An Empirical Study of Determinants of Pay-for-Performance in PPP Procurement

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Abstract: Pay-for-performance is important in procuring Public–Private Partnership projects to which existing research has not paid enough attention. We took 884 ecological construction and environmental protection PPP projects (eco-environmental PPPs) as a sample and used the fuzzy-set qualitative comparative analysis method to discuss the links among technological, organizational, and environmental conditions in pay-for-performance procurement based on the technology–organization–environment frameworks. We found the following: (1) A single condition alone does not constitute a necessary condition for the high-level pay-for-performance of PPP projects. The multiple concurrencies of technology, organization, and environmental conditions form three configurations that drive the pay-for-performance of PPPs with the same effect. (2) The existence of attention distribution and institutional regulation are crucial for optimizing pay-for-performance. To improve pay-for-performance, local governments should combine their own conditions to strengthen the synergy of technology, organization, and environmental conditions. In addition, the leader’s attention distribution and institutional regulation should be taken seriously. The contributions of this study are twofold: (1) Theoretically, this study provides new evidence of the determinants of pay-for-performance in PPP procurement, complementing empirical studies on the factors facilitating its implementation. (2) In practice, it provides a specific path for the government to improve the performance of eco-environmental PPPs.

Keywords: PPP; pay-for-performance; fuzzy-set qualitative comparative analysis; configuration analysis; technology–organization–environment

1. Introduction

Ecological construction and environmental protection are global issues. As an effective method of providing public services [1], Public–Private Partnership (PPP) has become an important means to provide ecological construction and environmental protection services. In addition, realizing the adequate performance of ecological construction and environmental protection PPP projects (eco-environmental PPPs) contributes considerably to the broader goals of governments to sustain green and low carbon development transitions. However, how to realize the performance of PPP projects has become a huge challenge faced by governments [2] and has increasingly attracted the attention of scholars [3,4].

Pay-for-performance is crucial to achieve the performance of PPP projects. Specifically, in theory, pay-for-performance can motivate suppliers to achieve procurement performance and thus maximize the efficiency and effectiveness of fiscal expenditure. In PPP projects, the government is the principal and the supplier is the agent. According to principal–agent theory, the key to overcoming agency costs is to design incentive contracts to change the incentives of agents, and the payment mechanism is a key element of incentive contracts because it defines the system of incentives and risks that are transferred to contractors [5–7]. Under pay-for-performance, the government pays only for the outputs and outcomes.
rather than the inputs and activities [8–11]. Thus, pay-for-performance can effectively motivate suppliers to improve service quality [12–14] and enable them to focus more on cost-effectiveness and the public interest [15]. In practice, many countries and international organizations have explored pay-for-performance in the procurement of public goods. For example, in the UK, the Open Public Services White Paper clearly states that payment-by-results is critical to open public services. Linking partial payments to results provides suppliers with continuous and stringent financial incentives throughout the procurement period. This, in turn, encourages suppliers to provide more efficient and higher-quality services [16]. The United States stipulates that performance-based procurement is the preferred method of service procurement in the Federal Acquisition Regulations (FAR), which specifies that service fees should be paid based on performance. The “Guidelines: Procurement of Goods, Engineering and Non-Consulting Services” issued by the World Bank also clearly states that payments should be made based on measurable outputs rather than inputs [17]. Given the above, to promote the realization of performance in PPP procurement, it is necessary to explore an effective incentive mechanism of pay-for-performance [18].

The extant relevant research on optimizing procurement performance focuses mainly on the measurement and influencing factors of procurement performance, however, the number of studies focusing on pay-for-performance is insufficient [18]. Specifically, on the measurement of procurement performance, Yuan et al. (2012) [19] identified 41 KPIs to measure PPP performance. Liyanage and Villalba (2015) [20] combined the perspectives of project management and stakeholder and contract management into a holistic measure of the “overall” success of PPP transportation projects. Liang and Wang (2019) [21] focused on the metrics of sustainable performance. Li et al. (2020) [22] focused on the importance of public satisfaction in the performance of environmental water treatment PPP projects. In terms of influencing factors, those that affect the performance of PPP procurement mainly include relationship management [23], the capabilities of the public and private sectors [24] and institutions [1,25,26]. In addition, some scholars have paid attention to pay-for-performance. For example, Zhang (2005) [27], Liu and Xue (2019) [28], and others theoretically analyzed the necessity of linking payment with operational performance to improve the quality of PPP procurement and reduce costs. Liu and Xue (2018) [29] took 18 river management PPP projects as examples and found that only a few projects used the government pay-for-performance method. Shi et al. (2020) [18] discussed the incentive mechanism of applying different availability payment methods in PPP contracts from a theoretical perspective, and pointed out that the incentive effect of an availability payment mechanism depends on whether it is correctly linked to project performance (output). They also pointed out that a limitation of their article was that it lacked support from empirical data. In summary, it can be seen that in the research on pay-for-performance, the existing literature mostly focuses on the summary and qualitative descriptive analysis of the practical experience of pay-for-performance. The above research has laid a solid foundation for the study of pay-for-performance, though the following voids can be noted. First, insufficient attention has been paid to the determinants of pay-for-performance in PPP procurement. Second, there is a lack of in-depth research based on empirical analysis. Therefore, to complement empirical research on pay-for-performance, this study mainly focuses on the determinants of pay-for-performance in PPP procurement, specifically answering the following two questions:

1. What conditions can determine pay-for-performance?
2. Which conditions are more important for achieving high-level pay-for-performance?

To answer the above questions, we took 884 eco-environmental PPPs as a sample and discussed the effects on the pay-for-performance procurement of technological, organizational, and environmental conditions based on technology–organization–environment (TOE) frameworks. In addition, given that the impact of different factors on pay-for-performance may not be independent, and they may have different combinations through linkage matching that affect the degree of pay-for-performance, carrying out research with a
“configuration perspective” can help deepen the understanding of the complex governance mechanisms behind different projects [30]. Thus, the fuzzy-set Qualitative Comparative Analysis (fsQCA) method was used to study the linkage effects of different conditions on pay-for-performance procurement.

The contributions of this study are twofold: (1) Theoretically, this study provides new evidence of the determinants of pay-for-performance in PPP procurement, complementing empirical studies on the factors facilitating its implementation. (2) In practice, it provides a specific path for the government to improve the performance of eco-environmental PPPs.

This paper commences with a theoretical framework of TOE to provide an analytical framework for the influencing factors. Then, the data construction and research methods are presented. Next, the empirical results and their implications are discussed, followed by the conclusions.

2. Theoretical Framework of Technology–Organization–Environment

As a highly generalized theoretical model, the TOE framework provides an appropriate balance of internal and external drivers to help organizations to effectively implement innovation [31]. The specific expression of its basic concepts is also varied due to the different research objects and fields [30]. Existing research has covered the following areas: firm performance [32], business performance [33], government public health governance performance [34], local government website construction performance [30], sustainable performance [35], etc. Based on the existing research results and the TOE framework, this paper constructs a debugged and expanded TOE framework based on the relevant theory and practical scenarios of pay-for-performance in PPP procurement, as shown in Figure 1.

![Analysis framework](image)

**Figure 1. Analysis framework.**

2.1. Technology Conditions

Modern society is witnessing the formation of a contracting government. Previously, public organizations were content with a self-sufficient public service model. Today, the model of public service reform is “contracting” [36]. In the contracting state, or the contract state, local authorities meet once a year to award the relevant contracts, have lunch and then go home, happy with a job well done [37]. This poses unprecedented challenges for modern governance, at least in part because the procurement function of selecting public service providers and the performance monitoring function of public service delivery are not core functions of traditional government. Correspondingly, the traditional government also lacks the expertise of procurement experts and the knowledge and expertise of contract performance supervision. As an innovative model compared to traditional procurement, the PPP model brings additional challenges to the transformation of governance in public service delivery. On the one hand, governments are not used to defining PPP projects with performance standards [38], but on the other hand, the definition of the performance standard of a PPP project is technically crucial for its success. Firstly, a PPP project by nature requires performance (outcome)-based technical specifications, in contrast with the input-based specifications of conventional procurement. Secondly, it follows that the
successful bidder is selected based on those performance criteria. Finally, and crucially for pay-for-performance, payment is based on the assessment of the successful delivery of the performance standards agreed in the PPP contract. Therefore, unlike the technical standards of electronic information technology used in traditional government TOE evaluation, we opt to use the government’s ability to define PPP performance standards as the technical condition of our TOE evaluation model.

The government’s ability in this paper includes two secondary conditions: the ability to utilize advisory services and the ability to utilize suppliers’ knowledge. Facing complex PPP projects, it is necessary to make full use of external expertise, which mainly comes from consulting agencies and potentially private partners. In particular:

(1) Consultancies play an important role in PPP procurement decisions. Not only do they help procurement officials better define performance but they also help officials design disciplined contracts, including pay-for-performance clauses. According to modern decision-making theory, increasingly complex public decision-making activities have exceeded the competence of the traditional empirical decision-making model. It is not enough to rely solely on the knowledge, ability, and experience of individual decision-makers to deal with the crises and challenges faced by rapid changes in society [39]. As an important part of the modern government’s public policy system, consultancies bear the important function of assisting decision making. Improving the scientific basis and the democratization of public decision making through consultation has become an important measure for modern countries to improve their governance capabilities [40,41]. Especially in complex PPP projects, consultancies are an important source of skills and experience in PPP project management [42]. In China’s PPP procurement process, consultancies play an important auxiliary role in decision making. According to the official website of the Ministry of Finance’s PPP Center, most local governments use consulting agencies to assist in the preparation of project implementation plans, including the definition of procurement needs and the design of pay-for-performance. Moreover, pay-for-performance is the core requirement of PPP procurement rules [43]. Therefore, higher-level consultancies tend to adopt a standardized pay-for-performance method when designing transaction structures;

(2) In PPP projects, making full use of the professional skills of the private sector is an important aspect of government governance [42,44–46]. Theoretically speaking, in PPP procurement, a complete, clear, and specific definition of procurement performance is the premise of realizing pay-for-performance [6,28,47], but it is difficult for procurement officials to define detailed technical specifications through their knowledge when facing complex PPP projects. In many cases, they need to take advantage of the private sector’s expertise [48–51]. The very design of the procurement law [52] or PPP law [53] that governs PPP procurement indeed encourages the employment of interactive procedures that allow for the use of private sector expertise, such as requests for proposals [52], or competitive dialogue [54]. Moreover, in some jurisdictions, “unsolicited proposals” (USP) are also used to implement PPP projects, such as the World Bank, China, South Korea, Australia, etc. In practice, the PPP procurement practices of some countries (e.g., the United Kingdom, Ireland, Portugal, the Netherlands, France, and Italy) tend to use the negotiation method of interacting with suppliers to purchase PPP projects [49]. This enables public procurers to make full use of the expertise of private partners, master more comprehensive project information, and then make well-informed decisions to promote the realization of pay-for-performance procurement goals.

2.2. Organization Conditions

Organizational conditions include two secondary conditions: attention distribution and the competence of the leader. Pay-for-performance is a government decision, and its implementation is affected by both of these secondary organizational conditions. In particular:

(1) Attention distribution may affect the extent of pay-for-performance in PPP procurement. As an important organizational condition affecting government decision-making, attention distribution has attracted the attention of many scholars [30,34]. Attention allo-
cation came from Simon’s development of bounded rational decision-making theory [55], which considered attention as a scarce resource. The actions of decision-makers depend on the issues and answers on which their attention is focused [56,57]. Furthermore, in bureaucratic organizations, the leaders (party secretaries and chief administrative officers) hold the power to arrange personnel, so their attention distribution affects the behavior of other government officials [58]. It can be said that the behavioral strategy of local officials is to express and respond to the leadership system in which the lower level is responsible for the higher level [59]. The critical role of political will and leadership is especially relevant in the successful delivery of PPP projects [60]. Moreover, in PPP projects, the attention distribution of leaders plays a particularly critical role in the reformation of the governance structure required for the successful delivery of PPP projects, including a vertical reformation of leadership, decision making, implementation, support functions, and horizontal reformation, integrating and coordinating related whole-government line functions. Therefore, in PPP procurement, the more attention allocated to PPP by higher-level leaders, the more likely lower-level procurement officials are to make scientific decisions within bounded rationality when making procurement decisions, thereby promoting pay-for-performance;

(2) The competence of the leader is also an important organizational factor. It not only determines the degree of the leader’s attention distribution but may also have a certain impact on the rational promotion of PPP pay-for-performance procurement. In existing research on performance budgeting, Zhao and Ho (2017) [61] found that the personal behavior of leaders in government departments will have a certain impact on the development of performance budgeting. If leaders have a clear understanding of performance budgets and are willing to achieve the core performance goals through positive incentives, then performance budgets are also likely to produce positive results [62]. If leaders have strong personal abilities and are good at grasping every possible opportunity to promote reform, they can promote the continued success of reform and new system construction. This is also one of the key factors for the success of performance budgeting [63,64]. Therefore, the role of leaders in the performance management of PPP procurement funds cannot be ignored. Tan et al. (2019) [65] also pointed out that the knowledge level of leaders determines the strategies of local governments in advancing PPP work. This may affect the degree of pay-for-performance implementation in PPP procurement practices. The higher the competence of leaders, the easier it is to promote the application of pay-for-performance in PPP procurement.

2.3. Environment Conditions

Environmental conditions mainly include two secondary conditions: PPP transparency and institutional regulation. The reason for this is that in the principal–agent relationship of public expenditure, the government as an agent often has more key information than its principal—citizens [66]. This situation of information asymmetry can lead to a suboptimal outcome in which the government does not meet the best interests of the public, leading to wasteful and inefficient spending [67]. Therefore, transparency is important because it facilitates accountability and shapes organizational performance. In addition, accountability rules provide a tool to ensure that PPPs achieve their public interest objectives and help to improve organizational performance [68], as follows:

(1) The improvement of transparency will help to optimize government decision making and to promote PPP procurement to the pay-for-performance method. Once the country improves transparency, information asymmetry in the allocation of public resources (and therefore budgeting) will be reduced and government accountability will improve, thereby making policymakers more accountable for the management of public resources and government accounts [69–71]. In PPP procurement, transparency is often considered one of the critical success factors (CSFs) of PPP projects [25,72]. It helps stakeholders to learn expertise in PPP procurement; safeguards the right to know in relation to achieving public interest goals; shapes organizational performance; achieves accountability; improves the public perception of PPP [68]; and is an important environmental factor in PPP procurement.
Furthermore, pay-for-performance is the core requirement of PPP procurement institutions, and procurement officials need to implement it under the law, which is more obvious in an environment with high transparency. This is because government officials have a risk-aversion mentality [59]. In a more transparent environment, government officials adopt a more standardized pay-for-performance approach to avoid accountability when procuring PPP projects;

(2) Institutional regulation for pay-for-performance plays a crucial role in pay-for-performance decision making. On the one hand, clear and specific pay-for-performance rules are the guidelines for purchasers to pay. Many studies have shown that institutional regulation is a key influencing factor of PPP procurement performance [1,25,26], and the issuance of specific rules provides a clearer basis for the actions of procurement officers. On the other hand, the corresponding accountability rules provide a guarantee for the implementation of pay-for-performance. Accountability refers to the ability of one actor to demand an explanation or justification for their actions from another actor and to punish the second actor based on their performance or explanation [73]. According to accountability theory, the subject of accountability should be “accounted for” or “counted up” on the authorized matters, and then explained as the “necessity” [74]. In the process of budget performance management, accountability plays a vital role in ensuring the seriousness and effectiveness of overall budget performance management, and strengthening the incentive and restraint effectiveness of budget performance management [75]. As an important aspect of budget expenditure, PPP procurement expenditures are more inclined toward pay-for-performance under the incentives and constraints of scientific and effective accountability rules. Therefore, the release of pay-for-performance rules helps to promote the realization of pay-for-performance.

2.4. The Linkage Effect of Technology–Organization–Environment

In the linkage effect, there is a mutual influence between technology, organization, and environment, which can be specified as follows:

(1) There is an interaction between technology and organization. On the one hand, technology can reshape organizations. In PPP procurement, the ability of the purchaser to utilize consulting services and private sector expertise influences the organization’s further decision making. Simultaneously, the characteristics of the technology itself affect a series of behaviors of organizations in terms of adopting and applying technology [30]. On the other hand, technology is also negatively influenced and even shaped by the organization [76]. Jane Fountain (2001) [77] put forward the concept of “the implementation of technology”, arguing that technology cannot determine its future by itself, but will be influenced by intermediary influences, such as politics, organization, and social arrangements. Organization and technology are two factors that can interact. In PPP procurement, organizational characteristics, including attention allocation and leadership competence, also affect the degree of technology application. For example, previous studies have shown that the higher the educational level of the municipal party secretary and the mayor, the higher the influence odds ratio of the city government in adopting the decision-making consultation system [40];

(2) Although the environment does not participate in the process of governance, it affects and dominates the interaction between the internal elements of the governance system [34]. Although bureaucratic decision making and behavior have a certain tendency to be fixed, their behavior does not necessarily remain the same, but instead adjusts to changes in the environment [55]. Therefore, consulting agencies and government officials are constrained by transparency when designing the payment mechanism of PPP projects. A transparent PPP market environment will help to strengthen the self-discipline of local governments and promote the implementation of a standardized pay-for-performance procurement system, thereby promoting the scientific design of payment mechanisms by procurement officials and consulting agencies in the procurement stage.
3. Data Construction and Research Methods

3.1. Data Construction

3.1.1. Data Collection

This paper takes eco-environmental PPPs as samples. The reasons are as follows: First, achieving the performance of eco-environmental PPPs will make a great contribution to sustainable development. Second, they represent an important area of PPP procurement in China, with a large number of projects, second only to municipal engineering and transportation projects. According to certain statistics, as of 20 March 2022, the number of eco-environmental PPPs was 1189, with an investment amount of 1.28 trillion CNY. The projects cover 31 provinces, with various types of procurement models, including government payments, feasibility gap subsidies and user payments. The operation mode covers seven kinds of BOT, BOO, ROT, etc. The investment scale is distributed between 13.42 million and 3 billion CNY, and the cooperation duration is distributed between 8 and 40 years. Therefore, it has a certain representativeness.

Among them, 884 projects proceeded to the procurement stage or the operation stage. After removing 446 projects for which the specific proportions of availability payment and performance could not be obtained—19 projects without the information of consulting institutions, 3 projects without the academic qualifications of leaders in their regions, and 83 projects without information on the transparency of PPPs in their regions—we obtained the data of 333 PPP projects.

The project data were collected from the PPP database of the Ministry of Finance (MoF) [78], which covers all national PPPs.

3.1.2. Measurement and Calibration

In fsQCA, each condition and result is treated as a separate set. Each case has a membership score in these sets. Calibration is the process of assigning a set membership score to a case. This paper draws on existing research and uses the direct calibration method [79] to convert the data into fuzzy-set membership scores according to the data types of each condition and result. Based on the calibration standards of Tao et al. (2021) [34], Du et al. (2021) [80], Du and Jia (2017) [81], and the actual situation of the case, the calibration standard for all variables is 0.5. The calibration standard for full non-membership is 0.05. The calibration standard for full membership is 0.95. Furthermore, to overcome the previous problem of cases due to membership at 0.5 being removed from the analysis in fsQCA [79], we refer to the study of Campbell et al. (2016) [82] and modify the value of membership of 0.5 to 0.501. Calibration information for each condition and result is shown in Table 1.

| Result and Conditions | Variables                          | Full Membership | Cross Over Point | Full Non-Membership |
|-----------------------|------------------------------------|-----------------|------------------|---------------------|
| Result                | The degree of pay-for-performance  | 100             | 30               | 3                   |
| Technology conditions | Ability to utilize advisory services| 1               | /                | 0                   |
|                       | Ability to utilize suppliers’ knowledge| 1               | /                | 0                   |
| Organization          | Attention distribution             | 270             | 122              | 82.2                |
| Conditions            | Competence of leader               | 3               | 2                | 1                   |
| Environment           | PPP transparency                   | 77.84           | 71.4             | 58.17               |
| Conditions            | institutional regulation           | 1               | /                | 0                   |
(a) Result Variable

The result variable is the degree of pay-for-performance. It is specifically reflected in the proportion of PPP project availability payment linked to operational performance assessment. The reason is that based on the basic theory of pay-for-performance, the performance in PPP procurement should be operation and maintenance performance rather than construction performance, as by nature, PPP deliveries are public services rather than construction structures themselves. This means that if the operation and maintenance performance are met, the fee will be paid. If there is no operational effect or the operational performance is not up to the agreed level, the fee will not be paid or will be paid less. For example, in sewage treatment PPP projects, fees are paid based on the effect of sewage treatment and purification and pollution control, rather than the quantity and quality of sewage treatment plants and pipeline construction. Therefore, to achieve PPP procurement performance, the payment should be linked to operational performance so as to motivate suppliers to achieve project performance goals and to prevent projects from focusing on construction rather than operation.

Typically, the fees payable to the private partner in PPP projects generally include the availability payment during the construction phase (including the construction period cost and reasonable income) and the operation and maintenance fees during the operation period (including the operation period cost and reasonable income). In the observed cases, the full payment of operation and maintenance fees is linked to the performance appraisal results during the operation period, and there is no difference. However, the proportion of availability fees linked to operational performance varies among projects. Therefore, this paper chooses the proportion of availability payment and operational performance to measure the degree of pay-for-performance.

The data are from the project procurement documents published on the PPP database of the MoF and are obtained through text analysis.

(b) Condition variables

For technical conditions, first, whether a consulting agency is directly managed by the MoF is used as the criterion for judging its level. This is because the MoF has strict screening conditions for consulting agencies in the treasury, including consulting service performance, information disclosure, etc., and it is subject to a high degree of regulation [83]. Therefore, generally speaking, the technical level of consulting agencies directly managed by the MoF is higher than that of other consulting agencies. The consulting agency data is from the PPP database of the MoF. Second, we choose the procurement method as a proxy variable for the ability to utilize the private sectors’ knowledge. The reason is that under different procurement methods, the degree of interaction between purchasers and suppliers is different [84]. Projects that choose the tendering method limit the interaction between the government and the private sector, which also limits the government’s ability to utilize the private sectors’ knowledge. Projects that choose competitive negotiation or consultation procedures encourage interaction between the government and the private sector, resulting in the government’s strong ability to utilize the private sectors’ knowledge. The procurement method data is from the PPP database of the MoF.

For organizational conditions, first, this study selects the number of PPP-related policies issued by the province as a proxy variable for attention allocation. The reason is that policies are the carrier of government behavior and awareness. The number of policies directly reflects how seriously leaders consider relevant issues [85]. The data come from the PKULAW database. Second, we choose the mayor’s educational background as a proxy variable for the leader’s level of competence. The reason is that the influence of an actors’ knowledge level and social experience on their cognitive ability and cognitive tendency cannot be ignored in the process of policy implementation. Generally speaking, the higher the knowledge level of the actor, the closer the actor’s cognition to the framework of rational choice [40]. Among the main leaders of each city, the mayor is generally considered to be responsible for the specific affairs of the government. Typically, many mayors will be
promoted to secretary of the municipal party committee. Therefore, referring to Tan et al. (2019) [65], we select the mayor as our analysis object. The data on the mayor is from the Zecheng network, and their educational background data is from the Baidu Encyclopedia.

For environmental conditions, first, the PPP transparency data come from the “China PPP Market Transparency Report” issued by the School of Public Economics and Management of Shanghai University of Finance and Economics. Second, to present the differences in institutional regulation, we divide PPP projects into two groups based on the enactment date (10 November 2017) of a new regulation (Caibanjin (2017) No. 92) [86], which clearly enforces strict requirements for pay-for-performance. The project initiation time data come from the Wind database.

3.2. Fuzzy-Set Qualitative Comparative Analysis

This paper does not employ the traditional statistical method based on the binary relationship of “independent variable-dependent variable,” but rather uses the fuzzy qualitative comparative analysis (fsQCA) method based on set theory to analyze the determinants of pay-for-performance from the perspective of configuration. This is mainly due to the following considerations:

(1) To reveal the optimal path of pay-for-performance in PPP procurement, it is not enough to study the independent effect of a single factor or the conventional statistical analysis of the interaction of two factors. Furthermore, the causes and conditions of social phenomena are mostly interdependent, rather than independent. Therefore, explaining the causes of social phenomena requires a “holistic” assemblage approach [87]. It is difficult for traditional statistical analysis methods to identify such complex causal relationships. Instead, QCA analysis believes that the interdependence and different combinations of causal conditions constitute Multiple Conjunctural Causation [88]. This contributes to an in-depth understanding of the differentiated driving mechanism of pay-for-performance in China’s PPP procurement practice. Therefore, the QCA method is more suitable for exploring the mechanism of many factors of pay-for-performance from the perspective of the overall relationship;

(2) There may be multiple “equifinal” causal chains leading to the same outcome. However, the traditional statistical analysis method can allow a unified analysis of the relevant factors affecting the pay-for-performance method and describe the influence of the independent variable on the dependent variable through the mediating variable and the moderating variable. However, this method uses only the substitution relationship or the cumulative relationship of the independent variables to explain the change in the dependent variable, rather than the complete equivalence relationship [89]. The QCA method can identify different antecedent configurations with the same effect [90]. Therefore, the QCA method is obviously more suitable for studies that aim to optimize pay-for-performance;

(3) Different from csQCA (clear-set Qualitative Comparative Analysis) and mvQCA (multi-valued Qualitative Comparative Analysis), fsQCA can handle problems of varying degrees and partial membership [81]. In addition, by converting fuzzy-set data into a truth table, fsQCA retains the advantages of truth table analysis and the processing of qualitative data, leading to limited diversity and a simplified configuration. This causes fsQCA to have the dual properties of both qualitative and quantitative analysis [79]. Therefore, we use fsQCA to calibrate the interval or ratio variables to avoid artificially treating the interval and ratio variables as categorical variables.

Notably, unlike traditional regression methods, fsQCA uses Boolean algebra, which does not lead to omitted variable bias, so there is no requirement for control variables in the fsQCA method [91].
this paper first examines whether a single condition (including its non-set) constitutes a necessary condition for the pay-for-performance of PPP projects. In QCA, a necessary condition is a condition that is always present when the result occurs [79]. Consistency is an important test criterion for necessary conditions, and when it is greater than 0.9, the condition is a necessary condition for the result [80,89,92–94]. Table 2 shows the results of the necessary condition test for high-level and non-high-level pay-for-performance methods, analyzed using fsQCA 3.0. It can be seen that the consistency of the non-high ability to utilize suppliers’ knowledge is greater than 0.9, which indicates that this condition may be a necessary condition to determine the impact of high-level and non-high-level pay-for-performance methods. To test this further, we plotted a scatter plot of this condition variable versus the outcome variable. It was found that most of the case points are near the right Y-axis. This indicates that the condition fails the “trivialness” test [30,95]. Therefore, this condition cannot constitute a necessary condition to explain the outcome variable. The above results show the complexity of the factors influencing pay-for-performance, that is, a single condition does not constitute a necessary condition for a high level of pay-for-performance. Technology, organization, and environmental conditions need to interact to collectively influence the extent of pay-for-performance.

Table 2. Analysis of Necessity Conditions.

| Conditions                          | High Level of Pay-for-Performance | Non-High Level of Pay-for-Performance |
|------------------------------------|-----------------------------------|--------------------------------------|
|                                    | Consistency | Coverage   | Consistency | Coverage   |
| High ability to utilize advisory services | 0.763371 | 0.595765 | 0.776796 | 0.472238 |
| Non-high ability to utilize advisory services | 0.323759 | 0.650606 | 0.335061 | 0.524486 |
| High ability to utilize suppliers’ knowledge | 0.183601 | 0.727364 | 0.200202 | 0.617819 |
| Non-high ability to utilize suppliers’ knowledge | 0.903529 | 0.591881 | 0.911654 | 0.465198 |
| High attention distribution        | 0.751153 | 0.826676 | 0.750584 | 0.64346 |
| Non-high attention distribution    | 0.676031 | 0.776765 | 0.797823 | 0.714076 |
| High competence of leader          | 0.772966 | 0.83957 | 0.875601 | 0.735876 |
| Non-high competence of leader      | 0.755192 | 0.886278 | 0.802432 | 0.73356 |
| High PPP transparency              | 0.679417 | 0.757347 | 0.662038 | 0.574852 |
| Non-high PPP transparency          | 0.618597 | 0.701472 | 0.720546 | 0.636471 |
| High institutional regulation      | 0.528959 | 0.649066 | 0.479008 | 0.457851 |
| Non-high institutional regulation  | 0.558173 | 0.579015 | 0.632853 | 0.511374 |

Own source based on the fsqca software calculation results, the same below.

4.2. Sufficiency Analysis of Conditional Configuration

Unlike the above analysis of necessary conditions, configuration analysis attempts to reveal sufficient configurations that can lead to results, and these configurations consist of multiple conditions. Consistency is also used to measure the sufficiency of the configuration, but the minimum acceptable criteria and calculation methods are different from the analysis of the necessary conditions. Schneider and Wagemann (2012) [95] stated that the agreement to determine sufficiency should not fall below 0.75. In addition, sufficiency condition analysis needs to set a frequency threshold, consistency threshold, and PRI consistency. For samples with more than 150 cases, the frequency threshold can be set to 3 [96]. We set the consistency threshold to 0.8 and the PRI consistency to 0.75, as the recommended values in the existing literature [97–99].

By comparing the nested relationship between the intermediate solution and the parsimonious solution, the core and edge conditions of each solution can be identified. The
condition that appears in both the intermediate solution and the parsimonious solution is the core condition of the solution. Conditions that occur only in intermediate solutions are marginal [81,100]. The analysis results are shown in Table 3.

| Condition Configuration | 1–1          | 1–2          | 2            | 3            |
|-------------------------|--------------|--------------|--------------|--------------|
| Ability to utilize advisory services | ●           | ●            | ●            | ●            |
| Ability to utilize suppliers’ knowledge | ●           | ●            | ●            | ●            |
| Attention distribution | ●           | ●            | ●            | ●            |
| Competence of leader | ●           | ●            | ●            | ●            |
| PPP transparency | ●           | ●            | ●            | ●            |
| Institutional Regulation | ●           | ●            | ●            | ●            |
| Consistency | 0.975926    | 0.975926    | 0.966427     | 0.973864     |
| Raw coverage | 0.362972    | 0.362972    | 0.316478     | 0.109478     |
| Unique coverage | 0.0739846   | 0.0739846   | 0.0249797    | 0.0257655    |
| Solution consistency | 0.960489    | 0.960489    | 0.0249797    | 0.0257655    |
| Solution coverage | 0.416228    | 0.416228    | 0.0249797    | 0.0257655    |

● or ● indicates that the condition exists, ● or ● indicates that the condition does not exist; ● or ● indicates a core condition, and ● or ● indicates an edge condition. Blank means that the condition may or may not exist.

Three configurations are presented in Table 3. The overall solution consistency is 0.96. This means that 96% of all PPP projects that meet these three conditions are at a high level of pay-for-performance. The solution coverage is 0.42, which means that 42% of the cases of high-level pay-for-performance can be explained by these three condition configurations. Moreover, the consistency of both individual solutions (configurations) and the overall solution is above the minimum acceptable standard of 0.75. This shows that the empirical analysis is valid. Therefore, these three configurations can be regarded as sufficient conditions for a high level of pay-for-performance. Based on the above configuration, we can further identify the differentiated adaptation relationship of technology, organization, and environment in promoting high-level pay-for-performance in PPP procurement.

Configuration 1 shows that in areas with insufficient leadership competence and an inability to utilize suppliers’ knowledge, increasing the attention distribution, PPP transparency, and accountability will enable PPP projects to achieve a high level of pay-for-performance. In configuration 1–1, institutional regulation is the core existence condition, and attention distribution and PPP transparency are marginal existence conditions. In configuration 1–2, PPP transparency is the core existence condition, and attention distribution and institutional regulation are marginal existence conditions. The consistency of this configuration is 0.976, the original coverage is 0.363, and the unique coverage is 0.074. This shows that this path can explain approximately 36.3% of PPP projects, and approximately 7.4% of PPP projects can only be explained by this path.

Configuration 2 shows that when the competence of leadership is high but the ability to utilize suppliers’ knowledge is insufficient, a high level of pay-for-performance can be achieved by improving the ability to utilize advisory services, attention distribution, and institutional regulation, which are the core existence conditions. The competence of the leader is a marginal existence condition. The consistency of this configuration is 0.986, the original coverage is 0.316, and the only coverage is 0.025. This indicates that this pathway can explain approximately 31.6% of PPP projects. Meanwhile, approximately 2.5% of PPP projects can only be explained by this path.

Configuration 3 shows that in regions with a higher competence of leadership but a weaker PPP transparency and institutional regulation, higher levels of pay-for-performance
can also be achieved if the government’s attention distribution and ability to utilize advisory services and suppliers’ knowledge can be simultaneously improved. The ability to utilize advisory services, the ability to utilize suppliers’ knowledge, and the attention distribution are the core existence conditions, and the competence of the leader is the marginal existence condition. The consistency of this configuration is 0.974, the original coverage is 0.109 and the only coverage is 0.026. This suggests that this pathway can explain approximately 10.9% of PPP projects and approximately 2.6% of PPP projects can only be explained by this path.

Furthermore, we found that attention distribution exists in all three configurations. This means that the existence of attention distribution plays a crucial role in optimizing pay-for-performance. In addition, institutional regulation is also important for the optimization of pay-for-performance; it appears in three paths as an existence condition, two of which are core existence conditions.

4.3. Robustness Test

For the robustness analysis of QCA studies, it should be examined whether the above results exhibit significant changes under different operations. A solution term can be considered robust if the results under different operations have a similar combination of conditions, consistency, and coverage to the original model. “Similar” refers to solutions with well-defined subset relationships and parameters such that a different substantive interpretation is not necessary [95]. This paper conducts a robustness test of the high-level pay-for-performance driving configuration regarding existing research [101,102]. First, the case frequency threshold was adjusted from 3 to 2, and the resulting configuration is the same as the benchmark result (Table 4). Secondly, considering that larger-scale cities (provincial capital cities and municipalities) and ordinary cities may have differences in organizational capacity and resource endowments, we analyze only 301 projects in ordinary cities. The configuration obtained by the analysis is consistent with the benchmark results (Table 5). Thirdly, to reduce the impact of different return mechanisms on pay-for-performance, we analyze only 218 projects that use feasibility gap subsidies. The obtained configuration is consistent with the benchmark results (Table 6). In conclusion, the robustness test shows that the basic results are robust.

Table 4. Configuration analysis of high-level pay-for-performance antecedent conditions after the frequency threshold was adjusted.

| Conditional Configuration | 1–1 | 1–2 | 2    | 3    |
|--------------------------|-----|-----|------|------|
| Ability to utilize advisory services | ☀    | ☀    | ●                | ●                |
| Ability to utilize suppliers’ knowledge | ☀    | ☀    | ☀                | ●                |
| Attention distribution    | ●    | ●    | ●                | ●                |
| Competence of leader      | ☀    | ☀    | ●                | ●                |
| PPP transparency          | ●    | ●    | ●                | ☀                |
| Institutional Regulation  | ●    | ●    | ●                | ☀                |
| Consistency               | 0.975926 | 0.975926 | 0.966427 | 0.973864 |
| Raw coverage              | 0.362972 | 0.362972 | 0.316478 | 0.109478 |
| Unique coverage           | 0.0739846 | 0.0739846 | 0.0249797 | 0.0257655 |
| Solution consistency      | 0.960489 |          |                  |                  |
| Solution coverage         | 0.416228 |          |                  |                  |

● or ● indicates that the condition exists, ☀ or ☀ indicates that the condition does not exist; ● or ☀ indicates a core condition, and ● or ☀ indicates an edge condition. Blank means that the condition may or may not exist.
approximately 10.9% of PPP projects and approximately 2.6% of PPP projects can only be seen in Table 6. In conclusion, the robustness test shows that the basic results are robust.

For the robustness analysis of QCA studies, it should be examined whether the above conditions, consistency, and coverage to the original model. “Similar” refers to solutions with different substantive inter-conditions, consistency, and coverage to the original model. This means that the existence of attention distribution plays a crucial role in optimizing the results exhibit significant changes under different operations. A solution term can be considered robust if the results under different operations have a similar combination of conditions.

Furthermore, we found that attention distribution exists in all three configurations. This implies that the condition does not exist; or indicates that the condition may or may not exist.

5. Discussions and Implications

5.1. Discussions

This paper uses the fsQCA method for the first time to analyze the conditional configuration of China’s eco-environmental PPPs and explores the linkage effect and driving path of technology, organization, and environmental factors on the pay-for-performance approach to PPP procurement. Through research, we found the following:

First, on the whole, technical, organizational, or environmental factors alone cannot provide the necessary conditions for pay-for-performance in PPP procurement. This shows that a single element does not constitute a bottleneck for high-level pay-for-performance.

Second, there is a synergy of multiple factors behind the pay-for-performance approach to PPP procurement. The effective combination of various factors can improve the level
of pay-for-performance in PPP procurement with the same effect. There are three driving paths for high-level pay-for-performance. Specifically, these can be summarized as the adaptation mode explained by environmental conditions and organizational conditions, the adaptation mode explained by technology–organization–environmental conditions, and the adaptation mode explained by technical conditions and organizational conditions. In detail:

(1) Configurations 1–1 and 1–2 provide an environment–organization linkage path for high-level pay-for-performance. The above path shows that the existence of environmental conditions and attention distribution can break the shackles of an insufficient leader’s level of competence and promote the optimization of pay-for-performance in PPP procurement. This path is mainly suitable for situations where the government has a weak ability to utilize suppliers’ knowledge and the competence of the leader is insufficient. A high level of pay-for-performance can be achieved by enhancing attention allocation, PPP transparency and institutional regulation. In configuration 1–1, the existence of institutional regulation plays a central role, and the existence of attention distribution and PPP transparency play an auxiliary role. In configuration 1–2, the presence of PPP transparency plays a central role, while the presence of attention distribution and institutional regulation plays a supporting role;

(2) Configuration 2 provides a technology–organization–environment linkage path for high-level pay-for-performance. This path is primarily suitable for projects with a higher competence of leadership but a weaker ability to utilize suppliers’ knowledge. These programs can achieve a high level of pay-for-performance by enhancing attention distribution and institutional regulation. Among them, the existence of an advisory body, attention distribution, and institutional regulation play a central role, while leader competence plays an auxiliary role;

(3) Configuration 3 provides a technology–organization linkage path for high-level pay-for-performance. This path shows that the combination of a high technical level and organizational level can break through the limitations of environmental conditions and achieve high-level pay-for-performance. This path is primarily applicable to regions with a high competence of leadership, and can optimize pay-for-performance by enhancing the ability to utilize advisory services, the ability to utilize suppliers’ knowledge and the attention distribution. Among them, the ability to utilize advisory services and the ability to utilize suppliers’ knowledge and attention distribution play a central role, while the competence of the leader plays a supporting role.

In addition, through the horizontal comparison of the configuration, we can find the following:

(1) Organizational conditions are very important to the realization of pay-for-performance. In particular, the presence of attention distribution plays a crucial role in pay-for-performance. It is a common condition of the three configurations. This confirms the views of Lian (2016) [58], Pang (2019) [59], etc., that the attention distribution of superior leaders plays an important guiding role in the decision making of local government officials. This also shows that the higher the provincial government’s attention to PPP procurement, the easier it is for its lower-level government to adopt a standardized pay-for-performance method of procurement;

(2) The improvement of the organizational level alone is not enough to optimize pay-for-performance. The level of technology can be upgraded to increase pay-for-performance. This is reflected in configuration 2 and configuration 3. On the one hand, this confirms the viewpoints of Wang et al. (2019) [103] and Peng and Yu (2019) [38]. That is, consulting agencies play an important role in the initiation and implementation of PPP projects. They are of great significance to the standardization of PPP procurement. On the other hand, this also confirms the views of Guevara et al. (2020) [104] and Delhi and Mahalingam (2020) [26] that interacting with private sectors during the procurement stage to evaluate and consider various alternatives is a prerequisite for achieving procurement performance. In addition, compared with the improvement of organizational and environmental conditions, the
optimization of technical conditions is an easier path to achieve in the short term. Therefore, improving the ability to utilize advisory services and the ability to utilize suppliers’ knowledge is an important way to optimize pay-for-performance in the short term;

(3) When the technical level is insufficient, the incentive and restraint effects of environmental factors can also be exerted to promote the optimization of pay-for-performance. This illustrates the important role of environmental factors in pay-for-performance, especially institutional regulation. Specifically, if the ability to utilize suppliers’ knowledge is insufficient, the incentive and restraint roles of the PPP transparency and institutional regulation can be used to promote the optimization of pay-for-performance. Governments can also synergize technology–environmental conditions to optimize pay-for-performance by increasing the ability to utilize advisory services and institutional regulation. This can be observed from configuration 1 and configuration 2. The above findings further confirm the view of Zhang et al. (2015) [1] and Casady (2020) [25]. That is, institutional regulation is important to PPP performance. The clear and specific rules of pay-for-performance play a crucial role in promoting pay-for-performance. Simultaneously, this also confirms the view of Reich (2018) [68] that transparency helps to optimize the decision making of government officials.

5.2. Implications

Compared with other related research on optimizing PPP procurement performance, the main knowledge implications of this paper are as follows: First, based on the theoretical framework of TOE, new evidence is provided for promoting the achievement of performance in eco-environmental PPPs from the dimension of optimizing pay-for-performance. Starting from the “configuration perspective,” this paper analyzes the concurrent synergy and linkage matching mode of multiple conditions, such as technology, organization, and environment, in promoting the level of pay-for-performance and explains the “causal complexity” behind pay-for-performance. Second, the fsQCA method was introduced into the study of pay-for-performance in PPP procurement. At present, existing studies are mainly limited to traditional qualitative analysis, such as that by Liu and Xue (2019) [28], Shi et al. (2020) [18], etc. The introduction of the fsQCA method in this study not only enriches the toolbox of research methods in the field of PPP pay-for-performance but also provides a holistic perspective on the complex interactions between the conditions behind pay-for-performance.

In addition, this research has the following practical implications: First, local governments should strengthen the synergy and integration of technical, organizational, and environmental factors. According to the organization’s conditions and resource endowments, each region should focus on the linkage and matching of multiple conditions between technology, organization, and environment from the perspective of “integrity,” in order to break through the constraints of objective conditions, such as those imposed by the local government and the external environment. In this way, policies to promote pay-for-performance in PPP procurement can be formulated in a targeted manner. Second, local governments should pay attention to the important role of attention distribution, which is a common existence condition for every high-level pay-per-performance path. Third, regulators should pay attention to institution regulation and promote pay-for-performance in PPP procurement by optimizing the formulation and implementation of specific rules for pay-for-performance.

6. Conclusions and Limitations

Pay-for-performance is crucial to the achievement of procurement performance, and how to optimize pay-for-performance has received insufficient attention in the existing literature. This study uses empirical data to analyze the conditions that facilitate the achievement of a high level of pay-for-performance. Specifically, we took 884 eco-environmental PPPs as a sample and used the fsQCA method to discuss the linkage effects on the pay-for-performance based on TOE frameworks. We found the following results: (1) A single condition alone does not constitute a necessary condition for the high-level pay-for-performance
of PPP projects. The multiple concurrencies of technology, organization and environmental conditions form three configurations that drive the high-level pay-for-performance of PPP projects with the same effect. Configuration 1 shows that increasing attention distribution, PPP transparency and accountability will optimize pay-for-performance in regions with an insufficient competence of leadership and an inability to utilize suppliers’ knowledge. Configuration 2 shows that improving attention distribution, institutional regulation, and the ability to utilize advisory service can optimize pay-for-performance when the competence of leadership is high but the ability to utilize suppliers’ knowledge is insufficient. Configuration 3 shows that improving the government’s ability to utilize advisory services, the ability to utilize suppliers’ knowledge, and the attention distribution can optimize pay-for-performance in regions with a higher competence of leadership but weaker PPP transparency and institutional regulation. (2) The existence of attention distribution and institutional regulation play an important role in optimizing pay-for-performance. The above findings have implications for optimizing pay-for-performance in PPP procurement.

Admittedly, this study has the following limitation: when observing the degree of pay-for-performance, we only observe the proportion of the availability payment linked to the performance of the operation period but do not consider the differences in the definition of the performance of the operation period between different projects. To reduce the error caused by the difference in the definition of performance, we focus on two types of indicators: operational performance and satisfaction. A project was included in our sample only if its performance indicators contained both of the above indicators. This minimized the impact of differences in the definition of operation performance, and made sense to compare the proportion of availability payment linked to operational performance. In addition, although we supplement the body of empirical research on the influencing factors of pay-for-performance in PPP procurement, the sample is limited to eco-environmental PPP projects. In the future, we can expand the sample to all PPP project fields, and conduct a more comprehensive study of the influencing factors of pay-for-performance so as to provide a reference for improving the performance of all PPP projects.

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