Research on Risk Issues under PPP Mode

Xin Jin[1], Youzhe Wang[2,*], Jian Luo[1], Qunli Sun[1]

[1]School of Finance and Taxation, Zhongnan University of Economics and
Law,Wuhan,430073,China

[2]Business School, Guilin University of Electronic Science and Technology,Guilin,541010,China

Abstract: The PPP mode is a new type of project financing model and a new type of partnership between the public sector and the private sector. This paper starts with three aspects of risk analysis: risk identification, risk control and risk allocation, and conducts an in-depth study of the PPP mode. . Using the risk distribution utility model and the risk game model, the risk problems in the operation of the PPP mode are analyzed.

Keywords: PPP mode , risk allocation utility model, risk allocation game model.

1. Introduction

With the increasing economic and social development, some public construction projects in our country cannot rely solely on the operation of government investment. Pure government investment and operation will bring huge financial pressure to the government, and at the same time, it cannot satisfy the public's demand for public construction. The demand of the project is easy to form a situation of high investment, high consumption and low efficiency. In order to solve such problems, the United Kingdom took the lead in applying a new financing model, namely the PPP (Public-Private-Partnership) model. The PPP mode is that the government and the private sector work together to provide public goods, and both parties gain benefits at the same time. Participate in risk-taking models[1]. The PPP mode establishes a new type of cooperative relationship between the public sector and the private sector. The two parties make a reasonable decision-making system through a reasonable evaluation of the investment project, thereby forming a "benefit sharing, risk sharing, Cooperation and win-win" community relationship. This community relationship is also a public-private partnership, also known as a principal-agent relationship in economics.

2. Risk Research of PPP mode

Due to the large amount of construction capital required in the financing process and the long construction period, the PPP mode has relatively large risks. Therefore, both the public and private sectors need to bear the corresponding risks according to their own capabilities . How to reasonably allocate the risks faced by the PPP mode in the operation process is an important issue that needs to be solved during the operation of the PPP mode. This paper starts from the three perspectives of risk, that is, risk identification, risk control and risk allocation.

2.1 Risk identification

Risk identification is the primary link of risk management. Only through a comprehensive understanding of risks can it be possible to predict the hazards caused by risks, and to take measures to manage and control risks and implement countermeasures related to risk allocation. Risk identification is before the occurrence of risk problems. , an important part of risk determination. During the operation of the PPP mode, it is also necessary to confirm the risks first, that is, to identify the risks.

2.2 Risk control

Risk control refers to the use of various measures and methods by risk managers to eliminate or reduce the various possibilities of risk events. If the possibility of risk occurrence can be reduced, or

the loss caused by risk can be controlled within a reasonable range, it is very helpful for the reasonable operation of the PPP project. In order to effectively control the risks in the PPP mode, it is necessary to understand the characteristics of the risks in the PPP mode [2] , and through the mastery of the characteristics, determine how the government and the private sector should carry out risk control.

2.3 Risk allocation

The most important problem to be solved in the operation of a PPP project is the problem of risk allocation. During the operation of a PPP project, there are many principles for sharing risks between the public and private parties, including the principle of fairness, the principle of equal risk and benefit, the principle of effective control, The principle of the lowest risk management cost and the principle of risk preference, etc., the reasonable sharing of risks is an important condition for the successful operation of the PPP mode. Operating costs are minimized. Through data collection and review [3] , it is learned that in the academic session, the following consensus has been reached on the principle of wind distribution in PPP projects: First, the benefits of the public and private parties are distributed through the degree of risk-taking of the project. Second, the party who has control over the risk bears the corresponding risk. Finally, there should be a limit to the risk borne by the private sector. Once this limit is exceeded, the risk mechanism should be renegotiated. Therefore, risk allocation can be divided into three stages: initial risk allocation stage, full risk allocation stage and risk tracking and redistribution stage.

3.   Research on distribution model

During the operation of the PPP mode, the public sector and the private sector will encounter project risks. If the project risks can be dealt with reasonably, the project will run more smoothly. Therefore, two related models for the allocation of risk scales are introduced, respectively. It is a risk allocation utility model and a risk allocation game model, through which the project risk is studied.

3.1 Risk Allocation Utility Model

Aiming at the risks existing in the operation of PPP projects, the risk allocation utility model is first introduced [4] . The purpose of this model is to study how the public sector and the private sector define their respective risks in PPP projects. The model uses a utility function to determine whether the public sector or the private sector will take a risk.

In this model, the elements involved in the model include participants, risks and utility. The utility mentioned in this model refers to a utility function of the public sector and the private sector for different risks. The difference of risk cost indicates that when the utility function value of one party is greater than 0 and the utility function value of the other party is less than 0, then the risk should be borne by the party greater than 0. If the utility function value of both parties is greater than 0, Then both parties should share the risk.

Make relevant assumptions about the model: First, in this risk distribution utility model, all participants, namely the public sector and the private sector, should be rational participants and pursue the maximization of their respective interests. Second, the risk-benefit function and the risk-cost function are generally accepted between the two parties, and the functions are linear.

The principle of the model is to analyze by constructing a utility function, i_1 denoting the public sector, i_2 representing the private sector, p_1^k representing the utility function caused by the first k risk to the public sector, p_2^k representing the utility function caused by the third k risk to the private sector, and y_1^k representing the first k risk to the public sector . The revenue function

brought by the sector represents the revenue function brought by y_2^k the k type th risk to the private sector, c_1^k represents k the cost function brought to the public sector by c_2^k taking the type th risk, and represents the cost function brought by the k type th risk to the private sector, p_1 representing the total cost function. The utility function caused by the risk to the public sector represents the utility function caused by the p_2 total risk to the private sector. So there is the following formula:

$$p_1^k = y_1^k - c_1^k \tag{1}$$

$$p_2^k = (y_2^k - c_2^k) \tag{2}$$

$$p_1 = \sum_{k=1}^{n}(y_1^k - c_1^k) \tag{3}$$

$$p_2 = \sum_{k=1}^{n}(y_2^k - c_2^k) \tag{4}$$

Through the analysis of the formula and model, the model results can be made into the following table 2:

Table 1: Model Analysis Results Table

Model results	Corresponding conclusion
$p_1 > 0, p_2 > 0$	Risks are shared by the public and private sectors
$p_1 > 0, p_2 < 0$	Risk is borne by the public sector
$p_1 < 0, p_2 > 0$	Risks are borne by the private sector
$p_1 < 0, p_2 < 0$	Risk is borne by third parties

Model conclusion: Through the above analysis of the risk allocation utility model, it can be known that in the process of PPP project operation, for a certain risk, it should be considered from the perspective of the public sector and the private sector, and firstly from the perspective of the public sector. The benefits brought by the risk factor to the public sector, and then consider the cost brought by the risk factor to the public sector, and then construct the risk utility function, judge the positive and negative conditions of the utility function, and then consider it from the perspective of the private sector. Considering the benefits and costs brought by risk factors to the private sector, construct a utility function about the private sector, and judge the positive and negative conditions of the utility function.

If the utility functions of the public and private sectors are both positive, then the risk should be shared by the public and private sectors, and if the utility function of the public sector is positive and the utility function of the private sector is negative, the risk should be If the public sector has a negative utility function and the private sector has a positive utility function, then the risk should be borne by the private sector.

3.2 Risk Allocation Game Model

In the research on the utility model of risk allocation, it can be seen that there are three situations for risk-taking, one is undertaken by the public sector, the other is undertaken by the private sector, and the other is jointly undertaken by the public sector and the private sector, then in the case of the

public sector and the private sector On the basis of the shared responsibility of the departments, the risk allocation game model is introduced to study the share that each party should bear.

The principle of the risk allocation model game is that for a risk, the public sector first stands in the perspective of the overall operation of the project, and considers the economic situation and other conditions, and gives a risk scale that the public sector is willing to accept, such as the scale, w_1 in the case of this scale w_1, the risk utility of the government sector in this utility is p_1 greater than 0, then if the private sector is willing to accept the scale from its own perspective at this time, then the scale of risk undertaken by the $1-w_1$ private sector is the utility obtained by the private sector in the risk at this time p_2 It should also be greater than 0, which realizes the distribution of risk utility, but if the private sector considers this issue from the perspective of maximizing its own interests, it may not accept the risk scale requirements of the government sector, and propose another risk scale Requirements, assuming that the new risk scale requirement proposed by the private sector is $1-w_2$, then the scale of risk that the government department will take w_2, whether the government department is willing to accept this scale, should be considered from the overall position of the project operation, the government department is willing to give up the individual Maximize the benefits, transfer some of the profits to the private sector, and at the same time ensure the normal operation of the project, or are unwilling to give up the maximization of benefits and insist on the w_1 risks determined at the beginning, which depends on the operation prospects of the PPP project and private cooperation. The quantity and quality of departments, this is a game process.

Through constant games, there will always be a part of the private sector that withdraws from cooperation because they cannot reach the scale of risk allocation with the public sector. Then the government should consider what type of private enterprises they need to invest in and make a reasonable investment in private enterprises. Evaluation should not simply pursue the maximization of benefits, but affect the long-term development of the project. Of course, it should not be overly subject to the risk scale allocation proposed by private enterprises. In the process of the game, there may be multiple games, that is, the risk allocation cannot be achieved through one or two times, and the scale of risk distribution needs to be determined through multiple games. In the process of multiple allocations, it is necessary to consider a risk discount change problem, record the risk discount rate λ, the risk discount will make the final distribution of interests between the public and private parties, because whenever a private sector withdraws from a public-private partnership project or joins a public-private project, Then the individuals who share the risk will be reduced or more, and the scale of the risk to be borne by each risk will become larger or smaller. The risk discount rate can describe when the risk needs to be redistributed, each subject changes in the scale of risk.

Because the risk discount rate should be considered λ in the second allocation, if both the public and private parties are willing to accept the risk scale in the second allocation, then the risk borne by the private sector is , and the risk $\lambda(1-w_2)$ borne by the public sector λw_2 is distribution, then the risk discount rate at this time is λ^2.

Through the risk-utility game model, we can better understand the entire process of risk allocation, and have a better understanding of the risk allocation of PPP projects, so that government departments can formulate a more reasonable allocation scale on the issue of PPP mode risk allocation, and better Promote the operation of PPP projects.

4. Conclusion

The research of risk is a hot topic at present. This paper starts from three research angles of risk, namely risk identification, risk control and risk allocation. Through these three perspectives, the risk

of PPP projects is systematically expounded. In the process of risk identification, systematic risk and non-systematic risk can be identified. In the process of risk control, the combination of public and private sector In the process of risk distribution, some principles of equal distribution should be paid attention to, and the smooth operation of the project can be realized through the reasonable distribution of risks.

Acknowledgments

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