Contrastive Analysis of Key Transport Indexes between Jiaxing and Other Cities in the Yangtze River Delta

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Abstract. Jiaxing is located in the center of economic circle of the Yangtze River Delta, and it has a unique natural condition. However, its level of economic development is far behind the other neighboring cities that are under the same conditions. First of all, in the context of urban agglomeration of the Yangtze River Delta, this paper focuses on the current situations of the traffic and transportation development in Jiaxing, and using data envelopment analysis method to evaluate the efficiency of urban transport, analyzes its operational effectiveness. Then through analyses of some key transportation indicators between Jiaxing and other same cities, advantages and disadvantages of Jiaxing among the urban agglomeration are clarified. Finally, based on the successful experience of some other cities, some suggestions on the future development of transportation industry are put forward for Jiaxing.

1 Introduction
Since the new century, Jiaxing has conscientiously implemented the provincial and provincial government’s strategy to make "initiative into Shanghai, and actively participates in the cooperation and exchanges of Yangtze River Delta". Jiaxing should give full play to its special advantage, and make efforts to enhance Jiaxing in the Yangtze River Delta regional economic development level in order to better study the successful experience, and to promote the development of Jiaxing transportation industry. Jiaxing chooses the city which has the same social and economic development level such as Changzhou, Zhenjiang, Taizhou, Huzhou and Jinhua. Jiaxing should compare and analyze the 5 representative cities in the Yangtze River Delta region to make the key indicators of transport.

2 Basic Summarization of Transportation

2.1 Comparison of highway transportation between cities
It can be seen from Figure 1, from 2011 to 2015, the volume of six urban road passenger showed a downward trend. Among them, in 2011 and 2012, the volume of Changzhou, Jinhua, Zhenjiang, and Taizhou is higher than that of Jiaxing, so during these two years fewer resources allocated on the passenger volume. In terms of road freight traffic, the freight traffic volume of Changzhou, Taizhou and Jinhua is on the decline, especially from 2012 to 2013, it decreases by 58%, 52% and 60% respectively. In contrast, Huzhou and Jiaxing have improved the development of cargo volume. From 2013 to 2015, in addition to the sharp drop in Zhenjiang, other cities have maintained a steady upward trend.

Jiaxing can learn some successful experience from other cities in the development process of passenger transport, and in combination with the practical situation of Jiaxing, better carry out passenger transportation industry. In the aspect of road freight transportation, Jiaxing can continue to attract the goods resources and rationally optimize the allocation of resources according to the existing development mode, so that the Jiaxing road freight transport can achieve the maximum utilization.

Figure 2 shows that the fluctuation of road passenger transport volume in these six cities is relatively large, showing a trend of increasing first and then declining, which is closely related to the change of urban transportation development mode and the economic level. For example, the increase in car ownership and the diversification of travel modes and routes have contributed to decreasing in passenger traffic volume in recent years. In addition, passenger traffic in Jiaxing in 2015 in six cities ranks third, indicating a relatively high demand for passenger transport, through the development of urban public transport in turn to improve passenger turnover. By comparing the six cities of road freight turnover, it can be found that only the road freight of Jiaxing, Changzhou and Huzhou is
maintained steady rising trend year by year, indicating that in the "Twelve-Five" period the economic development of Jiaxing has also led to the development of transportation industry.

2.2 Comparison of water transport in cities

From Figure 3, the waterway passenger traffic of Jiaxing decreased year by year, while the Huzhou waterway passenger volume showed a steady upward trend year by year. According to statistics, waterway carriage of passengers of Huzhou is mainly dominated by water tourism. With the rapid development of the tourism industry, it makes the waterway passenger transporta a rising trend of development. Therefore, Jiaxing can also increase the passenger traffic volume with the development of local tourism. In addition, the waterway freight volume in Changzhou, Zhenjiang and Taizhou increased year by year, while Jiaxing waterway freight volume declined slowly from 2011 to 2014, but suddenly increased in 2015 to the largest amount of the five years freight volume, second only to Taizhou. So the waterway freight of Jiaxing can be developed in the same way of Changzhou and Taizhou, combined with its own water transport needs, and thus the best development mode that can balance the Jiaxing water transport and other modes of transport is found.

Figure 3 the Past Five Years, the City’s Waterway Passenger and Cargo Traffic

Figure 4 the Past Five Years, the City Waterway Passenger and Cargo Turnover

Figure 4 reflects the overall water passenger turnover in Taizhou from 2012 to 2015, which showed a downward trend after the first rise, in Huzhou in 2014 and 2015, only a significant increase, but in Changzhou waterway passenger traffic volume ranked second, and Jiaxing's waterway
passenger transport volume as a whole showed a downward trend. In the aspect of waterway freight turnover, the freight turnover volume of Jinhua and Huzhou showed a declining trend year by year, the freight turnover of other cities showed an increasing trend year by year, and Taizhou ranked the first for five consecutive years. Jiaxing gradually ranked second from the initial third higher than Huzhou. The water resources of Jiaxing are rich, and water transport is relatively developed. Therefore, in its future water transport development planning, it can refer to some successful cases from Taizhou, which combines with their actual situation to have a steady development in the waterway passenger and freight traffic turnover.

2.3 Comparison of Railway Passenger and Freight Traffic among Cities

It can be seen from Figure 5, in the "Twelve Five" development period, the six cities of the railway passenger volume showed a steady state of growth year after year, which also benefited from the rapid development of China's high-speed rail after 2010. The six cities are located in the Yangtze River Delta economic zone and have high-speed railway traffic. Among them, Jiaxing and Jinhua have the volume of rail freight remaining stable development of the state, small in fluctuations, and in Zhenjiang in 2015 the railway freight volume has been greatly improved, with an increase of 50% over the previous year, and has ranked first in nearly the past five years, indicating that the city of Zhenjiang has a higher degree of dependence on rail transport. From the figure, it can be found that the railway freight volume in Jiaxing City has not changed greatly, but the overall performance showed a declining trend year by year. The reason is mainly due to the special geographical position of Jiaxing City, adjacent to Shanghai, Hangzhou and Nanjing. If railway transport is the main means of short-distance transport of goods, it will not be in line with the economic and rational development model, and in order to obtain more efficient cargo transport efficiency, we need to allocate more resources to freight transport and water transport.

3 Evaluation of Transportation Efficiency

By DEA, we can evaluate the transportation efficiency. Through reviewing the statistical yearbook and the traffic economic operation report, we can get the basic indicators of urban transport data. The results are shown in Table 1.

| Project | Input | Jiaxing | Changzhou | Jinhua | Zhenjiang | Huzhou | Taizhou |
|---------|-------|---------|-----------|--------|-----------|--------|---------|
| (I) Total mileage of the highway / km | 8067 | 8906 | 12270 | 7263 | 7511 | 12283 |

Table 1 Data of Transport Input and Output Indicators of Each City in 2014
For the six DMU in the above table, DEA-Solver Pro 5.0 is used to calculate the relative effectiveness of each DMU and the residuals of the input and output data. The results are shown in Table 2.

Table 2 Calculation Results of Transportation Operation Effectiveness in Each City in 2014

| Index                        | Jiaxing | Changzhou | Jinhua | Zhenjiang | Huzhou | Taizhou |
|------------------------------|---------|-----------|--------|-----------|--------|---------|
| Benefit rate (θ)             | 1       | 1         | 1      | 0.89      | 0.94   | 1       |
| Economies of scale           | 1       | 1         | 1      | 1.13      | 1.07   | 1       |
| Input redundancy              |         |           |        |           |        |         |
| Total mileage of the highway / km | 0       | 0         | 0      | 826       | 475    | 0       |
| Total route length / km      | 0       | 0         | 0      | 68        | 75     | 0       |
| Highway passenger capacity / 10^4 person | 0       | 0         | 0      | 1509     | 1708   | 0       |
| Highway freight volume / 10^4 t | 0       | 0         | 0      | 886      | 503    | 0       |
| Highway passenger turnover volume / 10^4 person·km | 0       | 0         | 0      | 76243    | 96835  | 0       |
| Highway freight turnover volume / 10^4 t·km | 0       | 0         | 0      | 93557    | 392416 | 0       |
| Insufficient output          |         |           |        |           |        |         |
| Waterway passenger capacity / 10^4 person | 0       | 0         | 0      | 180      | 43     | 0       |
| Waterway freight volume / 10^4 t | 0       | 0         | 0      | 505      | 387    | 0       |
| Waterway passenger turnover volume / 10^4 person·km | 0       | 0         | 0      | 802      | 278    | 0       |
| Waterway freight turnover volume / 10^4 t·km | 0       | 0         | 0      | 606500   | 2527138| 0       |

According to the results of the calculation, we can make the following evaluation and analysis on the effectiveness of transportation operation in cities in 2014:

1) Among the six cities, the development of the transportation industry is slightly uneven. Jiaxing's transportation efficiency is as high as that of Changzhou, Jinhua and Taizhou. It shows that the four cities have a reasonable scale in road and waterway construction and have a relative dynamic coordination in the inputs and outputs, achieving a basic balance between supply and demand. In the future transportation system work, the four cities with the city’s overall economic development should be steady in infrastructure investment and maintain good value for money.

2) Zhenjiang and Huzhou have the relatively poor efficiency of transportation system, where the efficiency value is less than 1, and this shows Zhenjiang and Huzhou’s highway and shipping transportation efficiency is insufficient, and existing transportation infrastructure has not been fully utilized, so the provincial should further expand demand, or reduce costs. From economies of scale, economies of scale in Zhenjiang is higher than that in Huzhou, which shows that the input redundancy rate of Zhenjiang is higher, and that the low output mainly reflected in the water. If the Zhenjiang waterway transportation demand is increased, its overall effect will be greatly improved, reducing the
efficiency of the gap with other city; The efficiency in Huzhou is better than that in Zhenjiang but seems to be insufficient, and still needs to reduce investment, and expands demand from two aspects of highway and waterway.

To evaluate the transportation efficiency of each city in 2015, the original enter data as follows:

| Project                | Index                      | Jiaxing | Changzhou | Jinhua | Zhenjiang | Huzhou | Taizhou |
|------------------------|----------------------------|---------|-----------|--------|-----------|--------|---------|
| Input                  | (I) Total mileage of the highway / km | 8088    | 9000      | 12432  | 7333      | 7666   | 12480   |
|                        | (I) Total route length / km     | 1957    | 1086      | 199    | 597       | 1175.5 | 993     |
|                        | (O) Highway passenger capacity / 10^4 person | 8822    | 6577      | 12908  | 4519      | 5976   | 12046   |
|                        | (O) Highway freight volume/ 10^4 t | 9933    | 11070     | 8233   | 7298      | 7819   | 9990    |
|                        | (O) Highway passenger turnover volume / 10^4 person·km | 304305  | 407179    | 395700 | 261470    | 201582 | 770943  |
| Output                 | (O) Highway freight turnover/ 10^4 t·km     | 1077812 | 1164674   | 624900 | 584373    | 602000 | 1666977 |
|                        | (O) Waterway passenger capacity / 10^4 person | 38      | 267       | 0      | 0         | 71     | 214     |
|                        | (O) Waterway freight volume / 10^4 t     | 8522    | 2060      | 15     | 1112      | 5746   | 10626   |
|                        | (O) Waterway passenger turnover volume/ 10^4 person·km | 191     | 1107      | 0      | 0         | 418    | 2057    |
|                        | (O) Waterway freight turnover / 10^4 t·km | 1457940 | 406924    | 2947   | 279762    | 865000 | 13378023|

According to the calculation results, the paper makes the following evaluation analysis on the effectiveness of urban transportation operation in 2015:

1) The average value of the city traffic transportation benefit rate has a increase in 2015, which is closer to the effective value of 1, and has a decrease of the average scale efficiency, which shows a good development of the overall level of the six Yangtze River Delta city traffic transport efficiency, narrowing the gap between individual.

2) Effect of slight shortage is still in the city of Zhenjiang and Huzhou, but the two cities over the
value of efficiency are improved, especially Zhenjiang has a larger increase, proving that the two-city basic level catch up with the development of several other cities transportation, but Zhenjiang and Huzhou should still reduce investment or increase the demand for dynamic efforts to coordinate the investment and output.

In summary, evaluation of six cities in 2014 and 2015 in Yangtze River Delta transportation efficiency, for two years the development of Jiaxing transportation industry is at the forefront, and the future still needs reasonable investment and plans to expand demand, which has guaranteed the resource input and output efficiency of dynamic balance.

4 Experience for reference

4.1 BRT Development - Changzhou
Changzhou attaches great importance to the construction of bus priority, and takes BRT as the backbone of the public transport system, effectively alleviating the traffic pressure in the city. Since the implementation of bus rapid transit, a "cross link" rapid transit skeleton network has been formed, which has a significant effect. According to the survey of the passenger satisfaction evaluation and the line state evaluation, it is showed that: the city bus line along the skeleton is firmly established, and traffic conditions is improved clearly, the operational efficiency and the city leading role gradually has been reflected, and city quality has been improved.

The status of Jiaxing has been the implementation of bus priority, but the problem of how to build the framework of passenger transport system is still wavering. The construction of both BRT and common bus passenger transport system is a more practical choice, which is very important to alleviate traffic pressure in the city in the next 5-10 years.

4.2 Infrastructure Development - Jinhua
Jinhua has achieved very good results in the construction of infrastructure. For example, its road network density is higher than the provincial average, it has built perfect function and strong radiation of the highway hub station system, it has 6 Logistics agglomeration area , the shipping development has established the "three-do two-spur-track and one-library", and it has built the new Hengdian general Airport etc. All these have laid a good foundation for the future "13th Five-Year" comprehensive traffic planning to build the "A vertical and two horizontal" three vertical, "one gold one meaning" two node, and "Bus, Railway, Waterway, Aviation "five network of integrated transport infrastructure system. However, it still needs to further improve the three-dimensional layout of integrated transport channels, improve the efficiency of the integrated transport network, and strengthen the seamless connection of passenger transport hub.

One of the main contents of the work in Jiaxing at the present stage is to adhere to the expansion of effective investment, and improve the comprehensive transportation network, so the development of infrastructure construction is particularly important, which can start by improving the road network, transport network, railway network, and the hub network. At the same time building a airport for further establishment of Jiaxing also has great significance of the status of the city comprehensive transportation hub in the Yangtze River delta.

4.3 Intelligent Transportation System Completed - Taizhou
The city bus group is based on "Taizhou Going" information system. Taizhou has not only set up intelligent electronic stop signs in the 32 major platforms, but also developed bus, public bicycle and parking space real-time information query service of mobile phone APP with the governance blocking office, enhancing the level of traffic and convenient travel service. The establishment of intelligent transportation system means the coverage of urban and rural residents of the information service system, making the public access to basic public services more convenient, timely and efficient. This is the only way to adapt to the development trend of information technology, and also to create a new development of Taizhou's scientific choice.
Jiaxing conducted a pilot construction of intelligent transportation in the "12th Five-Year" transportation development process, and has achieved initial results, but in the intelligent transportation integrated information service platform, industry monitoring capability of road transport and water level real-time detection is still lacking, which needs to further accelerate the integration of "Internet plus transportation". In the future it will be the foundation in Jiaxing for the construction of metropolitan area network and the integration of the Yangtze River delta group of world-class city.

4.4 Jiangsu's first low-carbon high-speed - Zhenjiang

Since 2014 when Zhenjiang was formally approved by the Ministry of transportation to carry out green low-carbon transport development cycle of regional low-carbon transport pilot start to build low-carbon transport pavilion, it has promoted the 312 National Road South, constructed Zhendan high-speed "Ministerial low-carbon demonstration highway", completed national and provincial highway greening and environmental remediation tasks, and carried out the greening project of the main channel. The city has launched a comprehensive green transportation construction, and the main goal is to build green recycling carbon transport demonstration city. Among them, Zhendan highway has been identified as a national Ministry of transport low-carbon demonstration highway, and it is the first low-carbon highway in Jiangsu province. Therefore, it will vigorously promote green technology in the construction, widely use green construction materials, and implement energy-saving emission reduction measures. At the same time in the construction it will add innovative ideas, increase the new technology application, and make Zhendan high-speed into transportation department the first batch of "low carbon demonstration road".

Zhejiang Provincial Committee in 2014 adopted 《the CPC Zhejiang Provincial Committee on the construction of beautiful Zhejiang to create a better life decision》，and proposed in 2020 to build a national demonstration area of ecological civilization and beautiful China first area. So for Jiaxing, we should put the construction of ecological civilization in an important position, and one of the comprehensive transportation planning in "13th Five-Year" in Jiaxing is the ecological strategy to build the quality of traffic, and to establish green traffic corridor. In layout and design the environmental impact of transport facilities should be first considered, and the damage of traffic construction the ecological environment should be reduced. Therefore, with reference to the low carbon high speed road in Zhenjiang, Jiaxing can also be regarded as one of the measures to build a "model city of Jiangnan Water Village".

5 Conclusion

Jiaxing is located in the central core of Yangtze River, and in northern zhejiang transportation hub, geographical advantages are obvious. The construction of the future expressway, the cross-harbor highway, the Shanghai-Hangzhou and Shanghai-Nanjing high-speed passenger dedicated lines, the construction of Binhai port area and the integration of military and civilian areas will greatly enhance Jiaxing’s traffic location in the Yangtze River Delta. Based on the Jiaxing Yangtze River, it strengthens the Jiaxing regional center city status, actively docks Su Hang, emphasizes the major transportation facilities, regional resource sharing and transportation integration construction, and constructs regional transportation hub city; to serve urban economy, serve marine economy, serve open economy and serve beautiful economy, the traffic management policy should be changed from "to be set for" to "supply to". To make economy, society, environment and resources of Jiaxing coordinated development, this transport policy is a correct choice to realize the sustainable development of Jiaxing traffic.

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