



Faculty of Economics and Business

**The Moderating Role of Country Risks on the Relationship between the
Success of Public-Private Partnership (PPP) Projects under the Belt and
Road Initiative and Its Determinants**

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The Moderating Role of Country Risks on the Relationship between the
Success of Public-Private Partnership (PPP) Projects under the Belt and Road
Initiative and Its Determinants

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

This study examines the factors influencing the success of Public–Private Partnership (PPP) infrastructure projects in countries along the Belt and Road Initiative (BRI). Using the World Bank’s Private Participation in Infrastructure (PPI) database, this study analyses the state of infrastructure in BRI countries from 1993 to 2023. Although several projects are in the “action” stage, a significant number of PPP infrastructure projects are either “cancelled” or “distressed”, indicating project failures. Therefore, examining the factors that influence the success of PPP infrastructure projects is crucial. The research objectives of this study are to explore the relationship between factors such as country risk and macro factors that influence the success of PPP projects. This study investigates the factors influencing the success of Chinese enterprises investing in PPP infrastructure projects in BRI countries, contributing theoretical value to the literature and practical value in providing decision support to enterprises. Taking country risk as the moderating variable and macro factors as control variables, the study demonstrates the relationship between the success of PPP infrastructure projects and project profile factors. The theories adopted in this research include public goods theory, institutional theory, cooperative game theory, and risk management theory. The analysis method was based on logistic regression analysis conducted using Econometrics software. Data on the success and failure of PPP projects, country risk, GDP, country openness and private sector development were obtained from the World Bank’s PPI database and the World Bank’s World Development Indicators (WDI) database, cross-referenced with the International Country Risk Guide (ICRG). The study conducted correlation analysis, heterogeneity analysis and diagnostic tests, with results indicating acceptable variables and reasonable model selection. The logistic regression analysis indicates that the notion of project profile factors significantly affecting project success was

partially accepted. For instance, multilateral country support has increased Log-odds of project success, while investment scale has decreased Log-odds of project success. Investment scale's negative correlation coefficient was reduced when the control variables—national GDP growth rate, support for the private sector, and openness—were added. The study also found that the moderating variables—political risk, economic risk, and financial risk—negatively affected PPP project success, which was accepted. Further, the negative impact of investment scale on project success was weakened based on the moderating effect of country risk. Based on the empirical results, this study provides recommendations for Chinese enterprises. This guidance can help improve the success rate of Chinese enterprises investing in PPP infrastructure projects in BRI countries, promoting joint development along the route.

Keywords: Belt and Road, infrastructure, Public-Private Partnership (PPP), performance, Critical Success Factors (CSFs)

Peranan Penyederhana Risiko Negara dalam Hubungan antara Kejayaan Projek Perkongsian Awam-Swasta (PPP) di bawah Inisiatif Belt and Road dan Penentu-penentunya

ABSTRAK

Kajian ini meneliti faktor-faktor yang mempengaruhi kejayaan projek Kerjasama Awam-Swasta (PPP) infrastruktur di negara-negara sepanjang Inisiatif “Jalur dan Jalan” (BRI). Dengan menggunakan pangkalan data Penyertaan Swasta dalam Infrastruktur (PPI) Bank Dunia, kajian ini menganalisis keadaan infrastruktur di negara-negara BRI dari tahun 1993 hingga 2023. Walaupun banyak projek berada dalam status “beraksi”, terdapat banyak projek PPP infrastruktur yang berada dalam status “dibatalkan” atau “tertekan”, yang menunjukkan kegagalan projek PPP. Oleh itu, kajian mengenai faktor-faktor yang mempengaruhi kejayaan projek PPP infrastruktur adalah sangat mendesak. Soalan kajian dan objektif kajian ini adalah untuk meneroka hubungan antara faktor projek profil, risiko negara, dan faktor makro dengan kejayaan projek PPP. Kajian ini menyelidiki faktor-faktor yang mempengaruhi kejayaan perusahaan China dalam pelaburan projek PPP infrastruktur di negara-negara BRI, memberikan sumbangan teori yang diperlukan kepada literatur serta nilai praktikal dalam menyokong keputusan perusahaan. Kajian ini bertujuan untuk membuktikan hubungan antara kejayaan projek PPP infrastruktur dengan faktor projek profil, dengan risiko negara sebagai pemboleh ubah moderator dan faktor makro sebagai pemboleh ubah kawalan. Teori yang digunakan dalam kajian ini termasuk teori barangan awam, teori institusi, teori permainan kerjasama, dan teori pengurusan risiko. Kaedah analisis yang digunakan ialah kaedah analisis regresi logistik, yang dijalankan menggunakan alat perisian Ekonomi. Data mengenai kejayaan dan kegagalan projek PPP, risiko negara, KDNK, keterbukaan negara, dan tahap pembangunan sektor swasta diperoleh dari pangkalan data PPI Bank Dunia, pangkalan data Penunjuk Pembangunan

Dunia (WDI) Bank Dunia, dan silang rujukan dari Panduan Risiko Negara Antarabangsa (ICRG). Kajian ini menjalankan ujian korelasi, ujian heterogenitas, dan ujian diagnostik, dengan keputusan menunjukkan pemboleh ubah adalah tepat dan pemilihan model adalah munasabah. Melalui analisis regresi logistik, didapati bahawa faktor projek profil secara signifikan mempengaruhi kejayaan projek, diterima secara sebahagian. Sebagai contoh, sokongan pelbagai hala negara telah meningkatkan Log-odds kejayaan projek, manakala skala pelaburan telah mengurangkan Log-odds kejayaan projek. Di bawah pengaruh tiga pemboleh ubah kawalan—kadar pertumbuhan KDNK negara, tahap sokongan negara kepada sektor swasta, dan keterbukaan negara—koefisien korelasi negatif skala pelaburan berkurang. Kajian ini juga mendapati bahawa tiga pemboleh ubah moderator—risiko politik, risiko ekonomi, dan risiko kewangan—secara signifikan mempengaruhi kejayaan projek PPP secara negatif, yang diterima. Di bawah kesan moderasi risiko negara, kesan negatif skala pelaburan terhadap kejayaan projek berkurang. Berdasarkan hasil empirik, kajian ini memberikan cadangan kepada perusahaan China. Kajian ini membantu meningkatkan kadar kejayaan perusahaan China dalam pelaburan projek PPP infrastruktur di negara-negara BRI serta mempromosikan pembangunan bersama dengan negara-negara di sepanjang laluan tersebut.

Kata kunci: *Jalur dan Jalan, infrastruktur, Kerjasama Awam-Swasta (PPP), prestasi, Faktor Kejayaan Kritikal (CSFs)*

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LIST OF ABBREVIATIONS

BRI	Belt and Road Initiative
CATPCA	Categorical Principal Component Analysis
CCCC	China Communications Construction Company Limited
CHINCA	China International Contractors Association
CIS	Commonwealth of Independent States
CRCC	China Railway Construction Corporation Limited
CRG	China Railway Group Limited
CSCEC	China State Construction Engineering Corporation
ICRG	International Country Risk Guide
ICT	Information and Communication Technology
MCC	China Metallurgical Group Corporation
MSW	Municipal Solid Waste
PPP	Public-Private Partnership
SOEs	State-Owned Enterprises
XGS	Exports of Goods and Services

CHAPTER 1

INTRODUCTION

1.1 Overview

Chapter 1 provides a comprehensive overview of the background of China's Belt and Road Initiative (BRI) and the countries along its route. Based on data from the World Bank's database, this chapter outlines the current state of Public–Private Partnership (PPP) project investments in BRI countries. It introduces the current status of Chinese enterprises investing in PPP projects in BRI countries. Furthermore, this chapter highlights the significant failure rate of PPP projects, leading to the research questions and study objectives. Finally, it outlines the study's significance and the organisation of the research.

1.2 Study Background

1.2.1 Belt and Road Initiative

The “Belt and Road Initiative” (BRI) is a collective term used to describe the “Silk Road Economic Belt” and the “21st Century Maritime Silk Road” (Ma & Chen, 2017). The strategic concept was proposed by China in 2013 and aimed at joint development between China and the countries along the BRI (Ma & Chen, 2017). The China Export Credit Insurance Corporation published the “BRI National Infrastructure Development Index Report”, listing 71 key countries along the BRI (CHINCA, 2023). Based on the United Nations' regional classification standards, the countries along this route comprise seven regions. Table 1.1 presents the number of countries along the BRI per region. Ukraine officially withdrew from the Commonwealth of Independent States on 12 April 2018, and is therefore classified under Central and Eastern Europe (Luo, 2018).

Table 1.1: Number of Countries along the “Belt and Road”

Region	Number of countries
Southeast Asia	10
Six Commonwealth of Independent States(CIS) countries and Mongolia	7
South Asia	8
Portuguese-speaking countries	8
West Asia and North Africa	14
Central Asia	5
Central and Eastern Europe	19
Total	71

Source: China International Contractors Association, China Export Credit Insurance Corporation (2023)

The core focus of China’s Belt and Road construction initiative surrounds infrastructure development. Generally, infrastructure aims to ensure the smooth operation of social production and the orderly conduct of residents’ daily lives. It centres on the provision of basic services and consists primarily of fixed assets in the form of products and services (Wang et al., 2021). Infrastructure serves production enterprises and the public, forming the material foundation for social reproduction and labour force reproduction. It is a crucial prerequisite for the steady development of the national economy. The World Bank (2008) has classified the following industries as infrastructure: airports, electricity, information and communication technology (ICT), municipal solid waste (MSW), ports, railways, roads, and water and sewerage.

1.2.2 Current Status of PPP Projects in BRI Countries

Public–Private Partnerships (PPPs) originated in Western countries (Adamou et al., 2021) and refer to collaborations between public and private sectors to provide public goods or manage societal services (Yu, 2016). During this collaborative process, various possible

relationships are established between the public sector and private capital (Darrin & Lewis, 2008). Klijn et al. (2007) suggest that PPP has become a widely adopted policy tool in Western countries, emphasising the added value it brings to society and the role of contracts in implementing public management reform (Mei, 2020). The World Bank (2008) suggests that PPPs can elicit long-term benefits for businesses and government departments, generate stable social and financial environments and achieve national goals. Therefore, governments worldwide, particularly those in infrastructure sectors, utilise PPPs extensively to enhance financial value (Hwang et al., 2013).

1.2.2.1 Annual Distribution of PPP Projects

The World Bank's Private Participation in Infrastructure (PPI) report indicates that there were a total of 5,010 PPP infrastructure projects along the BRI route by the end of 2023, with a total investment of \$1,3873 .8772 trillion (World Bank, 2024). Table 1.2 and Figure 1.1 illustrate the number of PPP infrastructure projects and investment amounts in BRI countries from 1993 to 2023. Investment volume and project number exhibited a fluctuating inverted "U-shaped" trend over this period. From 1993 to 2012, there was a clear overall upward trend. Due to multiple factors such as the growth in global infrastructure demand, policy support, and favourable financial market conditions (Lu,2014). Between 2012 and 2023, there is a significant overall decline in the number of infrastructure PPP projects in the countries along the route. This is because of the impact of the world economic crisis in 2008, which had a certain lag and led to the beginning of the decline in PPP projects in 2012. However, they have also experienced significant fluctuations due to global and regional political and economic factors. Investment in PPP infrastructure projects in BRI countries was \$19.235 billion in 2022, a significant decrease from 2021. However, PPP project

investments rebounded to \$29.88 billion in 2023, indicating signs of recovery alongside global and regional economic improvements.

Table 1.2: Number of Infrastructure PPP Projects and Investment in Countries along the BRI (1993- 2023)

Investment Year	Quantity	Investment (Billion USD)	Investment Year	Quantity	Investment (Billion USD)
1993	33	10.73	2009	259	79.50
1994	51	13.27	2010	295	94.32
1995	76	21.01	2011	351	98.33
1996	95	29.15	2012	391	122.25
1997	113	41.45	2013	231	59.59
1998	125	51.08	2014	213	79.50
1999	90	12.68	2015	198	75.01
2000	106	25.39	2016	159	44.22
2001	123	20.95	2017	178	59.35
2002	98	8.14	2018	187	44.69
2003	123	14.70	2019	160	46.66
2004	134	16.27	2020	131	30.09
2005	140	26.66	2021	126	56.41
2006	200	30.11	2022	40	19.23
2007	201	53.02	2023	144	29.88
2008	239	73.75	Total	5010	1387.39

Source: World Bank (2024)

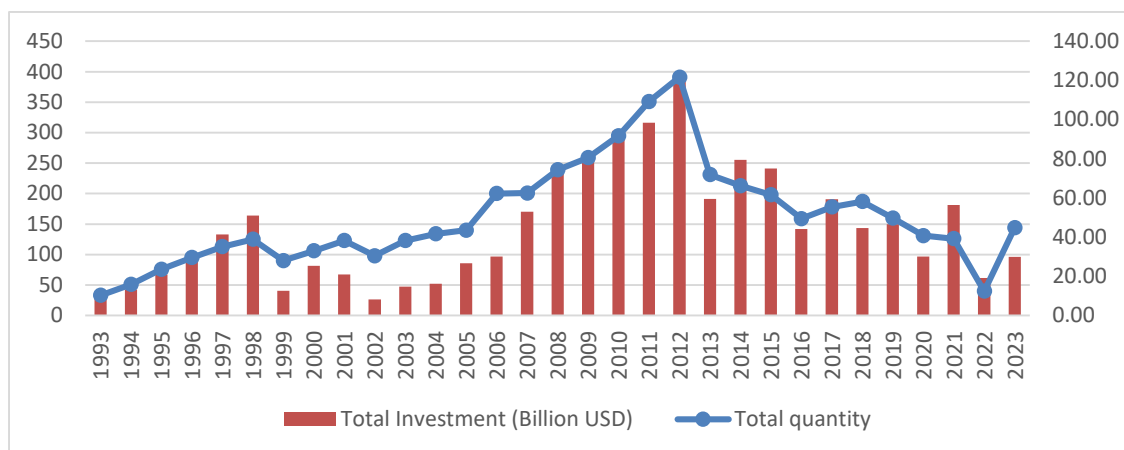


Figure 1.1: Trends in the Number of PPP Infrastructure Projects and Investment in Countries along the BRI (1993-2023)

Source: World Bank (2024)

1.2.2.2 National Distribution of PPP Projects

The data were obtained from the World Bank database. After excluding samples with incomplete indicators, a total of 5,010 projects were included from 1993 to 2023. Table 1.3 presents an overview of PPP projects in the BRI countries, where 31 countries had projects that were classified as “concluded”, “active”, “cancelled” or “distressed.” The national distribution of PPP projects is as follows: Brazil had 1,763 active projects, ranking first among the 31 countries. India had 1,165 active projects, ranking second. While Turkey ranked third, it only had 258 active projects. Thailand had 170 active projects, and the Philippines had 159 active projects.

Regarding projects that were concluded, Brazil had concluded 18 projects, ranking first. The Philippines followed with 15 projects, and India ranked third with nine concluded projects. Moreover, India was first in the number of cancelled projects at 35. This was followed by Brazil with 20 cancelled projects and Malaysia with 17. The Philippines ranked

first in the number of distressed projects at four. Malaysia ranked second with three distressed projects.

Table 1.3: Overview of PPP Projects in the Countries along the BRI (1993-2023)

Country	Active	Cancelled	Concluded	Distressed	Total
Brazil	1763	20	18	1	1802
India	1165	35	9	1	1210
Turkiye	258		3	1	262
Philippines	175	5	15	4	199
Thailand	170	1	2	1	174
Viet Nam	153	3			156
Russian Federation	155				155
Indonesia	130	12	5	1	148
Pakistan	125			1	126
Bulgaria	125				125
Malaysia	100	17		3	120
Sri Lanka	82		1	1	84
Ukraine	78				78
Bangladesh	76			1	77
Egypt, Arab Rep.	61		1		62
Jordan	37	1			38
Albania	24	3			27
Kazakhstan	27				27
Mozambique	20	1		1	22
Armenia	19				19
Myanmar	14				14
Serbia	14				14
Iraq	12				12
Uzbekistan	12				12
Angola	10				10
Belarus	9				9
Iran, Islamic Rep.	7				7
Moldova	7				7

Table 1.3 continued

Country	Active	Cancelled	Concluded	Distressed	Total
Azerbaijan	3	3			6
Mongolia	5				5
Lebanon	2	1			3
Total	4838	102	54	16	5010

Source: World Bank (2024)

1.2.2.3 PPP Project Industry Distribution

Table 1.4 presents the industry distribution for the PPP projects of the BRI countries. Each industry was observed across four dimensions: active projects, concluded projects, cancelled projects and distressed projects. The energy sector had 3,178 projects, including 3,113 active, 24 concluded, 32 cancelled and nine distressed projects. Except for the number of cancelled projects, the energy sector ranked first in the number of active, concluded, distressed and total number of projects. The transport sector had a total of 1,266 projects, with 1,193 active, 25 concluded, 46 cancelled and two distressed projects. The water and sewerage sector had 268 projects, including 249 active, five concluded projects, 10 cancelled and four distressed projects. The municipal solid waste sector had a total of 175 projects, of which 174 were active. There were no concluded or distressed projects and one cancelled project. The ICT sector had 123 projects, including 109 active projects. The ICT sector had no concluded projects, 13 cancelled projects and one distressed project during the study period.

Table 1.4: PPP Project Sectors in Countries along the BRI (1993- 2023)

Sector	Active	Concluded	Cancelled	Distressed	Total
Energy	3113	24	32	9	3178
Transport	1193	25	46	2	1266
Water and sewerage	249	5	10	4	268
Municipal Solid Waste	174		1		175
ICT	109		13	1	123
Total	4838	54	102	16	5010

Source: World Bank (2024)

1.2.2.4 PPP Project Investment Type Distribution

Table 1.5 illustrates the main investment types regarding the PPP projects of the BRI countries during the study period. The greenfield investment model comprised 2,893 projects, including 2,805 active, 29 concluded, 49 cancelled and 10 distressed projects. The brownfield investment model totalled 1,592 projects, with 1,515 active, 25 concluded, 46 cancelled and six distressed projects. The divestiture model totalled 382 projects, with 376 active, six cancelled and no concluded or distressed projects. The management and lease contract model totalled 143 projects, with 142 active and one cancelled project.

The greenfield investment model ranked first across all four dimensions regarding the total project count (active, concluded and distressed). The greenfield investment model was the most widely used investment method, as found in this study. The brownfield investment model ranked second. The divestiture and management and lease contract models were used less frequently, with the management and lease contract model being the least used.

Table 1.5: PPP Project Type in Countries along the BRI (1993- 2023)

Type	Active	Cancelled	Concluded	Distressed	Total
Green field	2805	49	29	10	2893
Brown field	1515	46	25	6	1592
Divestiture	376	6			382
Management and lease contract	142	1			143
Total	4838	102	54	16	5010

Source: World Bank (2024)

1.2.3 Current Status of PPP Projects in China

PPP projects in China are statistically managed by two platforms: the Comprehensive Information Platform of PPPs by China's Ministry of Finance and the PPP Project Information Monitoring Service Platform of the National Development and Reform Commission (NDRC) of China. To discuss the former, on 25 May 2014, the Ministry of Finance established a PPP Working Group led by Wang Bao-an, then Vice Minister of Finance (Song, 2017). On 1 June 2015, the NDRC, Ministry of Finance, Ministry of Housing and Urban-Rural Development, Ministry of Transport and Ministry of Water Resources jointly launched legislative work for concessions, culminating as the "Administrative Measures for Concessions in Infrastructure and Public Utilities", to ensure the smooth implementation of PPP projects. On 18 December 2015, the Ministry of Finance issued the "Notice on Regulating the Operation of the Comprehensive Information Platform for Government and Social Capital Cooperation", which established the PPP Comprehensive Information Platform and project database. The platform officially began operations in January 2016, aiming to collect relevant PPP data while effectively analysing the realisation of PPP projects (Song, 2017). The latter was formed based on the deployment of the State

Council of China in accordance with the “Regulations on Government Investment”, the “Regulations on the Approval and Recordation of Enterprise Investment Projects”, and the “Notice of the NDRC on Strengthening Investment and Construction Management of PPP Projects in Accordance with Laws and Regulations”, among other documents. The NDRC promoted the PPP model in a standardised and orderly manner to strengthen the monitoring of PPP project information and utilise PPP big data to meet the needs of various stakeholders more effectively. Thus, the NDRC established the National PPP Project Information Monitoring Service Platform. It relies on the National Online Approval and Supervision Platform for Investment Projects (National Development and Reform Commission, 2019).

1.2.3.1 The Vast Scale of China’s PPP Projects

Mingshu Technology (2024) consolidates PPP projects identified through publicly available sources, including but not limited to the National PPP Comprehensive Information Management Platform of the Ministry of Finance of China and the PPP Project Information Monitoring Service Platform of the National Development and Reform Commission (NDRC) of China. Mingshu Technology tracks the data if a PPP project is included in the National PPP Comprehensive Information Management Platform and the NDRC’s PPP Project Information Monitoring Service Platform but is still in an unawarded state. In contrast, if the awarded information has been publicly disclosed, it is included in the category of national PPP-awarded projects, referred to as “all-inclusive” data. A total of 15,267 projects had been awarded by the end of 2023, with an investment amounting to \$3,481.6 billion (Chinese yuan converted to United States dollars at the rate of 31 December 2023, The Dollar is 1:7.05 to the Chinese Yuan.). Since the implementation of PPP projects began in 2014, the highest number was reached in 2017, with 3,546 projects and investments amounting to \$749.75 billion. There was a decline after 2017, followed by a rise in 2022, with 1,271 projects and

investments amounting to \$354.25 billion. From February 2023, China imposed strict controls on PPP projects, approving only projects with a user-pay model, leading to a sharp decline in projects. Despite the decrease in the number of PPP projects, China's PPP project scale remained large, demonstrating China's robustness in PPP infrastructure projects (Mingshu Technology, 2024). Table 1.6 and Figure 1.2 illustrates the statistics on the number and investment amount of China's PPP projects.

Table 1.6: All-Inclusive Statistics of the Number and Investment Amount of PPP Projects in China (2014-2023)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Quantity	83	721	2338	3546	2593	1781	1684	1109	1271	141
Investment (Billion USD)	33.62	149.01	508.35	749.75	494.12	409.94	407.27	324.01	354.25	51.28

Source: Mingshu Technology (2024)

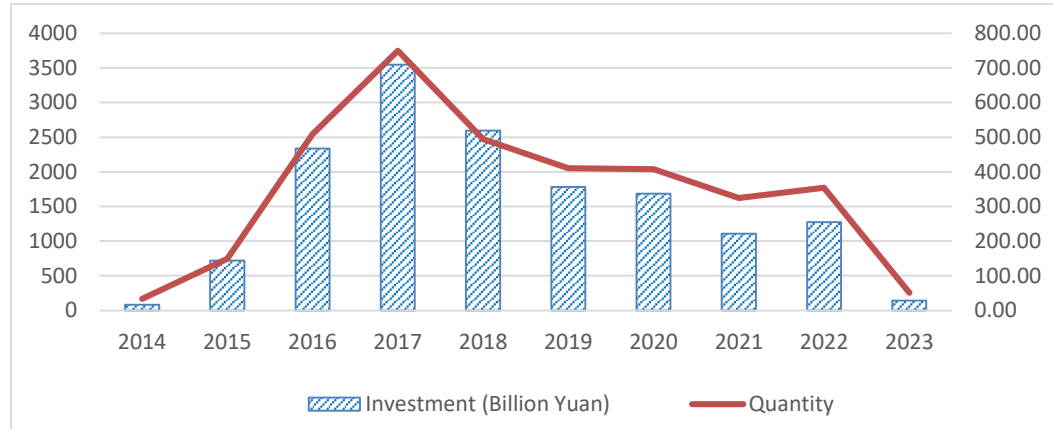


Figure 1.2: Trend of the Number and Investment Amount of PPP Projects in China (All-Inclusive Statistics, 2014-2023)

Source: Mingshu Technology (2024)

1.2.3.2 Broad Industry Distribution of China's PPP Projects

Based on the data from the PPP project platform of the Ministry of Finance of China, the top five industries by the end of 2023 for PPP projects were as follows: First, municipal engineering had the highest number of projects at 4,157, accounting for 40.87% of the total number. The investment amount was \$ 676.37 billion, accounting for 27.67% of total investments. Second, transportation ranked next with 1,469 projects, accounting for 14.44% of the total number. The investment amount was \$ 908.11 billion, accounting for 37.15% of total investments. Third, ecological construction and environmental protection included 970 projects, comprising 9.54% of the total number and an investment amount of \$ 162.04 billion, accounting for 6.63% of total investments. Next, comprehensive urban development had 662 projects, accounting for 6.51% of the total. The investment amount was \$ 300.07 billion, 12.27% of the total investment. Finally, 463 projects involved water conservancy construction, accounting for 4.55% of the total number. The investment amount was \$ 60.99 billion, which accounted for 2.49% of the total investment in this industry (Mingshu Technology, 2024). The data indicates that China has a strong presence and extensive industry experience. Table 1.7 illustrates the industry distribution of PPP projects in China as of the end of 2023.

Table 1.7: Industry Distribution of PPP Projects in China as of the End of 2023

Industry	Quantity	Percentage of Quantity	Investment (Billion USD)	Percentage of Investment
Municipal Engineering	4157	40.87%	676.37	27.67%
Transportation	1469	14.44%	908.11	37.15%
Ecological Construction and Environment	970	9.54%	162.04	6.63%
Comprehensive Urban Development	662	6.51%	300.07	12.27%
Water Conservancy Construction	463	4.55%	60.99	2.49%
Education	391	3.84%	33.63	1.38%
Affordable Housing Projects	324	3.19%	54.00	2.21%
Tourism	307	3.02%	52.76	2.16%
Healthcare	213	2.09%	24.57	1.00%
Others	187	1.84%	38.67	1.58%
Forestry	170	1.67%	36.07	1.48%
Government Infrastructure	161	1.58%	26.48	1.08%
Energy	161	1.58%	12.19	0.50%
Culture	134	1.32%	18.85	0.77%
Science and Technology	127	1.25%	10.41	0.43%
Sports	109	1.07%	13.41	0.55%
Elderly Care	94	0.92%	8.08	0.33%
Agriculture	50	0.49%	6.54	0.27%
Social Security	23	0.23%	1.34	0.05%
Total	10172	100%	2444.58	100%

Source: Mingshu Technology (2024)

1.2.3.3 PPP Projects Invested by Typical Chinese Central State-Owned Enterprises

According to statistics from Mingshu Technology (2024), the total value of PPP projects awarded by typical Chinese central state-owned enterprises (SOEs) exceeded \$ 1.07 trillion by the end of 2023 (See Table 1.8). Mingshu Technology (2024) used the following method for data calculation. When central SOEs jointly won bids with other private sectors, the awarded amount was calculated based on the equity proportion. If the equity proportion

was not publicly disclosed, the amount was divided equally. If multiple central SOEs won a bid for the same project, the project count was counted multiple times, but the investment amount was calculated proportionally.

Regarding PPP project investments, the top-ranking company is China Communications Construction Company Limited (CCCC), with 831 projects and a total investment of \$ 29.31 billion. The top five industries in which CCCC has invested are transportation, municipal engineering, comprehensive urban development, ecological construction and environment and tourism. Investment amounts comprise \$ 170.6 billion, \$ 70.3 billion, \$ 24.8 billion, \$ 10.4 billion and \$ 2.9 billion, respectively.

China Railway Group Limited (CRG) is the second-ranking company, with 458 projects and a total investment of \$ 233 billion. The top five industries in which CRG has invested are transportation, municipal engineering, comprehensive urban development, “other” and ecological construction and environment. Investment amounts were \$ 135.1 billion , \$ 67.9 billion , \$ 15.8 billion, \$ 2.8 billion and \$ 2.8 billion,, respectively.

The third-ranking company is China Railway Construction Corporation Limited (CRCC), with 425 projects and a total investment of approximately \$ 225 billion,. The top five industries in which CRCC has invested include transportation, municipal engineering, comprehensive urban development, ecological construction and environment and affordable housing projects. Investment amounts were \$ 149.5 billion, \$ 50.7 billion, \$ 10.1 billion, \$ 7 billion and \$ 2.5 billion, respectively.

The fourth-ranking company is China State Construction Engineering Corporation (CSCEC), with 595 projects and a total investment of approximately \$ 210 billion. The top five industries in which CSCEC has invested are transportation, municipal engineering,

comprehensive urban development, affordable housing projects and ecological construction and environment. The investment amounts were \$ 81 billion, \$ 68.4 billion, \$ 24.7 billion, \$ 9.9 billion and \$ 6.3 billion, respectively.

The fifth-ranking company is China Metallurgical Group Corporation (MCC), with 488 projects and a total investment of approximately \$ 108 billion. The top five industries in which MCC has invested are transportation, municipal engineering, comprehensive urban development, affordable housing projects and ecological construction and environment. Investment amounts were \$ 35.9 billion, \$ 35.1 billion, \$ 13.3 billion, \$ 5.3 billion and \$ 3.7 billion, respectively.

Chinese central SOEs invest in numerous projects with high investment amounts, demonstrating their strong capabilities and experience in PPP projects. These enterprises are crucial in investing in PPP projects along the Belt and Road Initiative (BRI) countries. Table 1.8 presents the number of industries and the investment amounts of central SOEs in China as of 2022.

Table 1.8: Number of Industries and Investment amount by Chinese Central SOEs as of 2023

Industry	CCCC		CRG		CRCC		CSCEC		MCC	
	Quantity	Investment	Quantity	Investment	Quantity	Investment	Quantity	Investment	Quantity	Investment
Municipal Engineering	338	70.3	188	67.9	129	50.7	256	68.4	193	35.1
Transportation	280	170.6	164	135.1	187	149.5	124	81.0	82	35.9
Ecological Construction and Environment	80	10.4	27	2.8	33	7.0	38	6.3	31	3.7
Comprehensive Urban Development	43	24.8	24	15.8	20	10.1	50	24.7	50	13.3
Water Conservancy Construction	22	2.9	7	0.3	7	0.9	9	2.1	/	/
Education	15	2.4	10	1.3	6	0.3	19	2.1	25	2.4
Affordable Housing Projects	11	2.5	9	1.7	8	2.5	23	9.9	22	5.3
Tourism	14	2.7	5	2.6	7	2.0	8	2.1	15	3.6
Healthcare	4	0.8	1	0.1	4	0.3	12	1.7	14	1.0
Others	6	1.7	4	2.8	3	1.4	7	2.2	6	0.6
Forestry	4	1.0	1	0.2	4	2.1	/	/	/	/
Government Infrastructure	6	0.6	9	2.4	3	0.1	11	1.6	9	1.4
Energy	/	/	/	/	/	/	1	0.3	1	0.4
Culture	5	0.9	5	0.8	7	1.0	18	3.9	19	1.7
Science and Technology	/	/	2	0.3	2	0.1	2	0.3	4	0.5
Sports	2	0.3	3	0.3	4	0.2	14	2.7	12	2.4
Elderly Care	/	/	/	/	1	0.0	1	0.2	2	0.5
Agriculture	1	0.7	/	/	1	0.2	2	0.2	/	/
Social Security	/	0.0	/	/	/	/	/	/	3	0.3
Total	831	291	460	233	425	225	595	210	488	108

Note: The unit of the investment amount is billions of dollars.

Source: Mingshu Technology (2024)

1.2.4 Current Chinese Enterprise Investments in PPP Projects of BRI Countries

World Bank data indicates that there has been significant growth in PPP projects in the infrastructure sector globally in recent years. This growth stems from the ability of PPPs to elicit higher value to the public sector. The public sector collaborates with the private

sector through PPP models to acquire management, financial and technical capabilities for better societal services (Ning & Zhao, 2018).

China's BRI strategy has played an indelible role in global infrastructure development (Xiao, 2018). The "2021 Belt and Road Countries Infrastructure Development Report", jointly released by the China International Contractors Association (CHINCA) and China Export Credit Insurance Corporation, indicates that the Infrastructure Development Index for BRI countries in 2021 was 113 (Dagong International Panda Bond Research Group, 2018), as shown in Figure 1.3. The investment index reached its highest value in 2011 at 123 and remained at this level for three consecutive years. In 2014, there was a significant decline, dropping to 116. Subsequently, the economy showed some growth and reached 121 by 2018. Infrastructure development was heavily impacted after the global outbreak of COVID-19 in 2020, with the index dropping significantly to only 110. However, from 2022 to 2023, the index increased by 8 points compared to 2020, indicating a renewed momentum and significant future growth potential (CHINCA, 2023). The Belt and Road Initiative (BRI) Countries' Infrastructure Development Index is a comprehensive index that reflects the development environment, development demand, development momentum, and development costs within the infrastructure sector of BRI countries. The higher the development index score, the better the prospects for the infrastructure sector in a country, and the more attractive it becomes for enterprises to invest in, operate, and conduct business within that country's infrastructure industry (CHINCA, 2023).

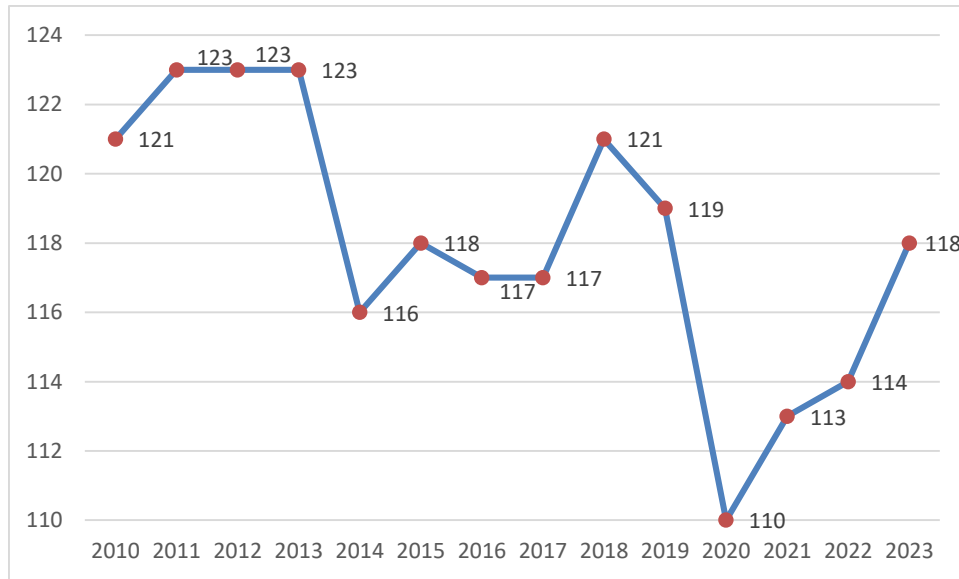


Figure 1.3: BRI Infrastructure Development Index (2014-2023)

Source: CHINCA (2023)

Based on the above, Chinese enterprises have invested heavily in BRI countries. From 1993 to December 2023, Chinese enterprises have invested in 167 PPP projects in BRI countries, with a total investment amount of \$69.749 billion. However, the number of projects accounts for only 3.33% of all projects in these host countries. The amount of investments accounts for only 5.03% of total investment in BRI host countries. The number of projects in 2011 and 2017 were the same and the highest, at 16 projects each year. Regarding amount of investments, 2017 saw the highest at \$17.51 billion. In 2023, six projects were invested in with a total investment amount of \$1.66 billion. The amount of investment and the number of PPP projects invested by Chinese enterprises in BRI countries have not fluctuated significantly from 1993 to 2023. However, regarding quantity, the highest proportion of Chinese enterprises' investments in host countries' total number of projects was 8.99%. Regarding investment amount, the highest proportion of Chinese enterprises' investments in host countries' total investment amount was 29.5%. Table 1.9

and Figure 1.4 illustrate the number of PPP projects and investment amounts of Chinese enterprises in BRI countries.

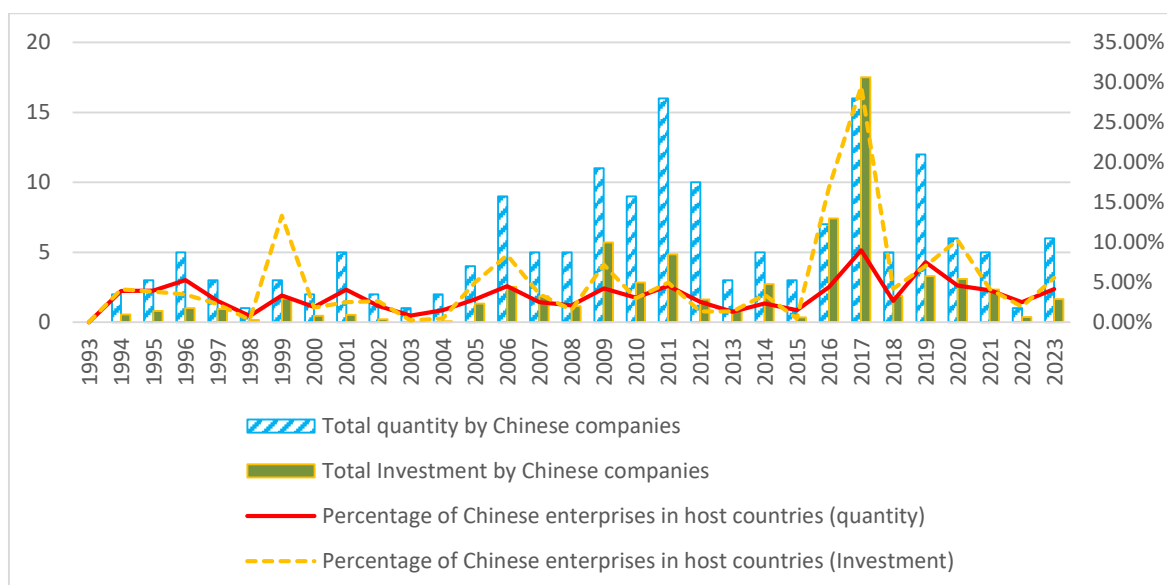
Table 1.9: Number of PPP Projects and Investment by Chinese Enterprises in Countries along the BRI (1993-2023)

Investment Year	Total quantity by Chinese companies	Percentage of Chinese enterprises in host countries (Quantity)	Total Investment by Chinese companies (Billion USD)	Percentage of Chinese enterprises in host countries (Investment)
1993	0	0.00%	0.00	0.00%
1994	2	3.92%	0.54	4.10%
1995	3	3.95%	0.80	3.81%
1996	5	5.26%	1.01	3.45%
1997	3	2.65%	0.94	2.27%
1998	1	0.80%	0.15	0.29%
1999	3	3.33%	1.69	13.32%
2000	2	1.89%	0.46	1.83%
2001	5	4.07%	0.53	2.52%
2002	2	2.04%	0.21	2.64%
2003	1	0.81%	0.03	0.22%
2004	2	1.49%	0.08	0.47%
2005	4	2.86%	1.33	4.97%
2006	9	4.50%	2.53	8.40%
2007	5	2.49%	1.85	3.50%
2008	5	2.09%	1.15	1.55%
2009	11	4.25%	5.70	7.17%
2010	9	3.05%	2.83	3.00%
2011	16	4.56%	4.86	4.94%
2012	10	2.56%	1.62	1.33%
2013	3	1.30%	0.80	1.34%
2014	5	2.35%	2.73	3.44%
2015	3	1.52%	0.35	0.47%
2016	7	4.40%	7.43	16.79%

Table 1.9 continued

Investment Year	Total quantity by Chinese companies	Percentage of Chinese enterprises in host countries (Quantity)	Total Investment by Chinese companies (Billion USD)	Percentage of Chinese enterprises in host countries (Investment)
2017	16	8.99%	17.51	29.50%
2018	5	2.67%	1.87	4.18%
2019	12	7.50%	3.29	7.04%
2020	6	4.58%	3.09	10.27%
2021	5	3.97%	2.34	4.15%
2022	1	2.50%	0.38	1.96%
2023	6	4.17%	1.66	5.54%
Total	167	100%	69.75	100%

Source: World Bank (2024)

**Figure 1.4:** Trends in the Number of PPP Projects and Investment by Chinese Enterprises in Countries along the BRI (1993-2023)

Source: World Bank (2024)

1.2.5 High Failure Rates of PPP Projects

While countries worldwide are adopting Public–Private Partnership (PPP) models for infrastructure development, such models may not be universally suitable for all infrastructure projects. Governments must assess whether PPP models add more value than traditional approaches (Wahab & Mohamed, 2009). If the added value is low or lacks feasibility studies, PPP projects may face budget overruns, delays, quality issues or even project cancellations (Alireza et al., 2016). Since PPP projects typically involve partnerships lasting 20 to 30 years, data from 1993 to 2023, spanning 30 years, was selected for analysis (Kukah et al., 2024). Table 1.10 presents the status of PPP projects along the Belt and Road Initiative (BRI) countries to illustrate that the majority of PPP projects were categorised as “active”, indicating ongoing projects that had not reached completion. There were 118 projects categorised as “cancelled or distressed” during the study period, amounting to \$56.18 billion while accounting for 4.04% of all PPP projects. In contrast, only 54 projects were categorised as “concluded”, amounting to \$4.1 billion and comprising only 0.29% of total PPP projects. The high failure rate of PPP projects is notable (World Bank, 2024).

Table 1.10: PPP Project Status in BRI Countries (1993-2023)

Status	Total quantity	Percentage of total	Total Investment (Billion USD)	Percentage of total
Active	4838	96.57%	1330.03	95.66%
Cancelled /Distressed	118	2.36%	56.18	4.04%
Concluded	54	1.08%	4.10	0.29%
Total	5010	100.00%	1390.30	100.00%

Source: World Bank (2024)

Based on the PPI data published by the World Bank in 2023, 118 PPP projects were either cancelled or distressed from 1993 to 2023. Analysing the unsuccessful projects from a regional perspective, East Asia and the Pacific had 47 projects, accounting for the highest proportion of the total investments across all BRI countries at 39.83%. The investment amount was \$26.55 billion, accounting for 49.84% of the total investment in all BRI countries. Sub-Saharan Africa had two projects. South Asia had 39 projects, accounting for 33.05%, with an investment amount of \$14.99 billion, accounting for 28.13%. Latin America and the Caribbean ranked third with 21 projects, accounting for 17.8% and an investment amount of \$10.12 billion, accounting for 18.99%. Europe and Central Asia had seven projects, accounting for 5.93%, with an investment amount of \$1.3 billion, accounting for 2.45%. The Middle East, North Africa and Sub-Saharan Africa each had such two projects. Table 1.11 indicates the number of unsuccessful PPP projects across the BRI regions.

Table 1.11: Number of Unsuccessful PPP Projects in Different Regions (1993-2023)

Region	Total quantity	Percentage of total	Total Investment (Billion USD)	Percentage of total
East Asia and Pacific	47	39.83%	26.55	49.84%
Europe and Central Asia	7	5.93%	1.30	2.45%
Latin America and the Caribbean	21	17.80%	10.12	18.99%
Middle East and North Africa	2	1.69%	0.15	0.28%
South Asia	39	33.05%	14.99	28.13%
Sub-Saharan Africa	2	1.69%	0.16	0.30%
Total	118	100.00%	53.26	100.00%

Source: World Bank (2024)

Analysing the unsuccessful projects from an industry perspective, based on Table 1.12, the industry with the most failed projects was transport, with 48 projects accounting for 40.68% of the total failed projects across all industries. The investment amount was \$24.46 billion for the transport industry, accounting for 45.92% of the total investment in all industries. Next was the energy industry, with 41 projects accounting for 34.75% of the total across all industries. The investment amount was \$14.08 billion, accounting for 26.43% of the total investment in all industries. Ranked third were two industries, water and sewerage and ICT, each with 14 projects that accounted for 11.86% of the total across all industries. However, the investment amounts differed at \$1.16 billion and \$3.53 billion, accounting for 6.61% and 20.95% of the total investment in all industries, respectively. Municipal solid waste had only one unsuccessful project, with an investment of \$40 million.

Table 1.12: Number of Unsuccessful PPP Projects in Different Sectors (1993-2023)

Industry	Total quantity	Percentage of total	Total Investment (Billion USD)	Percentage of total
Energy	41	34.75%	14.08	26.43%
ICT	14	11.86%	3.52	6.61%
Municipal Solid Waste	1	0.85%	0.04	0.08%
Transport	48	40.68%	24.46	45.92%
Water and sewerage	14	11.86%	11.16	20.95%
Total	118	100.00%	53.26	100.00%

Source: World Bank (2024)

Analysing the unsuccessful projects based on type (Table 1.13), greenfield projects had the highest number, with 59 projects accounting for 50% of all project types. The investment amount for greenfield projects was \$23.98 billion, accounting for 45.02% of the total investment of all project types. Next was brownfield projects, with 52 projects

accounting for 44.07% of all project types. The investment amount in brownfield projects was \$28.59 billion, accounting for 53.68% of the total investment in all project types. Third was divestiture, with six projects accounting for 5.08% of all project types. The investment was \$690 million, accounting for 1.30% of the total investment in all project types. Management and lease contracts had the fewest unsuccessful projects, with only one project accounting for 0.85% of all project types. The investment amount was \$2 million, accounting for 0.001% of the total investment in all project types.

Table 1.13: Number of Unsuccessful PPP Projects of Different Types (1993-2023)

Type	Total quantity	Percentage of total	Total Investment (billion USD)	Percentage of total
Green field	59	50.00%	23.98	45.02%
Brown field	52	44.07%	28.59	53.68%
Divestiture	6	5.08%	0.69	1.30%
Management and lease contract	1	0.85%	0.002	0.00%
Total	118	100.00%	53.26	100.00%

Source: World Bank (2024)

El-Gohary et al. (2006) and Rwelamila et al. (2015) note that an inadequate assessment of factors influencing the success of PPP projects increases risks that can lead to project failure. Mei (2020) indicates that countries along the BRI are influenced by various factors, such as politics, economic, legal, ethnic and geopolitical environments, all of which can contribute to project failure.

Chinese enterprises investing in infrastructure construction in BRI countries encounter substantial investment demands and opportunities but also face significant risks and a high likelihood of failure (Zhang et al., 2022). Therefore, predicting the success factors of PPP projects in infrastructure construction in BRI countries can provide decision support

for Chinese enterprises investing in these projects (Qi & Zhang, 2017). Consequently, PPP projects can mitigate risks, anticipate challenges, optimise business environments, ensure project success and enhance the added value of public–private collaboration (Mei, 2020).

1.3 Problem Statement

There is consensus regarding the factors influencing the success of PPP infrastructure projects in economics and management. Not all infrastructure developments using the PPP model are successful; many projects fail. Based on World Bank statistics from 1993 to 2023, 582 global projects faced cancellation or distress, with 118 occurring in BRI countries (World Bank, 2024). Jiao et al. (2017) argue that factors for PPP project failures include private sector withdrawal, indefinite suspension or cancellation of projects, inadequate progress or quality, poor management during operation phases and failure to achieve societal goals.

Aladağ & Işık (2020) suggests that different political environments, economic levels and social cultures in BRI countries introduce uncertainties into the PPP model. Alireza et al. (2018) attribute unsuccessful investments in Southeast Asian countries to insufficient market returns, foreign exchange risk, governmental corruption and inaction. Zhang and Xie (2020) highlight political inefficiency, public interest and revenue risks as reasons for PPP project failures in BRI countries. Sheng (2019) identifies political risks at the national level, including legal and micro-level risks such as financing, market, construction, and exchange rate risks in PPP infrastructure projects. Liu (2018) suggests that political instability, high national debt, inflation and cutthroat competition from foreign firms in BRI countries reduce the likelihood of PPP project success. Based on PPP project data in Africa, Huo et al. (2018)

indicate that national institutions and multilateral support increase the log-odds of project success.

Meanwhile, Alireza et al. (2016) consider that leveraging institutional strength and international support can enhance the success rate of PPP projects. Liyanapathirana et al. (2024) employed fuzzy analytic network process (FANP) models and grey cluster evaluation (GCE) methods to calculate risk-sharing proportions and project success rates of BRI countries' PPP projects. Liu (2020) used a random cooperative game model to determine mutual risk-sharing proportions that enhance project success rates. Dou et al. (2019) applied the triple integration theory of information technology, industry and finance (TIF) to reduce government credit risks and improve success rates. Hu et al. (2019) identified PPP project risks in BRI countries through a risk checklist method to strengthen risk management and increase success rates. Xue (2021) consider that improving project success rates begins with the economic environment.

Whether identifying reasons for unsuccessful PPP projects or determining solutions to enhance success rates, the relevant literature has primarily focused on risk management. However, several factors influence PPP project success, and risk is just one aspect. project profile factors, such as the impact of investment type, amount and industry on project success, remain underexplored. Similarly, studies on macro environmental factors such as GDP and market capacity and the success of PPP projects in infrastructure development in BRI countries are limited. These research gaps lead to the following questions. Does multilateral support impact the success of PPP projects? Do national openness and private sector development levels affect PPP project success? Under conditions of country risk, how do project profile factors and macro environmental factors influence PPP project success?

These issues have not received sufficient attention in the research on factors contributing to the success of BRI PPP infrastructure projects. Therefore, this study addresses these fundamental issues as the key factors influencing PPP infrastructure projects in BRI countries: the intrinsic connection between project success and project profile factors; the intrinsic connection between project success and the macro environment of the host country; and how country risk affects project success.

Based on the theoretical and empirical hypotheses, this study examines the impact of project profile factors on project success. It also examines the moderating role of country risk in the relationship between project profile factors and project success. By fully considering the impact of macro environmental factors in the host country on PPP project success through these key factor indicators, this study explores the crucial questions regarding the impact of project profile factors and country risk on PPP project success that have been underexplored.

1.4 Research Questions

Based on the discussion of PPP project issues and research gaps in the previous sections, this study addresses the following research questions:

- i. What is the relationship between the success of PPP projects in BRI countries and project profile factors?
- ii. How does country risk affect the success of PPP projects?
- iii. How does the moderating effect of country risk influence project profile factors and the success of PPP projects?

The study conducted empirical research on factors influencing the success of PPP projects in infrastructure across BRI countries. A rigorous investigation of these questions compares and expands upon previous research and theories. At the same time, this study identifies key influencing factors to provide decision-making recommendations for Chinese enterprises investing in infrastructure development PPP projects in BRI countries.

1.5 Research Objectives

The study objective is to examine the factors influencing the success of PPP infrastructure projects in BRI countries. Specific objectives are detailed below:

- i. To examine the relationship between the success of PPP projects under China's Belt and Road Initiative and project profile factors.
- ii. To examine the impact of country risk on the success of PPP projects.
- iii. To determine how country risk moderates the relationship between project profile factors and the success of PPP projects.

1.6 Scope of the Study

The research scope of the present study aligns with the standard for all research activities (Abbey et al., 2019), encompassing research subjects, methods and objectives.

First, the research subject is PPP infrastructure projects in BRI countries. While existing literature has examined the impact of project risks on PPP project success, this study introduces a novel investigation into country risk as a moderating variable. It explores how country risk moderates the effects of project factors and success. Thus, moderating variables include political, economic and financial risks. Additionally, this study examines the effects of project profile factors and project success under the control of macro environmental

variables. A project profile factors include variables such as investment type, investment amount, investment sector, multilateral support and private sector participation. The control variables comprise macro factors, including GDP, degree of national openness, and private sector development.

Second, this study selected data from PPP infrastructure projects in 71 BRI countries. Since the implementation period of PPP projects is typically around 30 years (Wang, 2021), data from the World Bank's PPI database spanning from 1993 to 2022 was selected for the study period. The World Bank categorises project status into four types: active, concluded, cancelled and distressed (World Bank, 2024). Projects labelled as active may conclude, be cancelled or face distress. Hence, failure is possible as long as projects are still active (Asadornborikarn, 2021; Luo et al., 2017). This study explored both the success and failure of PPP projects. To ensure the accuracy of empirical data, projects labelled as active were excluded, and only data from concluded, cancelled and distressed statuses were analysed. Data on country risk was sourced from the International Country Risk Guide (ICRG) published by the Political Risk Services of the United States.

Finally, this study investigated the impact of project profile factors and country risk on project success. It tested country risk as a moderating variable concerning project profile factors and project success. The study also examined the influence of macro environmental factors on project success. These analyses seek to clarify the key factors contributing to the success of PPP projects in BRI countries, thereby enhancing the overall success rate of PPP projects.

1.7 Significance of the Study

This study expands the decisive factors for the success of PPP projects by introducing investment type, investment amount, and investment industry within the projects themselves to explain their success. It reveals the impact of the macro environment on PPP project success through multilateral national support, private sector participation, GDP, and the degree of national openness. Additionally, it provides a comprehensive measurement of PPP project success using data on political risk, economic risk, and financial risk. Therefore, the study's significance is primarily reflected in the following aspects:

First, this study is of significant importance to China's central government in conducting PPP projects. It provides scientific evidence for the Chinese government and policymakers that can aid in optimising policy frameworks and implementation strategies regarding PPP projects, thereby enhancing the efficiency and effectiveness of the implementation of the BRI strategy. Through empirical research, this study analysed the success factors of PPP projects in BRI countries, which can be used to increase project success rates (Almarri, 2023). The results of this study provide recommendations for the Chinese government, such as enhancing communication and exchanges between countries. Moreover, the conclusions drawn suggest pathways to improve the success rate of PPP projects, such as strengthening multilateral collaboration while mitigating risks. Based on the findings, the Chinese government is also advised to enhance cooperation and exchanges with international banks such as the World Bank. The empirical results of this study provide an essential reference for the Chinese government to improve the success rate of PPP projects in BRI countries.

Second, the study findings are essential for Chinese enterprises investing in BRI countries. Chinese enterprises investing in PPP projects under the BRI can better respond to and mitigate potential risks while improving project success rates by drawing on the key success factors of PPP projects identified in this study. The study explores and identifies the factors affecting the success of PPP projects, further optimizing various aspects such as risk identification and mitigation. . Subsequently, it provides decision-making advice for Chinese enterprises investing in infrastructure construction in BRI countries, thus promoting project success while opening new pathways. The empirical results of this study illustrate the relationship between project profile factors and project success, as well as the impact of country risk on project success, leading to specific recommendations for Chinese enterprises. Factors such as investment amounts and industry regarding the projects themselves are evaluated to determine their influence on project success, offering insights for Chinese enterprises to consider reasonable investment scales. The macroeconomic environments of host countries, including GDP, openness, and the level of support from the private sector, are assessed for their impact on project success, providing a basis for Chinese enterprises to select appropriate countries for investment. The study also evaluates the impact of political, economic and financial risks on project success, providing risk assessment criteria for Chinese enterprises. Therefore, the study results provide a valuable reference for Chinese enterprises in selecting suitable countries, projects and scales when investing in PPP projects in BRI countries.

Third, this study is essential for BRI countries and their populations. The findings elucidate the understanding of the BRI and associated PPP projects within these countries. This knowledge can promote economic cooperation and exchange between BRI countries while advancing regional economic integration. The results of this study provide a reference

for the Chinese government and Chinese enterprises that encourage increased investment in BRI countries, improving the success rate of PPP projects. The success of PPP projects will promote infrastructure development in BRI countries, further boosting economic growth. Therefore, the construction and success rate improvement of PPP projects in BRI countries are crucial for developing host countries. Additionally, this study is significant for improving people's living standards in BRI countries based on PPP project success.

Finally, this study augments the relevant literature by constructing an empirical model of the determinants of PPP projects. This study innovates and optimises decision analysis tools, which enhances the applicability and explanatory power of theoretical models in practice. As more countries along the BRI increasingly adopt the PPP model for infrastructure construction, most research has focused on the cooperative models of PPP projects (Hu et al., 2019). Implementing PPP projects involves numerous risks, such as geopolitical and financing risks, which reduce project success rates (Li, 2015). While these risks have been studied extensively, literature specifically addressing the characteristics of Chinese enterprises investing in PPP infrastructure projects in BRI countries from the perspective of success factors is limited. Therefore, the present study explored the success mechanisms of BRI PPP infrastructure projects from the perspective of project profile factors. On this basis, it examined the interaction between project profile factors and project success using country risk as a moderating variable. Thus, this study makes new discoveries in the theoretical research on the success factors of PPP projects, holding considerable significance.

1.8 Organization of the Study

This study investigates the key determinants of the success of PPP infrastructure projects in countries along the Belt and Road Initiative (BRI).

Chapter 1 has introduced the research background and objectives. It provides a detailed overview of infrastructure development in BRI countries and the development index of Chinese enterprises investing in BRI. Additionally, it discusses unsuccessful PPP infrastructure projects as references for analysing success factors in subsequent sections.

Chapter 2 reviews the literature relevant to this study. Building on supporting theories, this chapter elaborates on the concepts and types of BRI infrastructure and PPP projects. It emphasises factors influencing PPP project success and synthesises these findings to propose the study hypotheses.

Chapter 3 outlines the research design and methodology. It details the research framework, models and data sources used. The dependent and independent variables influencing PPP project success are identified, and regression analysis is employed for hypothesis testing.

Chapter 4 presents the research findings. It provides descriptive statistic results of BRI PPP infrastructure projects and analyses correlations among variables specific to these infrastructure projects. Regression and moderation analyses are conducted to validate the study hypotheses. Finally, robustness tests are performed to strengthen the validity of the results.

Chapter 5 concludes by presenting the findings and recommendations. This chapter summarises the results of hypothesis testing. Based on the research findings, it provides recommendations for Chinese enterprises investing in infrastructure development in countries participating in the Belt and Road Initiative.

1.9 Chapter Summary

This chapter comprises the research background, including the current status of PPP infrastructure projects in countries along the Belt and Road Initiative (BRI). It has elaborated on the current state of PPP project failures. It has also introduced the problem statement, research questions, research objectives and study significance.

CHAPTER 2

LITERATURE REVIEWS

2.1 Overview

To examine the factors that influence Chinese enterprises' investment in PPP infrastructure projects along the Belt and Road Initiative (BRI), it is necessary to establish a theoretical framework. This chapter examines the supporting theories that influence the success of PPP projects. Second, it explores the concepts, characteristics and types of Belt and Road Initiative (BRI) infrastructure and PPP projects. Third, it analyses the factors influencing PPP project success.

2.2 Underpinning Theories

2.2.1 Public Product Theory

Public goods theory is a central theory for analysing the nature and social attributes of urban utilities and the provision of products and services (Song, 2020). The theory of public goods was first proposed by Samuelson in 1954. He proposed two concepts of public goods: public consumer goods and private consumer goods (Samuelson, 1954). Consumers consume public goods without affecting other consumers, which is characterised by non-competitiveness. Thereafter, based on the theory of public goods, Musgrave (1959) proposed beneficial goods characterised by coercion. For instance, education is a beneficial good where consumers have no choice but to be passive and therefore non-exclusive. Tianze Economic Research Institute Research Group (2013) argued that public goods differ from private goods regarding the objects and subjects of supply. The typical difference between private and public goods is that public goods are not exclusive or competitive. Therefore,

the criterion for determining whether a product is a public good is whether it exhibits non-exclusive and non-competitive characteristics.

The theory of public goods indicates that public goods include private goods, pure public goods and quasi-public goods (Zhang, 2023). Public goods can be classified as international, national, local and community-based (Zhang & Xie, 2020). Public goods can be divided into the following forms: resources from natural resources, the material form of satisfying people's needs, public services, institutional provisions and the cultural form of various cultures (Mahmoud, 2024).

Public goods theory suggests that infrastructure falls into the public goods type. Public goods theory further suggests adopting the PPP infrastructure model is more effective (Ye, 2017). Public goods theory indicates that the government buys and operates public goods but can fail to fulfil the public goods effect due to insufficient information or government short-sightedness (Duan & Sun, 2020). Therefore, governments must cooperate with the private sector to complement its strengths and weaknesses so that the private sector can provide pure public goods. At the same time, the government cooperates with the private sector through non-market and mixed products (Edward, 2022).

Regarding PPP infrastructure projects, the theory of public goods considers the constraints of project investment scale, investment sector and multilateral state support (Ye, 2017). Public goods serve to meet society's public needs, based on society's overall and long-term interests, and to maximise resource allocation (Zhang, 2018). In public goods theory, government credibility ensures the stability of long-term contracts in PPP projects, reducing uncertainties caused by policy changes, thereby influencing the success of PPP projects. The government can establish a reasonable pricing mechanism to balance social

welfare and PPP project investment returns, ensuring project profitability, which in turn affects its success. As PPP projects exhibit positive externalities, the government can guide policies to maintain their public service attributes while safeguarding private sector interests, ultimately promoting the success of PPP projects. Therefore, this study relies on the theory of public goods to analyse the factors of PPP infrastructure project success.

2.2.2 Institutional Theory

This study provides an in-depth analysis of the factors affecting the success of PPP infrastructure projects at the national level. Institutional factors, also referred to as national factors, emphasise the public sector's ability to govern a country (Zhao, 2020). In institutional theory, the institutional environment of PPP projects determines key factors such as the cooperation model between the government and the private sector, risk allocation, interest coordination, and contract enforcement, thereby influencing the success of PPP projects (Jiang et al., 2021). Therefore, this factor may impact PPP project success. Meanwhile, institutional study utilises institutional theory to determine the importance of macro environmental aspects on the success of PPP projects. From the perspective of institutional theory, the success of PPP projects depends on formal institutions such as laws and policies, which in turn influence the macro environment. The perspective of institutional theory is more prominent in the macro environment (Rahman et al., 2019). Institutional theory applies to the macro environment and institutional environment of the country where a PPP project is located, such as GDP and the country's degree of openness (Edward, 2022). Based on the World Bank's PPP project data from 2000 to 2018, Li et al. (2021) argues that the institutional environment positively correlates with PPP project success.

The earliest study of institutional theory was by Meyer in 1977. Research suggests that institutions are “regulatory, normative and cognitive structures and activities that provide stability and meaning to social behaviour” (Opawole & Jagboro, 2017). Institutions include laws, regulations, customs, social and professional norms, culture, ethics, etc. (Zhang et al., 2022). Institutional theory suggests that institutions exert a binding influence on organisations, referred to as isomorphism. Isomorphism can be categorised as normative, mimetic and coercive isomorphism (Percoco, 2014). PPP infrastructure projects are strongly associated with mandatory isomorphism (Mahdi et al., 2019).

Institutional theory suggests that organisations exhibit homogeneous characteristics (Panayides et al., 2015). Each organisation forms a field, such as the infrastructure industry. Therefore, organisations must comply with rules and protect organisational legitimacy (Du et al., 2018). Institutional theory suggests the existence of coercive isomorphism, which leads to pressure from the government, stakeholders and the private sector (Owolabi et al., 2020). Therefore, organisations in PPP project companies experience institutional pressure to comply with regulations.

Institutional theory considers institutional factors that affect the success of PPP infrastructure projects (Zheng, 2017). Institutions comprise formal and informal systems. Formal systems include laws and regulations, while informal systems comprise values, codes of conduct and conventions (Moore & Vining, 2023). Institutional theory emphasises that the socio-cultural system impacts organisational structure and decision-making processes. Therefore, organisations are affected by informal institutions, such as values, codes of conduct, etc., in their operations (Barley, 1997). PPP infrastructure projects cannot be developed without the safeguards provided by institutions. This can mitigate uncertainty

events in PPP project implementation and reduce economic transaction costs (McMillan & Woodruff, 2003). Based on institutional theory, Panayides et al. (2015) argue that the government must establish laws and regulations and ensure the effective functioning of the private sector in PPP project institutions. Prabhudesai and Sarode (2018) indicate that institutions are critical to PPP project success. Kim (2023) identified six positive effects of PPP projects that can be promoted through institutional innovation. By examining the institutional risk of BRI countries, Li and Li (2016) found that countries with high institutional risk have a high probability of PPP project failure. Wang et al. (2018) analysed data from 46 countries along the BRI and concluded that institutional quality is positive impact on the private sector's willingness to take risks in PPP projects. The core of PPP projects lies in the reasonable division of responsibilities between the government and the private sector, where the private sector is typically responsible for investment, construction, and operation, while the government provides policy support, regulatory protection, and partial funding or guarantees. The private sector's willingness to accept risks directly affects the feasibility, financing capacity, and operational efficiency of PPP projects, thereby determining their success (Cui, 2016). Analysing PPP projects in 50 BRI countries, Zhang et al. (2022) found that institutional differences are significantly negative impact on China's direct investment in BRI countries. Based on the above, effective institutional quality is bound to play an essential role in the success of PPP projects. Therefore, this study adopted institutional theory because PPP infrastructure projects must be based on specific institutions.

2.2.3 Risk Management Theory

This study aims to research the impact of country risk on the success of infrastructure PPP projects, including the study of macroeconomic environments and inherent project risks on PPP project success. Risk management theory posits that infrastructure PPP projects face

various uncertainties during implementation, which can lead to delays, changes, or even failures (Asadornborikarn, 2021). Therefore, risk management is a crucial aspect of PPP project research.

Risk management theory originated in the United States, where Haynes (1895) defined risk as the possibility of harm without any technical certainty. Risks arise from uncertain factors that could lead to loss, and managing these risks involves bearing them if they are implemented. According to the Committee of Sponsoring Organizations of the Treadway Commission (COSO), risk management refers to managing potential events that could affect the achievement of strategic objectives throughout an organization's management (COSO, 2004). Effective risk management allows organizations to control these events within reasonable limits and provides assurance for achieving organizational goals (Abdelkader et al., 2023). Therefore, risk management theory views risk management as a dynamic process integrated with corporate management, penetrating into the behavior of every employee (Meng, 2020).

In risk management theory, the process of managing risks includes risk identification, risk assessment, risk measurement, and risk control (Meng, 2020). Risk identification is the initial and most crucial step in risk management, requiring systematic and continuous efforts to identify the causes and impacts of risks. Methods for risk identification mainly include the Delphi method, flowchart method, risk checklist method, brainstorming method, and fault tree analysis method (Gao, 2018).

Determining and quantifying risks can be facilitated by technical means, establishing assessment models based on collected risk data to evaluate the extent of risk damage, thereby providing decision support for risk management. Therefore, risk management is an ongoing

process within an organization, characterized by a continuous cycle, aimed at ensuring the smooth achievement of organizational goals.

Risk management is a crucial task during infrastructure construction in Belt and Road Initiative (BRI) countries (Chen, 2016). Through studies on PPP models, it has been proposed that five attributes of risks measure the degree of risk in projects and effectively control the level of risk (Meng, 2018). Using the R River PPP project as a case study, empirical research demonstrates that more comprehensive and systematic risk management leads to higher project success rates (Mazher et al., 2022). Applying risk management models to study the high-speed highways in Country A within the BRI, it has been suggested that risk control significantly influences project success (Mei, 2020). Listing seven risk indicators in BRI infrastructure construction, the Generalized Set Pair Analysis (GSPA) is used for risk identification, measurement, and establishing risk assessment models, thereby supporting the theoretical framework for PPP project success.

Therefore, both theoretically and practically, risk management theory greatly contributes to this study. Through the lens of risk management theory, further investigation into how country risks impact the success of infrastructure PPP projects is conducted. Leveraging risk management theory, processes such as risk identification, risk mitigation, and risk management are applied to enhance project success rates.

2.3 Review of Literature

2.3.1 Literature on the Belt and Road Initiative

2.3.1.1 Theoretical Basis and Scope of the “Belt and Road”

“The Silk Road Economic Belt” and the “21st Century Maritime Silk Road” form the “Belt and Road Initiative” (BRI). In September 2013, President Xi Jinping proposed the construction of the “Silk Road Economic Belt” (Xinhua News Agency, 2013a). In October 2013, on the 10th anniversary of China’s accession to ASEAN, President Xi Jinping put forward the concept of jointly building the “21st Century Maritime Silk Road” (Xinhua News Agency, 2013b). In November 2013, the People’s Republic of China held discussions. It passed the “Decision of the Central Committee of the Communist Party of China on Some Major Issues Concerning Comprehensively Deepening Reform”, marking the formal elevation of the BRI from initiative to concept, ultimately leading to a national strategic height (China News Network, 2013).

The “Silk Road Economic Belt” is a transnational economic belt developed based on the ancient Silk Road, which encompasses nine provinces in China: Guangdong, Yunnan, Sichuan, Chongqing, Xinjiang, Ningxia, Qinghai, Gansu, and Shaanxi (Cao & Li, 2021). It extends eastward through economic corridors to benefit the Asia-Pacific Economic Circle and westward to support the development of the European Economic Circle (Si, 2018). The “Silk Road Economic Belt” has three main routes: (1) starting from China, passing through Central Asia and Russia to the Baltic Sea in Europe; (2) starting from China, passing through Central Asia and West Asia to the Persian Gulf; (3) starting from China, passing through Southeast Asia and South Asia to the Indian Ocean (Chen, 2018). The “Silk Road Economic

Belt” aims to promote economic and cultural connectivity across Asia, Europe, Africa and the surrounding oceans.

“The 21st Century Maritime Silk Road Economic Belt” originated during the Qin and Han Dynasties, starting from Guangzhou and extending to the east coast of Africa and the Red Sea coast (Liu, 2022). The “21st Century Maritime Silk Road Economic Belt” promotes dialogue and exchanges among coastal countries and regions by developing points, lines and areas (Chen, 2018). This belt links ASEAN, South Asia, West Asia, North Africa and Europe while connecting markets in the South China Sea, Pacific Ocean and Indian Ocean. The two main routes of the “21st Century Maritime Silk Road Economic Belt” are as follows: (1) from the South China Sea, passing through the Indian Ocean and extending to Europe; (2) the other connects coastal ports in the South China Sea and the Pacific Ocean (Wang, 2015). The BRI aims to achieve sea-land integration through the “21st Century Maritime Silk Road Economic Belt” while promoting the growth of interests among all participating parties.

Overall, the BRI comprises 71 countries and seven regions, including 10 ASEAN countries, eight South Asian countries, five Central Asian countries, 14 countries in West Asia and North Africa, 19 countries in Central and Eastern Europe, six Commonwealth of Independent States (CIS) countries and Mongolia and eight Portuguese-speaking countries (CHINCA, 2023). Table 2.1 presents the regions and countries along the BRI.

Table 2.1: Regions and Countries along the “Belt and Road”

Region	State
Southeast Asia (ten countries)	Philippines, Cambodia, Laos, Malaysia, Myanmar, Thailand, Brunei, Singapore, Indonesia, Vietnam
South Asia (eight countries)	Afghanistan, Pakistan, Bhutan, Maldives, Bangladesh, Nepal, Sri Lanka, India
Central Asia (five countries)	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
West Asia and North Africa (fourteen countries)	Egypt, United Arab Emirates, Oman, Bahrain, Qatar, Kuwait, Lebanon, Saudi Arabia, Turkey, Yemen, Iraq, Iran, Israel, Jordan
Central and Eastern Europe (nineteen countries)	Albania, Estonia, Bulgaria, Poland, Bosnia and Herzegovina, Montenegro, Czech Republic, Croatia, Latvia, Lithuania, Romania, North Macedonia, Serbia, Cyprus, Slovakia, Slovenia, Greece, Hungary, Ukraine
Six Commonwealth of Independent States (CIS) countries and Mongolia region (seven countries)	Azerbaijan, Belarus, Russia, Georgia, Moldova, Armenia, Mongolia
Portuguese-speaking countries (eight countries)	Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe, Timor-Leste

Source: CHINCA (2023)

2.3.1.2 Economic Effects of the BRI

Using the computable general equilibrium (CGE) model, Sun et al. (2024) found that BRI countries' GDP growth rate and total trade volume have increased. Lu et al. (2015) suggest that China's BRI proposal strategy jointly promotes development with other developing countries, providing new perspectives, while China is a reliable and capable partner for other countries. Wang (2015) notes that cooperation through the BRI has continuously improved the economy of the five Central Asian countries since the global financial crisis and that the living standards of the residents have generally improved. Liu et al. (2016) also suggest that the BRI has significantly strengthened the economies of the five Central Asian countries, with Kazakhstan being the most affected. Zou et al. (2015) found

that China's coastal provinces contribute significantly to the economic growth of BRI countries, with Xinjiang contributing significantly to the economic growth of the five Central Asian countries. Liu et al. (2016) suggest that Kazakhstan is the strongest country in Central Asia in terms of comprehensive strength and has close trade ties with China. The Global Trade Analysis Project (GTAP) model indicates that trade facilitation under the BRI strategy significantly reduces tariffs and time costs, positively affecting China–Kazakhstan trade liberalisation.

Yu and Wang (2015) used the global vector auto-regressive (GVAR) model to conclude that there is significant economic complementarity among the countries along the BRI, with trade and investment transmission mechanisms playing a dominant role. They also note that the volume of bilateral trade imports and exports is increasing (Yu & Wang, 2015). Huang et al. (2016) suggest that China bears the responsibility of being a major country; it leads global economic development, which significantly promotes the economic development of countries along the BRI and strengthens the closeness between nations. With the advancement of the BRI, the construction of the China–Pakistan Economic Corridor has improved Pakistan's economic situation, increased industrial transfer, enhanced the domestic industrial structure and established a “China–Pakistan Community of Shared Destiny” in supporting Pakistan's economic development (Li & Ma, 2016). Based on World Input–Output Database (WIOD) data, Wei and Wang (2016) found that China's industrial complementarity with BRI countries is higher than its competitiveness. At the same time, China has enhanced the value chain with high value-add, leading to high-end industrial development in countries along the Belt and Road. Regarding countries in West Asia, the promotion of China–West Asia Free Trade Area construction with tariff reductions has

elicited GDP growth and increased welfare for the residents under the BRI's strategic background (Wei & Wang, 2016).

Countries along the BRI can achieve industrial structural upgrades by optimising resource allocation, transitioning leading industries, and improving scientific and technological levels. These countries can achieve their goals of promoting economic growth, and economic growth can positively promote industrial structural upgrades through demand and supply effects (Liao & Yang, 2018). Moreover, economic cooperation between China and Vietnam has made significant progress since the inception of the BRI. Special geopolitical conditions and multiple cooperation mechanisms ensure the long-term stability of Sino-Vietnamese economic cooperation (Qiu, 2018). Liyanapathirana et al. (2024) found that the overall quality of urbanisation development in BRI countries has risen. The quality in Central and Eastern Europe is generally higher, while Central Asia and South Asia have relatively lower overall quality. Cao and Li (2021) suggest that the BRI initiative has significantly promoted economic growth in countries along the route. Specifically, they found a significant impact on economic growth in neighbouring countries of China, developing countries along the route and countries along the Silk Road Economic Belt (Cao & Li, 2021). Mohamed (2015) suggests that there is continuous room for expanding the economic cooperation between China and countries along the route. In the short term, the trend in East Asia, Central Asia, West Asia, South Asia and other regions is to expand cooperation with China. Cui (2020) argues that the business environment in BRI countries significantly positively promotes per capita GDP, which can stimulate national economic development.

2.3.2 Literature on Infrastructure

2.3.2.1 Concept of Infrastructure

The connotation of infrastructure is not static but dynamically changes with economic and social development (Song, 2017). Currently, there is no definitive consensus on the specific connotation of infrastructure (Ragnar, 1966). Ragnar states that infrastructure cannot simply be summarised as constructing basic facilities and services in individual fields. Infrastructure encompasses macro policies and laws and public services such as public health, education, communication and water and electricity services. Narrowly defined, infrastructure focuses on core areas such as transportation and power, primarily referring to public services like railways, highways, water supply and electricity (Qian & Mao, 1981).

Qian and Mao (1981) were the first to introduce “basic structure” into economic theoretical research in China. They suggest that the basic structure predominantly serves the commercial production sector, with supply mainly from transportation, communication, power, education, health and other essential service sectors. The basic structure is a prerequisite for the normal operations of various industries. Basic structure includes intangible services such as science, education, culture, and health, combining both intangible and tangible sectors. The narrow definition of basic structure focuses more on tangible sectors such as water and electricity, transportation, etc. (Ameyaw & Chan, 2015).

Liu (2015) indicates that infrastructure is a starting point for developing social production and ensuring people’s livelihoods by providing public facilities and services. Infrastructure can be categorised into three types based on application purposes: living infrastructure, productive infrastructure and social infrastructure (Fan, 1990). Economic infrastructure primarily includes sectors such as highways, railways and hydropower. Basic

sectors collectively refer to economic infrastructure and industries (Wei, 1993). Wei (1993) suggests that infrastructure primarily includes public facilities such as communication, water, electricity, gas supply, transportation, etc., providing essential products and services to develop social productivity and ensure people's livelihoods.

Based on the above, infrastructure ensures smooth social production and orderly daily life for residents. It provides essential services, primarily fixed assets and serves production enterprises and the public. Infrastructure is the material foundation for social and labour force reproduction, crucial for steady national economic development. Infrastructure exhibits significant characteristics such as foundational importance, priority, centrality, large economic investment, long construction periods and positive externalities (Yan, 2016).

2.3.2.2 Characteristics of Infrastructure

Deng (2003) identified three main infrastructure characteristics: foundation, natural monopoly and efficiency. The foundational nature of infrastructure is first manifested in the fact that after its completion, infrastructure should provide a large number of public goods and low-cost services in public places, improving the quality of public services (Asadornborikarn, 2021). Infrastructural products and services have a certain basicity, i.e. products and services must be based on costs (Deng, 2003). Regarding the monopolistic nature of infrastructure, a monopoly is first manifested because infrastructure incurs significant sunk costs after construction. Furthermore, after infrastructure is concluded, it depends on beneficiaries (Wu, 2021). Since infrastructure services are limited in scope and only provide specific services, there is a certain dependence on beneficiaries. Thus, infrastructure has a scale effect; it naturally achieves monopoly after the scale effect is achieved (Deng, 2003). Regarding the benefits of infrastructure, infrastructural

establishment provides several conveniences for residents while promoting a region's economic development (Li, 2022). Infrastructure construction requires a vast amount of capital. In the short term, it will burden government departments' finances. However, in the long run, infrastructure provides significant efficiency to a society/country and reduces social costs (Deng, 2003).

2.3.2.3 Classification of Infrastructure

Infrastructure can be classified according to the nature of services. Song (2017) identified several types of infrastructure, and the results vary according to different division criteria: (1) Production service infrastructure: The main body of production service infrastructure is the production sector of society (Chen & Chen, 2017). The focus is on energy supply, facility improvement, platform construction for transport, water supply, power supply, sewerage, water conservancy, environmental protection, greening, etc. (2) Social service infrastructure: Social service infrastructure refers to the sectors and institutions that provide basic facilities and services for the normal operations and sustainable development of a society (Song, 2017). It includes public transport, utilities, management, science, education, culture, health, commercial services, financial services, social security, and other institutions. Institutional safeguards represent different types of institutional facilities. (3) Institutional security institutions and facilities: Institutional security institutions and facilities primarily refer to the legislative level of social insurance, social relief, social welfare, social resettlement, social assistance, and other security institutions to clarify the content of services and service standards (Shen, 2003). For instance, public prosecutors and lawyers, resource management, urban management, urban and rural planning and other institutions.

Infrastructure has also been classified according to the World Bank. The World Bank divides infrastructure into economic and social infrastructure (Cui, 2020). Economic infrastructure primarily consists of permanent engineering structures, facilities, equipment, and the services they provide for residents' use and economic production. Economic infrastructure includes the following: public utilities such as electricity, communications, piped gas, piped water, sewerage, and solid waste collection and disposal. It also includes public works, such as dams, waterworks and roads. Other transport sectors include railways, urban transport, ports, rivers and airports. Economic infrastructure encompasses electricity, gas, and water production and supply sectors, fixed asset investment in transport, storage and postal services, information transmission, computer services and software, water, environment and public facilities management (Liu, 2022).

On the other hand, social infrastructure refers to infrastructure other than economic infrastructure. It primarily includes basic facilities and services that can directly and indirectly contribute to the quality of human life. For instance, cultural and recreational facilities, education and science and technology facilities, social welfare facilities, medical and health facilities, etc. (Almarri & Boussabaine, 2023).

2.3.3 PPP Project Literature Review

2.3.3.1 PPP Concept and Characteristics

PPP project concepts: Public-private partnerships (PPP) originated in Western countries and were introduced to China in the late 20th century, translated as “public-private cooperation”, “public-private partnership”, etc. (Liu, 2015). PPP refers to any arrangement between the public sector and private enterprises that provide society with public goods or management services. A range of possible cooperative relationships will be established

between the public sector and private enterprises during the process (Darrin & Lewis, 2008). Partnerships between the public sector and private firms are established with the provision of infrastructure and public services in mind (Keers, 2018). The definition of PPP varies depending on the degree of economic development, stage of development and direction of development between countries.

The European Commission defines PPPs as partnerships that establish cooperation between the public sector and private enterprises, whereby the public sector transfers the responsibility for providing public goods and services to private enterprises (Shen & Wu, 2005). PPP involves the public sector and private enterprises negotiating cooperation details and sharing risks through methods such as tendering and negotiations (Bing et al., 2005). The Canadian PPP National Committee indicates that by leveraging their respective experiences, public and private sectors establish cooperation to allocate resources, jointly bear risks effectively and share benefits (Almeile et al., 2024). To promote the implementation and development of PPP projects, the United States established the National Council for Public–Private Partnerships in 2009. It defines PPP as agreements between federal, state, or local governments and private enterprises to provide facilities or services to the public (Weng & Zeng, 2020).

China’s Ministry of Finance regards PPPs as a cooperative business relationship between government departments and private enterprises regarding infrastructure and service supply to maximise public interest. Typically, private enterprises are responsible for most aspects, from investment and construction to operation upon completion of infrastructure and service projects. Government departments typically oversee cost and the entire infrastructure and services process. For private enterprises, return on investment

primarily comes from appropriate user fees and necessary subsidies from the government (Ministry of Finance, 2014).

PPPs can be broadly or narrowly defined. Broadly, they serve the needs of providing and improving public infrastructure and services, aiming for mutual benefits among the public, government and private sectors. Narrowly, PPP represents a form of social financing where the government, as the initiator of financing needs, authorises private enterprises to participate in constructing and improving public infrastructure and services. Based on obtaining concession rights or management rights, private enterprises achieve investment returns through reasonable charges to infrastructure and service users or the government (Almeile et al., 2024).

Several Chinese enterprises have adopted the PPP model to invest in countries along the BRI. The host country's government signs PPP project contracts with Chinese state owned enterprises to jointly establish concession-based project companies. These project companies are funded jointly by Chinese enterprises and local governments for implementation. These projects involve participation from contractors, operators, suppliers and purchasers. Revenue for concession-based project companies comes from government payments, user fees and government subsidies to cover gaps. Figure 2.1 illustrates the framework for Chinese enterprises investing in PPP projects in BRI countries.

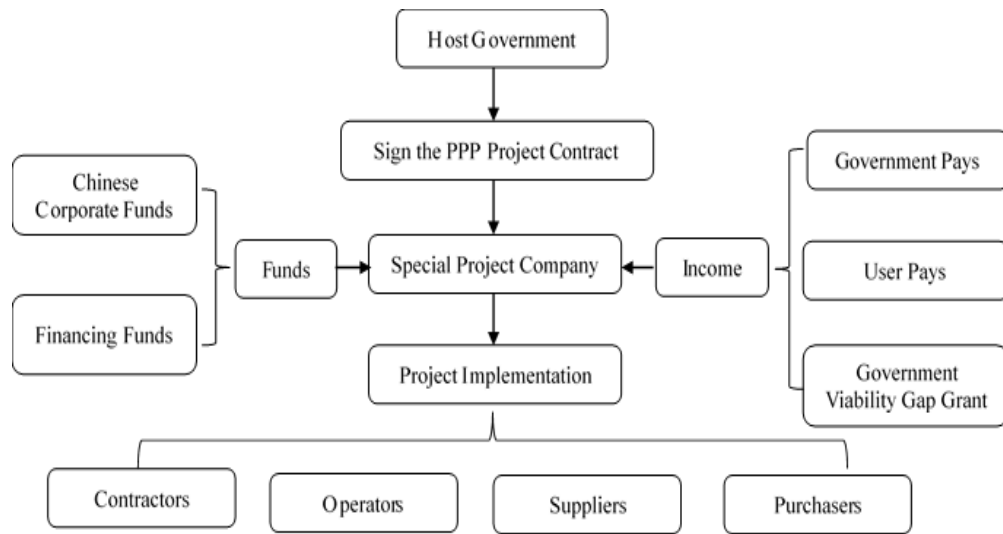


Figure 2.1: Framework Diagram of PPP Applied to Chinese Enterprises' Investment in National Infrastructure Construction along the “Belt and Road”

Source: PPP project model of the Ministry of Finance of China (2021)

PPP project characteristics: The PPP concept develops in different ways in each country it is implemented. While cooperation methods differ, they share common features (Sheng, 2019). First, regarding the number of participants, the PPP model generally includes two or more participants from the public and social sectors. Each participant, especially social capitalists, should have the right to make independent choices and negotiate and sign the cooperation agreement on behalf of their departments (Zeng, 2005). The number of participants in PPP projects is positively related to the complexity of the project, i.e. the more participants there are, the more complex the cooperative relationship is (Wei & Wang, 2016). Second, regarding cooperative partnerships, PPP project participants are not engaged in competitive relationships as the projects should be based on cooperation. This cooperative relationship starts with the date of signing the contract between the public/private parties and continues until the termination date specified by the contract (Chen, 2016). There should be no inequality in public–private cooperation because the public sector takes the initiative to concede the right to operate the contract. The relationship between the parties is based on

fairness and equality. The division of competence, benefits and risks between participants is clarified through the contract. Participants share the common goal of minimising resource consumption and optimising the supply of products and services through the process of cooperation (Chang & Wang, 2016). In this process, social capital participants seek reasonable benefits by providing their products or services during the PPP project participation process. On the other hand, public sector participants achieve concrete benefits through improved social service efficiency and public welfare (Sheng, 2019).

Cooperation and win-win: PPP projects promote cooperation and a win-win scenario among all parties. On the one hand, PPP projects are based on obtaining the benefits of the public while mainly producing public goods and services needed by the public (Bao & Ye, 2018). On the other hand, private enterprises also seek a reasonable return on investment for participating in PPP projects to achieve their own social reproduction and capital appreciation purposes (Yan, 2016). Therefore, the win-win aspect of PPP projects does not represent a win-win for all parties at the economic benefit level but for fulfilling the needs of all parties (Sheng, 2019). For private enterprises strictly regulated by the public sector during PPP project implementation, they must seek what can only be considered normal and reasonable interests (Zhao, 2016). However, governments will also help private enterprises achieve expected benefits through financial compensation, increased development and construction authority in PPP projects. This protects the enthusiasm for social capital participation, where it is challenging to obtain sectoral profits (Zhang & Qiu, 2020). Therefore, PPPs can help governments improve public product and service supply by reducing financial investment, meeting the growing demand for public goods and culture and broadening the channels of private capital gain.

Regarding risk sharing, risk exists in any project. Under the PPP cooperation model, each participant shares project risks based on the contract and their respective obligations and enjoyment of the right to share the project risks (Soroka et al., 2023). However, there are differences in the risk prevention ability of each participant in PPP projects. Each participant exhibits strengths and weaknesses in various prevention abilities. There are highs and lows of each risk type. As the central policymaker and implementer, the government has the unique ability to prevent policy risks. The private sector has the advantage of preventing the risks of specific technology, project management, market operations, and other risks by virtue of its intensive cultivation in relevant fields (Jiang, 2019). Each participating body negotiates a risk-sharing program to improve the overall risk-resistant capacity of the project based on their respective resource advantages (Sheng, 2019).

2.3.3.2 PPP Project Types

Based on the World Bank's classification criteria, there are four main types of PPPs: management and leasing projects, brownfield projects, greenfield projects and divestment projects (World Bank, 2024). (1) Regarding management and leasing projects, the government primarily assumes the role of a financier. This means that the government holds master control, which can be either a project management contract or a lease contract. The private sector undertakes project operation and maintenance, among other tasks, under this control (Wu, 2019). Table 2.2 illustrates the cooperation modes and characteristics of management and leasing projects. (2) Brownfield projects are also known as concession or stock projects. This occurs when the public sector leases or transfers existing infrastructure projects to the private sector through concession contracts; the private sector carries out renovations, renewals and operations. The private sector transfers ownership to the public sector after the expiry of the concession (Kim, 2023). Table 2.2 illustrates the modes of

cooperation and characteristics of brownfield projects. (3) Greenfield projects are also considered new construction projects. As project initiators, the public sector puts forward the demand for infrastructural construction. As a project investor, the private sector is responsible for project financing, construction, and other related work. The private sector transfers a project to the public sector upon completion of construction and acceptance. Participating parties jointly negotiate to determine the method of project risk sharing and benefit distribution (Gong & Zang, 2016). Table 2.2 illustrates the modes of cooperation and characteristics of greenfield projects. (4) Divestment or asset-stripping projects occur when the private sector finances part or all of a public product or service. The public sector primarily assumes the regulatory responsibility. Depending on the difference in the degree of social capital investment, divestments can be further subdivided into two categories: full privatisation and sectoral privatisation (Wang et al., 2021). Table 2.2 illustrates the modes of cooperation and characteristics of divestment projects.

Table 2.2: Types and Characteristics of PPP Projects

Type	Mode	Main features	Period (year)
Management and lease contract	MC	The parties involved are based on the contract, funded by the public sector, and the private sector is involved in the daily operation and back-end maintenance of infrastructure, with more initiative, such as sewage treatment, water supply, etc. (Wu, 2019).	3-5
	LC	The public sector contributes to lease specific public equipment, facilities or services to the private sector, such as rail transit agency operation (Galilea, 2010)	8-15
Brownfield	RLT	The public sector leases the existing infrastructure and management rights to the private sector. After the private sector obtains the management rights, it will transform and operate the project. After the franchise is over, it will be transferred to the public sector. (Heeju & Hyungtai, 2022).	20-30

Table 2.2 continued

Type	Mode	Main features	Period (year)
Greenfield project	ROT	The private sector obtains part or all of the property rights or use rights of the existing public infrastructure in the form of investment; Then the private sector will partially or completely renovate the infrastructure purchased, and operate within a specific period of time to obtain reasonable profits; Finally, after the expiration of the concession, the property right or management right will be transferred to the public sector free of charge (Yurdakul et al., 2022).	20-30
	BROT	The public sector will transfer the concluded infrastructure and management rights to the private sector. After obtaining the management rights, the private sector will transform and operate the project, and transfer it to the public sector after the end of the franchise. (Han et al., 2020).	20-30
	BLT	The public sector, as the initiator of the project, puts forward the demand for infrastructure construction, and the private sector, as the investor of the project, is responsible for the project financing, construction and other work, and will hand over to the public sector after the completion of the project construction and acceptance. The public sector will pay the fees to the private sector in installments and batches according to the lease contract between the two parties (Duan et al., 2020).	20-30
	BOT	The private sector, as the project investor, is responsible for the project financing, construction and other work. The private sector has the specific infrastructure operation authority within the agreed period of time, and obtains the project investment return through the exercise of the operation authority. After the expiration of the period, the infrastructure ownership is transferred to the public sector (Kukah et al., 2024).	30+
	BOO	The private sector invests in the construction of a certain infrastructure, and the private sector has the permanent ownership of the infrastructure on the premise of complying with the provisions of safeguarding the public welfare of the infrastructure agreed by both parties in the contract (Keers, 2018).	30+
	Merchant	The private sector builds and operates infrastructure (Han et al., 2020).	30+
	Rental	Private sector construction, public sector leasing to private sector operation (Soroka et al., 2023).	30+

Table 2.2 continued

Type	Mode	Main features	Period (year)
Divestiture	Partial	The public sector transfers part of the ownership of the infrastructure to the private sector in the form of holding shares. The risks of the operation and management of the public infrastructure are shared by both parties according to the contract (Duan et al., 2020).	30+
	Full	The private sector invests in the purchase of the existing infrastructure, and updates and transforms it. The private sector has the permanent ownership of the infrastructure on the premise of complying with the provisions of safeguarding the public welfare of the infrastructure agreed by both parties in the contract (Kahwajian et al., 2014).	permanent

2.3.3.3 PPP Project Stakeholders

Stakeholders in PPR projects typically include the public sector, private sector, project lenders and special project companies. Regarding the public sector, this sector is often the project initiator. The ownership and operation of PPP projects do not belong to the public sector alone (Andreas, 2024). The public sector can only perform the development, construction and financing of PPP projects by transferring the franchise, providing partial funding, or providing financing guarantees (Wang et al., 2021). When initiating a PPP project, the public sector should fully demonstrate the project's feasibility and clarify the project participants through the market competition mechanism. Regarding BRI PPP infrastructure project construction, initiators are mainly the respective host governments (Liu, 2020). Regarding the private sector, this sector is also a project investor. As the main body of PPP project benefit and risk sharing, private sector participation in PPP projects differs significantly from that of the public sector. The private sector obtains the right to participate in PPP projects by integrating its resource advantages and participating in competitive bidding in the market (Liu, 2022). Based on PPP project characteristics, such as large investment amounts, complicated construction, a long construction period and a slow return

on investment, requirements on the financial strength of the participating private sector are high. Only large multinational corporations and investment groups can shoulder this heavy responsibility. Regarding BRI PPP infrastructure project construction, as the strategic initiator of these projects, China is obliged to participate (Wen, 2016).

Regarding project lenders, PPP projects are characterised by large investment amounts. For the general private sector, the capital threshold is relatively high, making it necessary to rely on banks, other financial institutions and non-financial institutions for third-party financing (Liu, 2022). BRI PPP infrastructure projects consider the nature of third-party financing institutions and the financial strength of the World Bank, the Asian Investment Bank, etc., as the main project lenders (Amovic et al., 2020). In this regard, banks and other sectors play a significant role in the development of PPP projects through the integration of funds to ensure smooth project operations (Wang, 2018).

Special project companies (SPCs) are companies that are specifically established for the development, implementation and operation of a particular PPP project, including the project manager and decision-making executor (Wang, 2018). This type of agency is typically formed through a joint agreement between government departments and investors and therefore plays a vital role throughout the project. Compared to ordinary investors, the SPCs can push the government to make policy adjustments by proposing planning solutions that promote a project's smooth operations (Sheng et al., 2011). SPCs have the authority to decide on major project issues and execute them. Their managers and institutions are usually formed individually or collectively. When the progress of a project is hindered, the government can always join in to manage it. However, the proportion of government

personnel is generally small and will not significantly affect the normal implementation and operation of the project (Wang, 2018).

2.4 Factors Influencing PPP Project Success

2.4.1 Identification Key Success Factors in PPP Projects

2.4.1.1 Identify CSFs of PPP Projects at the Theoretical Level

Using the China National Knowledge Infrastructure (CNKI) and Web of Science foreign language databases, this study conducted a search on the theme of PPP critical success factors (CSFs). A total of 367 articles were identified and screened based on citation counts, with 166 highly cited articles selected for in-depth reading. Literature metric analysis was performed using CiteSpace software. The findings indicate that CSF citations for PPPs are concentrated mainly in recent years. Among the most cited authors, Zhang X.G.'s work is prominent, while most of the top 15 authors are non-Chinese. Figure 2.2 illustrates the authors' citation patterns regarding the CSFs of PPPs.



Figure 2.2: Citation Graph of Research on PPPs' CSFs

Through CiteSpace software, literature on CSFs of PPPs was clustered into nine categories, including: “public work”, “prison development”, “developing countries”, “iron triangle”, “asset-backed securitisation”, “canvas models”, “multiobjective bayesian network models”, “public–private partnership formation projects”, “affordable housing”, and “social capital explanation”. Figure 2.3 presents the cluster analysis of PPPs’ CSFs.



Figure 2.3: PPP CSFs Cluster Analysis Diagram

According to cite space software's annual clustering analysis, research on “CSFs of PPP” is increasing year by year. Figure 2.4 illustrates the trend of publication years for CSFs of PPP.

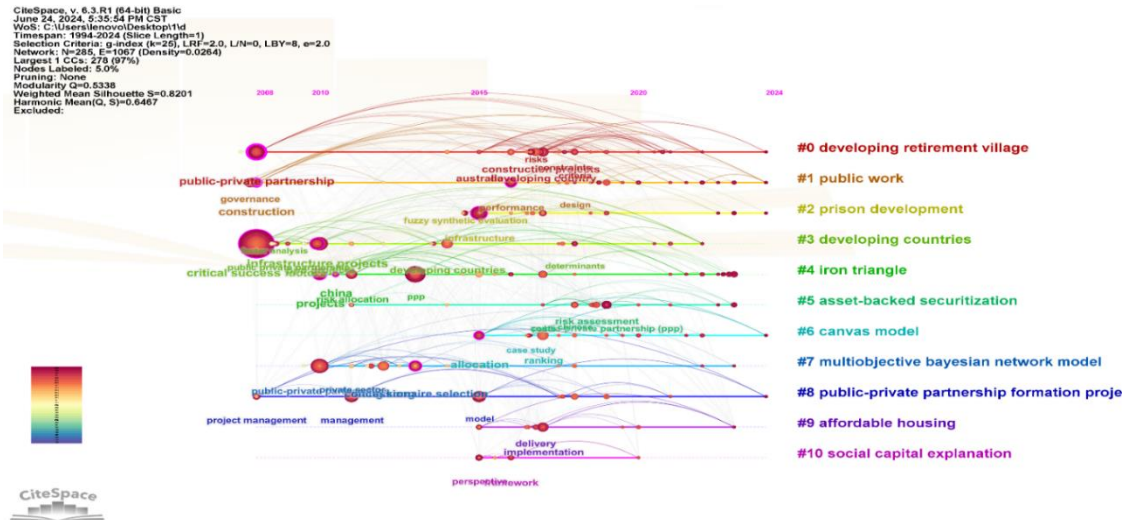


Figure 2.4: Clustered Timeline of Publication Years for PPPs' CSFs

In the collation process, the focus was on literature that is highly relevant to the research content of this study and is also published in core or international journals. After screening, 128 research results were obtained, identifying 24 critical factors for PPP model success. These results were sorted according to the number of studies from the most to the least per CSF. Table 2.3 illustrates the number of articles in the literature on CSFs of PPPs.

Table 2.3: Number of Theoretical CSFs of PPP

CSFs	Literatures	Quantity
Regulated legal system	(Babatunde et al., 2019); (Che & Li, 2008); (Chen et al., 2009); (Heeju & Hyungtai, 2022); (Ke et al., 2008); (Ke et al., 2024); (Jefferies & McGeorge, 2009); (Li et al., 2019); (Mahmoud, 2024); (Olusola et al., 2020); (Osei-Kyei & Chan, 2019); (Qi et al., 2018); (Salaj et al., 2018); (Song & Wen, 2017); (Wang, 2023); (Yuan et al., 2012); (Xu, 2015)	18
Feasible implementation program	(Andreas, 2024); (Babatunde et al., 2019) (Chen et al., 2009); (Cheung et al., 2012); (Jefferies & McGeorge, 2009); (Ke et al., 2008); (Ke et al., 2024); (Kahwajian et al., 2014); (Li et al., 2019); (Li, 2022); (Liyanapathirana et al., 2024); (Osei-Kyei & Chan, 2019); (Shah et al., 2024); (Wang et al. 2021)	14

Table 2.3 continued

CSFs	Literatures	Quantity
Reasonable risk sharing	(Andreas, 2024) (Babatunde et al., 2019); (Che & Li, 2008); (Chen et al., 2009); (Cheung et al., 2012); (Chourasia et al., 2023); (Heeju & Hyungtai, 2022); (Jefferies & McGeorge, 2009); (Li , 2022); (Mahmoud, 2024); (Osei-Kyei et al., 2022); (Salaj et al., 2018); (Zhang & Ye, 2017)	13
Transparent procurement process	(Almeile et al., 2024); (Andreas, 2024); (Chen et al., 2009); (Cheung et al., 2012); (Qi et al., 2018); (Li et al., 2019); (Liu et al., 2020)); (Mahmoud, 2024); (Olusola et al., 2020); (Xu et al., 2010); (Yuan et al., 2012); (Zhang et al., 2010)	12
Strong public support	(Babatunde et al., 2019); (Jefferies & McGeorge, 2009); (Liu & Wilkinson, 2015); (Mahmoud, 2024); (Osei-Kyei & Chan, 2015); (Gurgun & Touran, 2014) ; (Salaj et al., 2018); (Heeju & Hyungtai, 2022); (Xu, 2015); (Osei-Kyei & Chan, 2019); (Liu et al., 2018) ; (Yi & Xue, 2023)	12
Stable macro-economy	(Babatunde et al., 2019); (Chen et al., 2009); (Cheung et al., 2012); (Ke et al., 2024); (Jefferies & McGeorge, 2009); (Liu & Wilkinson, 2015); (Mahmoud, 2024); (Salaj et al. , 2018); (Olusola et al., 2020); (Okoro et al., 2023); (Yuan et al., 2012)	11
Long-term market demand	(Chen, et al., 2009); (Cheung et al., 2012); (Jefferies & McGeorge, 2009); (Yuan et al., 2012); (Salaj et al., 2018); (Qi et al., 2018); (Osei-Kyei et al., 2017); (Mahmoud, 2024); (Osei-Kyei et al., 2021); (Mahmoud, 2024); (Osei-Kyei et al., 2022) ; (Zhang & Ye, 2017)	10
Sound financial market	(Babatunde et al., 2019); (Chen et al., 2009); (Xu , 2015); (Qi et al., 2018); (Hou et al., 2019); (Olusola et al., 2020); (Ke et al., 2024) ;(Mahmoud, 2024); (Zhang et al., 2010); (Zhang, & Ye, 2017)	10
Strong policy support	(Babatunde et al., 2019); (Li, 2017); (Jefferies & McGeorge, 2009); (Xu et al., 2010); (Yuan et al., 2012); (Xu, 2015); (Diao et al., 2016); (Osei-Kyei et al., 2022) ; (Yi & Xue, 2023)	9
Effective cost assessment	(Babatunde et al., 2019); (Brewer et al., 2013); (Chen, et al., 2009); (Jefferies & McGeorge, 2009); (Ke et al., 2024); (Salaj et al., 2018); (Ning & Zhao, 2018); (Mahmoud, 2024); (Xu, 2015)	9
Multilateral country support	(Lee et al., 2020); (Luo et al., 2017), (Sachs et al., 2007); (Schepper et al., 2015), (Shen, 2016), (Yang & Wang, 2018), (Osei-Kyei et al., 2022); (Zhao, 2020)	8
Favorable investment environment	(Olusola et al., 2020); (Wang et al., 2021); (Liu et al., 2020); (Mahmoud, 2024); (Ke et al., 2024); (Yuan et al., 2012); (Zhang & Ye, 2017)	7

Table 2.3 continued

CSFs	Literatures	Quantity
Clean government	(Mona. et al., 2006); (Liu & Wilkinson, 2015); (Li et al., 2019); (Heeju & Hyungtai, 2022); (Olusola et al., 2020); (Xu, 2015); (Yuan et al., 2012)	7
Good government credit	(Cheung et al., 2012); (Liu & Wilkinson, 2015); (Liu et al., 2023); (Salaj et al., 2018); (Olusola et al., 2020); (Wang et al., 2021); (Zheng , 2017)	7
Reasonable capital structure	(Almarri, 2023); (Du et al., 2018); (Li, 2017); (Ma et al., 2020); (Heeju & Hyungtai, 2022); (Xu, 2015); (Zhang & Ye, 2017)	7
Reasonable pricing mechanism	(Babatunde et al., 2019); (Cheung et al., 2012); (Li, 2022); (Jefferies & McGeorge, 2009); (Yuan et al., 2012); (Xu, 2015); (Yi & Xue, 2023)	7
Standardized contract text	(Adamou et al., 2021); (Babatunde et al., 2019); (Cheung et al., 2012); (Ke et al., 2008); (Liu & Wilkinson, 2015); (Xu, 2015); (Li, 2022)	7
Clear benefit objectives	(Chen et al., 2009); (Cheung et al., 2012); (Liu & Wilkinson, 2015); (Osei-Kyei et al., 2022); (Salaj et al., 2018); (Xu, 2015)	6
Scale of investment	(Almarri & Boussabaine, 2023); (Andreas, 2024); (Liu et al., 2018); (Mohamed, 2015); (Olusola et al., 2020); (Schepper et al., 2015)	6
Types of investment	(Chou et al., 2015); (Hao et al., 2018); (Mohamed, 2015); (Opawole & Jagboro, 2017); (Rahman et al., 2019) (Schepper et al., 2015)	6
Excellent management capability	(Li, 2022); (Liu & Wilkinson, 2015); (Nguyen et al., 2018) ; (Osei-Kyei et al., 2022); (Wang et al., 2021)	5
Advanced technology level	(Ameyaw & Chan, 2016); (Li, 2022); (Lips et al., 2023) (Liu & Wilkinson, 2015); (Sun et al., 2016); (Zhang & Ye, 2017)	5
Investment sector	(Opawole & Jagboro, 2017); (Ameyaw & Chan, 2016); (Rahman et al., 2019); (Osei-Kyei et al., 2022); (Schepper et al., 2015)	5
Social Capital Participation	(Opawole & Jagboro, 2017); (Aundhe & Narasimhan, 2016); (Chou et al., 2015); (Feng et al., 2024); (Mei & Sun, 2017); (Schepper et al., 2015)	5
Project Operation Experience	(Luo et al., 2017); (Martimort et al., 2015); (Ke et al., 2024) (Sun et al., 2012)	4

2.4.1.2 Identify CSFs for PPP Projects Based on the Full Lifecycle Level

The full lifecycle of PPP projects comprises four stages: (1) selection and evaluation, (2) government/partner search, (3) construction and (4) operation and transfer stage. Therefore, this study comprehensively identified the critical success factors (CSFs) that impact PPP projects from a whole project full lifecycle perspective. A total of 19 influencing factors were identified from the existing literature. The comprehensive list of full lifecycle influencing factors is shown below. Table 2.4 displays the literature on the CSFs of PPPs across the entire project full lifecycle.

Table 2.4: Literature on CSFs of PPP across the Full Lifecycle

Project Stages	CSFs	Literatures
Selection Assessment Phase	Macro political, economic and legal environment	(Almeile et al., 2024); (Liao, 2015); (Liang, 2015); (Mei, 2020); (Mona. et al., 2006); (Wang et al., 2021); (Zhang et al., 2012); (Miao, 2016); (Okoro et al., 2023); (Tang, 2016)
	Sufficiently accessible financial markets	(Liu, 2018); (Deng et al., 2021); (Wang et al., 2021); (Jian & Zhang, 2023); (Zhang et al., 2010)
	Composition and strength of promoters	(Mona. et al., 2006); (Jian & Zhang, 2023); (Hu & Wang, 2015); (Sheng et al., 2011)
	Project feasibility	(Wang et al., 2023); (Miao, 2016); (Zhang et al., 2010)
Government Partner Search Phase	Transparent procurement process	(Almeile et al., 2024); (Chileshe et al., 2022) ; (Sun et al., 2024); (Opawole et al., 2019) ; (Zhang et al., 2010)
	Innovative financing options	(Hu & Wang, 2015); (Huwaina et al., 2022) ; (Yuan et al., 2011) ; (Sheng et al., 2011) ; (Okoro et al., 2023)
	Incentive mechanisms	(Liang & Wang, 2019); (Sun & Du, 2009); (Zhang et al., 2010); (Zhu, 2013)
	Clarity of the concession agreement	(Duan & Sun, 2020); (Opawole et al., 2019); (Sun et al., 2024); (Xu, 2015)

Table 2.4 continued

Project Stages	CSFs	Literatures
	Degree of involvement of the government in providing guarantees	(Feng & Song, 2016); (Engel et al., 2019); (Sun et al., 2024); (Xu, 2015)
	Reasonable risk-sharing mechanism	(Feng & Dai, 2019); (Heeju & Hyungtai, 2022) (Huo, 2011); (Liang, 2015); (Miao, 2016); (Mona et al., 2006); (Xu, 2015)
Build & Construction Phase	Efficient project team	(Liang, 2015); (Sheng et al., 2011); (Sun et al., 2024); (Xu, 2015)
	Convenience of government approval process	(Lu & Ma, 2008); (Liang, 2015); (Opawole et al., 2019); (Sun et al., 2024)
	Project schedule and cost control	(Deng et al., 2021); (Feng & Dai, 2019); (Sun & Du, 2009)
	Communication and coordination	(Lu & JMa, 2008); (Nguyen et al., 2022); (Sun et al., 2024)
Operation and Transfer Phase	Government credit	(Hu & Wang, 2015); (Mona. et al., 2006); (Zhang et al., 2012)
	Operation and maintenance and technology transfer	(Rahman et al., 2019); (Sun et al., 2024); (Xu, 2015)
	Operation of enterprises	(Jian & Zhang, 2023); (Lu & Ma, 2008); (Xu, 2015)
	Social support in the public interest	(Chen et al., 2015); (Liu, & Zhang, 2015); (Sun, et al., 2024); (Zhang et al., 2010)

2.4.1.3 Identifying CSFs for PPP Projects Based on Risk Dimensions

The most common method of classifying risk type is based on dividing risks into three levels: Politics, economics, finance, business. Bing et al. (2005), Wang et al. (2007) and Ke (2010) adopted this risk classification method in their studies on PPP project elements. Table 2.5 presents the CSFs of PPPs from a risk perspective.

Table 2.5: CSFs of PPP from the Risk Perspective

Country risk	CSFs	Literatures.
Political Risk	Government Stability	(Liu & Wilkinson, 2015); (Liu & Lu, 2016), (Salaj et al., 2018); (Wang, et al., 2021); (Zheng, 2017);
	Socio-Economic Conditions	(Cheung et al., 2012); (Sun et al., 2016); (Olusola et al., 2020); (Xu, 2015)
	Investment Profile	(Cheung et al., 2012); (Ke et al., 2008); (Olusola et al., 2020); (Li, 2022); (Xu, 2015);
	Internal Conflicts	(Liyanapathirana et al., 2024) ; (Sun et al., 2012); (Wamuziri & Jiang, 2008); (Yock, 2020)
	External Conflict	(Kentaro & Kiyotaka, 2021); (Mahdi et al., 2019); (Mousa et al., 2023); (Tariq et al., 2019)
	Corruption	(Heeju & Hyungtai, 2022); (Mona. et al., 2006); (Nguyen & Garvin, 2022); (Yuan et al., 2012); (Xu, 2015)
	Military in Politics	(Hou et al., 2024); (Soroka et al., 2023)
	Religious Tensions	(Biygautane et al., 2020); (Hu et al., 2019); (Liu, 2022); (Ni & Sun, 2022);
	Law and order	(Heeju & Hyungtai, 2022); (Olusola et al., 2020); (Liu, 2022); (Song & Wen, 2017); (Xu, 2015);
	Ethnic Tensions	(Biygautane et al., 2020); (Nevena et al., 2023); (Srivastava, 2017)
	Democratic accountability	(Heeju & Hyungtai, 2022); (Liu et al., 2019); (Liu & Wilkinson, 2015); (Olusola et al., 2020); (Xu, 2015)
	Bureaucratic Quality	(Nguyen & Garvin, 2022); (Sun et al., 2024); (Zhang et al., 2010); (Zhang & Ye, 2017);
Economic Risk	GDP per capita	(Chen et al., 2009); (Diao et al., 2016); (Qi et al., 2018); (Olusola et al., 2020); (Sun et al., 2024); (Xu, 2015)
	GDP Growth	(Chen et al., 2009); (Olusola et al., 2020); (Qi et al., 2018); ((Diao et al., 2016); (Sun et al., 2024) (Xu, 2015)
	Inflation	(Omid et al., 2022); (Sharma, 2023)
	Budget Balance	(Li, 2022); (Salaj et al., 2018); (Olusola et al., 2020); (Xu, 2015); (Zhang, 2023)

Table 2.5 continued

Country risk	CSFs	Literatures.
Financial Risk	Current account as % of GDP	(Cheung et al., 2012); (Mahmoud, 2024); (Yuan et al., 2012); (Salaj et al., 2018); (Zhang & Ye, 2017);
	External Debt	(Owolabi et al., 2020); (Omid et al., 2022); (Zhang et al., 2019)
	Current account as % of exports of goods and services (XGS)	(Cheung et al., 2012); (Mahmoud, 2024); (Yuan et al., 2012); (Zhang & Ye, 2017); (Salaj et al., 2018);
	International liquidity	(Chen et al., 2009); (Hou et al., 2019); (Xu, 2015); (Zhang & Ye, 2017); (Zhang et al., 2010);
	Exchange rate	(Ameyaw & Chan, 2015); (Li & Wang, 2023); (Tariq et al., 2019);
	Debt service	(Moore & Vining, 2023); (Nguyen et al., 2018); (Nevena et al., 2023) (Srivastava, 2017);
Business Risk	Poor choice of PPP model	(Kukah et al., 2024) (Osei-Kyei et al., 2022); (Wang, 2021); (Yu et al., 2018)
	Cost overrun risk	(Debela, 2022); (Huwaina et al., 2022)
	Organizational structure risk	(Aladağ & Işık, 2020); (Biygautane et al., 2020); (Mazher et al., 2022); (Olusola et al., 2020)
	Completion Risk	(Chan et al., 2014); (Owolabi et al., 2020); (Liu et al., 2024)
	Operation Management Risk	(Kim, 2023); (Yi & Xue, 2023)

2.4.2 List of CSFs for PPP Projects

This thesis collected the CSFs for PPP project implementation based on the above theoretical, entire full lifecycle and risk perspectives. During the implementation of PPP projects, several challenges arise, with political, economic, financial, legal, technical and social factors being essential considerations for decision-makers.

Based on the research objectives and study significance, this thesis investigates the external environment of Chinese enterprises to understand the investment environment. It

identifies the key success paths for PPP projects. Combining the research on Chinese enterprise investments, internal factors such as management and negotiation capabilities are considered success elements. However, for Chinese enterprises investing in PPP projects along the BRI, it is crucial to examine the external environments of the BRI countries. Only those that align with the investment goals and environment of Chinese enterprises can proceed with cooperation while continuously monitoring external environmental risks during the operation process. Thus, by mitigating various risks, CSFs can be identified to improve project success rates.

Therefore, this thesis classified CSFs based on the above three perspectives and the actual conditions of Chinese enterprises investing in PPP projects along the BRI. The CSFs established by the three perspectives can be grouped into four major categories: project profile factors, political factors, economic factors and financial factors. The list is detailed in Table 2.6.

Table 2.6: Success Factors of PPP Projects

Category	CSFs	Literatures.
Political Factors	Stable government	(Liu & Wilkinson, 2015); (Liu & Lu, 2016), (Salaj et al., 2018); (Wang et al., 2021) (Zheng, 2017);
	Good socio-economic conditions	(Cheung et al., 2012); (Olusola et al., 2020); (Sun et al., 2016); (Xu, 2015);
	Good investment profile	(Cheung et al., 2012); (Ke et al., 2008); (Li ,2022); (Olusola et al., 2020); (Xu, 2015);
	Less internal conflict	(Liyanapathirana et al., 2024) ,(Sun et al., 2012), (Wamuziri & Jiang, 2008); (Yock, 2020)
	Less external conflict	(Kentaro & Kiyotaka, 2021); (Mahdi et al., 2019); (Mousa et al., 2023) (Tariq et al., 2019)
	Less corruption	(Heeju & Hyungtai, 2022); (Nguyen & Garvin, 2022); (Mona. et al., 2006); (Yuan et al., 2012); (Xu, 2015)

Table 2.6 continued

Category	CSFs	Literatures.
	Less military in politics	(Hou et al., 2024); (Soroka et al., 2023)
	No religious tension	(Biygautane et al., 2020; Hu et al., 2019); (Liu, 2022); (Ni & Sun, 2022);
	Normative law and order	(Heeju & Hyungtai, 2022); (Li, 2017); (Olusola et al., 2020); (Song & Wen, 2017); (Xu, 2015)
	Ethnicity is not tense	(Biygautane et al., 2020); (Srivastava, 2017); (Nevena et al., 2023)
	Normative democratic accountability	(Heeju & Hyungtai, 2022); (Liu et al., 2018); (Olusola et al., 2020); (Liu & Wilkinson, 2015); (Xu, 2015);
	Less bureaucratic quality	(Nguyen & Garvin, 2022); (Sun et al., 2024); (Zhang et al., 2010); (Zhang & Ye, 2017)
Economic Factors	Higher GDP per capita	(Chen et al., 2009); (Diao et al., 2016); (Qi et al., 2018); (Olusola et al., 2020); (Sun et al., 2024); (Xu, 2015);
	Higher GDP growth	(Chen et al., 2009); (Olusola et al., 2020); (Qi et al., 2018); (Sun et al., 2016); (Sun et al., 2024); (Xu, 2015);
	Less inflation	(Li et al., 2023); (Omid et al., 2022); (Sharma, 2023);
	Reasonable budget balance	(Li, 2022); (Salaj et al., 2018); (Olusola et al., 2020); (Xu, 2015); (Zhang, 2023)
	Reasonable current account as a percent of GDP	(Cheung et al., 2012); (Mahmoud, 2024); (Salaj et al., 2018); (Yuan et al., 2012); (Zhang & Ye, 2017);
Financial Factors	Reasonable external debt	(Owolabi et al., 2020); (Omid et al., 2022); (Zhang et al., 2019);
	Reasonable current account as a percent of XGS	(Cheung et al., 2012); (Mahmoud, 2024); (Salaj et al., 2018); (Yuan et al., 2012); (Zhang & Ye, 2017)
	Reasonable international liquidity	(Chen et al., 2009); (Hou, et al., 2019); (Xu, 2015); (Zhang & Ye, 2017); (Zhang et al., 2010)
	Reasonable exchange rate	(Ameyaw & Chan, 2015); (Li & Wang, 2023); (Tariq et al., 2019);
	Reasonable debt service	(Moore & Vining, 2023); (Nguyen et al., 2018); (Nevena et al., 2023); (Srivastava, 2017)
Project profile factors	Reasonable size of investment	(Kukah et al., 2024); (Osei-Kyei et al., 2022); (Yu, 2018); (Wang, 2021)
	Suitable type of investment	(Debela, 2022); (Huwaina et al., 2022)

Table 2.6 continued

Category	CSFs	Literatures.
	Suitable Investment sector	(Aladağ & Işık, 2020); (Biygautane et al., 2020); (Mazher et al., 2022) (Olusola et al., 2020)
	Higher participation of social capital	(Chan et al., 2014); (Owolabi et al., 2020); (Liu et al., 2024)
	Rich project operation experience	(Kim, 2023); (Yi & Xue, 2023)

2.4.3 CSFs for Chinese Companies Investing in PPP Projects

Chinese enterprises investing in PPP projects in BRI countries focus on CSFs to improve project success rates. Based on the list compiled above, CSF factors for PPP projects include political, economic, financial and project profile factors. Domestic and international research on the success of PPP projects and the influencing factors of private sector participation primarily revolve around project profile, political and economic factors. International scholars tend to emphasise the impact of project profile factors on the success of PPP projects. In contrast, domestic scholars often analyse the influence of external political and economic factors on the success or failure of PPP projects and the involvement of the private sector. Zhang (2021) found that success factors related to political, economic and financial factors can be assessed using country risk research. Country risk is measured based on the data from the International Country Risk Guide (ICRG) database. Therefore, this thesis focused on political risk, economic risk, financial risk and project profile factors as key success factors for PPP projects in BRI countries.

2.4.3.1 PPP Project Profile Factors

Schepper et al. (2015) indicate that project profile factors influencing the success of PPP projects include investment type, the number of private investors and the investment amount. Through an empirical study of PPP project data from 1990 to 2003, Mona et al.

(2006) concluded that the success or failure of PPP projects depends on the nature of the project, the market, the investment amount and the project type. Oyedele (2013) suggests that the key to PPP project success is establishing effective cooperative relationships with social capital and all parties involved. Additionally, the probability of success varies with different investment sectors. Through a survey of PPP projects in Asia and China, Sachs et al. (2007) found that PPP project success is not only constrained by the type of investment but also critically influenced by the support of multilateral countries. Yuan et al. (2015) demonstrated that a key indicator of PPP project success is reducing residual value risk (RVR), which is the risk related to investment amount and type. Examining data from 46 countries along the BRI from 2002 to 2016, Hou et al. (2019) found that the more social capital involvement and the greater the support from multilateral countries, the lower the project success rate. Huo et al. (2018) examined 552 projects in African countries from 2002 to 2016 and concluded that project success is influenced by multilateral country support, investment scale and social capital participation. Through a study of 3,466 PPP project data from 1996 to 2015, Liu et al. (2019) found that participation in social capital is a crucial factor in project success. Using the entropy method, Xue (2021) showed that investment type, investment amount and multilateral country support significantly impact the success of PPP projects.

Therefore, project profile factors for PPP project success are influenced by investment scale, investment type, investment sector, social capital participation and multilateral country support.

2.4.3.2 Political Risk Factors

Country risk is an essential factor affecting the success of PPP projects (Biygautane et al. 2019; Fleta-Asín & Muñoz, 2020). Country risk impacts economic trade and the construction and development of a nation's PPP projects (Huang et al, 2016). The International Country Risk Guide (ICRG) was established by the US International Reports Group in 1980 and conducts risk assessments across 140 countries. ICRG categorises country risk into political risk, financial risk and economic risk, thus establishing three primary risk assessment indicators and 22 secondary risk assessment indicators (PRS, 2015). Regarding political risk, Biygautane et al. (2019) suggest that government political commitment is key to the success of PPP projects. Mohamed (2015) indicate that national laws and regulations can promote project development. Percoco (2014) suggests that a low-corruption environment and a good political climate are critical factors for project success.

Zhang and Man (2018) divided study samples into low-income, developing and middle-high-income countries, supplementing studies focusing on high-income countries. Their empirical results indicate that political risk in BRI countries affects their GDP, thereby hindering Chinese enterprise investments (Zhang & Man, 2018). (Ameyaw & Chan, 2016) combined political and economic risks to examine their relationship. The results indicate that lower political risk correlates with better economic development and that more developed economies tend to have lower political risk (Ameyaw & Chan, 2016). As such, country risk factors positively attract Chinese enterprises to invest in PPP projects. However, Zhang and Xie (2020) found that political risk deters foreign direct investment.

2.4.3.3 Economic Risk Factors

The macroeconomic stability of BRI countries plays a crucial role in the investment of Chinese enterprises in PPP projects. He and Xu (2018) conducted an empirical study on factors such as economic freedom and strategic assets of BRI countries, leading to several conclusions. Specifically, Chinese foreign investment is economically oriented: the larger the market size and the higher the degree of economic openness, the greater the amount of foreign direct investment. (Babatunde et al., 2019) selected panel data from 18 African countries and found that a country's economic growth rate and trade freedom can promote foreign direct investment. Aundhe & Narasimhan (2016) concluded from their empirical research that economic growth rates can promote foreign investment in PPP projects, while actual interest rates and export dependency can hinder foreign direct investment. Wu (2021) suggests that market economic factors significantly affect Chinese enterprises investing in PPP projects: the more open the market and the larger the market size, the more attractive it is for investment. Wang et al. (2018) empirically analysed panel data from 112 BRI countries, finding a positive relationship between the economic level of BRI countries and Chinese foreign direct investment. Using the computable general equilibrium (CGE) model for empirical analysis in the context of BRI, Chen and Yang (2015) concluded that the GDP growth rate positively influences Chinese regional investment in PPP projects. Through research on PPP projects in the transportation sector, Galilea and Medda (2010) found that the economic environment affects project success. If an economic environment has issues, it inevitably leads to fiscal risk, further impacting the development of PPP projects (Lusinyan et al., 2009).

2.4.3.4 Financial Risk Factors

(Biygautane et al., 2020) conducted an empirical study on 97 countries to find a negative relationship between financial risk and foreign direct investment in PPP projects. Xue (2021) examined the relationship between financial development in BRI countries and foreign direct investment in PPP projects. The findings indicate that the higher the level of financial development in BRI countries, the larger the scale of Chinese enterprises investing in PPP projects (Yan, 2021). In contrast, lower financial development restricts China's foreign direct investment. Liyanapathirana et al. (2024) focused on North African and Middle Eastern countries to examine the relationship between economic growth rate, trade freedom, and direct investment. They found that high economic growth and trade freedom positively influenced Chinese enterprises to invest in PPP projects (Liyanapathirana et al., 2024). Wang (2018) found that China's foreign direct investment is characterised by market-driven attraction, and the better the financial environment in BRI countries, the more it attracts Chinese enterprises to invest in PPP projects. Taking the heterogeneity of motivation, Tan and Zhao (2019) examined the relationship between financial development level and structure in BRI countries and Chinese direct investment in PPP projects. They concluded that the scale of financial development in BRI countries significantly promotes investment in PPP projects (Tan & Zhao, 2019). Wang (2021) examined the relationship between financial scale and efficiency and found a positive impact on the scale of indirect financing and investment in PPP projects. Yang (2021) suggests that the better the financial development structure in BRI countries, the larger the scale of Chinese enterprises investing in PPP projects. After examining 28 PPP projects in China, Nguyen et al. (2018) concluded that a sound financial system is key to project success. Luo et al. (2017) analysed data from

46 BRI countries' PPP projects and found that financial and political quality risks significantly correlate with project success.

2.5 Research Gap

This study aims to promote the development of infrastructure construction and economic growth in BRI countries. It investigates the impact of project profile factors on PPP project success. Additionally, it examines the influence of GDP growth rate, national openness, and private sector support on the success of PPP projects. The study also explores how political, economic and financial risks impact project success and how these risks moderate the relationship between project profile factors and project success. This research addresses three main gaps in the relevant literature: theoretical, methodological and empirical gaps.

First, this study addresses the theoretical gap. Regarding the theoretical framework, existing literature primarily focuses on PPP project models and risk management, with relatively few systematic studies on success factors, especially regarding BRI countries. Most regional studies are isolated and focus on single factors such as risk rather than comprehensively analysing how various factors contribute to PPP project success, including project profile and risk factors. Although several countries worldwide have examined PPP projects, research specifically on BRI countries is limited, particularly regarding success factors. Furthermore, interdisciplinary research is lacking. Typically used for infrastructure development, PPP projects are complex and multifaceted, involving economics, management, politics and law. Current literature predominantly focuses on single disciplines while lacking interdisciplinary analysis to comprehensively explain the multidimensional factors contributing to PPP project success.

Second, this study addresses methodological gaps. Regarding data sources, several existing studies rely on interviews and project reports. Despite being primary data, these sources may lack accuracy and completeness due to the subjectivity of interviews and the partiality of project reports. Moreover, these sources often lack long-term data, preventing a reflection of PPP projects' long-term performance. As such, this study examined 30 years of PPP project data from the World Bank and 30 years of country risk data from the PRS Group. This provides a long-term perspective to explore the intrinsic mechanisms of PPP project success. Regarding the representativeness of sample selection, existing literature primarily focuses on specific industries, such as transportation, limiting the generalizability of findings. In contrast, the study analyses and empirically tests data from five industries. Regarding research methods, many studies adopt regression analysis while overlooking the moderation effect of factors such as country risk on the relationship between project profile factors and project success. Therefore, this study used project profile factors as the independent variables, country risk as a moderating variable and macro factors as control variables to comprehensively examine their impact on PPP project success. By dynamically and comprehensively analysing 30 years of country risk, macroeconomic and PPP project data, this study reveals the specific reasons and intrinsic mechanisms behind PPP project success.

Finally, this study addresses an empirical gap in the relevant literature. Regarding government applications, most literature has focused on theoretical research with limited practical application, such as providing policy and regulatory recommendations. The present study used empirical results to analyse key factors for PPP project success while offering practical recommendations for the Chinese government, effectively bridging the gap between theory and practice. While much of the literature focuses on risk management for enterprise applications, other factors also influence the success of PPP projects in practice.

This study comprehensively analyses project profile, macroeconomic, political, economic and financial risks, providing insights for Chinese enterprises to improve PPP project success rates. Stakeholder coordination is challenging in BRI countries. It involves governments, private sectors and financial institutions. This study provides recommendations for stakeholders based on the research findings to enhance project success rates.

2.6 Chapter Summary

This chapter illustrates the supporting theories of this research. It provides a detailed introduction to the conceptual background of the Belt and Road Initiative, infrastructure and PPP projects. It further outlines the theoretical background of the factors influencing the success of PPP projects. These discussions establish the groundwork for identifying literature gaps and formulating the study hypotheses.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Overview

Examining the factors influencing the success of Chinese enterprises investing in PPP infrastructure projects in BRI countries is a rigorous, data-intensive task. Therefore, it requires reasonable research methods to support this study. Through the literature review, the factors influencing the success of PPP infrastructure projects are mainly investigated in the following ways. The first step was determining the research framework and hypotheses development based on the content and concepts outlined in Chapter 2. The second step involved identifying the samples and data sources for this study. The third step is to establish the research model and determine the measurement variables based on the model. Finally, the collected data will be analysed and econometrically estimated to verify the hypotheses.

3.2 Conceptual Framework

The study examines the direct relationship between project profile factors and the success probability of PPP projects while exploring the moderating effect of country risk as a third variable. Previous studies confirmed the impact of project profile factors on project success, while country risk is an unavoidable consideration. Therefore, this study added the moderating variable of country risk to observe whether it has a specific impact on the relationship between project profile factors and project success.

The conceptual framework for this research study is based on three theories: public goods theory, institutional theory and risk management theory. The conceptual framework presented in Figure 3.1 illustrates the relationship between the independent variables of PPP

project profile factors and the dependent variable of project success, as well as the moderating role of country risk.

The research framework also includes the macro environmental factors of PPP projects and control variables. There are three control variables: GDP, the degree of national openness and the degree of private capital openness. The reason for selecting these three control variables is to avoid bias and ensure that they do not affect the expected results of this study.

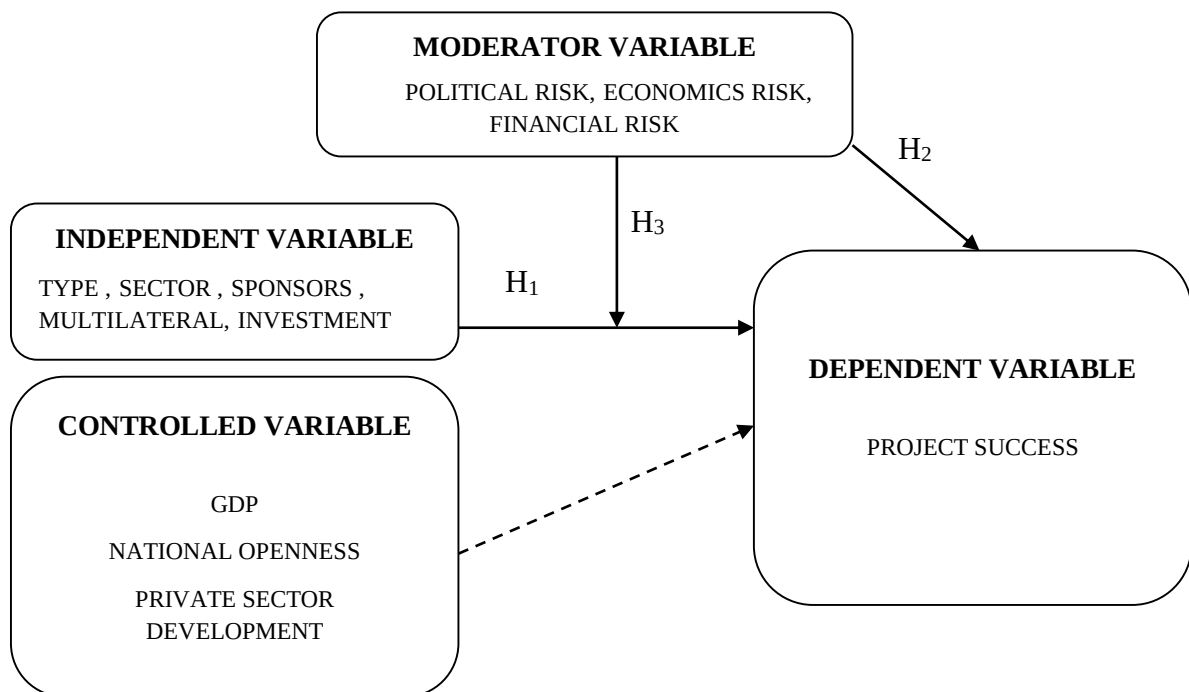


Figure 3.1: Conceptual Framework

3.3 Hypotheses Development

3.3.1 Relationship between PPP Project profile and Project Success

The success of PPP projects is affected by several factors, particularly in the context of PPP projects in BRI countries. Key influencing factors include investment scale,

investment type, investment sector, social capital participation and multilateral country support.

Schepper et al. (2015) studied the transaction costs of PPP projects and found that the larger the investment amount, the higher the investment costs, and the greater the risk of project failure. The higher the investment amount in a PPP project, the greater the capital input, the higher the financial leverage, and the lower the resilience to financial risks. Even a slight risk fluctuation may lead to project failure. When social capital enters PPP project investments, the greater the risk they are willing to bear and the higher their investment amount. However, excessive risk-taking through social capital is not conducive to a project's ultimate success (Debela, 2022). Based on correlation model between estimated project cost and Net Present Value (NPV), Islami and Hazhiyah (2020) further concluded that the investment cost in project construction significantly decreases Log-odds of PPP project success; the larger the investment amount, the greater the project's risk. Therefore, the investment amount in project construction decreases Log-odds of the success rate of PPP projects.

PPP project investment types include management and lease contracts, brownfield projects, greenfield projects and asset divestiture projects. Zhao (2020) indicates that social capital adopts management and lease contract project types, which exhibit the lowest investment risk and highest success rate while asset divestiture projects carry the highest risk. Huo et al. (2018) conducted a comparative analysis using PPP project data from African countries. They concluded that different investment types have varying impacts on project success rates, with asset divestiture projects generally carrying the highest risk. Tan and Tan (2019) examined PPP project types from an international comparative perspective and found

significant heterogeneity regarding the impact of different project types within BRI countries. Therefore, project type impacts PPP project success, and risks increase from management and lease contracts to brownfield projects, greenfield projects and asset divestiture projects, respectively.

The World Bank's classification of PPP project sectors includes energy, water supply and sewage treatment, information and communication technology (ICT), municipal solid waste management (MSW) and transportation (World Bank, 2024). At the industry level, Williamson (1988) suggest that the asset intensity of an industry varies across sectors, with varying degrees of volatility and differing capital structures. Thus, a sector is stable for low-tech industries with low failure risk; for high-tech industries, the failure risk is high (Engel et al., 2019). Regarding technological content, municipal solid waste management exhibits the lowest technological content and highest PPP project success rate. In contrast, information and communication technology exhibits the highest technological content and lowest PPP project success rates (Wang, 2021).

Social private capital participation is another factor influencing PPP project success. Menezes and Ryan (2015) stated that information asymmetry is a challenge facing the private sector while increasing risk and the likelihood of PPP project failure. Martimort et al. (2015) also found that one of the purposes of government–private sector cooperation is risk transfer. However, the private sector often chooses high return and highly privatised projects, increasing PPP project risks and the likelihood of failure. Through surveys and empirical analysis, Gurgun & Touran (2014) found that the more risk the private sector assumes in PPP projects, the higher the probability of project failure. In the context of the BRI, Yuan (2018) found that the risks borne by the private sector are positive impact on

investment amount. The private sector is willing to take on more risk, leading to larger investments and higher risks, thereby increasing the likelihood of failure. Asadornborikarn (2021) also found that the risks borne by the private sector significantly decreases Log-odds of the success rate of PPP projects.

PPP infrastructure projects in BRI countries cannot be concluded by a single department. They require the collaboration of multiple departments and countries (Zhang et al., 2010). Countries provide technical and financial support, with institutions such as the World Bank and the Asian Development Bank playing crucial roles in infrastructure development. Estache (2006) suggests that multilateral country support is crucial for the success of PPP projects. Galilea and Medda (2010) indicate that support from multilateral financial institutions aids the success of PPP projects. Through a study of PPP projects in BRI countries from 2011 to 2015, Shen (2016) empirically found a significant positive impact on multilateral financial institution support and PPP project success. Empirical research also indicates that multilateral financial institutions significantly influence the success of PPP projects (Heeju & Hyungtai, 2022; Yang & Wang, 2018; Ye, 2017). Based on the above critical review, the following hypotheses are proposed:

H₁: Project profile factors significantly explain the success of PPP projects.

H_{1a}: Investment scale significantly decreases log-odds of PPP project success.

H_{1b}: Investment type significantly explains the success of PPP projects.

H_{1c}: The investment sector significantly explains the success of PPP projects.

H_{1d}: Private sector participation significantly increases log-odds of PPP project success.

H_{1f}: Multilateral country support significantly increases log-odds of PPP project success.

3.3.2 Relationship between Country risk and Project Success

According to the International Country Risk Guide (ICRG) by the US International Reports Group, country risk is divided into political, economic and financial risks (PRS, 2023). Political risk includes 12 indicators: government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability and bureaucratic quality (PRS, 2023). Further, government stability includes government cohesion, legislative strength and public support. Socioeconomic conditions comprise unemployment, consumer confidence and poverty. Investment profile denotes contract viability, repatriation, and payment delays. Internal conflict encompasses civil war, civil disorder and terrorism. External conflict is represented by war, cross-border conflict, and foreign pressure (PRS, 2015). In terms of economic risk, per capita GDP risk, GDP growth risk, inflation risk, budget balance risk, and current account risk as a percentage of GDP are all factors (PRS, 2015). Financial risk involves foreign debt risk, current account risk as a percentage of XGS, international liquidity risk, exchange rate stability risk and debt repayment risk (PRS, 2015).

Regarding political risk, Galilea and Medda (2010) examined the data from 72 countries to find that corruption and democratic accountability play a crucial role in PPP project success. Kraay and Mastruzzi (2010) indicate that PPP project success is influenced by government factors from an institutional environment perspective. Kahwajian et al. (2014) note that a sound political environment promotes the success of PPP projects. Huo et al. (2018) examined PPP projects in African countries and found that the rule of law, corruption

control and government efficiency significantly influence the PPP project success rates. Based on data from 2,485 projects in BRI countries, Luo et al. (2017) empirically found that government risk significantly decreases the log-odds of the success of PPP projects. Danish (2018) found that terrorism in Afghanistan and neighbouring conflicts severely affects the development of PPP projects. Based on sample data from five BRI countries, Liu (2019) empirically found that internal disorder and public democracy levels significantly decreases log-odds of the success of PPP projects. Based on the World Bank database, Asadornborikarn (2021) found that government stability and departmental efficiency significantly influence PPP project success rates.

Regarding economic risk, Shen (2016) illustrated that countries with high economic risk have fewer financial institutions willing to provide financing, which easily affects the development of PPP projects. Heeju & Hyungtai (2022) examined large PPP infrastructure projects and found that if economic risk is high, even large national enterprises will have a lower probability of PPP project success. Kentaro & Kiyotaka (2021) applied an economic risk model and found that economic risk significantly decreases log-odds of the success of PPP projects. Using data from projects in 17 BRI countries, Wang (2018) empirically found that economic risk significantly decreases log-odds of PPP project success. Further research indicates that economic risk decreases log-odds of the success of PPP projects in BRI countries (Hu et al., 2019; Huwaina et al., 2022; Jiang, 2019; Liyanapathirana et al., 2024; Yang, 2021).

Regarding financial risk, Jefferies and McGeorge (2009) found that political risk is the most significant influencing factor, followed by financial risk regarding the key factors for PPP project success. Through the study of concession PPP projects in Nigeria, Opawole

and Jagboro (2017) found that exchange rate stability is a significant factor for project success. Yang (2018) examined PPP projects on the Beijing-Tianjin-Hebei expressway and found that financial risk decreases log-odds of project success. However, Wang (2018) suggests that financial risk does not significantly impact the success of PPP projects. Through generalised set pair analysis (GSPA), Mei (2020) found that financial risk is an essential factor affecting the success of PPP projects. Based on the above, most scholars indicate that financial risk significantly decreases log-odds of the success of PPP projects. Therefore, based on the above critical review, the following hypotheses are proposed:

H₂: Country risk significantly decreases log-odds of PPP project success.

H_{2a}: Political risk significantly decreases log-odds of PPP projects success.

H_{2b}: Economic risk significantly decreases log-odds of PPP project success.

H_{2c}: Financial risk significantly decreases log-odds of PPP project success.

3.3.3 The Moderating Effect of Country risk on Project Profile Factor and the Success of the Project

As previously discussed, country risk decreases log-odds of the success of PPP projects. However, there is much debate among scholars regarding the extent of this impact and how it influences the relationship between a project profile and its success.

(Demirag et al. (2012) studied the implementation process of PPP projects in Asian countries and argued that the collaboration between the government and the private sector is a form of risk-sharing. As a result, the government can alleviate financial pressure through the PPP model but must also bear the risk of project failure. Thus, the mutual constraints between the government and the private sector, along with the risk-sharing mechanism, become key to project success. The private sector must also determine a balance of

constraints, including investment type, the funding distribution ratio and return mechanisms (Hodge, 2004). Therefore, the assessment of country risk is critical. The private sector is reluctant to assume excessive risk, mainly from political risk. However, the private sector is more willing to cooperate with the government and choose projects with higher investment risks per the government's intentions if a country's political risk is low, the government has good credit, and international relations are favourable.

Sun et al. (2012) empirically analysed the success of PPP projects using structural equation modelling (SEM). They found that the technology, investment scale and investment model of PPP projects directly impact actual projects (Sun et al., 2012). In contrast, the political environment of a project has a weaker impact (Sun et al., 2012). Shi and Sun (2017) investigated PPP projects in BRI countries. They found that political, legal, economic and financial environments are significantly positive impact on the number and amount of PPP project investments. In contrast, high political, economic and financial risks in a country are bound to affect PPP project development.

Wipalak (2021) argued that if a country has low country risk, the private sector is willing to take on higher risks and invest in large-scale projects. Huang et al. (2016) suggest that when country risk is low, more private sector participation in PPP project construction is attracted to favourable national policies and high government efficiency, leading to more infrastructure construction and investment sectors.

Feng et al. (2017) examined failed PPP projects and found that the key to the success of PPP projects is having a sound policy and financial system. On this basis, the private sector will have more options to invest in PPP projects and be willing to choose higher-risk projects. Lips et al. (2023) examined PPP project data from 45 BRI countries from 1996 to

2015. They found that a stable political situation and good international relations attract more support from multinational financial institutions, thereby promoting the success of PPP projects (Lips et al., 2023).

PPP project cooperation is essentially a collaboration between the government and the private sector, reducing their respective risks and increasing the project's success rate. Therefore, government credit is the cornerstone of the success of a PPP project. If a project fails and the private sector withdraws, the government will have to take over, resulting in a financial burden. The private sector must also consider government credit, legal policies, and other factors constraining project development, leading to cautious investment and reluctance to participate heavily in PPP project investments (Jia, 2015). Based on the above critical review, the following hypotheses are proposed:

H3: High country risk weakens the relationship between project profile factors and success.

H3a: High political risk weakens the impact of project profile factors on project success.

H3b: High economic risk weakens the impact of project profile factors on project success.

H3c: High financial risk weakens the impact of project profile factors on project success.

3.4 Data and Sampling

The study subjects are PPP infrastructure projects in BRI countries. Among the 71 countries along the Belt and Road, only 31 countries have PPP infrastructure projects. Therefore, the sample was selected from PPP infrastructure projects in these 31 BRI countries. Data was obtained from the World Bank's PPI database. The database includes four project statuses: active, concluded, cancelled and distressed. Previous studies (Asadornborikarn, 2021; Huo et al., 2018; Luo et al., 2017; Oyedele, 2013) have excluded

project data with an active status when studying the success of PPP projects. Since this study explores the success and failure of PPP projects, the outcomes of active projects cannot be predicted. Since these projects may be concluded, cancelled or distressed, there is a possibility of failure as long as they are active. To ensure the accuracy of the empirical data, this study excluded project data with an active status while examining data with concluded, cancelled and distressed statuses. At the same time, to ensure a comparison between a country's successful and failed PPP projects, projects that include both successes and failures are selected. Projects that consist solely of successes or failures are not included as research subjects in this study.

Due to the prolonged cooperation period of PPP projects, primarily around 30 years, few projects have been concluded. Therefore, the study period was set to 30 years, from 1993 to 2023. The PPI database elicited 138 concluded, cancelled and distressed projects in the 31 BRI countries from 1993 to 2023. These 138 samples comprise the study sample and include information on investment type, investment amount, investment sector, multilateral country support and private sector participation. Table 3.1 presents the study sample data for the BRI countries with PPP projects.

Table 3.1: Sample Data of PPP Projects in BRI Countries

Country	Active	Cancelled	Concluded	Distressed	Total quantity	Total Investment (Billion USD)
Brazil	1763	20	18	1	1802	459.19
India	1165	35	9	1	1210	289.56
Indonesia	130	12	5	1	148	79.05
Mozambique	20	1		1	22	4.04
Philippines	175	5	15	4	199	66.11
Sri Lanka	82		1	1	84	3.88
Thailand	170	1	2	1	174	42.80
Turkiye	258		3	1	262	156.34

Source: World Bank (2024)

This study examined the key factors for the success of PPP infrastructure projects in BRI countries. Since project success is determined based on actual occurrences, real data is required to validate the hypotheses (Asadornborikarn, 2021). Therefore, this study adopted a quantitative method using secondary data. The data primarily comes from the World Bank's Private Participation in Infrastructure (PPI) database, the International Country Risk Guide (ICRG) by the US International Reports Group and the World Bank's World Development Indicators (WDI) database.

The sample data for the number of successful and failed PPP projects, investment types, investment amounts, investment sectors, multilateral country support and private sector participants were derived from the World Bank's PPI database. The samples for political, economic and financial risks in country risk come from the International Country Risk Guide (ICRG). The samples for GDP, national openness and private sector development in the macro environment of PPP projects were derived from the World Bank's WDI database. Table 3.2 illustrates the selection of variables and specific data sources.

Table 3.2: Source of Variable Data

Variable properties	Variable name	Indicator abbreviation	Data sources
Interpreted variable	PPP project status	Status	
Explanatory variable	Investment type	Type	World Bank PPI database
	Investment amount	Investment	
	Investment sector	Sector	
	Multilateral country support	Multilateral	
	Private Sector Support	Sponsors	
Moderator variables (Country risk)	Political risks	Politics	PRS Country Risk Report (ICRG)
	Economic risks	Economy	
	Financial risks	Finance	
Controlled variable	GDP Growth Rate	GDPg	World Bank World Development Indicators Database (WDI)
	National openness	Open	
	Private sector development	Credit	

Source: literature compilation

3.5 Model Estimation

This study examined country risk and factors influencing the success of PPP infrastructure projects in 31 BRI countries. Based on World Bank PPI project data from 1993 to 2023, 138 samples were statistically selected. The empirical analysis investigated the factors contributing to the success of PPP infrastructure projects and analysed their impact. The study quantified the specific influencing factors on PPP project success through data analysis. It also assessed the extent to which country risk obstructs PPP project implementation and the impact of the macro environment on project success. This basis

provides operational recommendations for Chinese enterprises investing in BRI PPP infrastructure projects to reduce risk and improve success rates.

This study constructed empirical models to test the hypotheses outlined in Chapter 2. First, a model was built to test the intrinsic relationship between the success and failure of PPP projects and factors such as investment type, investment amount, investment sector, multilateral country support and private sector participation to verify H1. Second, a model was constructed to verify H2 by examining the intrinsic relationship between the success and failure of PPP projects and country risk, including political, economic and financial risks. Finally, a model was built with country risk as the moderating variable, which weakened the intrinsic relationship between project profile factors and project success, thereby verifying H3. The following functional model was established through correlation analysis, multicollinearity diagnosis and the Hausman test:

$$\text{PPP Project} = f(\text{investment type, investment amount, investment sector, multilateral country support, private sector participation, political risk, economic risk, financial risk, GDP, national openness, private sector development}).$$

The focus of this estimation model is to examine the impact of investment amount, multilateral country support, and private sector participation on the success of PPP projects across different investment types and investment sectors. Additionally, it analyzes the influence of political risk, economic risk, and financial risk on the success of PPP projects.

3.6 Variable Measurement

3.6.1 Project Success

Based on the literature review, studies on project success have generally focused on project success and failure (Huo et al., 2018; Liu, 2019). This study considers the success and failure of PPP projects as the dependent variable. While the World Bank's PPI database indicates project statuses (active, concluded, cancelled and distressed), the success of active projects cannot be determined. Thus, they were not included in the research sample. Cancelled and distressed were considered failures and assigned a value of 0. Concluded projects were considered a success and assigned a value of 1 (Asadornborikarn, 2021; He et al., 2021; Zhao, 2020; Liu, 2019). The variable is denoted as *Status*.

3.6.2 Independent Variable

3.6.2.1 Investment Type

For PPP projects, project profile factors were taken as an explanatory variable, including the investment type, which refers to the project risk structure. Investment type also refers to the mode of cooperation between the public and private sectors (Yang, 2021). The World Bank's PPI database categorises investment types into asset divestiture projects, greenfield projects, brownfield projects and management and lease contract projects (World Bank, 2024). As reviewed in the previous literature, the risk borne by the private sector decreases sequentially from asset divestiture, greenfield and brownfield projects to management and lease contract projects (Liu et al., 2020). In this study, the four investment types—asset divestiture projects, greenfield projects, brownfield projects, and management and lease contract projects—are represented by 1, 2, 3, and 4, respectively. (Alireza et al.,

2018; Zhang & Man, 2018). *Type* was set as a dummy variable in the logistic regression analysis. The variable is denoted as *Type*.

3.6.2.2 Investment Sector

According to the World Bank's PPI database classification, infrastructure construction projects comprise five sectors. In order of technological content, they are energy, ICT, transportation, water supply and treatment, and municipal solid waste management (World Bank, 2024). Based on the technical nature of each sector, high-tech industries have larger investment scales, higher error rates and lower success rates (Wang, 2021). Therefore, from the highest to lowest technological content, the sectors are energy, ICT, transportation, water supply and treatment, and municipal solid waste management. Continuing from previous research, the five investment sectors are represented by 1, 2, 3, 4, and 5, respectively (Williamson, 1988). *Sector* was set as a dummy variable in the logistic regression analysis. The variable is denoted as *Sector*.

3.6.2.5 Private Sector Participation

The private sector is also referred to as private capital or social capital participants and plays a significant role in PPP projects. If multiple private sector entities participate in a PPP project, leading to more financial and technical support, the project's success rate will likely increase (Liu et al., 2018). Therefore, PPP projects with multiple private sector participants are represented by 1, while those with only one private sector participant are represented by 0 (Asadornborikarn, 2021; Martimort et al., 2015; Menezes & Ryan, 2015). *Sponsors* was set as a dummy variable in the logistic regression analysis. The variable is denoted as *Sponsors*.

3.6.2.4 Multilateral Country Support

Support from multilateral countries primarily manifests as financial and technical support. As mentioned in previous literature, receiving support from multilateral countries promotes the development of PPP projects and increases their success rates (Xue, 2021). PPP projects that have received multilateral country support are represented by 1, while those that received bilateral country support are represented by 0 (Estache, 2006; Galilea & Medda, 2010; Shen, 2016). *Multilateral* was set as a dummy variable in the logistic regression analysis. The variable is denoted as *Multilateral*.

3.6.2.5 Investment Amount

Investment amount is also known as total project investment, which refers to the total costs required for a PPP project to be entirely constructed and put into operation. This includes fixed asset investment, working capital investment and interest on loans during the construction period (Wu, 2021). Total investment is an important indicator reflecting the scale and value of project investment and is a crucial basis for economic evaluation and investment decision-making. It encompasses all costs required for the construction and operation of a project, including equipment purchase, installation, commissioning, working capital and taxes (Liu et al., 2020). The investment amount of a project differs from the investment amount of the public or private sector, although the total amount is the same. The project investment amount includes all construction and operational costs, while public or private sector investment refers to the total funds injected into the project. As noted, PPP infrastructure projects typically require significant investments. The larger the investment amount, the longer the investment cycle, the higher the risk and the lower the possibility of success (Asadornborikarn, 2021; Liu, 2022; Wang, 2021). Due to the large numerical values of the investment amounts, they were expressed in millions of dollars and converted using

the base-10 logarithm (Schepper et al., 2015; Yuan, 2018). The variable is denoted as *Investment*.

3.6.3 Country Risk

3.6.3.1 Political Risk

Political risk includes 12 secondary indicators: government stability, socioeconomic conditions, investment profile, internal conflict, and external conflict were valued between 0 and 12 based on risk level. Corruption, military political influence, religious political influence, law and order, ethnic tensions and democratic accountability were valued between 0 and 6 based on risk level. Bureaucratic quality was valued between 0 and 4 based on risk level (PRS, 2023). According to the indicators set by the International Country Risk Guide by the US International Reports Group, the total score for the 12 indicators is 100 points. The higher the score, the lower the corresponding risk; the lower the score, the higher the risk (Asadornborikarn, 2021; Galilea & Medda, 2010; Kraay & Mastruzzi, 2010; PRS, 2015). Table 3.3 illustrates the values assigned to each political risk indicator. The cooperation period for PPP projects between the public and private sectors is generally 30 years, with political risk varying each year, which may affect the empirical analysis. However, Chinese enterprises investing in host country PPP projects cannot predict future political risks and can only account for current and past political conditions without averaging future political conditions. Therefore, to reflect the actual investment status more accurately, political risk was valued based on the political risk for the year of PPP project investment (Hu et al., 2019; Jiang, 2019; Liyanapathirana et al., 2024; Moore & Vining, 2023; Yu et al., 2018; Zhang & Xie, 2020). The variable is denoted as *Politics*.

Table 3.3: Values Assigned to *Politics* Indicators

POLITICAL RISKS	Values Assigned		Note
	Minimum score	Maximum score	
Government stability	0	12	The higher the score, the lower the risk (PRS, 2023)
Socio-economic situation	0	12	
Investment overview	0	12	
Internal contradiction	0	12	
External contradiction	0	12	
Corruption	0	6	
Political influence of the army	0	6	
Political influence of religion	0	6	
Law and order	0	6	
Tension degree of arsenic group relationship	0	6	
Democratic accountability	0	6	
Administrative efficiency	0	4	
Total	0	100	

3.6.3.2 Economic Risk

Economic risk includes six secondary indicators. Per capita GDP was valued between 0 and 4 based on risk level. Real GDP growth rate, annual inflation rate and fiscal revenue as a percentage of GDP were valued between 0 and 10 based on risk level. The value range for the current account balance as a percentage of GDP was 0 to 15. The total score for these five indicators is 50 points. A total score means the country exhibited no economic risk, while a lower score indicates greater economic risk (PRS, 2015; Shen, 2016; Yang, 2021). Table 3.4 illustrates the values assigned to each economic risk indicator.

The cooperation period for PPP projects between the public and private sectors is generally 30 years, with economic risk varying each year, which may affect the empirical

analysis. However, Chinese enterprises investing in host country PPP projects cannot predict future economic risks and can only account for current and past economic conditions without averaging future economic risks. Therefore, to reflect actual investment status more accurately, economic risk was valued based on the economic risk for the year of PPP project investment (Hu et al., 2019; Jiang, 2019; Liyanapathirana et al., 2024; Mousa et al., 2023; Yu et al., 2018; Zhang & Xie, 2020). The variable is denoted as *Economics*.

Table 3.4: Values Assigned to *Economy* Indicators

ECONOMIC RISKS	Values Assigned		Note
	Minimum score	Maximum score	
GDP per capita	0	5	The higher the score, the lower the risk (PRS, 2023)
Real GDP growth rate	0	10	
Annual inflation rate	0	10	
Proportion of fiscal revenue in GDP	0	10	
Proportion of current account in GDP	0	15	
Total	0	50	

3.6.3.3 Financial Risk

Financial risk includes five indicators. The ratio of international capital flows was valued between 0 and 5 based on risk level. The percentage of external debt service to exports of goods and services, the percentage of external debt to GDP, and exchange rate stability were valued between 0 and 10 based on risk level. The percentage of the current account balance to exports of goods and services was valued between 0 and 15 based on risk level. The total score for these five indicators is 50 points. A total score means that the country exhibited no financial risk, while a lower score indicates greater financial risk (Opawole et al., 2017; PRS, 2015; Nguyen & Garvin, 2022).

The cooperation period for PPP projects between the public and private sectors is generally 30 years, with financial risk varying each year, which may affect the empirical analysis. However, Chinese enterprises investing in host country PPP projects cannot predict future financial risks and can only account for current and past financial conditions without averaging future financial risks. Therefore, to reflect the actual investment status more accurately, financial risk was valued based on the financial risk for the year of PPP project investment (Hu et al., 2019; Jiang, 2019; Liyanapathirana et al., 2024; Nevena et al., 2023; Yu et al., 2018; Zhang & Xie, 2020). Table 3.5 presents the values assigned to each financial risk indicator. The variable is denoted as *Finance*.

Table 3.5: Values Assigned to *Economy* Indicators

ECONOMIC RISKS	Values Assigned		Note
	Minimum score	Maximum score	
International Capital Flow Ratio	0	5	The higher the score, the lower the risk (PRS, 2023)
Percentage of External Debt Service to Exports of Goods and Services	0	10	
Ratio of External Debt to GDP	0	10	
Exchange Rate Stability	0	10	
Percentage of Current Account to Exports of Goods and Services	0	15	
Total	0	50	

3.6.4 Control Variable

This study set three control variables based on the research objectives: GDP growth, the degree of the country's openness and the degree of openness to private capital. GDP best represents the economic factors of PPP project CSFs (Yurdakul et al., 2022). A country can vigorously develop infrastructure with GDP growth. Increased GDP and national fiscal revenue can lead to more funds for PPP projects (Xue, 2021). The degree of national

openness best represents the political factors of PPP project CSFs (Chileshe et al., 2022). National openness implies relaxed national policies, strong attractiveness, the active attraction of foreign enterprises and the promotion of domestic development. National openness also indicates strong government leadership and high efficiency, which can improve the success rate of PPP projects (Zhang & Xie, 2020). The degree of private capital openness best represents the financial factors of PPP project CSFs (Han et al., 2020). Higher private sector openness indicates greater financial support from the government to the private sector (Wang, 2021). Thus, the government provides more financial support to the private sector, ensuring a greater amount of funds are available for PPP projects, thereby improving PPP project success rates. Therefore, these study's control variables were set as GDP growth, national openness and the openness of private capital.

3.6.4.1 GDP Growth Rate

Sharma (2012) empirically analysed PPP project data from 1990 to 2008 and found that market size and high income significantly impact PPP project. Examining water infrastructure projects, Liu and Lu (2016) concluded that the success of PPP projects is affected by the local government's economic level and fiscal expenditure, which is influenced by GDP. Hyun et al. (2018) suggest that GDP significantly affects the investment of PPP projects. Using comprehensive panel data from 137 low-income and developing countries, Yurdakul et al. (2022) found that GDP significantly impacts the PPP projects. The higher the GDP, the smaller the proportion of project investment to GDP, the greater the financing capacity of PPP projects and the government's ability to support them, and the stronger the resilience to financial risks. Therefore, PPP projects are more likely to succeed. Xue (2021) indicates that for Chinese enterprises to "go global", attention must be paid to the host country's investment environment. A host country's GDP significantly increase the

log-odds of PPP project success. For instance, Cui (2020) selected 58 BRI countries as samples from 2010 to 2019 and found that the business environment of BRI countries positively affects GDP growth. GDP growth subsequently positively affects PPP project success. Based on the above, a country's GDP and GDP growth rate significantly increase the log-odds of the success of PPP projects.

The annual GDP growth rate reflects a country's macroeconomic condition. GDP growth signifies that a country's economy is capable of sustaining development. As the economy continues to grow, the public demand for infrastructure increases, and the country develops the economic strength to invest in infrastructure construction. With national economic development, the private sector has a positive outlook on a country's profit prospects, leading to increased investment willingness. Using the actual growth rate for valuation, the variable is represented by *GDP* (World Bank, 2024). The variable is denoted as *GDPg*. When Chinese enterprises invest in PPP projects in host countries, they cannot predict future GDP; they can only calculate the current and past GDP and cannot average the future GDP. Therefore, to reflect the actual investment situation more accurately, GDP was valued based on the GDP for the year when the PPP project investment was made (Cui, 2020; Liu et al., 2019; Qi & Zhang, 2017; Yurdakul et al., 2022).

3.6.4.2 Degree of Country Openness

Examining the spillover effects of PPP project data from BRI countries between 1990 and 2017, Cai (2019) concluded that the degree of national openness significantly affects project success. Shi and Sun (2017) conducted a quantitative analysis and found that the degree of national openness and population growth rate in the macro environment is positive impact on project number. Zhao (2020) examined 31 concluded, 43 cancelled and 787

ongoing PPP projects from 1990 to 2017 while indicating that national openness significantly increases log-odds of PPP project success. Wang (2021) examined PPP projects from 39 BRI countries and found that financial openness significantly increases log-odds of the success of PPP projects and the proportion of private sector ownership. Taking Chinese enterprises and third-party financial institutions, Sheng (2019) analysed PPP project risks at macro, meso and micro levels. The findings indicate that the degree of national openness increase the log-odds of the success of PPP projects (Sheng, 2019). Based on the above, national openness significantly increase the log-odds of PPP project success.

The degree of a country's openness refers to the level of financial investment by international financial institutions in that country. If international financial institutions invest heavily in a country, it indicates a high degree of openness. A high degree of openness means a country is willing to accept foreign investment and attract foreign capital. The private sector is also more willing to invest in countries with a high degree of openness (Zhao, 2020). The variable is denoted as *Open*. To reflect the actual state of investment more accurately, *Open* was measured based on the indicators of the year in which the PPP project was invested (Wang, 2021; Wu, 2021; Xue, 2021). The calculation formula is as follows:

$$Open = FDI_t / GDP \quad \text{Equation 3.1}$$

where Foreign Direct Investment (*FDI*) represents the international direct investment finance of BRI countries, and *GDP* represents the nominal GDP of the year the PPP project was initiated (World Bank, 2024).

3.6.4.3 Development Degree of the Private Sector

Yang and He (2021) examined empirical data from the Asian Development Bank. They found that the degree of national and private sector openness is significantly positive impact on the number of PPP project investments. Chourasia et al. (2023) suggest that a country's degree of financial openness is significantly positive impact on the participation of private capital, and both significantly increases log-odds of the success of PPP projects. Xue (2021) indicates that the openness of the host country's private sector can significantly support PPP projects. Soroka et al. (2023) established a dynamic game model under incomplete contract conditions to find that government openness to the private sector significantly increase the log-odds of PPP project success. Using a questionnaire tool to collect data from participants living in the UAE and the UK, Almarri (2019) found that private sector openness is an essential factor in attracting foreign enterprises to invest in PPP projects and is also a success factor. Osei-Kyei and Chan (2017) explored the success factors in the operational phase of PPP projects from stakeholders' perspectives. They found that a country's openness to private consortia is a key success factor for PPP projects. As such, government openness to the private sector significantly increase the log-odds of PPP project success.

The level of private sector development reflects the private sector's ability to obtain funding. If the private sector can obtain funding, it is willing to invest in high-risk PPP projects (Ou & Jia, 2017). The level of private sector development is represented by *Credit*. To reflect the actual state of investment more accurately, *Credit* was measured based on the indicators of the year in which the PPP project was invested (Asadornborikarn, 2021; Guo, 2017; Ou & Jia, 2017; Wu, 2021). The calculation formula is as follows:

$$Credit = \text{Domestic credit to the private sector} / GDP \quad \text{Equation 3.2}$$

3.7 Data Analysis and Econometric Estimation

3.7.1 Descriptive Analysis

Descriptive statistical analysis was the first step in this study's data analysis and allowed for preliminary sample data analysis. Arif (2022), Han and Li (2021), Nicholas and Neema (2022) and Rasoolpur (2015) indicate that descriptive statistics involve classification data using tables, tabulating or charting to summarise data characteristics. For instance, frequency analysis, trend analysis and data distribution. Descriptive analysis enables the basic understanding of the PPP project overview. It helps to determine the frequency, maximum value, minimum value, mean, and standard deviation of various factors of PPP projects in BRI countries from 1993 to 2023.

3.7.2 Correlation Analysis

Correlation analysis examines the relationships between variables in a model. Chen (2022) suggests that correlation analysis measures the strength and degree of association between variables, typically assessing linear relationships. Linear correlation values between two variables range from -1 to 1, where -1 indicates a perfect negative correlation, and 1 indicates a perfect positive correlation. According to the correlation coefficient analysis, a value of 0.8–1.0 indicates a very strong correlation; 0.6–0.8 indicates a strong correlation; 0.4–0.6 indicates a moderate correlation; 0.2–0.4 indicates a weak correlation; and 0.0–0.2 indicates a very weak or no correlation (Oyedele, 2013).

This study studied the success factors of PPP projects in BRI countries. Based on previous research, Kendall's Tau correlation analysis is employed to examine the relationships among *Investment*, *GDPg*, *Open*, *Credit*, *Politics*, *Economy*, and *Finance* in

order to understand the strength of associations between the variables. (Liyanapathirana et al., 2024; Sachs et al., 2007).

3.7.3 Diagnostic Checks

3.7.3.1 Normality Test and Mann-Whitney U test

Numerical variables typically follow a normal distribution. The concept of normal distribution was first introduced by the French mathematician Abraham de Moivre in 1733 (Anderson, 1958). A normal distribution refers to a probability distribution where the frequency of variables is highest in the middle and gradually decreases symmetrically towards both ends, forming a bell-shaped curve (Yan et al., 2016). Normal distribution is one of the most essential statistical theoretical distributions, crucial for describing individual variation. Logistic regression analysis requires variables to follow a normal distribution (Hu, 2009). However, only numerical variables must be tested for normality. Being inherently discrete, categorical variables do not conform to a normal distribution (Yan et al., 2016).

Thus, methods for testing normality include the Chi-square goodness of fit test, Shapiro–Wilk test, Kolmogorov–Smirnov test and skewness–kurtosis coefficients (Yan et al., 2016). Shapiro-Wilk works by comparing the order statistics of the data with the expected values from a normal distribution. The probability (p-value) of the test statistic is estimated through simulation or lookup tables. If the p-value is less than the specified significance level (e.g., 0.05), the data is considered not to follow a normal distribution (Li,2024). Kolmogorov-Smirnov (K-S) works by comparing the maximum difference between the cumulative distribution function of the sample and the assumed theoretical distribution function. Based on the significance level (e.g., 0.05) and sample size, the critical

value is obtained from the K-S distribution table. If $P < 0.05$, the null hypothesis is rejected, indicating that the data does not follow a normal distribution (Wang, 2024)..

In binary logistic regression, if the data does not follow a normal distribution, the Mann-Whitney U test can be performed. If the Mann-Whitney U test is passed, logistic regression analysis can proceed. The Mann-Whitney U test was proposed by H.B. Mann and D.R. Whitney in 1947. It assumes that the two samples come from two populations that are identical except for their means, aiming to test whether there is a significant difference between these means (Ken, 2009). The Mann-Whitney U test merges two independent samples, ranks them in ascending order, and calculates the sum of ranks for each group. By computing the U statistic, it determines whether the ranks between the two groups are significantly different. If $p < 0.05$, the null hypothesis (H_0) is rejected, indicating a significant difference in the distribution of the two groups. In this case, the data is valid, and logistic regression can be performed (Li, 2024; Wang, 2006).

This study studies the success factors of PPP projects in BRI countries. Therefore, this study examines whether the PPP project data follows a normal distribution using the Shapiro-Wilk test, Kolmogorov-Smirnov test, and the 3σ rule. For data that does not conform to a normal distribution, the Mann-Whitney U test is conducted.

3.7.3.2 Multicollinearity Checks

Multicollinearity refers to a high degree of correlation or approximate impact on explanatory variables in the constructed model (Dong, 2020). When making model predictions, the prerequisite is that the explanatory variables are not correlated, where there is no multicollinearity (Ji, et al., 2024). To check for multicollinearity, the variance inflation factor (VIF) and tolerance can be used as indicators (Roberto et al., 2023). VIF is used to

verify whether there is multicollinearity between variables. The larger the VIF, the more severe the multicollinearity. When $0 < \text{VIF} < 10$, or tolerance is less than 0.1, there is no multicollinearity between variables; when $10 < \text{VIF} < 100$, there is strong multicollinearity; when $\text{VIF} > 100$, there is severe multicollinearity (Ozgur & Franklin, 2021). As such, this study further analysed the multicollinearity of PPP project data to determine whether there is multicollinearity among the variables.

3.7.4 Regression Analysis

The regression analysis of this study adopted the logistic model, which is a nonlinear regression model. Definition $X = (x_1, x_2, x_3 \dots x_k)$ is a set of factors that affect the success of PPP infrastructure projects, where $x_1, x_2, x_3 \dots x_k$ respectively represent independent influencing factors referred to as independent variables. This study used Y to indicate whether the PPP infrastructure project had achieved successful results. As mentioned above, ended/concluded were considered successful and assigned a value of 1. Cancelled and distressed projects failed and were assigned a value of 0. The result is defined as a dependent variable of two categories, namely:

$$Y = \begin{cases} 1 & \text{Project success} \\ 0 & \text{Project failed} \end{cases} \quad \text{Equation 3.3}$$

P is defined as the probability of success of PPP infrastructure projects, namely:

$$P = P\{Y = 1 \mid X = (x_1, x_2, \dots, x_k)\} \quad \text{Equation 3.4}$$

According to the traditional linear model, the P value greater than 1 or less than 0 may appear, failing to give a reasonable explanation and losing practical significance. Therefore, if P is logically transformed, the logit (P) value range can be any value. Namely:

$$\text{logit}(P) = \ln \frac{P}{1-P} = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k + \varepsilon \quad \text{Equation 3.5}$$

where x_k is the various factors affecting the success of PPP infrastructure projects and β_k is the regression coefficients corresponding to each independent variable. ε is the disturbance term. When the constant term $\beta_0 < 0$, then $\ln \frac{P}{1-P} < 0$, i.e. $p < 1-p$. This indicates that the probability of predicting success is less than that of predicting failure. This further suggests that assuming no influence from any success factors, the probability of predicting failure is higher than the probability of predicting success, indicating a high failure rate for the project.

Substituting the various factors of the PPP project into the equation, we get:

$$\begin{aligned} \text{logit}(P) = \ln \frac{P}{1-P} = & \beta_0 + \beta_1 \text{Type}_1 + \beta_2 \text{Type}_2 + \beta_3 \text{Type}_3 + \beta_4 \text{Sector}_1 + \beta_5 \text{Sector}_2 + \\ & \beta_6 \text{Sector}_3 + \beta_7 \text{Sector}_4 + \beta_8 \text{Sponsors} + \beta_9 \text{Multilateral} + \beta_{10} \text{Investment} + \varepsilon \end{aligned} \quad \text{Equation 3.6}$$

Where, in the *Type* variables, β_1 , β_2 , and β_3 are the differences in log-odds for the dummy variables “greenfield projects”, “brownfield projects”, and “management and lease” contract projects, respectively, with respect to the reference group divestiture projects. In the *Sector* variables, β_4 , β_5 , β_6 , and β_7 are the differences in log-odds for the dummy variables “ICT”, “transportation”, “water supply and treatment”, and “municipal solid waste management”, respectively, with respect to the reference group energy. The coefficient β_8 , for *Sponsor* is the difference in log-odds with sponsorship versus without sponsorship. The coefficient β_9 , for *Multilateral* is the difference in log-odds with versus without multilateral support. The coefficient β_{10} , for *Investment* is the change in log-odds per unit increase in investment.

Control variables were added to the regression equation, including GDP growth (*GDPg*), the degree of country openness and the level of private sector development, resulting in

$$\begin{aligned} \text{logit}(P) = \ln \frac{P}{1-P} = & \beta_0 + \beta_1 \text{Type}_1 + \beta_2 \text{Type}_2 + \beta_3 \text{Type}_3 + \beta_4 \text{Sector}_1 + \beta_5 \text{Sector}_2 + \\ & \beta_6 \text{Sector}_3 + \beta_7 \text{Sector}_4 + \beta_8 \text{Sponsors} + \beta_9 \text{Multilateral} + \beta_{10} \text{Investment} + \varepsilon + \\ & \beta_{11} \text{GDPg} + \beta_{12} \text{Open} + \beta_{13} \text{Credit} + \varepsilon \end{aligned} \quad \text{Equation 3.7}$$

Where, the dummy variable coefficients for the categorical variables are consistent as explained in Equation 3.6.

In the country risk assessment of PPP projects, *Politics*, *Economy* and *Finance* are incorporated into the regression model, results in:

$$\begin{aligned} \text{logit}(P) = \ln \frac{P}{1-P} = & \beta_0 + \beta_1 \text{Politics} + \beta_2 \text{Economy} + \beta_3 \text{Finance} + \beta_4 \text{GDPg} + \\ & \beta_5 \text{Open} + \beta_6 \text{Credit} + \varepsilon \end{aligned} \quad \text{Equation 3.8}$$

3.7.5 Moderating Effects Analysis

If the relationship between the independent variable (*X*) and the dependent variable (*Y*) is influenced by another variable (*M*), then the variable is defined as a moderating variable. This influence is called the moderating effect, the interaction effect or conditional effect (Zhong et al., 2005). The regression model for the moderating effect is

$$Y = \beta_0 + \beta_1 X + \beta_2 M + \beta_3 XM + \varepsilon \quad \text{Equation 3.9}$$

where *X* and *M* are referred to as the main effects, while *XM* is the interaction effect. The moderating effect can be categorised into four situations:

Situation 1: The main effect is positively correlated. The independent variable coefficient (β_1) is significantly positive, and the interaction term coefficient (β_3) is significantly positive. This indicates that moderating variable M significantly enhances the relationship between X and Y (Zhong et al., 2005). In other words, M significantly promotes the influencing relationship between X and Y , having a positive moderating effect (Abbey et al., 2019).

Situation 2: The main effect is positively correlated. The independent variable coefficient (β_1) is significantly positive, and the interaction term coefficient (β_3) is significantly negative. This indicates that moderating variable M significantly weakens the relationship between X and Y (Zhong et al., 2005). In other words, M significantly inhibits the influence relationship between X and Y , having a negative moderating effect.

Situation 3: The main effect is negatively correlated. The independent variable coefficient (β_1) is significantly negative, and the interaction term coefficient (β_3) is significantly positive. This indicates that moderating variable M significantly weakens the relationship between X and Y (Zhong et al., 2005). In other words, M plays a significant inhibiting role in the influencing relationship between X and Y , having a negative moderating effect (Wang et al., 2023).

Situation 4: The main effect is negatively correlated. The independent variable coefficient (β_1) is significantly negative, and the interaction term coefficient (β_3) is significantly negative. This indicates that moderating variable M significantly enhances the relationship between X and Y (Zhong et al., 2005). In other words, M significantly promotes the influence relationship between X and Y , having a positive moderating effect (Cai et al., 2019).

This study examines the extent to which country risk influences the moderation of key project factors and project success. The core explanatory variable (*CEV*) and the moderating variables, namely *Politics*, *Economy*, and *Finance*, are analysed in this context.

For the moderating effect of *Politics*, *Economy* and *Finance* the moderating effect model is

$$\begin{aligned}
\text{logit}(P) = & \ln \frac{P}{1-P} \\
= & \beta_0 + \sum_{i=1}^3 \beta_i \text{Type}_i + \sum_{j=1}^4 \gamma_j \text{Sector}_j + \delta \text{Sponsors}_1 + \eta \text{Multilateral}_1 \\
& + \theta \text{Investment} + \phi_1 \text{Politics} + \phi_2 \text{Economy} + \phi_3 \text{Finance} \\
& + \sum_{i=1}^3 \alpha_{i1} (\text{Type}_i \times \text{Politics}) + \sum_{i=1}^3 \alpha_{i2} (\text{Type}_i \times \text{Economy}) \\
& + \sum_{i=1}^3 \alpha_{i3} (\text{Type}_i \times \text{Finance}) + \sum_{j=1}^4 \beta_{j1} (\text{Sector}_j \times \text{Politics}) \\
& + \sum_{j=1}^4 \beta_{j2} (\text{Sector}_j \times \text{Economy}) + \sum_{j=1}^4 \beta_{j3} (\text{Sector}_j \times \text{Finance}) \\
& + \gamma_1 (\text{Sponsors}_1 \times \text{Politics}) + \gamma_2 (\text{Sponsors}_1 \times \text{Economy}) \\
& + \gamma_3 (\text{Sponsors}_1 \times \text{Finance}) + \delta_1 (\text{Multilateral}_1 \times \text{Politics}) \\
& + \delta_2 (\text{Multilateral}_1 \times \text{Economy}) + \delta_3 (\text{Multilateral}_1 \times \text{Finance}) \\
& + \varphi_1 (\text{Investment} \times \text{Politics}) + \varphi_2 (\text{Investment} \times \text{Economy}) \\
& + \varphi_3 (\text{Investment} \times \text{Finance}) + \varepsilon
\end{aligned}$$

Equation 3.10

Where, the coefficients α_{i1} , α_{i2} , α_{i3} , β_{j1} , β_{j2} , β_{j3} , γ_1 , γ_2 , γ_3 , δ_1 , δ_2 , δ_3 , φ_1 , φ_2 and φ_3 is the interaction term's moderating effects of the moderating variables *Politics*,

Economy, and *Finance* on the relationship between *Type*, *Sector*, *Sponsors*, *Multilateral*, and *Investment* and the success of the PPP project, respectively.

3.7.6 Robustness Test

In robustness testing, hypothesis testing is typically used to assess whether the model's results remain consistent under different conditions (Osei-Kyei et al., 2019). This involves formulating a null hypothesis (H_0) and an alternative hypothesis (H_1) using statistical methods to test these hypotheses. This study conducted robustness tests using alternative variables. Different variables were used to replace the original variables for regression analysis. The parameter estimates of the new model were compared with those of the original model (Amovic et al., 2020). Effect size, sample size and significance are interrelated in hypothesis testing. The null hypothesis H_0 and alternative hypothesis H_1 are defined as follows:

$$H_0: R^2 = 0 \text{ (no effect size)}$$

$$H_1: R^2 \neq 0 \text{ (effect size)}$$

This study used *GDP* instead of *GDPg*. When $R^2 = 0$, the null hypothesis H_0 is accepted, and the alternative H_1 is rejected. This indicates no effect size, suggesting that the model results are robust. In contrast, when $R^2 \neq 0$, the alternative H_1 is accepted, and the null hypothesis H_0 is rejected. This indicates an effect size, suggesting that the model results are not robust (Osei-Kyei et al., 2021).

CHAPTER 4

FINDINGS AND DISCUSSIONS

4.1 Overview

This chapter details the decisive factors influencing the success of PPP projects in BRI countries. It also discusses the empirical results of the model hypotheses. Data collection was explained in Chapter 3. Chapter 4 comprises seven sections: an overview of PPP, descriptive statistical analysis, diagnostic analysis, logistic regression analysis, moderating effect analysis, robustness test and discussion.

4.2 Diagnostic Analysis

4.2.1 Descriptive Statistics

Based on the previous discussion, this study examined projects that were concluded, cancelled or distressed, totalling 138 samples (Table 4.1). Descriptive statistics primarily include the total number of samples, minimum value, maximum value, mean, standard error and standard deviation. The descriptive statistics of this study are as follows: The minimum value of *Investment* is -0.52, the maximum value is 3.66, the mean is 1.912, and the standard deviation is 0.074. A negative minimum value of -0.52 for *Investment* is because the investment amount was logarithmically transformed with base 10, corresponding to \$300,000. The minimum value of *GDP* growth is 0.34, the maximum value is 9.80, the mean is 3.272, and the standard deviation is 0.224. The minimum value of *credit* is 3.06, the maximum value is 105.12, the mean is 22.929, and the standard deviation is 1.787. The minimum value of *Open* is 0.19, the maximum value is 9.66, the mean is 2.256, and the standard deviation is 0.152. *Finance*, indicating potential fiscal risk during the project full

lifecycle, has a minimum value of 20.38, a maximum value of 43.46, a mean of 30.962, and a standard deviation of 0.425. *Economy* has a minimum value of 20.03, a maximum value of 42.42, a mean of 25.100, and a standard deviation of 0.496. *Politics* has a minimum value of 41.13, a maximum value of 69.75, a mean of 57.111, and a standard deviation of 0.487.

Table 4.1: Summary of Descriptive Statistic

Variables	N	Minimum	Maximum	Mean	Std. Error
Investment	138	-0.52	3.66	1.912	0.074
GDPg	138	0.34	9.80	3.272	0.224
Credit	138	3.06	105.12	22.929	1.787
Open	138	0.19	9.66	2.256	0.152
Finance	138	20.38	43.46	30.962	0.425
Economy	138	20.03	42.42	25.100	0.496
Politics	138	41.13	69.75	57.111	0.487

4.2.2 Correlation Analysis

Table 4.2 shows the Kendall's Tau correlation analysis. *Investment* is significantly negatively correlated with *GDPg*, *Credit*, *Open*, *Finance*, *Economy*, and *Politics*. There is a significant positive correlation, indicating a possible synergy between these variables. A correlation coefficient greater than 0.3 and less than 0.7 indicates a moderate correlation (Oyedele, 2013). Among the independent, control and moderating variables, there were ten correlations with coefficients exceeding 0.3. The highest coefficient was 0.404 between *Investment* and *Finance*. The higher the impact on variables, the greater the possibility of multicollinearity (Fenyi, 2020). Therefore, further multicollinearity tests are necessary.

Table 4.2: Correlations

Variables	Investment	GDPg	Credit	Open	Financial	Economy	Politics
Investment	1						
GDPg	-.193**	1					
Credit	-.253**	.153**	1				
Open	-.163**	-0.037	.222**	1			
Finance	-.404**	.150*	.284**	.203**	1		
Economy	-.277**	.259**	.231**	.309**	.343**	1	
Politics	-.232**	0.060	0.070	.123*	0.107	.271**	1

Note: *** indicates significance at the 0.01 level (2-tailed); ** indicates significance at the 0.05 level (2-tailed).

4.2.3 Multicollinearity Test

Table 4.3 presents the results of the multicollinearity test, examining three models: the baseline model, the control variable model, and the moderating effect model. Model (I) represents the baseline model. The variance inflation factor (VIF) for the explanatory variable of PPP projects was tested to verify whether multicollinearity exists in the model. The results indicate that the VIF for *Investment* is 1.000, with a tolerance of 1.000. The Durbin-Watson statistic is 1.347. Since the VIF is far below 10, there is no concern regarding multicollinearity.

Model (2) is the model with control variables. Model (2) includes the *GDPg*, *Credit* and *Open* as control variables for further analysis. The results indicate that the variable with the smallest VIF was *Investment*, with a VIF of 1.238 and a tolerance of 0.807. The variable with the largest VIF was *Credit*, with a VIF of 1.847 and a tolerance of 0.541. The VIF was still less than 10.

Model (3) is the model with a moderating variable. The moderating variables in Model (3) were *Finance*, *Economy* and *Politics*. The results indicate that the variable with the smallest VIF was *Politics*, with a VIF of 1.220 and a tolerance of 0.820. The variable with the largest VIF was *Credit*, with a VIF of 2.057 and a tolerance of 0.486. The VIF was less than 10 for the moderating variables.

In all three models, the highest VIF was 2.057, while none exceeded 10. This indicates no multicollinearity among the variables, enabling further empirical analysis to test the hypotheses.

Table 4.3: Results of Multicollinearity Test

Variables	Model (1)		Model (2)		Model (3)	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Investment	1.000	1.000	0.807	1.238	0.636	1.573
GDPg			0.749	1.335	0.651	1.537
Credit			0.541	1.847	0.486	2.057
Open			0.634	1.578	0.508	1.969
Finance					0.644	1.552
Economy					0.517	1.933
Politics					0.820	1.220
Durbin-Watson	1.347		1.427		1.569	

4.2.4 Omnibus Likelihood Ratio Test

An Omnibus likelihood ratio test is necessary in a logistic regression model. This test is used to analyse overall model effectiveness. If the p-value is less than 0.05, the model is considered effective; otherwise, it is ineffective.

Analysis of the overall effectiveness of the logistic regression model is presented in Table 4.4, showing four models. Model 1 includes the likelihood ratio test for the five independent variables related to PPP projects. Model 2 includes the likelihood ratio test for six variables, including PPP project variables and GDP growth rate. Model 3 includes the likelihood ratio test for seven variables, including PPP project variables, *GDPg* and *Credit*. Model 4 includes the likelihood ratio test for a total of eight variables, including PPP project variables and control variables. The null hypothesis being tested is that the model quality is the same whether the independent variables are included or not. The p-values in Table 4.4 were all 0.000, far less than 0.05. At the same time, the Chi-square values for the four models were 93.244, 105.507, 126.319 and 144.517, respectively, all of which are relatively high. Therefore, the null hypothesis is rejected. The results indicate that the independent variables

in the model have significant explanatory power for the dependent variable. Therefore, the constructed model is valid.

Table 4.4: Omnibus Tests of Model Coefficients

Model	Step	Chi-square	df	Sig.
(1)	Step 1	93.244	10	0.000
(2)	Step 1	105.507	11	0.000
(3)	Step 1	126.319	12	0.000
(4)	Step 1	144.517	13	0.000

4.2.5 Goodness of Fit Test for Model Fit

The -2loglikelihood is one method used to test a model's goodness of fit. If the -2loglikelihood value is relatively small, it indicates that the model has achieved goodness of fit (Edward, 2022). Regarding the four models (Table 4.5), Model 1 included only the intrinsic variables of the PPP projects. Models 2, 3 and 4 sequentially added the variables *GDPg*, *Credit* and *Open*. Model 5 examines the impact of political, economic, and financial risks on the success of PPP projects. The -2loglikelihood values in the five models were 90.576, 78.314, 57.501, 39.303 and 49.954, respectively. The minimum value is 39.303, and the maximum value is 90.576. Smaller values indicate a higher goodness of fit. Therefore, from Model (1) to Model (5), the model fit improves progressively.

Table 4.5: Model Testing Regression Results

Variable	Model1	Model2	Model3	Model4	Model5
Type(1)	21.6779 (1.8317)	21.7778 (1.8110)	21.2078 (1.6449)	19.5694 (1.3690)	
Type(2)	21.8664 (1.8317)	22.3479 (1.8110)	21.5389 (1.6449)	20.3246 (1.4947)	
Type(3)	-4.8375 (1.2816)	-4.3094 (1.59370)	-5.0012 (0.8416)	-9.0693 (0.8614)	
Sector(1)	-21.2348 (1.8317)	-20.9122 (1.8110)	-19.5277 (1.6449)	-17.8926 (1.4152)	
Sector(2)	-0.1315 (0.3411)	-0.2365 (0.2819)	-0.7419 (0.5978)	-2.0065 (1.7866)	
Sector(3)	-2.0674 (1.2816)	-1.5711 (1.0848)	-2.1630 (1.6449)	-2.0918 (1.5761)	
Sector(4)	-20.7956 (1.8317)	-19.7062 (1.8110)	-17.8765 (1.6449)	-15.3687 (1.1193)	
Sponsors(1)	1.4056** (2.3273)	1.8071*** (2.6315)	1.9953** (2.3759)	3.6521*** (2.6603)	
Multilateral(1)	2.2419*** (3.0342)	2.6196*** (3.3308)	3.8437*** (3.5908)	4.7747*** (3.0432)	
Investment	-2.9153*** (-5.3774)	-2.6356*** (-4.6997)	-3.5924*** (-3.351)	-5.1087*** (-3.0064)	
GDPg		0.4135*** (3.2184)	0.4099** (2.5386)	0.8557*** (2.9667)	0.3362** (1.9850)
Credit			0.0951*** (3.4157)	0.1128*** (2.8977)	0.0763*** (2.7549)
Open				1.1459*** (3.1219)	0.7137** (2.314)
Politics					0.1485** (2.0714)
Economy					0.3017*** (3.3969)
Finance					0.4059*** (3.8578)
Constant	-17.351	-19.768	-20.013	-21.401	-34.253
-2 Log likelihood	90.576	78.314	57.501	39.303	49.954
Hosmer and Lemeshow Test (Sig.)	0.404	0.258	0.860	0.998	0.966
Nagelkerke R ²	0.667	0.726	0.815	0.882	0.844

Note: ***and ** indicate statistical significance at the 1% and 5% levels, respectively. “Z-values” are in parentheses.

Where, the reference group for the *Type* dummy variable is divestiture projects, *Type* (1) denotes greenfield projects, *Type* (2) denotes brownfield projects, *Type* (3) denotes management and lease contract. The reference group for the *Sector* dummy variable is divestiture projects, *Sector* (1) denotes greenfield projects, *Sector* (2) denotes brownfield projects, and *Sector* (3) denotes management and lease contract projects. *Sponsors* (1) indicates sponsors support. *Multilateral* (1) indicates multilateral support.

The Hosmer–Lemeshow test is another method for testing the goodness of fit of a model (Table 4.5). If the p-value of the Hosmer–Lemeshow test is greater than 0.05, the null hypothesis is accepted (Nikola et al., 2023). Table 4.5 presents the Hosmer–Lemeshow test for the four models. The p-values were 0.404, 0.258, 0.860, 0.998 and 0.966, respectively. The minimum value is 0.258, and the maximum value is 0.998. All p-values were much greater than 0.05, leading to the acceptance of the null hypothesis. This indicates that the models have goodness of fit according to the Hosmer–Lemeshow Test.

4.3 Logistic Regression Analysis

Conducting logistic regression on the PPP project's own influencing factors. After processing the variables, the system fit the model. This study used the backward elimination (likelihood ratio) method for binary logistic regression. The analysis systematically eliminated non-significant variables to ensure the model's effectiveness.

4.3.1 Regression with Hypotheses

Table 4.5 presents the model regression results of the four different models. Model 1 represents the regression impact of PPP project profile factors. Model 2 introduced the control variable GDP growth (*GDPg*) into the regression of PPP project profile factors. Model 3 introduced the control variable of *Credit* into the regression of PPP project profile

factors. Model 4 introduced the control variable of *Open* into the regression of PPP project profile factors. Model 5 introduced country risk under the control variables. The specific results are detailed below.

For *Type*, *Type* includes brownfield, divestiture, greenfield and management and lease contracts, where the type of PPP project operation in BRI countries largely depends on national policies. In logistic regression, although dummy variables were set, the p-values for each dummy variable were greater than 0.05. The results indicate that the *Type* has no significant impact on PPP projects (Table 4.5). Additionally, project type is influenced by the project profile, such as using greenfield for transportation projects and brownfield for energy projects (Almeile et al., 2024). Thus, *Type* was not significantly related to the success or failure of PPP projects. Hypothesis H_{1b}, stating that the investment type significantly explains PPP project success, fail to reject the null hypothesis.

For *Sector*, in logistic regression, although dummy variables were set, the p-values for each dummy variable were greater than 0.05. The results indicate that the *Sector* has no significant impact on PPP projects (Table 4.5). The operating range of Chinese enterprises in PPP projects is concentrated in specific fields. Enterprises focus on investment amounts, a country's macro environment and risk factors. Therefore, enterprises do not choose sectors based on the likelihood of success or failure. Therefore, Hypothesis H_{1c}, stating that the investment sector significantly explains PPP project success, is not supported, fail to reject the null hypothesis.

The regression results of Model 1 indicate *Sponsors*, *Multilateral* and *Investment* on the success or failure of PPP projects (Table 4.5). Based on the regression results, *Sponsors* increases log-odds of the success or failure of PPP projects at the 1% significance level. The

coefficient is 1.4056, and the Z-value is 2.3273. The data indicate that having sponsorship (*Sponsors* = 1), compared to no sponsorship (*Sponsors* = 0), increases the log odds of PPP project success by 1.4056. With sponsors' support, PPP projects are more likely to succeed. *Multilateral* increases log-odds of the success or failure of PPP projects at the 1% significance level. The coefficient is 2.2419, and the Z-value is 3.0342. The data indicate that having sponsorship (*Multilateral* = 1), compared to no sponsorship (*Multilateral* = 0), increases the log odds of PPP project success by 2.2419. With the support of multilateral countries, PPP projects are more likely to succeed. *Investment* negatively affected the success or failure of PPP projects at the 1% significance level, with a coefficient of -2.9153 and a Z-value of -5.3774. The results of the data show that for every unit increase in investment, the success of PPP projects decreases by 2.9153 units. The findings suggest that larger investment scales and longer project cycles result in a lower success rate. The constant term was -17.3509, indicating that $\ln \frac{p}{1-p} < 0$. According to the logarithmic formula, $p < 1 - p$ indicates the probability of success was less than the probability of failure. This is because when all success factors are absent, the intercept of Y equals -17.3509. Without any success factors influencing a PPP project, the probability of success is lower than the probability of failure, leading to a high failure rate.

Therefore, Hypothesis H_{1a}, stating that *Investment* significantly decreases log-odds of PPP project success, is supported. Additionally, the proposed H_{1d}, which states that *Sponsors* significantly increases log-odds of PPP project success, is also supported. The proposed H_{1f}, which states that multilateral support significantly increases log-odds of PPP project success, is also supported. The model expression is as follows:

$$\text{logit}(P) = \ln \frac{P}{1-P} = -17.3509 + 1.4056\text{Sponsors} + 2.2419\text{Multilateral} - 2.9153\text{Investment}$$

Equation 4.1

The regression results of Model 2 indicate the impact of GDP growth rate as a control variable (Table 4.5). This regression added the control variable for the GDP growth rate to the PPP project profile factors. Based on the regression results, *GDPg* positively affected the success or failure of PPP projects at the 1% significance level when added to the model, with a coefficient of 0.4135 and a Z-value of 3.2184.

Moreover, the *Sponsors* coefficient was 1.8071 with a Z-value of 2.6315. The data indicate that having sponsorship (*Sponsors* = 1), compared to no sponsorship (*Sponsors* = 0), increases the log odds of PPP project success by 1.8071. With sponsors' support, PPP projects are more likely to succeed. The *Multilateral* coefficient was 2.6196 with a Z-value of 3.3308. The data indicate that having sponsorship (*Multilateral* = 1), compared to no sponsorship (*Multilateral* = 0), increases the log odds of PPP project success by 2.6196. With the support of multilateral countries, PPP projects are more likely to succeed. The findings indicate that a country's GDP growth rate impacts the success of PPP projects, where sponsor and multilateral support has a deeper impact on a project's success. The *Investment* coefficient was -2.6356 with a Z-value of -4.6997. The findings suggest that the negative effect of investment amount decreased under the influence of a country's GDP growth rate. The constant term was -19.7679, indicating that $\ln \frac{P}{1-P} < 0$. According to the logarithmic formula, $p < 1 - p$ indicating the probability of success was less than the probability of failure. Similar to the previous analysis, when all success factors were absent, there were no success factors influencing the PPP project. This results in a lower success

rate compared to the failure rate, i.e. a high failure rate. Therefore, accelerated GDP growth promotes the success of PPP projects. The model expression is as follows:

$$\text{logit}(P) = \ln \frac{P}{1-P} = -19.7679 + 1.8071Sponsors + 2.6196Multilateral - 2.6356Investment + 0.4135GDPg$$

Equation 4.2

Where, *Sponsors* is the dummy variable for which *Sponsors* is “yes (1)”.

Multilateral is a dummy variable for which *Multilateral* is “yes (1)”.

The regression results of Model 3 show the impact of *GDPg* and *Credit* as control variables on the project (Table 4.5). According to the regression results, *Credit* had a significant positive effect at the 1% significance level, with a coefficient of 0.0951 and a Z-value of 3.4157. With the combined influence of *GDPg* and *Credit*, *Sponsor* and *Multilateral* support has an even greater impact on the success of PPP projects. However, the effect relative to investment scale is somewhat reduced. The constant term is -20.0131, indicating that $\ln \frac{P}{1-P} < 0$. According to the logarithmic formula, $p < 1 - p$, meaning the probability of success is less than the probability of failure. Similar to the previous analysis, when all success factors are absent, there are no success factors influencing the PPP project, resulting in a lower success rate compared to the failure rate, i.e., a high failure rate. Therefore, the *Credit* increases log-odds of the success of PPP projects. The model expression is:

$$\text{logit}(P) = \ln \frac{P}{1-P} = -20.0131 + 1.9953Sponsors + 3.8437Multilateral - 3.5924Investment + 0.4099GDPg + 0.0951Credit$$

Equation 4.3

Where, *Sponsors* is the dummy variable for which *Sponsors* is “yes (1)”.

Multilateral is a dummy variable for which *Multilateral* is “yes (1)”.

The Model 4 regression results indicate the impact of the three control variables on PPP projects (Table 4.5). The macro environment includes the factor of openness. The regression results indicate that the variable *Open* had a significant positive effect at the 1% significance level, with a coefficient of 1.1459 and a Z-value of 3.1219. The constant term was -21.4011 indicating that $\ln \ln \frac{P}{1-P} < 0$. The logarithmic formula $p < 1 - p$ indicates that the probability of success was less than the probability of failure. Meanwhile, the data indicate that the investment scale coefficient also decreased. Therefore, the combined influence of the macro environment reduced the negative impact of investment scale on project success. Hence, factors in the macro environment, such as national GDP growth, support for the private sector, and the degree of openness, significantly affected the success and failure of PPP projects.

$$\text{logit}(P) = \ln \frac{P}{1-P} = -21.4011 + 3.6521Sponsors + 4.7747Multilateral - 5.1087Investment + 0.8557GDPg + 0.1128Credit + 1.1459Open$$

Equation 4.4

Where, *Sponsors* is the dummy variable for which *Sponsors* is “yes (1)”.

Multilateral is a dummy variable for which *Multilateral* is “yes (1)”.

For *Politics*, according to the International Country Risk Guide by the U.S. International Report Group, the *Politics* score is assigned a maximum of 100 points, where a full score indicates the absence of political risk. The higher the score, the lower the political risk. Table 4.5 shows that *Politics* is positively correlated at a 1% significance level, with a coefficient of 0.4059 and a Z-value of 3.8578. This indicates that for every one-unit increase

in the *Politics* score (i.e., a one-unit decrease in political risk), the success rate of PPP projects increases by 0.4059 units. Therefore, hypothesis H_{2a}, which posits that political risk significantly decreases log-odds of the success of PPP projects, is supported.

For *Economy*, according to the International Country Risk Guide by the U.S. International Report Group, the *Economy* score is assigned a maximum of 50 points, where a full score indicates the absence of economic risk. The higher the score, the lower the risk. As shown in Table 4.5, *Economy* is positively correlated at a 1% significance level, with a coefficient of 0.3017 and a Z-value of 3.3969. This indicates that for every one-unit increase in the *Economy* score (i.e., a one-unit decrease in economic risk), the success rate of PPP projects increases by 0.3017 units. Therefore, hypothesis H_{2b}, which posits that economic risk significantly decreases log-odds of the success of PPP projects, is supported.

For *Finance*, according to the International Country Risk Guide by the U.S. International Report Group, the *Finance* score is assigned a maximum of 50 points, where a full score indicates the absence of financial risk. The higher the score, the lower the risk. *Finance* is positively correlated at a 1% significance level, with a coefficient of 0.1485 and a Z-value of 2.0714. This indicates that for every one-unit increase in the *Finance* score (i.e., a one-unit decrease in financial risk), the success rate of PPP projects increases by 0.1485 units. Therefore, hypothesis H_{2c}, which posits that financial risk significantly decreases log-odds of the success of PPP projects, is supported.

$$\text{logit}(P) = \ln \frac{P}{1-P} = -34.253 + 0.1485\textit{Political} + 0.3017\textit{Economic} + \\ 0.4059\textit{Financial} + 0.3362\textit{GDPg} + 0.0763\textit{Credit} + 0.7137\textit{Open}$$

Equation 4.5

4.3.2 Receiver Operating Characteristic

The receiver operating characteristic (ROC) curve can be used to evaluate the ability of a logistic regression model to distinguish between positive and negative samples (i.e. classification performance) (Huwaina et al., 2024). It assesses a model's classification ability by showing the trade-off between sensitivity and specificity (1-specificity) at different thresholds (Wang et al., 2024). The closer the ROC curve is to the top-left corner, the better the model's classification performance (Huwaina et al., 2022). This suggests that a model has a good balance between high sensitivity and high specificity. Figure 4.1 illustrates the ROC curves of the predicted probability (PRE). The ROC plot contains curves for the four different models. The area under the ROC curve (AUC) represents the area under the ROC curve. The closer the AUC value is to 1, the better the model's classification performance. The model's performance is excellent when the AUC value is between 0.9 and 1.0 (Gupta et al., 2024). Table 4.6 presents the AUC values for the five models as 0.928, 0.928, 0.952, 0.970 and 0.978, respectively. The data indicate that the model improves as more control variables are added.

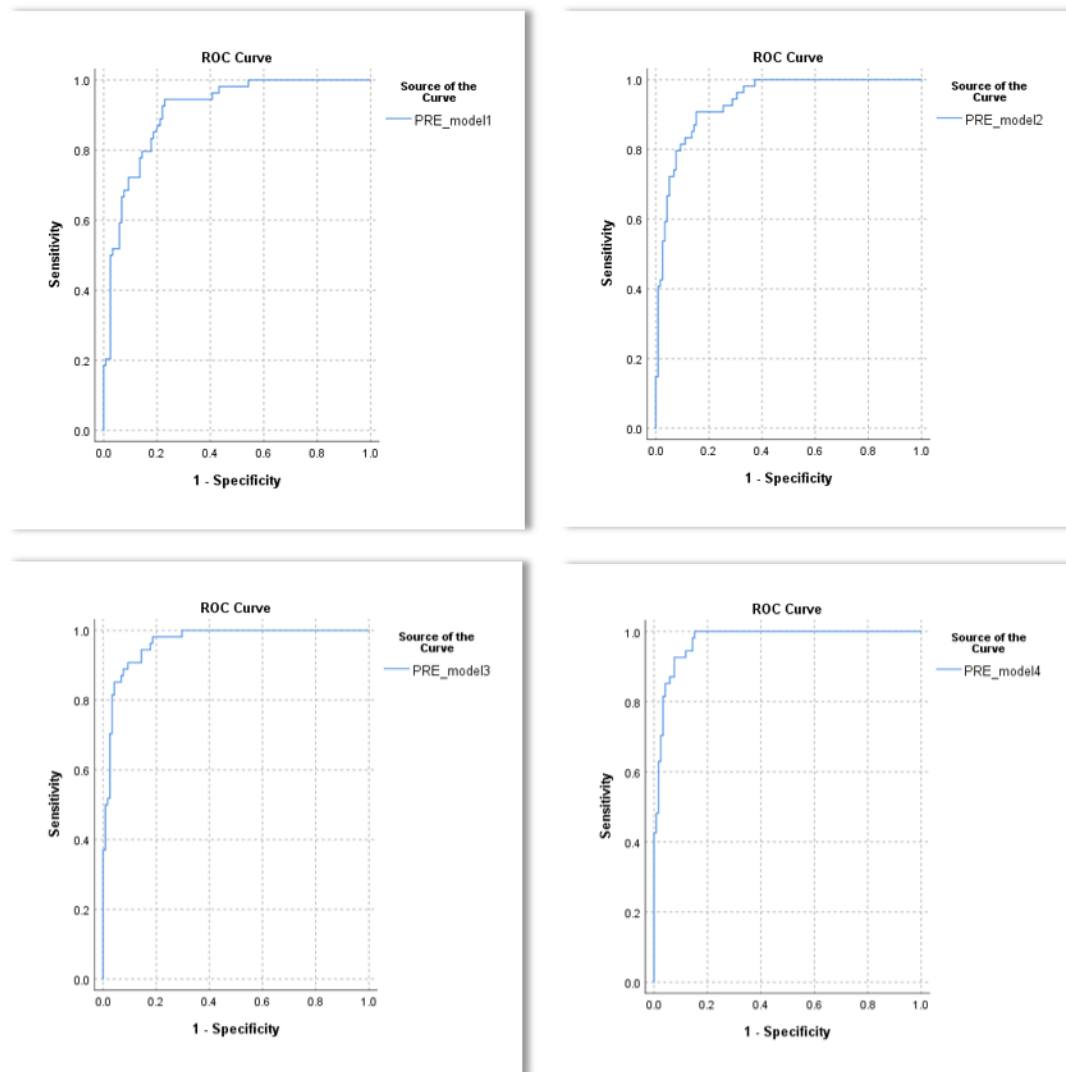


Figure 4.1: ROC Curve for Predicted Probability in Models 1-4

Table 4.6: Area under the ROC Curve

Test Result Variables	Area
PRE_model1	0.928
PRE_model2	0.928
PRE_model3	0.952
PRE_model4	0.970
PRE_model5	0.978

4.3.3 Confusion Matrix Analysis

A classification table, also known as a confusion matrix, is commonly used for evaluating the performance of classification models. It represents the performance of a classification model on actual and predicted categories (Gao, 2021). Comparing actual and predicted categories, various performance metrics can be calculated, such as accuracy, sensitivity, specificity, etc. (Gao, 2021). Table 4.7 illustrates this study's confusion matrix. Specifically, true negative (TN) represents the number of samples that are actually negative and correctly predicted to be negative. False positive (FP) represents the number of samples that are actually negative but incorrectly predicted as positive. False negative (FN) represents the number of samples that are actually positive but incorrectly predicted as negative. True positive (TP) indicates the number of positive samples and is correctly predicted as positive (Gao, 2021).

Table 4.7 Confusion Matrix

Confusion	Predicted as Negative	Predicted as Positive
Actual as Negative (0.00)	True Negative(TN)	False Positive(FP)
Actual as Positive (1.00)	False Negative(FN)	True Positive(TP)

Accuracy is an essential metric for evaluating the overall performance of a classification model. It represents the proportion of correctly predicted samples to the total number of samples. The higher the proportion, the higher the accuracy (Gao, 2021). The calculation formula to test the model accuracy is as follows:

$$\text{Accuracy} = \frac{\text{True Positive(TP)} + \text{True Negative(TN)}}{\text{Total Number of Samples}} \quad \text{Equation 4.6}$$

Based on the classification table in Table 4.8, the accuracy of Model 1 was calculated as: $\text{Accuracy} = \frac{42+78}{138} \times 100\% = 69.77\%$. Similarly, the accuracy for Models 2, 3 and 4 were 69.77%, 71.51%, 74.42% and 75%, respectively. Increasing accuracy indicates that the models have good and progressively higher accuracy. The proportion of correctly predicted samples was very high.

Table 4.8: Confusion Matrix Analysis Results

Model	Observed Status	Predicted Status		Percentage Correct	Percentage Accuracy	Percentage Sensitivity	Percentage Specificity	Percentage Precision
		0.00	1.00					
(1)	0.00	78	7	91.8	69.77	79.25	91.76	85.71
	1.00	11	42	79.2				
(2)	0.00	77	8	90.6	69.77	81.13	90.59	84.31
	1.00	10	43	81.1				
(3)	0.00	78	7	91.8	71.51	84.91	91.76	86.54
	1.00	8	45	84.9				
(4)	0.00	80	5	94.1	74.42	90.57	94.12	90.57
	1.00	5	48	90.6				
(5)	.00	79	6	92.9	75.00	94.34	92.94	89.29
	1.00	3	50	94.3				

Sensitivity, also known as the recall or true positive rate, is a metric used to evaluate the performance of a classification model in identifying positive samples. It represents the proportion of actual positive samples correctly predicted as positive by a model. The higher the proportion, the higher the sensitivity (Gao, 2021). The calculation formula for sensitivity is as follows:

$$\text{Sensitivity} = \frac{\text{True Positives (TP)}}{\text{True Positive (TP)} + \text{False Negative (FN)}} \quad \text{Equation 4.7}$$

Based on the classification table in Table 4.8, the sensitivity of Model 1 was calculated as: $\text{Sensitivity} = \frac{42}{42+11} = 79.25\%$. Similarly, the sensitivity for Models 2, 3 and

4 were 81.13%,84.91%, 90.57% and 94.34% , respectively. Increasing sensitivity indicates that the models have good and progressively higher sensitivity. The proportion of correctly predicted positive samples was high.

Specificity, also known as the true negative rate, is a metric used to evaluate the performance of a classification model in identifying negative samples. It represents the proportion of actual negative samples correctly predicted as negative by a model. The higher the proportion, the higher the specificity (Hu & Jiang, 2021). The calculation formula for specificity is as follows:

$$\text{Specificity} = \frac{\text{True Negatives (TN)}}{\text{True Negative(TN)}+\text{False Positive(FP)}} \quad \text{Equation 4.8}$$

Based on the classification table in Table 4.8, the specificity of Model 1 was calculated as: $\text{Specificity} = \frac{78}{78+7} = 91.76\%$. Similarly, the specificity for Models 2, 3 and 4 were 90.59%,91.76%, 94.12% and 92.94% , respectively. Increasing specificity indicates that the models have good and progressively higher specificity. The proportion of correctly predicted negative samples was high.

Precision, also known as positive predictive value, is an essential metric for evaluating the accuracy of a classification model in predicting positive samples. It represents the proportion of actual positive samples among all samples predicted as positive. The higher the proportion, the higher the precision (Gao, 2021). The calculation formula for precision is as follows:

$$\text{Precision} = \frac{\text{True Positives (TP)}}{\text{True Positives (TP)}+\text{False Positive(FP)}} \quad \text{Equation 4.9}$$

Based on the classification table in Table 4.8, the precision of Model 1 was calculated as: $\text{Precision} = \frac{42}{42+7} = 85.71\%$. Similarly, the precision for Models 2, 3 and 4 were 84.31%, 86.54%, 90.57% and 89.29%, respectively. The increasing precision indicates that the models have good and progressively higher precision. The proportion of correctly predicted positive samples was high.

4.3.4 Pseudo-R-squared

Pseudo-R-squared is a metric used to assess the goodness of fit of logistic regression models. Since the dependent variable in logistic regression models is binary, the traditional R-squared (R^2) used in linear regression models cannot be directly applied (Hu & Jiang, 2021). Pseudo-R-squared provides a measure similar to R-squared for evaluating the explanatory power of logistic regression models. Common pseudo-R-squared metrics include Cox and Snell's R^2 and Nagelkerke's R^2 . The Cox and Snell R^2 typically ranges from 0 to 1, with a reasonable range between 0.2 and 0.4. The closer it is to 1, the stronger the model's explanatory power for the dependent variable, indicating better fit (Cara et al., 2022). The Nagelkerke R^2 also typically ranges from 0 to 1, with a reasonable range between 0.3 and 0.5. The closer it is to 1, the stronger the model's explanatory power for the dependent variable, indicating better fit (Gao, 2021). In the four models (Table 4.9), the Cox and Snell R^2 values were 0.491, 0.534, 0.600, 0.649 and 0.621, respectively. The lowest value was 0.418, exceeding 0.4, which indicates that the model fit is good. The Nagelkerke R^2 values of the four models were 0.667, 0.726, 0.815, 0.882 and 0.844, respectively. The lowest value was 0.587, exceeding 0.5, which indicates that the model fit is good.

Table 4.9: Pseudo R-squared

Model	Cox & Snell R Square	Nagelkerke R Square
(1)	0.491	0.667
(2)	0.534	0.726
(3)	0.600	0.815
(4)	0.649	0.882
(5)	0.621	0.844

Based on the above, although residual analysis is essential for evaluating model fit and diagnosing outliers in logistic regression models, this study adopted a more reasonable evaluation method. The minimum p-value of the Hosmer–Lemeshow test among the four models was 0.258, indicating good model fit. The ROC curves of all four models were concentrated in the upper left corner, and the minimum AUC value was 0.928, which exceeds 0.9 and demonstrates excellent classification performance. The minimum values of accuracy, sensitivity, specificity and precision in the classification table were 69.77%, 79.25%, 90.59% and 84.31%, respectively, indicating high accuracy. The pseudo-R-squared values, with Cox and Snell’s R² exceeding 0.4 and Nagelkerke’s R² exceeding 0.6, indicate very good fit. Therefore, the logistic regression model exhibits good model fit and prediction accuracy.

4.4 Moderating Effect Analysis

Based on the previous logistic regression analyses of PPP project profiles, it was concluded that *Type* and *Sector* did not have a significant effect on project success. Therefore, *Type* and *Sector* were not included in the analysis of the moderating effect of country risk on project success. That is, the three independent variables *Sponsors*, *Multilateral*, and

Investment in the PPP project profile were analysed with the moderating effects of the three country risks.

The bootstrap method of Bias-corrected-accelerated was used when analysing the moderation effect through the econometric software due to the small sample size. The sample size was set to 5000 for logistic regression analysis. Table 4.10 shows the regression results for the moderating effect.

Table 4.10: Moderating Effect Regression Results

Variable	Model1	Model2	Model3
Sponsors	1.2029*** (2.2745)	2.0231*** (2.1264)	4.6306*** (2.6968)
Multilateral	1.6906*** (2.7627)	2.5216*** (2.6517)	6.806*** (3.0902)
Investment	-2.1629*** (-5.5372)	-2.6916*** (-4.0490)	-9.2810*** (3.2905)
Politics		0.2191*** (3.0254)	2.3162*** (3.0902)
Finance		0.31115*** (3.9602)	0.9696*** (2.7478)
Economy		0.2884*** (3.8221)	2.0752*** (2.8070)
Sponsors* Politics			-0.2370** (2.0642)
Sponsors*Economy			-0.6177** (2.2262)
Sponsors*Finance			-0.5827* (1.8808)
Multilateral*Politics			-0.2325** (2.2571)
Multilateral*Economy			-0.3337*** (2.6121)
Multilateral*Finance			-0.1075 (1.5382)
Investment*Politics			-0.8751*** (3.0902)
Investment*Economy			-0.5097** (2.3263)

Table 4.10 continued

Investment*Finance			-0.2633* (1.9349)
-2 Log likelihood	118.886	54.651	24.541
Hosmer and Lemeshow Test (Sig.)	0.715	0.804	0.998
Constant	2.6967	3.5863	12.5374

Note: ***and ** indicate statistical significance at the 1% and 5% levels, respectively. “Z-values” are in parentheses.

4.4.1 Main Effects

The regression results of Model 1 indicate *Sponsors*, *Multilateral* and *Investment* on the success or failure of PPP projects (Table 4.10). Based on the regression results, *Sponsors* increases log-odds of the success or failure of PPP projects at the 1% significance level. The coefficient is 1.2029, and the Z-value is 2.2745. The data indicate that having sponsorship (*Sponsors* = 1), compared to no sponsorship (*Sponsors* = 0), increases the log odds of PPP project success by 1.2029. With sponsors' support, PPP projects are more likely to succeed. *Multilateral* increases log-odds of the success or failure of PPP projects at the 1% significance level. The coefficient is 1.6906, and the Z-value is 2.7627. The data indicate that having sponsorship (*Multilateral* = 1), compared to no sponsorship (*Multilateral* = 0), increases the log odds of PPP project success by 1.6906. With the support of multilateral countries, PPP projects are more likely to succeed. *Investment* negatively affected the success or failure of PPP projects at the 1% significance level, with a coefficient of -2.1629 and a Z-value of -5.5372. The findings suggest that larger investment scales, longer project cycles and higher associated risks result in a lower success rate.

In Model 2, the moderating variables of *Politics*, *Economy* and *Finance* are introduced. As previously mentioned, according to the Country Risk International Guide by the U.S. International Report Group, the maximum score for *Politics* is 100, while both

Economy and Finance have a maximum score of 50. A full score indicates the absence of political risk. The higher the score, the lower the risk. Table 4.10 shows that political, economic, and financial risks are positively affected at the 1% significance level. The coefficient for *Politics* is 0.9801, with a Z-value of 2.1973. This indicates that for every one-unit increase in the *Politics* score (i.e., a one-unit decrease in political risk), the success rate of PPP projects increases by 0.9801 units. The coefficient for *Economy* is 3.5561, with a Z-value of 3.0902. This indicates that for every one-unit increase in the *Economy* score (i.e., a one-unit decrease in economic risk), the success rate of PPP projects increases by 3.5561 units. The coefficient for *Finance* is 1.8093, with a Z-value of 2.6521. This indicates that for every one-unit increase in the *Finance* score (i.e., a one-unit decrease in financial risk), the success rate of PPP projects increases by 1.8093 units. Higher scores for political, economic and financial risks indicate that their country risk is lower and the success rate of PPP projects is higher.

4.4.2 Moderating Effects of Politics

Model 3 analyses the interaction effects of political risk as moderating variables with *Sponsors*, *Multilateral* and *Investment*.

First, the moderating effect of the *Politics* on *Sponsors*. After the interaction of *Politics* and *Sponsors* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.4976, with a z-value of 3.0902, indicating that for every one-unit increase in the score of *Politics* (i.e., a one-unit decrease in political risk), the effect of *Sponsors* on the success of PPP projects increases by 0.4976 units. Following Aiken et al. (1991)'s method, the moderating effect of politics was plotted in Figure 4.2. Under conditions of higher politics, the slope between *Sponsors* and the success of PPP projects

was steeper, indicating a stronger impact of Sponsors on PPP success. Specifically, the higher the *Politics* score (indicating lower risk), the greater the impact of Sponsors on the probability of PPP project success.

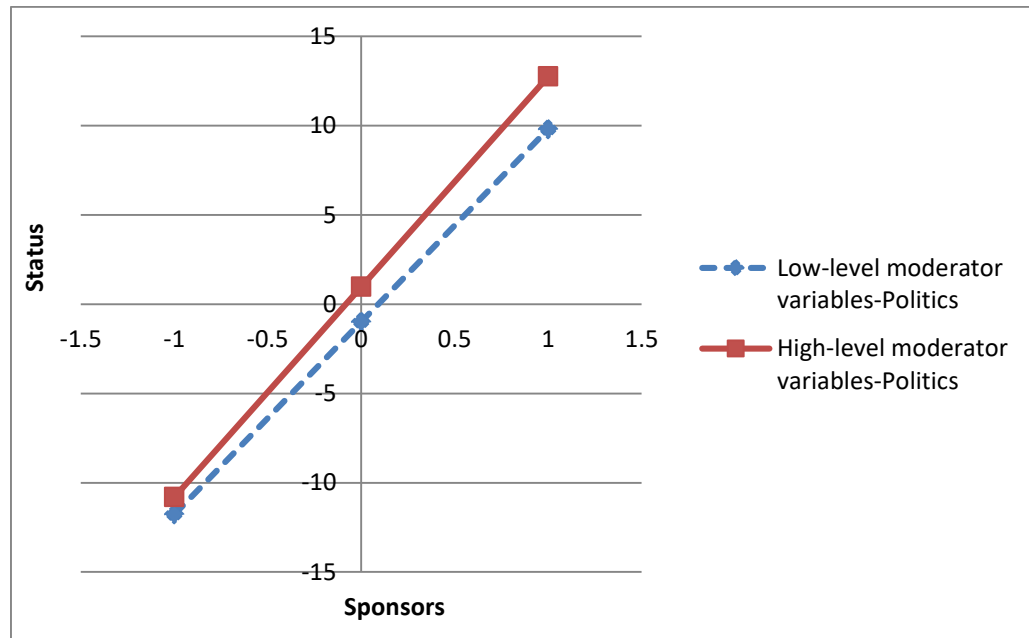


Figure 4.2: Moderating Effect of Politics on Sponsors

Second, the moderating effect of the *Politics* on *Multilateral*. After the interaction of *Politics* and *Multilateral* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.2598, with a z-value of 2.6521, indicating that for every one-unit increase in the score of *Politics* (i.e., a one-unit decrease in political risk), the effect of multilateral on the success of PPP projects increases by 0.2598 units. Following Aiken et al. (1991)'s method, the moderating effect of *Politics* was plotted in Figure 4.3. Under conditions of higher politics, the slope between multilateral and the success of PPP projects was steeper, indicating a stronger impact of multilateral on PPP success. Specifically, the higher the *Politics* score (indicating lower risk), the greater the impact of multilateral on the probability of PPP project success.

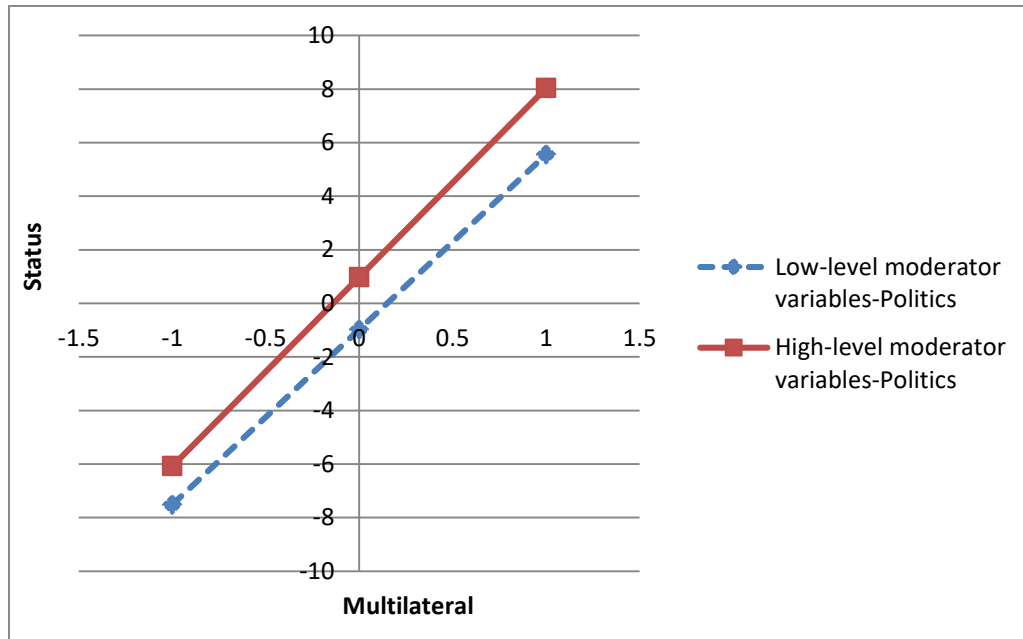


Figure 4.3: Moderating Effect of Politics on Multilateral

Third, the moderating effect of the *Politics* on *Investment*. After the interaction of *Politics* and *Investment* moderates, it shows a positive effect at the 5% level of significance. The coefficient of the interaction is 0.0926, with a z-value of 1.9863, indicating that for every one-unit increase in the score of *Politics* (i.e., a one-unit decrease in political risk), the negative effect of investment on the success of PPP projects weakens by 0.0926 units. Following Aiken et al. (1991)'s method, the moderating effect of *Politics* was plotted in Figure 4.4. Under conditions of higher politics, the slope between investment and the success of PPP projects was steeper, indicating a weakening of the negative impact of investment on PPP success. Specifically, the higher the Politics score (indicating lower risk), the lower the negative impact of investment on the probability of PPP project success.

Therefore, the smaller the *Politics* score, the higher the political risk, weakening the PPP project profile and the success of the PPP project. In support of hypothesis H_{3a}.

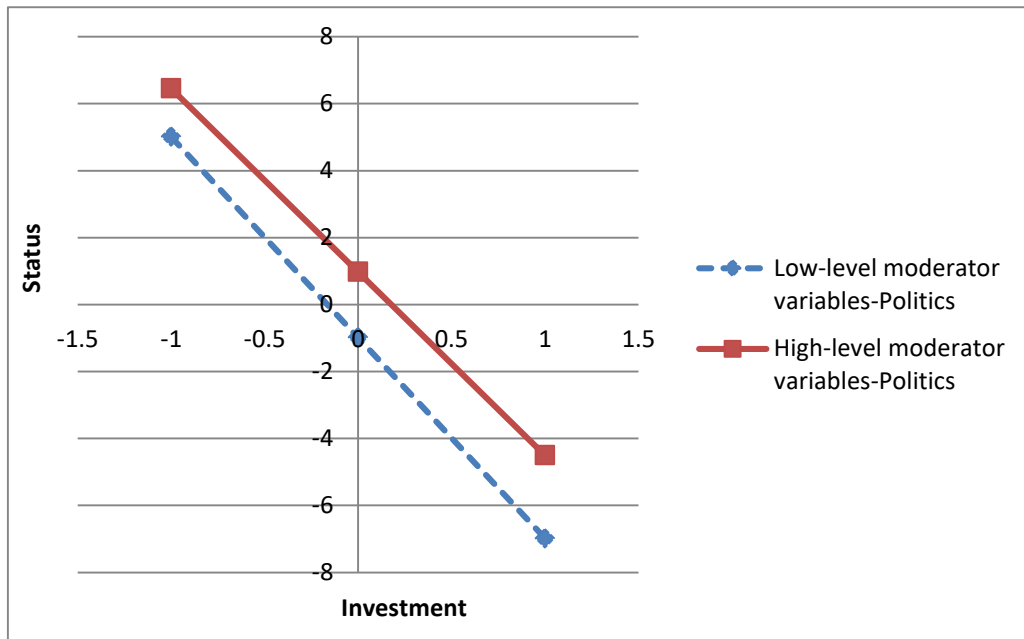


Figure 4.4: Moderating Effect of Politics on Investment

4.4.3 Moderating Effects of Economy

First, the moderating effect of the *Economy* on *Sponsors*. After the interaction of *Economy* and *Sponsors* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.7454, with a z-value of 3.0902, indicating that for every one-unit increase in the score of *Economy* (i.e., a one-unit decrease in economic risk), the effect of *Sponsors* on the success of PPP projects increases by 0.7454 units. Following Aiken et al. (1991)'s method, the moderating effect of *Economy* was plotted in Figure 4.5. Under conditions of higher economy, the slope between *Sponsors* and the success of PPP projects was steeper, indicating a stronger impact of *Sponsors* on PPP success. Specifically, the higher the *Economy* score (indicating lower risk), the greater the impact of *Sponsors* on the probability of PPP project success.

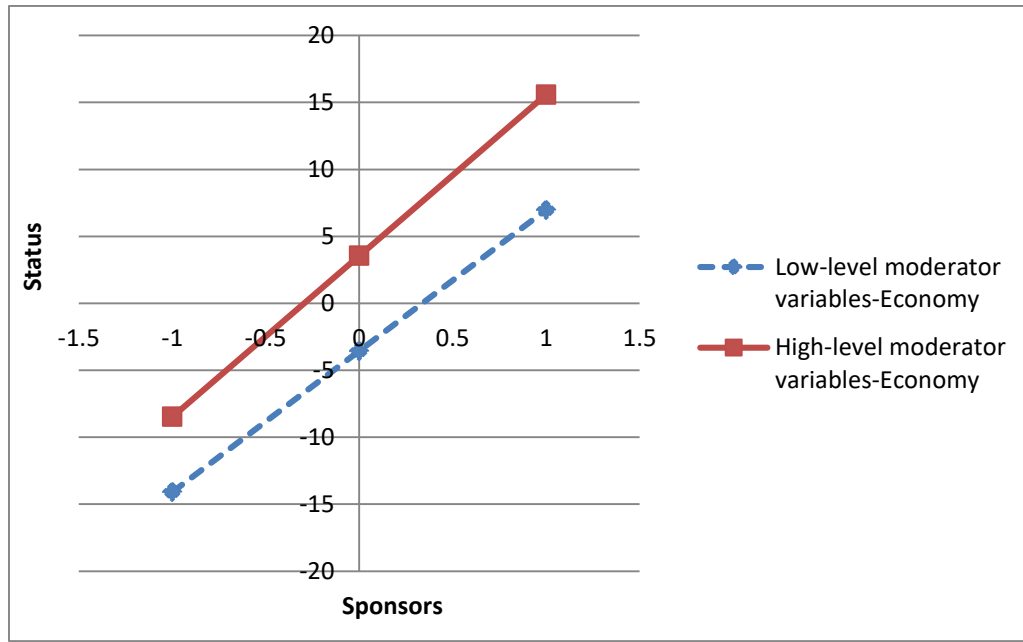


Figure 4.5: Moderating Effect of Economy on Sponsors

Second, the moderating effect of the *Economy* on *Multilateral*. After the interaction of *Economy* and *Multilateral* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.8602, with a z-value of 2.6521, indicating that for every one-unit increase in the score of *Multilateral* (i.e., a one-unit decrease in economic risk), the effect of multilateral on the success of PPP projects increases by 0.8602 units. Following Aiken et al. (1991)'s method, the moderating effect of *Economy* was plotted in Figure 4.6. Under conditions of higher economy, the slope between *Multilateral* and the success of PPP projects was steeper, indicating a stronger impact of multilateral on PPP success. Specifically, the higher the *Economy* score (indicating lower risk), the greater the impact of multilateral on the probability of PPP project success.

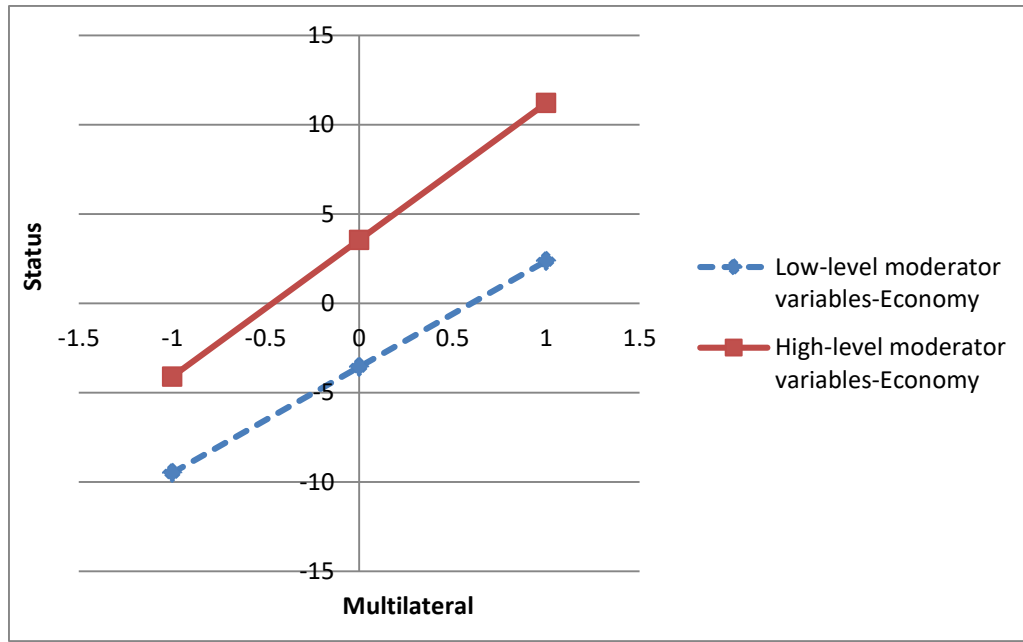


Figure 4.6: Moderating Effect of Economy on Multilateral

Third, the moderating effect of the *Economy* on *Investment*. After the interaction of *Economy* and *Investment* moderates, it shows a positive effect at the 5% level of significance. The coefficient of the interaction is 0.0885, with a z-value of 2.2115, indicating that for every one-unit increase in the score of *Economy* (i.e., a one-unit decrease in economic risk), the negative effect of investment on the success of PPP projects weakens by 0.0885 units. Following Aiken et al. (1991)'s method, the moderating effect of *Economy* was plotted in Figure 4.7. Under conditions of higher *Economy*, the slope between *Investment* and the success of PPP projects was steeper, indicating a weakening of the negative impact of investment on PPP success. Specifically, the higher the *Economy* score (indicating lower risk), the lower the negative impact of investment on the probability of PPP project success.

Therefore, the smaller the *Economy* score, the higher the economic risk, weakening the PPP project profile and the success of the PPP project. In support of hypothesis H_{3b}.

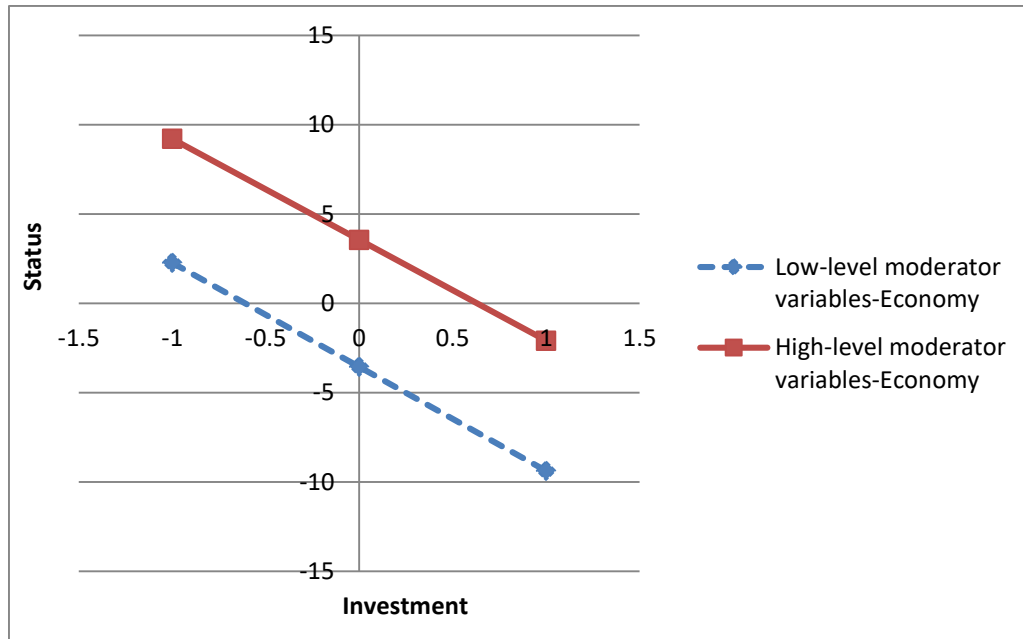


Figure 4.7: Moderating Effect of Economy on Investment

4.4.4 Moderating Effects of Finance

First, the moderating effect of the *Finance* on *Sponsors*. After moderating for the interaction of *Finance* and *Sponsors*, the results indicate non-significance.

Second, the moderating effect of the *Finance* on *Multilateral*. After the interaction of *Finance* and *Multilateral* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.4350, with a z-value of 2.5758, indicating that for every one-unit increase in the score of *Finance* (i.e., a one-unit decrease in financial risk), the effect of multilateral on the success of PPP projects increases by 0.4350 units. Following Aiken et al. (1991)'s method, the moderating effect of *Finance* was plotted in Figure 4.8. Under conditions of higher *Finance*, the slope between multilateral and the success of PPP projects was steeper, indicating a stronger impact of Multilateral on PPP

success. Specifically, the higher the *Finance* score (indicating lower risk), the greater the impact of multilateral on the probability of PPP project success.

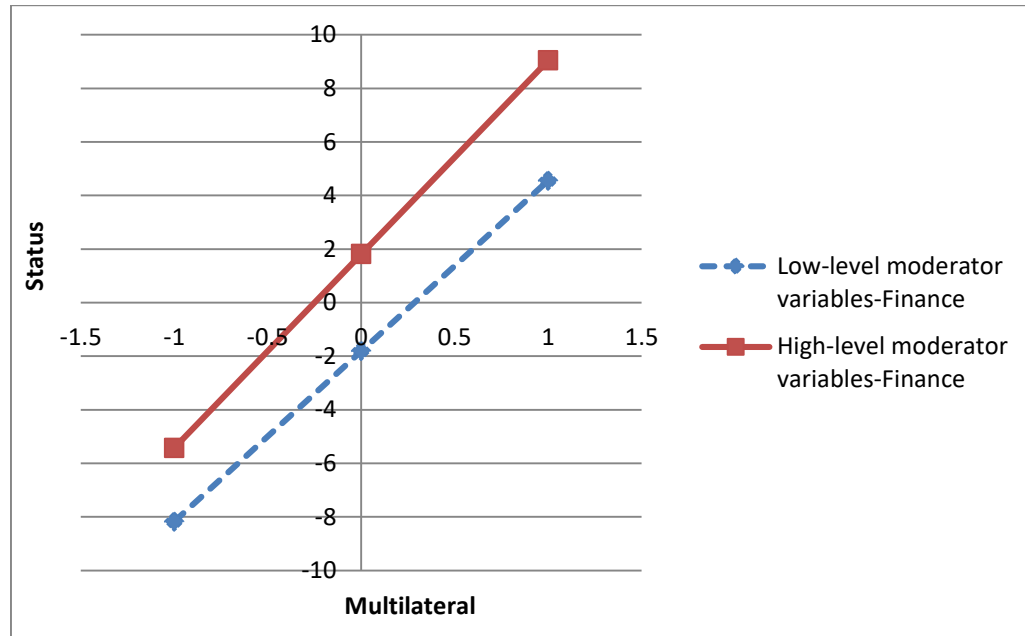


Figure 4.8: Moderating Effect of Finance on Multilateral

Third, the moderating effect of the *Finance* on *Investment*. After the interaction of *Finance* and *Investment* moderates, it shows a positive effect at the 1% level of significance. The coefficient of the interaction is 0.1208, with a z-value of 2.5758, indicating that for every one-unit increase in the score of *Finance* (i.e., a one-unit decrease in financial risk), the negative effect of investment on the success of PPP projects weakens by 0.1208, units. Following Aiken et al. (1991)'s method, the moderating effect of *Finance* was plotted in Figure 4.8 Under conditions of higher *Finance*, the slope between *Investment* and the success of PPP projects was steeper, indicating a weakening of the negative impact of investment on PPP success. Specifically, the higher the *Finance* score (indicating lower risk), the lower the negative impact of investment on the probability of PPP project success.

Therefore, the smaller the *Economy* score, the higher the financial risk, weakening the PPP project profile and the success of the PPP project. In support of hypothesis H_{3c}.

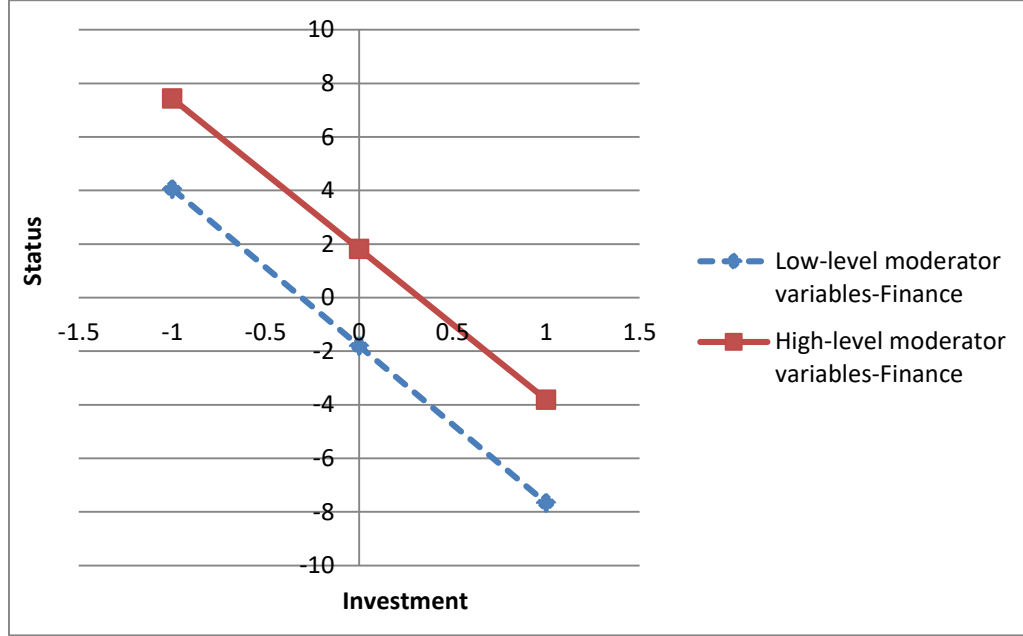


Figure 4.9: Moderating Effect of Finance on Investment

$$\begin{aligned}
 \log\left(\frac{P}{1-P}\right) = & 9.3600 + 11.2832Sponsors_1 + 6.7985Multilateral_1 \\
 & - 5.7389Investment + 0.9801Politics + 3.5561Economy \\
 & + 1.8093Finance + 0.4976(Sponsors_1 \times Politics) \\
 & + 0.7454(Sponsors_1 \times Economy) + 0.2598(Multilateral_1 \times Politics) \\
 & + 0.8602(Multilateral_1 \times Economy) + 0.4350(Multilateral_1 \\
 & \times Finance) + 0.0926(Investment \times Politics) \\
 & + 0.0885(Investment \times Economy) + 0.1208(Investment \times Finance) \\
 & + \varepsilon
 \end{aligned}$$

Where, the interaction term between *Sponsors* and *Finance* is not significant and is not included in the equation.

4.5 Robustness Test

Robustness testing is conducted by splitting a sample, changing the research method or using alternate variables. To verify the model's robustness, this study used alternate variables. The per capita growth rate of GDP was used instead of the GDP growth rate to observe changes in the model's results. Table 4.11 shows that the method used was the same as in Model 4 of Table 4.5. Except for replacing the GDP growth rate with the per capita growth rate of GDP, the other variables remained the same. A binary logistic regression with a backward stepwise (LR) method was used for analysis. The robustness test results are generally consistent with the original model results, showing no significant differences. Therefore, the data sufficiently demonstrate that the findings of this study are relatively robust.

Table 4.11: Robustness Test Results

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Sponsors(1)	2.499	1.065	5.505	1	0.019	12.172
MultiLateral(1)	5.283	1.553	11.572	1	0.001	196.966
Investment	-5.375	1.450	13.750	1	0.000	0.005
GDPg-per capita	1.351	0.481	7.907	1	0.005	3.863
Credit	0.084	0.030	7.991	1	0.005	1.087
Open	1.370	0.415	10.927	1	0.001	3.937

4.6 Discussion

This study posed three main hypotheses, comprising 11 sub-hypotheses. These were tested using binary logistic regression and other methods. The results of each hypothesis test are discussed in this section.

H₁ posits that PPP project profile factors significantly affect a project's success. The results indicate that project profile factors had no significant, positive or negative impact. H₂

posits that country risk negatively affects project success. The results indicate that country risk negatively affected the success of PPP projects. H₃ posits that country risk significantly influences the relationship between project profile factors and project success. The results indicate that country risk strengthened the effect of project profile factors on project success.

4.6.1 PPP Project Profile Factors and Project Success

A PPP project's success is influenced by various elements intrinsic to the project, including investment scale, investment type, sector, participation of social capital and support from multilateral countries. Based on the analysis results in Table 4.5, the following conclusions are drawn:

Based on H₁, investment scale significantly decreases log-odds of the PPP project success. The results indicate that investment scale negatively impacted project success in the study sample. This finding aligns with previous empirical studies (He & Kangning, 2018; Schepper et al., 2015; Wu, 2021; Yuan, 2018).

Regarding the hypothesis that investment type can significantly explain PPP project success, the results indicate that the relationship between investment type and PPP project success was not significant. While previous studies (Tan & Zhao, 2019; Alireza et al., 2018; Zhang & Man, 2018) suggest a significant impact, this study found no significant effect. The literature concludes that investment type is not a decisive factor for success, as the type of investment depends on the needs of specific BRI countries.

Regarding the hypothesis that investment sector can significantly explain PPP project success, the results indicate that the relationship between investment sector and project success was not significant, aligning with previous studies (Williamson, 1988). The reason

may be that earlier research focused on the industry selection of PPP projects. In contrast, this study focused on the environmental conditions of the countries where the investment is made.

For the hypothesis that private sector participation significantly increases log-odds of PPP projects, the results indicate that private sector participation significantly increases log-odds of project success. This finding consistent with previous empirical studies (Asadornborikarn, 2021; Luo et al., 2017; Martimort et al., 2015; Menezes et al., 2015; Yuan, 2018). Exploring the literature, PPP projects must be the result of collaboration between the government and the private sector. In other words, the participation of the private sector is essential, and the involvement of multiple private sector entities is even better.

Regarding the hypothesis that multilateral support significantly increases log-odds of PPP project success, the results indicate that the more support from other countries, the higher the success rate of PPP projects. This finding is consistent with previous empirical studies (Estache, 2006; Galilea & Medda, 2010; Luo et al., 2017; Shen, 2016; Yang & Wang, 2018; Ye, 2017).

Based on public goods theory (Samuelson, 1954), the public goods invested in PPP projects are non-excludable. Public goods theory posits that the investment scale, investment sector and multilateral support in PPP infrastructure projects are constraints (Ye, 2017). Therefore, when investing in PPP projects in BRI countries, companies should consider the investment scale and multilateral support policies based on public goods theory. At the same time, they should also consider the support level for infrastructure construction in terms of industry and type. This approach can help companies improve the success rate of PPP projects.

4.6.2 Country Risk and Project Success

The success of PPP projects is influenced by country risk, including political, economic, and financial risks. Based on the analysis results in Table 4.5, the following conclusions are drawn:

H₂ posits that political risk significantly decreases log-odds of the success of PPP projects. The results indicate that the higher the political risk, the lower the PPP project success rate. This is consistent with previous studies (Asadornborikarn, 2021; Danish, 2018; Galilea & Medda, 2010; Kraay & Mastruzzi, 2010). Based on the definition of political risk by the US International Report Group, political risk includes government stability, socioeconomic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability and bureaucratic quality. These political factors significantly negatively impact the success of PPP projects.

Regarding the hypothesis that economic risk significantly decreases log-odds of the success of PPP projects, the results indicate that the greater the economic risk, the lower the PPP project success rate. This finding is consistent with previous studies (Gao et al., 2017; Shen, 2016; Wang, 2018). Based on the definition of economic risk by the US International Report Group, economic risk includes per capita GDP risk, GDP growth risk, inflation risk, budget balance risk, and current account risk. The greater these risks, the more uncertain factors they bring to PPP projects, leading to lower success rates.

Regarding the hypothesis that financial risk significantly decreases log-odds of the success of PPP projects, the results indicate that the greater the financial risk, the lower the PPP project success rate. This finding is consistent with previous studies (Opawole et al.,

2017; Mei, 2020; Percoco, 2014; Yang, 2018). Based on the definition of financial risk of the US International Report Group, financial risk includes external debt risk, current account risk as a percentage of XGS (exports of goods and services), international liquidity risk, exchange rate stability risk and debt repayment risk. The greater these risks, the greater the uncertainty and the lower the success rate of PPP projects.

According to institutional theory (Rahman et al., 2019), PPP projects must be in a favourable macro environment, particularly a stable political environment. In such a macro environment, countries must apply institutional theory to create policies for the environment in which PPP projects operate. For instance, policies can be established to reduce political, economic and financial risks. These policies can safeguard the success of PPP projects.

4.6.3 Moderating Role of Country Risk in Project's Own Success

H₃ posits the moderating effect of country risk on the relationship between project profile factors and project success. The results indicate that when political risk increased, the negative relationship between project profile factors and project success was strengthened, reducing the success rate of PPP projects in the study sample. When economic risk increased, it also weakened the impact of project profile factors on project success, thereby reducing the success rate. Similarly, when financial risk increased, it weakened the impact on PPP projects while reducing the success rate. These findings are consistent with previous studies (Demirag et al., 2012; Huang et al., 2016; Jia, 2015; Khan et al., 2020; Liu et al., 2019; Nguyen et al., 2018).

The negative impact of country risk as a moderating variable on project success can be explained by risk management theory. Haynes (1895) suggested that risk involves uncertain factors and burdens project implementation. Meng (2020) argued that accurately

predicting risks and reducing the moderating effect of country risk can improve the success rate of PPP projects. Gao (2018) employed various risk identification methods to control risks, reduce the moderating effect of country risk and enhance project success rates.

4.7 Chapter Summary

This section encompassed the relationship between PPP project success and project profile factors, the relationship between PPP project success and country risk and the relationship between country risk, PPP project success and project profile factors. Table 4.12 presents the summary of the results and findings.

Table 4.12: Summary of Results and Findings

Hypothesis	Result	Support
H ₁ : Project profile significantly explains the success of PPP project;		/
H _{1a} : Investment scale significantly decreases log-odds of the success of PPP projects;	Supported	(Asadornborikarn, 2021); (He & Xu, 2018); (Wu, 2021); (Liu et al., 2020); (Liu, 2022); (Wang, 2021); (Schepper et al., 2015); (Yuan, 2018);
H _{1b} : Investment type significantly explains the success of PPP projects;	Not supported	/
H _{1c} : Investment sector significantly explains the success of PPP projects;	Not supported	/
H _{1d} : Private sector participation significantly increases log-odds of PPP project success.;	Supported	(Estache, 2006); (Galilea & Medda, 2010); (Luo et al., 2017); (Sheni, 2016); (Xue, 2021); (Ye, 2017); (Yang & Wang, 2018); (Zhao, 2020)
H _{1f} : Multilateral country support significantly increases log-odds of PPP project success.;	Supported	(Estache, 2006); (Galilea & Medda, 2010); (Luo et al., 2017); (Sheni, 2016); (Xue, 2021); (Ye, 2017); (Yang & Wang, 2018); (Zhao, 2020)

Table 4.12 continued

Hypothesis	Result	Support
H ₂ : Country risk significantly decreases log-odds of the success of PPP projects;		/
H _{2a} : Political risk significantly decreases log-odds of the success of PPP projects;	Supported	(Asadornborikarn, 2021); (Danish, 2018); (Galilea & Medda, 2010); (Kraay & Mastruzzi, 2010); (Xie, 2020)
H _{2b} : Economic risk significantly decreases log-odds of the success of PPP projects;	Supported	(Gao & Qin, 2017); (Wang, 2018); (Shen, 2016); (Wu, 2021) (Xie, 2020);
H _{2c} : Financial risk significantly decreases log-odds of the success of PPP projects;	Supported	(Mei, 2020); (Opawole & Jagboro, 2017); (Percoco, 2014); (Wang, 2021) (Yang, 2018), (Yang, 2021);
H ₃ : Increased country risk will increase the project's own relationship to project success in the reverse direction	Supported	/
H _{3a} : Increased political risk will increase the negative relationship of the project profile to project success	Supported	(Demirag et al., 2012); (Khan t al., 2020)
H _{3b} : Increased economic risk will increase the the project profile and project success.	Supported	(Asadornborikarn, 2021); (Huang et al., 2016); (Liu et al., 2018)
H _{3c} : Increased financial risk will increase the negative impact on the project profile and project success.	Supported	(Asadornborikarn, 2021); (Huang et al., 2016); (Liu et al., 2018)

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter presents the research results while providing a final explanation of the findings from Chapter 4. Second, targeted recommendations based on the research results are proposed. Third, the contributions of this study are highlighted. Finally, the limitations of this research and suggestions for future studies are discussed.

5.2 Conclusions

This study primarily explored the determinants of Public–Private Partnership (PPP) projects in countries along the Belt and Road Initiative (BRI). The research utilised the World Bank’s PPI database, selecting data on PPP projects in BRI countries from 1993 to 2022. Based on previous research, three control variables were included to better estimate the model.

This study proposed four research questions: (1) What is the relationship between the success of PPP infrastructure projects in BRI countries and the project profile factors? (2) How does the macro environment of the host country affect the success of PPP projects? (3) How does country risk impact the success of PPP infrastructure projects? (4) How does the moderating effect of country risk influence the relationship between the PPP project profile factors and project success?

The model in this study was based on previous literature, such as Wang (2021) and Wu (2021) and employed logistic regression. Before running the logistic regression model, this study tested normality, multicollinearity and heterogeneity. The results indicate that the

variables conformed to a normal distribution and no multicollinearity issues. Thus, the correlation and heterogeneity tests were optimally suited for the logistic regression model.

5.2.1 PPP Project's Own Factor and Project Success

The first question focused on one of the determining factors of PPP projects: the project profile factors. The study explored the relationship between the PPP project profile factors and project success. PPP project profile factors are numerous, including investment scale, investment type, investment sector, number of private sector participants and amount of support from multilateral countries. The analysis in this study indicates that project profile factors partially influenced project success. There was a negative impact on the scale of investment and project success, while the amount of support from multilateral countries significantly increases log-odds of PPP project success. project success. However, investment type, investment sector, and the number of private sector participants did not significantly impact project success in the study sample.

According to public goods theory, infrastructure built by the government is considered a public good, which, unlike other products, has the characteristic of non-excludability. Therefore, the investment sector and investment type are not decisive factors for the success of PPP projects. Rather, national policies and government construction needs are more influential. Additionally, public goods theory posits that public goods are non-competitive. Thus, the number of private sector participants is not a decisive factor for the success of a PPP project. The cooperation model of PPP projects requires collaboration between the government and at least one private sector participant. Consequently, the decisive factors for the success of PPP infrastructure projects in BRI countries are investment scale and the level of multilateral support.

5.2.2 Control Variables and Project Success

The second question focuses on one of the key determinants of PPP projects: the macro environment. Previous studies suggest that the macro environment of PPP projects includes three main factors. The first is the country's GDP growth rate, representing national strength. The second is the country's openness level, reflecting the extent to which it accepts foreign investment. The third is the level of support the country provides to the private sector through credit. The findings indicate that all three macro environment factors significantly increase log-odds of the success of PPP projects in the study sample.

Public goods theory posits that public goods are purchased by the government and used by the public, characterised by their shared nature. Meanwhile, institutional theory suggests that a country controls its resources and policy directions through institutions. Therefore, the success of PPP projects is influenced by a country's macro environment. A strong country with a high GDP growth rate and significant investment in infrastructure is more likely to facilitate successful projects. Similarly, the government supports PPP projects selectively based on national strategy and needs through credit and attracting foreign investment.

5.2.3 Country Risk and PPP Project Success

The third question focused on one of the key determinants of PPP projects: country risk. Based on the standards of the US International Report Group (PRS, 2023), country risk can be divided into political, economic and financial risks. The maximum scores for these three risks are 100, 50 and 50, respectively. The higher the score, the lower the risk level. The findings indicate that the country risk scores significantly increase log-odds of the

success of PPP projects. In other words, country risk significantly decreases the log-odds of the success of PPP projects. Risk management theory suggests that moderate risk can be beneficial, but excessive risk can lead to project failure. Therefore, PPP project companies should adequately address country risk and implement effective risk management to improve PPP project rates.

5.2.4 Moderating Role of Country Risk on PPP Project Own Factors and Project Success

The fourth question focused on the moderating effect of country risk. The model tests the moderating effects of political, economic and financial risks on the relationship between the PPP project profile factors and project success. The study evaluated the extent of the moderating effects of the three types of country risks. The CATPCA method was used to merge the variables of the PPP project profile factors. The findings indicate that the investment scale had the highest proportion and the greatest impact among the PPP project profile factors. There was a significantly decreases the log-odds of the PPP project profile factors and project success. Increased country risk scores weakened the negative relationship between project profile factors and project success; lower country risk scores strengthened the negative relationship between project profile factors and project success. In other words, as country risk increases, it strengthens the negative relationship between project profile factors and project success. When observing the three types of risks specifically, political risk had the lowest moderating effect on the relationship between PPP project profile factors and project success. Economic risk had the greatest moderating effect. Risk management theory suggests it is crucial to identify and control the core risks with the greatest impact during project implementation.

5.3 Policy Applications

This study explored the determinants of the success of PPP infrastructure projects in countries along the Belt and Road Initiative (BRI). The research has aimed to provide recommendations for Chinese enterprises investing in BRI countries by discussing the success factors of PPP projects, as discussed below.

5.3.1 Policy Recommendations for the Chinese Government

First, the Chinese government should strengthen communication and cooperation with countries along the Belt and Road Initiative (BRI). This study's results recommend that the Chinese government enhances mutual assistance and collaboration with BRI countries. Currently, China's Public–Private Partnership (PPP) model has developed rapidly in terms of both quantity and scale, covering a wide range of industries and accumulating considerable project management and practical experience. The Chinese government can establish communication mechanisms with BRI countries to transfer relevant technologies and experiences. At the same time, the Chinese government can help Chinese enterprises undertake PPP projects in host countries through cooperation with BRI countries. Under the guidance of the Chinese government, Chinese enterprises can improve the infrastructure construction and operational environment in host countries, thereby increasing the success rate of China's overseas PPP investments.

Second, the Chinese government should strengthen cooperation with bilateral and multilateral institutions. The study results suggest that support from multilateral countries increase the log-odds of project success. Therefore, it is recommended that the Chinese government strengthen cooperation with bilateral and multilateral institutions, especially multilateral financial institutions. Multilateral financial institutions such as the World Bank

and the Asian Development Bank are crucial for obtaining financing for PPP projects. They have high guarantees in BRI countries and can stimulate more Chinese enterprises to invest in higher-risk PPP projects (Wang, 2021). As the demand for funding for infrastructure projects in BRI countries increases, investments from multilateral financial institutions become indispensable. Thus, the Chinese government should fully utilise the role of multilateral financial institutions in project cooperation, risk prevention and international dispute resolution. By collaborating with the World Bank and the Asian Development Bank, the Chinese government can assist Chinese enterprises in investing in PPP projects in BRI countries.

Third, the Chinese government should adhere to the principles of mutual benefit and risk prevention. Based on the study results, it is recommended that the Chinese government insists on mutual benefit and win-win outcomes. The BRI provides international public goods for the countries along its route. The Chinese government should maintain an open and inclusive approach to geopolitical conflicts and Great Power rivalries, insist on mutual benefit and mitigate risk behaviours arising from conflicts between major powers and related interest groups. The Chinese government should steadfastly promote the open market system of BRI countries while actively exploring and establishing a dispute resolution mechanism for country risks during the BRI construction process.

Fourth, the Chinese government should strengthen the assessment of host country government credibility. The study results indicate that political risk negatively regulated project success in the sample. Therefore, good credit can enhance a host country's government credibility, which is a critical factor in ensuring the success of PPP projects in BRI countries. The Chinese government can improve government credibility in the

following ways: (1) establish a government credit evaluation system to play a supervisory role; (2) formulate relevant laws, regulations and policies to clarify government default penalties; (3) specify relevant government credit issues in PPP project contracts to prevent government defaults due to term changes or political shifts. Thus, strengthening the assessment of a host country's government credibility can mitigate the impact of political risks on the success rate of PPP projects.

Finally, the Chinese government should build an information-sharing platform for PPP projects. The study results indicate that country risks significantly increase log-odds of project success. Therefore, it is necessary to establish an efficient and timely information-sharing platform to promote the success of PPP projects. The basic function of a PPP project information-sharing platform would be to integrate and publish project-related information in a timely manner, including the host country's macro environment, political risks, economic risks and financial risks. At the same time, a PPP project information-sharing platform can serve as a vehicle for public sectors to promptly release project progress and specific information while facilitating public supervision of projects. The combination of the platform advantages can ensure the efficiency and transparency of BRI's PPP projects. Additionally, establishing a tracking and evaluation mechanism for PPP projects in BRI countries on the information-sharing platform would enable various stakeholders to evaluate projects from multiple perspectives, enhancing the platform's participation. Through the PPP project information-sharing platform, the needs of various stakeholders for project success can be met more effectively. This can achieve shared benefits for BRI PPP projects, reduce risks and improve project success rates.

5.3.2 Policy Recommendations for Chinese Enterprises

First, the study found that investment scale significantly decreases the log-odds of project success. Therefore, Chinese enterprises should choose appropriate countries for investment based on their PPP project industry advantages. Given that investment scale significantly decreases the log-odds of project success, it is essential for enterprises to fully consider country risks and balance the relationship between investment scale and project returns. Chinese enterprises should fully grasp the Chinese government's cooperation trends with BRI countries. Enterprises should select countries for imminent investment and seek support from multilateral financial institutions under the guidance of Chinese policies. When investing in PPP projects in BRI countries, Chinese enterprises should recognise the financial openness of these regions. They should actively seek credit support from financial institutions such as the World Bank and the Asian Infrastructure Investment Bank, making adequate financial preparations for long-term operations and large-scale investments to ensure project success. Chinese enterprises should review the overall scale, development trends, scale conditions, industry layout and regional distribution of PPP projects in BRI countries, selecting PPP projects that align with their goals. Priority should be given to regions with a strong foundation for PPP project development while controlling the total scale of project investments to comprehensively reduce risks and enhance project success rates.

Second, Chinese enterprises should assess the external openness of the countries where PPP projects are located and reasonably select countries and regions for investment in PPP projects. Factors such as per capita GDP, GDP growth, inflation, budget balance and current account status should be considered. Chinese enterprises should focus on investing in countries and PPP projects that align with their investment development goals and exhibit

economic growth potential. Particular attention should be paid to the openness of trade, investment and finance of the host country, making situational and regional decisions on participation in PPP projects. Enterprises should prefer countries with high degrees of openness, increasing their participation in PPP projects in these regions. In contrast, enterprises should be cautious about investing in PPP projects in countries with low degrees of openness. Additionally, choosing countries with strong support for the private sector is advisable, as these countries are more likely to prioritise and support the private sector, leading to higher success rates for investments.

Third, Chinese enterprises should consider the political system differences among BRI countries to reduce political risk. Thorough research on the political landscape of BRI countries is necessary, including government stability, law and order, internal and external conflicts, government corruption, military influence in politics, religious tensions, ethnic tensions and the quality of bureaucracy. Respecting local religious customs and traditions can mitigate conflict and political risks. Understanding and adhering to local laws, whether they follow common law or civil law systems, is crucial (Yock, 2020). From bidding and financing to contract signing, project implementation and operations, PPP projects involve various legal aspects. Strengthening legal knowledge can help mitigate legal risks.

Finally, Chinese enterprises should establish a risk management system. This system should guide the handling of various risks when investing in PPP projects in BRI countries and should be integrated throughout the entire PPP project process. First, before investing in PPP projects, enterprises should accurately identify project risks, including the host country's political, economic and financial environments. Enterprises must scientifically identify and evaluate potential risks related to policy regulations and legal provisions

involved in PPP projects. Based on the evaluation results, enterprises should construct risk warning and prevention mechanisms to reasonably manage, share and mitigate risks. Second, enterprises improve risk awareness across all departments. They should hire professional management talent and regularly hold educational seminars on risk management. By perfecting their risk management systems, the overall risk management capability of Chinese enterprises will be enhanced, thereby increasing the success rate of their investments in PPP projects in BRI countries.

5.4 Study Contributions

This study identified research gaps and issues that must be addressed and established the research objectives accordingly. Empirical research was conducted using World Bank data to achieve these objectives. Therefore, these contributions are logical to some extent.

5.4.1 Knowledge Contributions

First, this study enriches the understanding of the intrinsic relationship between the success of PPP infrastructure projects and the projects themselves. Previous research has primarily focused on the PPP model and the risks associated with PPP projects. Based on data from the World Bank database, this study empirically examined the decisive factors influencing the performance of PPP projects in BRI countries. These factors include project profile factors such as investment scale and support from multilateral cooperation, macro environmental factors such as national GDP growth, support for the private sector, and the degree of national openness, as well as country risk factors such as political, economic and financial risks. All these factors significantly increase log-odds of the success of PPP projects. This study is one of the first empirical studies on the decisive factors of PPP project performance, thus enriching the existing empirical research.

Second, the study enriches the understanding of the combined impact of a host country's macro environment on the success of PPP projects. While previous research on PPP projects has considered the macro environment, it has rarely done so comprehensively. The present study constructed a leading model of influencing factors and added macro environmental factors individually to analyse their combined impact. The empirical results indicate that project profile factors significantly increase log-odds of project success under the influence of the macro environment. These factors were also significantly positive impact on each other. By providing more comprehensive evidence, this study illustrates the key factors in the macro environment that influence the success of PPP projects, thereby enriching the existing literature.

Third, the study enriches the understanding of the impact of country risks on the success of PPP infrastructure projects. Previous studies on PPP projects have typically focused on specific countries and have rarely considered BRI countries as a whole. Using World Bank data, this study empirically analysed the BRI countries that have implemented PPP projects. The empirical results indicate that project success was negative impact on investment scale, positive impact on a country's macro environment and negative impact on country risk in the study sample. By providing more comprehensive evidence, this study illustrates the key factors for PPP project success, thus augmenting the existing literature.

Finally, the study enriches the understanding of the moderating role of country risk in the relationship between project profile factors and the success of PPP projects. Previous research on PPP project risks has focused on risk assessment, with little investigation into how these risks influence project success and their moderating effects. Using the US National Reports' country risk guide, this study empirically examined the impact and

moderating effects of three types of country risk on PPP project success. The study findings indicate that all three types of country risks significantly decreased the log-odds of PPP project success. Regarding moderating effects, political risk had the lowest moderating effect on the relationship between project profile factors and project success, while economic risk had the highest moderating effect. These findings enrich the current literature on this topic.

5.4.2 Contribution to Decision-Makers

This research poses significant implications for decision-makers and management within Chinese enterprises and the government. First, the key factors for the success of PPP projects in BRI countries identified in this study can influence the international investment strategies of Chinese enterprises. The findings provide guidance for Chinese enterprises and the government in several areas.

First, regarding the impact of project profile factors on project success, the study indicates that multilateral cooperation, especially financial cooperation, helps improve funding support for Chinese enterprises in PPP projects. Therefore, Chinese enterprises can seek to involve additional countries and the host country in PPP projects, as the findings provide theoretical support for such collaborative efforts.

Second, regarding the impact of macro factors on project success, the findings illustrate that macro factors such as GDP growth rate, the level of support for the private sector, and the degree of national openness increase the log-odds of the success of PPP projects in the sample. Therefore, Chinese enterprises can leverage this information to focus on the macroeconomic environment of host countries when making investment decisions and choosing to collaborate based on advantageous macro conditions.

Third, regarding the impact and moderation of country risk on project success, the study reveals that political, economic and financial risks significantly decreases the log-odds of project success. Additionally, these three risk types negatively moderated the impact of project profile factors on project success. Therefore, it is crucial for Chinese enterprises to accurately assess country risks in BRI countries and select suitable countries and PPP projects for investment. This insight also underscores the importance of international communication and cooperation for the Chinese government, suggesting that only by strengthening these aspects and through the operations of Chinese enterprises can mutual development between countries be promoted, providing theoretical support for these initiatives.

5.5 Research Limitations

First, a limitation of this study is that it focused on PPP infrastructure projects in BRI countries. Although this study aims to provide recommendations for Chinese enterprises by empirically studying data from BRI countries, the scope is limited to these countries. The findings do not reference non-BRI countries and cannot be generalised to PPP project construction in other countries.

A second limitation of this study is the broad range of PPP project industries considered without focusing on a specific infrastructure industry. This study aims to provide direction for Chinese enterprises' investments, so it has not focused on a single industry nor studied one industry in isolation. However, encompassing the variation across industries (energy, ICT, transportation, water supply and treatment, and urban solid waste treatment), the findings and recommendations may not apply to all industries. This study provides a

reference to enterprises and governments from the perspective of overall PPP projects, where industry-specific understandings should be explored in future research.

Finally, a limitation of this study lies in the variable selection for data collection. This study relied solely on secondary data from the World Bank, the World Bank PPI database and the US Intercountry Risk Investment Reports. Some data in the model were missing or not detailed, and these data were omitted from the sample. However, while this limitation was unavoidable, these data might be crucial and significantly impact the results. Data selection presented another limitation. PPP project contract periods range from 5 to 30 years, creating a significant period. Previous studies selected data from the project year (e.g. a project invested in 2000 would use data from 2000, such as GDP and country risk) without considering environmental changes during the construction period. Based on previous findings, there are several determinants of PPP project performance. However, due to the scope of this study, it was not feasible to examine all factors. Therefore, this study selected key variables based on the framework and objectives. Inevitably, not all determinants were comprehensively studied as a result.

5.6 Recommendations for Future Research

Based on the findings and limitations, this study poses recommendations for future research as follows. First, the research scope should be expanded beyond PPP projects in BRI countries. Based on the data provided by the World Bank PPI database, future research should examine the determinants of PPP project performance worldwide. The findings could assist governments and enterprises in other countries that invest in PPP projects to achieve better project success rates based on empirical data.

Second, research should focus on PPP projects of a specific industry to examine the determinants. While studying the determinants of PPP project performance in a specific industry is relatively straightforward, it can allow for thorough research. It can serve as a more specific model for that industry. Therefore, this study recommends focusing on specific industries in future research while examining these industries individually to elicit a more nuanced understanding of the determinants for each industry.

Third, future research should expand the selection of variables and increase the use of primary data. When studying a specific industry, it would be appropriate to increase the number of influencing variables and use primary data. As the research scope narrows, the study challenges would decrease. Therefore, adding more variables and combining primary and secondary data could lead to more comprehensive findings.

5.7 Chapter Summary

This final chapter has presented the research conclusions of this study. It explored the relationships between PPP projects themselves, the macro environment, country risk and project success. The chapter has provided recommendations for Chinese enterprises and the government based on the research results. It has discussed the contributions of this study to the existing knowledge system and decision-makers. Finally, it has outlined the limitations of this study while offering suggestions for future research.

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APPENDICES