needs, per capita GDP, investment amount of social fixed assets which are closely related to logistics and boost the infrastructure development, and gross retail sales of consumer goods representing social material needs, as is shown in TABLE 1.

Canonical correlation analysis on regional logistics capacity and regional economic development

The canonical correlation analysis refers to the process of effective multivariate statistics and analysis used for reflecting the relationship between two groups of variables. If $X=(x_1, x_2, \ldots, x_p)$, then $Y=\left(y_1, y_2, \ldots, y_p\right)$, reflecting the correlation existent in two groups of variables. The principal component analysis is used to select representative aggregate variables from two groups of variables and ensure they are the current combination of origin variables u_i and v_i. Let u_i equals $u_i = a_{i1}x_1 + a_{i2}x_2 + \ldots + a_{ip}x_p$ and ensure $v_i = b_{i1}y_1 + b_{i2}y_2 + \ldots + b_{iq}y_q$. In this case, representative variables can fully reflect the linear correlation between X and Y. On this basis, the research about the correlation between two groups of variables turns into the one about the correlation between several canonical variables, thus helping to analyze the essence of problems.

As is shown in TABLE 2, China's 31 provinces and cities are regarded as the research sampling, and regional logistics capacity is analyzed in detail based on the panel data from 2003 to 2008. These data are originally from *the China Statistic* ***Almanac*** and statistic yearbooks provided by provinces. Only part of the data is listed here due to space limitations as shown in TABLE 2.

TABLE 2 : Panel data of regional logistics capacity and regional economic development

Year	Province	x_1	x_2	x_3	x_4	x_5	...	y_5	y_6	y_7
	Beijing	533.49	30729	462.50	18.59	124.49		32061	10584	558.78
	Tianjin	460.37	32014	6521.10	14.09	99.35		26532	7836	501.37
	Hebei	1215.16	77089	3223.20	63.59	152.64		10513	3452	845.90
	Shanxi	377.70	106720	1259.10	31.89	109.11		7435	2934	498.25
2003	Inner Mongolia	397.55	50820	1160.30	20.23	197.08		8975	3742	750.73
	Liaoning	1298.88	83515	2385.20	35.94	133.27		14258	5159	683.16
	Jilin	479.94	31436	531.00	17.63	77.94		9338	4557	433.88
	Heilongjiang	702.83	54350	991.40	26.67	109.40		11645	4645	593.08
	Shanghai	1069.64	58507	8492.30	17.87	176.78		46718	15866	899.27
	Guangdong	4059.74	151282	4292.22	78.74	997.40		33151	12663	9294.26
	Guangxi	821.43	48860	1404.30	14.14	364.01		12555	4987	2939.67
2007	Hainan	207.46	17876	823.76	2.30	92.84		14555	5552	502.37
	Chongqing	631.93	50273	1051.55	17.08	370.53		14660	6545	3127.74
	Sichuan	1136.24	81426	1059.15	32.33	482.73		12893	5259	5639.80
	Shannxi	835.70	83493	2027.05	22.08	580.42		18246	6290	4614.42
	Gansu	408.04	23741	1594.90	16.36	154.42		12110	4869	1712.78
2008	Qinghai	94.00	9115	335.66	6.15	111.88		17389	5830	583.24
	Ningxia	120.15	26162	703.62	8.11	75.12		17892	7193	828.85
	Xinjiang	416.00	46087	1272.97	25.35	266.27		19893	5542	2259.97

Because 15 indexes in TABLE 1 have different dimensions, the following formula is used for the data normalization in order to eliminate the negative effects caused by dimensions and the cardinality size.

$$X_{ij}^{*} = \frac{X_{ij} - \overline{X}_j}{\sqrt{\mathrm{var}(X_j)}}$$

TABLE 3 : Correlation index between all indexes of regional logistics capacity and regional economic development

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
y_1	0.984	0.810	0.449	0.794	0.902	-0.260	0.128	0.495
y_2	0.704	0.708	0.154	0.713	0.726	-0.463	0.423	0.745
y_3	0.973	0.821	0.465	0.789	0.881	-0.285	0.136	0.482
y_4	0.977	0.789	0.424	0.796	0.893	-0.222	0.112	0.487
y_5	0.501	0.285	0.700	0.146	0.515	0.349	-0.251	-0.155
y_6	0.482	0.259	0.669	0.144	0.502	0.388	-0.300	-0.150
y_7	0.877	0.808	0.426	0.659	0.937	-0.294	0.190	0.570

By comparing two groups of indexes, it can be seen that seven indexes are with negative values. Theoretically, 7 pairs of comparatively canonical variables with minus values can be acquired. According to Barlett inspection rules, the first 6 pairs of canonical variables are significantly correlated when significant levels are respectively 0.05 and 0.01. In the results of the redundancy analysis, canonical variables from U_1 to U_6 can respectively explain the total fluctuation of regional logistics capacity, as well as regional economic development, and they are respectively 45.6%,14.2%,11.2%,7.1%,5.3%,4.6%, and 44.8%,10.6%,7%,3%,1%,0.4%. Canonical variables from V_1 to V_6 can respectively explain the total fluctuation of regional logistics capacity, as well as regional economic development, and they are respectively 67.5%, 14.4%, 4.3%, 0.8%, 0.3%, 0.1% and 68.7%, 19.3%, 7%, 3%, 1%, 0.4%. But canonical variables pairs U_3-V_3, U_4-V_4, U_5-V_5, and U_6-V_6 cannot fully explain and accurately predict regional economic development and regional logistics capacity. Thus, this paper mainly focuses on the study and exploration of the first two pairs of prediction variables. The canonical correlation index can reach over 0.850 in the first two pairs of prediction variables, which fully reflects the stronger correlation between the improvement of logistics capacity and regional economic development in China's 31 provinces and regions from 2003 to 2008, and the specific canonical variant is shown in TABLE 4.

TABLE 4 : Canonical correlation index, significant level, and canonical variable

Eigen value	Canonical correlation index	Canonical variable	Canonical variable
$\lambda_1 = 58.625$	0.992	0.000	$U_1 = 0.886x_1 - 0.001x_2 - 0.024x_3 - 0.018x_4 + 0.133x_5 - 0.017x_6 - 0.036x_7 + 0.09x_8$ $V_1 = 1.105y_1 - 0.026y_2 + 0.217y_3 + 0.12y_4 + 0.038y_5 - 0.065y_6 + 0.024y_7$
$\lambda_2 = 2.970$	0.865	0.000	$U_2 = -0.65x_1 + 0.155x_2 + 0.478x_3 - 0.505x_4 + 1.023x_5 + 0.237x_6 - 0.191x_7 - 0.262x_8$ $V_2 = -2.266y_1 + 0.172y_2 + 1.626y_3 - 0.829y_4 - 0.183y_5 + 1.387y_6 - 0.874y_7$

In the variant of U_1, x_1 and x_5 have larger loads compared with other variables, and U_1 means the combination of logistics output and investment in construction; in the variant of V_1, y_1 and y_3 carry larger loads and V_1 means the output of regional economy; in addition, the values of y_1 and y_3 increase in the same direction, and this trend means the increase in regional economic output and the investment expansion in logistics infrastructure construction contribute to the rapid growth of regional economy, especially the industrial economy. In the variant of U_2, x_5 has a larger load, and next $X_1$and X_4, X_5, $X_1$and X_4 are opposite in the development direction, meaning that the scale of regional logistics has an influence on logistics output capacity; in the variant of V_2, y_1, y_3, and y_6 are clearly big in load, and the development level of regional economy is further reflected through combination with residents' consumption level ; y_1 and the pair of $x_1$and x_4 are the same in the direction, but y_1 differs from x_5 in the direction, and it shows that regional economic development benefits from the expansion in the scale of regional logistics, but the level of infrastructure construction retards economic development; the pair of $y_3$and y_6 and x_5 are the same in the direction, but the pair of $y_3$and y_6 differs from the pair of x_1 and x_4 in the direction, and it shows the industrial development and the improvement of residents' consumption level, bringing more demands for logistics service and raising the investment in regional logistics construction. Meanwhile, satisfying such demands is limited by the scale of regional logistics.

From TABLE 5, the correlation between variables is analyzed concretely: the correlation index of $U_1$and the pair of X_1, X_2, X_4, and X_5 has already reached over 0.8, and the correlation index of V_1 and the pair of y_1, y_3, y_4, and y_7 has already reached over 0.9; moreover, the sameness of the correlation in the direction can be guaranteed. It explains that the increase in the investment amount of fixed assets such as GDP of the logistics industry, freight volume, and truck holdings is closely linked with factors including regional GDP, industrial GDP, and gross retails sales of consumer goods. Of all the indexes, the

index X_5 has the maximum load in the variant, but the correlation index between X_5 and U_2 is relatively low because X_5 is the suppressor variable of U_2. The correlation index between V_2 and y_5、y_6 is more than 0.75, higher than other indexes, which means the increase of cargo volumes helps to boost resident consumption power.

TABLE 5 : Correlation index between variables and canonical variables

	U_1	U_2		V_1	V_2
x_1	0.992	0.008	y_1	0.999	0.008
x_2	0.814	-0.002	y_2	0.755	-0.320
x_3	0.439	0.678	y_3	0.985	0.001
x_4	0.802	-0.352	y_4	0.992	0.001
x_5	0.911	0.226	y_5	0.476	0.783
x_6	-0.262	0.517	y_6	0.460	0.782
x_7	0.129	-0.338	y_7	0.919	0.151
x_8	0.503	-0.341			

The index of standardized data calculated in 2008 can be used in the above two groups of canonical variants to calculate the values of canonical variables in China's 31 provinces and regions. In addition, the trend chart can be used to fully reflect the characteristics of regional logistics development.

It can be seen from Figure 1 that the curve volatility between U_1 and U_2 is obviously smaller than that between V_1 and V_2. From this perspective, it is adequately stated that the balance of logistics development between provinces of China is lower than that of economic development. And U_1 represents the output of logistics industry and the corresponding investment while V_1 shows the precise output level of this region. The positive correlation is maintained between U_1 and V_1 in provinces of China so as to show their similar volatility and the specific role regional logistics capability plays in the economic development. Therefore, all provinces should make scientific and perfect investments in the logistics industry based on the current status to propel the development of regional logistics and economy. As it is shown in Figure 1, Guangdong Province, Shandong Province and Jiangsu Province rank the top three while the regional overall performance decreases gradually from eastern provinces to western provinces. U_2 reflects the major difference between logistics scale and the output of logistics industry. The variant $U_2 \leq 0$ shows that the region can take advantage of logistics scale to play its full role, thus ensuring its output capacity, and these provinces mainly include Guangdong, Henan, and so on. However, the variant of $U_2 > 0$ fully illustrates that the practical application of logistics scale lags behind and the deficiency exists in the development process, and provinces including Shanghai and Liaoning etc. are shown in Figure 1. The source of the growth in resident consumption power can been reflected in V_2. And the variant $V_2 \geq 0$ fully shows that regional economic development promotes resident consumption power in the region, while the variant $V_2 < 0$ reveals the positive influence of regional economic development over the industrial development. Besides, development features also vary to the characteristics of each province.

CONCLUSIONS

The above text introduces the process of empirical analysis on regional logistics capacity and regional economic development based on the panel data collected in 31 provinces and cities of China from 2003 to 2008. This paper focuses on the study of canonical correlation analysis between regional logistics capacity and regional economic development. Meanwhile, this paper further embodies the specific value, scientific properties and feasibility of the research, with the aim of laying a solid foundation in both theory and data for further research.

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