



Chinese Dequity: Transaction Structure and Two Applications

Jingxin CHEN

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

Supervisor:

Professor Rui Alpalhão, Associate Professor, ISCTE University Institute of
Lisbon

Professor Chaolong Chen, Associate Professor, School of Management and
Economics, University of Electronic Science and Technology of China

April, 2019

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Instituto Universitário de Lisboa

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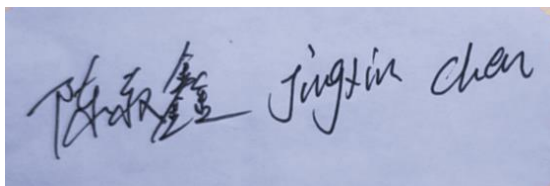
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Abstract

In recent years, the financial market has been under the dual pressure of macro-economic downturn and deleveraging of industry entities. In this context, the regulating authorities have been encouraging enterprises to resort to debt replacement in order to lower financing cost. Therefore, the financing instrument characterized by “Chinese dequity” came into existence (Chen & Kensinger, 1991). As an innovative investment business, it has significantly contributed to China’s economic development by making financing easier for enterprises and relieving the financial pressure on governments and banks. However, many problems have surfaced in its application in China, most notably the uneven distribution of each party’s control rights and interests, poor risk control and management, and a yet-to-be-perfected theoretical system. Further optimization is thus needed.

In the above context, this thesis intends to ensure the consistency between the ultimate financing result and the expected goal by designing a transaction structure for “Chinese dequity” in construction projects. Such financing transaction structures of two projects are studied as cases, namely, the PPP Project of the Underground Utility Tunnel in HS City and XNY Private Chemical Construction Project. The author studies many theories, introduces the concept of “control rights preference”, and constructs the optimal control rights allocation model by adopting stochastic cooperative games. On this basis, the designed transaction structure in infrastructure construction, allocation of control rights of participants, and existing problems are analyzed. In the end, a conclusion is made and suggestions for further research given.

Keywords: “Chinese dequity”, transaction structure, control rights, double-case analysis

JEL:G11,G32

Resumo

Nos últimos anos, o mercado financeiro tem estado sob a dupla pressão da recessão macroeconômica e da desalavancagem de entidades industriais. Neste contexto, as autoridades reguladoras vêm incentivando as empresas a recorrer à substituição de dívidas para reduzir o custo de financiamento. Portanto, surgiu o instrumento de financiamento caracterizado pela “deidade chinesa” (Chen & Kensinger, 1991). Como um negócio de investimento inovador, tem contribuído significativamente para o desenvolvimento econômico da China fazendo mais fácil o financiamento para empresas e aliviando a pressão financeira sobre governos e bancos. No entanto, muitos problemas têm surgido em sua aplicação na China, principalmente a distribuição desigual dos direitos de controle e interesses de cada parte, o insatisfatório controle e gerenciamento de risco e, um sistema teórico ainda a ser aperfeiçoado. Otimização adicional é, portanto, necessária.

No contexto acima, esta tese pretende garantir a consistência entre o resultado definitivo do financiamento e o objetivo esperado, projetando uma estrutura de transação para a “deidade chinesa” em projetos de construção. Tais estruturas de transação de financiamento de dois projetos são estudadas como casos, para esclarecer, o Projeto PPP do Túnel Utilitário Subterrâneo na cidade de HS e o Projeto Privado de Construção Química de XNY. O autor estuda muitas teorias, introduz o conceito de “preferência de direitos de controle” e constrói o modelo ótimo de alocação de direitos de controle adotando jogos cooperativos estocásticos. Com base nisso, a estrutura de transação projetada na construção de infraestrutura, a alocação de direitos de controle dos participantes e os problemas existentes são analisados. No final, uma conclusão é feita e sugestões para mais pesquisas são dadas.

Palavras chaves: “Dequidade chinesa”, estrutura de transação, direitos de controle, análise de caso duplo

JEL: G11,G32

摘要

近年来，金融市场受到宏观经济下行和行业实体去杠杆化双重压力，具有“中国股权”特征的融资工具应运而生。它缓解了企业、政府和银行的财务压力，为中国经济发展做出了重要贡献。但其应用尚存在各方控制权益分配不均、风险管理不善、理论体系不完善等诸多问题，需要进一步优化。

本文以 HS 市地下公用事业隧道 PPP 项目和 XNY 民营化工建设项目为例，引入“控制权偏好”的概念，并采用随机合作博弈的方法构建了最优控制权分配模型。通过分析基础设施建设中交易结构的设计、参与者控制权的分配以及存在的问题，得出了结论，并提出了进一步研究建议。

关键词：“中国股权”，交易结构，控制权，双案例分析

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Chapter 1: Introduction

1.1 Research background

The continuous development of the real economy is, in essence, a process of the constant change and formation of the financing structure. In recent years, under the dual pressure of macro-economic downturn and deleveraging of industry entities, enterprises seeking development have, through the support of the regulating authorities, resorted to debt replacement in order to lower financing cost. This measure provides a solution to the financing problems of issuers with a high credit rating. However, with the further slowdown of macroeconomic development, the net capital accumulation ability of enterprises has been severely weakened, resulting in a significant burden of rigid debts on the financing parties and the still dominant position of the PPP financial leverage (James, 2003). Su (2016) has studied this problem and suggested that financing entities should seek an innovative financing method. In this context, the financial instrument characterized by “Chinese dequity” came into being. It is essentially debt financing by way of equity financing.

In 2017, the Department of Budget under the Ministry of Finance of the People’s Republic of China published on its website the Notice on Further Regulating the Borrowing-Based Financing Activities of Local Governments (No. 50 [2017] of the Ministry of Finance), explicitly stipulating the following: The government and its affiliated institutions shall not take on debt by adding terms and conditions to any equity investment method such as limited partnership funds when participating in projects involving investment funds supported by policies. In other words, they shall not engage in activities that increase government debt in a disguised form such as “Chinese dequity”.

Despite certain restrictions imposed by the government, “Chinese dequity” is indeed a new financing model that can help address the current financing predicament, which is worth further study and discussion.

When studying “Chinese dequity” in 2015, Teng (2015) indicated that it is an innovative investment model, which, as its name suggests, “appears to be equity investment, but is in fact debt investment”. The biggest difference between this financing method and traditional bond investment or equity investment is that it invests in enterprises in the form of equity, but there is a certain capital preservation agreement.

In order to pursue more interests and obtain equity investment, many enterprises have adopted “Chinese dequity”. This financing method fully demonstrates the relationship between the interest demands from the financiers, managers and investors.

First, through the “Chinese dequity” model, the financing parties can increase equity capital and have their own financing needs met so as not to occupy the line of credit. This model can also effectively lower asset-to-liability ratio. Second, the investor can, on the one hand, be free from the legal requirement for loan disbursement qualifications, and on the other hand, gain corresponding returns under low risks. Third, asset management companies (including but not limited to trust companies) function as an important channel in the “Chinese dequity” model. Besides, asset management companies can further enlarge their management scale to gain corresponding management compensation in this transaction model. It can thus be inferred that widespread application of the “Chinese dequity” model has to do with the result of satisfying the interest demands from all parties.

In spite of this, as China witnesses a surge of engineering construction projects, the increased application of “Chinese dequity” financing tools has become a double-edged sword. On the one hand, it has made financing much easier for enterprises and eased the capital pressure on banks. On the other hand, due to the short history of “Chinese dequity” in China, problems have increasingly surfaced during its application, most notably the uneven distribution of each party’s control rights and interests, poor risk control and management and a yet-to-be-perfected theoretical system. Further optimization and improvement are thus needed.

Thus, it is of particular importance to ensure the consistency between the ultimate financing result and the expected goal by designing a characteristic transaction structure for “Chinese dequity” in large construction projects. In particular, efforts should be made to establish a standard and scientific mechanism that is conducive to balancing and ensuring the distribution of control rights among all parties involved so as to reduce the information asymmetry between investors and business operators in project construction.

1.2 Research significance

In theory, an analysis is made in the beginning to clarify the existing correlations between the transaction structure and theoretical definition. Second, the current framework setting of “Chinese dequity” is yet to be perfected. A solution is urgently needed to properly allocate control rights among all parties. Due to the lack of a mature theoretical framework and contract mechanism, the competition for control rights among various parties has become the primary feature of “Chinese dequity”. Therefore, this thesis studies relevant literature by scholars. And on this basis, control rights theory and game theory methods are used for an in-depth analysis of the control rights allocation of relevant stakeholders and establishment of a control rights allocation model. In this way, the theoretical thoughts for the design of transaction structure for “Chinese dequity”, especially control rights allocation, are provided.

In practice, the transaction structure design for financing through “Chinese dequity” can provide a practical reference for the transaction structure design for the “Chinese dequity” in engineering projects in such areas as large infrastructure construction and public utilities, especially control rights allocation. Besides, based on the detailed information of the project and an analysis of the actual situation, the targeted design of a scientific and effective transaction framework is designed, which has significant use value for ensuring the interests of various parties and facilitating project implementation.

1.3 Research methods and technical roadmap

1.3.1 Research methods

This thesis mainly uses a combination of theoretical study and case study and adopts game theory tools.

(1) Literature research. A review of relevant domestic and international literature provides an understanding of the research status, research content, methods and tools of the given area and lays a sound theoretical basis for the research. Besides, a full absorption of previous theories and establishment of a game model for control rights allocation lays a foundation for the design of transaction structure of the chemical construction project.

(2) Case study. This thesis adopts a double-case research method. The transaction structure of “Chinese dequity” is designed through an analysis of the PPP Project of the Underground Utility Tunnel in HS City and the financing of this project through “Chinese dequity”, as well as an analysis of the project transaction structure and the allocation of participants’ control rights.

1.3.2 Technical roadmap

Please see Figure 1-1 for the main technical roadmap of this thesis:

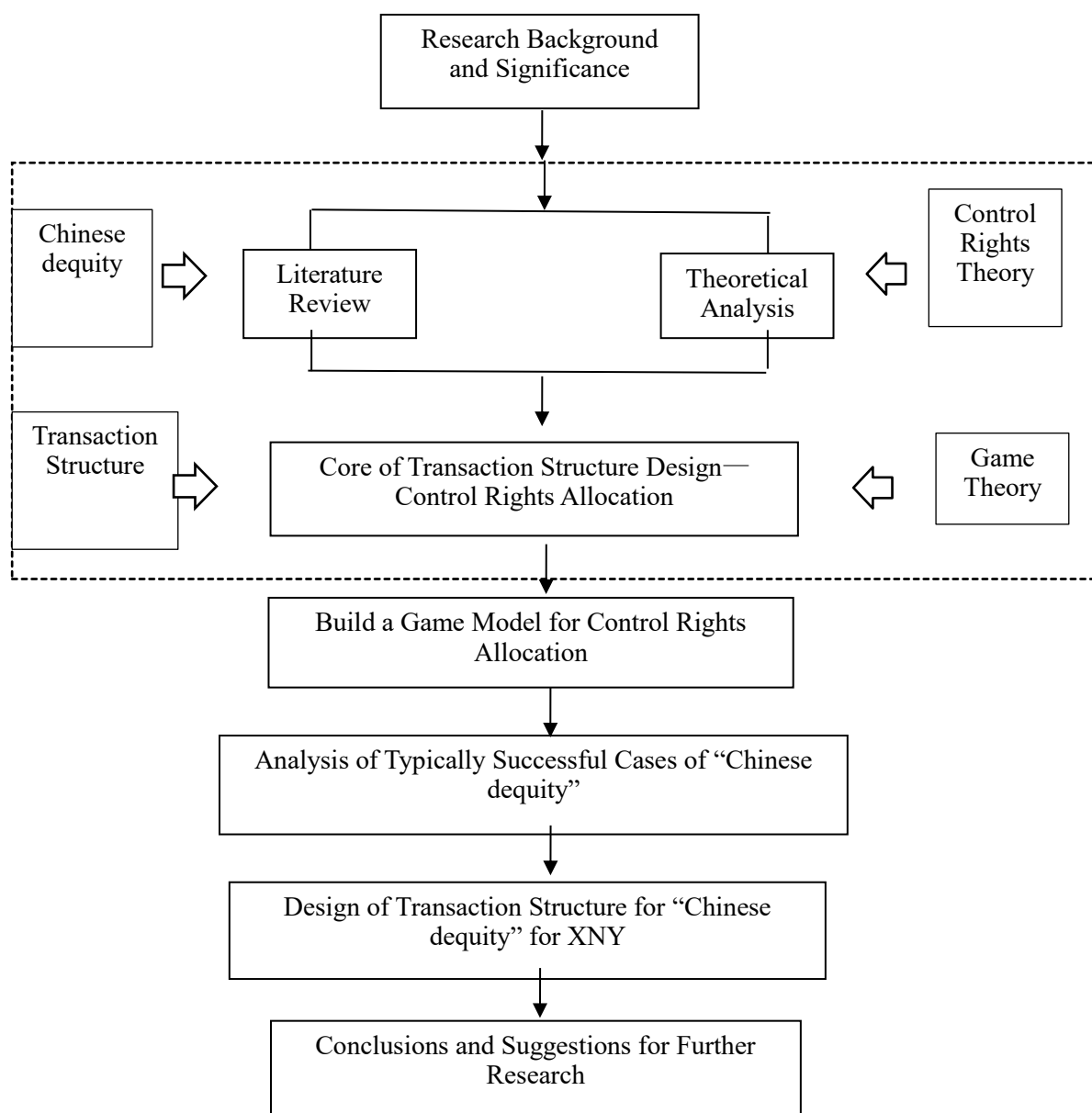


Figure 1- 1 Technical road map

1.4 Main content and structure arrangement

The present thesis follows this structure: First, a game model suitable for control rights allocation for China's engineering projects is established on the basis of relevant theories such as "Chinese dequity", transaction structure, control rights, and game theory as well as literature research. Second, an analysis of the typically successful case of "Chinese dequity"—the PPP Project of the Underground Utility Tunnel in HS City—is made. Third, XNY Chemical Construction Project and the transaction structure of "Chinese dequity" are analyzed and inspiring revelations and suggestions put forward based on the conclusions of game model research. Last but not least, this paper summarizes the research content, offers corresponding suggestions and proposes the prospects of future studies.

The present thesis consists of six chapters.

Chapter 1: Introduction. This chapter mainly introduces such matters as the research background, research significance, research structure and research methods of this thesis and describes research innovations herein.

Chapter 2: Literature review. This chapter is a review of relevant theories and literature, including "Chinese dequity", mezzanine financing, transaction structure, control rights theory, and game theory with a view to clarifying the theoretical skeleton and research design.

Chapter 3 provides an in-depth analysis of control rights allocation of relevant stakeholders in financing through "Chinese dequity" on the basis of the previous chapter of literature review. It also adopts stochastic cooperative games to build the optimal control rights allocation model.

Chapter 4 elaborates on such research methods as literature research, case study, interview method and questionnaire survey in order to provide the research basis and lay a foundation for the case studies in the following two chapters.

Chapter 5 mainly analyzes the successful cases of financing through typical "Chinese dequity"—the PPP Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project—by using the research methods given in the previous chapter. It mainly analyzes the financing means, economic benefits and highlights for learning of "Chinese dequity", introduces its transaction structure and applicable conditions, further illustrates its

economic benefits, and puts forward its operating model and matters needing attention for the two parties.

Chapter 6: Conclusions and prospects. This chapter summarizes the research content, offers corresponding suggestions and proposes the prospects of future studies.

1.5 Major innovations

This thesis is innovative mainly in two ways. Firstly, domestic and international research on mezzanine financing is mainly about its concept and relevant theories. Focus is given to its nature and characteristics, its advantages and disadvantages compared to other forms of financing, reasons for its emergence and its common forms. Some studies also focus on the practice and application of mezzanine financing among small and medium-sized enterprises in their own countries. Few studies deal with the research and practice of design of transaction structure for “Chinese dequity”. This thesis is innovative as it provides design of the transaction structure for “Chinese dequity” in financing projects.

Few domestic studies deal with such topics as control rights allocation in financing, interests gaming among the parties involved and control rights allocation mechanism. This thesis provides an in-depth analysis of the allocation ways of control rights among relevant stakeholders in financing based on such theories as control rights theory and game theory, and also establishes a control rights allocation model.

Chapter 2: Literature Review

Chapter 1 elaborates on the research background and significance of this thesis in detail as well as the thoughts and methods to be adopted for the research, and also summarizes its overall structural content and major innovations. It puts forward that the main research problem of this thesis is to design the transaction structure of “Chinese dequity” in chemical construction projects, especially to establish a mechanism to balance the control rights among various parties involved in the project. On this basis, this chapter mainly reviews relevant theories and literature, including “Chinese dequity”, mezzanine financing, transaction structure, control rights theory and game theory, so as to clarify the theoretical structure and research design.

2.1 Analysis and comparison of actual debt investment in the form of equity investment and related financing Instruments

2.1.1 Project financing

2.1.1.1 Definition of project financing

Project financing arose from the 70 's, and there is not yet a uniform definition. ISO10006 project financing is defined as: The project has a specific start time and end time, the whole process is unique, consisting of a series of coordinated activities, and mutual influence, the ultimate goal of the implementation process is to achieve pre-set project objectives ; The German national standard DIN69901 defines project financing as a project that must have established objectives, specific time planning, financial support, human resources support, a complete programme and a dedicated management coordination and operation organization, which can be called a project only if the above conditions are met; the United States Accounting Standards Manual argues that Project financing is a way for enterprises that need large-scale financing to obtain financing through financial activities, and the definition of project financing is also clarified in China's interim administrative measures on the financing of projects abroad: project financing refers to the financing method of raising funds abroad in the name of domestic projects, only with the external liability of the project's own income and assets. Although countries and academic circles have different views on the definition of project financing, but

summed up can be divided into broad-sense project financing and narrow project financing. Broadly speaking, all financing activities for the construction of new projects, acquisition projects or the completion of corporate restructuring can be described as project financing activities, which are more common in European countries. In a narrow sense, the recourse is limited or unlimited financing behavior can be considered as project financing, debt repayment is mainly through the project's operating income. This definition is recognized by most countries and regions (Jiang, 2006).

Project financing, with the revenue capacity of the financed project as the actual bank guarantee, has the characteristics of "risk sharing" and "project orientation", which is different from the traditional financial loan relying on the company's credit qualification and debt repayment ability (Xiao, 2005) . Project financing participation in the various departments as a whole, the bank will always participate in it, and bear the corresponding risks, so in the course of the project, the bank will reasonably design the financing method according to the actual needs of the project, to meet the needs of investors to the maximum extent, Some traditions can be used to obtain financing that some financial loans cannot obtain through the means of bank operations.

From the rise of project financing has been more than more than 30 years of history, project financing has gradually been widely used, especially in some large-scale industrial projects, such as transportation facilities construction, oil development, coal mining, water conservancy projects and so on.

2.1.1.2 Advantages of project financing

1. Ability to raise funds for large projects that exceed the company's own affordability.

The amount of investment in some projects is huge, the individual enterprise is not able to provide the capital requirements required by the project, nor bear the investment risk of the project. In this case, the project's own assets can be used as a guarantee through the project financing, the enterprise only undertakes limited recourse so that it can promote the successful implementation of the project and the acquisition of financing.

2. Helping the Government to achieve project financing

Most local governments impose restrictions on debt, which constrain government investment in relevant areas, especially in some public areas such as road construction, bridge

construction, energy projects, etc., through the way project financing can flexibly arrange government debt, reduce the impact of debt on the government.

3. Risk sharing in favour of overseas projects.

Some multinational companies engaged in project construction overseas, due to the local political, economic and social environment, and by the lack of familiarity with overseas markets, investment environment concerns, most enterprises want to be able to find overseas partners to share project risks, and the project and domestic enterprises to implement effective separation, the project financing method has become a better choice.

2.1.1.3 The model of project financing

In order to meet the needs of insufficient investors, project financing has spawned a variety of models in the development process, the most important of which are the following:

1. ABS Project financing model.

ABS (abbreviation for English Asset-backed-securitization) refers to a way in which the project company issues bonds on the market, on the basis of all the assets of the project, through an effective estimate of the future profitability of the project and as a safeguard (Kong & Yan, 2005).

ABS financing model to raise funds of lower cost, longer duration and raise the amount of funds generally larger, can provide a certain degree of financial protection for the smooth implementation of the project, and through securitization financing methods, reduce the risk of project investors and the risk of future development of the project uncertainty, is widely used in large-scale industrial projects.

2. TOT Project financing model.

TOT (abbreviated in English Translation-operation-translation) refers to the sale of completed projects to obtain funds and the use of the funds obtained for the construction of uncompleted projects. Specifically, the financier of the project will be completed and run the project for a certain period of time to the investor for management operations, by the investor to collect the proceeds of the project operation, in Exchange, the investor a one-time grant to the financier a sum of money for the construction of new projects, after the expiry of the agreed operating period, A model by which an investor returns a project to the financier .

This model is more suitable for the construction of infrastructure with stable income and longer periodicity.

3.PPP Project financing model.

In the latter part of the literature review in this paper, the PPP model will be introduced in detail, where it is not repeated.

4.BOT (abbreviation of English Build-operate-transfer) project financing model.

At present, BOT project financing is widely used in basic engineering projects and large-scale construction projects, such as the construction of power stations, highways, tunnels, bridges, corridors and so on, the two cases discussed in this paper are belonging to large-scale construction projects, all using BOT mode, so this paper focuses on BOT model project financing. BOT financing model refers to the government to grant a franchise for the construction of the project, by the project participants to jointly form the project company, responsible for the financing, construction and management of the project, take risks, and within the agreed time to operate the project and collect the proceeds of the project, the agreed operating hours after the expiry of the project company to the government (Liu, 2006). With the development of market economy, BOT model has derived several forms of financing, mainly BOOT (abbreviation of English Build-own-operate-transfer), BOO (abbreviation of English Build-own-operate), BLT (English build- Abbreviation of Lease-transfer). The difference between BOOT and BOT is that when the project is completed, the project company has ownership rights, and BOT has only the right to operate during the project operation, and the operating period of BOT project is generally shorter than BOOT, which means that the government gives the franchise to the contractor. The contractor is responsible for the construction of the operation and ownership; BLT means that the government authorizes the project company to finance and build, but immediately after the completion of the project, the project is transferred to the government, leased and operated by the government, the project company collects rent for repayment of the loan, and the project is handed over to the government after the lease period.

2.1.1.4 The mode of BOT project financing

BOT project financing procedures are more complex, mainly including the following steps: To determine the project plan, program declaration project, bidding preparation stage, bidding implementation stage, bid evaluation and award, consultation and signing of contracts,

construction implementation stage. Specifically, to determine the project programme stage is to determine the necessity of construction, the feasibility of the plan, the reality and effectiveness of the goal, feasibility analysis is the most important task of this stage, to deeply analyze the level of project financing, financial situation, construction costs, profitability, risk assessment and other aspects of the problem, to form a comprehensive and specific feasibility report. See Figure 2-1 for details.

Secondly, the program declaration stage, refers to the relevant competent departments to audit the project plan. In general, foreign BOT needs the approval of the Planning Commission, domestic BOT is generally approved by the local government departments.

The third stage is the bidding preparation stage, the establishment of the Tender Committee, the recruitment of relevant professional intermediary organizations, the preparation of tender documents and related materials, the public tender announcement, the pre-qualification of the company submitted by the preliminary examination, and the formation of an alternative list, to the pre-trial bidders to issue an invitation.

The fourth stage is to organise Tender Committee and relevant experts to carry out evaluation and award.

The fifth stage is to invite the winning bidder to negotiate with the government and sign a cooperation agreement with the participating parties to sign a concession agreement with the government.

The sixth stage is the construction implementation stage, in accordance with the contract agreed to promote the construction of the project.

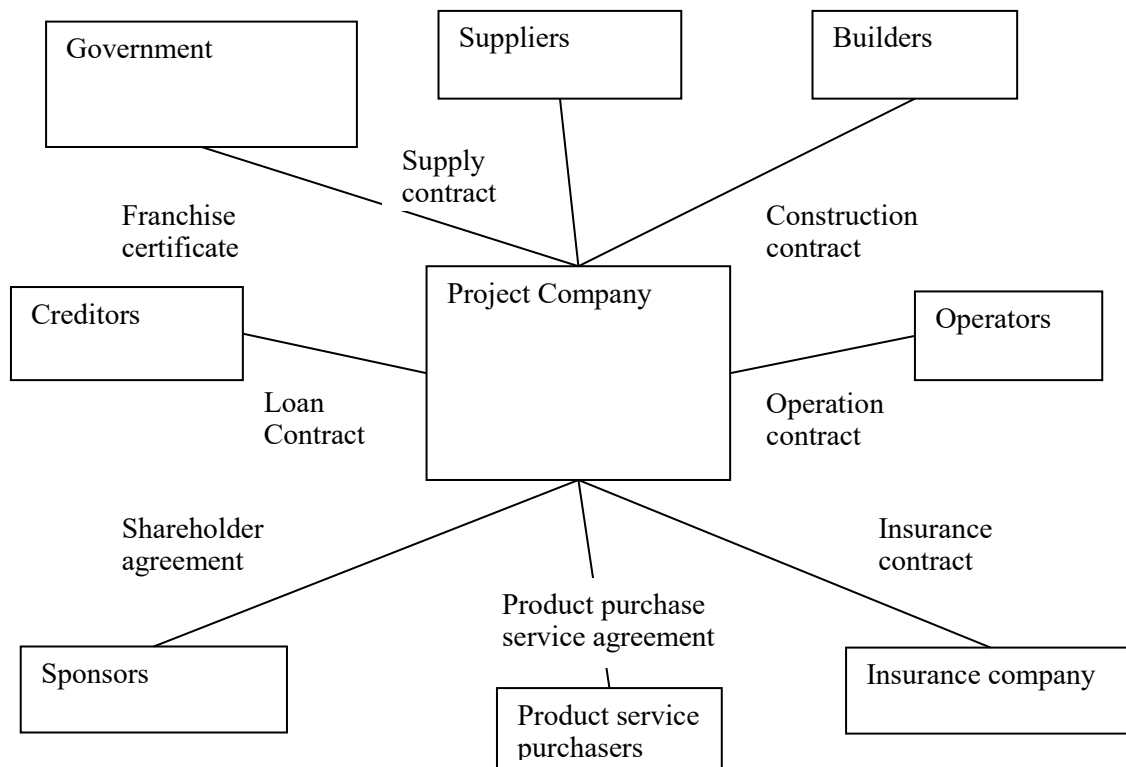


Figure 2-1 BOT project financing arrangement

2.1.2 Mezzanine financing

As one of the common financing methods, mezzanine financing develops on the basis of a hybrid of senior debt and equity financing. It refers to a new means where enterprises quickly gain capital through mezzanine capital. Mezzanine capital is a long-term unsecured debt-based risk capital whose returns and risks are related to corporate equity capital and debt capital. It's a form of capital that exists between the two. Compared to other financing methods, its financing cost is lower as it causes less dilution to the equity. Seen from the fixed interest rate of debt financing, it can fully reflect the advantages of creditor's rights owned by investors. Yet, from the perspective of the liquidation order of debts, it is inferior only to privileged debts. Thus, it has similar advantages to those of stock equity, which is favorable to repayment of debts to preferred creditors (Yin, 2013). Mezzanine financing has broken the financing pattern. It boasts flexible design ways, the possibility of design according to clients' specific needs, the

ability to reduce dilution degree of enterprise equity, and increase capital utilization efficiency. When enterprises go through bankruptcy liquidation, senior debt providers will get repaid first, followed by mezzanine capital providers, with corporate shareholders being the last.

As to studies on relevant concepts of mezzanine financing, Braun (2002) points out that the insufficient capital provided by the original way of financing and its inability to meet enterprises' needs is the primary reason for the large demand for mezzanine financing in the market, which has also contributed to the rapid development of mezzanine financing. He holds that the increase in SME's financing needs, decrease in the mortgage rate of commercial real estate and development of equity pledge loans have given rise to and facilitated the rapid development of mezzanine financing in European and American financial markets. Weissenberg, Cohen, and Culliney (2003) point out that mezzanine is a way of financing between equity and senior debt. As senior mortgage creditors have become more and more cautious and reduced debt amount, mezzanine financing has become more and more important correspondingly. In the mezzanine financing market, different investors have different attitudes towards risks and returns. Rosenthal (2004) analyzed the connotation of mezzanine debts & reasons for using mezzanine debts and compared the advantages and disadvantages between mezzanine debts and equity products. Berman (2005) believes that the difference between mezzanine financing and mortgage lies in priority level. To be specific, mortgage lenders have physical assets as mortgage, such as house and land, whereas mezzanine financing investors have the equity of the subsidiaries of the financier's group as mortgage and can thus control the financier's assets in an indirect way. Vasilescu (2009) hold that the key structure of mezzanine capital lies in the fact that compared to other investors, investors of this capital are at the secondary position in bankruptcy, debt restructuring and liquidation. Silbernagel and Vaitkunas (2012) analyzed the concept of mezzanine debt, structure and form of mezzanine financing, its advantages, development history and exit mechanism. Liu and Song (2007) analyzed the principles of mezzanine financing, introduced the development situation of mezzanine financing in the international capital market, analyzed successful cases of domestic application of mezzanine financing, illustrated the application conditions of mezzanine financing in China by using Lianhua Trust Company as an example, and pointed out the development prospects of mezzanine financing in China. Zhang and Wu (2008) introduced the concept and characteristics

of mezzanine financing, and analyzed and discussed on its advantages & disadvantages, risks, and application conditions.

As to the application and practice of mezzanine financing, Vasilescu (2010) analyzed mezzanine financing tools such as private placement tools (private mezzanine) and capital market tools (public mezzanine). They also discussed the characteristics of mezzanine financing as well as its advantages and challenges from the perspectives of enterprises and investors. On this basis, they pointed out that in the context of global financial crisis, mezzanine financing has become an important choice for filling the financing gap confronted by SMEs in the European Union. Tetrevova and Swedik (2011) introduced such forms of mezzanine financing as bonds, convertible bonds, warrants and preferred stocks as well as elaborated on the application and practice of mezzanine financing tools in the Czech Republic. Heller (2012), through a study on the structure and form of mezzanine financing, analyzed the differences between mezzanine debts and preferred stocks, discussed the internal and external advantages of mezzanine debt and pointed out that mezzanine debt is the best form of investment for some investors. In order to understand SMEs' needs for mezzanine financing under financial crisis, Amon and Gregor (2013) conducted an empirical examination using the 1,427 mezzanine transaction data in Europe between 1982 and 2011 and analyzed the typical cost composition of European mezzanine market and mezzanine loans. Ganatra and Acharya (2014) believe that mezzanine financing plays a significant role in facilitating enterprises' financing and expansion. Yet enterprises should consider the characteristics, financing effects and possible challenges of mezzanine financing when making investment decisions. Although mezzanine financing tools have been increasingly recognized, compared to traditional ways of financing, it is still rarely used. Bao (2008) first elaborated on the concept and characteristics of mezzanine financing, then used economic analysis methods to analyze its supply and demand motivation, before finally using typical cases to introduce the two models of trust companies' mezzanine financing, including equity model and loan model. Besides, he also systematically summarized the capital entry, risk control and exit models for trust companies to carry out mezzanine financing business. Ying and Sa (2011) analyzed the differences between mezzanine financing and private equity in detail, discussed on the advantages and disadvantages of mezzanine financing, pointed out that mezzanine financing is an available means for solving technological SMEs' financing difficulty, and put forward suggestions for the development of mezzanine financing in China. Chen and Zhao (2012) analyzed the financing status of real estate enterprises in China,

feasibility of mezzanine financing in real estate financing in China and pointed out that under the unsmooth financing channels and monotonous financing means for Chinese enterprises, small and medium sized real estate companies should include mezzanine financing strategies in their overall financing strategy system. Chen (2013) analyzed the necessity of developing mezzanine financing in China, possible barriers and specific measures for its progress. He regards mezzanine financing as an effective financing channel that real estate enterprises can make use of. Yang and Wu (2013), through studying and analyzing the capital replenishment operation of international banks, found that many of the capital replenishment tools of foreign banks bear mezzanine financing nature and that China should draw from the experience of foreign banks to actively explore the application of mezzanine financing capital supplement tools. Jiang and Li (2015) analyzed the essence and risk-return characteristics of mezzanine financing and discussed the measures for controlling mezzanine financing from three aspects, namely, interest rate risk management, financial risk management, and legal risk management.

Studies on mezzanine financing by scholars and mezzanine financing practices are many, whereas studies on “Chinese dequity” are relatively fewer. For example, the theoretical system of “Chinese dequity” is not complete enough, studies on such topics as control rights distribution, risk control and management and balance of various parties’ interests are not in-depth or complete enough, and the applicability of such studies is low.

Traditional investment and financing models include debt investment and equity investment. The former is aimed at gaining fixed returns, while the latter is mainly characterized by shared profits and risks with the invested enterprises. With the development of market economy, enterprises’ means of investment and financing have been updating. Currently, there have emerged a large number of mezzanine financing cases where the legal form is equity financing while fixed returns are gained and exit conditions outlined through contract. It is known as “Chinese dequity” (Wang & Zhang, 2014).

2.1.3 “Chinese dequity”

On the path to financing innovation, “actual debt investment in the form of equity investment” is one of the most important innovative financing models. As its name suggests, “it appears to be equity investment on surface, but is equity investment in essence”. The biggest difference between this financing method and traditional bond investment or equity investment

is that it is safeguarded with a certain break-even agreement despite input in the invested enterprises in the form of equity. The research and practice of mezzanine financing by scholars is relatively more that “actual debt investment in the form of equity investment”. The theoretical system of “actual debt investment in the form of equity investment” has not been perfected, many such as the distribution of control rights, risk control and management, the balance of the interests of the participants and other aspects of the study still need to be further improved.

2.1.3.1 The definition of “Chinese dequity”

“Chinese dequity” is not a legal concept. Currently, the regulatory authorities that have clearly defined it include China Banking Regulatory Commission and Asset Management Association of China.

In the “G06 Financial Management Monthly Statistics” updated by China Banking Regulatory Commission in 2017, “Chinese dequity” is defined as: “a structural financing arrangement where investors sign an equity repurchase agreement with the fund demander before investing the fund in the form of equity investment and the two parties agree that within the prescribed period, the fund demander shall buy back all equity held by the investors at the premium rate agreed in advance, and then make further arrangements for the structured equity according to the financing requirements.”

On February 14, 2017, the Asset Management Association of China issued “No. 4 Record-filing Management Regulations of Private Equity Management Plan of Securities and Futures Operating Institutions—Private Equity Management Program Investment in Real Estate Development Enterprises and Projects, which provided a clear definition of Chinese dequity: “Chinese dequity” is an innovative investment instrument where the return on investment is neither linked to the operating performance of the invested enterprise nor distributed according to the enterprise’s investment gains or losses. Instead, investors are provided with the promise of capital preservation and income protection and regular payment of the prescribed proceeds to the investors in accordance with a prior agreement. Besides, after certain conditions have been met, the invested enterprise will redeem equity and repay principal and interest. common forms include repurchase, regular dividend distribution and valuation adjustment.

Seen from the content of the above definitions, the description given by the Asset Management Association of China is more specific, more comprehensive and more inclusive. Through the above definition, we can understand “Chinese dequity” as an arrangement where

investors contribute to the invested company by purchasing an equity in the invested company, but investors' income is not linked to the operating performance of the invested enterprise. Besides, the invested company promises to repurchase the equity within a certain period and bears the corresponding interest by means of markup purchase or direct payment. In short, it is "preservation of principal and interest".

2.1.3.2 The characteristics of "Chinese dequity"

"Chinese dequity" has the following typical characteristics:

(1) It has the characteristics of both equity financing and debt financing.

Nominally, success in obtaining returns during an agreed period before exit and existence in the form of equity as specified in the contract and reflected in corporate equity capital during the term of investment is a form of equity. But both the investor and the financier actually regard it as a form of long-term creditor's rights and debt.

(2) The investor demands fixed capital returns.

When signing the *Equity Transfer Agreement*, both sides of the agreement will agree on capital returns. Different from the actual equity investment, investors' returns do not depend on the operating results of the target company. Besides, it specifies that the exit way is exit upon future premium repurchase. As to payment of returns, it is also similar to bank loans. Normally fixed returns will be paid to the investors after a specific period of time. These terms and conditions have basically clarified future risks for investors' capital and can enable them to gain corresponding returns when they withdraw their funds.

(3) The investors do not participate in specific management and profit sharing.

When an investor invests a certain amount of money in an enterprise, the transferee company will usually be required to hold a shareholders' meeting, change the articles of association and start business registration/alteration registration, after which the investors will become the shareholders of the transferee and hold shares. In accordance with the provisions of the *Company Law of the People's Republic of China*, the investor shall have certain rights, including the right to share assets returns, participate in the making of major decisions and choose managers. In the *Equity Investment Agreement*, the two parties often agree that the investor will not participate in the company's operation, management or profit sharing and that the company shall be managed and operated by senior executives of the company. If the

operating expenses incurred after the registration of the company require the investor to assume relevant liabilities, the loss thus caused shall be recovered from the company in an equal amount. Besides, the investor shall not send operators to the invested company, so as to keep the company's original management system intact.

(4) Investors tend to be non-bank financial institutions or organizations similar to financial institutions.

The mezzanine financing amount of “Chinese dequity” is generally quite large, and it is impossible to implement standardization of the lending model like in traditional banks. Instead, the key terms need to be arrived at through negotiation between the two parties. For enterprises, this method will be direct financing, where the funds mainly come from investors or self-owned capital of financial organizations, the most common of which are wealth funds, private equity funds and so on.

2.1.3.3 The merits of “Chinese dequity”

(1) The financing entities can obtain the funds rapidly.

Compared with traditional bank loans, “Chinese dequity” is more convenient to operate. It is only necessary to clarify means of equity repurchase and interest payment in the *Equity Transfer Agreement*. Equity repurchase can be done by shareholders or third parties; interest payment can be done through premium repurchase or monthly/seasonal/annual payment similar to that of commercial loans. The ways of operation are simple and convenient. It is conducive for financing entities to rapidly obtain the fund they need and satisfy their demand for funds.

(2) The financing entities face less fund use restrictions.

Compared with traditional bank loans, the financing model through “Chinese dequity” faces less restrictions on fund use and the financial contract. Once the fund goes into an enterprise, it is neither much different from the enterprise's equity capital nor subject to too much control by the investor. And it does not face too many regulatory constraints, neither.

(3) It is conducive to improving the credit rating of the financing entities.

For financing entities, fund is injected in the form of equity. It is not the enterprise's liability and does not occupy the enterprise's line of credit. Instead, it increases the enterprise's equity capital. The credit rating of the debt financing is correspondingly improved, and the utilization rate of the financing entities' assets is increased accordingly.

(4) It is conducive to ensuring the safety of the financing entities.

Investors inject fund into investees and investors naturally become the shareholders of investees. Although investors normally do not participate in companies' management and decision making, they often require the establishment of one-vote veto system with regard to major issues or issues concerning their interests, so as to fully ensure their right to know and participate as shareholders and timely involve and affect company decisions when companies make decisions involving their core interests. This is conducive to ensuring the fund security of investors.

2.1.3.4 Application types of “Chinese dequity”

“Chinese dequity” is neither the proper name of a financing tool nor a legal term. Its emergence mainly highlights the intrinsic contract of the financing method and the relationship in terms of rights and obligations among various interest parties, while breaking the sole pattern of financing forms (Su, 2016). In practice, the common application types of “Chinese dequity” include the following:

(1) Loans directly disbursed by private funds: Since private funds do not have loan disbursement qualifications, they often complete debt investment behavior in the form of equity investment plus repurchase through “Chinese dequity”.

(2) Equity + creditor's rights: The investor gains a certain percentage of equity of the target company in the form of registered capital parity when the company is established. The rest will be disbursed as loans to the target company in the form of bank loans or shareholder loans. In practice, however, this approach involves games. Investors believe that in accordance with the stipulation by the State Administration of Taxation that “shareholder loans shall be reasonably accounted in financial cost and not be regarded as operating expenses”, its legitimacy is confirmed. However, there are still some risks in practice. Neither the General Rules on Loans nor the Supreme People's Court has explicitly indicated approval or prohibition of lending between shareholders and the target company. Therefore, such practice lacks legal support.

(3) Industry fund in the form of PPP: From the Measures for the Administration of Concession for Infrastructure and Public Utilities released in 2015, we have learned that China encourages equity investment in enterprise projects by means of industrial funds so as to provide enterprises with sufficient funds and realize innovative PPP financing. The investors

hold shares of the PPP project company by establishing industry funds, while the government and other stakeholders shall be responsible for giving PPP project company income guarantee.

(4) Debt-to-equity model: Unlike the newly launched model of “debt investment in the form of equity investment”, the debt-to-equity model will still exist as creditor’s rights during the equity conversion. In the actual transaction structure design, first the contract is defined as capital increase agreement, which stipulates the occupied shares. Besides, a transition period will be agreed upon in the capital increase agreement to avoid capital borrowing and lending among enterprises.

2.1.3.5 Common forms of Chinese dequity

1. Structural asset management products

Make direct or embedded equity investment by designing structural hierarchical asset management products, such as trust plan, broker asset management, private equity and insurance asset management. On the asset management product level, secure the priority-level principal and interest earnings with inferior level in such forms as additional enhancement funds, issuance of earning gap compensation letter, acceptance or repurchase, so as to ensure the priority-level receive the principal and interests in full amount to realize exit.

When the new policy of asset management is implemented, this model will no longer exist.

2. Repurchase/Acceptance

By stipulating that such capital demanders as other shareholders or the actual controller of the target company shall unconditionally repurchase or accept the investor’s equity according to certain premium rate in the Equity Investment Agreement signed in advance or the independently signed Equity Repurchase or Acceptance Agreement, so as to ensure that the investors can be the first to recover principal and investment earnings.

There are two ways of operation in practice. One is long-term repurchase and long-term payment of investment principal and interests. The other is repurchase on demand and long-term payment of investment principal and interests. This model may appear to be fund equity investment. But it is in fact a credit-debt relationship. It is a typical model of Chinese dequity.

3. Periodic dividend distribution

Although the Asset Management Association of China has not given the boundary of “periodic dividend distribution”, it can be seen from the definition of Chinese dequity that

periodic dividend distribution refers to a model where investors enjoy the priority to gain some dividends from the target company regardless of the operation of the target company, the accumulated dividends gained by investors equal the addition of their investment principal and the earnings calculated according to certain premium rate, and the investors normally do not participate in the management and operation of the target company.

This model is to some extent invisible. It should be judged together with the signed investment contract. But its nature complies with the two characteristics of Chinese dequity, which belongs to atypical Chinese dequity.

4. Supplement of balance

Provide supplement of revenue differences or liquidity support through equity investment with the target company or other shareholders, the actual controller or a third party as the investor (or the management product), in order to compensate for the loss of the principal and the interest failing to reach the expected return portion received by the investor from the target company during the investment period. Then the investor transfers the corresponding equity to the difference supplement party at zero consideration.

The model, which has a certain hidden nature, has not been clearly included by the regulatory authorities as Chinese dequity. In practice, there are various forms of difference complement. Yet as long as the effect of securing the principal and interest is achieved, this thesis holds that it is still Chinese dequity in essence.

5. Valuation adjustment mechanism

VAM is a financial clause designed to invest in uncertainty about the future prospects of the investee, in order to protect the interests of investors. In the PE/VC investment, the original intention and purpose of the investor is not fixed income, but a several times or dozens of times of the return after successful investment.

Obviously, not all VAMs are Chinese dequity. Only the VAMs that comply with the two characteristics of Chinese dequity, which is, investors only charge a fixed amount of return and investors do not participate in the management of the target company, can constitute Chinese dequity.

In order to avoid legal risks, “Chinese dequity” is often worn a variety of disguises and multi-layer embedment. As a result, “Chinese dequity” has a variety of patterns. If the true color is revealed, “Chinese dequity” can be simply summarized in two models.

Firstly, the financing subject undertakes the obligation of repaying the principal and interest directly. Take Company A as the investor and company B as the investee. Company A injects its capital into Company B in the form of equity. In the meantime, Company A receives equivalent shares from Company B, and Company B shall, within a specified period of time, promise to buy back the issued shares from Company A at the issue price. In order to improve the performance ability, Company A will generally require Company B to mortgage equivalent assets to Company A.

This mode is somewhat based on a clear relationship between creditor's rights and liabilities and the clear rights and obligations of both parties. But it often records the changes of the board of directors, the shareholder roster and so on, showing that creditors are actually shareholders of the invested company, reflecting that the creditors are the shareholders of the invested enterprise. In accordance with the provisions of the *Company Law*, only in the following circumstances can the shareholders who vote against the resolution of the shareholders' meeting request the company to purchases their equity at a reasonable price: (1) The company has divided, merged or transferred its key property; (2) the company has been earning profits for five consecutive years and meets the conditions for distributing profits stipulated in this Law, but has not distributed profits to its shareholders; (3) the term of operation stipulated in the Articles of Association expires or the Articles of Association enables the company to survive. It can thus be seen that shareholders, under general circumstances, cannot ask the company to buy back their shares. Thus, this model of “Chinese dequity” has the risk of breaking the law.

Second, the third party assumes the obligation of repaying the principal and interest, and the invested enterprise does not assume the obligation of repaying the principal and interest. Assume that Company A is the investor and Company B is the investee. Company A injects its capital into Company B in the form of equity. Company B issues equivalent shares to Company A, and Company C promises to buy back the issued shares from Company A at a specific time at the issue price. In order to improve the performance ability, Company A will generally require Company C to mortgage equivalent assets to Company A.

The transaction structure of the second type of “Chinese dequity” is quite complex. But it does not have the risk of breaking the law.

2.1.3.6 Legal framework and risk analysis of “Chinese dequity”

The financing method of Chinese dequity divides the rights and interests of each interest party through various contracts, and the safeguarding of the rights and interests of the capital interest party is often stipulated by contract terms. According to the classification and definition of “Chinese dequity”, it is mainly restricted by two legal documents, namely, *Equity Transfer Agreement* and *Equity Contribution Agreement*. Further analysis of the two agreements will be made as below.

The *Equity Transfer Agreement* is an arrangement that facilitates capital withdrawal and helps the investors obtain fixed capital return. Generally, it stipulates rights and obligations of the two parties, exit time and the proportion of transferred equity. However, in this process, investors will have to bear the following two legal risks:

(1) Risk of bearing the liability with the amount of contribution as limit. Should the transferee fail to cover its debts due, and all its assets cannot cover all its debts or it obviously lacks solvency, the bankruptcy liquidation procedure will be entered into. Because the information published in the industry and commerce department possesses effect of demonstration, the investor cannot enjoy creditors’ compensation priority and can only get compensation after other bankruptcy credits are liquidated. Therefore, investors are confronted with risk of not being able to recover principal and might bear the liability with the amount of contribution as limit.

(2) The inability to safely exit. Whether the funds can safely exit depends on the operating results of the transferee. If the transferee meets with such problems as operating difficulties and insolvency and becomes unable to withdraw the amount used for equity purchase, then the investor will not be able to realize the safe exit of the funds.

Generally speaking, the *Equity Contribution Agreement* includes agreements on investment quotas, cooperation purpose, investors’ rights and obligations and so on. However, in this step, investors will have to bear the following two legal risks:

(1) Risk of inadequate funds. When the new company is established and enters into the subscription procedure, the investor shall subscribe the capital amount in accordance with the

provisions. If the investor fails to pay their respective amount of contribution in full amount within the stipulated period, other investors will undertake to make up for the missing amount. The party that fails to pay the amount in time shall not only pay the missing amount to the company, but also be liable for breach of contract for the shareholders that have paid the full amount of contribution in time.

(2) The pricing risk of the equity percentage taken up by the investment amount. For investors, the larger the investment, the greater the return. In short, the amount of contribution affects the future interest rates. Besides, both parties need to consider how much percentage the amount of contribution takes out of the equity, whether it will affect the original equity structure, and whether it will affect the actual control rights.

The main risks of “Chinese dequity” lie in the following aspects:

(1) Fairness of equity repurchase price

For commercial banks, the risk of “Chinese dequity” is higher than general debt financing business. Therefore, the main financing objects are state-owned enterprises. Yet state-owned enterprises tend to involve such issues as the preservation and appreciation of state assets. Thus, in the equity transfer link, it might not be approved by the State-owned Assets Supervision and Administration Commission (SASAC) due to the fairness of equity transfer price. For example, when the project company is suffering from losses and requires state-owned shareholders to repurchase shares at a premium, the repurchase price will go higher than the evaluated price and thus cannot be approved by SASAC.

(2) Risk of bankruptcy of the project company

Exit of the Chinese dequity business is mainly realized though equity repurchase by the project company’s shareholders/actual controllers. However, if bankruptcy liquidation happens in the project company, the equity held by the investors will lose its value, in which case the repurchase party may refuse to purchase the worthless equity.

(3) Legal risk

“Chinese dequity” is a vague state between “debt investment” and “equity investment”. As a result, its legal status is not clear. Therefore, in judicial practice, if “Chinese dequity” is regarded as equity investment, investors shall not demand repayment of capital with interest and thus cannot get regular returns. If it is regarded as debts, and the returns are not regarded as interest in accordance with the prior agreement, then deposit rates shall instead be applied

by arguing on the grounds of unclear agreement; Even if the returns are dealt with as interest but in excess of legal rates, the excess portion will be taken as invalid and thus unable to get expected returns.

(4) Credit risk

In the operating model of “Chinese dequity”, investors’ rights and interests are not guaranteed in the form of assets. Since corporate and individual credit systems are not sound in China at the present, once problems arise such as imbalanced operation, many enterprises will try to evade debts as much as possible. As a result, investors become the innocent victim.

(5) Return Risk

The “Chinese dequity” has two return risks: First, after the nature of the contract is identified as debt, the investors’ expected returns cannot be realized, and the part higher than banking interest rate in the same period cannot get support from the court. Second, when the target company enters into the bankruptcy liquidation procedure due to poor management, investors will have to assume the corresponding risk according to the equity allocation.

(6) Supervision Risk

Generally speaking, under the transaction model of “Chinese dequity”, investors often enjoy returns, but do not participate in the actual operation and management. Such mechanism will cause the shareholder’s right to be left unused, where investors lack effective supervision of the target company. Apart from this, “Chinese dequity”, which mainly targets such industries as government financing platforms and the real estate industry, is subject to the influence of relevant policies, leading to risks of compliance and regulation.

2.1.4 Putable common stock

2.1.4.1 Definition of putable common stock

Putable common stock refers to the company which undertakes equity financing promises that at a certain point in the future after the issuance of the stock or during a period of time after the issuance, if the market price of the stock issued by the company is lower than a predetermined price agreed upon at the time of issue, the holder will have the right to obtain a stock from the company that compensates for the difference between the stock market price and

the preset price difference. It indicates that the investors not only can obtain the new shares issued by the issuing company, but also obtain the selling option contract of the stock (Luo,2001). Since putable common stock has the characteristics of embedding common shares and selling options, it is an innovative financial instrument and product (Huang & Lin, 1998).

If company A prepares 5 million yuan of equity financing in order to expand the scale of operation, but investment banks think the company's stock issuance price is best set at 8 yuan per share due to the stock market downturn and the limited size and popularity of company A. However, the company's board of Directors is confident that the company has a certain core competitiveness and profitability to have a good prospect of investment income so that the price of each share should not be less than 10 yuan. In order to ensure the smooth proceeding of equity financing, Company A has adopted the financing model of putable common stock. The specific approach is: Company A sells shares to the public at a price of 10 yuan per share, and at the same time provides investors with a free share of the stock's selling options contract, stimulating that after 2 years investors can sell all their putable common stock to Company A at a price which equals to the price when stock is issued. If 2 years later the company's stock price equals 10 yuan per share then investors can preserve capital, there is no gain or loss; if 2 years later Company A's stock price is higher than 10 yuan per share, investors can obtain certain income of investment. In both cases above, investors generally choose to abandon the implementation of the option contract in consideration of their own interests. The selling option will automatically expire, and the putable stock will be reverted to common stock; if the stock price of Company A is less than 10 yuan per share after two years, the investor will generally choose to sell the option contract from the perspective of evading the risk, and be able to obtain compensation for the difference between the selling option price of 10 yuan and the stock market price. At the same time, the putable stock will be reverted to common stock. It can be seen that the putable common stock has a certain degree of innovation. For investors, the putable common stock can guarantee that the value of the equity owned by investors must not be lower than a certain preset value, which can effectively reduce the investment risk of investors and market fluctuations and investment problems created by uncertainties. It is conducive to investors to form reasonable forecasts and effective expectations. To some extent, investors' commitment to investment can be enhanced. For stock issuers, companies can issue shares at its intended price, effectively avoiding the undervalued value of its shares, helping it

to sell shares quickly and get financing, while also demonstrating its confidence in the company's development prospects and profit prospects.

2.1.4.2 Characteristics of putable common stock

1. Investors can't sell stocks before they exercise their rights

The core of the putable stock is “putable”, which means that the investor sells their putable stock to the issuing company when the selling option expires. If the stock market price is lower than the issuing price at that time, The investor can obtain the difference between the issue price and the market price, which is equivalent to the investment, and can obtain the repurchase price consistent with the issue price to ensure that the investor does not lose money. The “putable” here is limited by the option contract and must be exercised at the agreed time. During this period, investors hold the putable stock instead of the ordinary stock, and cannot be sold at will (Tian, 2000).

2. Selectiveness of exercising of investors

After the expiration of the putable stock option, the decision of whether the investor chooses “repurchase” is made by the investor, but the exercise of the right is conditional. The investor can only exercise the power within the agreed period. If the power is not exercised during the appointed period, it will automatically expire. At the same time, the exercise of power must be carried out at a pre-agreed price. Regardless of whether the investor exercises power or not, as long as the exercise period is exceeded, the stock held by the investor will be converted into ordinary stock.

3. Diversity of compensation methods

There are several main ways for investors to obtain margin compensation: First one is cash, which is the issuing company compensates the investor in cash for the difference between the selling option price and the stock market price, but because the way of advanced payment is not conducive to the management of corporate capital and it will also increase the company's liquidity pressure, so this way is rarely used. The second way is common stock. That is, the issuing company compensates the investor for the difference between the selling option exercise price and the stock market price in the form of common stock. For example, A has 500 shares of the putable stock issued by Company B, and the issue price per share is 10 yuan. If the stock

price during the period of the investor's exercise is 5 yuan per share, then the investor can obtain 500 shares of the ordinary from the issuing company for free. After the shares are exercised, the original 500 shares are also converted into ordinary shares, which means that A owns 1000 shares of common stock of Company B. In this way the wealth of investors has not changed. If the investors can sell all stocks, although there is no profit but it can ensure that there is no any loss as well. If the investors are willing to continue to hold, the stock price will increase and as the number of shares held by investors increases, the income will also increase under the premise of which stock price increases. Reverse these approaches for shorting in downtrends of the price of stocks; for the issuing company, the putable shares that compensate the difference by ordinary shares will not occupy the company's cash flow but help the company to operate and manage.

The third way is to choose to pay. That is, the issuing company may select one or more combinations of common stock, cash, preferred stock and bonds to pay the difference compensation. This approach gives the issuing company greater payment options with a high degree of flexibility to help the issuing company according to its actual operating conditions to choose the most appropriate way to "put" shares in the manner that is most conducive to its own actual situation, which is currently the most widely used one.

2.1.4.3 Advantages of putable stock

First, the putable stocks can help companies to effectively finance in a weak market. The stock market has characteristics of marketability which is cyclical and volatile. The demand for corporate equity financing may not coincide with the changes in the stock market. During the bull market, the equity financing conditions of enterprises may be not mature yet; when stock market is getting down, companies need to expand through equity financing. At this time, companies either choose to give up the opportunity to develop, in the risk of venture or seriously underestimate the value of the company's shares.. By issuing putable stocks, it can ensure that investors will not lose money and also attract investors to buy stocks in a depressed stock market environment, which enables enterprises to obtain ideal stock issuance prices and effectively achieve equity financing.

Second, the putable stock can help strengthen the company's governance structure of the improvement. The nature of putable of the marketable stock determines that the investor can preserve the capital, and the issuer will bear certain risks because of the volatility of the stock

market. If the market price is lower than the issue price when the investor exercises, then the issuing company will produce a loss. This will force enterprises to conscientiously fulfill the company's management functions, promote the company's product upgrading, improve the effectiveness of the company's business governance, is conducive to the company to promote the construction of corporate governance structure.

Third, the putable stock can help reduce the asymmetry of market information. In general, the issuing company has more information about the stock market so there is a large gap of information between the issuing company and the investor, which has obvious advantages of information resources. If the issuing company can not accurately judge the future operating performance and profitability of the company, it is necessary to bear the corresponding risk of loss, the issuing company dares to sell putable shares, indicating that the company can effectively grasp the relevant information, to cut the market changes full of information, which also reflects from the side the company's confidence in the development prospects and profitability and willing to transfer the future risks that investors often struggle to grasp to themselves. In this sense, the putable shares can effectively alleviate the problem of information asymmetry between the investment and financing sides in the market, promote the flow of resources to high-quality enterprises and industries, and achieve the optimal allocation and rational application of resources.

2.1.5 Convertible bond

2.1.5.1 Definition of convertible bond

A convertible bond is a mutually convertible financing instrument between bonds and stocks. Bondholders can convert bonds into ordinary shares of the company at the price agreed upon at the time of issue. Apparently, bondholders can also continue to hold bonds without conversion, until the expiration of the receipt of the principal and interest, or directly in the market to sell and cash.

2.1.5.2 Literature research of convertible bond

Convertible bonds first appeared in the 19th century, formed a variety of research models in the development process. C.J.Pilcher (1955), E.Brigham (1966) and J.R.Hoffilleister (1977),

presented the "Sweetheart Hypothesis" and the "Premium distribution hypothesis". They believe that the issuance of convertible bonds is based on two motives: one is that convertible bonds have low interest and contains options, and the other is the premium conversion of convertible bond. Jalan and Barone-desi (1995) proposed a tax offset hypothesis which interprets the issuance of tax-subsidized convertible bonds issued using bonds and delays equity financing. Mayers (1998) proposed the sequential financing hypothesis that demonstrates convertible bonds can solve the problem of stage financing, avoid excessive investment to reduce the cost of bond issuance and guide investors to avoid investment risk, which is the best way for corporate financing. Jensen (1986) and Stulz (1990) believe that debt will reduce the cash flow of enterprises and effectively motivate management to make beneficial shareholder behavior; Green (1984) believes that creditors and shareholders will have a conflict of interest in the investment and financing process and decision-making, because shareholders bear only limited liability. Shareholders will transfer the risk of investment and financing to creditors; Brennan and Schwarts (1988) argued that when a certain risk occurs in the company's operation, the company will issue transferable bonds because the transferable bonds can be regarded as a combination of ordinary bonds and warrants, which can reduce the risk of the company; Myers (1984) considered that because of the asymmetry of information, which makes the stock market difficult to predict, there is a greater risk in investing in stocks. Convertible bonds can be used as an effective attempt to make equity entry "through the back door", which can reduce the company's operating risk.

The Chinese domestic convertible bond market has developed slowly. Chinese scholars Yang, Wei, and Liu (2002) in the book "Convertible Bonds and Performance Evaluation", analyzed the timing, distribution method, circulation of convertible bonds, and optimized companies for convertible bonds. The internal governance structure and the role of the external governance environment were fully explored; Deng (2004) discusses the clause design of convertible bonds and how the value of bonds can affect the value of the option in time from the aspects of the term of convertible bonds, the period of conversion and the correction of the conversion price.; He and Xia (2005) compared the financing costs of different types of bonds, analyzed the financing preferences of convertible bonds and how the convertible bonds affect the stock price and other aspects of the comprehensive study of convertible bonds; Ling, Zheng Feng (2005) believes that convertible bonds have the characteristics of both option and equity, and can use convertible bonds to achieve equity incentives, thereby inhibiting and stimulating

the company's management, which can effectively reduce the conflict of interest between shareholders and creditors; Liu Yuping (Liu,2006) analyzes the investment tendency of convertible bonds to the management of the company through model construction Impact.

2.1.5.3 The characteristics of convertible bonds

Convertible bonds combine the characteristics of bonds and stocks and have the following three characteristics:

1. It has both creditor's right and equity nature. Convertible bonds is a kind of bond, with the basic nature of ordinary bonds. There are agreed interest rates and deadlines. Because of the restrictions imposed by the laws of our country, convertible bonds can not be higher than the bank deposit rate at the same time so that convertible bonds are low-interest low-cost financing before they are converted into equity. When convertible bonds expire, investors can charge interest, or they can convert them into shares. The original bondholders are converted into shareholders of the company who are able to participate in the company's business decisions and distribution of benefits and to affect the company's equity structure to a certain extent.

2. Convertibility. Convertibility is an essential feature of convertible bonds, and bondholders can convert bonds into stocks on agreed terms. When an investor purchases a convertible bond, it is expressly agreed that, under the agreed conditions, the investor may convert s the bond into a stock, and certainly the investor may not exercise the power to hold the bond, charge interest and principal until it expires. However, due to the low interest rate on convertible bond investment, investors will fully consider the stock market situation and decide whether to convert according to the price trend of the stock. If the investor is optimistic about the shares issued by the company, investors will certainly exercise the right to convert, if the investor believes that the stock is fluctuating and the investment risk is too high, the investor may consider the maturity of the income receivable. For companies, convertible bond rates are much lower than ordinary bond rates, and companies can effectively reduce corporate financing costs by issuing convertible bonds

3. Redeemability. Redemption means that the stock price of the convertible bond of issuing company continues to rise for a certain period of time. When a certain price standard is reached, the issuer can purchase back the convertible bonds at the price agreed in advance. A typical issuing company will design a redemption clause when it is agreed on the terms of the

convertible bond, with the aim of reducing the company's issuance costs. The redemption right is actually a kind of call option, which is a kind of right given to the issuing company. its exercise accelerates the conversion of convertible bonds to the company's ordinary shares, helps to reduce the company's financial operating costs and to avoid the occurrence of financial crisis has a certain inhibitory effect.

4. Puttable. Contrary to redemption, put provision is mainly a clause designed for investors, and it is a right given to investors. When the value of convertible bonds converted into stocks is much lower than the denomination of bonds, the investor conversion is bound to face serious losses and investors are certainly unwilling to convert. Meanwhile, the investor may require the issuer to add a certain interest rate to the repurchase period of the bond in denomination amount. This design clause protects the interests of investors to a certain extent, reduces the investment risk of investors, and can effectively weaken the behavior of the shareholders of the issuing company to the detriment of the bondholders, so that the interests of shareholders and the interests of creditors are consistent.

2.1.5.4 The stock nature of convertible bonds and the judgment of debt tendency

Convertible bonds combine the nature of equity and the nature of bonds, so they are both stock and bond, and can be considered as the superposition of equity and bonds. Analyzing the aspects of convertible bond stock and debt is more explicit can be judged from the following three criteria: (1) analysis of the risk appetite of the investment subject. If the investment subject's risk appetite is high, then convertible bonds are more emphasis on equity; If the investment subject's risk appetite is low, then convertible bonds are more bond-oriented. (2) Analysis of the design of the terms of the convertible bonds. If convertible bonds are clearly set up to be converted into shares after a certain period of time, then convertible bonds are clearly biased towards bond. (3) If the mandatory conversion clause is not set, it needs to be analyzed from the conversion intention of the investment subject, if the conversion intention is strong, then the emphasis is on the stock; if it is unwilling to convert, then the emphasis is on bond.

2.1.5.5 Advantages and disadvantages of convertible bonds

Convertible bonds have the following advantages:

1. Low cost of convertible bond. Interest on convertible bonds is lower than the interest rate on bank deposits over the same period, while ordinary bond interest rates tend to be higher than bank deposit rates, which can effectively reduce the cost of financing enterprises.

2. Flexible manner. Ordinary bonds have specific expiration dates and interest rates, and the redemption clauses and put provision of convertible bonds are more flexible and can be designed with more flexible expiration dates. Moreover, the terms and conditions of convertible bonds are designed in various forms, with flexible design and flexible financing methods.

3. Obvious capital advantage. If the company has a good development prospect and the company's stock premium ability is strong, then convertible bond holders will convert convertible bonds into stocks, so the company is equivalent to a low-cost financing and there is an opportunity advantage of investment costs.

4. Ability to reduce corporate debt. Ordinary private lending or financial borrowing will aggravate the company's debt, which is not conducive to the company's credit rating assessment. The convertible bonds have the nature of equity and generally will not be counted in the company's balance sheet, which helps to reduce the company's debt, improve the company's credit rating.

Disadvantages of convertible bonds:

1. Small tax shield effect. The financing cost is low because of the low interest rate on convertible bonds, which has a lower tax shield effect than ordinary bonds.

2. Large dilution effect. If investors choose to convert bonds, they will become shareholders of the company, which will lead to the company's original shareholders to reduce the amount of shares, dilute the original shareholder equity.

3. Strong uncertainty factor. The issuance of convertible bonds will certainly ensure the success of the conversion. If the conversion fails, then the company would face a higher interest rate burden than ordinary bonds, the company will therefore bear greater financial pressure.

4. Since convertible bonds are bonds issued by companies that are directly linked to the company's operating performance, there may be some pressure to be paid if the company's operating conditions deteriorate.

2.1.6 Leverage employees stock ownership plans

2.1.6.1 Definition of leverage employees stock ownership plans

Employee Stock Ownership Plans (ESOP) refers to employees who own part or all of the company's equity by purchasing part or all of the company's equity. The employees become shareholders of the company and exercise the company's management rights.

Leveraged ESOP refers to the use of equity guarantees to purchase company stocks through borrowing. This practice involves the employee stock ownership plan foundation, the company where the employees work in, the shareholders of the company and the loan bank. The purpose of the employee stock ownership plan is to motivate employees to be positive and creative, to make employees become the masters of the company, to enhance the cohesiveness of the company, to ensure that employees can get the benefits, to obtain the benefits, and to give employees the opportunity to increase the additional income, so it is widely used in the industry.

2.1.6.2 Implementation steps of the leveraged employee stock ownership plan

1. Firstly, establish an Employee Stock Ownership Plan fund that is recognized by all participating employees on the basis of soliciting the will of all participating employees. They can choose to manage the foundation by a bank or a trust company, or by an individual or company that is not related to the company or a general employee.

2. Secondly, the company guarantees that the employee stock ownership plan trust fund will apply for a loan to the bank as a debtor on the grounds of implementing the employee stock ownership plan, and sign a loan agreement with the bank, or directly loan the bank to the company, and then the company will transfer the loan to the employee stock ownership foundation. After the employee stock ownership foundation obtains the loan, it purchases part of the company's stock at a fair market price. The foundation becomes the company's shareholder, participates in the company's business management decision, uses the profits and other benefits it receives for the return of the principal and interest of the bank loan.

3. The return of the loan is still a gradual process. The gradual return of the loan also means that an equal proportion of the stock will be admitted to the employee's account. After the loan principal and interest are returned, the stock is converted to all employees.

2.1.6.3 Characteristics of leverage ESOP

1. Credit leverage must be used. Capital must be obtained in the form of a bank loan to purchase shares in the company.

2. Must be managed by a specialized agency. In practice, most companies establish an employee stock ownership plan trust foundation, which is managed by the foundation. Enterprises generally cannot intervene in the shares managed by the foundation

3. Corporate employees must be required to participate extensively. If the scope of employee participation is not enough, it will increase the risk and the bank may refuse the loan. The United States stipulates that employees participating in the ESOP must account for 70% of non-high-paying employees, and those employees in the program must earn more than 70% of the benefits of high-paying employees.

4. Equity is limited. In practice, although the employee stock ownership plan allows employees to become shareholders of the company, but for the sake of healthy and reasonable operation of the enterprise, it often only gives the employees the right to earn income, while voting rights, participation decision-making power, management rights, etc. are rarely given to employees. That is because it is difficult to reach a unified opinion, which is not conducive to the effective management of enterprise management and corporate strategy opportunities.

2.1.7 Analysis and comparison of several financing models

Through a systematic analysis of the actual debt investment in the form of equity investment, mezzanine financing, puttable stocks, convertible bonds, leverage employee stock ownership plans and project financing arrangements, we can clearly realize that the application of mezzanine financing financing generally needs to meet the following conditions: 1. The company lacks sufficient funds to expand the industry or acquire mergers and acquisitions; 2. The company has high debts, bank loans are difficult, or the amount of loans obtained is insufficient to support the development of the enterprise; 3. The company is in the growth stage and has good internal and external environment, and the company administration department is full of confidence in the future development of the company and the profitability of the company; 4. Enterprises that are most suitable for MBO, having M&A plans, can grow rapidly and will be listed on the stock market. There are different reasons for each type of mezzanine

financing certainly, but it is undeniable that the cost of mezzanine financing is relatively high, and the general interest rate is between 10% and 20%. Mezzanine financing is also a kind of borrowing financing. The company's debt repayment sequence is ranked after the loan; mezzanine financing is a subordinated bond, and will be required to provide the equity subscription right when the company is listed or acquired.

The puttable stocks are riskier for the issuer. If the issuer's mismanagement leads to a sharp fall in the stock price, the issuer will bear huge compensation for the difference, triggering the company's financial crisis and even directly leading to bankruptcy. Therefore, the issuing company needs to have good profitability and development potential, but the company's development potential is subject to the company's management mechanism, operating mechanism, company products, company visibility, company innovation ability, and the company's core competitiveness, so it is difficult to effectively control. In the actual investment, it is suggested that a large-scale listed company or a company with strong profitability and good market prospects can be used as a resaleable stock issue target, which can reduce investment risks and inject capital for the company's development. It is rarely used in large-scale infrastructure construction.

There are also many risks in the actual operation of convertible bonds. For example, the dilutable effect of convertible bonds analyzed above is large, the uncertainty factor is strong, and there is a risk of redemption, so there are still many uncertain factors in actual operation. In large-scale infrastructure construction projects, large-scale financing is needed, which often makes it difficult to raise sufficient funds for project construction.

The leverage employee stock ownership plan mainly involves the company's employees to subscribe for the company's equity. In the process, the company needs to guarantee. The source of funds for this financing method is still the bank. Banks generally review the guarantor's guarantee qualifications, that is, the company's credit rating and liabilities. For some debt-ridden companies with poor credit ratings, it is difficult to obtain effective financing.

The financing model of the actual debt investment in the form of equity investment has advantages that are the financing entity obtains funds quickly, it has less restrictions on the use of funds, is conducive to improving the credit rating of the financing entity, and is beneficial to the security of the investment entity. In the process of construction of large-scale engineering projects, although the above-mentioned centralized financing mode has certain advantages, for the financing needs of large-scale construction project construction, there are still disadvantages,

either the financing cost is too high or the financing risk is large. Therefore, this paper mainly focuses on the application of the real-stock debt financing model in large-scale construction projects.

2.2 Transaction structure

2.2.1 Transaction structure overview

Transaction structure design is a way to better serve investment practices. It is an applied discipline that combines management and investment, with information economics and principal-agent theory as the analytical method. It is risk management-oriented and aimed at value creation. Apart from that, transaction structure design, whose core content include incentive and constraint, uses system and mechanism design theories as well as risk management theories as guiding thoughts. It is implemented through governance and finance and develops continuously in the context of culture and law.

Transaction structure design realizes further optimization of system, contract and mechanism as well as reasonable allocation of control rights, returns and risks. Through maximum mobilization of human capital, it exercises overall control of risks and resolves the conflict of interest between the principal agent and the interested party. Combined with improved Pareto efficiency of information cost and transaction cost, the goals of value appreciation and risk reduction are thus achieved.

The transaction structure of financial products is actually an organizational model established for various stakeholders and a way to comply with and perform the contract. The contract involves such various aspects as risk taking, default penalty, profit sharing and behavior constraint. This structure involves not only the arrangement of responsibilities and rights and the sharing of risks between capital providers and the invested enterprise, but also the participation of other stakeholders (such as industry associations and insurers). Financing can only be completed under the premise of mutual restriction and interaction. Therefore, to establish a transaction structure, various aspects need to be taken into consideration, including what role stakeholders play, what approach to take and what risks to take.

2.2.2 The functions of transaction structure

Transaction structure design mainly addresses the following problems:

First, information cost and information efficiency. Increase signal screening effect and signal transmission through reasonable transaction structure design, establish equal and fair investment cooperation relationships of mutual benefit, and abandon non-cooperative behaviors such as cheating, stealing and damaging the other party, thus reducing information cost.

Second, control rights allocation. In project financing, scientific allocation of control rights can not only motivate contractors to maximize project financing efficiency, but also lower project financing cost and implementation cost.

It can thus be seen that the key to transaction structure design is the allocation of control rights. In addition, factors such as information exchange, establishment of supporting systems and corporate operation and management are also indispensable.

2.2.3 The purpose of transaction structure design and the composition of transaction structure

The basic principle of transaction structure design is the principle of balance, which requires that during transaction structure design, full emphasis should be laid on the balance among transaction complexity, transaction risks and transaction cost and full attention paid to the balance of the rights and obligations, risks and responsibilities of both parties. The purpose of transaction structure design is to select an optimal arrangement within the legal framework to determine the rights, status and responsibilities of the two parties after mergers and acquisitions under the premise of fully satisfying the transaction intention of both parties and reducing the transaction costs and risks of both parties, so as to finally determine the decision-making power of the future development direction of the enterprise.

In general, a transaction structure consists of the following parts:

1. Acquisition method (assets/equity);
2. Payment method (cash/equity swap) and time;
3. Risk allocation and control;
4. Financing structure;
5. Transaction organization structure (ownership structure, internal control and so on);

6. Exit mechanism.

2.2.4 Issues needing attention in transaction structure

1. Whether it can meet the purpose of the two transaction parties

The purpose of transaction structure design is to meet the needs of all parties and balance the interests of all parties. Therefore, the actual needs of both parties must be fully considered. However, in practice, the needs of the two parties are often inconsistent, or even contrary to each other. Satisfaction of Party A's wishes may damage Party B's wishes. Therefore, we need to take full account of the transaction structure design. For example, if the seller wants to trade quickly, then the transaction structure design should be as concise as possible. For another example, if the buyer's funds are insufficient to pay off the bid in one time, the payment model can be designed into installment payment; if the two parties find it difficult to predict the future profits and losses of the transaction object, they can arrange a VAM clause; if the buyer is worried that the seller may leak the core technology after transaction, a non-competition or compensatory clauses can be set.

2. Whether the transaction structure complies with legal provisions.

Transaction structure design must be within the legal framework. Any transaction structure that goes beyond the law or violates the law is invalid from the beginning, it cannot pass the examination and approval of the regulatory authority. During transaction structure design, the provisions of such laws as the *Company Law* and *Securities Law* should be complied with and operation be done to the extent permitted by law.

3. Whether the transaction structure is operable.

Transaction structure design must be practical and operable. When it comes to the acquisition of major assets, the obstacles encountered during assets acquisition and the problems that might occur in the process of acquisition should be taken into full account; When it comes to the reorganization or placement of personnel, the opinions of employees should be fully considered to understand their needs as well as the impacts of various potential factors.

4. Transaction tax payment

From the tax point of view, the buyer can obtain the after-tax benefits through discount after the transaction. Yet it also needs to bear the risks that may arise after the acquisition, such

as debt risk; the seller needs to pay both enterprise income tax and individual income tax. In some real estate mergers and acquisitions, increment tax on land value and deed tax are also involved.

5. Risks

Transaction structure risks include the risks of the transaction itself, such as false information provided by the seller, asymmetric information, unavailability of delivery conditions (whether there is a court freeze, whether relevant approval procedures are complete); operational risks after transaction completion, such as the existence of debts and potential lawsuits, the possibility of the loss of employees, core technicians and core technologies, change of market environment, and adjustment of the operation mechanism. These risks will more or less affect the development of the enterprise after transaction and should thus be fully considered.

2.2.5 Transaction structure design of Chinese dequity

Transaction structure aims at distinguishing the coordination between the two parties and the realization of the interest relationships of transaction between them through the form of contract. Therefore, through different transaction structure arrangements, further differentiations can be made regarding equity rights, debt rights and “Chinese dequity”.

(1) Typical equity investment transaction structure

In the typical structure where assets management products are used for equity investment, investors gain equity of the target company by investing in assets management products. This is a commonly seen equity investment structure. In this transaction structure, capital increment agreement or investment agreement are signed between assets management products and the target company, without special profit-sharing arrangement.

(2) In the transaction structure design for “Chinese dequity”, investors acquire shares of the target company by subscribing to assets management products. The organization that has administrative authority over the asset management product will set up a regular repurchase agreement with the target company and sign a capital increase agreement accordingly. In relevant laws and regulations, without further restrictions on repurchase arrangements within this transaction structure, it will be identified as “Chinese dequity” in most cases. Besides, in relevant legal provisions, if the asset management company possesses loan disbursement

qualifications (such as trust), the court normally tends to deem the contract valid. But when judging the returns of the target company and the asset management organization, the decision should be based on distinguishing between debt and equity. Please see Figure 2-2 for the specific transaction structure:

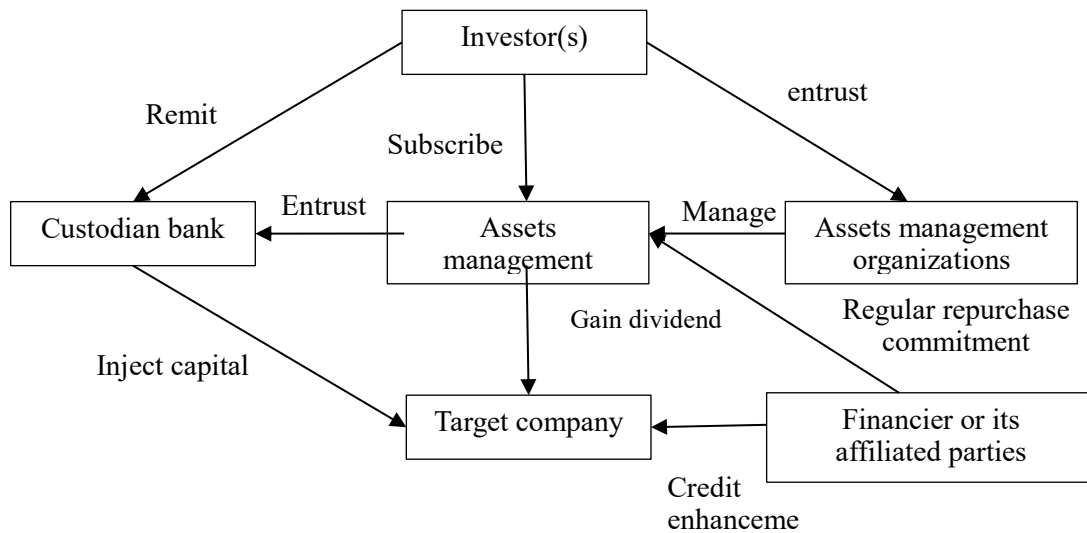


Figure 2- 2 Transaction structure of general “Chinese dequity”

(3) Transaction structure of indirect “Chinese dequity”

Transaction structure design for indirect “Chinese dequity” is often utilized by local governments through financing platforms to implement the construction of related projects. In this transaction structure, investors tend to join the partners fund in the prior stage to safeguard their interests, whereas the local government join this partners fund in the inferior stage, after which the partnership fund thus formed be used by the target company. Besides, as local governments cannot provide strong guarantee for enterprises, they tend to use such means as financial support or letter of condolence to provide minimum protection for the target company’s returns.

2.3 Control rights theory

2.3.1 Connotation of project control rights

The idea of “control right” comes from the English word “authority”. Its connotation, which focuses on corporate management, was first studied in Western countries. Corporate control rights address such issues as coordinative management and balance of interest conflicts among different stakeholders. And decision-making problems in government-invested agent construction projects, PPP projects and BT projects are also a sign reflecting the contradictions among different stakeholders. scholars maintain two major views on project control rights. See Table 2-1 below for details.

Table 2- 1 Definition of project control rights in China’s theory circle

Representative Views	Relevant Scholars and Connotation Definitions
Two-right theory under the perspective of incomplete contract	Sha (2004), Yan (2005) & Ke (2007) et al. believe that control rights of public projects refer to the residual claim about a project. It includes the residual control right and residual claim of projects. The residual control right of projects refers to the right of various stakeholders to exert influence and monitor on various activities in order to realize the residual claim.
	Ye (2011) pointed out that PPP project control right is the concentration of control rights of resources invested by collaborative subjects in order to realize benefits maximization. It includes actual control right and residual control right.
	Yin (2010) divides the control rights of enterprise agent construction projects into control right of decision-making operation and control right of decision-making control.
Concentration of rights under decision-making perspective	Through in-depth studies, Du and Wang (2013) and Gao (Gao, Liu& Zhu, 2015) point out that BT project control rights are a control rights matrix formed by multiple parts: various decision-making points throughout the project lifespan, the four procedures of the decision-making process, and various major participants.
	Xu (2009), Wu and Wang (2015) define PPT project control rights as the ultimate decision-making rights that control project investment in the project operation process.

In conclusion, this thesis defines PPP project control rights as the concentration of influencing rights (abilities) of PPP project major participants about the ultimate decisions of decision-making activities (issues under dispute). In essence, PPP project control right is

resource allocation right or decision-making right. To be specific, the connotation of PPP project control right is mainly reflected in the following aspects:

(1) PPP project control right originates from equity but is higher than equity. Following the characteristics of the project's whole lifecycle, it distributes, transfers and makes dynamic adjustments between different participants.

(2) PPP project control right is a multi-dimensional vector based on multiple factors, multiple subjects, multiple stages and multiple decision-making activities in order to ultimately form PPP project governance structure.

(3) PPP project decision-making activities include vertical supervisory control decision-making activities and horizontal business coordination decision-making activities. Therefore, PPP project control rights include vertical supervisory control rights and horizontal business coordination rights.

2.3.2 Control rights allocation principles

Control rights allocation principles are the important basis for ensuring the smooth implementation of control allocation, increasing cooperation efficiency and realizing optimized resource allocation. Seen from the subjective needs of the principal, control rights allocation principles reflect the value demands of the principal; seen from the overall efficiency of the project, control rights allocation principles reveal the efficiency characteristics of the input factors. Therefore, design and formulation of allocation principles is a key link of control rights allocation.

Aghion and Tirole (1997) put forward that control rights allocation should match up with the available knowledge and information. Lam, Wang, Lee, and Tsang (2007) hold that project control rights should match responsibilities and that control right allocation follows the principle of matching risk sharing. Some scholars believe that control rights allocation is closely related to the efficiency of PPP cooperation model (Hart & Moore, 1988; Hart, 1993; Martimort & Pouyet, 2008). Domestic scholars have done a lot of research and discussions about the principles control rights allocation should follow. The main views include: Symmetry between "risk taker" and "risk maker", symmetry between "residual control right" and "residual claim" (Gong, 2008); match between control right, knowledge & abilities, and responsibilities (Li &

Shi, 2008); Zhang, Jia, and Wan (2009) point out that control rights should be regulated within a certain range to guarantee effective cooperation; Ye et al. (2011) believe that PPP project control rights have always been at the status of adjustment-balance-adjustment in the project operation process.

In conclusion, currently, control rights allocation principles mainly include three types of principles, namely, symmetry principle, efficiency principle and dynamic principle. In the research process, the three principles are constantly given new connotation and the factors for consideration are continuously improved.

2.3.3 Control rights subject

Domestic and international studies on control rights subject can be divided into three schools:

(1) Allocation theory oriented toward the owner of physical assets based on transaction expenses and property rights. This school proceeds from such dimensions as transaction cost reduction, asset specificity protection and team production. It holds that the owner of an enterprise's assets shall have control of the enterprise, whereas human capital shall play a subsidiary role.

(2) Allocation theory oriented toward the owner of human capital based on the resource dependence theory. With the development of market economy, the role of human resources has been more and more prominent in enterprise development. Proceeding from such perspectives of human capital as ability endowment, exciting characteristic and specificity investment, this school holds that human capital should play a dominant role in enterprise control rights allocation, and its status increases with the increase of its importance in enterprise value creation.

(3) Joint allocation theory with the stakeholder theory as a precondition. This school believes that physical assets are not enterprises' only key resources. In the process of enterprise operation, apart from the operational risks assumed by investors, various stakeholders also undertake certain risks. Therefore, based on the principle of symmetry, stakeholders who bear the risk of enterprise operation shall take the leading position in the enterprise control rights.

2.3.4 Control rights allocation model

Control rights allocation research in PPP projects, which has been developing for years, originates from the control rights allocation model GHM for collaborative production of private goods among private departments. Seen from its development history indicated in Table 2-2, the model hypotheses have become more and more specific, factors to consider have been increasing, and the applicability of the research conclusions has been increasing.

Table 2- 2 Development of control rights allocation research

Model	Partner Type	Status	Product Attribute	Investor	Means of Control Rights Allocation	Control Rights Allocation Determinants
GHM (Grossman, &Hart, 1986; Hart& Moore , 1990)	Private-Private		Private goods	Both parties		Level of importance of the investment by two parties of the contract
HSV(Hart, Shleifer & Vishny ,1997)			Public goods	Private		Impact on cost of goods and quality improvement
BG (Besley, T. and Ghatak, 2001)	Public		Purely public goods	Both parties	0 /1	Evaluation of both parties on project value
Onishi	— Private		Public goods	Private		Level of consistency of interest relationship between both parties
FM (Franc &Mut hoo, 2006)			Public goods-to-be	Both parties		(1) Level of importance of the investment (2) Evaluation of project value (3) Degree of publicity of goods
Hu Zhen		Dominated by public departments	Public goods	Private	When the time point is 0 /1, on the time zone there are	(1) Control level of the maintenance cost; (2) Risk management level; (3) VFM effect demonstrates a conic relationship between the project company's control rights. Therefore, binomial coefficient

Zhang Zhe & Jia Ming	Public goods-to- be	Both parties	continuous variables. Continuous allocation	and monomial coefficient determine the optimal allocation of control rights. (1) Level of importance of the investment by two parties of the contract (2) Degree of measurability of the value of goods (3) Degree of publicity of goods (4) Evaluation of both parties on project value (5) Long-term potential of cooperation relationship
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2.4 Literature on game theory

2.4.1 Origin and development of game theory

Game theory is a very important theoretical subject in the present economics and even the whole social science. It adopts mathematic tools to conduct in-depth analysis of various socio-economic options and has gained fruitful research results. It studies the rational behaviors in the choice of strategies under mutual interest restrictions between people and people and the corresponding results. Game theory has been applied in various areas in very early times. Nowadays, systematic study of the game theory has become an important part of academic research and has developed into an independent subject. The ideas and theories of the game theory have been widely applied in various fields, especially the economic field. The development of the game theory has enriched the means and ways for people to understand the world.

Its development history can be roughly divided into the following stages:

In the beginning of the 18th Century, there were mathematicians studying the Game Theory. In 1838, Gounod put forward the Gounod Model(Cournot,1863) and in 1883 Bertrand put forward the Bertrand Model (Xie,2002). The two models both studied the optimal decision function of duopoly respectively from the perspectives of output decision and price decision. These are both studies attempting at analyzing economic issues using the Game Theory.

In the 20th Century, the German mathematician Zermelo put forward in "On an Application of Set Theory to the Theory of the Game of Chess" Zermelo's theorem Osborne (Osborne & Rubinstein, 2000), according to which in any finite two-person game, one of the two players must have a winning strategy. Based on this type of competition and game, scholars put forward

the strict competition game—two-person zero-sum games, in which there are no cooperation or alliance and one player's gain comes from the other's loss.

The period between the end of the 1940s to the 1950s witnessed significant development of the Game Theory. In this period, non-cooperative game theory was established, cooperative game theory made significant progress, and many important theories of the Game Theory were put forward. For example, Nash (1950;1953) explicitly elaborated on the differences between cooperative game and non-cooperative game for the first time in *The Bargaining Problem*, and put forward the famous definition—Nash Equilibrium (Nash,1953), according to which “if other players keep theirs unchanged, then no player can benefit by changing theirs”. Besides, he also proposed the Nash theorem that proves the definite existence of Nash Equilibrium in finite games between people and activities. The proposal of Nash Equilibrium is an important milestone of the development of Game Theory. It lays the theoretical foundation for non-cooperative game, and gave rise to the important equilibrium concepts in non-cooperative theories.

The period from the end of the 1940s and the mid-1950s also saw great success of the cooperative game theory. For example, “the Bargaining Model” was set up by Shapley in 1950. In 1953, Shapley put forward the cooperative game concept of “Shapley Value” and made axiomatic elaboration about it. Studies on cooperative game in this period were mainly concentrated on exploring how alliance is formed and achieves stable existence in cooperative game while analyzing the distribution method of interests among all parties in the alliance and probing into its rationality.

In the 1960s and the 1970s, there emerged various game theories, such as “Strong Equilibrium”, “Repeated Game” and “Differential Equilibrium”. Among these theories, the most well-known ones included the “Subgame Perfect Nash Equilibrium” put forward by Selten in 1965 (Selten, 1973) and the “Trembling Hand Perfect Equilibrium” put forward by Selten (Hart, 1983; Harsanyi& Selten, 1988) in 1975. These two new equilibrium concepts were both further developments of the Nash Equilibrium.

The period from the 1980s to the present is one for the comprehensive perfection of the Game Theory system. In this period, Game Theory has been adopted to explain many practices. Over the past three decades, Game Theory has evolved into an independent and sound

theoretical system with rich connotation. Besides, a large number of applied research results have been made in this period. All these show that Game Theory has become a commonly used theoretical analysis method for multiple disciplines, including Economics, Statistics, Sociology, Politics, Military Science, Biology, Computer Science and Ethics. In particular, the status of Game Theory has been significantly improved in Economics. To be specific, Game Theory has been regarded by the economic circle as one of the most important part of the economic theory system and Game Theory methods have become the core analytical methods for making new breakthroughs in the field of economics.

2.4.2 Development of cooperative game and its application in allocation

Game theory is divided into two theoretical systems: Cooperative game and non-cooperative game. The fundamental difference between cooperative game and non-cooperative game lies in that cooperative game has a guaranteed coalition similar to a mandatory agreement.

In the 1950s, Gillies first introduced the concept of core for the analysis of stable sets. Shapley and Shubik (1954;1966;1972) developed it into a concept of solution, forming the solution represented by stable sets and core. It is called dominant solution, which mainly considers payoff allocation in cooperative games from the principle of preventing objection in coalition. Another solution is the Shapley value and the valuation method represented by its expansion (Shapley, 1967). Its research idea is to consider insiders' benefit distribution and explain the reason for such benefit distribution from the perspective of contribution margin.

Aumann and Maschler (1964;1985) believe that cooperative game is in fact a negotiation process and put forward the solution with negotiation as cooperative game. Davis and Maschler (1965) put forward the idea of using kernel as cooperative game from the perspective of the degree of dissatisfaction within the coalition. Schmeidler (1969) used the excess value to represent the coalition's degree of dissatisfaction, axiomatically depicting the solution to the cooperative game that satisfies minimization of the coalition's degree of dissatisfaction—nucleolus. Besides, he also created the concept of solution that is most basic and important. Later on, kernel and nucleolus were constantly developed, expanded and perfected by scholars, and solution method was also innovated. Through the research on the solution to cooperative game, the essential attributes of cooperative game were revealed.

Over time, the study of game theory has achieved great success, and the solution of cooperative game has been applied in multiple areas. Game theory is gradually gaining attention. For example, it has been used to explain votes in politics, equity options and so on.

The cooperative game theory has seen application in many fields. Among them, the cooperation profit distribution is where it plays an important part. In the 1950s, Shapley put forward the Shapley value based on the idea that multiple game players expect marginal revenue. It is an exploration into benefits allocation through qualitative methods. The idea is to measure a member's contribution to the coalition with the loss to the coalition caused by "losing" this member. Besides, it distributes benefits according to the marginal contribution members have made to the coalition. This has to some extent reflected fairness and rationality. It is also conducive to rational income allocation for and long-term stability of the coalition. The Nash bargaining solution was arrived at by Nash with mathematical proof method. It pioneered the discussion about means of income distribution with mathematical methods and proved the unique solution in compliance with these principles. Mariotti and Sgobbi (2001) discussed how corporate income increases as well as the model and significance of income distribution under the e-commerce business model. Burrows and Black (1998) analyzed the influence of income distribution on coalition members through studying companies' management behavior and mode of operation, arriving at the income distribution method based on fuzzy theory. Duca and VanHoose (1998) designed a set of theoretical models mainly based on how to allocate cooperation income in a competitive market. Gavirneni (2001) discussed income distribution in the production-sales link of the supply chain.

Ye established the group weight model for profit distribution in virtual enterprises from the perspective of negotiation and put forward the profit distribution method for virtual enterprises based on asymmetrical bargaining model. Sun and Liao (1998) published several articles in 2008, putting forward the mechanism for profit distribution among cooperation partners at different levels in the supply chain based on symbiosis theory and marginal distribution principle. Feng and Chen (2002) applied fuzzy research methods to study income distribution for virtual enterprises, and gave the clear income distribution ratio based on the importance and risk tolerance of virtual enterprise members. Dai, in light of previous studies, studied the profit distribution model for partner enterprises in a dynamic coalition based on Shapley value methods as well as the successes and deficiencies of using Shapley value

methods for profit distribution in a dynamic coalition. At last, he also put forward a correcting algorithm based on risk factors regarding its deficiencies. Gu and Li established an income distribution model for knowledge chain organizations using relevant cooperative game theories and gave their definition about such type of organizations. In other words, they defined knowledge chain and knowledge chain management from the perspective of knowledge flow. Wang et al. studied and established the principal-agent model between the insurance company and the bank in the loan-insurance risk control process, and analyzed the feasibility and stability of cooperation. They quoted the examples of financial groups, revealed the effective incentive mechanism for profit sharing and risk sharing that should be established between the insurance company and the bank. Yu and Yang (2007) analyzed the strategic choices of commercial banks and evaluation agencies in the face of real estate mortgage under the information asymmetry framework. They found that under the effect of information and feedbacks, there is cooperation possibility and stability between commercial banks and evaluation agencies. Besides, they also revealed that commercial banks and evaluation agencies should establish “profit sharing” cooperative game mechanism according to the principal-agent model. Hou and Nie (2007) analyzed the coalition and profit distribution among real estate development enterprises from the perspective of cooperative game, and identified through study how the final benefits are distributed among various enterprises. Zhou (2009) studied the information asymmetry between real estate developers and banks and analyzed the cooperative game process between banks and real estate developers and its feasibility through a dynamic game model of complete information.

2.4.3 Application of game theory in project control rights allocation

In project financing, game theory has become a commonly used tool for control rights and profit distribution among relevant financing stakeholders. As the project financing process involves many stakeholders, there will be repeated exploration, competition and game among them centering on their own interests and risks in project financing. In the end, they will reach consensus on financing through various players’ game results, solidify the consensus in the form of transaction structure, specify the responsibilities and obligations in project financing, and determine the future benefit distribution and risk assumption of the project. Many of the existing studies also suggest that in project financing, control rights have become the key to transaction structure design, as well as the object of game between the project company and the

lender. For the project company, control rights mean the right to allocate the future surplus value of the project as well as the control and possession of multiple interests involved in the project financing process; for the lender, claim for control rights can appropriately lower project financing risks and get involved in conversations about reducing financing risk. Control rights transfer has become an insurance mechanism provided for the lender by the project company. However, control rights transfer will result in division of profit of project stakeholders. Therefore, the success of project financing is directly related to control rights transfer and allocation. And game theory has become an excellent tool and method for addressing this problem.

PPP model underscores the risk sharing, mutual benefit and win-win progress between the public and the private sectors. It focuses more on the partnership between various members, whereas such partnership requires division of labor and close coordination between the public sector and various private sectors (He & Zhao, 2011). Therefore, whether the project can succeed is determined by whether participants can give full play to their own expertise, make positive contribution in their area of excellence, and shoulder respective responsibilities. And stimulation of such initiative relates directly to the reasonable allocation of control rights.

Rational control rights allocation is a process of mutual game and negotiation. In this process, full consideration should be given to various players' control rights preference. This not only is conducive to giving full play to the incentive effect of control rights allocation, but can also realize the stability of PPP project coalition. Besides, rational control rights distribution should cater to both collective rationality and individual rationality. In other words, it should ensure that project participants can gain greater benefits in the project than working on its own, and make sure that the overall interest of the project are greater than the sum of the interests created by all participants working on themselves. Only when this premise is met can excellent professional companies or private investors be attracted to the investment and development of public infrastructure projects. It can be known from the above analysis that the cooperative game idea is very suitable for addressing control rights allocation issues.

2.5 Theoretical literature on PPP model

2.5.1 Basic connotation of PPP model

PPP refers to Public-Private Partnerships. Up to now, there has not been a universally recognized definition of PPP. Different countries have given different definitions for PPP. The following are some representative definitions of PPP:

(1) United Nations Institute for Training and Research:

PPP covers all the institutionalized ways of cooperation among advocates of different social systems, with the aim of solving some complicated local or regional problems. PPP contains two meanings: One is the various cooperation relationships established between public and private advocates to meet the needs of public goods; the other is the implementation of large-scale public projects carried out under partnerships between public and private sectors to meet the needs of public goods.

(2) Definition by National Council for Public-Private Partnerships, U.S.: PPP is a mode of public goods supply that combines the characteristics of outsourcing and privatization. It makes full use of private resources to maintain, build and operate infrastructure, and provides related services to meet public needs.

(3) Definition by the Canadian Council for Public-Private Partnerships: PPP is a cooperative relationship between the public sector and the private sector. Based on the respective experience of both sides, it satisfies the clearly defined public needs through reasonable allocation of interests and risk sharing.

(4) European Commission: PPP refers to a cooperative relationship between the public sector and the private sector, whose purpose is to provide public projects or services.

In the Circular on the Promotion and Application of the Cooperation Model between Government and Social Capital issued by the Ministry of Finance, “the Cooperation model between government and social capital” (PPP) is defined as: a cooperative relationship between government departments and social capital in the field of infrastructure and services. In general, social capital is responsible for most of the work, such as the construction, design and operation of the infrastructure, and obtains returns on investment through “payment by users or by government”. Government departments are responsible for the price and quality supervision of infrastructure and public services in order to maximize public interest. This description defines

the main body of the PPP project for government departments and social capital. It also defines the cooperation mode of PPP projects as well as the responsibilities and means of investment returns of each investor in the project. In the meantime, the National Development and Reform Commission defines PPP as a cooperative relationship that the government establishes, through franchising, equity cooperation, purchasing services and other means, with social capital in order to improve the efficiency of public services and enhance the quality of public goods. During the period of cooperation, both parties share risks and benefits. It can be easily seen from the above definitions that the NDRC pays more attention to the purpose and form of cooperation in the PPP model. Yet on the whole, the definition given by the Ministry of Finance shares the same direction as that of the NDRC, only with a different focus.

With regard to relevant theoretical studies of PPP, foreign academia took an early start. Studies on PPP model mainly focuses on the following aspects: theoretical research of PPP, empirical research of PPP projects, risk analysis of PPP projects, implementation purpose and social significance of PPP projects, and related technologies of PPP projects.

Lossa and Martimort (2015) proposed that PPP is a contractual arrangement of public-private cooperation, risk sharing and revenue sharing. Savas (2002) discussed PPP model in detail, analyzed its advantages in infrastructure construction, and made a detailed division of the formation of PPP model. Sambrani (2014) believes that PPP model can expand the scale of investment, strive for more funds, social capital and risk sharing by the public sector, greatly improving the efficiency of infrastructure provision. Bingetal (2005) considers that there is a risk structure in the design of PPP projects. Upon entry into PPP projects, social capital should fully consider economic, social, policy and environmental factors, and comprehensively select the risk-taking mode (Martimort & Straub, 2016). Shen Platten, and Deng (2006) holds that PPP projects have diversified risk structures and rich incentives, which enables them flexibility. Thomsen (2005) divides PPP project risks into endogenous risks and exogenous risks. To be specific, endogenous risks come from the project itself, and social capital can control such risks through reasonable means, while exogenous risks come from the economic, social and political environment of the project country. Such risks are not easy to control. Hammami, Ruhashyankiko, and Yehoue (2006) argue that when the government is burdened with heavy debts, the PPP model becomes popular as a way to alleviate the financial pressure of the government. To ensure the healthy and orderly progress of PPP projects, a clean government,

effective legal protection and good system designers are crucial. Percoco (2014) proposes that the effectiveness of PPP projects is limited by their risk structure design. Deschepperetal (2015) considers that there is a negative correlation between PPP project cycle and investment and PPP project success probability (Schepper, Haezendonck & Dooms, 2015). Based on the “national risk index” data published in the *International Country Risk Guide* (ICRG), Banerjee and Ranganathan (2006) did an empirical analysis and found that there is a significant negative correlation between the system quality of the PPP project country and the success rate of the PPP project.

Domestic research on PPP model started relatively late. And relevant studies mainly focus on theoretical research and case study.

Wang (2004), after in-depth study of the classification of PPP model, holds that the PPP model in the broad sense can be divided into three categories: outsourcing, franchising and privatization. With regard to the efficiency of the PPP model, Lai and Fei (2010) point out that: The PPP model has the functions of integrating project responsibilities, integrating project risks and forming a long-term contract. It can effectively introduce the market mechanism into the public sphere. However, it is necessary to design reasonable and appropriate contracts and rules, especially the formulation of reasonable allocation of benefits and risks among players in the private sector, so as to enhance the PPP projects and public service supply efficiency. From the perspective of organizational structure design of the PPP model, Li and Zhang (2002) hold that the PPP model is conducive to allocating risks in the project life cycle, making full use of the advanced technologies and management experience of private enterprises, and forming long-term good cooperation relationship or a strategic alliance between the public and the private sectors, forming strategic alliances, so as to achieve the objectives of all parties. He and Sun (2010), from the perspective of price supervision of PPP projects, studied the price formation mechanism of public service projects under the PPP model. They believe that it should include four aspects: First, establish the basic database of service cost and quality evaluation for public projects; second, scientifically select the price management model; third, improve the hearing system; and fourth, establish relatively independent regulatory authorities. Yang (2012), after studying the pricing mechanism of PPP model, points out that the main factors restricting the price of PPP projects are the government’s price restrictions, the public’s affordability, social demand restrictions, the government’s financial subsidy restrictions and the enterprise’s profit restrictions. Xu, Zheng, and Zhou (2009) studied the benefit allocation of the PPP model and

put forward its benefit allocation coefficient. The benefit allocation coefficient of PPP can be obtained from risk allocation and control right allocation in PPP. Ke and Wang (2008) analyzed the risk sharing in infrastructure PPP projects; Chen and Zhao (2012) used Bayesian network to study the assessment and prediction of residual value risk in uncertain environments of PPP projects. Dai, Fan, and Yu (2012) analyzed the problems of the PPP model in rural infrastructure construction projects in China and put forward four suggestions: First, strengthen the improvement of relevant laws and regulations of the PPP model; second, select appropriate cooperation projects; third, establish a sound profit model; fourth, formulate flexible policies and strong incentives; fifth, establish a long-term, reasonable and effective risk-sharing structure. Wu (2010) analyzed the problems existing in the municipal infrastructure construction in China and elaborated on the advantages of the PPP model in municipal construction: First, it is conducive to alleviating the financial pressure of the government; second, it is conducive to improving the efficiency of municipal construction and operation; third, it is conducive to increasing risk sharing effectiveness; fourth, it is conducive to improving fund utilization rate; fifth, it is conducive to promoting institutional reform and talent cultivation. Pan (2007) analyzed the application of the PPP model in new campus construction projects in Chinese universities from two aspects, namely, necessity and feasibility.

2.5.2 The advantages and disadvantages of the PPP model (See table 2-3 for details)

Table 2- 3 An analysis of the advantages and disadvantages of the PPP model

Advantages	Disadvantages
It is conducive to improving economic efficiency and reducing the economic cost of the project. The basic principle of the PPP model is benefit sharing and risk sharing. The public sector boasts management advantages and the private sector has technologies, construction and operation advantages. The combination of the two can give full play to their respective strengths, which can improve economic efficiency and reduce project risks.	It can lead to financing difficulties for the private sector. Compared with the public sector, financial institutions have a lower degree of credit to the private sector, which is confronted with more financing difficulties and limited financing amount.
It is conducive to increasing time efficiency.	The PPP model may lead to monopoly. The PPP model involves high transaction fees or costs, complex contracts, and a long cycle, which intimidate many small enterprises. As a result, there is a lack of competition during the bidding process. Large enterprises

It is conducive to increasing the source of funds for projects. Under the PPP model, project funds are mainly financed by the private sector, which can effectively alleviate public sector debt, resolve local debt and provide off-balance-sheet financing for the government.

It is helpful to improve the quality of products. The private sector involved in PPP projects boasts advanced technologies and rich experience. The relevant government acceptance standards require that the project must meet the quality standards. This means that the private sector must improve product quality to meet the needs of acceptance departments and users.

It is conducive to sound project operation in the long term. The design, construction and operation of PPP projects are all undertaken by a consortium, because the objectives are the same and the interests are linked. The different project participants can be fully integrated and coordinated to achieve sound cooperation.

It is conducive to the realization of long-term plans for all participants. PPP project construction involves the whole cycle, including design, construction and operation. Participants cannot just focus on the immediate interests. Instead, they need to consider the long-term value of construction and operation facilities in the light of their development. This helps to get rid of financial pressure, policy orientation and budgetary constraints.

The PPP model helps to improve the image of government departments. The quality of PPP project facilities can be effectively guaranteed. All projects can be carried out smoothly as expected. It can also increase the government's financial management ability and reputation as well as the public's trust in the government.

It is conducive to the sustained and healthy development of private institutions. The PPP model provides long-term development

become frequent customers of PPP projects, showing a certain degree of monopoly.

The complex transaction structure of the PPP model may reduce efficiency. PPP projects require the collaboration of multiple participants. The more participants, the more constraints put forward by each participant according to their own interests and needs, and eventually the more constraints for the whole project, resulting in obstacles to communication among the participants. Besides, a lot of time may be spent on the disputes of contract terms, eventually leading to the slow progress of the project as a whole.

It lacks flexibility. Since PPP projects involve a large number of participants, a complex transaction structure and long-term nature, their project contracts are often more stringent and inflexible. However, it is often difficult to cover all aspects during contract drafting. As a result, the later phases of construction management cannot be tailored to the time and often suffer a lack of flexibility in operation.

The use cost of PPP products by the public may increase. Under the PPP model, the private sector needs to make up all the investment costs of PPP projects and obtain the maximum benefits in the operation stage. Therefore, the price of PPP products may be higher than the market price, which leads to increased use cost for the public.

opportunities for private enterprises and can effectively stimulate industrial transformation and upgrading and improve local employment rate.

2.5.3 Characteristics of the PPP model

1. Partnership

The primary feature of the PPP model is partnership, which is the foundation of its existence. The ultimate pursuit of PPP projects by the public sector and the private sector differs. The public sector hopes to maximize the public interests through the cooperation of PPP projects, whereas the private sector hopes to maximize its own interests through the cooperation of PPP projects. The ultimate goal of both parties is to achieve the maximum and best supply of products and services with the least resources. Consistency of goals is a prerequisite for their partnership.

2. Interest sharing

The public sector participates in the PPP model mainly for obtaining financing and advanced technologies and operation management of private enterprises, whereas private enterprises participate in the PPP project mainly for obtaining relatively peaceful and long-term stable returns on investment, yet not simple profit-sharing. Because of the participation of the public sector, the PPP model shows certain public welfare nature, which requires the public sector to control the possible high profits of the private sector. But ultimately, it requires all parties involved to obtain relevant benefits. Without the profit acquisition mechanism, formation of a partnership is impossible.

3. Risk sharing

Interests and risks go hand in hand. In PPP, the reasonable sharing of risks between the public sector and the private sector is a remarkable sign that is different from other forms of transactions by the public sector and the private sector. In the PPP, the public sector bears the associated risks of its own advantages as much as possible, while the other party bears the risks as little as possible. At the same time, in the private sector, the degree of risk taking will be determined based on comparative advantages. And this area is an area that tends to suffer “bureaucratic inefficiency risks” of government management. Thus, risks can be avoided. If each risk can be borne by the partner who are best at dealing with it, there is no doubt that the

cost of the entire infrastructure project can be minimized. In the PPP management model, it is necessary to go beyond the simplified understanding of the “financing mode” to the understanding and summary at the level of management mode innovation.

2.5.4 The model of “Chinese dequity” for PPP

The model of “Chinese dequity” for PPP refers to an arrangement where in the process of capital financing, financial institutions invest in the project and become shareholders without participating in project operation or project management and the operating performance of the project has nothing to do with the return on investment of financial institutions. The role of shareholders of financial institutions is only nominal. After the completion of the project, financial institutions transfer their equity holdings to the capital demanders by signing a repurchase agreement and obtain corresponding returns. In fact, it is a financing method with debt nature. Financial institutions, represented by banks, securities firms and trust companies, act as financial investors, while social capitalists take construction-type state-owned enterprises as the subject and act as strategic investors. From the perspective of the capital supply form of PPP projects, the open-ended real debt can be divided into management plan, nested betting and industrial fund, among which industrial fund is the mainstream. Industrial funds usually consist of social capital and financial capital. Social capital mostly comes from the self-owned capital of central construction enterprises, while financial capital usually manifests as capital management plan, which mainly comes from wealth management. In industrial funds, financial capital acts as a priority LP (limited partner), gaining returns first and withdrawing ahead of time; social capital acts as an inferior LP, reflecting the role of financial capital security cushion; fund management company acts as GP (general partner) to exercise management rights and assume unlimited joint and several responsibilities. The repurchase is the core link of Chinese dequity. Considering the different repurchase subjects, the real debt of open-ended shares can be divided into three modes: social capital repurchase, project company repurchase (Type A) and government repurchase (Type B). Among them, social capital repurchase can be further divided into two modes: internal fund repurchase (C type) and external fund repurchase (Type D). See Figure 2-3 for details.

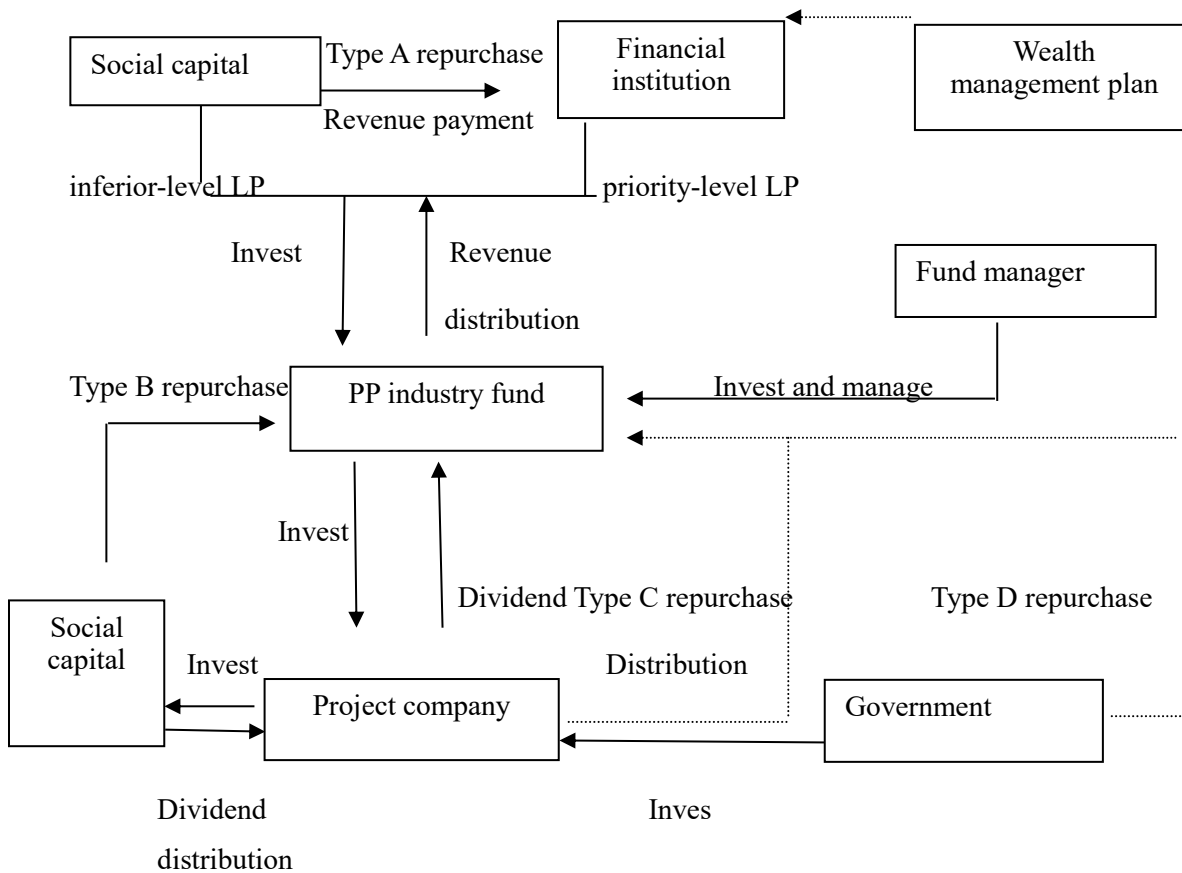


Figure 2- 3 The PPP model of “Chinese dequity”

2.6 Chapter summary

This chapter introduces the theories and methods used in the process of analyzing control rights allocation in project financing. First, this chapter provides an in-depth analysis, summary and conclusion of the basic concepts, characteristics and application types, legal framework and main risks. Second, this chapter elaborates on the connotation of transaction structure and the general transaction structure of “Chinese dequity”, and then clarifies that the core of transaction structure design is the allocation of control rights. Third, this chapter also provides an in-depth analysis and conclusion of the connotation, allocation principles, allocation subject, and allocation mechanism. Last but not least, it elaborates on and introduces the origin and development of Game Theory, application of cooperative game in distribution, and application of Game Theory in control rights allocation, laying a solid foundation for establishing control rights game theory in the next chapter. Fifth, this chapter elaborates on the definition, merits

and demerits, characteristics and categorization of PPP model as well as the structure of “Chinese dequity”, laying a foundation for the following chapters.

Chapter 3: Research Methods

3.1 The case study method

3.1.1 Definition of the case study method

At the beginning of the 20th century, Harvard University successfully introduced the case study method into the fields of law and medicine, after which the method was extended to various fields and found progressively widespread application. The definition of case study is rife with controversies in academia, where Bromley (1986) argues that all case studies derive from the same apparent purpose: the desire to approach or gain insight into one or a group of “cases” in the real world. Yin (2009) believes case studies are empirical studies that place current phenomena such as “cases” in real-world situations, especially when there is no clear boundary between the phenomenon and the social context. Stake (2000) considers a case study as a process of understanding behavior in a particular situation or under a particular condition (in a single event). Combining the views of scholars at home and abroad, I believe that case analysis is a research method that, based on typical cases, explores and refines general conclusions and particular issues as reflected in events through a thorough and detailed analysis of the processes and principles of events. On this basis, a research conclusion is drawn to inspire others to study or guide their practice.

3.1.2 Features of case studies

Drawing on the thoughts of Yin and Stake, the Chinese scholar Yu (2004) has absorbed and adopted a number of other representative views, outlining the common features of case studies:

(1) Case studies are not purely theoretical studies, but empirical studies that mainly answers the questions of “why” and “how”.

(2) Unlike experimental research and investigations, case studies focus on exploring the correlation between the evidence of each case in real socio-economic phenomena.

(3) Case studies should be considered a complete system. They take a holistic approach to research rather than dealing with problems in isolation. In order to draw inductive conclusions or predict the future through cases, researchers must conduct an in-depth study of the causes and related factors of the cases. Case studies must be put under the basic premise of integrity, so that the research results can fully show authenticity, extensiveness and universal adaptability.

(4) In the process of studying the integrity of things, case studies involve more variable relationships, the most important of which is the correlation between different variables in the socio-economic phenomena. These variables have no fixed form of expression and their manifestation largely depends on the specific social events. Researchers have no control over whether and when the event occurs and what the results will be.

3.1.3 Applicable conditions of the case study method

(1) When the questions of “how” or “why” are raised. As is noted by Yin (1984), the case study method applies to questions such as “how” or “why”, as it provides a more reasonable explanation and clarifies the relationship between various parties. The question of “how” and “why” is often left unanswered in a real-life context due to a lack of existing literature. We can only establish a theoretical research model by summarizing events in terms of time and space, and draw general conclusions through detailed, in-depth and comprehensive analysis. This is a process of theoretical construction rather than theoretical verification.

(2) When researchers have little control over events. Given the complexity and dynamic nature of many existing problems and the constant emergence of new problems in the research process that might not be consistent with the original theoretical assumptions, it is sometimes necessary to readjust the original theoretical framework or look at the problems from a new perspective. Through the effective acquisition of primary data and the reconstruction of the whole event, the case study method “describes a touching story”, which helps researchers grasp the overall picture and essence of the problems, facilitating a comprehensive understanding of them. Therefore, the case study method is the most effective and scientific research method when the object of study is a certain phenomenon in the contemporary real-world environment and the researchers are not allowed or able to control the object of study (Qiao & Ma, 2008).

(3) When the research focuses on a current phenomenon in a real-world context. The case study method tends to collect data in natural situations, rather than relying on "derived"

data, such as feedback on research tools in experiments or responses to questionnaires in surveys (Yin, 2009).

3.1.4 Classification of the case study method

Based on different research tasks, the case study method can be divided into five categories (Scapens, 1990; Hussey & Hussey, 1997), which are exploratory case studies, descriptive case studies, illustrative case studies, experimental case studies and explanatory case studies. See table 3-1 for details.

According to the number of cases used in the actual research, case studies can also be divided into single case study and multiple cases studies.

Advantages:

(1) Case studies help researchers understand the cause and effect of an event by offering a solid description of the phenomenon and provide references to answer or explain questions of “how” and “why”.

(2) Case studies are a comprehensive and true reflection of objective facts, with a high degree of authenticity, which helps enhance the effectiveness and reliability of empirical evidence.

(3) Case studies offer a multitude of suggestions in the course of research and make considerable preparations for addressing future practices and improving research competence.

(4) Case studies contain various elements in real scenarios as well as emergent phenomena and special phenomena, the capture and analysis of which are conducive to the construction of new theories and the testing of the scope of application of previous theories in specific situations

(5) Yin believes that some of the early data collected in case studies could redefine “cases”.

Limitations:

(1) Case studies can be time-consuming and labor-intensive, covering a wide range of investigation data.

(2) Case studies summarize a large number of cases, but the summary is analytical rather than statistical, which could easily lead to random and subjective conclusions that are unable to reflect all the data covered by various findings. As a result, the validity of case studies could be compromised.

(3) Case studies are excessively dependent on the proper selection of cases, the authenticity, integrity and systematicness of data and the correlation between research problems and data. Any problem in any of these aspects could have an adverse or even devastating effect on the reliability of case studies.

Table 3- 1 A comparison of five types of case studies

	Exploratory	Descriptive	Illustrative	Experimental	Explanatory
Purpose	To pave the way for the formation of a new theory	To describe a case through story telling or picture drawing	To test a theory and illustrate new trends of practices in enterprises or social organizations	To test the implementation of new practices and methods in enterprises or social organizations and evaluate their benefits	To judge a particular case
Findings	Experimental	Conclusive	Conclusive	Conclusive	Conclusive
Results	Further exploratory or conclusive studies are generally needed.	The results can be used as a reference for decision making.	The results can be used as a reference for decision making.	The results can be used as a reference for decision making.	The results can be used as a reference for decision making.

3.1.5 Advantages and limitations of case studies

Advantages:

(1) Case studies help researchers understand the cause and effect of an event by offering a solid description of the phenomenon and provide references to answer or explain questions of “how” and “why”.

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3.1.6 The design process of case studies

The design of case studies consists of the following steps: 1, Select a topic. 2, Design. 3, Select samples and collect data. 4, Analyze data. 5, Produce an analysis report.

In this process, an appropriate and representative choice of research object should be made. Research data should be selected properly and comprehensively to guarantee the systematism, authenticity and relevancy of the selected data. It is also necessary to formulate an elaborate and thorough research plan, standardize the research practice of researchers and establish a case database to ensure the validity and reliability of the research results.

3.1.7 The connection between case studies and the present study

Today, as an investment tool that meets the interests of all parties, “Chinese dequity” has been widely used in construction engineering, infrastructure construction, etc. However, there are still many problems in practice due to the lack of a perfect operating mechanism in terms of transaction structure design, profit distribution mechanism, legal risk management and other aspects. Researchers will need to select a scientific and reasonable research method in order to find a model of “Chinese dequity” that suits China’s realities. The case study method is without doubt the most important one for three major reasons. First, “Chinese dequity” is a newly-emerging financing model in recent years with no established or authoritative literature available for reference. Although this model has experienced some development in China,

where there are certain typical cases and advanced empirical practices that can be drawn upon, these experiences are one-sided, immature and imperfect that can only serve as a “key” to open the gateway to theoretical research of “Chinese dequity”. Through the study of typical successful cases, we hope to summarize modes of application and operation with universal applicability, so as to provide support for the theoretical perfection and development of “Chinese dequity”. Second, this is a time of theoretical construction, and the theories of “Chinese dequity”, with its weak foundation, needs to be enriched and strengthened with a basis of typical case studies. Blind and direct copying of successful cases without combining them with the reality or adjusting to local conditions could easily result in a poor fit. Third, case studies often aim at identifying problems within a certain social phenomenon and explaining the problems in a scientific and reasonable way.

In the current process of academic research, scholars are more inclined to use the quantitative empirical research method, which is a statistical analysis method used in natural science, to prove problems existing in social science (Feng & Dong, 2011). Management research, however, is an extremely complex field involving various elements. A model obtained through the empirical research method can only focus on two or three elements, making it difficult to grasp the nature of the event only by virtue of the existing models and literature (Porter, 2006). The case study method, thanks to its many advantages, will have an important effect on the study of management theories in the following aspects: inspiration, motivation and illustration (Siggelkow, 2007). Therefore, the case study method is used to analyze the experience and practice of the PPP Project of the Underground Utility Tunnel in HS City, from which general conclusions are drawn. Finally, a system of design, operation, management and supervision of “Chinese dequity” will be established.

By using the PPP Project of the Underground Utility Tunnel in HS City as a preliminary sample, this study refines and draws general conclusions through in-depth interviews with participants in the project (including the managers and operators of all partners and the person in charge of the project.), in-depth observation of the project operation model, comprehensive collection of relevant information in the project files (including all published documents, such as news reports, annual reports, financial statements, PPP cooperative documents signed with the government, concluding reports submitted to the government, reports and memoranda), distribution of questionnaires to partners and local residents, extraction of data relevant to the study and integrated analysis of the data.

3.2 The interview method

3.2.1 Definition of the interview method

What is the interview method? Dong (2004) points out in his *Research Methods in Psychology and Education* that the interview method is a research method by which researchers investigate the behavioral characteristics of the research objects through oral conversations. In *Qualitative Research Methods and Social Studies*, Chen (2000) believes interviews are in essence research conversations; they are a research method in which researchers obtain first-hand information from the respondents through oral conversations. In *Educational Research Methods: An Introduction*, Pei (1995) considers interviews, namely research conversations, as a way to use verbal language to investigate objective factual material. As summarized by Zhou, Yao, and Jiang (2004) in *Literature Review on the Interview Method in Qualitative Research*, the interview method is a research method in which interviewers purposefully construct linguistic activities with interviewees and obtain first-hand information. The above viewpoints are typical definitions of the interview method. Despite differences in expression, they all make it clear that interviews are a research method that is conducted orally, whose purpose is to collect objective and authentic first-hand information.

3.2.2 Classification of the interview method

Based on the degree of researchers' control over the interview process, they can be divided into structured interviews, semi-structured interviews and unstructured interviews. See table 3-2 for details.

Table 3- 2 A comparison of the three interview methods

	Structured Interviews	Unstructured Interviews	Semi-Structured Interviews
Features	The interview process is highly controlled and conducted according to the directed standard procedures.	Free conversation with little or no control over the interview process and no directed standardized procedures.	The overall framework of the interview is somewhat controlled, but the format and content of the conversation are not.
Degree of control	High	Low	Medium
Scope of application	The interview results can be easily analyzed	The interview results cannot be easily	The degree of control over the interview results

	statistically and are usually applicable to quantitative analysis.	quantified and are usually applicable to qualitative analysis.	is not high and the results are usually applicable to qualitative research.
Primary form	Questionnaires	Individual interviews	Individual interviews, key informant interviews, group interviews and focus group interviews

In terms of formality, they can be classified into formal and informal interviews:

According to the number of interviewees, interviews can be divided into individual interviews and group interviews. Generally, individual interviews consist of one interviewer and one interviewee, while group interviews might involve 1-3 interviewers and 6-10 interviewees.

Depending on the direction in which the interview content flows, interviews can be categorized into derived interview (that is, to derive the situation or opinions from the interviewee), injected interviews (that is, the interviewer informs the interviewee of the relevant situation) and discussion interviews with both derivation and injection.

There are one-time interviews and multiple interviews based on the number of interviews conducted, situational and non-situational interviews depending on whether scenarios are used and fact-finding investigation and collection of opinions according to the interview content. When the content discussed in the interview is centered around the interviewee, it is called person-oriented interviews; interviews centered on the issue are called question-based interviews. From the perspective of psychological study, the interview method can be divided into the interview survey method and the interview test method. Interview surveys are processes in which the interviewer interviews many interviewees one by one and conduct surveys on attitude, public opinion and so on, while interview tests refer to the testing of psychological problems observed through interviewing and observing interviewees at the same time.

There are various forms of interviews, the selection of which should vary according to the problems we intend to study, the purpose, the objects, the situations and the stage of research. Different forms can be combined when necessary (Zhang, 2013).

3.2.3 Procedures of the interview method

1. Formulate an interview plan that includes the purpose, content, form and schedule of the interview. Prepare a backup plan as well.

2. Select appropriate interviewees. Find interviewees who are willing to participate with certain language skills and experience in the field of research. At the same time, have a certain understanding of the basic information and situation of interviewees.

3. Prepare the necessary interview tools. Prepare all items needed for the interview, such as a letter of introduction, a questionnaire, a recording pen, a camera, etc.

4. Establish a good cooperative relationship with the interviewees. Fully respect the interviewees by creating an accessible and friendly atmosphere for the interviewees in terms of your attitude, clothing and language. It is better to build a relationship of mutual trust with the interviewees by having dinner or taking a walk before the formal interview.

5. Control the conversation using interview skills. Take proper control of the topic direction, guide the answers with a heuristic approach and pay attention to the effective connection between questions

6. Record the interviews with the consent of the interviewees, accurately and without personal bias, by means of a transcript and audio recording.

7. Organize the conversations and generate an interview report. Sort out and classify the original data after the interview. Conduct statistical analysis of the results and formulate a report.

3.2.4 Advantages and limitations of the interview method

Advantages:

1. More extensive information can be obtained, so as to have a deeper understanding of the interviewees' thoughts, mentality and psychological activities

2. First-hand information can be collected in a flexible way according to the specific conditions of the interview process.

3. The interview method uses face-to-face communication, which is a process of mutual influence between the thoughts, emotions and language of both parties. It helps researchers learn the details within a short period of time and identify problems.

4. The interview method is interactive where researchers can directly explain or guide specific questions that some interviewees do not understand, which contributes to first-hand information with high credibility.

5. The interview method uses simple language communication and is applicable to a wider range than other survey methods.

Limitations:

1. The reliability of interview results is affected by the quality and situation of the interviewees. The interview process is, in essence, the application of interview skills, rather than aimless chatter. The interviewer should be the leader of the interview, selecting a proper approach as the starting point and using appropriate interview skills to guide the interviewees. The reliability of interview results could be compromised by the inadequate quality of the interviewees. Besides, interviewers and interviewees are often strangers, which could lead to a sense of distrust among the interviewees. The attitude, communication skills, personal bias and values of the interviewers and the actual situation and atmosphere of the interview will all have an influence on the interviewees, resulting in the deviation of interview results.

2. Higher costs of human, financial and material resources. The interview process consists of many steps—the selection of interviewees, the design of interview plans, the preparation and distribution of questionnaires.—that require huge investment of manpower, materials and capital. In addition, a large number of interviewers are often necessary for interviews of a larger scale, leading to an increase in expenses to some extent. Meanwhile, interviews are rather time-consuming.

3. Lack of privacy. Since the two parties are communicating face to face, interviewees may feel a lack of privacy and be reluctant to tell the truth about some private issues.

4. Difficulties in recording. Interview surveys are verbal communications conducted between the two parties, which present a high demand on the interviewer's note-taking speed should the interviewee disapprove of tape recording. Generally, it is difficult for interviewers to fully record the interview content, and information omission may occur.

5. Difficulties in processing results. Different interviewees may give different answers to the same question. As a result, the processing and analysis of the interview results can be rather complicated. Researchers can only calculate percentages based on the number of occurrences of the same answer. It is difficult to analyze quantitatively, which results in deviation.

3.2.5 The connection between the interview method and the present study

As analyzed above, there are few indigenous experiences and practices worthy of reference in the current domestic model of “Chinese dequity”. Or there are certain literatures available for reference, but they are not mature. In this context, data collection and analysis through the interview method have the following advantages:

1. In the process of investigating and studying the PPP Project of the Underground Utility Tunnel in HS City, we seek to obtain not only documents and data regarding the project financing method, project reporting mechanism, project transaction structure, operation model, implementation process, agreement system, agreement on rights and obligations, profit distribution mechanism, project supervision mechanism and other aspects, but also information on attitudes of all parties involved toward the project, their concepts, etc. Only through the interview method can we access such data in a more intuitive and concrete way.

2. The interview method has great flexibility and adaptability. By conducting one or more interviews of the participants, managers or actual operators of the PPP Project of the Underground Utility Tunnel in HS City and managers or actual operators of project partners, we can effectively control the whole interview process and guide the questioning about non-verbal information (capturing the thoughts and emotions of the interviewees by observing their facial expressions, gestures and movements, for instance) while obtaining the information within the scope of the plan. It's a method that reveals how case study participants construct interpretation of the reality and think about the status quo rather than merely providing answers to the researcher's specific questions and indirect interpretation of the reality (Meng & Chang, 1999). Such knowledge of many hidden facts facilitates the acquisition of more extensive and richer primary information.

3. During the research process, in order to fully grasp the relevant information, we will adopt the form of questionnaire survey. To make sure the survey data make more sense, researchers should interview the research objects and find the problems to be investigated before compiling the questionnaire, thus forming a two-way checklist of the questionnaire. Only in this way can we develop a questionnaire with strong pertinence and practicability.

To ensure the reliability of data, this thesis uses structured interviews and selects 20 experts evenly distributed among government agencies, financial institutions, social enterprises and academic circles. Through the comprehensive use of a variety of methods such as questionnaire

surveys and interviews, the information provided by the experts will be comprehensively mastered, summarized, analyzed and formulated into a report. To obtain a comprehensive viewpoint on the PPP project and ensure the reliability and validity of the results, the respondents should be selected from different departments with different years of work experience and different roles in the PPP project (Table 3-3).

Table 3- 3 The selection of PPP experts

Type of Organization	Work Experience	Work Experience	Role in the investment model of "Chinese dequity"
Government agencies 25%	<5 years 25%	0 year 0%	The government or relevant government departments 25%
Financial institutions 25%	6-10 years 25%	1 year 25%	
Participating enterprises 25%	11-15 years 25%	2 years 50%	Private projects 25%
Academic circles 25%	>16 years 25%	>3 years 25%	Companies 25%
			Third-party consultants 25%

3.3 The questionnaire survey method

3.3.1 Definition of the questionnaire survey method

The questionnaire survey method was originally created by Galton, who set up an anthropological testing laboratory in London in 1882. He compiled all the questions to be investigated into questionnaires, sent them out and collected the completed questionnaires in order to obtain necessary information. Since then, questionnaires have become a new tool that assists people in exploring social phenomena. Opinions vary concerning the concept of questionnaires in academic circles. In his *Educational Research: An Introduction*, Gall, Borg, and Gall (2002) defines it as a written survey in which all the sample respondents are asked several of the same questions. Li (1989) proposes the definition that a questionnaire is "a question form" designed by the researchers and distributed to the respondents to be completed by themselves truthfully. Meng (1995) describes a questionnaire as a type of question or form, whose content is discussed by researchers, so as to be formulated into the format of a questionnaire and distributed to respondents, who will then be asked to answer truthfully. They can also answer the questions in person under the guidance of an instructor, or through interviews. As defined by Chen (2005), questionnaires are various question forms compiled

according to the needs of the research topic and filled in by the respondents themselves. They serve as a data collection tool as well as a measure of personal behavior and attitude.

Hence one can see that scholars basically share the same views on the concept of questionnaires. Most of them agree that a questionnaire is a piece of written material, composed of a series of questions designed in advance that reflect the survey purpose and content, that aims at obtaining valid information from the respondents (Zheng, 2014).

3.3.2 Classification of the questionnaire survey method

Based on the purpose, content and method of the survey, the questionnaire survey method can be categorized in different ways, the most important one being the self-administered questionnaire surveys and interviewer administered questionnaire surveys. Self-administered questionnaire surveys can be divided into newspaper questionnaires, postal questionnaires and couriered questionnaires according to the different ways of questionnaire delivery, while interviewer administered questionnaire surveys fall into two categories: interview questionnaires and telephone questionnaires, depending on how researchers talk to respondents. see Table 3-4.

There are closed questionnaires and open questionnaires based on different ways of giving answers. Closed questionnaires require respondents to choose from limited answers, while open questionnaires welcome open-ended answers, which means respondents can answer freely.

According to the different requirements and standards of questionnaire preparation, they can be divided into standardized questionnaires and self-designed questionnaires. Standardized questionnaires are scale questionnaires developed by experts in accordance with strict procedures and standards and applicable to a wide range of specific problems. Self-designed questionnaires are developed by researchers based on the purpose of research and the characteristics of research objects.

Table 3- 4 A comparison of five types of questionnaire survey methods

	Self-administered Questionnaires			Interviewer Administered Questionnaire	Telephone
	Newspaper Questionnaires	Postal Questionnaires	Couriered Questionnaires	Interview Questionnaires	Questionnaires
Definition	Questionnaires are distributed	Researchers send questionnaires to selected	Questionnaires are sent to selected	Researchers fill out the designed	Researchers conduct a survey of

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	along with newspapers.	respondents by post, who then complete and send them back to researchers.	respondents by then they then send them to researchers by a designated courier.	and to by a	questionnaires based on the respondents' oral responses.	selected respondent through telephone.
Scope of Survey	Wide	Wide	Narrow		Narrow	Wide or Narrow
Respondents	Highly random, difficult to control and poorly representative	Somewhat controllable but the responses are poorly representative		Controllable but overly concentrated	Controllable and highly representative	Controllable and relatively highly representative
Response Rate	Low	Low	High		High	Relatively high
Quality of Responses	Relatively high	Relatively high	Relatively low		Unstable	Fairly unstable
Cost of Survey	Relatively low	Relatively high	Relatively low		High	Relatively high
Survey Time	Relatively long	Relatively long	Short		Relatively short	Relatively short
Benefits	A high degree of privacy, low cost, free from the limit of time and space	A high degree of privacy, free from the limit of time and space	Low privacy, high response rate, relatively high quality of responses		high response rate, high quality of responses, wide range of application	High efficiency, less labor and time
Drawbacks	Difficult to control and sample	Higher cost, difficult to control, guarantee of response rate	Low privacy, staff-intensive, no cost-intensive and time-intensive, low response rate, more complicated questions cannot be included		Low privacy, high cost, susceptible to subjective factors of interviewers and interviewees	Limited time and content, low continuity, difficult to ensure random sampling

Wu divides questionnaires into structured questionnaires and non-structured questionnaires according to the researchers' control over the questionnaires (Wu, 2012). Qin and Wu (2000) put questionnaire surveys into two categories: self-administered questionnaires and interviewer administered questionnaires.

Scholars have made a variety of classifications regarding the questionnaire survey method based on their different positions and starting points, but the process of dealing with specific cases is often a combination of multiple methods rather than a single siloed one. We should,

therefore, refrain from directed thinking in practice. Only through the proper use of the questionnaire survey method can we obtain more accurate research results.

3.3.3 The design of questionnaires

Questionnaires generally consist of following sections: preface, instruction, questions and answers, coding and other information. The preface and instruction parts explain the purpose, content and method of the survey as well as matters that require attention. The questions-and-answers section comprises of survey questions to be answered by respondents. Coding refers to the translation of questions and answers into codes such as a/b/c/d to enable systematic processing of the data by a computer. Other information includes the name of the questionnaire, the home address of the interviewee or the organization he/she belongs to, the name of the interviewer, the start time and end time of the interview, the completion of the interview, the name of the auditor, his/her feedback and so on.

The following steps are a guide to the implementation procedure of questionnaires:

1. Design a preliminary draft of the questionnaire: create a main frame, select an appropriate question format (multiple-choice, fill-in-the-blank, true-or-false, matrix, etc.), design the questions and answers (the answers should be exhaustive), check the design of all questions and answers and pay attention to the connection between related questions to formulate a questionnaire.
2. Trial survey (distribute the designed questionnaire on a small scale, check the response rate and feasibility of the questionnaire and correct the problems found in time).
3. Revise, finalize and print.
4. Distribute questionnaires to pre-selected respondents.
5. Collect the questionnaires
6. Code the collected questions and answers (create a unique code for each question and answer in each questionnaire and conduct data processing on this basis).
7. Obtain the survey results based on coding and formulate a survey report.

3.3.4 Advantages and disadvantages of questionnaire surveys

Advantages:

1. A high degree of standardization. The content of a questionnaire survey is established. Respondents, however different they are, can only answer the same questions. Without influence from the subjective factors of researchers and respondents, the survey results remain relatively certain, which facilitates quantitative statistical analysis.

2. A high degree of privacy. Questionnaire surveys need not be conducted face-to-face. Nor do they require the respondents to sign their names. They eliminate the concerns of respondents regarding some sensitive issues, improving the authenticity and accuracy of the survey results.

3. High efficiency. Questionnaires help ensure high efficiency of surveys with a simple process of implementation where multiple respondents can be surveyed at the same time and more information can be gathered in less time.

Disadvantages:

1. No guarantee of the authenticity and reliability of the survey results. If the respondents refuse to cooperate or know little about the questions in the survey, there will be perfunctory answers, random answers and random checks, jeopardizing the authenticity of the questionnaire results.

2. Lack of depth and initiative. A questionnaire can only be as comprehensive and exhaustive as the design process allows it to be. The designer, therefore, should be able to put everything in perspective. Owing to the designer's limited competence and limited response options provided, it is difficult for a questionnaire to achieve 100% accuracy and for researchers to take initiative by obtaining a deeper understanding of the respondents' view on a certain issue.

3. Limited scope of application. Questionnaire surveys are presented primarily in a written form, which is not applicable to the illiterate or the visually challenged.

3.3.5 The connection between questionnaire surveys and the present study

The use of any single survey method has its limitations, which is why in this study, a questionnaire survey will be designed (see Figure 3- 1), combined with the use of the interview method and the case study method, so as to gain deeper insight into the “Chinese dequity” of

the PPP Project of the Underground Utility Tunnel in HS City, generating a reliable and accurate analysis report.

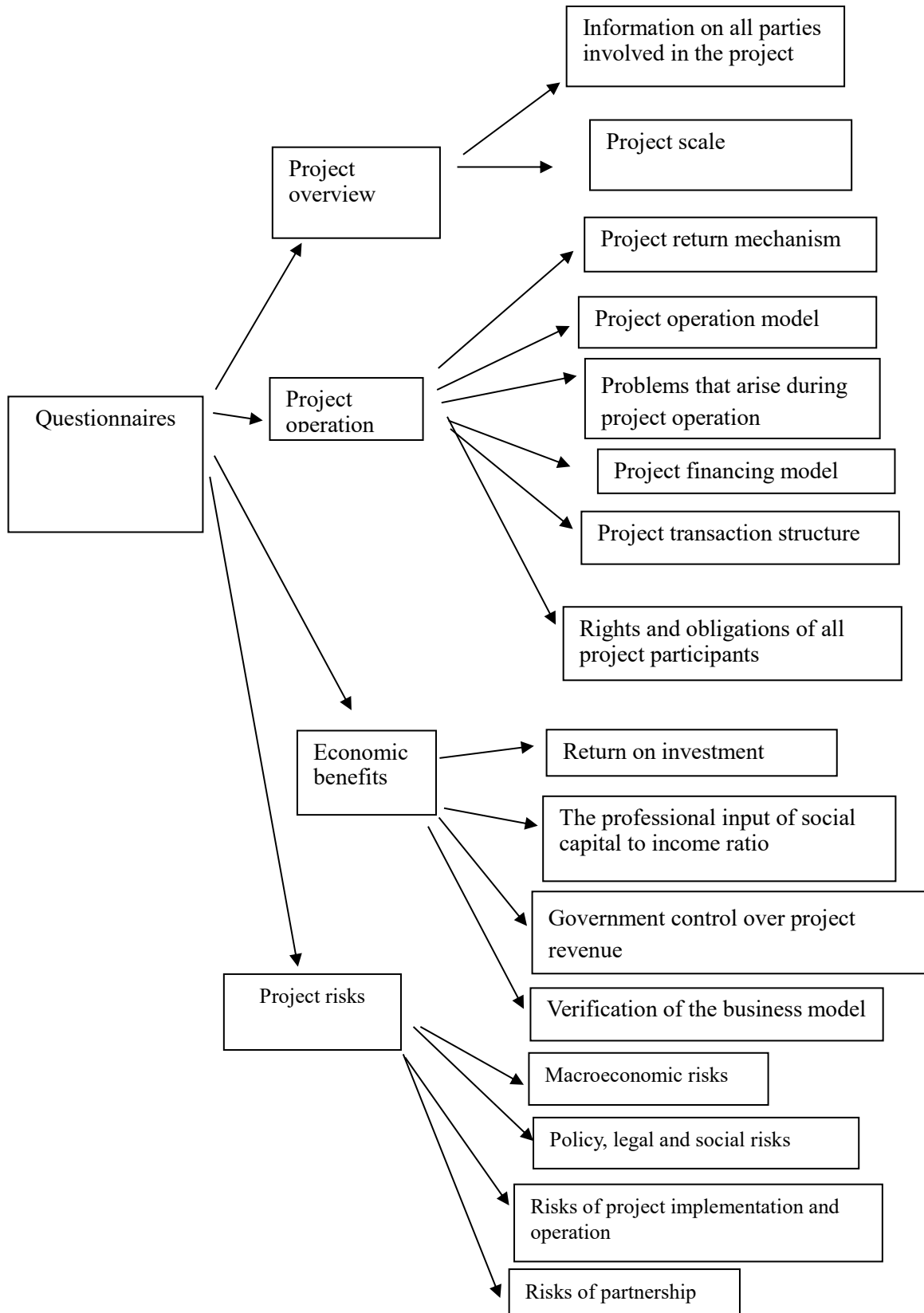


Figure 3- 1 The framework of questionnaire in this study

3.4 Chapter summary

First of all, this chapter introduces the definition, features, classification, applicable conditions, advantages and limitations of the case study method as well as its connection with this study. Second, it details the definition, classification, implementation procedure, advantages and disadvantages of the interview method as well as its connection with this study, suggesting some issues that require attention when using this method and a general framework for interviews with relevant experts. Last but not least, it presents the definition, classification, design, benefits and drawbacks of the questionnaire survey method as well as its connection with this study, proposing a design direction of the questionnaire required in this study. Through an introduction of the three survey methods above, this chapter emphasizes the comprehensive application of these three survey methods to ensure the authenticity and reliability of the survey results.

Chapter 4: Partner Control Rights Game Model of Projects with Multiple Participants

The previous chapters have already summarized the main studies relating to “Chinese dequity” and “mezzanine financing” at home and abroad as well as the general transaction structure design of “Chinese dequity”. They also introduced control rights theory and game theory methods that are used in analyzing the control rights allocation in the application of “Chinese dequity” in construction projects. In light of the status of financing through “Chinese dequity” and based on the differences in investment factors, this chapter proposes to further divide social capital into specialized companies and pure investors, introduce the concept of “control rights preference”, and establish the optimal control rights allocation model with stochastic cooperative game.

4.1 The relationship between input factors and control rights allocation

In recent years, domestic specialized companies have gained rapid development. These companies tend to play multiple roles. These companies participate in PPP projects as investors out of two main reasons: One is the expectation of the government. The government expects to gain the proprietary technologies of specialized companies and use their professional advantages to make scientific decisions for projects while ensuring the comprehensive benefits of project development and management. Allowing such specialized companies to become shareholders of PPP projects can encourage both sides to improve their own specialties and improve project quality. The other is the expectation of the specialized companies themselves. The entry of such companies into the project companies’ management as investors suits their interests. In the short run, by providing professional services for projects, they can gain project dividend and some project control rights, obtaining benefits for enterprises. In the long run, participation in such projects can help boost their own reputation and establish a sound social image. Besides, they also have the opportunity to cooperate more with the government, thus boosting enterprise sustainable development.

Du and Wang (2013) pointed out that the main purposes of control rights allocation are two-fold: The first is to lower transaction cost; and the second is to motivate project participants

to give dedicated input. Li and Xu (2009) believes that seen from the perspective of input factors, the main participants of PPP projects differ. Compared to government and pure investors, specialized companies tend to invest in professional technologies, whereas pure investors mainly invest capital. The multiple project input factors have determined that control rights do not just come from ownership. Members have different shares of equity due to the difference in their input type. But it is biased to just address control rights allocation from the perspective of equity. In fact, ownership corresponds to claim. It focuses more on interest distribution. In comparison, control rights correspond to the right of resource allocation. This chapter measures members' specific inputs based on their proceeds gained through independent decision making and fully considers the contribution of different input factors to project decision making.

4.2 Control rights preference

Different from existing studies that abstract the control rights of the whole process of PPP project as a whole, this thesis believes that control rights are a series of rights centered around the “decision-making” process. Only by decomposing control rights into specific rights can various participants be allocated with specific control rights. Therefore, this thesis uses the PPP Decision-Making List (Table 4-1) by Du and Wang (2013) and Wu, Wang, and Feng (2015) and decomposes PPP control rights into 28 specific rights according to control rights nodes in the whole process of the project. Different fields and subjects of project construction and operation are involved.

Du and Yin (2011) believes that according to project governance theories, control rights distribution must achieve two “matches”: One is to match benefits distribution; the other is to match the corresponding risk responsibilities. In other words, control benefits are uncertain. Since the specific inputs of the main participants of PPP projects differ, they have different degrees of preference for the benefits brought about by a certain joint decision. It is usually manifested as a desire to gain control benefits in areas that are closely related to their own specific inputs. The author refers to this phenomenon as control rights preference. Take the decision-making issue in D11 construction site preparation in the PPP decision-making list (Wu, 2015) for example. The specialized company is both an investor and the contractor and has high specific investments in the project. This determines that it has a higher degree of control

preferences than other participants in the project. Similarly, for payment and applicability of investment indicated in D6, pure investors have a stronger preference than other participants.

Table 4- 1 28-item decision-making list of PPP projects

		D01. Calling for bids for design unit		
Detailed investigation and construction design	project and drawing	D02. Detailed investigation and supplementary investigation		
		D03. Preliminary design supplement and correction		
		D04. Design of construction drawing		
		D05. Financing plan design and implementation		
		D06. Payment and utilization of investment		
Project investment and financing		D07. Calling for bids for supervision (and supervision management) unit		
		D08. Calling for bids for construction unit		
		D09. Calling for bids for suppliers of Party B's equipment/materials/professional construction		
Construction period	Project construction preparation	D10. Land requisition and demolishing and traffic relief		
		D11. Construction site preparation		
		D12. Overall construction organization design		
		D13. Commencement of work		
		D14. Construction progress control		
		D15. Materials, equipment and construction quality control		
		Project construction		D16. Measurement and payment
				D17. Project change
				D18. Settlement of project cost
				D19. Onsite safety management and accident management
D20. Dispute settlement				
Completion acceptance		D21. Completion inspection and acceptance		
		D22. Equipment and system debugging and trial operation		
		D23. Completion acceptance		
Handover period	Handover period	D24. Project handover		
		D25. Project materials and right takeover		
		D26. Warranty and maintenance		
Repurchase period	Repurchase period	D27. Operation and management		
		D28. Repurchase payment or land (land replacement model BT)		

For project decision-making, technical expertise and management capabilities can help make more scientific decisions. Therefore, compared with other participants, specialized companies should have more say in project decision-making. This is what the government wants and is the overall need of the project. The participation in decision-making by specialized companies can help reduce project construction risks and increase the likelihood of project benefits. Besides, it can also mobilize the initiative of specialized companies to make specific investment. Specialized companies always want to gain control over their own specialties, thus providing a guarantee for the returns of their own specific investment, thereby achieving higher returns.

Considering that control rights can bring owners benefits, the present thesis assumes that project participants all show preference for control rights. This thesis uses r_i ($r_i > 0$) to indicate the degree of preference of Participant i . The bigger r_i is, the higher the participants' preference over control rights is.

4.3 Stochastic cooperative game

PPP projects have their own characteristics, such as long investment periods, large investment amount, and complex investment subjects. These determine that their risks are bigger than other traditional projects and the project revenues are largely uncertain. Therefore, this thesis adopts stochastic cooperative game model. We assume a certain control right N of the PPP project is a stochastic variable. Because the proportions of different control rights will have different influences on the project's overall returns, then the stochastic returns corresponding to the control rights is $R(N)$. In the meantime, we assume the stochastic returns of members who participate in the allocation of control right N of the PPP project is $pR(N)$, $P = \{p_1, p_2, \dots, p_n\}$ (p stands for the proportion of control rights returns). If $\sum_{i \in N} p_i = 1$ is satisfied, then such distribution is valid. However, PPP projects often have many participants and allocation of control rights for all members is excessively complicated. In order to simplify the arithmetic process, this thesis assumes that only two companies participate in allocating a specific control right and they are respectively Company 1 and Company 2. Then when $p_1 + p_2 = 1$, we believe the allocation is valid.

4.4 Shapely value

In cooperative game, Shapely value distributes returns based on participants' marginal contribution. It not only meets various participants' individual rationality, but also satisfies the overall collective rationality of the PPP project. Therefore, it is the basis for realizing optimal distribution solution of PPP control rights. Since the characteristics of PPP project determine the uncertainty of returns on control rights, this thesis first establishes Shapely value to ensure initiative of various participants and the rationality of cooperative establishment.

Regard $E(R(N))$ as the stochastic returns expectation of control right N, and $E(R(S)) \geq E(R(T))$ is satisfied under the condition that $R(S) \geq_i R(T)$, we believe that Participant i has more preference for control right return R(S). According to the conclusions drawn by Timmer et al., Shapley transition function of control rights returns utility can be represented as:

$$a_i(p_i R(S), q_i R(T)) = E(U_i(R(S))) / E(U_i(R(T))) \quad (1)$$

According to the studies by Suji et al., various participants of PPP project have a determined control right equivalent yield m_i in the control rights distribution game. It is no different from participant i's control right stochastic returns. Therefore, this thesis uses certain equivalent yields to replace the stochastic returns of PPP project participants as follows:

$$a_1(R(S), R(T)) = \frac{m_i(S)}{m_i(T)} \quad (2)$$

Therefore, the author uses two PPP project participants as examples to establish the Shapely value for allocation of various PPP project patriciates' control rights:

$$\begin{aligned} z_1 &= \frac{1}{2} a_1(R(1), R(N)) R(N) + \frac{1}{2} (1 - a_2 R(2), R(N)) R(N) \\ z_2 &= \frac{1}{2} a_2(R(1), R(N)) R(N) + \frac{1}{2} (1 - a_1 R(2), R(N)) R(N) \end{aligned} \quad (3)$$

In the above equations, R(1), R(2), R(N) respectively stand for the independent decision returns of Member 1, the independent decision returns of Member 2, and the total returns of the decisions made by both parties through consultation.

In Equation (3), we have given each member's Shapely value the same weight where each lexicographic order is 1/2. But in reality, control rights allocation of PPP projects needs to consider both parties' preference for and bargaining power on and negotiation ability about control rights. It is a process of consultation and negotiation. Therefore, this thesis uses weight $p = \{p_1, p_2, \dots, p_n\}$ to replace the average weight $(n!)^{-1}$ in (3), of which $\sum p_i = 1$. Thus, the Shapely value of two parties can be further indicated as:

$$\begin{aligned} z_1 &= p_1 a_1 (R(1), R(N)) R(N) + p_2 (1 - a_2 R(2), R(N)) R(N) \\ z_2 &= p_2 a_2 (R(1), R(N)) R(N) + p_1 (1 - a_1 R(2), R(N)) R(N) \end{aligned} \quad (4)$$

4.5 Super-additivity of cooperative games

In stochastic cooperative games, stochastic cooperation returns can still meet super additivity. In other words, control rights allocation of PPP projects meets collective rationality, and the total revenues gained from the joint decisions made by PPP project participants are bigger than the sum of revenues gained through each participant's independent decisions. Besides, the Shapely value of PPP project participants meet individual rationality. In other words, the returns gained through joint decisions made by project participants are more than the returns gained through independent decisions. Therefore, even when control right returns are uncertain, participants still have the willingness to participate in joint decision making. No matter how situation changes in the future, joint decision-making is always better than independent decision-making, indicates as follows:

$$EU(z_i) = \int f(z_i) U(z_i) \geq \int f(R(i)) U(R(i)) = EU(R(i)) \quad (5)$$

In the above equation, $EU(z_i)$ is the expected utility of the returns gained through joint decision-making by participant i of the PPP project, and $EU(R(i))$ is the expected utility of the returns gained through independent decision making by participant i of the PPP project. Since participants all show preference for control rights, when using the utility of certainty equivalent to replace the expected utility of control right returns, the following equation exists:

$$m(z_i) = E(z_i) - \frac{1}{2r_i} D(z_i) \quad (6)$$

In the above equation, $\frac{1}{2r_i} D(z_i)$ represents the uncertain loss Member i has to bear when gaining control rights return Z_i apart from the certain returns $E(z_i)$. The more preference participants have for control rights, the less concerned they will be about the uncertainty of project returns, and the less utility loss there will be. Because Z_i is the function of control rights allocation proportion p , the utility of the certainty returns of control rights is also the function of p . For PPP project participants, although investment objective differs from the expected return on investment, realization of various parties' objectives is all affected by the overall project performance. Therefore, they will all make full use of their own complementary capacity in order to realize maximization of their own return on investment and increase the project's overall cooperation efficiency. This thesis attempts to increase project cooperation efficiency by regulating control rights allocation weight p .

$$P^* = \arg_p [\sum_{i=1,2} m_i(z_i) \rightarrow \max] \quad (7)$$

Gain the Shapely value of PPP projects according to the characteristics of PPP project involvement in various parties' game.

$$\begin{aligned} E(Z_1) + E(Z_2) &= p_1 \alpha_1(R(1), R(N)) \mu(N) - p_2 \alpha_2(R(2), R(N)) \mu(N) \\ &+ p_2 \alpha_2(R(2), R(N)) \mu(N) - p_1 \alpha_1(R(1), R(N)) \mu(N) + (p_1 + p_2) \mu(N) = \mu(N) \end{aligned} \quad (8)$$

In the above equation, $\mu(N)$ is the fixed value of expectation for the income utility of PPP project control right N . Thus, Equation (8) can be simplified as follows:

$$\begin{aligned} \min g &= \frac{1}{2r_1} D(z_1) + \frac{1}{2r_2} D(z_2) \\ p_1 + p_2 &= 1 \end{aligned} \quad (9)$$

4.6 Equilibrium solution to the stochastic cooperative game model

In order to gain the optimal percentage of PPP project control rights allocation, Lagrangian mechanics is constructed as follows:

$$L = \frac{1}{2r_1} D(z_1) + \frac{1}{2r_2} D(z_2) + \beta(1 - p_1 - p_2) \quad (10)$$

A derivation of Equation (9) leads to the optimal distribution proportion of PPP project control rights.

$$\begin{aligned}
 p_1^* &= \frac{g_2 - g_3}{M} \\
 p_2^* &= \frac{g_1 - g_3}{M} \\
 \beta &= \frac{g_1 g_2 - g_3^2}{M}
 \end{aligned} \tag{11}$$

$$g_1 = \frac{1}{r_1} a_1^2 \sigma^2(N) + \frac{1}{r_2} (1 - a_1) \sigma^2(N)$$

In which, $g_2 = \frac{1}{r_2} a_2^2 \sigma^2(N) + \frac{1}{r_1} (1 - a_2) \sigma^2(N)$,

$$g_3 = \frac{1}{r_1} a_1^2 (1 - a_2) \sigma^2(N) + \frac{1}{r_2} a_2 (1 - a_1) \sigma^2(N)$$

$$M = g_1 + g_2 - 2g_3 = \frac{1}{r_1} (1 - \alpha_1)^2 + \frac{1}{r_2} (1 - \alpha_2)^2 + \frac{1}{r_2} (1 - \alpha_1)^2 + \frac{1}{r_1} (1 - \alpha_2)^2 + \left(\frac{1}{r_2} + \frac{1}{r_1} \right) (2\alpha_1 \alpha_2 - 1)$$

Because of $\alpha_1 \alpha_2 \neq \frac{1}{2}$, $M \neq 0$. The it can be known that p_1^* and p_2^* are the only optimal solution to control rights distribution.

4.7 The relationship between control rights preference and the weight of PPP project participants

Rational control rights allocation cannot only fully mobilize the imitative of all participants and increase their efforts, but also enable more participants with professional technologies to have bigger say in decision making, thus leading to maximized cooperation efficiency. As to the returns brought about by a specific control right, the preferences of PPP participants differ. Only by taking into consideration the preference of each participant can the two parties identify a win-win result through negotiation and consultation. The optimal control rights allocation model constructed in the present thesis exactly proceeds from the perspective of participants' control right preference. It allows deviation of control rights according to members' preferences so as to enable the party with stronger preference to have more control rights, thus realizing maximized cooperation efficiency of the PPP project on the whole.

In order to verify this, this thesis calculates the derivative of P_1^* to r_1 as follows:

$$\begin{aligned} \frac{\partial p_1}{\partial r_1} &= \frac{1}{M^2} \left(\frac{\partial(g_2 - g_3)}{\partial r_1} M - \frac{\partial M}{\partial r_1} (g_2 - g_3) \right) = \frac{1}{M^2} \left(\frac{\partial(g_2 - g_3)}{\partial r_1} (g_1 - g_3) - \frac{\partial M}{\partial r_1} (g_2 - g_3) \right) \\ &= \frac{1}{M^2} \left\{ \left[(1 - \alpha_2)^2 - \alpha_1(1 - \alpha_2) \right] \sigma^2(N) \left[\frac{1}{r_1} \alpha_1^2 + \frac{1}{r_2} (1 - \alpha_1)^2 - \frac{1}{r_2} \alpha_1(1 - \alpha_2) - \frac{1}{r_2} \alpha_2(1 - \alpha_1) \right] \right. \\ &\quad \left. - \left[\alpha_1^2 - \alpha_1(1 - \alpha_2) \right] \sigma^2(N) \left[\frac{1}{r_2} (1 - \alpha_1)^2 + r_2 \alpha_2^2 - \frac{1}{r_2} \alpha_1(1 - \alpha_2) - \frac{1}{r_2} \alpha_2(1 - \alpha_1) \right] \right\} \end{aligned} \quad (12)$$

When $\alpha_1^2 > (1 - \alpha_2)^2$, $\frac{\partial p_1^*}{\partial r_1} > 0$. Based on the above discussion, $\frac{1}{2r_1} \alpha_1^2 \sigma^2(N)$ represents the uncertainty loss it suffers from its participation in control rights allocation earlier, whereas $\frac{1}{2r_1} (1 - \alpha_2)^2 \sigma^2(N)$ stands for the uncertainty loss Member 1 suffers from participation in control rights allocation later. Therefore, in order to realize cooperation efficiency maximization, in other words, maximization of the returns generated by the overall control rights allocation, it can be known from (9) that the stronger the control rights preference r_1 of participants who join PPP project control rights allocation later, the smaller the $D(z_1)$; and the bigger P_1^* gets, the smaller P_2^* will be.

4.8 The quantification and calculation of control rights

4.8.1 Explanation of model variables

Based on the results of the model in Section 4.6, we can conclude as follows:

$$p_1 = \frac{\frac{1}{r_1} \left(1 - \frac{E(R_2)}{E(R_N)} \right) \left(1 - \frac{E^2(R_1)}{E^2(R_N)} \right) + \frac{1}{r_2} \left(\frac{E^2(R_2)}{E^2(R_N)} \right) \left(\frac{E(R_1)}{E(R_N)} \right)}{\frac{1}{r_1} \left(1 - \frac{E(R_1)}{E(R_N)} \right)^2 + \frac{1}{r_2} \left(1 - \frac{E^2(R_2)}{E^2(R_N)} \right)^2 + \frac{1}{r_2} \left(1 - \frac{E^2(R_1)}{E^2(R_N)} \right)^2 + \frac{1}{r_1} \left(1 - \frac{E(R_2)}{E(R_N)} \right)^2 + \left(\frac{1}{r_1} + \frac{1}{r_2} \right) \left(2 \frac{E(R_1)E(R_2)}{E^2(R_N)} - 1 \right)}$$

$$p_2 = 1 - p_1$$

$$p_2 = 1 - \frac{\frac{1}{r_1} \left(1 - \frac{E(R_2)}{E(R_N)} \right) \left(1 - \frac{E^2(R_1)}{E^2(R_N)} \right) + \frac{1}{r_2} \left(\frac{E^2(R_2)}{E^2(R_N)} \right) \left(\frac{E(R_1)}{E(R_N)} \right)}{\frac{1}{r_1} \left(1 - \frac{E(R_1)}{E(R_N)} \right)^2 + \frac{1}{r_2} \left(1 - \frac{E^2(R_2)}{E^2(R_N)} \right)^2 + \frac{1}{r_2} \left(1 - \frac{E^2(R_1)}{E^2(R_N)} \right)^2 + \frac{1}{r_1} \left(1 - \frac{E(R_2)}{E(R_N)} \right)^2 + \left(\frac{1}{r_1} + \frac{1}{r_2} \right) \left(2 \frac{E(R_1)E(R_2)}{E^2(R_N)} - 1 \right)}$$

p^1 : the control rights obtained by Company 1 as a participant of a specific right;

p^2 : the control rights obtained by Company 2 as a participant of a specific right;

N : a specific control right associated with the specific rights of a PPP project;

r_i : the control rights preference of Company i ;

R_N : the returns gained by Company 1 and Company 2 through joint decision-making (the stochastic returns of the specific control right N);

$E(R_N)$: the expected returns gained by Company 1 and Company 2 through joint decision-making (the expected stochastic returns of control right N);

R_1 : the returns gained by Company 1 after joining the allocation of control right N ;

R_2 : the returns gained by Company 2 after joining the allocation of control right N ;

$E(R_1)$: the expected returns gained by Company 1 after joining the allocation of control right N ;

$E(R_2)$: the expected returns gained by Company 2 after joining the allocation of control right N ;

As long as $r_1, r_2, E(R_N), E(R_1), E(R_2)$ are determined, we can determine control rights p^1, p^2 . Next, this thesis will discuss how to quantify the above variables.

4.8.2 The calculation of control rights preference

As mentioned before, control rights can bring returns to owners, the present thesis thus assumes another condition, namely, project participants always prefer control rights. This thesis considers only two participants: Company 1 and Company 2.

With regard to the quantification of control rights preference, two aspects need to be taken into consideration: One is that both Company 1 and Company 2 always prefer control rights; the other is that companies tend to show stronger control rights preference for the areas closely related to their own specific inputs (the more specialized a company is, the stronger control rights preference it tends to have).

Therefore, this thesis adopts the expert scoring method to quantify control rights preference. As to the advantages of this method, various specific indicators are used to score Company 1 and Company 2 respectively, thus presenting a more objective evaluation. Besides, such indicators are selected based on the strengths of each company.

First, this thesis refers to the PPP Project Decision-Making List proposed by relevant scholars and decomposes PPP control rights into 28 specific rights (Du & Wang, 2013; Wu, 2015). Then, it further decomposes each specific right into four categories: the right to propose, the right to approve, the right to execute and the right to supervise. Finally, experts score each company based on the abovementioned four categories and calculate control rights preference of Company 1 and Company 2 respectively. The data given in Table 4-2 are randomly assigned by functions.

Table 4- 2 Scoring system on control rights preference

		The right to propose	The right to approve	The right to execute	The right to supervise	Result (degrees of preference)					
		Com pany 1	Com pany 2	Com pany 1	Com pany 2	Com pany 1	Com pany 2				
Construction period	D01. Calling for bids for design unit	2	6	5	4	6	3	9	3	0.58	0.42
	D02. Detailed investigation and supplementary investigation	6	9	10	3	2	9	9	3	0.53	0.47
	D03. Preliminary design supplement and correction	9	2	1	4	8	3	4	10	0.54	0.46
	D04. Design construction drawing	5	6	9	10	6	8	6	8	0.45	0.55
	D05. Financing plan design and implementation	2	5	10	8	5	9	4	5	0.44	0.56
	D06. Payment and utilization of investment	9	8	7	7	8	3	2	9	0.49	0.51

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	D07.										
	Calling for bids for supervision (and supervision management) unit	6	3	2	7	9	7	1	10	0.4	0.6
	D08.										
	Calling for bids for construction unit	3	3	8	2	4	7	9	7	0.56	0.44
	D09.										
Project construction preparation	Calling for bids for suppliers of Party B's equipment/materials/professional construction	4	5	1	5	5	6	10	3	0.51	0.49
	D10.										
	Land requisition and demolishing and traffic relief	8	2	8	8	5	2	2	10	0.51	0.49
	D11.										
	Construction site preparation	3	6	5	6	10	1	3	5	0.54	0.46
	D12.										
	Overall construction organization design	10	3	4	8	3	3	7	3	0.59	0.41
	D13.										
Project construction	Commencement of work	5	2	10	10	2	4	2	6	0.46	0.54
	D14.										
	Construction progress control	6	8	7	2	2	4	8	4	0.56	0.44
	D15.										
	Materials, equipment and construction quality control	3	3	6	10	10	9	3	4	0.46	0.54

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		D16. Measurement and payment	8	5	9	8	8	5	4	8	0.53	0.47
		D17. Project change	4	5	8	2	4	8	7	4	0.55	0.45
		D18. Settlement of project cost	9	4	7	9	2	10	3	4	0.44	0.56
		D19. Onsite safety management and accident management	2	9	8	2	8	2	9	7	0.57	0.43
		D20. Dispute settlement	2	6	10	7	4	10	3	4	0.41	0.59
		D21. Completion inspection and acceptance	8	9	8	7	6	9	7	8	0.47	0.53
	Completion acceptance	D22. Equipment and system debugging and trial operation	5	4	5	7	3	2	4	2	0.53	0.47
		D23. Completion acceptance	2	7	1	9	2	7	7	1	0.33	0.67
		D24. Project handover	8	6	10	3	1	8	7	7	0.52	0.48
Handover period	Handover period	D25. Project materials and right takeover	7	7	8	7	4	4	7	2	0.57	0.43
		D26. Warranty and maintenance	3	2	4	2	4	2	3	6	0.54	0.46
Repurchase period	Repurchase period	D27. Operation and management	4	1	7	6	6	5	3	6	0.53	0.47
		D28. Repurchase payment or land (land	1	5	9	6	7	8	5	2	0.51	0.49

The demerit of this method is: When experts have different opinions, it is very difficult to identify which score is the optimal. For example, when 10 experts score the proposal right for D01 of the Company, 9 score 8 and one scores 2.

The simplest way to deal with such situation is to average the scores of 10 experts or eliminate the highest score and the lowest score before calculating the average. This thesis suggests that analytic hierarchy process can be applied on a trial basis in future studies so as to reduce the inconsistency and error of expert scoring.

4.8.3 Calculation of random expected returns

R_N refers to the random returns of the control rights of a specific right in project decision-making. It is a random variable. In order to calculate R_N , the following methods can be used:

- (1) Obtain the probability distribution function $f(R_N)$ of R_N through data simulation.

Then

$$E(R_N) = \int_0^{\infty} f(R_N) \tag{14}$$

It is worth noting that while simulating the probability distribution function of R_N , a large number of data are needed to support the results so as to make the results reliable. However, it is difficult to operate and the data are difficult to get. Therefore, this thesis chooses the second quantification method.

- (2) Comparable transaction method: First, compare the random returns of control rights of similar PPP projects, and use the comparable exchange method to obtain the random returns of the control rights of the present project. Take the rights of D06 (Payment and utilization of investment) for example. See table 4-3 for details:

Table 4- 3 Comparable transaction method

D06 Payment and utilization of investment (Refer to the project)	
The financing scale (quantification) of the PPP project>Returns of this item	C_1
.....	..

The input scale of the PPP project (quantification)/
Returns of this item C_i

D06 Payment and utilization of investment (the target project)

The financing scale (quantification) of the PPP project O_1

..... ..

The input scale of the PPP project (quantification) O_i

Then, based on the PPP project referred to:

$$E(R_N) = \frac{1}{i} \sum_1^i \frac{O_i}{C_i} \tag{15}$$

This thesis uses the comparable transaction method together with the expert scoring method to decompose 28 rights. It first determines the weights of the “construction period”, “handover period” and “repurchase period”, and then determines the weights of each stage in each period, and gradually decomposes to obtain the $E(R_N)$ of each right. See the following table for the specific indicator system and calculation results. See table 4-4 for calculation details

Table 4- 4 Expert scoring reference indicators and calculation of random expected return E (RN)

Expert scoring reference indicators (Obtain the random return R(N)of each right)

Project phases	Specific project phases	Specific contract rights	Specific indicator	Expert scoring indicator	Scoring instructions	Expert scoring (actual items)	Expert scoring (comparable items)	Comparable transaction value	Compare the project's E(RN): For calculation convenience, random numbers are used for simulation here.	The project's E(RN) are for
Construction period	Detailed project investment and construction	D01. Calling for bids for design unit	A1: Degree of specialization of the design unit	Whether the design unit has experience of such	Note: It can be scored from 0-10 points according to the previous experience of the design unit. 0 point means no experience in	7	3	2.33333333	18.00%	27.30%

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ruction drawing design	<p>projects such projects, before. and 10 points mean the most experienced and authoritative leader in the industry.</p> <p>Note: It can be scored from 0-10 points according to the previous project records of the design unit. 0 point means that the unit has a delayed strong tendency to postpone completion, whereas 10 points mean that the unit can deliver on time.</p> <p>Note: It can be scored from 0-10 points according to the qualification of the design unit. 0 point means that the qualification of the personnel is extremely low, and they have no such ability to undertake the project, whereas 10 points mean that the quality of the personnel is extremely high.</p> <p>Note: The industry status of the design unit can be evaluated by experts (0-10 points), referring to the industry leader, which has 10 points.</p> <p>Whether the design unit's quotation meets the requirements</p>	3	2.33333333
	<p>Personnel qualifications of the design unit</p>	3	0.66666667
	<p>Industry status of the design unit</p>	10	0.9
	<p>A2: Minimum offer of the design unit</p> <p>Note: Score the design unit within the reasonable offer range between 0 and 10 points.</p>	3	0.33333333

n drawi ng	of the compa ny	experien ce	So it should be considered that the participating companies may outsource the design work to a professional design company. Therefore, the experts should score between 0 and 10 points based on an evaluation of the actual design unit.										
			D1: The cost needed by the company to complete the design	Whether the company has an advantage in investment and financing	Note: The financing scale and financing cost of the project can be considered to determine the company's choice. For example, a professional investment company may get more and cheaper money than a non-professional company. (This thesis considers the participation of two companies in the PPP project. So it should be considered that the participating companies may entrust professional investment institutions to design the financing plan. Therefore, expert scores should be between 0 and 10 points based on an evaluation of the actual		7	2	3.5				
					E1: Degree of specialization of the participating companies	Whether the company is reasonable in management and use of raised funds		8	4	2			
Proje ct invest ment and finan cing	Finan cing plan and imple ment ation	D05.	Degree of specialization of the participating companies	Whether the company is reasonable in management and use of raised funds									
					Whether the company is reasonable in management and use of raised funds	Whether the company is reasonable in management and use of raised funds		9	6	1.5		12.00%	13.00%

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		participating institution).				
		Note: It is not necessarily a good thing for the budget cost to be as low as possible. The scoring should focus on the rationality of the companies in cost control and cost budgeting. Scores should be between 0 and 10 points.				
E2:	The participating companies' budget reasonable for the project	Whether the budget cost is reasonable	3	6	0.5	
E3:	The participating companies' investment in the project	Whether the scale of funds invested in the project by the participating companies meets the requirements or whether it matches the scale of the overall project.	1	3	0.33333333	
F1:	The speed of fund payment of participating companies	Note: Companies with higher financing efficiency should be given more control. Scores should be between 0 and 10 points.		6	1.5	
D06.	Payment of participating companies investment	Note: The higher the income and net profits the participating companies gain		4	2.25	
						19.00% 24.65%

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s income F3: The net profits of the PPP project	profits from the project, gained the more control by the they should participa obtain. Scores ting should be compani between 0 and 10 es after points. impleme nting the PPP project	1	7	0.1428571 43	
G1: Degree of speciali zation of the particip ating compa nies	The participa ting compani es' experien ce in supervisi on and manage ment	2	4	0.5	
D07. Calli ng for bids for super visio n (and super visio n mana geme nt) unit	G2: Cost of supervi sion of the project Whether the amount of cost and G3: The extent of project supervi sion	7	2	3.5	15.00% 22.14%
	Note: The more professional a company is, the better supervision it has over PPP projects, and the more guarantee there will be for smooth project progress. (This thesis considers the participation of two companies in the PPP project. So it should be considered that the participating companies may outsource this right to a third supervisory unit. Expert scores should be based on an evaluation of the actual unit.) Scores should be between 0 and 10 points. Note: A balanced evaluation should be made	3	7	0.4285714 29	

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		between the supervision cost, supervision quality and supervision efficiency. Scores should be between 0 and 10 points. Note: The degree of specialization and credibility of the construction					
		Whether unit ensure the the smooth progress construct of the PPP ion unit project. (This H1: has such thesis considers Degree bad the participation of records of two speciali as companies in the zation delayed PPP project. So it and delivery should be 2 4 0.5 credibil and considered that ity of arrears the participating the and companies may D08. constru whether outsource this ct Calli ction it has right to a third ng for unit experien construction unit. bids for const similar should be based ructio ructio projects, on an evaluation n unit etc. of the actual unit). Scores should be preparation between 0 and 10 points. Note: In the ration H2: The bidding for the degree The in a PPP project, of construct deposit payment project ion by the unit guarant unit's provides a strong 1 9 0.11111111 ee by margin guarantee for the the payment smooth project constru quota implementation. ction Scores should be unit between 0 and 10 points.					
	D09. Calli ng for materia n bids for the PPP' suppl	Quality Note: Experts should fully of consider the and demerits of the suppliers'	11	3	3	11.00%	13.95%

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iers of Party B's equip ment/ mater ials/p rofess ional const ructio n	I2: Equip ment for the PPP project	nt and materials equipment in the same type of project when scoring. In addition, the procurement cost should also be considered. Scores should be between 0 and 10 points.	3	8	0.375		
	I3: The purcha sing budget of the PPP project	as the material quality and procure ment budget	3	7	0.4285714 29		
	J1: Land acquisi tion and demolit ion invest ment of the PPP project	Note: The less cost the participating companies pay to solve land acquisition and transportation problems, the more control they should get. This thesis considers two companies and makes a direct comparison between them. Relative scores can be given between 0 and 10 points. Note: The handling of post-demolition issues is also a key step. The efficiency and cost of participating companies' handling of subsequent issues should be used as a reference evaluation indicator. Scores should be between 0 and 10 points.	6	3	2		
D10. Land requi sition and demo lishin g and traffic relief	J2: Traffic relief invest ment for the PPP project	Investme nt in this right makes a direct comparison between them. Relative scores can be given between 0 and 10 points. Note: The handling of post-demolition issues is also a key step. The efficiency and cost of participating companies' handling of subsequent issues should be used as a reference evaluation indicator. Scores should be between 0 and 10 points.	1	7	0.1428571 43	11.00%	9.69%
	J3: Efficie ncy of post- demolit ion issue handlin g	Refer to the note for details	5	10	0.5		
D11. Const ructio n site ment	K1: Site invest ment	Include input costs, site size	8	2	4	16.00%	64.00%

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preparation	selection , etc.	participating companies' investment in the site, the site scale, and the equipment preparation on the construction site. Scores should be between 0 and 10 points.					
	L1: Electrical input for the PPP project		9	5	1.8		
	L2: Water and sanitation input of the PPP project	Total investment overall construction	Note: affects the allocation of this right.	The amount of investment actual	3	6	0.5
Project construction organization design	D12. Over all construction organization design	Technical input of the PPP project	8	4	2		
						11.00%	18.24%
	L4: Degree of specialization of the design unit	Dedicated input of design unit	7	3	2.33333333		
		implementation, control and coordination, as well as the allocation and use of resources. (This thesis considers the participation of two companies in the PPP project. So it should be considered that					

			the participating companies may outsource this right to a third design unit. Expert scores should be based on an evaluation of the actual unit). Scores should be between 0 and 10 points.					
	M1: Construction start time		Note: Whether the participating companies can start work on time determines whether the PPP project can be delivered on time. In addition, the construction preparation of the participating companies should also be included in the supplementary considerations. Yet the main consideration is the timeliness of the commencement of construction. Scores should be between 0 and 10 points.	4	4	1		
D13. Commencement of work preparation	M2: Construction preparation	Whether the participating companies start on time and have made construction preparations.	Yet the main consideration is the timeliness of the commencement of construction. Scores should be between 0 and 10 points. Note: The formulation of the construction schedule affects the direction of the entire project. The plans made by the participating companies are an important factor for the allocation of this right. Scores should be between 0 and 10 points.	3	1	3	15.00%	30.00%
D14. Construction progress control	N1: Construction schedule is optimal	Whether the construction schedule is optimal	The plans made by the participating companies are an important factor for the allocation of this right. Scores should be between 0 and 10 points.	4	2	2	19.00%	16.04%

		Note: Participating companies should regularly check the construction progress to ensure the continuity of the project. Scores should be between 0 and 10 points.					
N2: Situation check	Whether a perfect construction schedule inspection plan has been formulated	Whether participating companies should regularly check the construction progress to ensure the continuity of the project. Scores should be between 0 and 10 points.	9	0.33333333			
N3: Post-event handling	Whether the adjustment measures are formulated	Note: This indicator means that if the construction schedule or construction plan deviates from the expectation, the participating companies should analyze the causes and impacts on the construction period in a timely manner, find out the necessary adjustment measures, modify the original plan, and repeat this process until the completion of the project acceptance. Scores should be between 0 and 10 points.	5	0.2			
D15. Materials, equipment and construction quality control	O1: Method control	Such things as the technical plan, process flow, organizational measures, testing methods, and construction with the actual	7	1.285714286	16.00%	15.45%	

	<p>ion project to ensure organizat that the plan is ion technically design feasible, adopted economically during reasonable, the advanced in whole technology, construct effective in ion measures and period of convenient in the operation, so as project to improve the overall quality of the project, speed up the construction progress and reduce the cost.</p>			
<p>O2: Quality control for construction machinery and equipment selection</p>	<p>Construc be made by tion site focusing on three conditio aspects: First, ns, ensure that the building type of structure mechanical type, equipment is mechani applicable; cal equipme Second, ensure nt that the main Quality nt performance control performa parameters of for nce, mechanical constru construct equipment are ction ion reasonable; 1 machin technolo Third, ery and gy and 9 equipm method, grasp the use and ent construct operating selectio ion requirements of n organizat mechanical ion and equipment. manage Therefore, ment, experts should construct score from the ion above aspects, technolo and scores gy and should be economy between 0 and 10 , etc. points.</p>	<p>1</p>	<p>9</p>	<p>0.1111111 11</p>
<p>O3: Control of environmental factors</p>	<p>Take Note: strict and Participating of effective companies environ control should fully mental measures consider the factors on characteristics of</p>	<p>6</p>	<p>4</p>	<p>1.5</p>

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D16. Measurement and payment method and payment period	P1: Choice of measurement payment method and payment period	<p>environ the project and mental specific factors conditions, such that as construction affect safety in the quality summer rainy season, so as to ensure the overall safety and quality of the project. Scores should be between 0 and 10 points.</p> <p>Note: Participating companies should pay attention to the following points when measuring payment: First, make no measurement or payment for any project with problems until the responsible unit repairs the project to meet the relevant standard requirements and meet the quality requirements. The scope of measurement and payment does not include repair costs so as to guarantee the project quality. Second, timely deduct the payment that should be deducted and refuse to measure and pay any money that does not meet the contract requirements. Scores should be between 0 and 10 points.</p> <p>Note: Participating companies The cost should achieve incurred the maximum by by cost-</p>	6	0.66666667	13.00%	8.67%
D17. Project change	Q1: Cost incurred by changes	<p>project effectiveness in changes the process of caused project changes. And whether the participating by the changes companies are greater than the cost of such change is an important factor affecting the</p>	5	1.2	18.00%	55.80%

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			distribution of this control right. Scores should be between 0 and 10 points.					
	Q2: Scale of changes	The extent and scale of project changes	The changes will affect the total period of the project and the project progress. Scores should be between 0 and 10 points.	10	2	5		
	R1: Payment settlement method	Participating companies' choice of the settlement method for the construction unit's project payment	Note: When participating companies participate in the distribution of control rights, they mainly consider the rationality and scientificity of the companies' payment settlement. Specific reference indicators can be considered from the settlement method and settlement period. Scores should be between 0 and 10 points.	4	8	0.5		
D18. Settlement of project cost							12.00%	6.60%
	R2: Settlement period	Participating companies' settlement period for the construction unit's project payment	Note: When experts score, they should consider whether participating companies' measures for site safety management can be soundly managed whether to standardize site safety production	3	5	0.6		
D19. Onsite safety management accident management	S1: Safety management measures	Whether the participating companies have formulated sound safety management measures	Note: When experts score, they should consider whether participating companies' measures for site safety management can be soundly managed whether to standardize site safety production	4	4	1	17.00%	23.80%

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		management, and minimize all types of safety accidents. Scores should be between 0 and 10 points. Note: When experts score, they should take into special consideration whether the participating companies have formulated a comprehensive pre-arranged emergency plan	9	5	1.8		
		Whether the participating companies have prepared the dispute resolution measures in advance and the reasonableness of the measures	10	7	1.428571429		
D20.	Dispute settlement	Note: The cost of participating companies' dispute resolution and the strength of the resolution should be fully included in the evaluation considerations.				17.00%	17.46%
		T2: The participating companies' dispute resolution cost	5	8	0.625		

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		Scores should be between 0 and 10 points.						
		Rationality	Note:					
D21. Completion inspection and acceptance of completion	U1: Design of the completion inspection plan	Design feasibility of the participating companies' design plans	This control is mainly reflected in which company can reasonably control the completion time and formulate a perfect acceptance plan so as to ensure that the project can be completed smoothly. Scores should be between 0 and 10 points.	5	8	0.625		
	U2: Time of completion	Whether the participating companies can complete the project on time	Whether the participating companies can complete the project on time	2	6	0.3333333	16.00%	7.67%
Project completion	D22. Equipment commissioning and operation system debugging and operation plan	Equipment commissioning and operation cost is the economical and efficient	This right mainly depends on the operability of the participating companies for commissioning and work, whether the cost can be controlled under the premise that the project can be successfully completed. Scores should be between 0 and 10 points.	10	4	2.5		
	V2: Equipment commissioning and operation plan	Whether the participating companies can be controlled under the premise that the project can be successfully completed. Scores should be between 0 and 10 points.	Whether the participating companies can be controlled under the premise that the project can be successfully completed. Scores should be between 0 and 10 points.	7	5	1.4	18.00%	35.10%
D23. Completion acceptance plan	W1: Design of completion acceptance plan	Design of the participating companies' completion	Note: Participating companies should develop an acceptance solution after the failure of the participating companies' PPP project. Scores should be	2	9	0.2222222	15.00%	9.17%

	document handover are carried out, and whether there is a project handover report Whether to					
	X4: conduct regular return visits after the project handover	10	1	10		
	Note: This indicator refers to the sum of various forms of complete information such as documents, materials, drawings, icons, calculation materials, and audio-visual materials formed during the project construction, preparation, survey, design, completion, and completion. Scores should be between 0 and 10 points. Note: While scoring this indicator, attention should be paid to what rights need to be handed over, whether the handover process is in accordance with the standard, and whether it can be					
	Y1: the project data, whether the project information is true, and whether the project materials are valid		9	0.55555556		
D25. Project materials and right hand over	Y2: Timeliness of the transfer of rights		9	2.25	15.00%	21.04%

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			cost of transfer	of handed over in time.	Scores should be between 0 and 10 points.					
				Note:	This indicator refers to the minimum warranty period of construction period under normal use conditions.					
	D26. Warranty and maintenance enhancement	Z1: Warra Warranty and maintenance investment	participating companies' financial investment in this right	Experts consider financial factors in this input	should such as warranty time, cost and maintenance measures when scoring. Scores should be between 0 and 10 points.	5	10	0.5	17.00%	8.50%
Repurchase period	Repurchase period	D27. Operation and management	α1: Capital chain funds	Participating companies' funds in this right	Note: This indicator refers to the planning, organization, implementation, and control of the operation management work closely related to product and service creation. Scores should be between 0 and 10 points.	2	5	0.4		
			α2: Operating expenses	Participating companies' operating expenses in this right (fixed capital and working capital)	It is a management work closely related to product and service creation. Scores should be between 0 and 10 points.	5	4	1.25	13.00%	10.73%
		D28. Repurchase payment or land replacement	β1: Repurchase fund	Project investment amount	Note: Experts should fully consider such factors as the composition of the repurchase funds and the repurchase period when scoring. Land replacement	4	3	1.33333333		
				Various taxes		5	4	1.25	18.00%	25.45%
				Project management		10	9	1.11111111		
						3	8	0.375		

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mode 1 BT)	ment cost	refers to a method of transforming different grades of land in the process of urban development, thereby							
	β2: Land replace ment situation	Replace ment of old city and parcels in different areas, whether replacement of parcels in the same area	transforming the old city and speeding up urban development. Factors such as whether the selection method optimizes the land structure and whether the cost control is reasonable or not should also be considered. Scores should be between 0 and 10 points.	6	2	3			
Total	—	—	—	—	—	—	—	—	—

4.8.4 Calculation of expected returns for the participating companies

$E(R_1)$ and $E(R_2)$ represent the expected returns gained by Company 1 and Company 2 respectively through independent decision-making and such returns are easy to quantity. Take $E(R_1)$ for exemple, the expected returns of Company 1 through independent decision-making can be replaced by the expected returns of Company 1, while the expected returns of companies can be given by themselves. In order to simplify the calculation, this thesis adopts random numbers to directly simulate the expected returns.

Assignment instructions: In order to simplify the calculation, this thesis adopts random numbers to directly simulate the expected returns. (When simulating the expected returns with random numbers, we need to satisfy the super additivity of cooperative games. It means that the returns gained from each right by Company 1 or Company 2 through independent decision-making are lower than $E(R_N)$ of each right and that $E(R_1) + E(R_2) < E(R_N)$. See table 4-5 for calculation details.

Table 4- 5 Calculation of expected returns of the participating companies

Returns of the participating companies through independent decision-making (such data can be directly obtained from the companies)

		Company 1	Company 2	$E(R_N)$ (Returns from joint decision-making)	
Construction period	Detailed project investigation and construction drawing design	D01. Calling for bids for design unit	7.18%	9.33%	27.30%
		D02. Detailed investigation and supplementary investigation	9.80%	12.01%	23.38%
		D03. Preliminary design supplement and correction	0.22%	6.95%	10.67%
		D04. Design of construction drawing	9.25%	16.44%	40.08%
		D05. Financing plan design and implementation	0.35%	8.51%	13.00%
	Project investment and financing	D06. Payment and utilization of investment	6.18%	14.98%	24.65%
		D07. Calling for bids for supervision (and supervision management) unit	9.08%	8.69%	22.14%
		D08. Calling for bids for construction unit	2.23%	1.41%	4.58%
	Project construction preparation	D09. Calling for bids for suppliers of Party B's equipment/materials/professional construction	6.39%	4.40%	13.95%
		D10. Land requisition and demolishing and traffic relief	2.05%	3.84%	9.69%
		D11. Construction site preparation	27.71%	30.99%	64.00%
		D12. Overall construction organization design	5.66%	6.85%	18.24%
	Project construction	D13. Commencement of work	6.14%	6.47%	30.00%
		D14. Construction progress control	5.90%	10.80%	16.04%
		D15. Materials, equipment and construction quality control	4.60%	6.69%	15.45%

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		D16. Measurement and payment	5.01%	2.22%	8.67%
		D17. Project change	22.41%	18.42%	55.80%
		D18. Settlement of project cost	1.38%	2.09%	6.60%
		D19. Onsite safety management and accident management	5.63%	13.81%	23.80%
		D20. Dispute settlement	5.23%	9.65%	17.46%
		D21. Completion inspection and acceptance	1.45%	4.13%	7.67%
	Completion acceptance	D22. Equipment and system debugging and trial operation	11.89%	13.22%	35.10%
		D23. Completion acceptance	2.35%	4.76%	9.17%
		D24. Project handover	21.48%	14.12%	51.04%
Handover period	Handover period	D25. Project materials and right takeover	5.63%	11.28%	21.04%
		D26. Warranty and maintenance	4.25%	2.99%	8.50%
Repurchase period	Repurchase period	D27. Operation and management	5.85%	3.89%	10.73%
		D28. Repurchase payment or land (land replacement model BT)	10.82%	13.75%	25.45%

4.8.5 Calculation of the weight of each right

The control rights of the PPP project are decomposed into 28 specific rights and the weight of each right can be calculated based on the scoring of experts. The detailed calculating procedures are as follows: First, calculate the weights of the construction period, handover period and repurchase period of the project; second, further decompose each period into specific stages and calculate the weights of each stage; third, calculate the weights of each of the 28 specific rights. In order to simplify the calculation, this thesis adopts random assignment. see Table 4-6.

Table 4- 6 Calculation of the weights of each right

Scoring the weights of each of the 28 specific rights (simulation based on random numbers)

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Periods	Assignment by experts (0-10)	Weight of each period	Stages	Assignment by experts (0-10)	Weight of each stage	Specific rights	Assignment by experts	The weight in each stage	Final results
						D01. Calling for bids for design unit	8	40.00%	3.08%
			Detailed project investigation and construction drawing design		7.69%	D02. Detailed investigation and supplementary investigation	6	30.00%	2.31%
Construction period	10	38.46%				D03. Preliminary design supplement and correction	3	15.00%	1.15%
						D04. Design of construction drawing	3	15.00%	1.15%
			Project investment and financing	9	7.69%	D05. Financing plan design and implementation	9	45.00%	3.46%
							1	5.00%	0.38%

		D06. Payment and utilization of investment		
		D07. Calling for bids for supervision (and supervision management) unit	10	50.00% 3.85%
		D08. Calling for bids for construction unit	9	37.50% 2.56%
		D09. Calling for bids for suppliers of Party B's equipment/materials/professional construction	7	29.17% 1.99%
Project construction preparation	8		6.84%	
		D10. Land requisition and demolishing and traffic relief	4	16.67% 1.14%
		D11. Construction site preparation	4	16.67% 1.14%
		D12. Overall construction organization design	4	8.70% 0.67%
Project construction	9		7.69%	
		D13. Commencement of work	3	6.52% 0.50%
		D14. Construction	9	19.57% 1.51%

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		progress control			
				D15. Materials, equipment and construction quality control	2.17% 0.17%
				D16. Measurement and payment	19.57% 1.51%
				D17. Project change	2.17% 0.17%
				D18. Settlement of project cost	19.57% 1.51%
				D19. Onsite safety management and accident management	8.70% 0.67%
				D20. Dispute settlement	13.04% 1.00%
				D21. Completion inspection and acceptance	47.62% 4.07%
	Completion acceptance	10	8.55%	D22. Equipment and system debugging and trial operation	23.81% 2.04%
				D23. Completion acceptance	28.57% 2.44%
Handover period	30.77% Handover period	10	30.77%	D24. Project handover	11.11% 3.42%

				D25. Project materials and right takeover	88.89%	27.35%
				D26. Warranty and maintenance	7.14%	2.20%
				D27. Operation and management	64.29%	19.78%
Repurchase period	8	30.77%	Repurchase period	10	30.77%	
				D28. Repurchase payment or land replacement model BT)	28.57%	8.79%
Total	—	100.00%	—	—	100.00%	100.00%

4.8.6 The control rights calculation results

Table 4- 7 Calculation results

Calculation results										
	r_1	r_2	$E(R_N)$	$E(R_1)$	$E(R_2)$	p^1	p^2	Weight	Weight of P1	Weight of P2
D01	0.58	0.42	0.273	0.0718	0.0933	50.50%	49.50%	3.08%	1.52%	1.56%
D02	0.53	0.47	0.23375	0.0980	0.1201	60.90%	39.10%	2.31%	1.41%	0.90%
D03	0.54	0.46	0.106666667	0.0022	0.0695	16.90%	83.10%	1.15%	0.19%	0.96%
D04	0.45	0.55	0.400833333	0.0925	0.1644	72.82%	27.18%	1.15%	0.84%	0.31%
D05	0.44	0.56	0.13	0.0035	0.0851	35.85%	64.15%	3.46%	1.24%	2.22%
D06	0.49	0.51	0.246547619	0.0618	0.1498	47.72%	52.28%	0.38%	0.18%	0.20%
D07	0.4	0.6	0.221428571	0.0908	0.0869	70.48%	29.52%	3.85%	2.71%	1.14%
D08	0.56	0.44	0.045833333	0.0223	0.0141	66.21%	33.79%	2.56%	1.70%	0.87%

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D09	0.51	0.49	0.139464286	0.0639	0.0440	42.40%	57.60%	1.99%	0.85%	1.15%
D10	0.51	0.49	0.096904762	0.0205	0.0384	96.52%	3.48%	1.14%	1.10%	0.04%
D11	0.54	0.46	0.64	0.2771	0.3099	62.39%	37.61%	1.14%	0.71%	0.43%
D12	0.59	0.41	0.182416667	0.0566	0.0685	45.78%	54.22%	0.67%	0.31%	0.36%
D13	0.46	0.54	0.3	0.0614	0.0647	56.87%	43.13%	0.50%	0.29%	0.22%
D14	0.56	0.44	0.160444444	0.0590	0.1080	46.66%	53.34%	1.51%	0.70%	0.80%
D15	0.46	0.54	0.154497354	0.0460	0.0669	98.35%	1.65%	0.17%	0.16%	0.00%
D16	0.53	0.47	0.086666667	0.0501	0.0222	58.50%	41.50%	1.51%	0.88%	0.62%
D17	0.55	0.45	0.558	0.2241	0.1842	32.60%	67.40%	0.17%	0.05%	0.11%
D18	0.44	0.56	0.066	0.0138	0.0209	48.59%	51.41%	1.51%	0.73%	0.77%
D19	0.57	0.43	0.238	0.0563	0.1381	76.62%	23.38%	0.67%	0.51%	0.16%
D20	0.41	0.59	0.174553571	0.0523	0.0965	89.56%	10.44%	1.00%	0.90%	0.10%
D21	0.47	0.53	0.076666667	0.0145	0.0413	74.30%	25.70%	4.07%	3.02%	1.05%
D22	0.53	0.47	0.351	0.1193	0.1322	67.03%	32.97%	2.04%	1.36%	0.67%
D23	0.33	0.67	0.091666667	0.0235	0.0476	42.29%	57.71%	2.44%	1.03%	1.41%
D24	0.52	0.48	0.510404762	0.2148	0.1412	56.50%	43.50%	3.42%	1.93%	1.49%
D25	0.57	0.43	0.210416667	0.0563	0.1128	44.14%	55.86%	27.35%	12.07%	15.28%
D26	0.54	0.46	0.085	0.0425	0.0299	82.59%	17.41%	2.20%	1.82%	0.38%
D27	0.53	0.47	0.10725	0.0585	0.0389	68.59%	31.41%	19.78%	13.57%	6.21%
D28	0.51	0.49	0.2545	0.1082	0.1375	64.90%	35.10%	8.79%	5.71%	3.09%
Total	_____	_____	_____	_____	_____	_____	_____	100%	57.50%	42.50%

The present thesis quantifies control rights with such methods as expert scoring method and comparable transaction method and finally calculates the control rights allocation results of the joint PPP project. The p^1 column and p^2 column in Table 4-7 respectively represent the control rights of each specific right allocated to Company 1 and those to Company 2. The sums at the lower right corner of the table represent the control rights of the entire project allocated to Company 1 and those to Company 2 respectively.

4.9 Chapter summary

In light of the status of specialized companies' equity investment in PPP project companies, this chapter proposes to further divide the private sector into specialized companies and pure investors based on the difference in input factors. Besides, based on existing literature, this chapter divides control rights in PPP projects into 28 specific decision-making items (Du, 2013). Yet for the interests and responsibilities brought about by the control rights of the same

decision-making item, different participants show different levels of preference and the concept of control rights preference is introduced. In addition, this chapter puts forward that the reason for a project member's stronger preference for a certain control right is that it has more professional information about and more specific investments in the area where control rights are involved. More control rights cannot only guarantee the returns of such specific investments, but also seek more benefits for itself without jeopardizing the overall interests of the project. This cannot only fully mobilize the initiative of project participants, but also effectively utilize each member's expertise for decision making, thus reducing the uncertainty of project returns and eventually maximizing cooperation efficiency.

The characteristics of PPP projects themselves determine that their returns are highly uncertain compared to other projects. Therefore, this chapter adopts stochastic cooperative game to construct the optimal control rights allocation model under the assumption that the project returns are uncertain, which is closer to reality. Besides, this thesis adopts Shapley value to distribute project returns based on differences in participants' marginal contribution. It satisfies both collective rationality and the individual rationality of project members. In other words, the benefits participants obtain from a certain project are bigger than the sum of benefits they obtain from working alone. The total revenues of the project are bigger than the sum of revenues earned by each participant alone. This has guaranteed project members' initiative to participate.

Chapter 5: Double-Case Analysis

Based on relevant theories and methods, the previous chapter constructs the optimal allocation model of control rights by adopting stochastic cooperative games and studies the important issue of control rights allocation in designing the transaction structure of “Chinese dequity”. As a financing tool that meets the interest demands from all parties, “Chinese dequity” has been widely used in such areas as infrastructure construction, and public utilities. Through case studies of the PPP Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project, this chapter sets out to construct the transaction structure of “Chinese dequity” financing projects and the allocation of control rights among all project participants, analyze the specific application of the actual debt investment in the form of equity financing project and its transaction structure and the allocation of control rights of the participants.

5.1 Transaction structure design of the PPP Project of the Underground Utility Tunnel in HS City

5.1.1 Project introduction

Project name: Implementation Plan of the PPP Project of the Underground Utility Tunnel in the Core Area of the Daye Lake Ecological New District in HS City

Implementation organization: Municipal Commission of Urban-Rural Development of HS City

Consulting unit: Hubei Realthom Appraisal and Consulting Co., Ltd.

Construction location: The Core Area of the Daye Lake Ecological New District in HS City

Project overview: Construction of underground utility tunnel in the Core Area of the Daye Lake Ecological New District

The project plans to build underground utility tunnel in the core area of Daye Lake. Construction is expected to last for 5 years and operation 25 years. Construction and operation of the utility tunnel will be completed by the PPP project company.

In this project, HS City government grants Zhongbang Company and its subsidiaries the franchise to operate all underground utility tunnel in the districts of HS City. Zhongbang Company and social capital providers will provide the capital to establish the project company of this PPP project. The project company will accept the franchise for underground utility tunnel in this project range and take over the responsibility of project design, financing, construction and operation and pay “long-term equity maintenance fee” to the social capital providers. HS City Government performs supervisory functions over the whole construction and operation process of the project. After 30-year franchise period expires, the project company shall hand over the underground utility tunnel and supporting facilities to the government, and the government shall repurchase the equity of social capital providers at the agreed amount in accordance with the *Equity Transfer Agreement*.

5.1.2 Research methods

5.1.2.1 Basis for the selection of research methods

This thesis adopts the case study method largely because of the following reasons. From the perspective of the research object, the research problem must be placed in a specific context. In their studies, Hodgson (2008), Becker (2004) et al. all touch upon conventional contextualized features, believing that it is necessary to place a problem in a specific context so as to analyze its causes and features. The case study method mainly answers and explains the questions of “how” and “why”, which makes it an appropriate research method to explore contextualization. Through analysis of specific cases, the correlation between various factors can be found.

The interview method has great flexibility and adaptability. It can be used by researchers not only to obtain relevant information such as project financing methods, financing channels, financing entities and project progress, but also to guide the questioning about non-verbal information by capturing the facial expressions and body language of the interviewees. Such knowledge of many hidden facts facilitates the acquisition of more extensive and richer primary information.

The detailed design of specific questions through the questionnaire survey method, followed by summarizing and combing through the responses of interviewees, combined with data acquired through the interview method and the case study method, will lead to a more comprehensive understanding of all information.

5.1.2.2 Basis for the selection of cases

The construction industry, where “Chinese dequity” enjoys wide application, is selected in this thesis as the case setting. With its potential for replicability, relative stability and sophisticated experience in the industry, “Chinese dequity” has established a series of standardized processes and models. Delving into these features and summarizing the relevant successful experience and best practice to generate research results with universal applicability will help promote the innovative development of ideas.

5.1.2.3 Research process and interviewees

1. Preparation of the interview outline

Before the interview, we specifically designed relevant questions for government personnel in charge of this project and employees at different levels in the construction companies and the project financing enterprises, which concern the following information: project overview, project operation model, project financing means, project transaction structure, project return mechanism, rights and obligations among project participants and so on. In the course of investigation, we will adjust and supplement the above questions depending on the time we have. During interviews, for example, we would talk about the specific financing methods of the project, but the financing risks and risk exposure involved were not discussed in detail. We would then inquire about risks in the process of project financing through appropriate control over the conversation and add the question to the interview outline.

2. Research process

(1) Field research. Field interviews were mainly scheduled from August to September 2018, with the length of time of each interview controlled around one hour, as shown in Table 5-1.

(2) Supplementary research. In the supplementary research stage, the respondents with whom we failed to schedule an appointment during the first stage of interviews for various reasons would give additional interviews through the phone, including one interview of a Deputy Director of Municipal Commission of Urban-Rural Development of HS City on August 13, 2018, and another given by the general manager of a financial institution on September 14, 2018. In addition, we confirmed some of the issues that needed to be verified, both by telephone and by e-mail, with interviewees who had previously been interviewed.

Table 5- 1 A summary of field interviews

Department of the Interviewees	Number of Interviews	Number of Interviewees	Total Interview Time
HS City Government	2 (1 in August and 1 in September, 2018)	5	6 hours
HS Municipal Commission of Urban-Rural Development	2 (1 in August and 1 in September, 2018)	2	3 hours
Zhongbang Housing Investment Co., Ltd.	2 (1 in August and 1 in September, 2018)	5	4 hours
A financial institution	2 (1 in August and 1 in September, 2018)	4	5 hours
A metallurgy, science and engineering group	2 (1 in August and 1 in September, 2018)	3	3 hours

(3) Distribution of questionnaires. The interviews aimed at key personnel, executives and managers with a higher degree of engagement in the project. They are somewhat representative but in an inadequate and incomplete way, which is why we also developed a questionnaire based on the questions listed in the interview outline and sent them out to the employees involved in the project at the same time as the interviews to collect opinions from all sides.

3. Data collection

Research data can only be mutually corroborated after reaching a certain amount and level, which requires the data to come from a wide range of sources. This study will collect relevant data from the following aspects:

(1) Semi-structured interviews. The so-called “semi-structure” refers to the loose setting of interview outline, where constant revisions are made during the interview based on the answers of the interviewees, as opposed to a strictly-formal structured outline. A semi-structured interview takes into account the fact that during the interview, we might learn about some new issues and perspectives that are not covered by existing research results. Data obtained through this method play an important role in this thesis.

(2) Secondary sources. These mainly include various kinds of literature, relevant reports on the project, transcripts of managers’ interviews with the media, materials publicly available on the websites of government agencies and enterprises and so on.

(3) Archived documents. These include paper-based internal information and printed materials, such as internal archives of government agencies and companies well as internal publications of companies and brochures.

(4) Questionnaires. Carefully collect the questionnaires sent out, mark the questions that tend to be consistent according to the responses of different interviewees to the same question and interview insiders or authorities one by one on the questions with vastly different answers, so as to form reliable data.

5.1.3 Research findings

5.1.3.1 Project financing means

The project's financing subject is the project company specially established as a subsidiary of the Zhongbang Company that wins the bid. The project company initiates project financing activities, sourcing capital from three channels: project capital owned by the company, government fiscal appropriation distributed to the project company in the form of subsidies, and newly added debt capital, repayment of which shall be made with the investment proceeds of the project. The total assets and credit of the existing project entity will serve as guarantee. The project company shall fully assume the financing responsibilities and risks.

Source of capital consists of equity financing, financing through "Chinese dequity" and debt investment, of which equity investment is 183,229,400 yuan (6.06%), investment through "Chinese dequity" is 427,535,400 yuan (14.14%), and debt investment is 2,412,326,000 yuan (79.80%).

(1) Equity Financing

The government invests 183,229,400 yuan, which is included in project capital, and signs *Equity Investment Agreement* with social capital, taking up 30% of the project company's equity.

(2) Financing through "Chinese dequity"

The selected social capital entity invests 427,535,400 yuan, which is included into project capital, and signs *Equity Investment Agreement* with the government, taking up 70% of the project company's equity.

The government Investment amount 183,229,400 Equity ratio 30%

The selected social capital entity Investment amount 42753.54 Equity ratio 70%

After the 5-year project construction term is due, the project company shall pay the social capital entity “equity long-term maintenance fee” on an annual basis starting from the first year of the operation period; After the 30-year franchise period is due, the government shall repurchase the 70% equity held by the social capital entity at a price of 427,535,400 yuan in accordance with the terms set forth in the *Equity Transfer Agreement*.

(3) Debt financing

The project capital is designed to take up 20% of the total project investment. The remaining 80% construction capital shall be gained through social capital financing. To be specific, an amount of 1.2-billion-yuan line of credit was gained from the National Development Bank in the initial period, with the interest rate calculated as 20% below the benchmark interest rate. The remaining construction capital (970 million yuan) is financed by social capital through other financing channels, with the interest rate calculated as 20% above the benchmark interest rate. The principal and interests shall be fully paid back after 20 years.

5.1.3.2 Project return mechanism

The project return mechanism mainly consists of pipeline entry fee as well as pipeline operation, management and maintenance fees.

1. Pipeline entry fee

The pipeline entry fee of the project will be paid by users, which means the end users of the pipeline will purchase products and services, so as to recover the construction and operation costs of the project. It is important to consider the fact that, once the return mechanism of payment by users is adopted, the project company will generally bear all or part of the demand risk. Therefore, we must take into account whether or not the demand after project completion can be predicted. If the project demand is predictable and the prediction is close to the actual result, a fixed income will thus be generated; if it is much lower than the predicted level, there will be a certain deficit. On the other hand, it is necessary to think through the feasibility of charging users an entry fee, including such issues as the method of payment and their ability to pay on schedule.

HS City Government grants Zhongbang Company and its subsidiaries the franchise for all utility tunnels in the whole HS City. Zengzi Zhongbang Company that wins the bid is the

subsidiary specially established for this project. As the responsible company of this project, it inherits the franchise for all utility tunnels within the scope of this project.

In order to collect the pipeline entry fee and obtain a certain amount of income, the return on investment of the project must be fully considered. For investment projects paid by users, the return on investment should be at least not lower—preferably higher by 2-3 percentage points—than the interest rate for long-term loans set by banks. Based on the ROT and relevant information on project investment and operation, combined with the analysis of the national GDP growth rate calculated at current prices, it was finally confirmed that this project shall charge an equal amount of pipeline entry fee every year for six years from the fifth year to the tenth year of the franchise period, with the annual amount being 186,191,500 yuan.

2. Operation, management and maintenance fees

Based on the approved report, the operation, management and maintenance fees for the first year of the project operation period (the fourth year of the project) amount to 7 million yuan/year. The charging standards for the following years shall be calculated based on the CPI indicators of HS City.

5.1.3.4 Rights and obligations of the government and social capital

Right and responsibilities of the government and the implementation organizations are as follows:

- (1) Compile project implementation plans together with the municipal financing department and submit to the municipal government for approval;
- (2) Organize project planning, consulting and demonstration to scientifically determine the engineering construction scale and standards;
- (3) Go through project approval procedures including environmental impact assessment, feasibility analysis and planning;
- (4) Organize project bidding and determine investigation, design and supervision units and investors;
- (5) Manage the work of the investigation, design and supervision units. Exercise supervision on the project company's contract performance status.

(6) Organize design and supervision units to control engineering construction scale, standards and investment. Examine and determine the engineering design changes and onsite visa;

(7) Assist the project company in acquiring relevant permissions or approvals timely;

(8) Guarantee the land for project construction and that for supporting construction facilities;

(9) Connect or coordinate the temporary or permanent supporting facilities of this project, such as water, electricity and communication lines to the project location;

(10) Take charge of land requisition and demolishing and change of land ownership, and apply for land use right certificate and property ownership certificate etc.

(11) Grant Zhongbang Company to invest on behalf of the government, sign joint investment agreement with social capital entity as the project company's shareholder, and execute shareholder rights in accordance with the articles of association;

(12) Compensate for investment in public service facilities in the project construction process;

(13) Exercise veto power on issues concerning public interest and public security;

(14) Supervise project construction and operation;

(15) Recover franchise when the franchise period is due;

(16) Repurchase social capital entity's all equity in accordance with the agreed amount when the franchise period is due;

(17) Exercise unified scheduling, temporary takeover or requisition of underground utility tunnel when emergencies mentioned in PPP project contract happen that could seriously affect public interests;

(18) Have the right to terminate agreement or acquire the project in advance;

(19) In case the project company defaults, have the right to require the project to rectify such default, charge the project company liquidated damages, or require it to make up for the loss and adopt other remedial measures specified in the agreement until such agreement is terminated in advance;

(20) Take care other work the government should be responsible for.

The project company's rights and responsibilities are as follows:

(1) HS City Government grants Zhongbang Company and its special subsidiary the franchise for the utility tunnel in the whole city. Zengzi Zhongbang Company that wins the bid is the specially established subsidiary of this project. As the project company of this project, it carries out investment, financing, construction as well as operation and maintenance of the underground utility tunnel in accordance with the agreement;

(2) Gain rational returns using the income generated from utility tunnels (such as pipeline entry fee as well as operation and maintenance fees) in accordance with the franchise agreement;

(3) In accordance with the franchise agreement, social capital entity cannot transfer its equity of the project company before gaining the written consent from the government;

(4) Pay construction cash deposit or submit letter of guarantee, pay operation cash deposit or submit letter of guarantee, and pay quality cash deposit or submit letter of guarantee in time and full amount in accordance with the government's requirements;

(5) Undertake corresponding social responsibilities in the project construction and operation process;

(6) Hand over the utility tunnel to the government in accordance with the *Equity Transfer Agreement* when the franchise period is due;

(7) Special mention should be made that Zhongbang Company and its special subsidiary shall be fully responsible for operation and management of the project company. The social capital entity shall not participate in the project company operation. The project company shall pay the social capital entity fixed returns on an annual basis in accordance with the *Equity Transfer Agreement*. Besides, based on the expertise of the two types of companies, the metallurgy, science and engineering group is mainly responsible for construction of the project's infrastructure whereas the financial institution is mainly in charge of the project company's debt financing;

(8) Take care of other work that the project company should be responsible for.

A note on control rights allocation: Since the conclusion of 4.8 on control rights allocation is applicable to PPP projects in which both parties participate and cooperate with each other and the government is not involved in the design unit bidding process, the selection of social capital and so on, control rights allocation will not be explained in this case. The conclusion of 4.8 will be reflected in the next case.

5.1.3.4 Control allocation of government and project company

Using the conclusions of Chapter 4 of this paper, this paper can quantify the control rights of government participants and project company participants in the project. According to the analysis of 5.1.3.3, it is clear that in this project, government participants should show a high degree of control preference and expected benefits in D01 (Design Unit bidding), D02 (detailed survey and supplementary survey) and other rights related to project preparation and dispute handling. Similarly, project company participants showed higher control preferences and expected returns in D05 (financial design and implementation) and D06 (in place and use of funds). Therefore, in conjunction with the model in chapter fourth, the calculation steps are as follows:

- (1) First calculate the control right preference (the previous six indicators as examples) Table 5-2.

Table 5-2 1 Control Preference Calculation

Control Preference Calculation										
	The right to propose		Approval right		Execution right		Supervisory power		Total (extent of preference)	
	The government	Project company	The government	Project company	The government	Project company	The government	Project company	The government	Project company
D01. Bidding for design units	8	2	8	2	6	3	9	3	0.76	0.24
D02. Detailed survey and supplementary survey	9	6	10	3	9	2	9	3	0.73	0.27
D03. Supplement and correcti	9	2	1	4	8	3	4	10	0.54	0.46

on of preliminary design D04. Construction Drawing Design	5	6	9	10	6	8	6	8	0.45	0.55
D05. Design and implementation of financing scheme	2	5	8	10	5	9	4	8	0.37	0.63
D06. Funds in place and use	5	8	7	7	3	8	2	9	0.35	0.65

(2) Calculation of stochastic expected income (excerpt part of the indicator as examples)

When calculating the stochastic expectation of the project, this paper finds the comparable transaction evaluation data of the same type project (A City Wetland public Park underground pipe Corridor construction project), and obtains the stochastic expected income of the project according to the quantitative system of the expected income. Some of the results are shown in the following):

Segmentation indicators: D01, E(RN)0.29. D02, E(RN)0.13. D03, E(RN)0.11.

D04, E(RN)0.43. D05, E(RN)0.13, D06, E(RN)0.24.

Calculate expected income from government and project companies and cooperative decision-making gains (examples from the previous six indicators)

(2) Participant and cooperative income calculation

Segmentation indicators: D01. Bidding for design units. D02. Detailed survey and supplementary survey. D03. Supplement and correction of preliminary design. D04. Construction Drawing Design. D05. Design and implementation of financing scheme. D06. Funds in place and use.

The corresponding subdivision index of The government and Project company is: D01,0.2892 0.1072; D02,0.0465 0.2105; D03,0.0289 0.0264; D04,0.1117 0.0327; D05,0.1797 0.1953; D06, 0.0964 0.0649.

(4) Calculate the weight of each indicator (detailed calculation slightly)

(5) Calculate the final control of government and participating companies see Table 5-3.

Table 5-3 Calculation Results

Calculation Results										
——	r1	r2	E(RN)	E(R1)	E(R2)	p1	p2	Weigh ts	The propor tion of P1	The propor tion of P2
D01	0.76	0.24	0.29	0.2892	0.1072	78.20%	21.80%	2.08%	1.63%	0.45%
D02	0.73	0.27	0.13	0.0465	0.2105	60.90%	39.10%	1.32%	0.80%	0.52%
D03	0.54	0.46	0.11	0.0289	0.0264	83.10%	16.90%	5.11%	4.25%	0.86%
D04	0.45	0.55	0.43	0.1117	0.0327	72.82%	27.18%	1.76%	1.28%	0.48%
D05	0.37	0.63	0.13	0.1797	0.1953	35.85%	64.15%	4.36%	1.56%	2.80%
D06	0.35	0.65	0.24	0.0964	0.1649	47.72%	52.28%	2.88%	1.37%	1.51%
...
D28	0.51	0.49	0.11	0.0554	0.0781	49.23%	50.77%	1.22%	0.60%	0.62%
Tota l	——	——	——	——	——	——	——	100%	42.76 %	57.24 %

The final result is that the government participants (HS municipal government and its implementing agencies) have a control right of 42.76% in this project, and the control of the project company (Zhongbang Company, etc.) is 57.24%.

5.1.3.4 Transaction structure chart of the project

The transaction structure of this project is indicated as Figure 5-1:

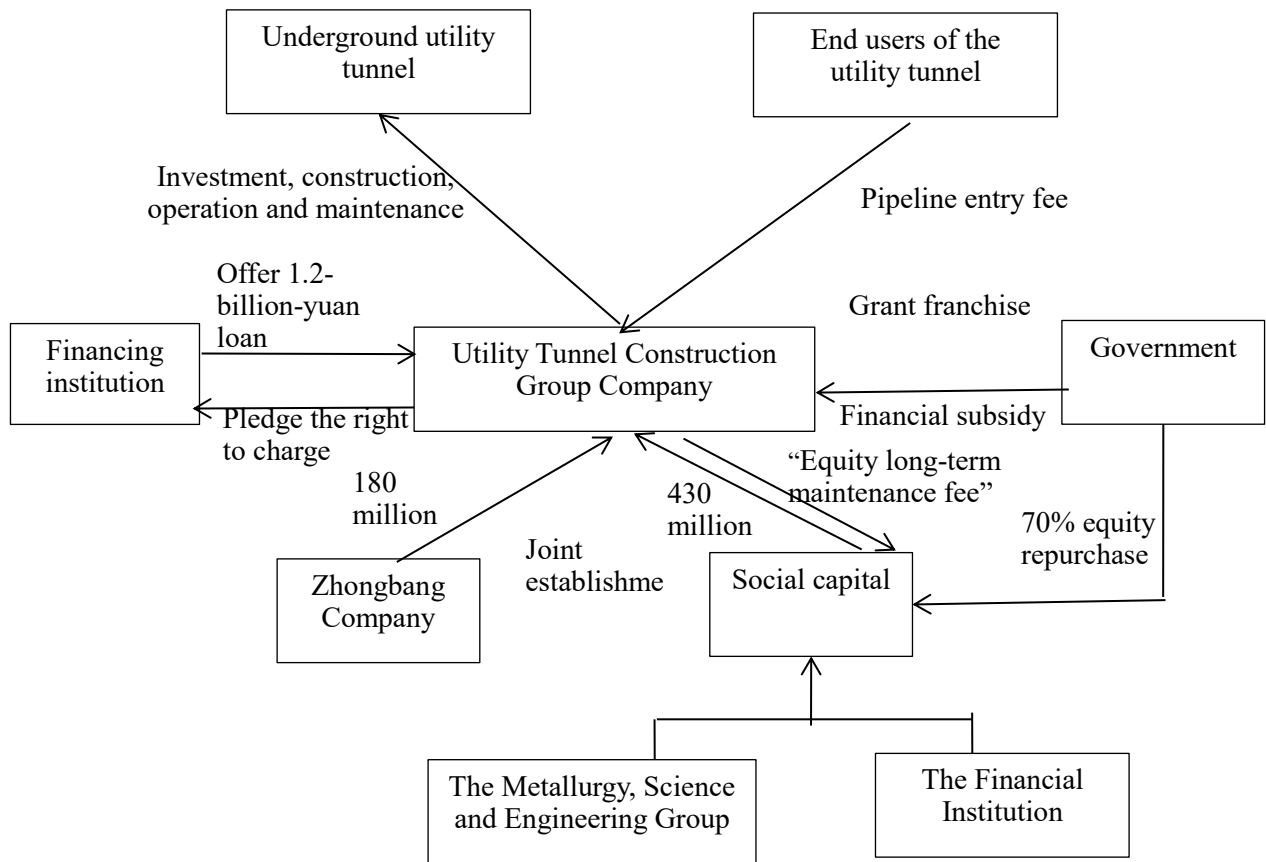


Figure 5- 1 Transaction structure chart of the PPP Project of the Underground Utility Tunnel in HS City

In this project, HS City Government and the selected social capital providers signed *Equity Investment Agreement* to jointly establish the project company responsible for underground utility tunnel construction and operation. The project company is responsible for project financing and construction, to be more specific, the construction of the underground utility tunnel and supporting facilities; the project company is responsible for project operation and maintenance, to be more specific, the operation and maintenance of the underground utility tunnel; project handover: after the 30-year franchise operation period is due, the project company shall hand over the underground utility tunnel and supporting facilities to the government and the government shall pay the social capital providers fixed returns on an annual basis and repurchase the equity of social capital providers at the agreed amount in accordance with the *Equity Transfer Agreement*.

In this project, the specific operation model is as follows:

(1) With the Municipal Commission of Urban-Rural Development authorized by HS City Government as the purchaser, social capital is selected and confirmed through government procurement. The municipal government authorizes the state-owned enterprise Zhongbang Urban Housing Investment Co., Ltd. in HS City to sign *Equity Investment Agreement* with social capital to jointly establish the project company. The *Equity Investment Agreement* sets forth agreements on cooperation purpose, investment amount and proportion, business establishment/change of registration, investors' rights and obligations, tax bearing in the process of investment/capital increment, and dispute resolution. Special mention should be made that social capital consists of two types, namely, professional companies (in this case a metallurgy, science and engineering group) and investment companies (in this case a certain financial institution).

(2) Zhongbang Urban Housing Investment Company from the project companies is responsible for financing, construction, project facility operation and maintenance, signing of *Pipeline Entry Agreement*, and charging the pipeline entry unit the pipeline entry fee as well as operation, management and maintenance fees.

(3) After the project is completed and goes into operation, the project company will be granted a franchise period of 30 years. Within this period, the project company shall charge the pipeline entry unit of the comprehensive utility tunnel the pipeline entry fee as well as the tunnel operation, management and maintenance fees in accordance with the pricing plan and price adjustment mechanism set forth in the franchise agreement. In the project construction period and operation period, the government and its authorized implementation organization evaluate the project company's business performance and contract fulfillment and pay the project company financial subsidies and viability gap funding based on the evaluation.

(4) The project company pays the social capital providers fixed returns on an annual basis in accordance with *Equity Transfer Agreement*.

(5) After the project franchise period is due, the project company shall hand over the underground utility tunnel and supporting facilities to the government and the government shall repurchase the equity of social capital providers at the agreed amount in accordance with the *Equity Transfer Agreement*.

5.2 Transaction structure design of XNY chemical construction project

5.2.1 Project introduction

Project name: 450,000-ton Annual Output LNG Project of Xinxin New Energy Chemical Engineering Co., Ltd.

Project location: Industry cluster area of Willow Spring Farm in Hami, Xinjiang

Owner: Sichuan Shunfa Electric Smelting Co., Ltd.

This project is organized by Sichuan Shunfa Electric Smelting Co., Ltd., which is a group company with management functions. The company owns 580 million yuan assets, over 1,400 employees, and around two-billion-yuan annual output. It has paid 74.3-million-yuan tax and produced 21.4 million yuan profits. The group administers four subsidiaries with production capacity, namely, Maoxian New Epoch Electrometallurgy Co., Ltd., Wenchuan Shunfa Electric Smelting Co., Ltd., Sichuan Hongya Shunfa Electric Smelting Co., Ltd., and Maoxian Xinxin Energy Co., Ltd.

This project is scheduled to be an LNG project that produces 450,000-ton coke oven off-gas annually, with 5 million-ton annual production capacity coking units developed. Phase-I project aims to develop an LNG project with 140,000-ton annual production capacity, together with 1.5-million-ton annual production capacity coking units. Phase II project aims to develop an LNG project with 140,000-ton annual production capacity, together with 1.5-million-ton annual production capacity coking units. Phase III project aims to develop an LNG project with 170,000-ton annual production capacity, together with 2-million-ton annual production capacity coking units.

The master plan of this project is to enable sound economic benefits and social benefits for the LNG project with 450,000-ton coking oven gas.

It can be known from the feasibility analysis report of the project that the annual total profits are 2,197,559,300 yuan, the annual income tax is 549389800 yuan, and the annual after-tax profits are 1,648,169,500 yuan. The financial interim rate of return of the project investment are respectively 24.94% and 21.07% before and after tax: the project payback period is respectively 8.12 years and 8.68 years (including 6-year construction period) before and after tax. The project generates sound profits and the financial interim rate of return is far higher than the benchmark yield of 12%. The long-term loan principal of this project is around

4,165,014,300 yuan, and the repayment period of the project's long-term loan is 8.46 years (including 6-year construction). The project's interest coverage ratio and debt service coverage ratio indicators suggest that the project has sound repayment capacity. According to the plan, the construction period of the project shall not exceed 7 years, and the project shall be guaranteed to be put into operation in the 7th year of construction and start full-load production in the 8th year. The operating revenues of each year shall not be less than the overall cost, and the cash flow of each year shall reach 2,030,000,000 yuan, suggesting that the project has strong financial viability.

Based on the above analysis, the project has good financial returns. The after-income-tax financial interim rate of return is far higher than China's industry benchmark yield; its loan repayment is in compliance with banks' loan requirements. Seen from sensitivity analysis, the project has strong anti-risk capability and its financial evaluation conclusions are feasible.

The project's implementation has sound social benefits, mainly represented in the following three aspects:

First, construction of engineering projects can lead to increase in the society's fixed assets, and contribute to the development of a series of supporting industries, thus stimulating regional economic growth and promoting socio-economic development. After implementation, the project can bring jobs to 1,720 people, with each having an annual income of 40,000 yuan. This has not only created jobs, but also increased residents' income, thus contributing to increase in residents' consumption.

Second, construction of engineering projects promotes national development. Seen from social stability and development, construction of engineering projects can enable local residents to live and work in peace and contentment, satisfy their requirements for their daily life and welfare, and bring social stability. Development of engineering projects is an indispensable force for social stability and harmonious development. It is very conducive to the revitalization and takeoff of regional economy, and improves local people's economic development initiative and collectivism spirit.

Construction of engineering projects can significantly contribute to people's level of education as well as scientific and cultural level. It is an indispensable force to push forward the development of socialist ideological and ethical progress. Besides, it is also an important factor for facilitating people's all-round development. In the process of development,

engineering projects need to constantly train workers. Before project input and operation, employees need to be trained to improve their scientific level and hands-on operation ability, so as to meet the project's new technique and new equipment management and operation.

5.2.2 Analysis of the financing challenges of the project

5.2.2.1 Estimation of the project's overall investment

The investment estimation refers to the estimation of the investment needed for the LNG project that produces 450,000-ton coke oven off-gas annually, with 5 million-ton annual production capacity coking units developed. The engineering work includes: LNG process units, coking process units and supporting facilities, utilities and service engineering.

Estimation bases and descriptions:

(1) No. 76 Document issued in 2006 by Sinopec: *Feasibility Report Formulation Measures for Chemical Investment Projects*;

(2) No. 203 Document issued in 2006 by Sinopec: *Feasibility Study Investment Estimation Formulation Measures for Petrochemical Projects of Sinopec Group*;

(3) Refer to recent enquiry information and relevant quotation materials for the prices of main equipment; refer to similar engineering materials for installation and construction fees, with consideration of prices of local construction installation materials and the actual situation;

(4) Other engineering fees should be calculated and estimated according to stipulations in relevant documents and also in light of the actual engineering situation.

The construction investment budget is as follows: 1, equipment purchasing fee ¥2,278,852,000. 2, Installation fee ¥1,174,964,000. 3, Construction cost ¥886,496,500. 4, Other development fee ¥300,148,900. 5, Construction investment ¥4340,312,500.

Interests estimation for the construction period: Construction of this project will last for six years. According to fund utilization plan, fixed assets investment is scheduled to be used this way: 20% for the first year, 15% for the second year, 15% for the third year, 15% for the fourth year, 15% for the fifth year, and 20% for the sixth year. An amount of 4,165,014,300-yuan loan is to be applied for from the bank, with the interest rate being 6.55%. The interest rate for fixed assets loan during the construction period is 818,425,300 yuan.

The total investment of this project is estimated as follows: The total investment of this project includes 5,131,595,100-yuan construction investment, 818,425,300-yuan interest during the construction period, 69,568,500-yuan initial working capital, adding up to a total investment of 6,019,588,900 yuan.

This project needs to finance 6,019,588,900 yuan, of which 4,165,014,300 yuan (70% of the fixed assets investment) will be from bank loans and the remaining 1,854,574,600 yuan will be acquired by the company through other means.

5.2.2.2 Analysis of the contractor's capital structure

This project is mainly undertaken by Maoxian Xinxin Energy Co., Ltd., a subsidiary of Sichuan Shunfa Electric Smelting Co., Ltd.

Therefore, this section mainly analyzes the financing situation of the organizer Maoxian Xinxin Energy Co., Ltd. from its financial statements. It also analyzes its capital structure and financing situation in light of the company's actual situation.

The company's balance sheet between 2013 and 2014 is shown in Table 5-4:

Table 5-4 Maoxian Xinxin Energy balance sheet

(Unit: yuan)

Item	2014	2013
Monetary funds	4817693.76	2167658.58
Accounts receivable	355617.40	
Prepaid accounts	582998.60	90591814.65
Other accounts receivable		650000.00
Inventory	1851904.79	816239.33
Total current assets	7608214.55	94225712.56
Fixed assets	362246554.47	1867745.43
Projects under construction		218051600.44
Intangible assets	7826490.00	7826490.00
Total non-current assets	370073044.47	227745835.87
Total assets	377681259.02	321971548.43
Short-term loans	20000000.00	
Accounts payable	19231325.63	14371437.95
Payroll payable	790145.74	
Tax payable	-13354887.34	-12600950.29

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Other accounts payable	160764479.24	201451060.77
Total current liabilities	187431063.27	203221548.43
Long-term loans	65000000.00	
Other non-current liabilities	11800000.00	11800000.00
Total other non-current liabilities	76800000.00	11800000.00
Total liabilities	264231063.27	215021548.43
Paid in capital	100000000.00	100000000.00
Capital reserves	6950000.00	6950000.00
Undistributed profit	6500195.75	
Total owners' equity	113450195.75	106950000.00
Total liabilities and owners' equity	377681259.02	321971548.43

According to the company's financial reports and relevant materials, its equity financing mainly comes from intrinsic equity financing, with no other means of equity financing, such as finance lease and project financing. It can be known through relevant analyses that the following few problems exist in the company's financing.

(1) The asset-to-debt ratio is high.

The company has borrowed quite a lot of short-term loans and long-term loans, leading to high asset-to-debt ratio that affects further financing.

(2) The way of financing is monotonous.

It can be seen from the financial statements in recent years that the company mainly relies on indirect financing, mostly bank loans. There is no indirect financing. Thus, the advantage of financing has not been reasonably brought out and the financing channels are very limited.

(3) There is heavy reliance on bank loans.

It can be seen from statistics that in 2014 the company had a long-term loan of 65 million-yuan and a short-term loan of 20 million yuan. Plus, its assets-to-debt ratio was around 70%, which suggests that the company had been operating on liability for a long time and the proportion of bank loans was high. From the perspective of the source of loans, the choice of banks was also not sound enough. The proportion of policy-based bank loans was very small, and most of the loans came from commercial bank, which increases the financing cost of the company and causes great financial pressure.

It can be seen from the table that currently the company's main source of financing is bank loans, which poses strict requirements for the company's financial indicators such as its asset-to-debt ratio and net asset ratio. The continuous increase of asset-to-debt ratio has made it increasingly difficult for the company to access bank credit. Its debt financing has become increasingly saturated. As a result, the company is facing a funding challenge and huge capital pressure.

5.2.2.3 The introduction of the financing model of “Chinese dequity”

The reason for and motivation of the project's financing activities lie in investment, which mainly includes current assets investment and fixed assets investment. In the process of project financing, we should consider the project as a whole and take all elements into consideration, determine the financing plan based on the overall situation of the project, list the financing amount, the lowest financing cost and the optimal capital structure in detail, then choose the financing method, and formulate a plan to create a favorable external financing environment.

Judging from its funding structure, the project needs to raise 6,019.5889 million yuan, of which 4,165.0143 million yuan will come from medium and long-term bank loans. Since the bank loans have reached the upper limit, the remaining 1,854.5746 million yuan can only be obtained by other means. Based on the analysis in the previous chapter, we can probe into “Chinese dequity”, a new financing method that companies have started exploring in order to reduce the asset-liability ratio, solve the problem of financing bottleneck, and improve the ability to resist risks. The decision of staged equity financing through “Chinese dequity” is based on the following reasons:

1. It helps adjust capital structure and control financing cost.

At present, the asset-liability ratio of the construction contractor Maoxian Xinxin Energy Co., Ltd. is on the high side, and its capital structure is not reasonable enough. There is still a financing gap of 1,854.5746 million yuan, which is difficult to fill. Worst still, a potential financial crisis can be easily caused by this high debt ratio. By adopting the financing model of “Chinese dequity”, the project company will be able to improve its level of financing, increase the amount of funding and optimize the financing structure, thus avoiding financial risks caused by a high debt ratio. Besides, with low financing cost and a high capital utilization rate, “Chinese dequity” meets the financing target and demand of the project company. When designing the specific financing model, however, the financial status of the company must be

taken into full consideration and some measures to reduce financial risks should be formulated on this basis.

2. It conforms to the requirement of consistency between the financing product and the project development cycle.

In designing the scale of financing, the development and construction cycle of the whole project in particular needs to be thoroughly considered. When choosing a financing product, the project company should give priority to the need of consistency between the project development cycle and the product. As can be seen from the case profile, the construction duration of the whole project is 6 years, during which the production begins in the seventh year. The construction duration is relatively long, which means the financing period is relatively long. As a new financing product, “Chinese dequity” boasts flexibility and convenience in terms of repayment options, effectively circumventing the problems of debt financing (short term and high risk, for example), which is in line with the characteristics and financing needs of project development and construction. There is generally no specific time limit for the financing term of “Chinese dequity”. Repayment is subject to the time agreed by both parties, which can be after the completion of the whole project, during the construction or within a few years after the completion of the project. It covers the entire project development cycle so that the project company does not need to worry about funding during development and construction. The whole project will proceed as planned in terms of funding.

3. This financing model has fewer restrictions.

In the financing process, due to the constant fluctuations and changes of the financial market, banks are very strict about the amount and duration of loans. Compared with bank loans, “Chinese dequity” focuses more on the review of project feasibility and profitability. Its review of corporate finance is generally not as strict. In addition, investors basically do not interfere with the daily operation of the project company or take any control of the project company, which makes it possible for them to raise funds flexibly, operate normally and improve the operating efficiency of the enterprise.

4. This financing model excels in speed.

In bank loans and general financing, the creditor generally requires the debtor to provide collateral exceeding or equivalent in value and go through the complicated procedure of mortgage application. With “Chinese dequity”, however, the investor becomes a shareholder of

the company mainly by purchasing equity stakes, providing a certain scale of financing for the project company more quickly and easily. Moreover, under the established financing structure, the investor can adjust the repayment method to meet the cash flow requirements and match other characteristics of the borrower. This is especially suitable for projects with a long development cycle, large capital input in the early stage and fast capital recovery in the production and sales stage, such as the case under discussion. A proper repayment method can reduce the financing cost of the project company and improve the profitability of the project.

Therefore, a business plan of the whole project is formulated with debt financing as the chief form of project investment and financing through an accurate estimation of project capital gap and the prediction of project profits. Interested financial institutions and trusts institutions are then given detailed presentations and invited to conduct field research. Finally, one of the financial institutions is identified as the partner of “Chinese dequity” through a two-way selection process. The specific funding structure of the project is also determined:

Source of funds include equity financing, financing through “Chinese dequity” and debt financing. To be specific, the amount of equity investment is 556,372,700 yuan (9.24%), the amount of “Chinese dequity” is 1298202200 yuan (21.56%), and the amount of debt investment is 4,165,014,300 yuan (69.2%).as see Table 5-2.

(1) Equity financing

Maoxian Xinxin Energy Co., Ltd. invests 556372700 yuan, which is included into the project capital and takes up 30% of the project company’s equity.

(2) Financing through “Chinese dequity”

The chosen partner invests 1,298,202,200 yuan, which is included into the project capital and takes up 70% of the project company’s equity. After the project construction term is due, the project company shall pay the social capital entity “equity long-term maintenance fee” on an annual basis starting from the first year of the operation period; After the operation period is due, the government shall repurchase the 70% equity held by the social capital entity at a price of 1,298,202,200 yuan in accordance with the terms set forth in the *Equity Transfer Agreement*.

(3) Debt financing

The project capital is designed to take up 30% of the total project investment. The remaining 70% construction capital (4,165,014,300 yuan) shall be gained by the project

company through financing, with the loan interest rate calculated as 20% above the benchmark interest rate. The principal and interests shall be fully paid back after 20 years.

Table 5-5 Capital composition of the project

Unit: 10,000 yuan			
Financing method	Financier	Financing amount	Proportion
Equity financing	Maoxian Xinxin Energy Co., Ltd.	55637.27	9.24%
Financing through Chinese dequity	A financial institution	129820.22	21.56%
Debt financing	banks	416501.43	69.2%

5.2.3 Operating model of “Chinese dequity”

5.2.3.1 The organizational structure of the project’s “Chinese dequity”

This project plans to finance through “Chinese dequity” by involving the project partners, namely, a chemical engineering limited liability company and a financial institution.

The chemical engineering limited liability company is a pioneer and leader in China’s industrial engineering field, with the most complete qualifications, the most complete functions, and the most complete supply chain among its peers. Its main advantages include: a long history, outstanding capabilities, excellent technologies, first-class services, glorious achievements, abundant talents and complete qualifications.

The specific way of operation for this project is as follows:

(1) Sichuan Shunfa Electric Smelting Co., Ltd. entrusted its subsidiary Maoxian Xinxin Energy Co., Ltd. to identify the project partners after a selection from multiple parties. Then Maoxian Xinxin Energy Co., Ltd. and the project partner jointly established the project company and signed the *Equity Investment Agreement*. Project partners consist of two types of companies, of which the chemical engineering limited liability company participates in the project as a professional company and the financial institution participates in the project as a pure investor. The equity contribution is made by Maoxian Xinxin Energy Co., Ltd. (Party B), while the “Chinese dequity” financing is conducted by the financial company (Party A) as social capital. The contribution made by Party A takes up 70% of the equity of the project company and Party B contributes the remaining 30%. The equity ratio of Party A to Party B in the project company is 70%-30%. The corresponding equity contribution amount and shareholder loan amount are shown in Table 5-6 below:

Table 5-6 Capital composition of “Chinese dequity”

Unit: 10,000 yuan

	Investment amount	Investment ratio	Equity ratio
Maoxian Xinxin Energy Co., Ltd.	55637.27	30%	30%
The Financial company	129820.22	70%	70%
Total	185457.49	100%	100%

(2) The project company is responsible for financing, construction as well as the operation and maintenance of project facilities. To be specific, China Chemical Engineering Limited Liability Company is mainly responsible for the development of production and management equipment of LNG technique devices, coking technique devices, and thermal devices. The commercial bank is mainly responsible for project financing, and Maoxian Xinxin Energy Co., Ltd. is mainly responsible for the operation and management of the project company.

(3) After the project construction is finished and the project goes into operation, according to regulations, the project company shall get relevant revenues by selling such chemical engineering products as liquefied natural gas (LNG) and coke within the 15-year operation period, and pay fixed returns to the project partners—the chemical engineering limited liability company and the financial institution in accordance with the *Equity Transfer Agreement* signed between the project company and the project partners.

(4) Project handover. When the project company’s 7-year construction period and the 15-year operation period are due, Sichuan Shunfa Electric Smelting Co., Ltd. shall repurchase all the shares of the project partners at the agreed amount specified in the *Equity Transfer Agreement*.

(5) In this project the project company is responsible for project financing and construction. Its main responsibility is to include completing the development of such production and management equipment as LNG technique devices, coking technique devices and their supporting facilities. The project company is responsible for the operation and maintenance of the project facilities; Maoxian Xinxin Energy Co., Ltd. is responsible for the operation and management of the project company and paying fixed returns to the project partners, namely, the chemical engineering limited liability company and the financial institution in accordance with the *Equity Transfer Agreement* within the operation period. After the 15-year operation

period is due, Sichuan Shunfa Electric Smelting Co., Ltd. shall repurchase all the shares of the project partners at the agreed amount specified in the *Equity Transfer Agreement*.

5.2.3.2 Control rights allocation

The main participants of the “Chinese dequity” in this project are Sichuan Shunfa Electric Melting Co., Ltd., the project company, and Maoxian Xinxin Energy Co., Ltd. The rights and responsibilities of the project have referred to the “Chinese dequity” Project of the Underground Utility Tunnel in HS City.

The rights and responsibilities of Sichuan Shunfa Electric Melting Co., Ltd. are as follows:

- (1) Cooperate with relevant departments to formulate project implementation plan;
- (2) Organize project planning, consulting and demonstration to scientifically identify the engineering construction scale and standards;
- (3) Go through project approval procedures such as environmental impact assessment, feasibility analysis and planning;
- (4) Organize project bidding to identify survey, design supervision companies and investors;
- (5) Manage the survey, design and supervision companies. Monitor the contract implementation status of the project company;
- (6) Organize design and construction control units to control engineering construction scale, standards and investment, as well as examine and confirming engineering design changes and on-site visa;
- (7) Assist the project company in obtaining relevant permit or approval in time;
- (8) Guarantee the land for project construction and supporting facility development;
- (9) Make sure that the temporary or permanent supporting facilities, such as water, electricity and communication circuits are connected to the project location;
- (10) Authorize the branch company Maoxian Xinxin Energy Co., Ltd. to invest on behalf of Sichuan Shunfa Electric Smelting Co., Ltd., sign Equity Investment Agreement with project collaborators as shareholder of the project company, and exercise shareholder rights in accordance with Article of Association;
- (11) Supervise project construction and operation;

(12) Authorize the project company 15-year operation right and recover the operation right when the period is due;

(13) Repurchase all the shares held at an amount agreed in the *Equity Transfer Agreement* after the 15-year operation period is due;

(14) Perform unified scheduling and temporary takeover when emergencies specified in the project contract occur that may severely jeopardize the corporate interests;

(15) Have the right to terminate the Agreement or acquire projects in advance;

(16) In case the project company defaults, Shunfa has the right to require the project company to rectify such defaults, charge liquidated damages from the project company or demand compensation and take other remedial measures specified in the agreement until the agreement is terminated in advance;

(17) Other work that Sichuan Shunfa Electric Smelting Co., Ltd. should be responsible for.

The rights and responsibilities of the project company, Maoxian Xinxin Energy Co., Ltd. and the project partners are as follows:

First, Sichuan Shunfa Electric Smelting Co., Ltd. authorizes its subsidiary Maoxian New Energy Co., Ltd. to jointly establish the project company with the chemical engineering limited liability company and the financial institution, and do investment, financing, construction and operation in accordance with the Equity Investment Agreement;

Second, gain responsible returns through selling such chemical products as LNG and coke in accordance with relevant agreements;

Third, in accordance with relevant agreements, the project partners cannot transfer its project company equity without the written consent of Sichuan Shunfa Electric Smelting Co., Ltd.;

Fourth, undertake corresponding responsibilities in the construction and operation process;

Fifth, hand relevant equipment over to Sichuan Shunfa Electric Smelting Co., Ltd. when the franchise operation period is due in accordance with the terms of the agreement;

Sixth, special mention should be made that the operation and management of the project company the full responsibility of Maoxian Xinxin Energy Co., Ltd. The project partners do not participate in the project company's operation. The project company shall pay its partners "long-term equity maintenance fee" on an annual basis in accordance with the *Equity Transfer*

Agreement. And project partners shall be divided into two types according to different input elements. To be specific, the chemical engineering limited liability company is mainly responsible for project infrastructure construction, whereas the financial institution is mainly responsible for the financing business of the project company;

Seventh, other work that the project partners should be responsible for.

As can be seen from 4.8, the main responsibilities of Sichuan Shunfa Electric Smelting Co., Ltd. in this project basically conform to D02 (detailed survey and supplementary investigation), D03 (preliminary design and supplementary corrections), D19 (site safety management and accident handling), D20 (dispute resolution) and D27 (operation management) of the 28 subdivided rights. Therefore, the company should demonstrate a higher control rights preference in these rights and show higher expected returns.

Similarly, the main tasks in this project performed by the companies that participate in the cooperation, namely the project company, Maoxian Xinxin Energy Co., Ltd. and the project partners, are basically in line with D06 (implementation and utilization of funds), D13 (commencement of construction), D15 (debugging and running of equipment and systems) and D24 (project handover) of the 28 subdivided rights. Consequently, these participants should demonstrate a higher control rights preference in these rights and show higher expected returns.

In this way, based on the control right score calculation system in 3.8, the ratio of control rights allocation between the two sides of the project can be calculated by combining the expert scoring method and the comparable transaction method. The calculation results are as follows Table 5-7 (the relevant calculation steps are omitted)

Table 5-7 control rights allocation Calculation Results 1

Calculation Results										
—	r1	r2	E(RN)	E(R1)	E(R2)	p1	p2	Weigh ts	The proportio n of p1	The proportio n of p2
...
D02	0.6 9	0.3 1	0.29	0.289 2	0.107 2	68.20 %	31.80 %	2.08%	1.42%	0.66%
D03	0.5 9	0.4 1	0.13	0.046 5	0.210 5	71.60 %	28.40 %	1.32%	0.95%	0.37%
...
D06	0.3 5	0.6 5	0.11	0.028 9	0.086 4	17.70 %	82.30 %	5.11%	0.90%	4.21%
D15	0.4 5	0.5 5	0.43	0.111 7	0.132 7	38.80 %	61.20 %	1.76%	0.68%	1.08%
...

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D19	0.6 3	0.3 7	0.13	0.179 7	0.145 3	68.90 %	31.10 %	4.36%	3.00%	1.36%
D24	0.3 5	0.6 5	0.24	0.096 4	0.064 9	47.72 %	52.28 %	2.88%	1.37%	1.51%
...
D28	0.5	0.5	0.17	0.369 1	0.403 6	49.88 %	50.12 %	2.29%	1.14%	1.15%
Tota l	— —	— —	—	—	—	—	—	100%	46.88%	53.12%

Finally, the result is that the control of Sichuan Shunfan Electrofusion Smelting Co., Ltd. is 46.88%, and the control right of the project company is 53.12%.

5.2.3.3 Project transaction structure chart

The project's transaction structure chart is as follows(Figure 5- 2):

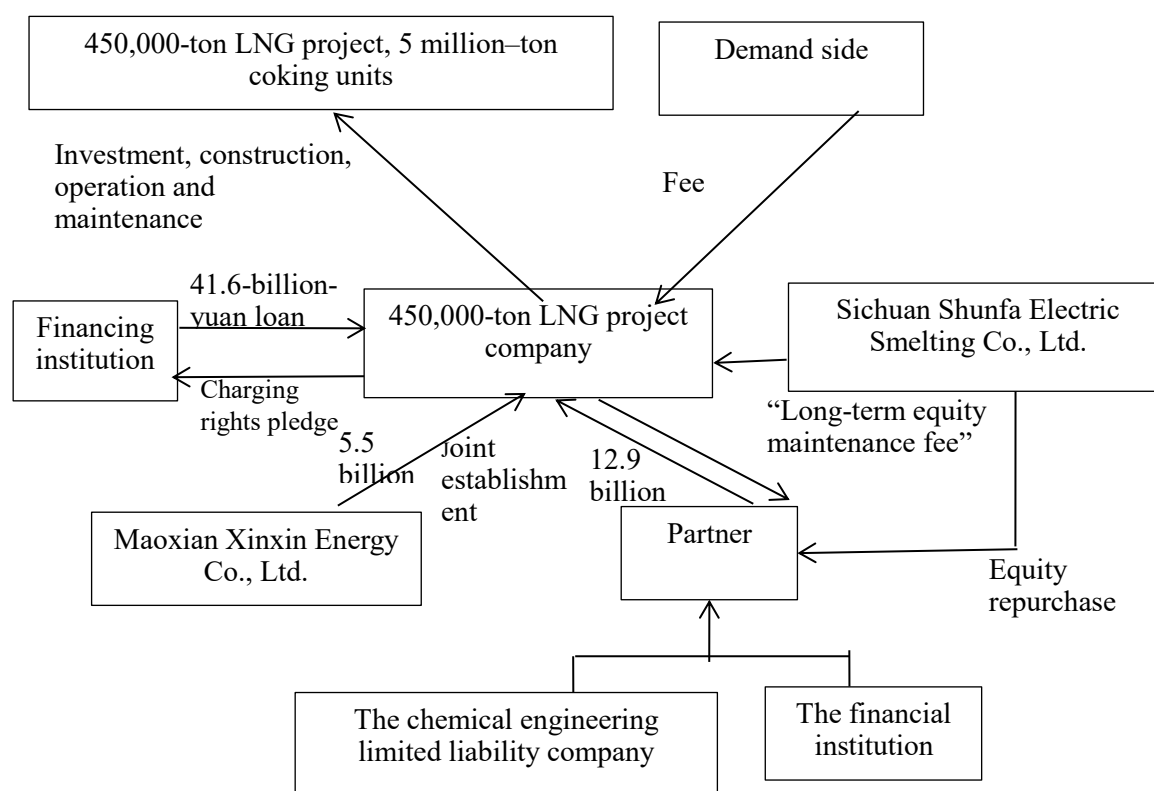


Figure 5- 2 Transaction structure chart of “Chinese dequity” in XNY Chemical Construction Project

5.2.3.4 Return mechanism of the project

The project's return mechanism mainly consists of the sales revenues of relevant chemical projects after the project is completed and goes into operation.

This project produces 4.7-million-ton cokes and 448,000-ton LNG annually. It also produces such by-products as tar, crude benzene, ammonium sulfate and Sulphur. The annual sales revenue is around 5,250,422,800 yuan according to the designed capacity.

This project will go into operation in the 7th year after construction and will start full prosecution in the 8th year. The turnover of each year can all cover the expense of the total cost. The cash flow of each year within the project production and operation period can reach 2,030,000,000 yuan.

5.3 Case study

5.3.1 Case characteristics analysis

The Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project have the following characteristics:

(1) The core facilities and supporting facilities of the Project of the Underground Utility Tunnel in HS City all require new construction. So, it is a new project. This project is characterized by a complex design process. The government should make the appropriate choice of professional companies that possess core technologies and relevant experience to participant in the design and construction at the earlier stage.

(2) The two projects need a huge amount of investment. The project company has taken over the responsibility of financing, which significantly reduced the government's financial pressure. Relevant government departments only give an appropriate amount of subsidy for the project, and shall repurchase the equity owned by social capital at the agreed amount in accordance with the *Equity Transfer Agreement* when the franchise period is due.

(3) The two projects have high requirements for the professional level of technologies and operation management standards in the operation process. Besides, the project agrees with the long-term plan of HS City and has a long operation period. Its operation and management are both taken full charge of by Zhongbang Company and its subsidiaries. Social capital does not take part in its operation or management, nor does it participate in the profit sharing of the project company.

(4) Social capital gains benefits from fixed revenues and the mechanism of government equity repurchase.

According to the characteristics of this project, social capital entity does not participate in operation or profit sharing in the operation period. As to means of exit, government repurchase is adopted. Thus, it is a typical PPP project of “Chinese dequity”. In other words, the financing means adopted in this project is financing through “Chinese dequity”.

This project, in response to the actual situation of the participants, divides them into pure investors and professional companies based on the difference in input factors. Pure investors are mostly financial institutions that only put in capital, while professional companies contribute all kinds of expertise and skills. The project company is in full charge of the financing, construction, operation and management of the project, whereas appropriation of financial subsidy, pricing of public products and services, and supervision of project quality and operation are the obligations of the government.

5.3.2 Transaction structure analysis

The PPP model of “Chinese dequity” is adopted in the above cases, where the project company enters into a “drawer agreement” with social capital, which is manifested in the form of direct equity investment (*Equity Transfer Agreement*) in the cooperation documents. Outside the filed documents, however, the two parties agree on a fixed proportion of dividend sharing by signing this drawer agreement (*Equity Forward Repurchase Agreement*), and the original shareholders or related parties of the financing party agree to buy back the equity to realize exit upon expiration. In the *Equity Forward Repurchase Agreement*, such items as fixed return on investment, capital exit, proportion of equity transfer, time arrangement, calculation of the transfer price and ways of making up the balance are agreed upon.

The BOT structure is employed when designing the transaction structure. In the BOT financing method, the government signs a project franchising agreement with investors, granting the project to the project company established by the investors, which will be fully in charge of the investment, financing, construction, operation and maintenance of the project. Once the franchise period is due, the project company will hand over the project to the government free of charge. To be specific, in the above two cases, the project company is set up to take charge of financing. Its financing model consists of equity financing, financing through “Chinese dequity” and debt financing. After the completion of the project, the project company enjoys franchise rights for a certain number of years. When the franchise expires, the facility will be transferred to the government department for free or with compensation.

There are certain requirements in terms of applicable conditions in the BOT transaction structure, which can be summarized as follows:

(1) It is applicable to complicated projects, especially large-scale PPP projects.

In terms of specific projects, the BOT model is generally applicable to large-scale PPP projects, as they generally involve more participants, complicated interest relationships and complex and diverse processes. Not all PPP projects are suitable for the BOT model. Generally, such projects must meet two conditions: First, they should be infrastructure projects or competitive projects; second, they should be highly profitable. Examples of such projects include large-scale thermal power plants, large-scale hydroelectric power plants, high-grade expressways with a length of 30-80 kilometers, independent bridges and independent tunnels with a length of over one kilometer, urban water supply plants, all types of public transportation, postal and telecommunications facilities and so on. Unlike public goods, these facilities are highly exclusive and competitive, which means they can obtain price compensation through market evaluation. As a result, the BOT financing model can be introduced into such facilities.

(2) With a long financing period, the financing party should be confident and prepared.

Most BOT projects cannot proceed without bank loans. When reviewing such large loans, banks have complicated assessment and approval procedures in place, thus extending the negotiation process between the project company and the banks and putting the agreement on loan capital increase to “the test of time”. The financing model of “Chinese dequity”, on the other hand, contributes to a higher financing efficiency, but the evaluation of the overall project, project profitability and risks performed by the investors can also be time-consuming. Therefore, in practice, the uncertain factors arising from the timing of financing should be fully considered.

(3) Enterprise participating in the project must possess a strong anti-risk capability.

The BOT model is a multilateral cooperation mechanism, in which all participants should work together and share risks. However, participants tend to seek advantages and avoid disadvantages, and non-cooperative games are often formed due to this preference for risk aversion. Besides, the ability of the project to generate profits according to the plan after completion is still unknown. In the meantime, various unexpected risks may occur as the project proceeds, requiring all participants to have a strong risk resistance capacity. To this end, it is better to establish a risk-sharing system to ensure equal rights and obligations of all parties.

(4) The government should supervise and regulate BOT projects.

In the initial stage of construction, effective resources must be carefully planned, rationally arranged and used under the direction of the government. In the construction process, reasonable and effective financing should be carried out; the whole construction process should be supervised by the government; the acceptance and evaluation mechanism in line with national standards should be established to ensure the smooth completion and handover of the project. In the operation process, the government should exercise its supervisory and regulatory function on behalf of the interests of the government to guarantee the healthy and continuous development of the whole operation.

5.3.3 Analysis of merits and drawbacks

The application of the financing model of “Chinese dequity” is a double-edged sword with both advantages and disadvantages, as reflected in the following aspects:

First, on the one hand, a huge amount of capital is needed in the initial stage of project investment, which can be difficult to obtain through government investment. Adopting the financing model of “Chinese dequity” can transfer the initial investment to social capital, thus lightening the government’s financial burden. On the other hand, the project company can benefit from the entry fee paid by utility tunnel users as well as the operation and management fee to pay for the fixed returns of social capital. Besides, it can also reduce the investment risk of social capital in the way of exit through government repurchase.

Second, control rights are rationally distributed among the government, the project company and social capital. Putting social capital in charge of project investment and construction will motivate it to adopt the optimal model with the lowest cost of construction and highest project benefits. Meanwhile, social capital is further divided into professional companies and pure investors. Control rights are distributed according to different preferences of social capital and the government. Social capital, which is used in more dedicated investment, constantly seeks for more control over its area of expertise. This helps guarantee the return on its investment, balancing the overall interests of the project with its own interests.

Third, “Chinese dequity” is flexible in its financing operation. When considering the capital entry model for this financing method, the project company can choose either one-time investment or investment by stages. One-time investment means that the investor injects at once all the capital of its subscribed share into the investee, which leads to higher cost of capital occupation by the investee, but fully ensures the share and stability of capital. Investment by

stages refers to a process in which the investor puts in part of the capital in advance to fill the funding gap of the enterprise and revitalize the whole project, and then invests the remaining capital according to the actual situation when the project moves into the implementation stage. It is conducive to a win-win situation, in which the continuity of capital supply chain can be fully guaranteed and the cost of capital occupation reduced, and the investor can also obtain certain interest income and repayment premium.

Fourth, “Chinese dequity” offers flexible repayment options. The investee can either pay interest on term or pay a certain premium when buying back the shares. In order to provide the project company with enough leeway in capital and ensure sufficient capital flow, the case in this dissertation combines an “equity long-term maintenance fee” with share repurchase. The social capital (investor) injects capital into the project in a lump sum and receives an “equity long-term maintenance fee” from the project company every year since the project is completed and put into operation. Once the operation expires, the government will buy back the shares held by social capital at the original purchase price. This arrangement allows the project company to flexibly adjust the project schedule.

Last but not least, the repayment interest rate is flexibly set for “Chinese dequity”. When setting the interest rate, the lender adheres to the principle of risk-return equivalence and adopts a flexible interest rate level. The investor should take into full consideration the credit rating of the investee and other comprehensive factors in calculating the final interest rate, or negotiate with the borrower to reach a consensus. In this case, at the beginning of the first year of the project operation period, the project company (the investee) will pay annual interest to social capital (the investor) in the form of “equity long-term maintenance fee”.

On the whole, the project company undertakes most of the risks. Post-construction operational risks of the project can be avoided through such means as strengthening internal management. The government, on the other hand, is mainly responsible for the supervision and management as well as the overall planning of the project based on the principle of public interest first. In addition, the power and responsibilities of all parties involved are divided by the government to ensure the smooth operation of the project and the balancing of interests among all parties.

Although the PPP model of “Chinese dequity” boasts numerous advantages, there are also many risks involved:

Firstly, the project construction scale in the two cases is relatively large, requiring a huge amount of capital, most of the which needs to be obtained through bank loans. Though a certain proportion of funds have been raised by adopting the model of “Chinese dequity”, the financing term is long, resulting in a higher cost of time, which will have to be compensated for with a higher rate of return on investment after the completion of the project, but the rate of return is still unknown. In the above cases, the investment amount of the project reaches 3,023.09 million yuan, with a construction period of 5 years and a franchise period of 30 years. Due to this huge amount of project investment, the long construction and operation cycles and various unpredictable risks during the period, there is great uncertainty in terms of income.

Secondly, it is a time-intensive process. The financing model of “Chinese dequity” is a complicated procedure. In the early stage, the financing party shall prepare a bidding proposal, analyze the intentions of potential investors and share the proposal with the investors. After determining their investment intention, potential partners will generally conduct field investigation and comprehensive evaluation of the project's construction, profitability, risks and so on. In order to ensure the success of project financing, the investors must spend a lot of time and energy on the related preparation and planning work.

Finally, “Chinese dequity” faces such risks as unfair equity repurchase prices, possible bankruptcy of the project company, legal risks, credit risks and regulatory risks, which will not be covered in detail here, as they have been discussed in the second chapter of this thesis.

5.3.4 Inspiring revelations from the two cases

The Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project have many highlights that we can draw lessons from:

1. Allocation of control rights. Social capital is further divided into professional companies and pure investors and control rights are distributed according to different preferences of social capital and the government, so that the professional companies will have more say. Such an arrangement can motivate participants to engage actively, give full play to their professional expertise, induce scientific decisions, reduce project risks, and maximize efficiency through close cooperation.

2. Reasonable transaction structure design. A reasonable transaction structure is indispensable for the realization of maximum cooperation efficiency in PPP projects of

“Chinese dequity”. In the transaction structure design, the constraint of the *Equity Investment Agreement* and the *Equity Transfer Agreement* is particularly important. The project company should coordinate and balance the interests of all parties involved. The perfection of this transaction relationship network has a great influence on the quality and benefit of the project. The project company should pay attention to this aspect and build a comprehensive transaction relationship network to ensure the smooth construction and operation of the project. In addition, the project company should actively make use of its own advantages to obtain more preferential arrangements for itself, so as to promote the optimization of the transaction structure.

3. Professional organizations. Professional teams are often needed in PPP projects of “Chinese dequity”. In the cases studied in this thesis, the Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project have both set up professional technical teams to organize project planning, consultation and demonstration, scientifically determine the scale and standard of project construction and so on. Relevant technical experts have been organized to repeatedly demonstrate the project, formulate viable project implementation plans and ensure their feasibility. It provides reference for social capital to establish a PPP project company, which then conducts reasonable optimization according to the existing design plans and actual situation.

4. Sufficient reliability of project investment. Most PPP projects, the Utility Tunnel Project in HS City included, are generally complex with various technical and administrative requirements—electricity, drainage, gas supply, heating, to name a few— and characterized by a huge amount of project investment, a long construction cycle and a long payback cycle. When formulating the investment plan, therefore, the above factors shall be taken into full account, so as to reasonably assume risks and distribute benefits and formulate a scientific, specific and highly workable implementation plan, which will help clarify the confusion in investment on the side of social capital and facilitate feasibility analysis of the project by social capital.

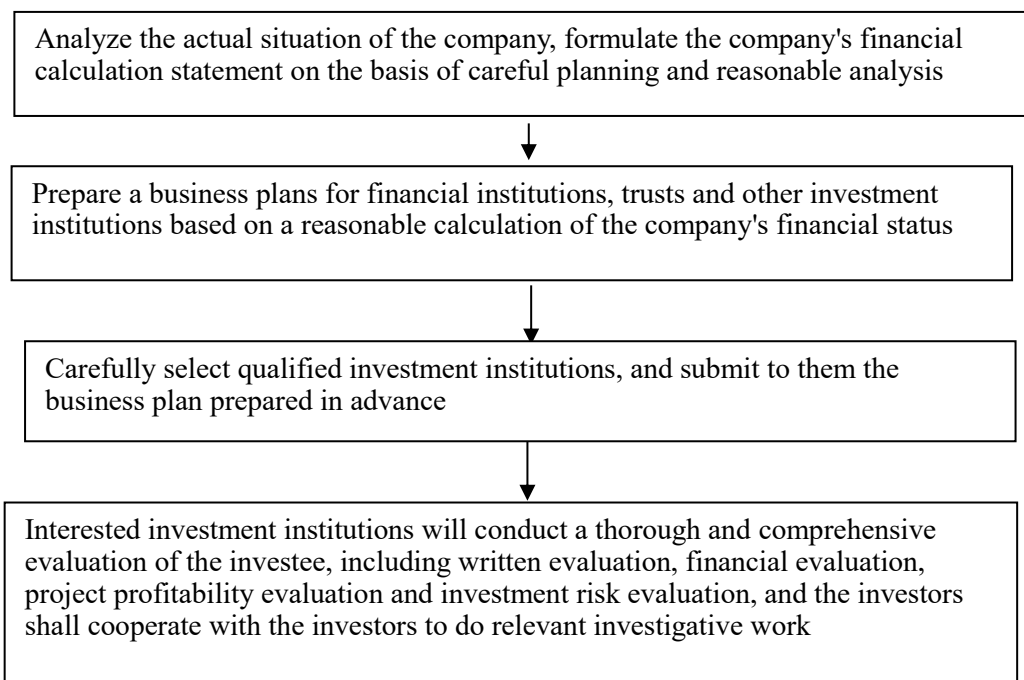
5. Stability of project income. In the cases discussed here, the relevant fees collected by social capital must be able to cover its investment income, so that the social capital can generate profits from it. Therefore, when social capital collects relevant fees from the demand side, it is necessary to fully consider the return on investment and establish reasonable charging standards based on the local consumption level and market mechanism. The government should play an active part in the pricing process and excise control according to the local economic level.

6. Controllability of project operation and maintenance. The operation and maintenance of PPP projects are mainly reflected through the supervision of the project management committee on the PPP project company established by social capital, the performance appraisal of the project and the price adjustment mechanism. Operation and maintenance are the most important step in the later stage of a PPP project. Therefore, it is particularly important to supervise and regulate the operation and maintenance of the PPP project company, which directly affects the service quality provided by the project for consumers, and consumers' consumption choices will in turn influence the benefits of the project.

When drawing upon the above highlights, it should be noted that there is no unified model of PPP projects of “Chinese dequity”. It is necessary to design the most appropriate transaction structure according to the actual situation of the project and based on the status of industry development and the technical, economic and legal attributes of the project.

5.3.5 Suggestions on the specific operating procedure of the financing model of “Chinese dequity”

The financing process of “Chinese dequity” follows a regular procedure. The implementation of each step in this procedure is conducive to the overall coordination and advancement of the project. When designing the structure of financing through “Chinese dequity”, we should fully consider the specific problems in each step, thoroughly analyze our specific needs, and formulate a detailed business plan according to these needs. The process of financing through “Chinese dequity” in practice can be shaped as follows (Figure 5- 3):



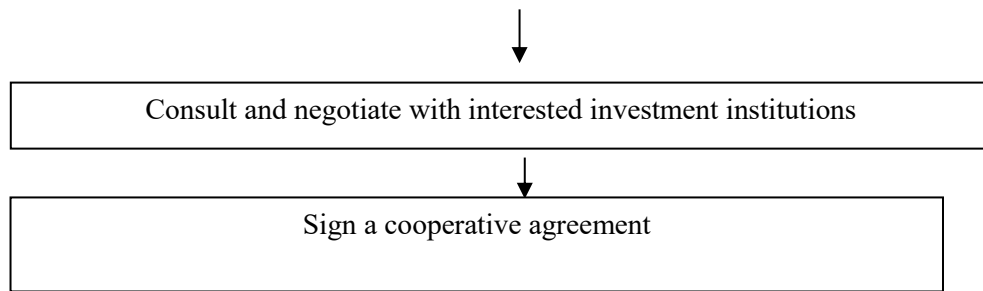


Figure 5- 3 Specific operating procedure of the financing model of “Chinese dequity”

5.3.6 Matters needing attention for the two parties in the financing process of “Chinese dequity”

We must fully consider the interest demands from all parties involved and fully understand them before designing a financing plan of “Chinese dequity”. Matters needing attention are illustrated below:

1. Factors to be considered by investors

(1) Managerial competencies of the project company

When selecting an investment project, investors will certainly go through some strict screening procedures, in which major considerations include the investment amount, return on investment and investment risks of the project. The return on investment and investment risks are related not only to the project itself, but also to the managerial competencies of the project company. A good project management team can ensure that the project runs with high quality and is delivered on time and put into operation as agreed. Only in this way can the project generate a fixed return. Therefore, the managerial competencies of the project company are a key factor in the investment decision of investment companies.

(2) Profit forecast of the project

The market value of the project and its ability to bring in a huge profit when put into operation are the major concerns for investment companies, because high returns are the only compelling reason that motivates them to invest. Generally, the investment companies will assign relevant technical personnel or hire relevant consulting companies to conduct research on the project and evaluate the rate of return, and the evaluation result will become an important basis for investment.

(3) Project risks and control measures

Investment comes with risks. The bigger the investment and return are, the higher the risks will be. Risk reduction and control are therefore immediate concerns for investors. Although the investors become the shareholders of the project company through the investment model of “Chinese dequity”, they do not participate in the operation of the project company. To safeguard their rights and interests, the investors can pay attention to the following aspects:

A. Meeting of shareholders. Investors may require the project company to invite them to participate in the shareholders' meeting involving important matters or major interests of the investors and require the shareholders' meeting to grant them veto power.

B. Board of directors. Investors may nominate a director to sit on the board of directors, who shall then be elected through the meeting of shareholders. Where important matters or significant interests of the investors are involved, the directors selected by the investors may request an interim shareholders' meeting to be held, and the matters may be voted on only with the consent of more than two-thirds of the voting directors.

C. Board of supervisors. Investors may have the right to nominate supervisors, who shall then be appointed through the meeting of shareholders.

D. Operational and managerial organization. The investee is responsible for the operation and management of the project company. The investors may nominate a financial supervisor to monitor the financial activities of the project company, including but not limited to the formulation and implementation of financial strategies, financial budgets and capital plans, and the preparation of financial and accounting statements and statements on management accounting.

2. Factors to be considered by financiers

(1) Financing model and financing needs

To ensure the smooth progress of the project, the project company should fully understand its own liabilities, financial situation and capital structure, and then develop a financial budget plan based on the comprehensive consideration of each step and item in the process of project development, and finally determine the total amount of project financing. However, the financing model is generally affected by the liabilities and credibility of the project company and local policies. In terms of capital sources, bank loans account for a very high proportion with a high leverage ratio, which increases the financing cost and reduces the overall efficiency of the project. Through the financing model of “Chinese dequity”, the project company will be

able to not only effectively reduce the disadvantages of its high debt ratio, but also satisfy the financing needs of the project construction cycle.

(2) Corporate management and actual control right

The control right of a company is its core right. In the process of project financing, the project side is definitely not willing to obtain financing capital at the cost of weakening or losing control. Under normal circumstances, by adopting the model of “Chinese dequity”, investors will become the shareholders of the project company in name, but do not participate in the management and operation of the project, and have no influence on the actual control right of the project company.

(3) Cooperation framework and synergy

Before finalizing the investment, investors will conduct multiple investigations and surveys and carry out several rounds of negotiations with the investee. After basically reaching a cooperative intention, the two parties will sign a formal and legal cooperation agreement. Usually, both parties share resources to ensure the smooth progress of the project. The consistency of goals and interests will enable both parties to form good synergy and jointly commit to advancing the goals in an atmosphere of mutual cooperation and mutual trust.

All in all, the process of implementing the model of “Chinese dequity” requires the investors and the investee to collaborate with each other, trust each other and work together. The investors (primarily financial institutions and trust companies) should possess a strong risk identification and control capability, so as to predict various risks in each step and formulate control plans in advance. Moreover, it is also very important to strengthen the management of the funds obtained through financing. The investee should choose an appropriate capital leverage ratio to reduce its financial risk, and strive to achieve the expected profit and cash flow, so as to guarantee payment in due course.

5.4 Chapter summary

This chapter establishes a solid foundation for the conclusion of this thesis by presenting basic information on the successful cases of the Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project, and, on this basis, conducting an in-depth analysis of the characteristics of the double cases, the transaction structure as well as the merits and drawbacks of the financing model of “Chinese dequity”, summarizing experience and

inspiring revelations from the cases, and putting forward the general operating procedure of and matters needing attention in this financing model.

Chapter 6: Conclusions and Prospects

6.1 Conclusions

This thesis elaborates on the definition, characteristics, application types, as well as legal framework and risks of “Chinese dequity” and analyzes its general transaction structure. On the basis of control rights theory, game theory and literature research, a control rights allocation model is built using stochastic cooperative games. Then, according to conclusions of the model research and with reference to the typically successful cases of “Chinese dequity”—the Project of the Underground Utility Tunnel in HS City and XNY Chemical Construction Project—the author analyzes the financing model of “Chinese dequity” as well as its economic benefits and highlights to learn from. Finally, the merits and drawbacks and applicable conditions of the transaction structure of “Chinese dequity” are summarized, along with its economic benefits, operating procedures and matters needing attention for both parties.

Through the thorough elaboration of this thesis, we conclude as follows:

(1) The transaction structure of financing through “Chinese dequity” is applicable to large-scale infrastructure construction, public utilities and other fields.

Large construction projects require huge capital investment, with a long construction cycle and time-consuming recovery of funds. Moreover, the barriers to entry and exit are extremely high, the project structure complex and a variety of technical expertise needed. The financing model of “Chinese dequity”, which is perfectly in line with the above demands, is bound to be widely used in such areas as large-scale infrastructure construction and public utilities and achieve considerable and substantial results.

(2) As an innovative financing method, “Chinese dequity” has addressed the lack of capital and technology in large-scale infrastructure projects in China.

(3) Many problems remain unsolved in the financing model of “Chinese dequity”.

At present, this financing model is in want of sound and comprehensive legislation as well as abundant and diverse applications. As its practical applications gradually increase, relevant issues have surfaced, including the imperfect design of transaction structure, the lack of depth in the research into the game relationship and control rights allocation among all participants

in the whole financing process and so on, which are precisely the key to the financing efficiency of “Chinese dequity”.

6.2 Prospects of future studies

In recent years, large-scale infrastructure construction and public utilities have been developing rapidly. However, due to the long project construction period and huge demand for construction capital, there have arisen a lot of challenges in financing. In this context, the innovative way of financing characterized by “Chinese dequity” has emerged. Yet it has also been confronted with many problems. This thesis mainly aims to design the transaction structure of “Chinese dequity” with a view to providing reference to future research practices. Despite this, this thesis is to some extent only an exploratory research with preliminary endeavor. Given the many uncertainties in the highly complicated issue regarding the transaction structure of “Chinese dequity”, especially control rights allocation, further efforts need to be made to arrive at a more in-depth understanding of many aspects. It is in the author’s hope that the research will continue in the future.

Control rights allocation in transaction structure is in fact a complicated issue, which can be tested empirically and studied extensively. Factors influencing control rights allocation in financing through “Chinese dequity” and the influence relations can be found through empirical tests so as to draw more scientific and reliable research conclusions. Furthermore, in the quantification of control rights in this thesis, the measurement of “random expected return”, an important indicator, relies on the comparable transaction method, which is difficult to be quantified in practice.

Influences of various laws on control rights allocation have not been taken into consideration in this thesis. In subsequent studies, factors influencing control rights allocation in financing through “Chinese dequity” and the influence relations can be analyzed from the perspective of each specific law.

With accelerated infrastructure development in China, relevant theories such as “Chinese dequity”, mezzanine financing, control rights theory and game theory have gained further development. The unique advantages of financing through “Chinese dequity” will gradually play a more and more important role. Research into and practices of its relevant transaction structure will also be further improved and developed.

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