An Empirical Study on Regional Logistics Competitiveness in Guangdong

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Abstract: Through the construction of factor analysis of regional logistics competitiveness evaluation model, we objectively evaluate the regional logistics competitiveness of Guangdong Province. Then we find out the main influencing factors of regional logistics competitiveness. According to the short-term of each city, we propose some suggestions to improve regional logistics competitiveness.

1. Introduction
With industrial upgrading and transforming of economic development mode, the logistics industry has a deeper impact on economic development and its position in the national economy has become more important. So, the governments have introduced many measures to accelerate the development of the logistics industry. However, due to the lack of scientific evaluation of competitiveness of logistics development in the region, some cities have blindly copied the development experience of others, which seriously affected regional logistics efficiency and logistics competition.

With the rapid development of logistics industry, regional logistics has become a research hotspot. For regional logistics competitiveness, scholars conduct qualitative and quantitative research. Shun Yao (2007) [1] defines the concept and connotation of regional logistics competitiveness, and constructs a "network diamond model" to measure regional logistics competitiveness. Xiuli Gao (2010) [2], Cheng Zhang (2012) [3], Peihua Zhao (2013) [4], Zhang Cheng (2014) [5] Separately analysed regional logistics competitiveness in Guangdong, six central provinces, Henan and Jiangxi provinces, by using factor analysis, cluster analysis and other quantitative methods. However, the current research mainly focuses on the static study of logistics competitiveness, but the regional logistics competitiveness is dynamic change. We will introduce competitive potential to dynamically evaluate the regional logistics competition.

2. Evaluation model of regional logistics competitiveness in Guangdong

2.1. Construction of evaluation model
Based on the references, it is found that the factor analysis model is more suitable for regional logistics competitiveness evaluation, because it is not affected by different indicators and different dimensions,
and it can find significant impact factors. Therefore, we use factor analysis model to analyze the comprehensive logistics capacity of Guangdong province.

The form of factor analysis model:

\[
\begin{align*}
X_1 &= a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m + \epsilon_1 \\
X_2 &= a_{21}F_1 + a_{22}F_2 + \cdots + a_{2m}F_m + \epsilon_2 \\
& \vdots \\
X_p &= a_{p1}F_1 + a_{p2}F_2 + \cdots + a_{pm}F_m + \epsilon_p \\
\end{align*}
\]

(1)

\[X = (X_1, X_2, \ldots, X_p)\] are Observable random variables, \(E(X)=0\).

\[F = (F_1, F_2, \ldots, F_m)\ (m<=p)\] are unknown vectors, \(E(F)=0\).

\[\text{Cov} (F, \epsilon) = 0.\ \ D(F)=I.\]

After extracting the common factor, the common factor can be represented by the linear combination of the common factor variables. Formula is (2).

\[F_j = \sum_{j=1}^{m} \beta_{jj} X_j \quad j=1,\cdots, m \quad (2)\]

2.2. Selection of evaluation index

Regional logistics competitiveness refers to the comparative advantages of logistics industry, including regional logistics foundation, logistics demand, logistics supply, logistics environment, Regional logistics competitiveness is dynamic development, so regional logistics development potential index is increased. Freight volume growth rate reflects the scale potential of logistics development, while Per capita GDP growth rate reflects the regional logistics demand potential. In order to avoid the sudden change of indicators, the two indicators have chosen the average growth rate in the past five years. The evaluation indicators are shown in Table 1.

| First level index                        | Second level index                                      |
|------------------------------------------|--------------------------------------------------------|
| Regional social development economic environment | Per capita GDP (X1)                                   |
|                                          | Per Capita Disposable Income of Urban Permanent Households (X2) |
|                                          | GDP of primary industry (X3)                           |
|                                          | GDP of second industry (X4)                           |
|                                          | GDP of tertiary industry (X5)                         |
|                                          | Total Retail Sales of Consumer Goods (X6)              |
| Development scale of regional logistics | Freight Traffic (X7)                                    |
|                                          | Freight Ton-kilometers (X8)                           |
| Regional logistics foundation support    | Length of Highways (X9)                                |
|                                          | Freight Vehicles (X10)                                 |
|                                          | Business Volume of Postal and Telecommunication Services (X11) |
|                                          | Number of Higher Education and Secondary Schools (X12) |
| Regional logistics development potential | Freight volume growth rate (X13)                       |
|                                          | Per capita GDP growth rate (X14)                       |

3. Evaluation of regional logistics competitiveness in Guangdong

The data are from the Guangdong statistical yearbook 2017 and the statistical yearbook of various cities in 2017.
3.1. Data standardization
Because of the different dimensions of the 14 indicators, standardization of index data is needed. Using SPSS23.0, the normalized data matrix is obtained by averaging the original data.

3.2. Applicability test
Using SPSS23.0, we get KMO and Bartlett spherical test results (Table 2). KMO 0.640>0.5, sig.=0, Through testing, it is suitable for factor analysis.

Table 2. KMO and Bartlett’s Test

| Kaiser-Meyer-Olkin | Measure of Sampling | Bartlett’s Test of Sphericity |
|--------------------|---------------------|-----------------------------|
|                    |                     | Approx. Chi-square | df | Sig. |
|                    |                     | 528.906          | 91.000 | 0.000 |

3.3. Factor extraction and common factor determination
The principal component is used to extract the factors. The results are shown in Table 3. As is shown in Table 3, The first three factors can explain 88.395% of the variance. After the fourth factor, the curve gradually flattened and the explanation ability was not strong. Therefore, the first three common factors can better represent the competitiveness of Guangdong's cities.

Table 3. Total Variance of Explained

| Factor | Initial Eigenvalues | Extraction Sum of Squared Loadings | Rotations Sum of Squared Loadings |
|--------|---------------------|-----------------------------------|----------------------------------|
|        | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % | Total | Variance % | Cumulative % |
| 1      | 8.548 | 61.057     | 61.057       | 8.548 | 61.057     | 61.057       | 7.219 | 51.564     | 51.564       |
| 2      | 2.779 | 19.849     | 80.907       | 2.779 | 19.849     | 80.907       | 2.805 | 20.037     | 71.601       |
| 3      | 1.048 | 7.488      | 88.395       | 1.048 | 7.488      | 88.395       | 2.351 | 16.795     | 88.395       |

3.4 Calculation of factor matrix and rotated factor matrix
In order to make the common factor have more obvious meaning, when the explanation meaning of the initial factor is not very clear, it is necessary to take the rotation of the row factor to get a more satisfactory principal factor, and enhance the explanatory meaning of the factor. Table 4 is the factor matrix and rotated factor matrix.

As it is showed from table 4, Common factor F1 has a large load in X1, X2, X4, X5, X6, X7, X8, X10, X11, X12. These indicators mainly reflect the regional economic strength and logistics development scale. Common factor F2 has a large load in X3 and X9, which indicates that F2 is related to the development of primary industry and regional traffic conditions. Common factor F3 has a great load on X13 and X14, which mainly reflects the development scale potential and demand potential of regional logistics. The common factor F1 and F2 together constitute the regional logistics competitiveness, expressed in F4.

Table 4. Component Matrix and Rotated Component Matrix

| Index   | Component | Rotated Component |
|---------|-----------|-------------------|
|         | Factor    | Factor            |
|         | 1  | 2  | 3  | 1  | 2  | 3  |
| Zscore(X1) | 0.864 | -0.364 | -0.081 | 0.596 | 0.500 | 0.530 |
| Zscore(X2) | 0.850 | -0.413 | 0.031 | 0.587 | 0.592 | 0.447 |
| Zscore(X3) | -0.209 | 0.750 | -0.476 | 0.028 | -0.911 | 0.045 |
| Zscore(X4) | 0.918 | -0.201 | -0.123 | 0.703 | 0.359 | 0.525 |
| Zscore(X5) | 0.978 | 0.078 | -0.042 | 0.889 | 0.184 | 0.374 |
| Zscore(X6) | 0.976 | 0.175 | 0.038 | 0.944 | 0.142 | 0.270 |

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Zscore(X7) 0.876 0.390 0.137 0.966 -0.015 0.068
Zscore(X8) 0.807 0.499 0.217 0.968 -0.086 -0.066
Zscore(X9) -0.377 0.713 -0.318 -0.103 -0.849 -0.139
Zscore(X10) 0.947 -0.111 -0.110 0.768 0.299 0.490
Zscore(X11) 0.959 -0.031 -0.060 0.823 0.261 0.423
Zscore(X12) 0.788 0.505 0.209 0.951 -0.100 -0.069
Zscore(X13) -0.079 0.796 0.448 0.355 -0.463 -0.707
Zscore(X14) -0.529 -0.161 0.608 -0.409 0.284 -0.654

ZXi is Xi after standardization.

3.5. Calculation factor score
In order to facilitate the comparative analysis of regional logistics development differences in Guangdong Province, the regression method was used to calculate the factor scores of each city through SPSS23.0. The results are shown in Table 5.

Table 5. Factor Score Component Matrix

| Index  | Factor 1 | Factor 2 | Factor 3 |
|--------|----------|----------|----------|
| ZX1    | 0.019    | 0.099    | 0.153    |
| ZX2    | 0.032    | 0.165    | 0.067    |
| ZX3    | -0.004   | -0.452   | 0.275    |
| ZX4    | 0.040    | 0.032    | 0.167    |
| ZX5    | 0.105    | -0.011   | 0.066    |
| ZX6    | 0.135    | -0.003   | -0.011   |
| ZX7    | 0.176    | -0.025   | -0.124   |
| ZX8    | 0.202    | -0.022   | -0.207   |
| ZX9    | 0.005    | -0.372   | 0.145    |
| ZX10   | 0.059    | 0.013    | 0.145    |
| ZX11   | 0.083    | 0.012    | 0.095    |
| ZX12   | 0.199    | -0.028   | -0.202   |
| ZX13   | 0.200    | -0.032   | -0.473   |
| ZX14   | 0.042    | 0.314    | -0.493   |

The score of factor 5 of Table 2 is substituted by (2), and the scores of common factors F1, F2 and F3 are obtained. The three common factors all reflect the regional logistics competitiveness of Guangdong Province from different angles, but the single factor can not reflect the overall competitiveness of regional logistics, Therefore, we use the variance contribution rate of Table 3 to weigh F1, F2 and F3, and get the score of comprehensive factor F. Calculation formula is shown in formula (3). F=0.6106F1+0.1985F2+0.0849 F3  

The results are shown in table 6.

Table 6 Factor scores and rankings

| City     | F1   | F1 rank | F2   | F2 rank | F3   | F3 rank | F4   | F1 rank | F   | F1 rank |
|----------|------|---------|------|---------|------|---------|------|---------|-----|---------|
| Guangzhou| 4.08 | 1       | -0.52| 15      | -0.70| 17      | 3.56 | 1       | 2.34| 1       |
| Shenzhen | 0.95 | 2       | 1.13 | 4       | 2.97 | 1       | 2.08 | 2       | 1.02| 2       |
| Zhuhai   | -0.38| 17      | 1.32 | 2       | 0.26 | 7       | 0.94 | 5       | 0.05| 6       |
| City         | F4  | F3  | F2  | F1  | R1  | R2  | R3  | R4  | R5  | R6  |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Shantou     | -0.29 | 11  | 0.82 | 7   | -0.84 | 19  | 0.53 | 8   | -0.08 | 8   |
| Foshan      | 0.32  | 3   | 0.99 | 5   | 0.51  | 4   | 1.30 | 4   | 0.43  | 3   |
| Shaoguan    | -0.31 | 14  | -0.77 | 17  | 0.11  | 9   | -1.07 | 16  | -0.33 | 14  |
| Heyuan      | -0.21 | 9   | 0.07  | 10  | -1.47 | 20  | -0.13 | 10  | -0.22 | 11  |
| Meizhou     | -0.32 | 15  | -0.68 | 16  | -0.40 | 16  | -1.00 | 15  | -0.36 | 16  |
| Huizhou     | -0.02  | 5   | 0.10  | 9   | -0.37 | 14  | 0.08  | 9   | -0.02 | 7   |
| Shanwei     | -0.58  | 20  | 0.18  | 8   | -0.37 | 15  | -0.40 | 13  | -0.34 | 15  |
| Dongguan    | 0.06  | 4   | 1.62  | 1   | 0.06  | 10  | 1.69  | 3   | 0.37  | 4   |
| Zhongshan   | -0.36  | 16  | 1.25  | 3   | 0.41  | 6   | 0.89  | 6   | 0.06  | 5   |
| Jiangmen    | -0.26  | 10  | -0.01 | 12  | -0.06 | 11  | -0.27 | 11  | -0.17 | 10  |
| Yangjiang   | -0.85  | 21  | -0.39 | 14  | 1.07  | 3   | -1.24 | 18  | -0.51 | 21  |
| Zhanjiang   | -0.05  | 6   | -1.88 | 21  | 0.21  | 8   | -1.92 | 21  | -0.38 | 18  |
| Maoming     | -0.20  | 8   | -1.57 | 20  | 0.42  | 5   | -1.77 | 19  | -0.40 | 19  |
| Zhaoqing    | -0.44  | 19  | -1.37 | 19  | 1.16  | 2   | -1.81 | 20  | -0.45 | 20  |
| Qingyuan    | -0.29  | 13  | -0.93 | 18  | -0.22 | 13  | -1.22 | 17  | -0.38 | 17  |
| Chaoshan    | -0.19  | 7   | 0.87  | 6   | -1.86 | 21  | 0.69  | 7   | -0.08 | 9   |
| Jieyang     | -0.29  | 12  | -0.29 | 13  | -0.13 | 12  | -0.58 | 14  | -0.24 | 12  |
| Yunfu       | -0.40  | 18  | 0.07  | 11  | -0.77 | 18  | -0.34 | 12  | -0.29 | 13  |

Note: F4 is the competitive strength factor of regional logistics, which is weighted by F1 and F2.

4. Discussion on the results of regional logistics competitiveness in Guangdong

As is showed in table 6, we find that the top three of F4 are respectively won by Guangzhou, Shenzhen and Zhuhai, and the top six are all cities in the Pearl River Delta except Shantou. This shows that the regional logistics competitiveness in Guangdong Province is most affected by economic strength. The only exception to the Pearl River Delta is Zhaoqing, ranked 15th, mainly because Zhaoqing's freight volume and highway mileage rankings are behind. The ranking of F3 is quite different from that of F4. Foshan Foshan ranks first, and Jiangmen, Qingyuan and Maoming have great potential for development. Guangzhou and Zhuhai are lagging behind other Pearl River Delta cities.

Based on the Boston matrix analysis method, we classify the regional logistics competitiveness of 21 cities in Guangdong Province by using the two indexes of regional logistics competitiveness and regional logistics competitiveness potential, as shown in Figure 1.

5. Conclusions

The logistics competitiveness of each city in Guangdong Province shows a serious imbalance, and the situation and characteristics of logistics competitiveness vary from place to place. Therefore, targeted development proposals should be put forward according to the characteristics of logistics competitiveness in different regions.
Area A: Regions in this area have good performance both in competitiveness and in competitiveness potential. These regions are in the leading position in the regional logistics competitiveness of Guangdong Province, as long as these regions continue to give full play to their advantages.

Area B: Although the region in this Area have strong competitive strength, but have logistics competitiveness potential. The typical city is Guangzhou. Although the economy in these area are developed, but growth momentum are lack. The most important thing for these areas is making full use of the advantages of economic strength and tapping the potential of regional logistics growth.

Area C: In this area, the logistics competitiveness is poor, but the logistics competitiveness potential is huge. The typical city is Shanwei. For these regions, on one hand, they should continue to keep their growth momentum, on the other hand they should enhance their competitiveness. And the key to enhance the competitiveness of these areas lies in accelerating economic development by undertaking industrial transfer, and improving the regional traffic environment and personnel training conditions.

Area D: In this area, regional logistics competitiveness and competitive potential are both poor. In order to change this situation, these regions should develop economic innovate the logistics development model through adopting the unconventional development model. For example, they can vigorously develop e-commerce logistics, reverse logistics to enhance the level of regional logistics competitiveness.

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