Original Research Article

Study on the Impact of PPP Project Payment Formula on Investment Income

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Abstract: Nowadays, with the increasingly fierce competition in the PPP market, the bidding quotation and investment returns are gradually declining. This paper systematically analyzes the current transaction structure and payment formulas commonly used in PPP projects, such as the Ministry of Finance formula method, average capital method as well average capital plus interest methods, and variant forms such as price-tax separation and equity-debt separation methods. By comparison, the advantages and disadvantages of different payment modes are displayed as well as matters needing attention. The Ministry of Finance formula method usually offers little operating subsidy in the early period and more subsidy in the later period, which is difficult for the companies to repay the capital and interest in the early period. Due to influence of the discount rate with reference to the local government bond yields during the same period, the investment returns are generally not promising and is not commonly used in actual operation. The average capital plus interest method maintains a stable level of operating subsidies every year, and owns a good capability to repay the capital and interest, thus having a relatively fair investment return. Therefore, it is the most commonly used method at present. In terms of the equal capital method, the operating subsidy is usually huge in the early period and less in the later operation period, which will increase the financial burden of the local governments, so it is rarely recognized by the local government in the actual operation. At the same time, this article analyzes the impact of different methods of repaying the capital and interest on the project investment returns. As average capital plus interest repayment can fully take the advantage of the low-cost debt to refinance, the project investment return is also higher than the average capital method in the same project.

Keywords: PPP project; Transaction structure; The Ministry of Finance formula; Average capital plus interest method; Average capital method.

1. Introduction

BOT was piloted in China in 1980s. Having gone through several stages as initial trial stage, barbaric development stage and regulation and rectification stage, China's PPP mode has successfully transformed from regulation and rectification stage to steady development stage at present. According to the data of Ministry of Finance, as of October 2019, 9,299 projects have been incorporated in the National PPP project management databases, with a high investment of 14.2 trillion, a promising contract signing rate of 65.6%, and a project operation rate of 58.7%. In 2019, the net warehousing project amounted to 1.0 trillion yuan and the landed investment was 2.1 trillion yuan, including 10 warehousing projects in October, with an investment of 177.2 billion yuan and 45 local canceling warehousing projects, with an investment of 60.8 billion yuan[1].

In some areas, the financial affordability of PPP projects is gradually approaching the upper limit. Among the 2,605 administrative regions with PPP projects in the country, there are 19 regions with the financial affordability indicator exceeding 10%, accounting for 0.7%, and 721 regions not higher than 10% but exceeding the warning line of 7%, accounting for 27.7%, and 456 regions between 5% and 7%, accounting for 17.5% and 1,049 regions less than 5%, accounting for 54.1%. With the approaching of financial affordability indicator to its limitation, the financial market carried out more rigorous financing restrictions for the PPP project. Specifically, an improved system for various regulations and management has gradually been established. Moreover, the PPP projects are gradually changing their way of development, from the barbaric development

stage centered on developing numerous new projects to the sustainable development stage based on dealing with the stored projects.

With the increasingly fierce market competition in PPP, the floating downward ratio of the construction and installation project is decreasing, so is the cost-return ratio of the bidding quotation. Under such circumstance, it is necessary to guarantee the fair return of the social investors by optimizing and selecting a reasonable transaction structure and payment mechanism.

2. Payment Formula of PPP Project

2.1 Payment Formula of PPP Project

According to the practice of PPP project at home and abroad, there are three payment modes for the PPP project, namely, government payment, viability gap funding (VGF) and user payment, of which user payment will receive no government subsidies[2]. And the operating subsidy formula of the government payment and VGF can be presented as follows:

$$S = P \times (1-a) + (P \times a + Q) \times \eta - U \tag{1}$$

where S is the annual operating subsidy amount; P is the availability payment, and a is the performance appraisal ratio of availability payment, which should be no less than 30% as required by the documents of Ministry of Finance. If it is below 30%, it will not be included in the PPP management database. We can regulate it by adjusting the performance appraisal index during the construction period. Q is the operation and maintenance performance service fee, and η is the performance appraisal index of the operation and maintenance; U is the user payment, and if it is the government payment mode, $U = 0$.

1.2 Availability service fee

Availability service fee P is the average annual construction cost (converted into annual present value) the government paid to the SPV companies for the availability of the PPP projects, including overall construction cost, fair return and financial cost during the operating period[3]. Among the main transaction structure of the PPP market, the payment modes of the availability service fee P can be divided into three types, namely the Ministry of Finance formula, average capital formula, and average capital plus interest formula[4–7].

1.2.1 The Ministry of Finance Formula

In Financial and Fiscal Document 2015 NO. 21[8], a formula to calculate the annual government operation subsidy expenditure was put forward, which is called the Ministry of Finance formula. According to it, the available payment P can be calculated by the following equation:

$$P = \frac{A \times (1+r_i) \times (1+r_d)^n}{N} \tag{2}$$

Where A is the calculation base of availability payment, including overall construction investment and interest during construction period. If the investment subsidy is unavailable or the government does not pay dividends, the government subsidy and its contributed capital should also be deducted. r_i is the fair return ratio; r_d is the annual discount rate, which is reasonably determined with reference to the return rate of local government bonds in the same period. n is number of years related to discount, and N is the operating cycle of the financial operation subsidy (year), referring to the number of years when the government provides operation subsidy.

As the annual discount rate in the formula of the Ministry of Finance refers to the local government bond yield during the same period, it belongs to the risk-free investment yield within ten years, usually between 3.8% and 4.0%, which is far lower than the financing cost of social capital. As a result, it will lead to low operation yield of the project, which is not consistent with the risk-return characteristics of the project. In addition, the

government pays less before the operation and more after the operation, which makes it difficult for SPV companies to repay the capital and interest in the early stage of operation. Therefore, this mode is rarely recognized by the social capital and financial institutions, and it is rarely used in practice. In order to make the PPP project using the formula of the Ministry of Finance feasible, it is usually necessary to increase the annual discount rate r_d to 6%−7%, with the fair return ratio r_i amounting to 7%−8%. At this point, the annual discount rate r_d is equivalent to the comprehensive capital cost of the PPP project considering various factors such as taxes and fees, which is similar to the investment return ratio i in the formula of average capital and average capital plus interest.

1.2.2 The Average Capital plus Interest Method

When the method of average capital plus interest is adopted, the calculation formula of availability payment P is:

$$P = \frac{A \times i \times (1+i)^N}{(1+i)^N - 1} \tag{3}$$

where A is the calculation base of availability payment; i is the investment return ratio; and N is the total years of operating subsidy.

When adopting average capital plus interest method, the annual government payment is average, which is conducive to guaranteeing the stable cash flow of the project companies[9,10]. In addition, there are fair returns to repay the capital and interest during the initial operation period. Therefore, it is applied in numerous practice of the PPP project for its fair investment return, stable currency flow and so on.

1.2.3 The Average Capital Method

The equation of the availability payment P is:

$$P = \frac{A}{N} + \frac{A \times (N+1-n) \times i}{N} \tag{4}$$

where A is the availability payment calculation base, i is the investment return, n is the number of operating years in the current year, and N is the total number of operating subsidies years.

When adopting average capital method, the annual government operating subsidies are more in the early stage and gradually reduce in the later stage, which is beneficial for the social capital institutions to quicken the social capital recovery while it is not conducive to the government since it will add financial pressure to the government during the initial operating period. Hence this method is rarely used in the actual operation.

1.2.4 Adjustment of the Availability Payment Formula

In the practice of many PPP projects, in addition to the abovementioned formulas such as the Ministry of Finance formula, average capital plus interest formula and average capital formula, there are also some derivative formulas to calculate the availability payment, including price-tax separation and equity-debt separation modes[11]. The price-tax separation mode can avoid the tax risks such as uncertainty of output tax rate of value-added tax and exemption of input tax deduction for land expropriation and demolition costs to some extent. The equity and debt separation mode only separates equity and debt, and calculates capital and interest respectively, which is no essential difference from the original mode. Taking the most commonly used formula of equal principal and interest as an example, the practical operation modes of the two derivative modes are as follows.

The price and tax separation mode is a method to split the calculation base of availability payment A in the original availability payment calculation formula into two parts, that is, original value of fixed assets A_1 and value-added input tax rate A_2, excluding value-added input tax rate of social capital investment of the original value of fixed assets. In this mode, A_1 is calculated according to the original availability payment formula, while A_2 is calculated according to the real annual value-added input tax. Meanwhile, the government will

provide subsidies according to the social capital value-added tax and additional paid amount. The derivative equation of average capital plus interest under the price and tax separation mode is as follows:

$$P = \frac{A_1 \times i \times (1+i)^N}{(1+i)^N - 1} + A_2 \times i + T_n \tag{5}$$

where A_1 is the original value of fixed assets invested by social capital without VAT input tax; A_2 is the retained value of VAT input tax at the beginning of the year; i is the investment return of the project, and Tn is the actual amount of VAT and additional amount paid in the current year. In the debt-equity separation mode, the availability payment calculation base A in the original availability payment formula is divided into two parts: equity investment A_1 of the social capital party and debt financing A_2 of the social capital party. According to the different capital costs of the two parts, the returns of the two parts are quoted by the social capital respectively in the bidding. The derivative equation of average capital under the debt-equity separation mode is as follows:

$$P = \frac{A_1 \times i_1 \times (1+i_1)^N}{(1+i_1)^N - 1} + \frac{A_2 \times i_2 \times (1+i_2)^N}{(1+i_2)^N - 1} \tag{6}$$

where A_1 is the amount of social capital equity investment; i_1 is the return rate of social capital equity investment; A_2 is the amount of social capital debt financing, and i_2 is the interest rate of social capital debt financing.

1.3 Operation and Maintenance Performance Service Fee

Operation and maintenance performance Q is the fee government paid to the SPV companies for purchasing the operation and maintenance service of the PPP project. There is usually a relatively uniformed payment formula, which concerns the fair returns based on the annual operating cost, and the formula is as follows:

$$Q = C \times (1 + r_0) \tag{7}$$

where C is the annual operation and maintenance cost, and r_0 is the fair return of operation. Generally, according to the contract, the annual operation and maintenance costs include salary and welfare, raw material purchase costs, fuel and power costs, daily maintenance costs, major and medium repair costs, insurance costs, office and management costs, etc., which vary according to the specific operation content and industry of the project. In practice, such situation should be taken into consideration, for example, the sufficiency of the major and medium repairs cost, and the additional maintenance and operation investment and annual operation cost caused by comprehensive renovation and expansion of construction and operation scale. Detailed adjustment plans should be made for the changes of project boundary conditions and price changes in the contract. In most cases, VAT and corporate income tax that need to be paid in operation and maintenance are not taken into account in the annual operation and maintenance cost, resulting in the actual profit rate lower than the fair return ratio r_0 of operation in the formula. Therefore, the impact of taxes and fees should be taken into comprehensive consideration when the quotation of operating performance service fee is required.

1.4 User Payment

User payment U shall be determined according to specific operational content and market conditions, as well as different operational content and requirements of different industries. It should be noted that when the user payment corresponding to the operating cost of the business content has been considered in the operation and maintenance performance service fee, the user payment U can directly adopt the forecast operating revenue; When the users payment P corresponding to business contents of the construction investment and operation cost has not been considered in the availability payment and operational performance in the service fee the user payment fee U shall be calculated by the operation revenue deducted annual value of corresponding

construction and the net margin of overall profits in the current year after the tax and fees. And the user payment formula is calculated as follows:

$$U = U_s - U_p - U_q \tag{8}$$

where U is the user payment deducted from the operating subsidy each year; U_s is the operating income of the user payment each year, U_p is the annual apportion of the construction investment increased due to the operation needs of the user fee business that is not included in the total investment of the availability payment. U_q is the operation cost and tax fees excluded in the operation and maintenance service fee during the user payment operation.

2. Quantitative Analysis of the Impact of Payment Formula on Investment Income

2.1 Quantitative Analysis of Financial Indicators of Different Payment Formulas

The main indicators of investment return of PPP projects are financial internal rate of return (FIRR) and financial net present value (FNPV), which can be divided into two levels of project total investment and capital according to different evaluation subjects[12–14]. The calculation formula of total investment financial indicators of project companies is as follows:

$$\sum_{t=1}^{M+N} \left(-A_t + S_t + U_t - C_t - T_t\right) \times \left(1 + FIRR\right)^{-t} = 0 \tag{9}$$

$$FNPV = \sum_{t=1}^{M+N} \left(-A_t + S_t + U_t - C_t - T_t\right) \times \left(1 + i_c\right)^{-t} \tag{10}$$

where t is the year of project cooperation; m is the project construction period; n is the project operation period; A_t is the static total investment of the project in the NO. t year of cooperation period; S_t is the operating subsidy paid by the government in the NO. t year of cooperation period; U_t is the return of the users payment in the NO. t year of cooperation period; C_t is the operating cost in the NO. t year of cooperation period; T_t is the taxes paid in the NO. t year of cooperation period, including value-added tax and enterprise income tax, etc.; i_c is the social benchmark rate of return.

Since the regulations of the investment return reflected by financial internal rate of return (FIRR) and financial net present value (NPV) are consistent, the financial net present value (NPV)are selected to quantitatively compare the difference of investment income between different payment formulas. Suppose that the investment, user payment, operation cost and the corresponding tax fees are consistent while the operation subsidy and corresponding tax fees are varying each year, then the difference of financial net present value between different payment modes is:

$$\Delta FNPV = \sum_{n=1}^{N} \Delta S_n \times \left(1 - \tau\right) \times \left(1 + i_c\right)^{-(M+n)} \tag{11}$$

where $\Delta FNPV$ is the difference of financial net present value between different payment modes; n is the year of project operation, ΔS_n is the difference of financial net present value between different payment modes in the NO. n year of project operation; τ is the comprehensive tax ratio of project operation subsidy, which varies according to different payment formulas. To simplify, we hereby suppose that they are consistent.

Combined with Formula (1), when the performance of construction period and operation period is considered to be consistent, the difference of financial net present value can be displayed as follows:

$$\Delta FNPV = \sum_{n=1}^{N} \Delta P_n \times \left(1 - \alpha \times (1 - \eta)\right) \times \left(1 - \tau\right) \times \left(1 + i_c\right)^{-(M+n)} \tag{12}$$

2.2 Comparative Analysis of Investment Return between Average Capital Method and Average Capital Plus Interest Method

Among all payment modes, average capital plus interest method is the most widely applied, therefore, all schemes shall take average capital plus interest method as the benchmark scheme for comparative analysis. Hence, the difference of the financial net present value (NPV) between the average capital method and average capital plus interest method can be displayed like this:

$$\Delta FNPV_{3-2} = \sum_{n=1}^{N} A \times \left(\frac{1+(N+1-n)\times i}{N} - \frac{i\times(1+i)^N}{(1+i)^N-1} \right) \times \mu \times (1+i_c)^{-n}$$

$$= \frac{A\times\mu}{1+i_c} \times \left(\left(\frac{1+(N+1)\times i}{N} - \frac{i\times(1+i)^N}{(1+i)^N-1} \right) \times \frac{1-\left(\frac{1}{1+i_c}\right)^N}{1-\frac{1}{1+i_c}} + \frac{i}{N} \times \frac{1-\left(N+1-\frac{N}{1+i_c}\right)\times\left(\frac{1}{1+i_c}\right)^N}{1-\left(\frac{1}{1+i_c}\right)^2} \right)$$

Where $\mu=(1-\alpha\times(1-\eta))\times(1-\tau)\times(1+i_c)^{-M}$ is the comprehensive index considering performance, efficiency, taxes and fees. i is the benchmark return considering pre-tax comprehensive capital cost WACCbt, which can be calculated as follows:

$$WACC_{bt} = \frac{i_{ce}}{1-\tau_{it}} \times \alpha + i_{cd} \times (1-\alpha) \tag{14}$$

where i_{ce} is the capital income requirement of social investors; i_{cd} is the debt financing cost of social investors; a is the proportion of project capital; and τ_{it} is the corporate income tax rate of SPV companies.

When the rate of return on investment i is greater than the benchmark return rate i_c, $\Delta FNPV3\text{-}2\ I<0$, indicating that the return on investment applying average capital method is higher than that applying average capital method. On the contrary, when the rate of return on investment i is less than the benchmark rate of return ic, $\Delta FNPV3\text{-}2\ I>0$, indicating that the return on investment applying average capital method is lower than that applying average capital method.

When the rate of return on capital is 6%-8%, the ratio of capital is 20%, and the debt financing cost is about 4.9%-5.15%, the corporate income tax rate is 25%, and the comprehensive pre-tax capital cost is 5.52%-6.24%. According to the statistics of the PPP comprehensive information platform of the Ministry of Finance, the rate of return on investment of the completed PPP projects, which is more than 90%,is between 5% and 8%, and the medium return rate is around 6.5%. The social capital of PPP projects mainly focuses on central state-owned enterprise, local stated owned enterprise and large listed private enterprises, whose financing cost and capital income requirements are not high. Therefore, the return on investment is usually higher than the pre-tax comprehensive cost of capital, and the average capital plus interest method is a better payment mode. For projects with low investment return, the average capital method should be adopted.

2.3 Comparative Analysis of Ministry of Finance Formula Method and Average Capital Plus Interest Method

The difference of financial net present value (FNPV) between the Ministry of Finance formula method and average capital plus interest method is:

$$\Delta FNPV_{1-2} = \sum_{n=1}^{N} A \times \left(\frac{(1+r_i)\times(1+r_d)^n}{N} - \frac{i\times(1+i)^N}{(1+i)^N-1} \right) \times \mu \times (1+i_c)^{-n}$$

$$= A\times\mu \times \left(\frac{(1+r_i)}{N} \times \frac{1+r_d}{1+i_c} \times \frac{1-\left(\frac{1+r_d}{1+i_c}\right)^N}{1-\frac{1+r_d}{1+i_c}} - \frac{i\times(1+i)^N}{(1+i)^N-1} \times \frac{1}{1+i_c} \times \frac{1-\left(\frac{1}{1+i_c}\right)^N}{1-\frac{1}{1+i_c}} \right) \tag{15}$$

Since the difference of financial net present value (FNPV) between the Ministry of Finance formula and average capital plus interest method is related to such values as r_d, i_c, i, N and so forth, dimensionless analysis

was adopted in order to more intuitively and clearly analyze the relationship between $\Delta FNPV1$-2 and 0. Here the relationship between $\Delta FNPV1$-2 and 1 was explored applying the Ministry of Finance formula and the average capital plus interest formula to compare the ratio of financial net present value , and the calculation formula is as follows:

$$FNPV_{1/2} = \cfrac{\dfrac{(1+r_i)}{N} \times \dfrac{1+r_d}{1+i_c} \times \dfrac{1-\left(\dfrac{1+r_d}{1+i_c}\right)^N}{1-\dfrac{1+r_d}{1+i_c}}}{\dfrac{i \times (1+i)^N}{(1+i)^N - 1} \times \dfrac{1}{1+i_c} \times \dfrac{1-\left(\dfrac{1}{1+i_c}\right)^N}{1-\dfrac{1}{1+i_c}}}$$

(16)

According to the bid-winning project information of the PPP central project management database of the Ministry of Finance, the fair return rate of the Ministry of Finance formula method is usually 6%-8%, and the discount rate is 4.5%-5.5%. The average bid-winning investment return rate of the average capital plus interest method is about 6.5%. When the discount rate is 6%, the comparison of the investment return of different bid-winning price applying two kinds of payment mode is shown in Table 1.

Table 1. Analysis of the financial net present value ratio with different quotation schemes applying the Ministry of Finance formula method and average capital plus interest method.

Year	Fair return ratio	Discount rate	Benchmark rate of return	Rate of return on Investment	Ratio of financial net present value	Remarks
N	r_i	r_d	i_c	i	FNPV1/2	
20	7.00%	5.00%	6.00%	6.50%	93.2%	
20	6.00%	5.00%	6.00%	6.50%	92.3%	
20	8.00%	5.00%	6.00%	6.50%	94.1%	Basic
20	7.00%	4.50%	6.00%	6.50%	88.8%	scheme
20	7.00%	5.50%	6.00%	6.50%	97.8%	
10	7.00%	5.00%	6.00%	6.50%	99.2%	
30	7.00%	5.00%	6.00%	6.50%	87.9%	

According to the results of Table 1, under the normal market quotation, the financial net present value of the Ministry of Finance formula method is lower than that of the average capital plus interest formula method. When the fair return ratio and discount rate are higher, with a limited operating life, the return on investment of the projects may be equal to or slightly better than that of average capital plus interest formula method.

3. Case Study

3.1 A Brief Introduction of the Projects

The estimated total investment of the PPP project is 11.89813 million yuan, including the project construction and installation expenditures of 8,475,079 yuan , other related project expenditures of 191,301,000 yuan (including land expropriation and demolition costs of 113,808,100 yuan), reserve funds of 74,000.00 yuan and the interest during the construction period of 77005,800 yuan (the interest rate is calculated according to the benchmark interest rate of the People's Bank of China for bank loans of more than 5 years, 4.90%, or 5.88%). The construction period lasts for 3 years, and operation period for 15 years. DBOT operation mode was adopted under the authorization of the government's franchise agreement. The enterprise, as the investor and operator of the project, is responsible for financing arrangement and project design. The enterprises have the access to obtain certain commercial profits during this process. Finally, the projects will be transferred to the project

implementation agency or the government designated agency paid or unpaid according to the agreement. The proportion of equity invested by government representatives and social investors bid-winning is 10% and 90%. The annual operating performance service fee amounts to 17 million yuan. Since the user payment is relatively low, it will not be taken into consideration.

3.2 Analysis of bidding quotation

In order to analyze the difference between different payment formulas and their impacts on the investment return of PPP projects, the average industrial level of the expected bidding quotation will be regarded as the criterion. According to the characteristics of the project, the floating rate of construction and installation cost of each scheme is assumed to be 10%, the operation and maintenance performance service fee to be 17 million yuan, and the quotation index of investment return is as follows: i) the Ministry of Finance formula method: the common bidding ceiling price of fair return ratio and discount rate is 7%−8% and 5.2%-6.0% respectively, and the bid-winning price is initially considered as 6.5% and 5.0%; ii) Average capital plus interest method: the bidding ceiling price of fair return ratio is usually between 6.5% and 7.5%, which is related to the property of the project and the actual financial strength of the region, and the winning bid price is initially considered as 6%; iii) Average capital method: the bidding ceiling price of fair return ratio and discount rate are basically similar to average capital plus interest method, and the bid price in this comparative analysis is initially considered as 6%.

3.3 Comparative Analysis of Availability Payments

The most important influence among the three types of government payment modes as Ministry of Finance formula method, average capital plus interest method and average capital method on the income and expenditure as well as operation of the project company lies in that the availability payment is calculated in different ways, resulting in different annual operating income[15]. After calculation, the return on availability payments of the three payment mode is shown in Figure 1, and the return on availability payments in the 1st, 5th, 10th and 15th year is shown in Table 2.
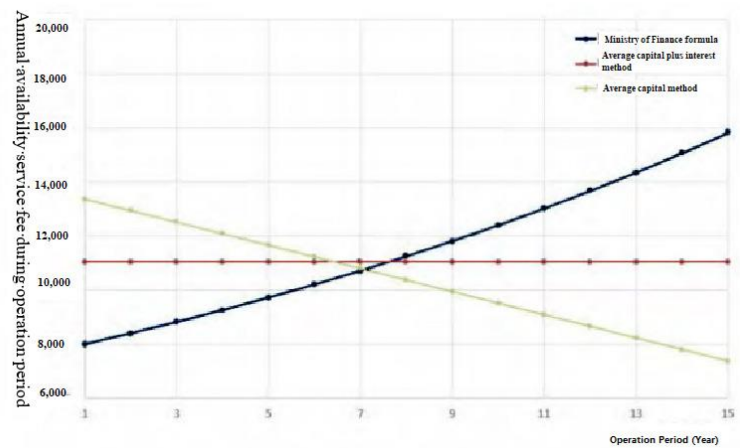
Figure 1. Annual returns on the availability payment during the operation period under three different payment.

Table 2. Returns on the availability payment in the representative years under three different payment mechanisms.

Payment mechanisms	Net present value	Total revenue	1st Year	5th Year	10th Year	15th Year
Ministry of Finance formula	88,971	172,526	7,995	9,718	12,403	15,830
Average capital plus interest method	90,047	165,637	11,042	11,042	11,042	11,042
Average capital method	88,297	155,508	13,370	11,654	9,509	7,364

According to the calculation results in Table 2 and Figure 1, the total availability payments by the Ministry of Finance formula method, average capital plus interest method and average capital method in the 15th year of the operation period are 1,725.26 million yuan, 1,656.37 million yuan and 1,555.08 million yuan respectively. According to the result, the Ministry of Finance formula has the largest total returns on availability payment, which is characterized by relatively low income in the initial period. Under this mode, the annual income in the first three years only accounts for 70%-77% of the average income level, thus having a huge repayment pressure. The availability payment income of the average capital plus interest method is stable and consistent in each year. The total amount of availability payment of average capital method is the lowest, with an unbalanced annual distribution of more income in the early period and less in the following period. Under this mode, the annual income in the first three years accounts for 129%–121% of the average level, which can effectively reduce the pressure to repay the capital and interest while imposing a huge pressure on the government payment.

If discounting according to the benchmark rate of return on social low-risk investment of 6%, the net present value of each scheme is 889.71 million yuan, 900.47 million yuan and 882.97 million yuan respectively. Therefore, from the perspective of return on investment, there is little difference among the three schemes, among which the average capital plus interest method is better.

### 3.4 Comparison of Financial Index Analysis of the Project

The capital ratio of the project is initially considered to be 20% of the total investment. For the rest, long-term loans from banks are used. The construction period is a grace period of 3 years, and the operation period is a repayment period of 15 years. The VAT output tax rate of government subsidies is 6%. Since the mode of repaying capital with interest will influence the return on investment of the project, the corresponding returns on investment of the three modes were calculated under two repayment modes of average capital plus interest repayment and average capital repayment. The financial index calculation results are shown in Table 3 and the cash flow of the project of each scheme under average capital plus interest repayment mode is shown in Figure 2, while that under the average capital repayment mode is shown in Figure 3.

Table 3. The financial index of the PPP project by three different payment mechanisms.

Capital with interest repayment mode	Financial index	Ministry of Finance formula method	Average capital plus interest method	Average capital method
Average capital plus interest repayment	Financial internal rate of return(FIRR)	5.09%	6.51%	5.51%
	Net present value (NPV) capital	431	2390	546
Average capital repayment	Financial internal rate of return(FIRR)	4.71%	5.93%	5.05%
	Net present value (NPV)	-515	2003	213
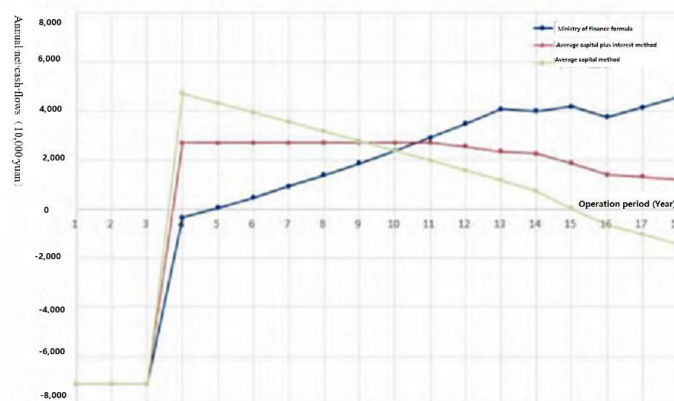
Figure 2. Annual net cash flow of the PPP project of three different schemes using the average capital plus interest method.
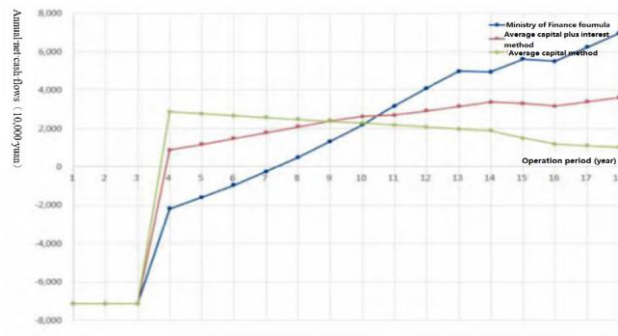
Figure 3. Annual net cash flow of the PPP project of three different schemes using the average capital plus interest method.

According to the financial calculation results, a comparative analysis is made on different payment methods. In terms of profitability, the average capital method is the highest, the average capital plus interest method is the second, and the Ministry of Finance formula method is the worst. In terms of debt paying ability, the average capital method and average capital plus interest method are better while the Ministry of Finance formula method is relatively worse in the initial period, which not only have no surplus funds to pay dividends, but also need to make up the losses in the initial operation period through short-term loans, shareholder loans, and increasing capital fund. In particular, when it refunds by the average capital, it will suffer a long period of capital shortage, with a relatively higher level of capital shortage.

In terms of repaying the capital with interest, by comparison, it found that the returns on the investment by the average capital plus interest methods are higher than that by average capital methods. Considering the stability of cash flow, when adopting the Ministry of Finance formula method, it shall repay by the average capital plus interest method to avoid a large fund gap in the early stage of operation. When adopting the average capital plus interest method, whether the average capital repayment or the average capital plus interest method will can be used in the repayment in terms of cash flow, but the average capital plus interest methods is recommended so as to enhance the comprehensive returns on the investment by making full use of low-cost debt financing and recovering the high cost of capital in advance; when adopting the average capital method, if there exists funding gap problems lasting for few years, it shall prepare surplus funds to repay the capital and interest in advance, or repay the funds in advance. In actual operation, the average capital method is manly adopted since the financial institutions would like to recovery the capital in advance to reduce the risk of funding gap in the later period.

4. Conclusion

With the increasingly fierce competition in PPP market, the downward floating rate of construction and installation and bidding quotation of returns on investment is continuously declining. Under such circumstance, it is of great importance to compare the different transaction structures and repayment modes to make a better choice, so as to protect basic and fair returns of the social investors.

Through detailed analysis of the three common payment mechanisms of the Ministry of Finance formula method, equal principal and interest method and equal principal method, as well as some derivative forms such as price-tax separation and equity-debt separation modes, and comparison of case analysis results, it concluded that, through the Ministry of Finance formula method, the operation subsidy is less in the initial period but more in the later period, which is difficult to repay the capital affected by the discount rate referring to the yield of local government bonds in the same period, the investment yield is generally not high; through the average capital plus interest method, the annual operating subsidies maintain a stable level, which has a good ability to repay the capital and interest, with a relatively fair returns on investment, thus it is widely used in the practical operation and deserves to be promoted; through the average capital method, the operation subsidy is more in the initial period and less in the later operational period. Due to the increased financial burden of local governments

at the initial stage of operation, it can hardly be recognized by the local governments in practice. Therefore, the social capital side gives the following suggestions in the practice of PPP projects:

(1) When choosing transaction structures and payment formulas, the average capital and interest method should be adopted as far as possible in order to maintain stable cash flow and better debt paying ability, which will be easily accepted by the local government, financial institutions and social capital sides.

(2) Under the same payment modes and circumstances, the returns on projects capital using average capital plus interest repayment method are higher than that using average capital repayment method. Therefore, it shall introduce low-cost and long-term debt funds as far as possible to improve returns on the investment of the project.

Conflict of Interest

The authors declare that they have no conflict of interest.

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