Research on the Selection of Discount Rate in Value-for-money Evaluation

——Based on the Data Analysis of the Third Batch of Demonstration Projects

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Abstract: The quantitative evaluation of value for money (VFM) in PPP projects needs to be compared by discounting both the PSC value and the PPP value. An important factor that affects VFM evaluation is the value of the discount rate. At present, the research on the discount rate of PPP projects in our country is not yet very deep, and there is no clear standard for the discount rate in different industries. Generally, historical experience is used to determine the line rate. Therefore, taking the third batch of demonstration project data as a sample, this paper analyzes the factors that influence the discount rate in detail and finally summarizes the law of value discount rate of PPP project, which will be of reference for similar PPP projects in the future.

1. Introduction

Essence quantitative evaluation of PPP projects worth a quantitative means of financing government using two comparison. The result of calculating the PSC value and the PPP value is often affected by the discount rate, which is calculated by converting the future expected return into Value ratio, not only reflects the time value of funds, but also investors under the risk of certain circumstances, the desired rate of return on investment. Therefore, the discount rate not only affects the value of the PPP project evaluation conclusion, but also affect whether the project truly value for money. However, the existing research seldom deals with the issue of the value of the discount rate, and in practice the historical experience value is often used to determine the value of the discount rate.

In order to better guide the practice, based on the data analysis of the third batch of demonstration projects, this paper analyzes the factors affecting the discount rate in detail, and finally puts forward reasonable suggestions for the value of the discount rate.

2. Literature References

With the gradual deepening of our concept of value for money, the quantitative evaluation of VFM has become a key issue in our country's research. A complete VFM evaluation includes two aspects: qualitative evaluation and quantitative evaluation [1]. Through literature analysis, there are relatively many domestic studies on VFM evaluation of PPP projects. For example, GAO Hu et al. [2] have comparatively analyzed the value-for-money evaluation methods of different countries in the world and thus provided a method for evaluating the VFM of PPP projects in China. Sun Hui [3] and Yuan Jingfeng [4] also emphasized in their research that the basic idea of the quantitative evaluation of value for money is comparison between PSC and PPP. However, there are few researches on discount rate in quantitative evaluation. For the issue of the value of the discount rate, all industries still do not have a clear standard, so there are many take the form of the status quo, the general use of historical experience to determine the value of the line rate, resulting in a variety of discount rate values .The situation is not conducive to the allocation of risk and the estimation of future costs.

According to China Assets Appraisal Association's "China Assets Evaluation Guidelines" shows that the discount rate is an expected rate of return on investment, refers to the project investment risks under certain circumstances, investors expect the project investment rate of return; also described the discount rate includes not only the risk-free rate of return, but also the return on risk

[5]. Xu Han believes that the discount rate should be a changing value. Because assets go through the stages of immature, mature, and out of the market, they have a certain lifespan; and in different stages, the final amount of the proceeds to be realized by the assets is different and the risks are not the same [6]. From 1964 to 1996, William Sharp, Rintlott, Trino and Mohsin all published articles in "Management Science" "Finance" in response to the theory of optimal portfolio selection. They put forward the pricing of capital assets Model (CAMP) [7]. Capital asset pricing model mainly refers to the discounted cash flow of the equity should take into account the specific risks of the enterprise should not ignore this risk. In addition, William Sharp, in his writings on "Portfolio Theory and Capital Markets," elaborates and summarizes the research on standardization and empirical research in these fields.

Wang Shaohao pointed out that the enterprise-specific risk adjustment coefficient should not only refer to the risk management risk return rate and the company's financial risk return rate, but should be the sum of the two [8]. This method has some feasibility, often used by many asset valuation firms. However, the method that mainly depends on subjective judgment and determines the enterprise-specific risk adjustment coefficient [9] inevitably leads to certain inaccuracies.

Therefore, in order to make the discount rate of PPP projects in different industries and in different fields more accurate, based on the data of the third batch of demonstration projects, this paper first identifies the influencing factors of the discount rate. Secondly, it analyzes the impact of different factors on the discount. Finally, it summarizes the law of the discount rate of PPP project, so as to provide reference for similar PPP projects in the future.

3. Based on the analysis of the discount rate of the third demonstration project released by the Ministry of Finance:

Based on the third batch of demonstration projects released by the Ministry of Finance, this article first identifies three influential factors of the discount rate, namely, the method of determining the discount rate, the period of cooperation and the mechanism of return; secondly, analyzes the discount from these three perspectives Rate value problem.

3.1 Identify the factors affecting the discount rate:

Through the literature review of the discount rate and the way of the questionnaire, three influential factors that may affect the discount rate of the PPP project are identified: the method of determining the discount rate, the cooperation period and the return mechanism.

3.2 The discount rate is analyzed from the point of view of discount rate determination:

Through the data statistics of the third batch of demonstration projects, we first analyze the application in practice from the point of view of the method of determining the discount rate. A total of 17 methods for determining the discount rate are used, respectively, marked with a to q17 letters, where a: with reference to the local government bond coupon rate to determine; b: reference local government bonds coupon rate and risk compensation to determine; c: reference place Government bond coupon rate and risk transfer premium; d: reference local bond coupon rate combined with the actual local financial conditions and risk factors; e: reference local government bond coupon rate multiplied by the floating coefficient (which coefficient based on the shareholders of the project investment return decision) F: Reference to the average coupon rate of local government bonds, combined with market factors, economic growth factors and industry conditions to determine; g: Reference RMB loan benchmark interest rate determined; h: Reference market requirements Funding ratio or loan benchmark interest rate Floating rate Calculate the weighted average cost of capital; i: Determine with reference to the interest rate of government bonds and the characteristics of municipal infrastructure industry; j: The weighted average cost of reference capital, the capital asset pricing or risk-free interest rate; k: Reference to determine the scope of investment return and lending rate Longer duration of the franchise period; l : Reference to risk-free interest rates and municipal facilities industry benchmark rate of return to determine; m: reference formula to determine; n: with reference to the feasibility study report and the actual situation to determine; o:

determined with reference to the actual situation; p: Parameter "(3rd edition); q: Custom.

Among the above methods for determining the discount rate, the most typical one is based on the coupon rates of local government bonds mentioned in the above-mentioned legal provisions. The first six methods of a, b, c, d, e and f referred to above Method to determine the discount rate value. Among the 66 selected demonstration projects, there are 27 demonstration projects that take the coupon rate of local government bonds, accounting for 40.9% of the total number of demonstration projects. In addition to the above methods, many demonstration projects did not specify clearly the discount rate in the VFM evaluation. In this survey, there are 12 such projects, accounting for 18.2% of the total survey demonstration projects. There are more demonstration projects that use the weighted average cost of capital to determine the discount rate. The method j involving the weighted average cost of capital is applied to 8 projects, accounting for 12.1% of the total. In addition, there are also 4 projects using the benchmark interest rate of RMB loans, g and h, accounting for 6.1% of the total number of projects. In the meantime, there are four projects based on the formula [risk-free rate + β × (social average rate of return - risk-free rate of return)], which also accounts for 6.1%. There are also two projects with the same proportion of 4.55%, which are the projects adopting treasury bond interest rate combined with industry characteristics and the projects referring to the scope of investment return and lending rate in combination with the time of franchise. The remaining methods using l, n, o, p accounted for 3%, 1.5%, 1.5% respectively. 1.5%.

To sum up, we can divide our country's discount rate determination into eight categories, namely the local government bond coupon rate, the average cost of capital weighted average interest rate of RMB loans, the formula (risk-free rate + β × (Social average rate of return - risk-free rate of return)), combined with the characteristics of the industry using the national debt rate, with reference to the scope of the return on investment and loan interest rates, risk-free interest rates and municipal infrastructure industry benchmark rate of return and custom. Therefore, it is concluded that the most used method to determine the discount rate in the third batch of demonstration projects involved in this survey is the coupon rate of local government bonds, which can be promoted in nearly half of the PPP projects. Our country uses the discount much of the response to the Fitch (2015) Circular 21 has been made with a strong reference to the coupon rate of LGFVs.

3.3 Analysis of the discount rate from the perspective of cooperation

Table 1 municipal project discount rate changes with the cooperation of the trend

Project properties	Discount rate and franchise period related research		
Pipe Network	According to the increasing arrangement of cooperation period, the analysis of the discount rate shows that as the project year by year increases, the discount rate decreases from the highest discount rate of 6.37% during the cooperation period of 15 years to the lowest of 3.96 years % Discount rate, although the discount rate for the same period of cooperation of different values, but the overall downward trend. The discount rate in the municipal pipe network project ranged from 3.96% to 6.5%.		
Heating	According to the increasing arrangement of cooperation period, the analysis of the value of discount rate shows that as the project year increases year by year, the discount rate rises from the lowest discount rate of 3.3% during the 22-year cooperation period to that of the cooperation period of 30 years The lowest discount rate 7.94%, the overall upward trend. The discount rate in municipal heating projects ranges from 3.3% to 7.94%		
Sewage treatment	According to the increasing arrangement of cooperation period, the analysis of the discount rate shows that as the project year increases year by year, when the project cooperation period reaches 25 and 30 years, the discount rate appears the maximum value, which is 8% ; When the cooperation period is 41 years, 3.53% is the minimum discount rate of the selected wastewater treatment project. And in the same period of cooperation, even if the projects belong to different cities, the discount rate is basically unchanged. The discount rate in municipal sewage treatment projects ranges from 3.53% to 8%		
Garbage disposal	According to the increasing arrangement of cooperation period, the analysis of the discount rate shows that as the project year increases year by year, the discount rate in municipal waste disposal projects fluctuates from 4% to 8%		
Water supply	According to the increasing arrangement of cooperation period, the analysis of the discount rate shows that the overall trend is still rising except for the cooperation period of 22 and 30 years before the 31 years of cooperation; the discount rate drops after 31 years of cooperation trend. The discount rate in municipal water supply projects fluctuates between 3.3% and 6.5%		
Project properties	**Cooperation period**	**Discount Rate**	**Discount rate and franchise period related research**
Gas supply	20	5%	Municipal gas supply project discount rate fluctuates around 5%
Drainage	25	5.42%	The discount rate of municipal drainage projects fluctuates around 5.42%
park	20	4%	Municipal Park discount rate of about 4% fluctuations
Sponge city	12	6.91%	Municipal Sponge City project discount rate fluctuates around 6.91%

Through the statistics of municipal projects in the third batch of demonstration projects, the value of discount rate in practice is analyzed from the perspective of cooperation. Municipal project discount rate method of statistics in Table 1.

Based on the above analysis, the discount rate of some types of projects shows an increasing trend with the growth of the cooperation period, but some projects show a decreasing trend. Due to the existing data volume to be developed, only the cooperation period Impact of discount rate. Calculate the average to determine the discount rate for each type of item. The average discount rate of each type of project in Table 2.

Table 2 municipal project average discount rate and the average period of cooperation

Municipal project		
Industry	The average period of cooperation	Average discount rate
Pipe Network	25.5	5.66%
Heating	28.4	5%
Sewage treatment	29.8	6%
Gas supply	20	5%
Drainage	25	5.42%
Garbage disposal	25.75	6%
park	10	5.36%
Water supply	27	5%
Sponge city	12	6.91%

By averaging the cooperation period and discount rate of all types of projects, it can be concluded that the average cooperation period for most of the projects is between 20 and 30 years, and the discount rate is between 5% and 6.5%.

3.4 Analyzing the discount rate from the point of return mechanism

3.4.1 Users pay

Select all the demonstration projects in the return mechanism for the user to pay the project, according to the cooperation of these projects from small to large arrangement. After research and analysis shows that, generally in the user payment model, the discount rate increased year by year with the trend of cooperation.

3.4.2 Government pays

Select all the demonstration projects return mechanism for the government to pay the project, these projects arranged in ascending order of cooperation, the research shows that when the cooperation period rose, the discount rate is not a clear single-incremental changes in the discount, at The discount rate in the same year also has a larger value range. In order to find out the trend of changes during the cooperation period and the discount rate, after averaging the discount rates for the same period of cooperation, it can be concluded that the discount rate varies from 4% to 8% under the government payment model.

3.4.3 Feasibility gap subsidy

All the demonstration projects will be selected for the mechanism of reimbursement for the implementation of the feasibility gap subsidy projects, according to the cooperation of these projects from small to large arrangement. Through research and analysis we can see that with the growth of the cooperation period, the discount rate does not have an accurate trend of change. For example, there are a total of 12 projects that stipulate the 30-year co-operation period with the mechanism of reimbursement of feasible subsidies and the discount rate varies between 3% and 8%. Due to the wide range of changes in the discount rate, in order to facilitate the analysis, The average

discount rate of the project with the cooperation period, the average discount rate calculated is 5.27, the variance is 1.52; thus research and analysis of the gap model of the discount rate of fluctuation of the trend that most of the discount rate to 5.27 as a benchmark up and down fluctuations in the volatility of ± 1.27%.

4. Conclusion

In this paper, the factors affecting the discount rate VFM quantitative assessment to identify PPP projects, combined with the third batch of demonstration projects, from the method for determining the discount rate, duration of cooperation mechanisms and return three point of view of the value of the discount rate issue, summed it out:

(1) The most used method of calculating the discount rate is the return of local government bonds.

(2) The discount rate of some types of projects tends to increase with the growth of the cooperation period, but some projects show a declining trend. By averaging the cooperation periods and discount rates of various types of projects, most of the projects can be analyzed the average duration of cooperation projects are between 20 to 30 years, the discount rate of 5% to 6.5%.

(3) The discount rate is the lowest in the user-paid mode, the discount rate is the highest in the government-paid mode, and the return mechanism of the feasible gap subsidy is the middle rate.

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