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The trend and influence of railway reform in China from the perspective of time and space

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Abstract: *This paper mainly discusses the trend of railway management reform in China and its influence on railway operation. The paper points out that with the construction and development of high-speed rail network, the gross profit margin of China National Railway Group continues to decline, and the transportation scale and profitability diverge. To this end, the group promoted the joint venture railway reform guided by "classified investment and construction and hierarchical management", realized the concentration of trunk lines to the group, increased local authority in branch railways, intercity railways and other aspects, and optimized the assets of the Group.*

Keywords: *China's railway reform; Gross profit margin of China Railway Group; Classification and stratification management; High-speed rail profit and loss; Fare mechanism*

1. Introduction

With the construction and development of the high-speed rail network, the gross profit margin of the National Railway Group continues to decline, showing the contradiction between the scale of transportation and the profitability. From 2008 to 2023, the compound growth rate of revenue of China Railway Group is 5.8%, the compound growth rate of total cost is 6.4%, the gross profit rate fell from 9.4% in 2008 to 1.3% in 2019, and the asset-liability ratio rose from 42.6% in 2006 to 65.5%.

In addition to bearing the depreciation of fixed assets, the line property owner also needs to pay the construction loan repayment and entrusted transportation management costs. The main source of income is the various rights fees paid by the railway transportation enterprises that play the role of trains. The line property owner with a small number of trains has weak profitability and is generally in a state of loss or net cash flow outflow.

According to rough speculation, the 250 km/h line, the average daily train number of 50 pairs can fully cover the operating costs and maintenance costs including the principal and interest, and the 350 km/h line has little difference. According to the statistics in July 2024, the high-speed rail line mileage with 50 pairs of trains in operation accounted for more than half of the total high-speed rail mileage. It can be roughly believed that more than half of the mileage of the EMU lines in China can realize profit according to the average daily train number in July 2024. The lines with less than 50 train pairs per day are basically non-backbone channels, most of which are newly built joint venture lines opened to traffic in recent years, among which the majority are 200-speed lines, including some intercity railways and branch railways.

2. Structural problems of railway: Transport scale and market efficiency

The rapid development of high-speed rail since 2008 has brought about a rapid rise in the debt ratio of China National Railway Group. From 2008 to 2023, the asset scale of China National Railway Group has increased by 5.04 times. By the end of 2023, China Railway Group had assets of 9.35 trillion yuan and total liabilities of 6.13 trillion yuan, with an asset-liability ratio of 65.54 percent, compared with only 42.6 percent in 2006. From 2010 to 2019, the average net interest rate of China Railway Group was 0.1 percent. In 2023, the total revenue of China Railway Group increased from 533.4 billion yuan in 2008 to 1,245.4 billion yuan in 2023, an increase of 133%. The compound growth rate of revenue was 5.8%, but the compound growth rate of total cost reached 6.4%, and the net interest rate remained low. Gross profit rate fell from 9.4% in 2008 to 1.3% in 2019, fell to negative during the epidemic, and recovered to 2.2%

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in 2023. There is a certain degree of correlation between the benefits of China National Railway Group and a series of railway reforms. Therefore, this paper starts from the benefits of China National Railway Group, aiming to introduce the reform trend of railway operation and management mode, profitability of high-speed rail lines, pricing mechanism of high-speed rail passenger tickets, line shares and division of powers.

3. The management mode of the railway

There are two modes of railway operation and management in China, namely entrusted transport management mode and independent operation by the line owner. At present, entrusted transport management mode is the core.

Entrusted transport management mode is a mode in which assets and operations are separated, and the line owner entrusts all or part of the business to the railway transport enterprise (usually the local railway bureau under the National Railway Group) for management. The entrustment management mode comes from the rise of the joint venture railway. At present, most of the line property owners in China adopt the entrustment transport management mode.

In terms of specific implementation, the entrusted transport management mode can be divided into two types:

One is the "Fully entrusted" management mode, that is, all the line assets of the joint venture company are entrusted to the railway transportation enterprise (local railway bureau) for management and management, and the corresponding use rights fees are charged, including line use fee, vehicle use fee (or no), contact line use fee, station water service fee, ticket service fee, station passenger service fee. And pay the corresponding entrusted transportation management fee, facility usage fee and other entrusted fees. The transport enterprise shall be responsible for organizing the train service, retaining the transport business income and bearing the risk of revenue.

The other is "Fully entrusted" management mode, that is, the joint venture company retains its independent operating structure and obtains transportation revenue and other legal income, while the joint venture company pays corresponding entrusted transportation management fee, facility usage fee and other entrusted expenses to the railway transportation enterprise.The details of these two modes are shown in Fig.1

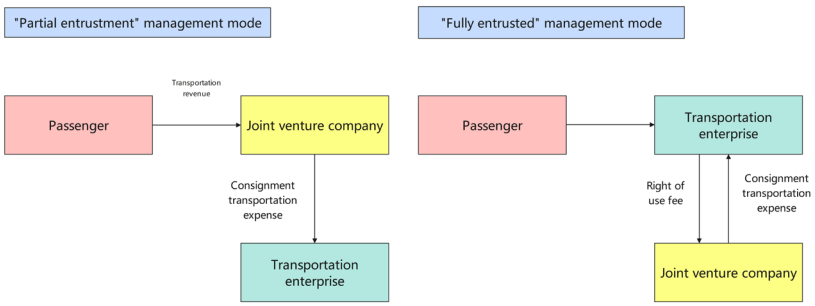

Figure 1: Schematic diagram of the two modes of entrusted transportation management

In addition to bearing the depreciation of fixed assets (infrastructure), the owner of the line also needs to pay the loan repayment of construction loans and the entrusted transportation management expenses. The main source of income is the various rights fees paid by the railway transportation enterprises acting as trains, and the costs are mainly fixed costs [1]. Therefore, the line property owner with a small number of trains has weak profitability and is generally in loss, or the cash flow is in a net outflow state due to the repayment of loan principal and interest.

4. Calculation of profit and loss capacity of high-speed railway

To measure whether a high-speed rail line can operate sustainably, it mainly measures the passenger revenue and the overall operating cost of the entire line -- that is, the owner of the line and the railway transportation company are regarded as one, and the income and cost of the related transactions of the two parties offset each other after the combined statements.

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The passenger load factor of China Railway EMU was 74.4% on the whole road in 2018, and under the efficiency means of "one map a day, no flow stops" of China Railway, there is not much difference between different railway bureaus. Here is a more conservative estimate of 70%. That is, the ticket revenue corresponding to 60% of the seats can be used to cover the daily operation costs of the high-speed rail line, fixed costs such as loans and depreciation -- that is, the operating costs of the joint ventures of the owners of the high-speed rail. The number of short-order EMU seats converted into second-class seats is about 650, and the newly-built passenger pricing rate of 130 million /KM is about 0.5 yuan/km. 1800000000/365/2/(650×257×0.5×0.6)=49.2 -- that is, after the above series of conservative estimates, a cost of 130 million /KM of pure motor passenger special, charging 0.5 yuan/km ticket price, at most 50 pairs of short lines per day can achieve profit [2].

This is based on the calculation of the construction cost, operating cost and pricing rate of the 250 km/h line, the construction cost, operating cost and pricing rate of the line above 300 km/h are different, and the calculation results will be different, but the difference is not large.

According to the number of train pairs, the daily average of more than 100 pairs of lines totaled 6,436 kilometers; The total number of lines between 70-100 train pairs is 8415 km; The daily average of 50-70 train pairs is 9353 km; A total of 20,535 km of lines of 10-50 train pairs per day; And a total of 2,303 km for routes with 10 or fewer pairs of trains per day.

If based on the above assumptions, it can be roughly believed that more than half of the mileage of China's EMU lines can be profitable according to the average daily number of trains in July 2024, but considering the off-peak season factors, the actual mileage of profitable lines will be lower. The lines that reach 50 pairs of trains per day are mostly four vertical and four horizontal main channels, most of which will be completed and opened to traffic before 2018, among which there are more 300-speed lines; The lines with average daily train times less than 50 pairs are basically non-backbone channels, and most of them are newly built joint venture lines opened to traffic in recent years, among which the majority are 200-speed lines, including some intercity railways and branch railways.The train density of the national high-speed rail network is shown in Fig.2

Photo source: Schematic Diagram of the National high-speed Rail Network Train Density, July 2024

Figure 2: Schematic diagram of the train density of the national high-speed rail network 2024.07.13

According to “Schematic diagram of the train density of the national high-speed rail network 2024.07.13”, in July 2024, the average daily operation of electric EMUs in the country averaged 57.43 pairs of trains, among which the average daily operation of 43.29 pairs of trains in the 200-300 km/h range. The average daily operation of lines above 300 km/h is 72.62 pairs. Passenger flow and train number are still mainly concentrated in the old trunk line which has been open for a long time.

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5. The reform of the shareholding authority of high-speed rail

5.1 The cooling down of the new construction of high-speed railway lines

The 350km/h standard can be adopted in the planning and construction of high-speed rail main passage lines that run through provincial capitals and megacities, have a recent two-way passenger flow density of more than 25 million passengers per year, and the proportion of medium and long-distance passenger flow is more than 70%. When planning and building high-speed rail lines connecting cities at prefecture-level or above with large series, with a recent two-way passenger flow density of more than 20 million passengers per year, and with prominent network functions, 350km/h can be reserved. Regional high-speed rail connection lines with a two-way passenger flow density of 15 million or more passengers per year in the near future can be planned for construction, and the standard speed of 250 km/h can be adopted. In the planning and construction of intercity railway lines, the standard of 200 km/h or below shall be adopted in principle [3]. In addition, the planning and construction of new railway lines in the central and western regions of the road network blank area generally adopts the standard of passenger and cargo sharing.

The railway standard of 350 KM/H requires (after opening) the minimum two-way passenger flow density in the near future to be 25 million passengers/year, with 16 knots of length and 0.7 passenger load factor, the number of daily running needs to be more than 40 pairs; For the 250 KM/H standard railway, the minimum two-way passenger flow density (after opening) is required to be 25 million passengers/year, and the daily number of running times is required to be more than 40 pairs at 16 knots and 0.7 passenger load factor [4].

5.2 Division of powers for railway construction

At present, the National Railway is mainly responsible for the management of trunk railway, and the investment of the national railway is further concentrated in the trunk railway, which is mainly jointly funded by the national railway and local governments. Trunk railways will be jointly funded by the central and local governments, with China National Railway Group Corporation playing the main role in project construction and operation. Projects with good expected returns should actively attract the participation of non-government capital. Intercity railways, urban (suburban) railways, branch railways and special railway lines shall be mainly funded by relevant localities and enterprises, and project owners may independently choose the mode of construction and operation.

Railway project funds are divided into capital part and financing part. The capital part is responsible for the investment subject, and the other part is mainly solved by domestic bank loans. In terms of capital, the capital borne by the National Railway Group or the local (provincial/city, district level). The capital contribution of China National Railway Group Co., Ltd. includes its own or self-raised funds, investment within the central budget, railway construction fund, railway development fund and railway construction bonds.

6. Railway passenger ticket pricing mechanism

The pricing mechanism of railway passenger ticket is very complicated, and the ticket pricing method of universal speed railway is different from that of high-speed EMU trains and intercity trains. The following is only a brief introduction to the pricing mechanism of high-speed EMU trains.

In 2024, the market-oriented reform of high-speed rail fares will be further accelerated. The Beijing-Guangzhou high-speed Railway Wuguang section, Shanghai-Kunming high-speed Railway Shanghai-Hangzhou section, Shanghai-Kunming high-speed railway Hangchang section, Hangzhou-Shenzhen Railway Hangzhou-Ningbo section, which will be opened to traffic before 2016, announced the optimization and adjustment of published fares, and established a flexible pricing mechanism according to market conditions, different factors such as season, date, time period and seat class, and implemented a differentiated discount floating strategy.

To sum up, with the market-oriented reform of high-speed rail fares, the right to set high-speed rail fares belongs to the owner of the line, and the fare rates of each line are different. Since passengers often travel across lines, from the perspective of passengers, the error in calculating passenger fares according to the benchmark fare × mileage will increase day by day, which actually depends on the sum of the fares of each segment. Specifically, it can be expressed as: high-speed rail ticket price = the sum of base price

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× mileage of each section of the segmented line, and appropriate discounts or increases or decreases according to the condition of the line, and some other fees are added [5].

7. With the development of high-speed rail, the development of universal speed railway has fallen into stagnation or even retrogression.

However, from the adjustment chart of the first quarter of 2024, we can see some directions of the changes of the universal speed railway in the future: A new batch of power concentrated EMU (CR200J type long unit power concentrated EMU) is gradually allocated to place, used to replace some high-grade common speed trains (some lines Z-head train number replaced by D-head train number), and further improve the quality of service, the original bottom of these trains will also be simultaneously transferred to low-grade trains. As a result, the overall condition and service quality of the general speed trains are also improved. According to the quarterly adjustment chart, at present, CR200J is mostly used for bureau trains along the Beijing-Guangzhou Line and some cross-line Beijing-Guangzhou Line trains, but it may be further upgraded for Z-class trains on the Beijing-Harbin Line. The direct benefits of using CR200J train upgrade service to upgrade Z train number to D include:

1) Staff reduction - The CR200J can be centralized control, and the demand for personnel is basically reduced to the level of moving points

2) Efficiency increase -CR200J has a great increase in the occupation of station lines and throats compared with the locomotive

3) Cost reduction -CR200J compared with dynamic points, the procurement cost has been significantly reduced, and the proportion of cost reduction is far greater than the proportion of fare reduction

4) Revenue-cr200j can conduct independent pricing according to the moving points, which is obviously helpful to the increase of the income level of the Railway Group

After the high-speed railway replaces the function of the universal speed railway, the G-train faces two different travel markets and divides into two corresponding product forms, respectively, the benchmark car and the ordinary high-speed rail with more stops. According to the latest adjustment chart, the number of benchmarking vehicles on the core channel has increased significantly, mainly to serve the needs of long-distance travel, and to compete with civil aviation through regular and regular departure time arrangements. On the other hand, ordinary high-speed trains increase the number of stops and inevitably reduce the speed, mainly serving the demand for short and medium distance intercity travel, which is the absolute mainstream of railway travel.

8. Railway development trend

8.1 Increasing pressure on local governments to undertake construction funding responsibilities and loss subsidies

Taking the "One province and one company" reform in Shandong and Zhejiang as an example, the newly established Shandong Railway Co., Ltd. is formed by the reorganization of seven joint venture railway companies controlled by Shandong Province and Delongyan, Haiqing, Yishu, Dongping, Zao Lin, Qingrong and Qinglian controlled by National Railway Group. After the reorganization, the controlling shares of the above seven joint venture railways are transferred to the provincial side. According to Shandong Province, the annual loss of the 7 railways is about 3 billion yuan; And Zhejiang integrated nearly 10 branch railway joint venture projects through the "one province, one company" reform, and the annual loss of these branch railways reached nearly 5 billion yuan.

For the same reason, although there are similar statements in many documents that "intercity, city area, gathering and distribution will gradually become the strategic focus of railway construction and development", under the mechanism of "classified investment and construction and hierarchical management", how much is the construction necessity and feasibility of intercity and city railway, that is, the construction space.

8.2 Further marketization of fares and strengthening the integrated development of railways

By 2025, China's comprehensive transport should basically achieve integrated and integrated

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development, which puts forward higher requirements for accelerating the "hard connectivity" and "soft connectivity" of China's comprehensive transport infrastructure, and promoting the deep integration and development of cross-mode, cross-field, cross-region and cross-industry integration of transport. Persisting in systematic promotion and convergence is an inherent requirement for the construction of a modern comprehensive transport system.

Although the owner of the line has the right to increase the announced ticket price of the line segment according to the actual market situation, which in theory is also conducive to the improvement of the income level of civil aviation, high-speed rail mainly serves the demand for short - and medium-distance intercity travel, and the space for the increase of segment ticket price depends on the increase of residents' disposable income level. Moreover, the penetration rate of new energy vehicles continues to increase and the cost of self-driving has decreased significantly. The fare increase space for short-distance travel is limited, so it also affects the announced fare increase space for long-distance high-speed rail travel to a certain extent.

9. Conclusion

China's railway reform has optimized resource allocation and promoted the marketization of high-speed rail ticket pricing mechanism through classified investment and construction and hierarchical management, but the reform has also brought about problems such as declining gross profit margins and increasing financial pressure on local governments. In the future, China's railway needs to continue to deepen market-oriented reform, explore the balanced development path of trunk and branch railways, and strengthen the integrated development of railways and other modes of transport, in order to cope with the growing transport demand and market competition pressure, and achieve sustainable development of the railway industry. The large expansion phase of high-speed rail has entered history, and high-speed rail construction has begun to cool down. Some lines incorporated into the planning by local governments have been gradually reduced.

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