Study on the Operating Cost and Profit Balance of Chinese Port Railway Lines Based Under the Modes of Independent Operation and Entrusted Operation

Nan Yu[1], Jichun Li[2,*]

[1]Author: yunan@wti.ac.cn

[2,*]Corresponding author: ljc217@wti.ac.cn

[1]China Waterborne Transport Research Institute, Beijing, China

[2]China Waterborne Transport Research Institute, Beijing, China

Abstract: Based on the advantages and disadvantages of two operation modes of port railway lines, including independent operation by port enterprises and entrusted operation towards the China railway corporation, this study analyzes the formation of railway lines revenue and cost under the existing system, builds a function of cost and volume, calculates the volume balance point of freight cost of different operation modes. Then from the angle of investment builders, this study constructs the functional relationship among revenue, operating cost and traffic volume, and calculates the profit balance point of port railway lines under different circumstances.

Keywords: port railway lines; operation modes; intermodal Transport

1 Introduction

In recent years, with the intensive introduction of a series of policies such as The Work Plan (2021-2025) for Promoting the Development of Intermodal Transport and Optimizing and Adjusting the Transport Structure, the China ports container rail-water intermodal transport has witnessed rapid development. According to the statistics of The Ministry of Transport of China, during the 13th Five-Year Plan period, the China ports container rail-water intermodal transport volume increased from 2.75 million teus to 6.87 million teus, with an average annual growth rate of 25.8% [1], among which, the accelerated construction of port railway lines gave a strong support. By 2021, 43 of the 95 container harbour in 45 major ports across China have access to railway lines, and Qingdao, Dalian and Yingkou ports and other major ports will have seamless rail connections.

However, although the port collection and distribution system has been gradually improved with the continuous progress of railway engineering, the operation of railway lines has been troubled by many enterprises under the influence of the general environment of China's railway network responsibility system. At present, there are three main construction subjects of port railway lines, namely, self-construction by port enterprises, investment construction by local governments and investment construction by China Railway Corporation. Behind each

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construction mode, there are two main operation modes, namely, the one who builds and the one who operates, or the one who is uniformly assigned to China Railway Corporation for operation [2]. Which operation mode is suitable for the development of port enterprises cannot be judged by experience. It is necessary to make systematic calculation based on the volume of traffic and mining the balance point between the two.

2 Comparison between independent operation and entrusted operation modes

The typical independent operation management mode refers to the self-adjustment and self-scheduling command of freight rates according to the relationship between market supply and demand. Its main advantage is that the port has independent management rights and dispatching command, which is convenient for internal production and operation organization management and relatively controllable operating costs. However, because China Railway Corporation has a strong position in railway management (mainly reflected on unified dispatching and unified liquidation), the port railway line is greatly restricted in transportation organization and operation, and there are congenital limitations in personnel and equipment management.

Entrusted operation management mode refers to entrusting dispatching command, freight organization, maintenance of corresponding infrastructure and equipment, and even production and operation management within the scope of its own business management to the China Railway Corporation [3]. Its main advantage lies in the separation of ownership and management rights of railway lines, which saves operation and management costs, and helps to make full use of national railway equipment and facilities and production command system, saving investment and realizing professional management. However, it also weakens the decision-making power and initiative right of port in transportation organization and marketing to a certain extent, and easily causes the problems of operating results and corporate profits being manipulated and transferred.

3 Operation cost analysis of port railway line under different operation modes

3.1 Composition of railway freight rates

At present, China's railway freight rates are regulated by the market and guided by the government. Freight rates are mainly composed of freight charges, railway construction funds and miscellaneous fees.

(1) Freight charges: In 2017, when deepening the reform of railway freight prices, the government pointed out that the benchmark freight rates of all cargo categories under the guidance of the government will remain unchanged. Railway transport enterprises can refer to the benchmark freight rates, within the range of no higher than 15% and no limit on lower freight rates [4]. At present, the benchmark rate 1 of coal and other bulk goods on railway trunk lines is 16.3 yuan/ton, and the benchmark rate 2 is 0.098 yuan/ton km.

(2) Railway construction fund: Railway construction fund is generally only collected from the official national railway operation line and the temporary management operation line that implements uniform freight rate. At present, the railway construction fund for most full carload goods is 0.033 yuan/tonnage km [5].

(3) miscellaneous fees: in the whole process from railway transporting goods to delivery, the auxiliary operations and labor services provided by railway transportation enterprises to the shipper and consignee, as well as the expenses incurred by the shipper or consignee to occupy additional railway equipment, use of appliances and spare parts, are miscellaneous fees. The miscellaneous fees is not inevitable collect fees, and it is collected due to actual project and concerned regulation. Through sorting out the 26 miscellaneous fees in the "Railway Miscellaneous Fees Charging Items and Standards", combining with the actual port railway line business, from the perspective of operation, the miscellaneous fees are screened purely without considering cars or containers' delayed use, breach of rules and other special circumstances, finally, 10 miscellaneous fees including container usage fee, cargo pickup and delivery fee, cargo insurance fee, car pickup and delivery fee, locomotive operation fee, cargo handling fee, storage fee, car use service fee, locomotive use service fee and site use service fee are determined.

3.2 Composition of railway freight costs

The operation cost of railway line mainly includes equipment depreciation, maintenance cost, personnel cost, locomotive fuel cost, administrative expenses, value-added tax and additional, enterprise income tax and so on.

(1) Personnel costs: including the salaries and remuneration of management personnel, dispatching personnel, loading and unloading personnel, testing personnel, logistics personnel, maintenance personnel, etc. Each local railway company personnel cost standard is different, and depends on local economic production level and business scale.

(2) Maintenance cost: including the repair and inspection fee of railway fixed assets such as locomotives, vehicles, lines, housing construction and mechanical power, which shall be accounted by railway works department.

(3) Equipment depreciation: refers to the depreciation cost of railway fixed assets on their original value. Article 60 of the Regulations for the Implementation of the Enterprise Income Tax Law of China stipulates that, unless otherwise stipulated by the competent financial and tax authorities of The State Council, the minimum period for calculating depreciation of fixed assets is as follows: Houses and buildings shall be depreciated for 20 years. Port railway lines can be depreciated for 20 years according to the depreciation life of buildings.

(4) Locomotive fuel cost: refers to the fuel consumption of railway line locomotives during operation and running.

(5) Administrative expenses: including business entertainment, transportation, travel expenses and other expenses incurred due to business requirements.

(6) VAT and Surcharge: according to the Second Edition of The Measures for Economic Evaluation of Railway Construction Projects, VAT and surcharge are calculated at 5% of the transportation revenue.

(7) Corporate income tax: According to the supplementary Notice on Preferential Policies of Corporate Income Tax for Public Infrastructure Projects (Finance and Taxation (2014) No. 55), the corporate income tax of the project conforms to the preferential policy of "three exemptions and three halving", and the corporate income tax rate is 25%.

3.3 Comparison of operating costs between independent and entrusted modes

This study is based on the premise that the costs incurred jointly in the independent operation mode and entrusted operation mode are not included in the analysis of the operation cost of port railway line, and only compares the cost differences between independent operation mode and entrusted operation mode. When the enterprise seeks the entrusted operation mode, the cost of picking and delivering cars, locomotive operation, equipment depreciation, locomotive fuel and administrative affairs shall be borne by the railway company, while the enterprise income tax, value-added tax and additional expenses shall be common expenses with independent operation mode, but management fees and maintenance fees shall be paid to the railway company.

3.3.1 Exclusive operation cost of entrusted modes

According to the investigation and analysis, under the jurisdiction of Shanghai Railway Bureau, when port railway lines are entrusted and managed by China National Railway, the allocation of personnel and equipment shall be taken charge by the Railway Bureau, while the port shall pay the corresponding pick-up and delivery fee, management fee and maintenance fee to the Shanghai Railway Bureau.

(1) Car pick-up and delivery fee: According to the notice on the adjustment of some railway miscellaneous fees (Railway General Cargo [2019] No. 46), the full carload rate is 8.1 yuan/vehicle km. According to the factual elements that average port railway line is 16 kilometers, the round-trip travel is 32 kilometers, the operation of each car is 60 tons of goods, and the annual transportation volume is V tons, and we can get the following formula:

$$F_{\text{Car pickup\& delivery}}=V/60*8.1*32=4.32V \text{ yuan} \quad (\textbf{Formula 1})$$

(2) Locomotive operation fee: according to the notice on adjusting locomotive operation fee, pick-up and delivery fee rate (Tieyun [2008] No. 138), the locomotive operation fee is 90 yuan/half an hour. According to the factual elements that 1 hour for one round trip for each train, 50 cars for each train and 60 tons of goods for each car, and we can get the following formula:

$$F_{\text{Locomotive operation}}=V*180/(60*50)=0.06V \text{ yuan} \quad (\textbf{Formula 2})$$

(3) Management fee: under the entrusted mode, the management fee paid by the port to the railway bureau mainly includes personnel fee, operation fee, transportation fee, loading and unloading fee, storage and other comprehensive service fees. According to the factual elements that the current management fee standard charged by Shanghai Railway Bureau is 1 yuan/ton, and we can get the following formula:

$$F_{\text{Management fee}}=V \text{ yuan} \quad \textbf{(Formula 3)}$$

(4) Maintenance fee: According to the factual elements that the current maintenance fee standard for port railway lines charged by Shanghai Railway Bureau from port enterprises is 150,000 yuan/km, and the average length for port railway lines is 16 km, and we can get the following formula:

$$F_{\text{Maintenance fee}}=16*150{,}000=240{,}0000 \text{ yuan} \quad \textbf{(Formula 4)}$$

(5) Total exclusive operation cost: above all, the total exclusive operation cost should be the sum from formula 1 to formula 5, then we can get the following formula:

$$F_{\text{Total exclusive operation cost}}=5.38V+240{,}0000 \text{ yuan} \quad \textbf{(Formula 5)}$$

3.3.2 Exclusive operation cost of independent mode

When the port railway lines adopt self-management mode, except common cost with entrusted operation mode, the operating cost mainly includes locomotive rental fee (including maintenance fee), car service fee, maintenance fee, locomotive fuel fee, personnel fee and administrative affairs fee.

(1) Locomotive rental cost (including maintenance fee): According to the investigation and analysis that the rental fee standard for Shanghai railway bureau collecting from port railway lines operation is 160,0000 yuan per year, including driver payment, locomotive repair fee, maintenance fee, etc., and we can get the following formula:

$$C_{\text{Locomotive rental fee}}=160{,}0000 \text{ yuan} \quad \textbf{(Formula 6)}$$

(2) Service cost for car Use: According to the notice concerning the adjustment of partial Passenger and Freight miscellaneous fees Rates and the announcement of Railway Coal Dust Suppression Transportation and Charge Rates (Tieyun [2009] No. 224), the service fee for car use is 3.00 yuan per ton for freight cars on the business lines, and we can get the following formula:

$$C_{\text{car use service fee}}=3*V=3V \text{ yuan} \quad \textbf{(Formula 7)}$$

(3) Maintenance cost: According to the investigation and analysis that, at present, under the independent operation mode, the maintenance cost of port railway lines in China is between 55,000 yuan/km and 77,000 yuan/km, and if the average is 66,000 yuan/km, the cost is as follows:

$$C_{maintenance}=66{,}000*16=1056000 \text{ yuan} \quad \textbf{(Formula 8)}$$

(4) Locomotive fuel cost: the current unit price of fuel is about 0.68 yuan/ton. And taking 100 tons per year as the average standard for port railway lines locomotive use, the locomotive fuel cost is about 680,000 yuan.

(5) Personnel cost: Generally, a total of 38 people are involved in the railway line operation team, including 10 people in the dispatching team, 15 people in the engineering staff and 13 people in the other staff. According to the national average labor cost, calculated at 120,000 yuan per person per year, the annual personnel cost will reach 456,0000 yuan.

(6) Administrative cost: according to the nature of railway companies and the average input of local enterprises in administrative affairs, it is estimated that the port needs to pay administrative fees of about 150,0000 yuan.

(7) Total exclusive operation cost: above all, the total exclusive operation cost for independent mode shall be the sum of all the cost listed above, then we can get the following formula:

$$C_{Total\ exclusive\ operation\ cost}=3V+939{,}6000 \text{ yuan} \quad \textbf{(Formula 9)}$$

3.3.3 Comparison of operating costs between independent and entrusted modes

To get the cost balance point of adopting independent mode and entrusted mode, we should set **Formula 5** equals to **Formula 9,** then we can get the following formula:

$$F_{Total\ exclusive\ operation\ cost}=C_{Total\ exclusive\ operation\ cost}$$

$$5.38V+240{,}0000=3V+939{,}6000$$

$$V=300{,}0000 \text{ tons}$$

(Formula 10)

From the calculation, we can conclude that when the annual volume of port railway line reaches 3 million tons, the cost of adopting independent mode and entrusted mode is the same. When the annual volume is less than 3 million tons, the entrusted operation cost is lower; On the contrary, when the volume exceeds 3 million tons, the independent operation cost is lower.

In 2021, the container rail-water intermodal transport volume of 19 major coastal ports in China reached 7.3 million TEU. If each container is converted into 11 tons, the actual carrying capacity of each railway line would exceed 4 million tons, and the value keeps growing rapidly. Therefore, the independent mode is more suitable for the railway line operation of Chinese port enterprises.

4 Calculation of the profit balance of port railway line under the independent operation mode

4.1 Total operation cost of port railway line under the independent mode

Following the above analysis, operating costs in independent mode also include depreciation costs, administrative expenses, income tax, value-added tax and additional taxes, among which the occurrence of relevant taxes is directly related to the total income, as follows:

(1) Depreciation cost: depreciation is carried out according to the original value of fixed assets. At the same time, referring to the investment scale of Chongqing Xintian Port railway line, the original value of fixed assets of the 16-km special line is about 2.3 billion yuan. The straight-line depreciation method is adopted to calculate depreciation, with an annual depreciation rate of 3%, that is, 69 million yuan per year.

(2) Income tax: According to relevant regulation, the corporate income tax rate is 25%, then we can get the following formula:

$$C_{\text{income tax}}=25\%\ (Q_{\text{total income}}-C_{\text{total cost}})\ \text{yuan} \qquad \textbf{(Formula 11)}$$

(3) VAT and surcharge: according to the second edition of the Measures for economic evaluation of railway construction projects, VAT and surcharge are calculated at 5% of the transportation revenue, then we can get the following formula:

$$C_{\text{VAT and surcharge}}=5\%Q_{\text{total income}}\ \text{yuan} \qquad \textbf{(Formula 12)}$$

(4) Total operation cost： in chapter 3, we got the exclusive operation cost under the independent mode calculated as formula 9, the total operation cost equals to the sum of exclusive cost, depreciation cost, income tax, VAT and surcharge, then we can get the following formula:

$$C_{\text{total cost}}=C_{\text{Total exclusive operation cost}}+6900{,}0000+C_{\text{income tax}}+C_{\text{VAT and surcharge}}=3V+939{,}6000+6900{,}0000+25\%\ (Q_{\text{total income}}-C_{\text{total cost}})+5\%Q_{\text{total income}}$$

at last, we can get the relationship between total cost, volume and total income under the independent mode:

$$C_{\text{total cost}}=2.4V+6265{,}8800+0.24Q_{\text{total income}}\ \text{yuan} \qquad \textbf{(Formula 13)}$$

4.2 Total operation income of port railway line under the independent mode

The total operating income under independent mode mainly includes freight and handling income.

4.2.1 Adopting national railway charging standard, calculate volume scale profit balance point

(1) Freight transport charge: Refer to the latest freight rate table of full carload in China, railway freight transport rate = benchmark price 1+ benchmark price 2× transportation distance, then we can get the transportation price of coal and other bulk goods on port railway lines as following:

$$Q_{\text{freight transport charge}}=16.3\text{ (benchmark price1) } V+0.098\text{ (benchmark price 2)}\times 16V=17.87V\text{ yuan} \quad \textbf{(Formula 14)}$$

(2) Handling charges: In regard to the revision and re-promulgation of the Railway Cargo Handling Procedures and other notices (Tieyun (2005) No. 5), railway handling charges are calculated according to the billing weight and specified rates, and the loading and unloading rates of bulk cargo vehicles are 5.16 yuan/ton, so the loading and unloading charges of port railway lines are as follows:

$$Q_{\text{handling charge}}=5.16V\text{ yuan} \quad \textbf{(Formula 15)}$$

(3) Volume scale profit balance point: above all, when adopting the national railway charging standard, the volume scale profit balance point shall be calculated as follows:

$$Q_{\text{total income}}=Q_{\text{freight transport charge}}+Q_{\text{handling charge}}=17.87V+5.16V=23.03V\text{ yuan} \quad \textbf{(Formula 16)}$$

When we set $C_{\text{total cost}}=Q_{\text{total income,}}$ then we get:

$C_{\text{total cost}}=2.4V+6265{,}8800+0.24Q_{\text{total income}}=Q_{\text{total income,}}$

Finally, we get the profit balance point of volume equals to 415,0000 tons. Which means that if the volume exceeds 415,0000 tons per year, the port railway line under independent operation mode will profit.

4.2.2 Setting the volume fixed, calculate the profit balance point of freight rate

As mentioned above, in 2021, the port railway lines of Coastal ports in China transported 4 million tons of cargo annually on average. So, when the volume is fixed, the profit balance point is related to the freight transport rate, more particularly the sum of freight transport charge and handling charge, the we can get the following formula:

$$C_{total\ cost}=2.4V+6265,8800+0.24Q_{total\ income}=7225,8800+0.24Q_{total\ income}\ yuan$$

(**Formula 17**)

Besides, the total operation income of the railway lines equals to the freight transport charge plus handling charge, then we can get the following formula:

$$Q_{total\ income}=Q_{freight\ transport\ charge}+Q_{handling\ charge}=$$
$$400*(q_{freight\ transport\ charge}+q_{handling\ charge})\ yuan$$

(**Formula 18**)

When we set $C_{total\ cost}=Q_{total\ income}$, then we finally get the profit balance point of freight rate equals to 23.7 yuan/ton. Which means that if the sum of freight transport charge and handling charge exceeds 23.7yuan/ton, the port railway line under independent operation mode will profit.

5 Conclusion

Independent operation and entrusted operation of port railway lines are only relative, each mode has advantages and disadvantages, as well as limitations. No matter which mode is adopted, win-win cooperation of all parties, efficient transportation wisdom, integrity of railway network and rationality of resource allocation should be considered. But for port enterprises, during the high quality development period of China's port container rail-water intermodal transport, from the perspective of economic benefit, taking independent operation model is more suitable for today's rapid pace of development, at the same time, from the perspective of transportation organization, taking independent operation model has greater flexibility, and can achieve seamless docking between port and railway, which could improve production efficiency.

References

[1] Nan Y.: Discussion on countermeasures for the development of port container rail-water intermodal transportation in China under the new situation, Railway transportation and economy, 2021, pp.35-41

[2] Jianyu G.: Study on the problems and countermeasures of speeding up the construction of railway special line, Transport business China, 2021, pp.119-121

[3] Dechun N.: Comparison and selection of railway Station and yard schemes under different operation and management modes, Shanxi construction, 2020, pp.120-122

[4] Congyin L.: Rail freight rate cut, Yearbook of China Railway Beijing Bureau Group Co., LTD, 2020, pp.77

[5] Cong W.: Research on current situation and standardized management of Railway Construction Fund, Journal of Beijing Jiaotong University, 2020, pp.33-40