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Research on Equity Financing Models for Infrastructure Investment Projects

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Abstract: This study provides an in-depth analysis of the equity financing model of infrastructure investment projects. Under the background of high-quality economic development, innovative infrastructure investment financing mode is of great significance to expand effective investment. The study finds that China's infrastructure equity financing presents a diversified development trend, with the parallel development of REITs, industrial funds, equity investment and mixed ownership reform, etc. The operation of PPP mode is becoming more and more mature, with the establishment of a complete management system for the whole life cycle of the project and a risk-sharing mechanism. The policy support system has been improved continuously, and the market operation mechanism has been optimised, but there is still room for improvement in the institutional environment, innovation of financing tools and risk prevention and control. It is suggested to promote the healthy development of infrastructure equity financing by improving laws and regulations, innovating financing tools, optimising operation mechanism and other measures.

Keywords: Infrastructure investment, Equity financing, PPP model, Risk sharing, REITs.

1. Introduction

Infrastructure is an important support for the development of the national economy, and the innovation of infrastructure investment and financing mode is of great significance for expanding effective investment and promoting high-quality economic development. In recent years, China's infrastructure investment demand has continued to grow, and the traditional government-led, debt-financing-based model faces sustainability challenges [1]. Equity financing, as an important innovation direction, helps to improve investment and financing efficiency, optimise resource allocation and diversify investment risks by introducing social capital to participate in infrastructure investment and operation [2]. Based on the theoretical foundation of infrastructure equity financing, this paper analyses the characteristics of various financing modes and practice cases, discusses the policy support system and market operation mechanism, and aims to provide reference and inspiration for the promotion of the innovative development of infrastructure equity financing [3].

2. Theoretical Basis of Equity Financing for Infrastructure Investment Projects

The theoretical basis of equity financing for infrastructure investment projects covers the core theories of project financing, public product, risk management and principal-agent. Project financing theory emphasises the use of project cash flow and assets as the basis of financing to achieve risk isolation; public product theory elaborates on the attributes of quasi-public products of infrastructure and explains the necessity of cooperation between the government and social capital; risk management theory provides a systematic framework for risk identification, assessment and control, guiding the reasonable allocation and management of project risks; and principal-agent theory reveals the principal-agent relationship between various participants, providing a theoretical basis for the establishment of an effective governance mechanism and incentive and constraint system [4]. The principal-agent theory reveals the principal-agent relationship between the participants and provides theoretical basis for establishing effective governance mechanism and incentive and constraint system. These theories together constitute the theoretical support for equity financing of infrastructure projects, and provide important theoretical guidance for innovative financing mode, optimised resource allocation and sustainable development of projects.

3. Analysis of Equity Financing Models for Infrastructure Projects

3.1. Types of Infrastructure Project Equity Financing

Infrastructure project equity financing mainly includes four types: REITs, industry funds, equity investment and mixed ownership reform. As shown in Figure 1, from the development data from 2020 to 2024, the scale of infrastructure REITs has grown rapidly, with the number of issued projects growing from the initial 9 to 47, and the scale of fund-raising reaching RMB 187.6 billion, of which the proportion of transport and energy projects is the highest, reaching 52%. In the field of industrial funds, by the end of 2023, the market stock size exceeded 3.5 trillion yuan, and the proportion of funds invested in the infrastructure sector was about 35% [5]. In the field of equity investment, infrastructure projects attracted 472.1 billion yuan of social capital investment in 2023, up 23 per cent from the previous year. Mixed ownership reform drove infrastructure investment of 1.2 trillion yuan, prying the proportion of social capital participation up to 43%.

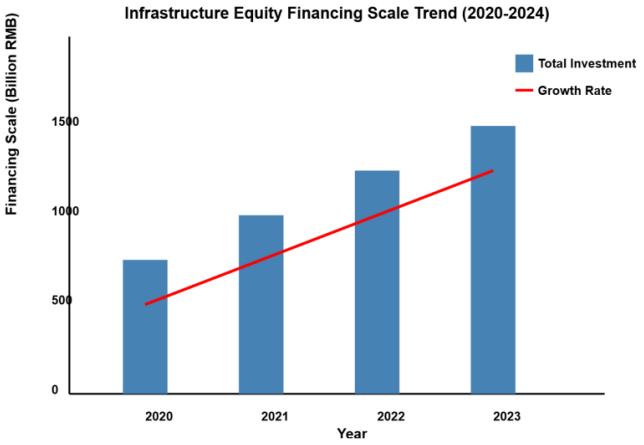

Figure 1. Trend in the scale of infrastructure equity financing, 2020-2024

3.2. Special Analysis of PPP Model

3.2.1. Basic Framework of PPP Model

The basic framework of the PPP model consists of three core subjects: the government party, the social capital party and the project company. The government party is mainly responsible for project planning, implementation programme approval, performance assessment and other work, and designates a government-funded representative to participate in the project company. The social capital party provides project design, investment, construction and operation services according to the project agreement. The project company, as an independent legal entity specialising in project construction and operation, undertakes the specific implementation of the project. In terms of funding structure, project capital and debt funds are combined, and debt funds include bank loans, bonds and other forms. The return mechanism of the project can be user-paid, government-paid or feasibility gap subsidy according to the type of project. The full life cycle of the project covers the construction and operation periods, and at the end of the concession period, the project assets are transferred to the Government as agreed.

3.2.2. PPP mode operation mechanism

The PPP project operation mechanism forms a complete closed loop from identification to exit. As shown in Table 1, the operation mechanism of a municipal wastewater treatment plant PPP project is standardised and perfected, and the project was fully prepared in nine months beforehand, including the completion of the value-for-money evaluation and financial affordability demonstration in the two-month identification phase, the completion of the preparation and approval of the implementation plan in the three-month preparation phase and the identification of the social capital party through competitive negotiation in the four-month procurement phase, which resulted in a saving of 12% in the transaction amount compared with the budget [6]. The project company invested RMB320 million to build a wastewater treatment facility with a daily treatment capacity of 100,000 tonnes, and the operation data in 2023 showed that the annual average daily treated water volume reached 85,000 tonnes, the operation load rate was 85%, and the effluent compliance rate remained at a high level of 98.9%. In terms of economic benefits, the average annual operating revenue is $12 million and the operating cost is $8.5 million, with stable operation in all quarters. The performance appraisal adopts a percentage system, and the quarterly appraisal scores are all above 90 points, with an annual average score of 92.5 points. The operation of the project shows obvious seasonal characteristics, but the relative stability of revenue and cost is maintained through effective regulation, reflecting good operation and management capabilities, and providing successful experience for the promotion and application of PPP mode in the field of municipal environmental protection.

Table 1. Statistics of operation data of PPP project of a municipal wastewater treatment plant (2023)

Indicators	Q1	Q2	Q3	Q4	Annual Average
Daily Water Treatment Volume (10,000 tons)	8.2	8.5	8.8	8.6	8.5
Operational Load Rate (%)	82	85	88	86	85
Compliance Rate of Discharge Water (%)	98.5	99.2	99	98.8	98.9
Operating Revenue (10,000 RMB)	1150	1220	1280	1150	1200
Operating Costs (10,000 RMB)	820	850	880	850	850
Performance Assessment Score	92	94	93	91	92.5

3.2.3. Risk sharing in PPP mode

The risk sharing mechanism of PPP projects reflects the principle of 'optimal risk allocation'. The risk sharing scheme adopted in a highway PPP project is representative: the total investment of the project is 8.5 billion yuan, and the cooperation period is 30 years. The government bears the legal policy risk, land acquisition risk and force majeure risk, the social capital party bears the construction risk, operation risk and financing risk, and both parties bear the over-investment risk and income risk. The corresponding compensation mechanism is activated after the occurrence of risk events, such as when the traffic flow is lower than 85% of the expected, the government will give subsidies; when it is higher than 115% of the expected, the revenue will be shared. Over the past three years of project operation, the cumulative sharing of risk events 8 times, the compensation mechanism was activated 3 times, and the total amount of risk sharing was 120 million yuan, which effectively guaranteed the smooth operation of the project, as shown in Figure 2. The successful practice of the project's risk sharing mechanism shows that scientific and reasonable risk allocation is the key to the sustainable development of PPP projects. By establishing a clear risk sharing and compensation mechanism, it can effectively reduce project uncertainty and improve the enthusiasm of all parties to cooperate and the overall benefit of the project [7].

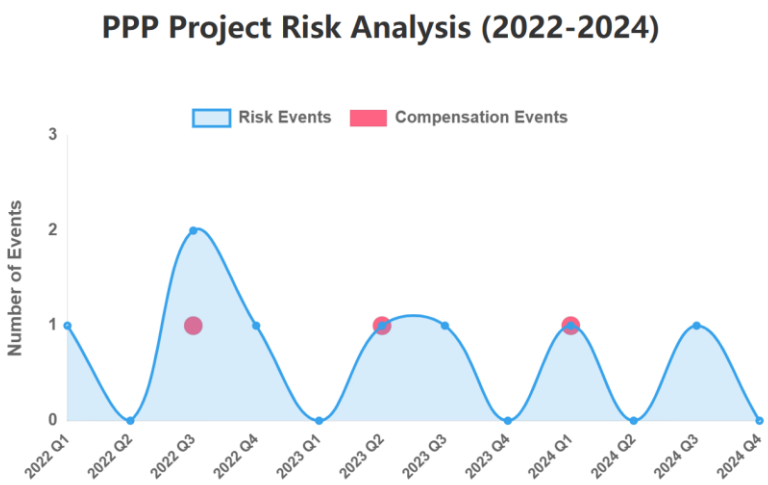

Figure 2. PPP project risk analysis

4. Analysis of Practice and Environment of Equity Financing of Infrastructure Projects

4.1. Analysis of Domestic and International Practical Experiences

4.1.1. International Typical Case Studies

The Melbourne urban rail transit project in Australia demonstrates a mature infrastructure equity financing mode. As shown in Table 2, the project has a total investment of AUD 8.2 billion and adopts a fund-based operation mode. The pension fund consortium invested A$3.2 billion to acquire 49 per cent of the project's equity, with the government holding 51 per cent. Over the past five years of operation, the project's average annual passenger flow has reached 120 million, and the return on investment has remained at around 8.5 per cent. With the introduction of an intelligent system in the operation process, the departure interval has been shortened to 2 minutes during peak hours, and the punctuality rate has been increased to 98.2%. Singapore Changi Airport's T5 project introduced a sovereign fund investment model, valued at S$15.5 billion, with Changi Airport Group and Temasek Holdings contributing at a ratio of 6:4, and S$8.5 billion in equity financing through asset securitisation. The project adopts the smart airport concept and introduces automated operational systems, with an annual capacity of 50 million passengers and a 22% reduction in operating costs.

Table 2. Statistics of International Infrastructure Equity Financing Cases

Project Type	Investment Scale (Billion USD)	Equity Financing Ratio	Return on Investment (%)	Construction Period (Years)
Transportation Infrastructure	82.5	45%	8.50%	4.5
Energy Infrastructure	65.3	38%	7.80%	3.5
Municipal Engineering	43.2	42%	6.90%	2.8

4.1.2. Review of domestic practice cases

Domestic infrastructure equity financing practice shows diversified development. The scale of the intercity railway network project in the Yangtze River Delta region reaches 56.3 billion yuan, and comprehensively adopts REITs and industrial funds to raise funds. As shown in Figure 3, the REITs issue size is 12.5 billion yuan, the industry fund raises 21.8 billion yuan, and the rest of the funds are solved by bank loans. Upon completion, the project will achieve cross-regional road network interconnection and an average daily passenger flow of 350,000 trips. Chengdu Tianfu International Airport adopts a mixed ownership reform model, introducing social capital of RMB 15.2 billion, accounting for 42%. The scale of asset securitisation of the project reached RMB 8.5 billion, and the passenger throughput in the first year of operation exceeded 17 million, with cargo and mail throughput of 280,000 tonnes, driving the output value of the airport economic zone to exceed RMB 20 billion. Shenzhen's waste treatment facilities adopted the fund investment method, with a total investment of RMB 8.1 billion for the construction of five treatment centres, with a daily treatment capacity of 28,000 tons, driving the value of the surrounding land to increase by 36% [8].

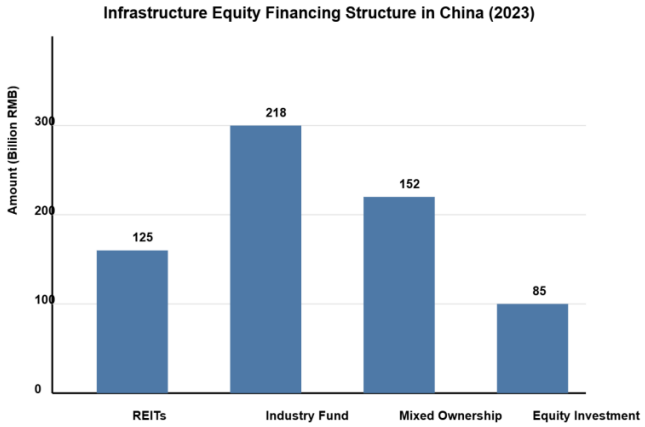

Figure 3. Structure of infrastructure equity financing in China (2023)

4.2. Analysis of Financing Environment

4.2.1. Policy support system

The policy support system for infrastructure equity financing in China is becoming more and more perfect. The National Development and Reform Commission (NDRC) has formulated a pilot work programme for infrastructure REITs, and 87 infrastructure REITs projects have been reviewed and approved by the end of 2023, with a total scale of 268 billion yuan, as shown in Fig. 4. The Ministry of Finance (MOF) has

launched a preferential policy for taxation of real estate investment trusts (REITs) in the field of infrastructure, with the investor's income tax rate being lowered from 25% to 20%, which has led to the enhancement of the enthusiasm for participation of social capital by 42% [9]. The central bank set up a special infrastructure refinancing quota of 500 billion yuan, with interest rates 45 basis points lower than market rates. The Ministry of Housing and Construction formulated urban infrastructure franchise management methods, clarified the revenue guarantee mechanism, and attracted various types of social capital to invest in infrastructure projects of more than 1.8 trillion yuan. The CBIRC has relaxed the restrictions on insurance funds investing in infrastructure projects, raising the upper limit of the investment ratio to 30 per cent.

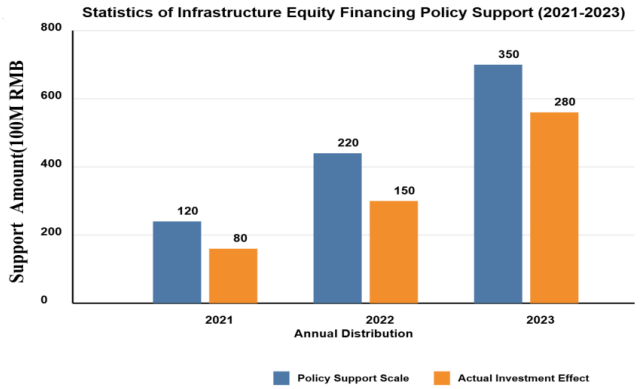

Figure 4. Infrastructure equity financing policy support statistics

4.2.2. Legal and regulatory framework

The legal and regulatory system for infrastructure equity financing has been gradually improved. The Measures for the Administration of Infrastructure and Public Utility Concessions stipulate that the maximum concession period can be up to 30 years, and regulate the procedures for the transfer of project revenue rights. The Securities Investment Fund Law has been revised to improve the infrastructure securities investment fund system, clarifying the responsibilities of fund managers and investor protection measures [10]. The Regulations on Government-Social Capital Co-operation formulate multiple return mechanisms, such as government payment and user payment, to ensure the stability of investment returns. The Regulations on the Administration of Filing of Real Estate Investment Trust Funds in the Infrastructure Sector refine the project screening criteria, requiring that the operating yield of the investment target be no less than 6 per cent. The Interim Measures for the Administration of Infrastructure Investment Funds provide for a duration of not less than five years, mandatory information disclosure requirements, and control of the number of investors within 200.

As shown in Table 3, in terms of the implementation of infrastructure equity financing laws and regulations, the five main types of regulations have been implemented well nationwide, with the implementation of franchise management and risk management norms having a significant effect, the compliance rate of information disclosure system reaching up to 95 per cent, and the market satisfaction rate of each regulation remaining above 82 per cent. The regulation of REITs is still in the pilot stage but the implementation effect is better, with a compliance rate of 87 per cent. 87%. Overall, the implementation of laws and regulations has been effective, providing a strong guarantee for the healthy development of the equity financing market.

Table 3. Statistics on the Implementation of Laws and Regulations on Infrastructure Equity Financing

Regulation Type	Coverage	Implementation Effect	Compliance Rate (%)	Satisfaction Rate (%)
Franchise Management	Nationwide	Significant	92%	88%
Investment Fund Management	Nationwide	Good	89%	85%
REITs Regulation	Pilot Regions	Fair	87%	82%
Information Disclosure System	Nationwide	Good	95%	90%
Risk Management Standards	Nationwide	Significant	93%	87%

4.2.3. Market operation mechanism

The operating mechanism of the infrastructure equity financing market has been continuously optimised. The Beijing Financial Assets Exchange has set up a special zone for infrastructure equity trading, with turnover reaching RMB 325.6 billion in 2023, up 35 per cent from the previous year. The Shanghai Stock Exchange launched a market maker system for infrastructure REITs to enhance the liquidity of the secondary market, with the average daily turnover rate rising to 0.8%. The Shenzhen Stock Exchange established a reserve database of infrastructure projects, which has included 436 projects with a total valuation of RMB 1.2 trillion. The Inter-bank Market Dealers Association simplified the filing process for the transfer of infrastructure revenue rights, and shortened the timeframe for review to 15 working days [11-13]. The China Securities Investment Funds Association issued guidelines on infrastructure private equity fund valuation, standardising the project pricing mechanism. As shown in Figure 5, China's infrastructure equity financing market develops rapidly in 2020-2023, and the market transaction scale grows from about 200 billion yuan in 2020 to 325.6 billion yuan in 2023, with an average annual growth rate of more than 30%. During the period, with the continuous improvement of the system and mechanism and the increasing diversification of investment subjects, the investment scale of insurance funds reached 852.6 billion yuan, the investment ratio of social security funds was raised to 12%, the market trading activity and liquidity were significantly improved, and the degree of marketisation of infrastructure investment and financing was significantly increased.

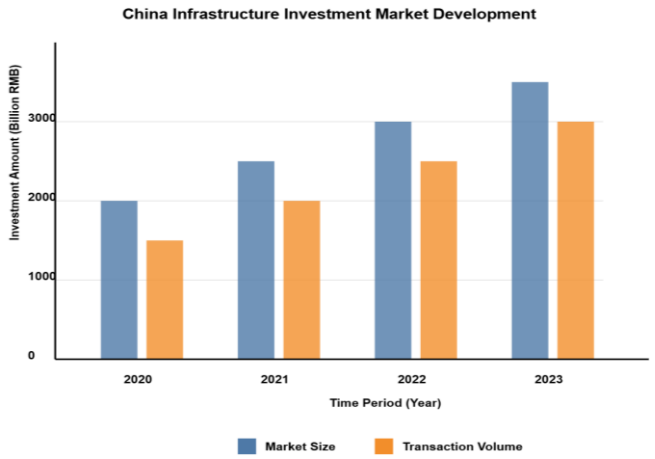

Figure 5. Development of China's infrastructure investment market

5. Conclusion and Recommendation

Based on the systematic research on China's infrastructure equity financing mode, this paper draws the following conclusions: infrastructure equity financing shows a diversified development trend, with parallel development of REITs, industrial funds, equity investment and mixed ownership reform, among which REITs have developed the most rapidly, with the number of projects increasing from 9 to 47, and the scale of fund-raising amounting to RMB 187.6 billion yuan.The operation of the PPP mode is becoming more and more mature. A complete project life cycle management system has been formed, and the risk sharing mechanism has been optimised. The policy support system continues to improve, including the expansion of REITs pilot, tax incentives and special refinancing and other measures to promote, effectively driving the participation of social capital increased by 42%. However, the study also found that the current equity financing model still has deficiencies such as case sample limitations and data timeliness constraints. In the future, we should focus on improving the institutional environment, innovating financing tools, enhancing operational efficiency, and strengthening the research on new infrastructure investment and financing models to promote the sustainable development of infrastructure investment and construction.

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