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Economic Evaluation and Analysis of Jinan-Qingdao High Speed Railway Construction Project

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***Abstract*— China's economic and social development has been rapid, and the scale of the project construction has been large. The transportation network is gradually being improved and the railway as a major artery of the national economy has received special attention. During the 13th Five-Year Plan period, Shandong Province has also started construction of a number of railways. This article has established suitable economic evaluation methods and indicators for the Jinan-Qingdao high-speed railway construction project, and discussed and analyzed the financial and national economy. The analysis shows that the railway construction project is feasible and has a certain risk tolerance.**

***Index Terms*— Jinan-Qingdao high-speed railway; economic evaluation; evaluating indicator; risk assessment**

I. INTRODUCTION

The economic evaluation of railway construction project is based on the national economic and social development strategy and the transportation development planning requirements. On the basis if doing a good job in transportation demand forecasting and project are calculated, in addition, the financial feasibility and the economic rationality of the proposed project are analyzed and demonstrated. So as to make a comprehensive economic evaluation and a provide basis for project decision.

The cost-benefit analysis method of project evaluation was first proposed by Franklin. In 1844, the French engineer Dolby first put forward the concept of consumer surplus, and created a modern cost-effective system analysis method [1]. World Bank economists Lin Si·Squair and Van Dytak focused on the theory and method of shadow prices, deduced the calculation formula of shadow prices, and considered the impact of income distribution [2]. After the funding of China, the model of project economic evaluation was basically used in the construction of the former Soviet Union [3]. According to the situation of our country at that time, the economic effect of the project was evaluated in the project design, which usually adopts three major indexes, investment cost, product cost and labor productivity, and excluded the use of profit index [4].

However, with the development of the society, the traditional construction project economic evaluation method is difficult to meet the actual needs, so the project feasibility study needs to be gradually incorporated into the national project decision-making process [5]. This paper discusses and analyzes the Jinan-Qingdao high-speed railway project from both financial and national economic aspects by establishing suitable economic evaluation methods and indicators.

II. PROJECT OVERVIEW

The Jinan-Qingdao high-speed railway is China's first high-speed railway that is built mainly for local investment and is an important part of China's "Four horizontal and Four vertical" express railways, as shown in Figure 1. The railway runs through the Shandong Peninsula, leading from the Jinan East Railway Station and passing through Zouping, Zibo, Qingzhou, Weifang, Gaomi, Jiaozhou, and the Qingdao Railway Hub Hongdao Station. The length of the main line is 307.9 kilometers, and the main channel of the "Three horizontal and Three vertical" intercity rail transit network in Shandong Provence is built [6].

The Jinan-Qingdao high-speed railway connects with the Jinan hub on the west and is connected with the Beijing-Shanghai high-speed railway and passenger-dedicated lines such as Shi-Ji and Shi-Tai lines. It can form a rapid passenger transport from the Shandong Peninsula to Beijing-Tianjin-Hebei, the Northeast and Shandong Peninsula to the Central Plains City Group and the Yangtze River Delta. It is connected to the Qingdao hub in the east, links up with Qing-Rong Intercity Railway and Qing-Lian railway, and forms a fast-passenger main channel that connects several central cities between Jinan and Qingdao and access to central cities such as Yantai, Weihai and Rizhao along the Shandong coast within 2 hours traffic circle. The construction of the Jinan-Qingdao high-speed railway is of great significance for accelerating the infrastructure construction in Shandong Province, communicating with the Shandong Province and the three major economic belts, and advancing the implementation of the national-level development strategy.

Fig.1. the Sketch Map of Jinan-Qingdao High-Speed Railway

III. EVALUATION METHOD

The evaluation of the Jinan-Qingdao high-speed railway project is carried out from two aspects of finance and national economy respectively. The financial evaluation is based on the current fiscal and taxation system and price system conditions of the country, analyzed from the perspective of the railway company's finance, and calculates the cost and benefit of the project itself, and investigates the project's profitability. The national economic evaluation is based on the principle of rational allocation of resources, using cost-benefit analysis methods, and using economic parameters such as shadow prices, shadow exchange rates, shadow wages, and social discount rates to calculate and analyze the project's cost to the country and its contribution to the country. On this basis, we can consider the economic rationality and macro-feasibility of investment behavior.

The evaluation indexes include internal rate of return, net present value and investment recovery period.

From various aspects of financial considerations, the financial internal rate of return refers to the discount rate when the current value of the net cash flow (*FNPV*) for each year of the construction project is accumulated and equals to zero during the entire calculation period. It indicates the profitability of the project's possession of funds and is the main dynamic evaluation index of project profitability. We compare the financial internal rate of return (*FIRR*) of all investments or free funds that we find with the railway benchmark rate of return or the set discount rate (i_c). When $FIRR \geq i_c$, we think that its profitability has met the minimum demand and is financially acceptable. The expression of the financial internal rate of return is:

$$\sum_{t=1}^{n}(CI-CO)_t(1+FIRR)^{-t}=0 \qquad (1)$$

Where: *CI* means Cash Inflow; *CO* means Cash Outflow; $(CI\text{-}CO)_t$ means net cash flow of *t* years; *n* means period of calculation.

Financial net present value (*FNPV*) is a dynamic indicator that reflects the profitability of a project in the calculation period. It can be calculated in two cases of total investment and its own funds. It is based on the railway benchmark rate of return or the set discount rate (i_c), and converts the annual net cash flow (*CI-CO*) in the "fiscal cash flow statement" during the calculation period to the present value at the beginning of the construction beginning year, and finally Accumulated. When $FNPV \geq 0$, the project is acceptable, the expression is:

$$FNPV=\sum_{t=1}^{n}(CI-CO)_t(1+i_c)^{-t} \qquad (2)$$

The payback period refers to the period of time required for the project's net income to cover all the investment. It is the main static indicator for investigating the financial recovery of the project. The investment recovery period starts from the beginning of the construction period, and indicates the number of years starting from the beginning of operation. We compare the recovered payback period (P_t) with the railway's benchmark payback period (P_c). When $P_t \geq P_c$, the calculation formula is:

$$\sum_{t=1}^{P_t}(CI-CO)_t=0 \qquad (3)$$

From the perspective of the national economy, the economic internal rate of return (*EIRR*) is a relative indicator reflecting the contribution of the railway construction project to the national economy, and is the discount rate for the cumulative net present benefit of the railway project in each year during the calculation period.

Table.1 Details of various expenditures

Entry Name	Total Investment Estimate(¥)	Locomotive Purchase Fee (¥)	Passenger Expenditure Rate (¥ per 10,000people·*km*)	Unrelated Expenditure Rate (¥ per 10,000*km*)
Amount of money	599.83	56	534.33	52.58

$$\sum_{t=1}^{n}(B-C)_t(1+FIRR)^{-t}=0 \qquad (4)$$

Where: *B* means economic benefit inflow of railway construction project; *C* means economic cost outflow of railway construction project; $(B\text{-}C)_t$ means economic benefit flow of railway construction project in *t* year; EIRR means economic internal rate of return for railway construction projects.

When the economic internal rate of return is not less than the social index of refraction, it indicates that the project's net contribution to the national economy has reached or exceeded the required level. We think that the project can be acceptable.

The economic net present value (ENPV) is an absolute indicator of the project's net contribution to the national economy. Its value is calculated by using the social discount rate to convert the net benefit flow in each year of the project calculation period to the sum of the present value at the beginning of the construction period. The expression is:

$$FNPV=\sum_{t=1}^{n}(B-C)_t(1+i_x)^{-t} \qquad (5)$$

Where: i_x means social discount rate.

When assessing the national economic contribution of a railway construction project, if the economic net present value is not less than 0, it indicates that the railway construction project can achieve a net national economic contribution that meets the social discount rate. We believe that this railway construction project is acceptable from the perspective of the national economy.

IV. PROJECT EVALUATION AND ANALYSIS

Regarding the evaluation basis, we consider the evaluation period is 30 years. The construction period is 4 years and the operation period is 26 years. The discount rate for the industry is 12%.

The Jinan-Qingdao high-speed railway project belongs to the local railway, and the transport function is the passenger transport. The planning and transportation capacity is 50 million people a year. In the process of evaluation and analysis, the economic factors of freight transportation can not be considered. The basic data are as follows:

1) Passenger revenue = Traffic price rate× Passenger volume× Transport distance;
2) The passenger price rate is ¥1700 per 10,000 people·*km*.
3) The transport distance is 307.9 *km*.

In terms of cost, the investment in the financial evaluation of this project includes civil engineering investment, locomotive and vehicle purchase fees, and loan interest during the construction period. The amount of funds for this project is shown in Table 1. The project capital accounts for 50% of the total investment, funds other than capital are settled using domestic bank loans. The basic depreciation expense consists of the depreciation of civil works and the depreciation of locomotives and vehicles. The basic annual depreciation rate of fixed assets in civil engineering projects is estimated to be 3.8%, and the annual basic depreciation rate of fixed assets for locomotives and vehicles is 6%. Financial expenses are working capital loan interest and short-term loan interest. Operating expenses include operating costs, basic depreciation expenses, and financial expenses.

The overall investment financial revenue rate of Jinan-Qingdao high-speed railway construction project is 6.87%, which is greater than the railway industry benchmark return rate (6%); the investment recovery period from the construction period is 18.6 years, less than the railway industry benchmark recovery period of 20.7 years. It shows that the conclusion of the financial evaluation of the project is feasible.

With regard to the sensitivity analysis of the financial evaluation index, the sensitivity of the financial internal rate of return is calculated when the price, volume, operation cost, and civil engineering investment of the project change. The most sensitive factor affecting the internal rate of return of all investment is freight rate, followed by traffic volume, civil engineering investment and operation cost.

In the national economy, the cost of the project includes the investment in fixed assets of civil engineering, the investment of mobile funds and the purchase cost of locomotives and vehicles. The value of the project is the conversion coefficient of the shadow price for the financial cost. The expenses for land acquisition, environmental protection expenses and construction costs related to the project are included in the total investment of the project and will not be calculated. The direct benefit in the national economic evaluation is: the transportation revenue generated by the increase in traffic brought about by the implementation of this project. Calculated by shadow price: The shadow price of passenger transport is ¥1680 per 10,000 people·*km*.

In the cash flow calculation, apart from the transportation income, the cash flow portion shall also be used to calculate the recovery of residual and residual value of fixed assets and the recovery of working capital. The recovery amount is calculated based on the shadow price of the original value of the fixed assets, and the residual value rate and depreciation rate are unchanged. It is estimated that after the completion of the railway, the amount of passenger traffic and passenger traffic in the nearby railways will account for 100% of the total passenger traffic on the line.

V. CONCLUSION

Based on the financial evaluation, national economic evaluation and sensitivity analysis of each index, the following conclusions can be drawn:

1) The overall investment financial revenue rate of Jinan-Qingdao high-speed railway construction project is 6.87%, and the investment recovery period from the construction period is 18.6 years.
2) The transportation function of the railway construction project is a single passenger transport. Through the major indicators and the sensitivity analysis results, we can see that the project is feasible and has a certain risk tolerance capability.
3) After this railway project is completed, it can meet the travel needs of most of the passengers in the city, that is, it can ease the pressure on the passenger transportation of the original route, and it can also promote the economic development of the surrounding cities.

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