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Influence of Project Governance Mechanisms on the Sustainable Development of Public-Private Partnership Projects: An Empirical Study from China

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Abstract: In China, achieving sustainable development goals for PPP projects is an urgent issue. Project governance mechanisms are important to PPP project sustainability, but there are many risk factors in traditional project governance mechanisms. This research focuses on embedding risk governance mechanisms into the traditional project governance system with contract governance mechanisms and relationship governance mechanisms. The main purpose is to reveal the integration of PPP project governance mechanisms and its impact on governance performance and project sustainability, and to propose governance optimization strategies. First, by enriching the understanding of the governance mechanism, governance performance and project sustainability, and improving the measurement scale. Then, by constructing a structural equation model, collecting data through questionnaires, and exploring the effect of the project governance mechanism on project sustainability. (1) The results of direct effect testing show that contractual governance mechanisms, relational governance mechanisms and risk governance mechanisms are positively associated with governance performance, and governance performance is positively associated with project sustainability; (2) the results of mediating effect testing show that interaction of the three governance mechanisms has a positive effect on governance performance. The research results provide a new approach and perspectives for improving project governance mechanisms and achieving sustainable development in the practice of PPP projects.

Keywords: PPP project; governance mechanism; governance performance; sustainability

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1. Introduction

The PPP model refers to the cooperative model in which the government introduces social capital through market mechanisms, which can not only relieve pressures on public finance, but also helps improve the supply efficiency of public facilities and services [1]. This model has become a major innovation of institutional supply in the field of infrastructure and public services, and has been widely adopted by more and more countries, especially developing countries [2]. In recent years, the Chinese government has successively issued policy documents related to the PPP model, formally proposing that the model be widely adopted in the construction of public infrastructure. Various local governments have launched PPP projects in succession, and this model has been vigorously developed in China [3]. The latest data from the PPP project database of the Ministry of Finance shows that, as of February 2023, a total of 10,396 PPP projects have been signed nationwide, with an investment of 16.4 trillion yuan [4]. However, from 2018 to 2022, the cumulative number of returned projects reached 3817, with an investment of 4.58 trillion yuan. The reason is that the problems existing in the explosive development of PPP projects, such as imperfect theories and systems and insufficient practical experience, restrict the healthy and sustainable development of PPP projects in China [5]. People began to focus on the development of PPP projects from rapid and vigorous development to the stage of healthy and sustainable development [6].

The United Nations is promoting a PPP model guided by the concept of sustainable development and has formulated more than 30 international PPP standards that match the 17 United Nations Sustainable Development Goals to promote the realization of sustainable development in PPP projects [7]. This study holds that project sustainability is not limited to the scope of the "iron triangle" (cost, schedule, and quality) of project management, but the comprehensive and coordinated development of economic, social and environmental dimensions. Chinese scholar Xiong Wei et al. (2017) [8] proposed sustainable development-oriented PPP project version 3.0 for the first time from the three perspectives of object-subject-process. This paper introduces the application and promotion of PPP project version 3.0 in reality, which provides enlightenment for research on sustainable development management of PPP projects. More and more PPP projects incorporate the concept of sustainability into the objectives of project management [9–11]. How PPP projects achieve sustainable development goals is an important issue that needs to be solved urgently.

Traditional project management methods have been unable to meet the management needs of sustainable development of PPP projects [6]. Project governance has been playing an irreplaceable role in the realization of the objectives of construction projects. Kong and Ma constructed a unified theoretical framework with internal governance and the external institutional environment and discuss the important impact of MNE participation on the survival of PPP projects [12]. Crawford [8] points out that project governance is a set of common management frameworks and procedures. Project governance is always for the realization of enterprise objectives, it covers a series of methods such as governance structure, value system, process system and so on, which can help to achieve organizational goals [8].

A good project governance mechanism can improve project governance performance and promote the sustainable development of projects [13,14]. In the field of project management, performance is recognized as the combination of processes and results based on comprehensive consideration of the "5E" criteria of PPP projects (economy, efficiency, effect, fairness and environmental factors). In this study, PPP project governance performance is defined as the comprehensive consideration of the governance process performance and governance result performance of PPP projects within the project life cycle based on the "5E" standard.

China's PPP project governance mechanism mainly relies on the contract governance mechanism and relationship governance mechanism, and the construction of the governance mechanism needs to be improved. Combined with the governance theory of Williamson, contractual governance is often regarded as a series of formal institutional arrangements in the process of project cooperation. Relational governance, as an informal governance mechanism opposite to formal contractual governance, mainly relies on social relations and shared norms to achieve relationship governance [15–17]. In a complex and uncertain environment, the existing governance system based on PPP project contracts and relationship norms finds it difficult to effectively deal with the complex practical problems it faces. Affected by the incompleteness of contracts and instability of partnerships, there are many complex risk factors in the process of contractual governance and relational governance, which increase the difficulty of project governance, resulting in a generally low governance effectiveness for PPP projects [18]. Therefore, it is necessary to improve the traditional project governance mechanism in view of the risks existing in PPP projects.

Scholars have tried to research project risk management from the aspects of project risk identification, risk assessment, risk prevention and control [19,20]. However, there have been few studies on PPP project risk governance in the past, especially a lack of research on the relationship between PPP risk governance mechanisms and project sustainability. The risk factors in PPP projects tend to have multiple impacts on the internal and external environment required for the stable development of PPP projects. Risk governance oriented by value creation is crucial to the healthy and sustainable development of PPP projects [21]. Therefore, in order to make up for the limitations of previous studies, this study embedded a risk governance mechanism into the project governance system with a

contract governance mechanism and relationship governance mechanism as the core, and comprehensively integrated project rules, relationships and values to form an integrated governance mechanism, and explore the relationship between the integrated governance mechanism and the sustainability of PPP projects.

This study contains some theoretical contributions. The first is to combine the reality of PPP projects in China, propose the definition and implications of the project governance mechanism, project governance performance and project sustainability, and divide the dimensions, design measurement scales, and conduct empirical research. The second is to analyze the impact mechanism of the project governance mechanism on project sustainability and explore the interaction of the three types of governance mechanisms. The research results provide new research perspectives and ideas for the governance of PPP projects, which are conducive to the development of project sustainability.

The following are two main research questions (RQ):

RQ1: How does the PPP project governance mechanism influence project governance performance and project sustainability?

RQ2: What is the interaction between the contract governance mechanism, relational governance mechanism and risk governance mechanism?

According to the above analysis, the sustainable development of PPP projects in China requires a more adaptable integrated governance mechanism. The aims of this paper are as follows: (1) to reveal the interaction mechanism between the integrated governance mechanism of PPP projects and project governance performance and sustainability; (2) to propose an optimization strategy for the PPP project governance mechanism.

2. Conceptual Model and Research Hypotheses

2.1. The Establishment of a Conceptual Model

Based on the above research hypotheses, this paper tries to integrate the three-dimensional mechanisms of a contract governance mechanism, a relational governance mechanism and a risk governance mechanism, and analyzes their internal interaction. Following the research idea of "project governance mechanism—project governance performance—project sustainability", the internal mechanism of the PPP project governance mechanism is studied theoretically and analyzed empirically. The conceptual model of the impact path of the PPP project governance mechanism is shown in Figure 1.

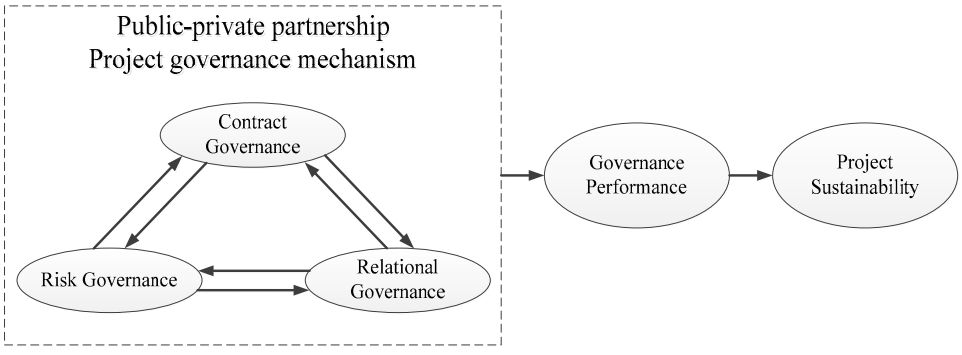

Figure 1. Conceptual model.

2.2. Governance Mechanism and PPP Project Governance Performance under the Direct Effect

The current research mainly focuses on the influence of a project governance mechanism on project governance performance [16,17,22]. Chen and Manley (2014) [23] developed a scale to measure the relationship between PPP project governance and performance, and the research showed that the project governance mechanism could well predict the deviation of project governance performance. Lu et al. (2015) [24] concluded that both contract governance and relational governance can improve project governance performance based on transaction cost economics. Zhang proposed that team interdependence has a positive

impact on cooperative performance in public-private partnership projects [25]. Risk governance is an important institutional arrangement to effectively resolve project conflicts and improve project performance [26]. Incorporating it into the PPP project governance mechanism with contract governance and relational governance as the core is a beneficial supplement and improvement to the existing governance mechanism, which can effectively avoid or reduce project risks and ensure the smooth implementation of projects. The existing research results show that the improvement of the governance mechanism will improve project governance performance. Therefore, it is hypothesized that:

H0. *The governance mechanism is positively associated with PPP project governance performance.*

The hypothetical Model of H0 is shown in Figure 2.

Figure 2. Hypothetical Model of H0.

Most of the existing studies deconstruct the governance mechanism from the two aspects of contractual governance and relational governance. According to the above analysis, this study regards the risk governance mechanism as equally important as the other two governance mechanisms.

In PPP projects, contract governance mechanism refers to the formal and legally effective agreement to constrain and manage the transactions between various organizations, and to stipulate the responsibilities and rights of both parties [27]. Contractual governance can clarify the responsibilities of participants through formal contract terms, achieve reasonable benefit distribution and risk sharing, reduce the opportunistic behaviors of both parties, and reduce cooperation risks [28]. However, the complexity of the PPP project environment and the characteristics of the relationship structure make contract governance unable to solve the problem completely, and relational governance needs to cooperate with it. A relational governance mechanism refers to the mechanism that implements transactions through relational rules different from formal contracts [29,30], this governance mechanism can play a restrictive role in informal mechanisms through trust, commitment, communication and joint problem solving [11]. Risk governance is to recognize and understand project risks based on the coordination and interaction of the government, social capital and the public, according to their own value judgment and interest demands, and to flexibly use corresponding management tools and methods at different stages of project development, systematically and scientifically identify, analyze and cope with the internal and external risks of the project, and eliminate or reduce the losses caused by project risks. Ultimately it creates the shared value of the project and promotes social public interests [21].

Therefore, this study divides the governance mechanism into three types and uses these three mechanisms to reflect the internal influence mechanism of governance mechanism on governance performance.

2.3. Three Types of Governance Mechanism and PPP Project Governance Performance

This study quotes the views of SCHEPKER, Yan and Sun that the contract governance mechanism is composed of two dimensions: risk sharing and benefit distribution [21,28]. In the process of PPP project implementation, contractual governance is an important link connecting stakeholders [31]. Ferguson (2005) [32] believes that contract governance can improve project performance and success rate by restricting the opportunistic behavior of relevant personnel. According to the cost transaction theory, rigorous and detailed contracts can effectively protect stakeholders by using the constraints of the formal framework [33,34]. Reasonable risk sharing means that when developing the contract governance mechanism, in addition to the mandatory provisions of the contract, moderate flexibility

should be maintained to deal with possible risks. Risk sharing is a commonly used incentive mechanism in PPP projects. Joyner (2007) [35] believed that PPP projects could improve project governance performance by establishing a reasonable risk sharing mechanism. In addition, contractual governance also includes income distribution clauses that determine the content and means of remuneration, and its incentive effect has been demonstrated by studies [36,37]. Therefore, making clear and detailed contract terms can avoid the opportunistic behaviors of stakeholders, protect the rights and interests of all parties, and improve governance performance [38]. It is thus hypothesized that:

H1. *A contract governance mechanism is positively associated with PPP project governance performance.*

H1a. *Risk sharing is positively associated with PPP project governance performance.*

H1b. *Income distribution is positively associated with PPP project governance performance.*

The hypothetical Model of H1, H1a and H1b are shown in Figure 3.

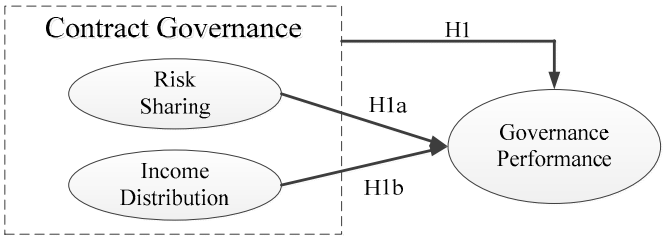

Figure 3. Hypothetical Model of H1, H1a and H1b.

It is found that some projects with strict contract customization do not achieve satisfactory project performance [39,40]. On the contrary, some projects without strict contracts have achieved satisfactory performance results in project practice [30]. This study reflects the views of Ness and Haugland, Cao and so on, and believes that the relational governance mechanism is composed of two dimensions: relationship maintenance and cultural construction [16,41]. Relationship rules often play a crucial role in market transactions. Establishing a good relationship with stakeholders can improve the satisfaction of all parties and the level of various indicators of project performance [24,42]. According to stakeholder theory, relationship governance is based on trust and common norms to reduce transaction costs [43]. Larson (1990) [44] found that the partnership management model was more suitable than other project management models in terms of quality, schedule, cost and satisfaction of project stakeholders through case studies of related projects. It can be seen that the good maintenance of stakeholder relationships can promote the project governance performance. Culture is the product of social practice. Eastern culture emphasizes "humanism", pays attention to human kindness, collectivism and people's sense of belonging to a collective. Under the influence of this environment, the interpersonal relationship has a higher degree of intimacy and trust, and the relationship is relatively stable [45]. Based on the Oriental cultural background, strengthening cultural construction and establishing organizational relationships can often result in more financial help, information resources and cooperation opportunities, which is conducive to PPP project governance and promotes project governance performance [46]. Hence, it is hypothesized that:

H2. *A relational governance mechanism is positively associated with PPP project governance performance.*

H2a. *Relationship maintenance is positively associated with PPP project governance performance.*

H2b. *Cultural construction is positively associated with PPP project governance performance.*

The hypothetical Model of H2, H2a and H2b are shown in Figure 4.

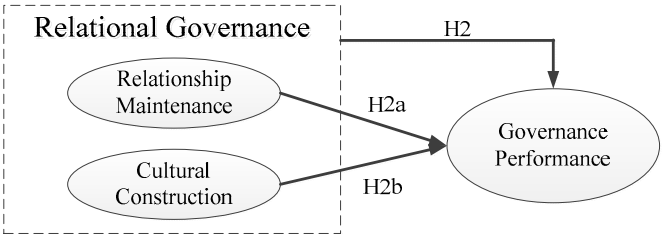

Figure 4. Hypothetical Model of H2, H2a and H2b.

The risk governance concept of IRGC provides important guidance for promoting the risk governance of PPP projects, which covers the collection, analysis, communication of risk information, risk management and decision making, etc. This study reflects the views of sun and R. Ortwin and believes that the risk governance mechanism is composed of three dimensions: risk identification, risk communication and risk decision-making [47,48]. Effective identification of project risk factors is considered to be an important prerequisite for risk governance, and rapid identification of the explicit or potential risk sources that affect the smooth implementation of projects can effectively avoid the accumulation and amplification of risk-induced problems [49–51]. At the same time, risks are common and even hidden in various stages of PPP projects. Effective risk communication can timely rectify the deviations generated in the process of project development [52,53]. According to Simon's decision-making theory, the essence of risk governance is risk decision-making. Risk identification and communication can provide a basis for project managers to make scientific decisions, improve the scientificity of project risk management and decision-making, realize the interaction and circulation of the PPP project risk management system, and then improve governance performance [54,55]. Therefore, it is hypothesized that:

H3. *A risk governance mechanism is positively associated with PPP project governance performance.*

H3a. *Risk identification is positively associated with PPP project governance performance.*

H3b. *Risk communication is positively associated with PPP project governance performance.*

H3c. *Risk decision-making is positively associated with PPP project governance performance.*

The hypothetical Model of H3, H3a and H3b are shown in Figure 5.

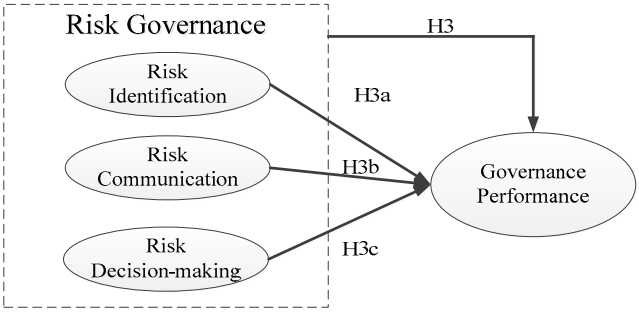

Figure 5. Hypothetical Model of H3, H3a and H3b.

2.4. Governance Mechanism and PPP Project Governance Performance under the Mediating Effect

Many studies have explored the relationship between contract governance and relational governance. Overly strict formal contracts may weaken the trust between partners and encourage rather than hinder the emergence of opportunistic behaviors [39,40]. Poppo

(2002) [56] studied and verified the complementary relationship between contract governance and relational governance and points out that the organic integration of the two governance mechanisms can improve project governance performance. Taking risk governance as a necessary link in contract governance and relational governance provides a "backbone" for efficient collaboration between contract governance and relational governance, which can make up for low governance performance caused by incomplete project contracts and unstable partnerships [47].The internal and external interaction and orderly coordination of risk governance, contract governance and relational governance can further improve project contracts, strengthen partnerships, avoid or reduce project management risks and external environmental risks, and help improve project governance performance. Therefore, it is hypothesized that:

H4. *A governance mechanism is positively associated with PPP project governance performance under the mediating effect.*

The hypothetical Model of H4 is shown in Figure 6.

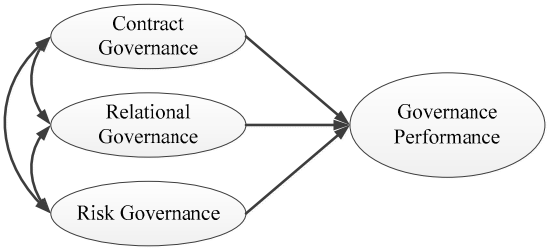

Figure 6. Hypothetical Model of H4.

2.5. Governance Performance and PPP Project Sustainability

An efficient governance mechanism for PPP projects ensures the success of the project [7]. The success of the project requires not only the realization of time, cost and quality objectives, but also the satisfaction and identity of the owners and related parties, as well as the economic, social and environmental impacts of the project [10,57–60]. Efficient project governance can provide a reasonable institutional environment, effective incentives and constraints for all project participants. It will improve the quality of managers' decisions, promote the development of partnerships, and increase the output of high-quality projects with low costs and low energy consumption [61,62] to achieve a series of social outcomes such as health, safety, self-identity, accessibility and belonging [63]. All these provide a strong guarantee for PPP projects to achieve sustainable development of the economy, society and environment [64,65]. Hence, it is hypothesized that:

H5. *Governance performance is positively associated with PPP project sustainability.*

The hypothetical Model of H5 is shown in Figure 7.

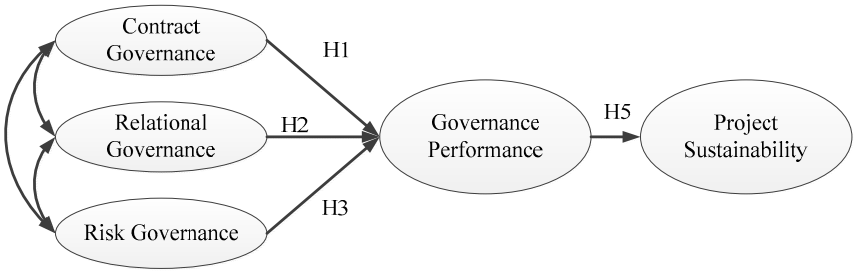

Figure 7. Hypothetical Model of H5.

2.6. List of Hypotheses

The summary of research hypotheses in this paper are shown in Table 1.

Table 1. Summary of research Hypotheses.

Related	Action Path	Relationship Properties
Project governance and governance performance	H0: Project governance → Governance performance	+
Contract governance and governance performance	H1: Contract governance → Governance performance	+
	H1a: Risk sharing → Governance performance	+
	H1b: Income distribution → Governance performance	+
Relational governance and governance performance	H2: Relational governance → Governance performance	+
	H2a: Relationship maintenance → Governance performance	+
	H2b: Cultural construction → Governance performance	+
Risk governance and governance performance	H3: Risk governance → Governance performance	+
	H3a: Risk identification → Governance performance	+
	H3b: Risk communication → Governance performance	+
	H3c: Risk decision-making → Governance performance	+
Three types of governance mechanism to each other	H4: Contract governance, relational governance and risk governance play an intermediary role in the correlation of other governance to governance performance	Mediatory
Governance performance and project sustainability	H5: Governance Performance → Project sustainability	+

+: Positive influence.

3. Research Methods and Data Collection

The influence of a PPP project governance mechanism on project sustainability is not yet clarified in existing research, and empirical studies still stand as an academic gap in context of China's PPP projects. Mohammed Abdelkader proposed a method called multi-criteria decision making (shortened to the MCDM model) in the process of studying selection of the best private partner, providing a way to evaluate the importance of different criteria [66]. However, the MCDM model cannot reveal the intrinsic mechanisms between variables. In this paper, the variables of the governance mechanism, governance performance and project sustainability show multidimensional characteristics, and the intrinsic structural and hierarchical relationship between these multidimensional variables is to be clarified in this paper. Obviously, the MCDM model is not suitable for the solving of these problems, but the method of structural equation model (SEM) happens to show advantages in solving these problems. Therefore, the SEM is adopted as the main research method in this research.

In this paper, effective data required for each component of the research was firstly obtained through questionnaires, and the reliability and validity of the sample data was tested using the SPSS and Amos 24.0 software. Finally, the interaction between PPP project governance mechanisms and their impact on project sustainability was further analyzed, which may contribute a lot for project governance practices.

3.1. Research Methods

The questionnaire was mainly designed for the conceptual model, and the required effective data was obtained through questionnaire-based investigation. In order to ensure that the measurement items in the questionnaire can accurately reflect the variables in the conceptual model, first of all, on the basis of extensive reading, collection and review of the existing literature, combined with the characteristics of China's PPP projects, a preliminary list of measurement items for the research variables was formed. Secondly, prior to the formal questionnaire survey, we invited Chinese professionals with PPP project management experience to conduct a pre-test. Finally, the questionnaire items were modified according

to the feedback of the pre-survey. The measurement items of the formal questionnaire are shown in Table 1.

The items pertaining to project governance (PG) were designed from three dimensions: contract governance, relational governance and risk governance. The contract governance (CG) items were designed with reference to previous studies [67]: risk sharing (CG1–CG3) and income distribution (CG4–CG6). The items pertaining to relational governance (RG) were designed on the basis of two dimensions [16,68]: relationship maintenance (RG1–RG3) and cultural construction (RG4–RG5). The items pertaining to risk governance (RG) were designed on the basis of three dimensions [69]: risk identification (KG1–KG2), risk communication (KG3–KG4) and risk decision-making (KG5–KG6). Governance performance (GP1–GP4) and project sustainability measurement items (PS1–PS5) were designed using relevant studies [6,8,70]. A five-point Likert scale was adopted in this questionnaire to measure the respondents' level of agreement, with 1 indicating strongly disagree, 5 indicating strongly agree.

3.2. Data Collection

The questionnaire consists of four parts, including the preface, the basic information of the respondents, the characteristics of the project, the investigation of the PPP project governance mechanism and the actual completion of the project. Combined with the number of measurement questions and the predicted recovery rate, a total of 320 questionnaires were distributed, and a total of 272 questionnaires were recovered, with a recovery rate of 85.00%. After checking the recovered questionnaires and eliminating the invalid ones, 248 valid questionnaires were finally obtained with an effective rate of 91.18%.

In terms of the education level of the respondents, a master's degree accounted for the highest proportion, accounting for 42.91%. In terms of work experience, 46.64% of the respondents had 6–8 years of working experience in PPP projects. In terms of the nature of the place of employment of the respondents, they include government agencies, private enterprise, construction units and scientific research institutions. The PPP projects involved were mainly transportation and municipal engineering, accounting for 31.34% and 25.37%. Managers accounted for the majority of respondents, with a total of 80.97%. The results of descriptive statistical analysis are shown in Table 2.

Table 2. Constructs and items.

Constructs	Measurement Items	References
Contract Governance (CG)	CG1: The duties and rights in the contract are fully set up CG2: The contract imposes strict penalties for failure to perform CG3: The contract sets up flexible and efficient renegotiation procedures such as changes and price adjustments CG4: The contract sets up a clear system of income distribution CG5: The contract sets out specific ways to obtain income CG6: The contract establishes a price readjustment mechanism	SCHEPKER et al. (2014) [28] Sun, Y.G. (2021) [47] Yan et al. (2016) [67]
Relational Governance (RG)	RG1: The partners keep their commitments to us and act as expected RG2: The partners have been fair in their negotiations with us RG3: Our communication with the partners is timely, complete and accurate RG4: The partners are willing to share their proprietary information RG5: The partners are committed to improving the relationship as a whole, not just individually	Cao and Lumineau (2015) [16] Li X.G. (2019) [41] Ness & Haugland (2005) [48] Mohr and Spekman (1994) [68]
Risk Governance (KG)	KG1: We have a strong sense of risk management KG2: We can quickly identify the sources of risk that affect the smooth implementation of the project KG3: We value risk communication with our partners KG4: Risk communication plays an important role in risk identification and risk decision-making KG5: The project has a complete risk assessment system KG6: We can make correct judgments about the treatment of risk factors	Sun, (2021) [21] M. Haellgren, T.L. Wilson (2008) [48] R. Ortwin, K. Andreas et al. (2011) [69]

Table 2. *Cont.*

Constructs	Measurement Items	References
Governance Performance (GP)	GP1: Stakeholder cooperation has a high degree of satisfaction GP2: The public has a high degree of satisfaction with the public products GP3: The progress, cost and quality of the project are within the control target range GP4: The investment income of the project has reached the expected target	Henisz W, Richardscott W. (2012) [15] She L, Tang S. (2017) [70]
Project Sustainability (PS)	PS1: The project has a low whole life cost PS2: The project has a high internal rate of return PS3: The project can improve the quality of life of local residents PS4: The project does not cause water, air or noise pollution PS5: The project focuses on energy conservation during the construction and operation stage	Shen et al. (2016) [6] Babatunde et al. (2020) [9]

4. Model Quality Assessment

4.1. Reliability and Validity Tests

The basis and premise of the SEM analysis is the precision and availability of data sources. Therefore, it is necessary to analyze whether the measurement model meets the conditions of applying factor analysis. In this paper, the Bartlett sphere test and KMO test were used to analyze the variables, and the results are shown in Table 3. The KMO value of each variable was >0.7, and the statistical value was significant, indicating that the data were suitable for factor analysis.

Table 3. The profile of respondents.

Item	Categories	Number	Ratio (%)
Education background	Bachelor's degree or below	109	40.67%
	Master's degree	115	42.91%
	Doctorate	44	16.42%
Work experience in PPP project	Less than 3 years	31	11.57%
	3–5 years	86	32.09%
	6–8 years	125	46.64%
	More than 8 years	26	9.70%
Project type	Traffic and transportation	84	31.34%
	Municipal engineering	68	25.37%
	Environmental protection	32	11.94%
	Energy power	29	10.82%
	Hydraulic engineering	25	9.33%
	telecommunication	20	7.46%
	Other	10	3.73%
Role in the project	Government agency	68	25.37%
	Private enterprise	67	25.00%
	Construction unit	102	38.06%
	Scientific research institution	31	11.57%
Job position	General staff	51	19.03%
	Grass-roots management	64	23.88%
	Middle management	92	34.33%
	Senior management	61	22.76%

SPSS 22.0 software was used to evaluate the reliability and validity of the model. The evaluation results are shown in Table 4. The Cronbach's alpha coefficient of each construct is >0.7, and the AVE value is >the recommended value of 0.5. In addition, the composite reliability (CR) of each structure was >0.7. These values indicate that the construct has good convergent validity.

Table 4. Results of KMO and Barlett Test.

Variable	KMO	Bartlett Spheroid Test Results		
		Approximate Chi-Square	df	Sig.
Contract governance (CG)	0.886	951.40	15	0.000
Relational governance (RG)	0.732	499.49	10	0.000
Risk governance (KG)	0.772	288.82	6	0.000
Governance performance (GP)	0.833	802.81	6	0.000
Project sustainability (PS)	0.813	670.44	10	0.000

Discriminative validity means that the measurement results of different constructs can be distinguished, and the level of discriminant validity can be reflected by comparing the square root of AVE and the correlation coefficient. SPSS was used to calculate the correlation coefficients of each variable. According to the test results in Table 5, the square root of AVE corresponding to each variable was higher than the correlation coefficients of other constructs, indicating that the scale had high discriminant validity.

Table 5. Reliability and convergent validity analysis.

Variable	CITC	Cronbach'sα	AVE	CR
CG		0.907	0.683	0.928
CG1	0.671			
CG2	0.754			
CG3	0.782			
CG4	0.785			
CG5	0.769			
CG6	0.695			
RG		0.821	0.591	0.877
RG1	0.486			
RG2	0.643			
RG3	0.640			
RG4	0.681			
RG5	0.626			
KG		0.943	0.815	0.965
KG1	0.830			
KG2	0.847			
KG3	0.831			
KG4	0.822			
KG5	0.868			
KG6	0.857			
GP		0.923	0.812	0.945
GP1	0.840			
GP2	0.853			
GP3	0.760			
GP4	0.832			
PS		0.874	0.670	0.909
PS1	0.665			
PS2	0.709			
PS3	0.776			
PS4	0.686			
PS5	0.709			

4.2. Goodness of Fit Testing

Before hypothesis testing and analysis, Amos software was used to evaluate the goodness of fit. Table 6 shows the final goodness of fit index values. The fitting parameters of the structural model all meet the discrimination standard, it can be judged that the structural model fits well with the sample data. The external quality of the model is

evaluated, and the theoretical model can be used to analyze the path relationship between various variables.

Table 6. Discriminate validity.

Variable	1	2	3	4	5
1 Contract governance (CG)	**0.826**				
2 Relational governanc (RG)	0.612	**0.769**			
3 Risk governance (KG)	0.569	0.519	**0.903**		
4 Governance performance (GP)	0.530	0.437	0.260	**0.901**	
5 Project sustainability (PS)	0.568	0.588	0.281	0.721	**0.819**

5. Hypotheses Testing

5.1. Direct Effect Testing

According to the research hypotheses proposed in this study, a structural equation model of the influence of the PPP project governance mechanism on governance performance and project sustainability is constructed (as shown in Figure 8).

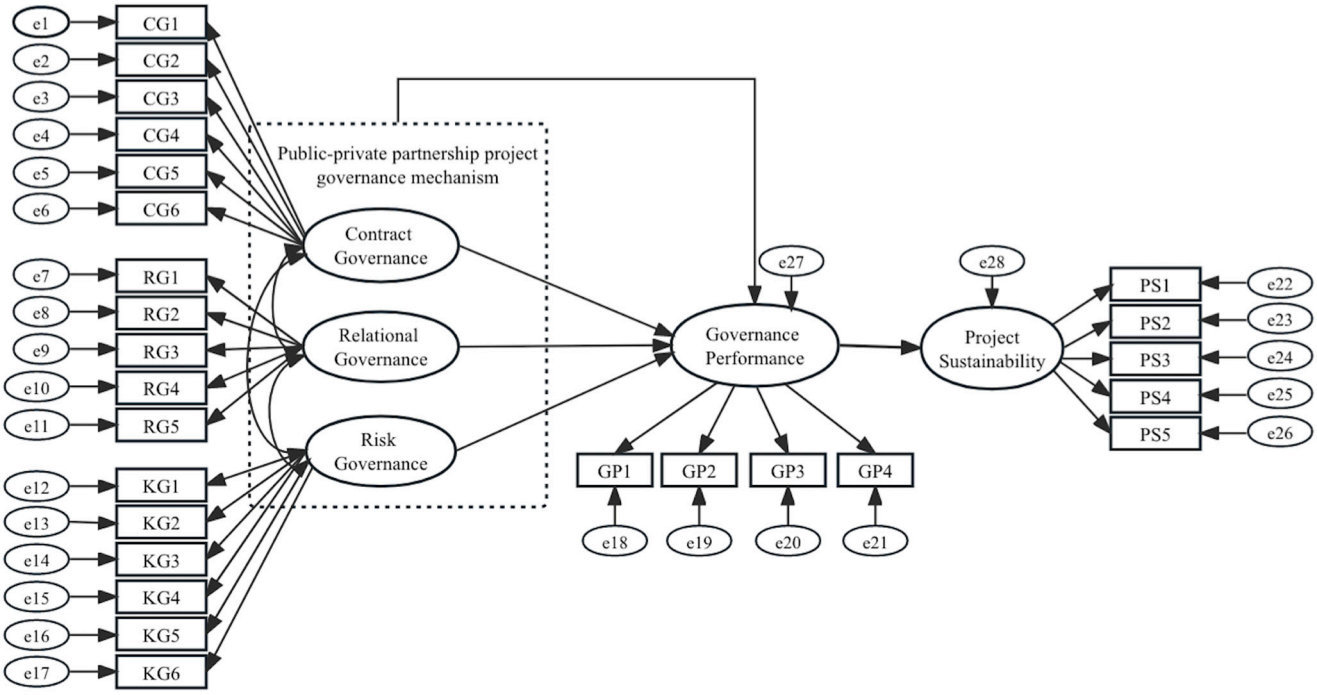

Figure 8. Structural equation model.

Table 7 shows the test results of the research hypotheses. By judging the significance level of the path coefficient in the structural equation model, we can judge whether the research hypotheses are supported by the sample data, and then consider accepting or rejecting the theoretical hypotheses.

The results of the path analysis support H0 and H5 with path coefficients = 0.849 and 0.791, and p-value < 0.001, meaning that H0 and H5 are accepted.

Contract governance is positively associated with governance performance (path coefficient = 0.771, p-value < 0.001), thus, H1 is accepted. Income distribution is positively associated with governance performance (path coefficient = 0.791, p-value < 0.001), thus, H1b is accepted. However, the path coefficient of H1a is −0.024, the hypothesis that risk sharing is positively associated with governance performance has not been verified. The results of the path analysis support H2 with path coefficient = 0.843, and p-value < 0.001.

Table 7. Goodness of fit test of the structural model.

Model Index	Inspection Standard	Value
χ2/df	1 < χ2/df < 3 (the limit is 1 < χ2/df < 2)	1.998
RMR	RMR < 0.05	0.032
RMSEA	RMSEA < 0.05 indicates good adaptation RMSEA < 0.08 indicates proper adaptation	0.038
GFI	GFI > 0.90 (the limit is GFI > 0.80)	0.952
AGFI	AGFI > 0.90 (the limit is AGFI > 0.80)	0.922
IFI	IFI > 0.90	0.981
TLI	TLI > 0.90	0.982
CFI	CFI > 0.90	0.975

Relational governance is positively associated with governance performance. The path coefficients of H2a and H2b were 0.542 and 0.293, respectively, with p values < 0.001 and <0.01. Relationship maintenance and cultural construction are positively associated with governance performance.

Risk governance is positively associated with governance performance (path coefficients of H3, H3a, H3b and H3c are, respectively, 0.735, 0.318, 0.410 and 0.513, p-value < 0.001), thus, H3, H3a, H3b and H3c are accepted. Risk identification, risk communication and risk decision-making are positively associated with governance performance.

Through direct effect testing (as shown in Figure 9), project governance shows a substantial positive correlation effect on governance performance, and governance performance is positively associated with project sustainability. In the three types of governance mechanism, the correlation of relational governance to governance performance shows the highest strength, while the correlation of contract governance and risk governance to governance performance is not as strong as that of relational governance, meaning that relationship rules play a crucial role in PPP projects mainly through improving the satisfaction of all parties related [25] (Lu et al., 2015). Notably, H1a has not been proven, meaning that the main parties in PPP projects tend to avoid potential risk that may emerge in future development. The reason for this is that the private and public parties could be seen as bounded rational persons, tending to draw on advantages and avoid disadvantages [41].

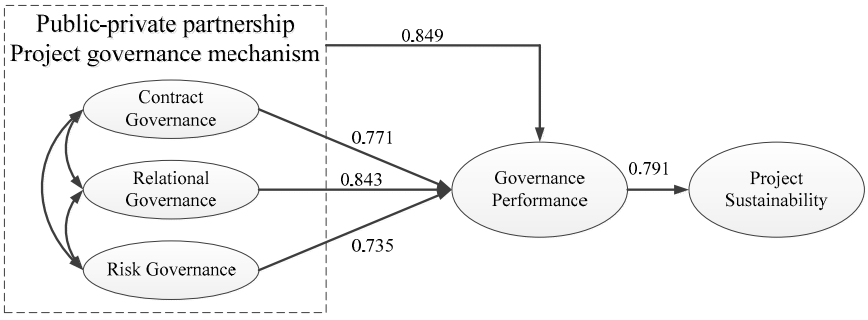

Figure 9. Direct Results of the Structural Equation Model.

5.2. Mediating Effect Testing

For the mediating role of the contract governance mechanism, relational governance mechanism and risk governance mechanism, bootstrapping was adopted with 5000 samples and a 95% confidence interval to test the mediating effect. The results are shown in Table 8. The values of BootLLCI and BootULCI are both positive, indicating the existence of mediation roles.

Table 8. Results of direct effect testing.

Action Path	Standardized Path coefficient	*p*-Value	Test Results
H0: Project governance → Governance performance	0.849	***	Accepted
H1: Contract governance → Governance performance	0.771	***	Accepted
H1a: Risk sharing → Governance performance	−0.024	—	Refused
H1b: Income distribution → Governance performance	0.791	***	Accepted
H2: Relational governance → Governance performance	0.843	***	Accepted
H2a: Relationship maintenance → Governance performance	0.542	***	Accepted
H2b: Cultural construction → Governance performance	0.293	**	Accepted
H3: Risk governance → Governance performance	0.735	***	Accepted
H3a: Risk identification → Governance performance	0.318	***	Accepted
H3b: Risk communication → Governance performance	0.410	***	Accepted
H3c: Risk decision-making → Governance performance	0.513	***	Accepted
H5: Governance performance → Project sustainability	0.791	***	Accepted

Note(s): ** $p < 0.01$; *** $p < 0.001$.

Test Results of Mediating Effect Testing

Test results of mediating effect testing is shown in Table 9. The results show that the hypothesis that CG → GP, CG → KG → GP, CG → RG → GP are significant supports the mediating effect of risk governance and relational governance on the association between contract governance and governance performance. The hypothesis that KG → GP, KG → CG → GP, KG → RG → GP are significant supports the mediating effect of contract governance and relational governance on the association between risk governance and governance performance. The hypothesis that RG → GP, RG → KG → GP, RG → CG → GP are significant supports the mediating effect of risk governance and contract governance on the association between relational governance and governance performance. Therefore, H4 is accepted.

Table 9. Test results of mediating effect testing.

Hypothetical Path	Total Indirect Effects	Indirect Effect	Lower Limit	Upper Limit	*p*-Value
CG → GP	0.219		0.139	0.306	***
CG → KG → GP	0	0.180	0.106	0.283	***
CG → RG → GP	0	0.132	0.062	0.239	**
KG → GP	0.207		0.186	0.394	***
KG → CG → GP	0	0.180	0.115	0.281	***
KG → RG → GP	0	0.106	0.115	0.249	**
RG → GP	0.150		0.063	0.256	**
RG → KG → GP	0	0.133	0.058	0.233	**
RG → CG → GP	0	0.179	0.116	0.279	***

Note(s): ** $p < 0.01$; *** $p < 0.001$.

6. Discussion

6.1. Mechanism of the Governance Mechanism Acting on the Sustainability of PPP Projects

Based on the empirical analysis, the results of direct effect testing are analyzed as follows:

The research results confirm that the PPP project governance mechanism has a direct positive effect on governance performance, and governance performance has a direct positive effect on PPP project sustainability. It supports the views of [23,61,63], proves that project governance is an effective tool to promote the sustainability of PPP projects, and can ensure the comprehensive and sustainable development of PPP projects in multiple dimensions of the economy, society and the environment.

The contract governance mechanism, relational governance mechanism and risk governance mechanism all have a direct positive effect on PPP project governance performance. These findings are consistent with the views of [38,46,55]. In terms of the contract governance mechanism, making clear and detailed contract clauses in PPP projects can avoid the opportunistic behaviors of both parties, and reasonable income distribution has a

positive incentive effect on stakeholders, thus improving project governance performance. In terms of the relational governance mechanism, maintaining a good relationship with stakeholders can improve the satisfaction of all parties and promote project governance performance. Eastern cultures emphasize collectivism and people's sense of belonging in the collective. Strengthening cultural construction can enhance the intimacy and trust of stakeholders, which is conducive to improving project governance performance. In terms of the risk governance mechanism, timely risk identification can avoid the accumulation and amplification of risk-induced problems, effective risk communication can promptly rectify deviations arising from the implementation of the project, and scientific risk decision-making is conducive to improving the efficiency and quality of project cooperation. Therefore, the contract governance mechanism combined with income distribution, the relational governance mechanism combined with relationship maintenance and cultural construction, and the risk governance mechanism combined with risk identification, risk communication and risk decision-making are all conducive to achieving PPP project sustainability by improving governance performance.

The results of mediating effect testing are analyzed as follows:

The research results confirm that the risk governance mechanism and relational governance mechanism have a mediating effect on the relationship between the contract governance mechanism and governance performance; the contract governance mechanism and the relational governance mechanism have a mediating effect on the relationship between the risk governance mechanism and governance performance; the risk governance mechanism and the contract governance mechanism have a mediating effect on the relationship between the relational governance mechanism and governance performance. The results support the views of [47,56].

The contract governance mechanism in PPP projects increases the constraints of stakeholders by establishing a formal governance framework, which has a positive effect on relational governance. By establishing a good relationship with stakeholders, relational governance can reduce conflicts in management based on trust and common norms, which has a positive effect on the contract governance mechanism. Through a normative contract governance mechanism and relational governance mechanism, the probability of contract risk and relational risk occurrence can be reduced. Therefore, both the contract governance mechanism and the relational governance mechanism have a positive effect on the risk governance mechanism. The risk governance mechanism can make up for the incompleteness of the contract governance mechanism and the instability of the relational governance mechanism, further improving the project contract and strengthening partnerships. Therefore, the risk governance mechanism has a positive effect on both the contract governance mechanism and the relational governance mechanism. The results show that the interaction of the contract governance mechanism, the relational governance mechanism and the risk governance mechanism can improve project governance performance and promote the sustainable development of PPP projects.

6.2. Optimization Strategy for PPP Project Governance Mechanisms

On the one hand, more effective measures of the PPP project risk governance mechanism should be further implemented and adopted by project managers. Most of the risks of PPP projects are due to the imperfection of the existing traditional governance mechanism. Through risk governance, project risks can be effectively avoided or reduced. Therefore, it is necessary to improve the awareness of risk governance, accurately understand the complexity and variability of the internal and external environment of PPP projects, quickly identify explicit or potential sources of risk that affect the sustainability of PPP projects and avoid the accumulation and amplification of risk-induced problems. Secondly, we should attach importance to risk communication and enable the role of risk communication as the central medium for risk identification and risk decision-making. Make risk decision-making and risk governance more scientific, realize the interaction and circulation of the PPP project risk governance system.

On the other hand, the relationship between the PPP project contract governance mechanism, the relational governance mechanism and the risk governance mechanism should be balanced by project managers. Each of the two governance mechanisms is closely related, and each governance mechanism has a very important impact on project governance performance. Therefore, to ensuring orderly coordination among contract governance, relational governance and risk governance is an important prerequisite for improving the governance mechanism of PPP projects. In China, balanced governance strategy is an important direction for the development of governance theory and practice for PPP projects. Firstly, risk governance applies to the whole life cycle of PPP projects. It is a new governance mechanism coupled and supported by contract governance and relational governance. The integration and interaction of contract governance and relational governance cannot be separated from the drive of risk governance. Promoting the effective collaboration of different governance mechanisms is key to solving the governance problems of PPP projects. Secondly, it is necessary to pay attention to the balance of factors in project governance, such as income distribution, relationship maintenance, cultural construction, risk communication, etc., so as to achieve a relative balance between the contract governance, relational governance and risk governance of PPP projects, reduce project conflicts and uncertainties, effectively avoid project risks, and achieve the sustainable development of PPP projects.

7. Conclusions

This study reveals the relationship between the contract governance mechanism, relational governance mechanism and risk governance mechanism of PPP projects, as well as the mechanism of the integrated governance mechanism on PPP project governance performance and project sustainability. We conducted empirical research via questionnaires administered to Chinese PPP professionals. The results of direct effect testing show that the contract governance mechanism, relational governance mechanism and risk governance mechanism are positively associated with PPP project governance performance, and governance performance is positively associated with PPP project sustainability. The results of mediating effect testing show that the integration of the governance mechanisms is positively associated with PPP project governance performance.

The five hypotheses of this study were all supported, and it has been confirmed that the contract governance mechanism, relational governance mechanism and risk governance mechanism of PPP projects can improve governance performance. At the same time, it also reflects the incomplete governance characteristics of a single governance mechanism and confirms that the integration of governance mechanisms can improve project governance performance, so as to achieve the sustainable development of PPP projects. Based on the empirical results, an optimization strategy for PPP project governance is proposed. The first step is to implement PPP project risk governance mechanism-related measures, and the second is to balance the relationship between the PPP project contract governance mechanism, relational governance mechanism and risk governance mechanism. The results of this study make up for the lack of research on risk governance mechanisms and have important theoretical and practical guiding significance for improving governance mechanisms, coordinating different governance mechanisms, and realizing the healthy and sustainable development of PPP projects.

Innovatively in this paper, the risk governance mechanism is embedded in the project governance system, which was considered as being made up of contract governance and relational governance in traditional studies, and this three-mechanism governance system shows better practical significance in China's context, supplementing the research gap of empirical research based on Chinese experience and providing new research perspectives and ideas in the area of PPP project governance. Moreover, the three key factors of PPP project governance could be emphasized in practical projects of a broader scope like international PPP projects of Chinese construction enterprises, and may even be applicable in other countries, which on the other hand still needs to be verified in further research.

However, this research focuses on analyzing the governance mechanism of PPP projects and its functional relationship from a macro perspective and is committed to solving prominent problems in the current practice of PPP project governance in China. The differences between different types of PPP projects are not clearly distinguished, and the analysis process is not microscopic enough. Furthermore, the PPP model has now been applied to several kinds of projects in different industry areas, and the correlation of the three types of mechanism on governance performance may show different strengths in different kinds of PPP projects, for the determined parties and determined factors exhibit large differences in different industry areas. In future studies, PPP project types can be refined based on the conclusions of the current research and combined with project cases to analyze the relationship between the governance mechanisms of different types of PPP projects and their impact on governance performance and project sustainability, so as to propose more detailed governance mechanisms for PPP projects. The synergistic effect formed by the integrated governance mechanism will be utilized to improve the governance performance of different types of PPP projects and promote the healthy and sustainable development of PPP projects.

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