Study on the Price Forming Mechanism of the Urban Utility Tunnel Using PPP Mode

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ABSTRACT

This article briefly analyzes the price composition of the urban utility tunnel using PPP mode, determines the factors affecting the project price and finds out 31 key factors. On the basis of this, combined with the principle of system dynamics, this paper analyzes the price forming mechanism of the urban utility tunnel using PPP mode from the perspective of the causal relationship between influencing factors and price formation, in order to provide a theoretical basis for the pricing and price adjustment mechanism of the urban utility tunnel using PPP mode.

INTRODUCTION

With the continuous development of the urban economy in our country, it is very common for roads to be repeatedly excavated in order to renew, expand and maintain underground tunnel and affect the appearance and traffic. As an important infrastructure for urban operation, the utility tunnel can effectively solve the municipal traffic and drainage problems, and can promote the carrying capacity of the city and economic development [1]. However, the utility tunnel is costly and difficult to operate and maintain. While achieving significant social benefits, there is also a problem of excessive government fiscal pressure. In 2015, the General Office of the State Council promulgated the Guiding Opinions on Promoting the Construction of Underground Utility Tunnel in Urban Areas, clarifying the promotion of the Public-Private Partnership (PPP) model in the construction of the urban utility tunnel, and encouraging social capital involved in the investment,
construction and operation by way of franchising. Up till now, the urban utility tunnel using PPP mode in our country has ushered in a boom in development [2].

Through the analysis of theoretical research and practical cases, it can be found that the price is one of the key factors affecting the success of project and is also an urgent problem to be solved in the field of public project management [3]. Analyzing the price forming mechanism of the project can provide theoretical basis for pricing and price adjustment mechanism and ensure the normal progress of the project. Therefore, this paper discusses the price forming mechanism of the urban utility tunnel using PPP mode based on the system dynamics.

THE COMPOSITION OF THE PROJECT

The investment return mechanism of PPP project mainly includes three types of payment methods: user payment, feasibility gap subsidy and government payment. The urban utility tunnel using PPP mode belongs to the quasi-public goods. It is competitive and has the basis of market-oriented charge and can bring economic benefits. Therefore, it can be charged to the pipeline users. However, the urban utility tunnel has a certain public welfare and a large investment in construction, which makes it impossible for it to completely cover the investment cost and reasonable return by simply charged to the pipeline users. It also requires the government to take certain measures to subsidize the project. Therefore, the investment return mechanism of the urban utility tunnel using PPP mode should adopt the method of "user payment and feasibility gap subsidy".

The users mainly pay for the entrance fee and the routine maintenance fee. The entrance fee is mainly used for compensating the cost of construction and the routine maintenance fee is mainly used for compensating the routine maintenance and management expenses of the project company [4]. Due to the huge investment in the construction of the project, the payment by pipeline users alone is not enough to cover the construction and operation costs and the reasonable income. Therefore, the government also needs the necessary financial subsidies and tax incentives.

ANALYSIS OF THE INFLUENCING FACTORS PROJECT PRICE

The analysis of the influencing factors of the price is a prerequisite to study its price formation mechanism. As a complex engineering system, the urban utility tunnel using PPP mode has many factors affecting the price both internally and externally. For the project itself, the three stakeholders have their own interests and they are all related to the project price. For the external macroscopic level, the political environment, the legal environment, the economic environment, and the market conditions are all have an impact on the price. Consulting a large number of documents and using the expert investigation method, a total of 31 major factors affecting the price in above seven aspects are list in detail, as shown in Figure 1.
Impact of Project Stakeholders on Price

The stakeholders of the urban utility tunnel using PPP mode mainly include government, social capital and pipeline users. For the government, the reasonable price policy and effective regulatory mechanism will play a restraint role on the price, which can effectively avoid the monopoly price [5]. The profit distribution mechanism will affect the cash flow and expected return on investment, which in turn affect the concession pricing [6]. In the meantime, the low entrance rate will also affect the cash flow during the operation period, which will ultimately affect the concession pricing. In addition, if the relationship between government and enterprises is good, it will help to speed up the approval of project and will reduce the capital cost to a certain extent, thereby reducing the service price. If bureaucratic corruption occurs within the government, it will not only be detrimental to the smooth implementation of the project, but will also affect the construction and operation costs as well as the cash flow, thus affecting the price [7]. In addition, if the government changes during the project, it will also have a positive or negative effect on the price.

The impact of social capital on prices is mainly reflected in its own capital structure, expecting investment return, social capital financing, construction and operation management. The reasonable capital structure can minimize the total cost, thereby reducing the price. The strong financing capabilities can reduce the
repayment time and thus decrease the interest expenses. The strong ability of construction management will control the construction cost at a low level and the total investment in construction will be correspondingly reduced, so that the price will also be reduced. At the same time, efficient operational management can reduce operating costs and increase the operating income.

Pipeline users on the price impact is mainly reflected in the affordability, the usage intention and pipeline category. The utility tunnel has a certain public welfare and its price needs to consider the user’s affordability. The user's usage intention directly determines the number of pipeline user, to a large extent affect the operating income. Besides, the charge level is positively related to the pipeline category and cross-sectional area. In addition, the public support for the project also has a greater impact on the price. If the public opposes the construction of the project, it may hinder the construction progress through parades and other ways, leading to the extension of the project construction period, resulting in the increase of the total investment cost and eventually affecting the price.

**Impact of External Environment on Project Price**

(1) The impact of the market environment on prices

In the market economy, the relationship between market supply and demand and market competition will have an impact on the commodity prices. In the case of the urban utility tunnel using PPP mode, the demand and the competition of similar projects all will affect the price. When the entrance rate is low, the project company will reduce the price to increase the demand, then the entrance rate will increase, so as to increase operating income. The competition of similar projects will directly affect the entrance rate, which will affect the operating income. In a specific market environment, the concession pricing and franchising period are mutually influential. After determining the return on investment and assuming a fixed amount of usage, the franchise pricing will be reduced when the franchise period is longer, and it will be increased when the operating period is relatively short.

(2) The impact of the economic environment on prices

Factors that affect the price of the economy include interest rates and exchange rate fluctuations, inflation, the soundness of financial markets and the level of development of the regional economy. Changes in interest rates and exchange rates, as well as inflation, will directly or indirectly result in changes in financing costs, construction costs and operating costs, which will affect the return value and cash flow and eventually cause changes in the price. The investment and construction of the urban utility tunnel using PPP mode requires a lot of capital loans and a longer payback period. The soundness of the financial system directly affects the project financing and financing costs, which indirectly affect the price. The level of regional economic development mainly affects the public affordability and the daily maintenance cost in the operation period.
(3) The impact of the political environment on prices

The influence of the political environment on prices mainly considers the stability of the political situation, while this factor mainly has a greater impact on overseas projects. The stability of the political situation in the host country will affect the continuity and the implementation of the policy, which will exert some influence on the implementation, construction cost, financing and income of the project. If the project is located in our country, due to the high degree of political stability, it will have a small impact on the price. However, if the project is located offshore, especially in the Middle East or Eastern Europe, the social unrest will have a greater impact on the price.

(4) The impact of the legal environment on prices

The completeness of the legal system and contracts and changes in the standards of laws and regulations are legal environmental factors. Under normal circumstances, the more complete the legal system related to the project, the lower the impact on the price. And the degree of contract completion is similar to the effect it has on project prices. Besides, changes in the standards of laws and regulations will affecting the project cash flow and thus affecting the final pricing of the project.

CAUSAL ANALYSIS OF PROJECT PRICE BASED ON SYSTEM DYNAMICS

System dynamics is a comprehensive discipline which was born in the 1950s and used to study information feedback system and recognize and solve system problems based on the theories of system theory, cybernetics and information technology [8]. According to the analysis in Chapter 2, 31 key factors affecting the price have been determined, but it is unclear how these factors affect the price and what interaction between them, so the causal feedback in system dynamics can be used. And in order to further explore the mechanism of price formation, some auxiliary variables can also be introduced into the causality diagram, as shown in Figure 2, it should be pointed out that the project price in the diagram includes the entrance fee and routine maintenance fee in two parts. Based on the causality diagram, qualitative analysis can be conducted on how the project price influence factors affect the price formation.
As can be seen from the causality diagram, the main factors affecting the entrance fee are construction investment, government subsidies and expected return on investment. The entrance fee usually increases as the construction investment increases. Further analysis shows that, there are many factors affecting construction investment, of which construction interest and equipment purchase cost have a positive impact on construction investment, while public support, bureaucratic corruption, construction management capability are all have a negative impact on it. At the same time, government subsidies will also affect the entrance fee, obviously the higher government subsidies is, the lower entrance fee users need to pay. Furthermore, the factors influencing the government subsidies are the preferential policies, the affordability of users and the annual profit of social capital. If the region has a high economic level, the users will have strong affordability and the social capital will receive a huge annual profit, therefore, the government subsidies will be reduced as appropriate.

The operating costs will directly affect the routine maintenance fee. The higher operation costs are, the higher maintenance fee is. Inflation and social capital’s operational capabilities has a positive impact on operating costs while changes in laws and regulations has a negative influence on it. In addition, government subsidies and expected return on investment will also have some impact on routine
maintenance costs. The higher government subsidies and expected investment return are, the lower maintenance fee is.

There are two routine maintenance costs causal feedback loop in Figure 2. The first of these is a positive feedback loop, which contains "unit operating costs → routine maintenance fee → the usage intention → competition of similar projects → utilization → unit operating costs". With a certain number of users, the rising unit operating costs will result in an increase in the maintenance costs. Once the maintenance costs rise, users will take other more economical ways to replace this service, the utilization rate will be reduced, so that the unit operating cost will continue to rise, then forming an unfavorable feedback loop.

Figure 3. Causal feedback loop(1).

Figure 4. Causal feedback loop(2).

The second loop is the "subsidy discount → routine maintenance fee → the usage intention → competition of similar projects → utilization → annual operating income → annual profit of project company → annual profit of social capital → subsidized preferential treatment", which is a negative feedback loop. Once the government subsidies rise, the routine maintenance fee will be controlled in a low range, therefore the users will have strong willing to use the tunnel, then the competition of similar projects will also be weakened. As a result the utilization and the project company’s annual operating income will increase. Assuming that the operating costs remain unchanged, the annual profit will increase, thus the dividend profits obtained by the social capital will also increase. In order to ensure the maximum social welfare and prevent the social capital resorting to huge profits, it will correspondingly reduce the subsidies. In addition, the reduction of subsidies will in turn cause the routine maintenance fee rise correspondingly. Through such repeated cycles and adjustments, a dynamic balance will eventually be reached as shown in Figure 4.
CONCLUSIONS

This article first briefly analyzes the price composition of the urban utility tunnel using PPP mode, points out that the price includes two parts: the entrance fee and the routine maintenance fee, and then uses the expert investigation method to find out the 31 main factors affecting the price, and summed up the impact of the project itself and the external environment on the price of two major parts. By analyzing these factors, the project price is not only formed by the interaction of government, social capital and pipeline users, but also influenced by the external politics, economy, law and market environment. Finally, this paper uses the theory of causal feedback in system dynamics to discuss in detail how each factor affects the entrance fee and routine maintenance fee, and draws two causal feedback loops about the routine maintenance fee, trying to provide a good foundation for pricing and price adjustment of the urban utility tunnel using PPP mode.

REFERENCES