

THE COMPETITION BETWEEN AVIATION AND HIGH-SPEED RAILWAY

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Keywords: Aviation, High-speed Railway, Competition, Share Rate.

Abstract: In this article, we mainly want to analyze the competition between high-speed railway and aviation in China, and study whether the opening of high-speed railway will have tremendous impact on the airlines. Firstly, we analyze the development and trends of both the high-speed railway and aviation in China. Secondly, we compare the advantages of these two travel tools. Thirdly, we take the examples in and outside China that high-speed railway affects the operation of airlines. And then we use the Share Rate Model to analyze the share rate of these two transportations in different mileages and reach the results. When the mileage is below 900 km, the high-speed railway occupies more percents of passengers than the aviation. With the increase of mileage, the share rates of these two ways are getting closer to each other. And at the 900 km, each way occupies 50% of passengers.

1 INTRODUCTION

In China, from 2003 till now, especially in the latest three years, the development of high-speed railway is surprising. China uses no more than ten years to catch up with and finally surpass the construction of high-speed railway in all the western countries.

The rapid development of high-speed railway does improve passengers' travel status, but at the same time, it results in strong impact on other modes of transport, especially on aviation. In this article, we'd like to analyze the competition between these two modes and use Share Rate Model to do some quantitative analysis.

2 THE DEVELOPMENT AND TRENDS OF AVIATION AND HIGH-SPEED RAILWAY

2.1 The Aviation

2.1.1 The Development

Since 1978, in which China began to carry out the policy of reform and opening up, the total turnover and transport passengers of Chinese aviation each has an increase of about 20%. From January to September in 2010, the passengers turnover got an

increase of 17.8% compared with the same period in 2009. And It is estimated that the whole 2010, the transport of passengers can be as many as 0.266 billion, and ranks second all over the world.

Now there are 176 airports, 1610 transport aircrafts and 1000 general aircrafts in China, and the airlines can be as much as 300, with a total mileage of 500 thousand kilometres, which cover 91% of the economic area.

2.1.2 The Trends

Firstly, as for 2030, China will own a well-known air company and its overall strength can rank into the top 5 all over the world. Secondly, China will accomplish the build of 3 international airports and 10 national hub airports. The quantity and location of airports can meet the air transport demand of 95% population.

2.2 High-speed Railway

2.2.1 The Development

In China, the High-speed Railway refers to the railway system whose top speed is 200 km/h above and travel speed is 160 km/h above.

At present, China has open several high-speed railways, such as Beijing-Tianjin Railway (01/08/2008), Shijiazhuang-Taiyuan Railway

(01/04/20009), Wuhan-Guangzhou Railway (26/12/2009), Zhenzhou-Xi'an Railway (28/01/2010), and Shanghai-Hangzhou Railway (26/10/2010). And in June of 2011, the longest high-speed railway—Beijing-Shanghai Railway will be completed and put into operation.

Now in China, the whole mileage of high-speed railways which have been put into operation can reach as long as 7500 km, in which the newly-built ones are about 4500 km, and the promoted railways of old ones are almost 3000 km with travel speed of 200-250 km/h. With no doubt, the railway mileage of our country has ranked No.1 in the world.

2.2.2 The Trends

According to the 《Long-term Railway Network Plan (2008 revision)》, as for 2020, the total mileage of China's railways may reach 120000 km or above, and Double-track rate and power rate reach 50% and 60%. Basically speaking, it will build a rational layout, clear structure, perfect function, smooth convergence of the railway network. And the transportation capacity can meet the needs of national economic and social development. In addition, its main technical equipment will reach or approach the international advanced level.

3 THE COMPETITION BETWEEN AVIATION AND HIGH-SPEED RAILWAY

3.1 The Comparison of Advantages of Aviation and High-speed Railway

3.1.1 The High-speed Railway

(1) The high-speed railway network is planned perfectly.

According to the 《Long-term Railway Network Plan (2008 revision)》, in the coming few decades, there will be several railways beginning to be built, and after they are put into use, they can cover three most economically developed areas in China: Bohai area, Yangzi River area, Zhujiang area. And these areas are also the most important regions for the aviation, so the two travel tools may have intense competition.

(2) The capacity of transportation is strong and the transport frequency is high.

The aviation is always faced with high-end customers, including the businessmen and travellers.

And the transport capacity of each aircraft is limited. An aircraft can convey about 200 to 600 passengers, no more than 800. In addition, the airline is fixed and an aircraft can not stop at more than 2 stations.

On the contrary, the high-speed railway is faced with the ordinary passengers and the train can add its car if necessary. At the same time, the train will stop at several depots in the line. So a train can transport about 1500 to 5000 passengers.

(3) The train is pretty safe and its operation is regular.

The high-speed railway operates in the closed environment with automation, and it has a series of safe-protection system to ensure the safety of passengers. So the operation safety of train is the top one among so many travel tools.

In addition, the operation of high-speed railway is not so easy to be effected by bad weather, even in the strong wind.

(4) The train is environmentally friendly and the profit is considerable.

The power energy of high-speed railway is electricity, not oil and other liquid fuels, so it is very environmentally friendly. But the aircraft need to consume fuels.

At the same time, if the high-speed railway is perfectly planned, the economic benefit will be high. The Tokaido Shinkansen in Japan with draw all the build money after put into operation about 7 days.

3.1.2 The Aviation

(1) The advantages in the long-distance airline

In the long-distance airlines, the aviation has more advantages than the high-speed railway, especially in the mileage of 1500 km. Because with the increase of mileage, the aviation can be more efficient.

(2) Pricing advantage

The aviation makes the price of air ticket according to the relationship of supply and demand, and it can use such as bundled pricing to make diversity of different passengers to attract their interests and ensure its own profits.

But the price of train ticket is almost fixed, and the pricing methods are limited.

(3) Cost advantage

The building cost of high-speed railway is much higher than the aviation, at the same time, the high cost means high risk. For example, the cost per kilometer of Beijing-Shanghai railway is about 0.167 billion, and the price of it may be 600 to 800 yuan. But the air ticket price between these two cities can be as low as 400 yuan.

(4) The advantage in international airline
The aviation can run the international airlines and transport international passengers, but the high-speed railway could not carry out the international business because our country haven't built railways with other neighbour countries.

3.2 The Experience of Competition between High-speed Railway and the Aviation

3.2.1 Experience in Other Countries

(1) Japan

Since 1964, Japan gradually open several new railway routes, which makes the airline from Tokyo to Osaka and Nagoya stopped and two years later the route from Tokyo to Sendai also closed.

Japanese Airlines was founded in August 1951. In January 19th, 2010, it submitted the bankruptcy protection to the court, which was the biggest bankruptcy in Japan. The reasons for it are sundry, but the most important one is the strong impact from Shinkansen.

Japanese Airlines bankruptcy is a typical example that high-speed railway defeats the aviation in history.

(2) France

In 1983, The French high-speed rail (TGV) opened the fast lane from Paris to Lyon, which almost get the France Flights to a corner and forced it to give up the air routes in this area.

Generally speaking, in the market of 2 hours travel time, TGV accounts for 90% to 95% share. In the market of 3 hours, TGV occupys 60% share, and in the 4 hours market, TGV accounts for 38% share.

3.2.2 Domestic Experience

(1) Shijiazhuang-Taiyuan high-speed railway

In April 1st, 2008, Shijiazhuang-Taiyuan high-speed railway opened and everyday there are 8 trains from Taiyuan to Beijing. The opening of high-speed railway had a really obvious effect on the airlines from Taiyuan to Beijing.

Before the opening of high-speed rail, there were more than 20 flights from Taiyuan to Beijing, and the average load factor can reach about 70%. But from April to June, several flights from Taiyuan to Beijing is closed and only reserved flights in the day. At the same time, the load factor decreased to less than 50%.

(2) Taipei railway

In 2007, the high-speed railway from Taipei-

Kaohsiung was open and daily delivery of passengers was up to 30 million, which made the current Taipei to Kaohsiung and Tainan air traffic decreased by 50% or more.

3.3 The Model to Compare the Substitutes between High-speed Railway and Aviation

3.3.1 Modeling

We use the Share Rate Model to compare the substitutes between high-speed railway and aviation with mathematics method.

(1) First step:

$$P_i = \frac{\phi(u_i)}{\sum_{j=1}^n \phi(u_j)} \quad (1)$$

P_i : the probability of transport way i .

n : the number of transport ways.

u_i : the utility function of passenger to choose transport way i .

(2) Second step:

$u_i = f$ (efficient, economy, comfort, safety, habits, the time value of passengers)

Efficient means the total time a travel tool needs to convey passengers to the destination.

Economy means the cost of a travel tool.

Comfort means the environment of a travel tool and service attitude quality.

Safety means the extent a travel tool can meet the safety demand of passengers.

Habits mean the the passengers' preference of travel tools.

The time value of passenger means the opportunity cost of choosing a travel tool.

(3) Third step:

Based on the second step, we propose the model below:

$$u_i = \frac{aA_i + bB_i + cC_i}{(\frac{L}{V_i} + t_i) \times W \times \alpha + \beta \times P_i} \quad (2)$$

u_i : utility function;

A_i : efficient; B_i : safety; C_i : safety; L : mileage; V_i : travel speed; t_i : the waiting time of transport way i ; W : the time value of passenger; P_i : price; α : the weight of time; β : the weight of price; a : the weight of comfort; b : the weight of safety.

3.3.2 The Data

(1) Speed data

The average speed of high-speed railway is 300 km/h (In terms of the speed data of the operating high-speed railway now). In detail, the low speed high-speed railway's speed is 275 km/h and the high-speed railway can reach a speed of 350 km/h. The speed of aviation is 800 km/h.

Table 1: Parameters 1.

	comfort	safety	habit	speed
High-speed Railway	10	10	10	300 km/h
Aviation	9.5	8.5	7.5	800 km/h

Table 2: Parameters 2.

	Waiting time	Price (1 level)	Price (2 level)
High-speed Railway	1 h	0.6 yuan/km	0.45 yuan/km
Aviation	1.5 h	0.75 yuan/km	0.6 yuan/km

Weight: $a=0.15$, $b=0.35$, $c=0.5$, $\alpha=0.67$, $\beta=0.33$, $W=2.59$.

Note: These data are calculated and analyzed through the operation of these two travel tools. The original data are from the website of National Bureau of Statistics of China and experience data.

3.3.3 The Results of Calculation

(1) Using the average speed data of high-speed rail —300 km/h.

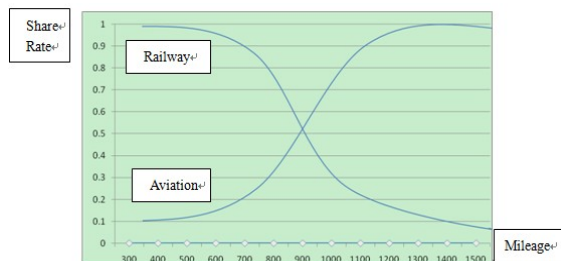


Figure 1: Share rate.

According to the model and data we listed above, we make the graph as this. From this graph, we can see that the share rate between high-speed railway and aviation is changing with the increase of mileage.

(2) Using the classified data of high-speed rail. The low speed railway's speed is 275 km/h and the high-speed railway can reach a speed of 350 km/h.

Table 3: Share rates in different distances.

	Mileage	Share Rate
Low speed high-speed railway 275 km/h	300-700 km	75-90%
	700-900 km	70-50%
	900-1100 km	20-50%
	1100-1500 km	25%-10%
High-speed railway 350 km/h	300-700 km	Above 90%
	700-900 km	75-55%
	900-1100 km	50-25%
	1100-1500 km	25-10%

4 CONCLUSIONS

Through the analysis of the experience abroad and in China, and combined with the calculation with the Share Rate Model, we found that the high-speed railway may affect the aviation with the increase of mileage to some extent. The result is below.

When the mileage is below 900 km, the high-speed railway occupies more percent of passenger than the aviation. With the increase of mileage, the share rates of these two ways are getting closer to each other. And at the 900 km, each way occupies 50% of passengers.

5 FUTURE WORK

In this article, we do some basic analysis of the competition between aviation and high-speed railway using the Share Rate Model. The future work must be the explanation and analysis of the results we get, combined with the experiences in reality.

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