

## Government Credit Risk and Private Capital Participation in Public-Private Partnership: The Case of Local Governments in China \*\*

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### Abstract

*In China the Public-Private Partnership (PPP) projects are adopted to achieve the strategic goals of governments and to ensure the sustainable operation of local government finances. However, rigorous empirical research on the determinants of private capital's participation in PPP is sparse. This study investigates the effects of government behaviours on the participation of private capital in the PPP projects by focusing on the role of government credit risks. We construct a dynamic game and adopt an empirical analysis using panel data of Chinese provinces from 2013 to 2018. Our findings reveal a significant inverse relationship between the government credit risk and the private capital participation in PPP. It provides policy-makers and researchers with useful information about using the PPP to promote investment on infrastructures while ensuring a sustainable local fiscal system.*

Keywords: public-private partnership, government credit risk, private capital participation, local government finance, incomplete information dynamic game, Tobit Panel Model

JEL: C73, H72, R53

### 1. Introduction

Since 2013 the Public-Private Partnership (PPP) model has become a popular policy tool in China to advance the modernization of the national governance system and governance capabilities which is a strategic goal of the Chinese central government. Due to the support and advocacy of relevant laws and policies issued by the National Development and Reform Commission and the Ministry of Finance, the PPP model has ushered in a new development boom in China. From 2014 to February 2021, the cumulative number of PPP projects registered in the database of China Public Private Partnership Center was 10,033, with a total investment equaling RMB 15.5 trillion (approximately \$2.2 trillion).<sup>1</sup>

Compared with the traditional model in which the government independently completes project construction and operation, PPP helps to improve the efficiency and quality of public goods supply by lowering the cost and time (O'Shea et al, 2019; Verweij & Meerkerk, 2020). It is a popular way to form synergies between public sectors and private capital, to control local government debt risks, and effectively improve the modernization level of the national governance system and governance capacity (Rybnicek et al, 2020). However, problems with PPP have gradually emerged during recent years, such as the low participation of private capital, the heterogeneity of regional investment, and the uneven landing rates (Wang et al, 2018).

At present, there is no unified PPP concept throughout the world (Rybnicek et al, 2020). In China, the State Council issued document No.42 in 2015, which stipulates that the participating non-public capital comes from both the private sector and the state-owned enterprises, and that government must adopt a bidding method to select the private capital partner for a PPP project.<sup>2</sup> The project contract must specify the reasonable income of both parties, and the government shall pay the private partners based on an evaluation of the public service performance. The above stipulations clarify the main factors of equal contract negotiation and the guarantee of reasonable return to private capital included in PPP.

<sup>1</sup> Data source: Public Private Partnership Center of the Ministry of Finance, *National PPP Integrated Information Platform Management Database Project February 2021 Report*. (<https://www.cpppc.org/jb/999851.jhtml>)

<sup>2</sup> Notice of the General Office of the State Council on Forwarding the Guiding Opinions of the Ministry of Finance, the Development and Reform Commission, and the People's Bank on Promoting the Government and Private Capital Cooperation Model in the Public Service Field (Guobanfa [2015] No. 42). (<http://www.cPPPc.org/zh/gwyPPPxgwj/2623.jhtml>)

However, considerable risks remain concerning even after the project is implemented, including the uneven contractual spirit of the parties involved, the long life cycle in which risk sharing is unavoidable, and the complex legal relationships subject to administrative law, economic law, civil law, etc. (Pinz et al, 2018; Becker and Patterson, 2005).

The government integrity, i.e. a government's ability to keep its words, is an important determinant for a healthy investment environment and contributes to the local economic development (Du et al, 2018). The government credit risk exists because a government may fail to fulfill its commitment to protect the interests of investors or meet their expectations of investment returns (Christensen and Legreid, 2005). When it comes to the PPP, the large state-owned enterprises can perform the regulatory responsibilities on behalf of the government in PPP projects (such as the transformation and upgrading of original financing platform companies), in addition to participating in project construction, management, and operation (Gong et al., 2019). In contrast, the private enterprises and foreign businesses are relatively small, so the funds used by both parties of the project cooperation are mainly derived from the government budget ledger, forming the "internal circulation" (Cheng et al., 2018). This and the government budget funds "extracorporeal circulation" overlap greatly affect the vitality of the private economy. Therefore, the government credit risk has become a prominent risk in project implementation and the source of project uncertainty that private capital is most concerned about (Weihe, 2008). As the government is the main participant of the project, it has the status of a social manager compared with market participants. The government credit risk during the project execution process will have a destructive blow to the entire project operation. The endorsement model cannot completely prevent government risks, which is why this type of risk has outweighed the other risks faced by private capital (Liu et al., 2016).

By reviewing the implementation process of previous PPP projects, it is observed that the government's failure to comply with the relevant project contract regulations on the grounds of renewal and policy changes may also cause the government to overestimate its own financial affordability, leading to early termination or redemption of projects (Feng et al., 2017). For example, one of the main reasons for the failure of the Changchun Huijin Sewage Treatment Plant Project, the Xinyuan Minjiang Fourth Bridge, and the Qingdao Veolia Sewage Treatment Plant was the government's dishonesty (Feng et al., 2018).

Although case studies of PPP projects in China are abundant, there is lack of empirical investigations that are based upon theoretical models, and such research on the determinants of private capital participation in the PPP projects is particularly rare. The present study aims to fill the gap in this literature by focusing on the effects of the local government credit risk on the PPP projects in China. Our dynamic game model indicates the main motivations of local governments to initiate PPP projects include weakening the fiscal deficit constraints and responding to the central government policies. As for the participation of private partners in PPP projects, the policy support from local governments has a guiding role. Hypotheses are put forward accordingly and are empirically tested using a panel Tobit model for Chinese provinces from 2013 to 2018. The findings reveal a significant inverse relationship between the government debt and PPP turnover, suggesting the government credit risk is a main restricting factor for private capital participation in PPP.

Our study highlights the importance of preventing the risk of PPP projects from becoming an upgraded local debt financing platform. It is of considerable interest to the policy makers and researchers who look at the PPP as an effective way to promote investment on infrastructures while ensuring a sustainable local fiscal system.

## **2. Literature Review**

Since 1990 there has been an increase in the number of research papers focusing on the topics of PPP projects and related policy. Osei-Kyei and Chan (2015) reviewed 27 publications on the PPP projects in 12 countries/regions between 1990 and 2013 with a focus on the Critical Successful Factors (CSFs) identified as important for the implementation of PPP projects. Among a total of 37 CSFs identified by the literature, Osei-Kyei and Chan (2015) further highlighted that the most important CSFs, which were mentioned in 8 or more papers, include risk allocation and sharing, strong private consortium, political support, community/public support, and transparent procurement. Focusing on China, Meng et al. (2011) examined the CSFs for Transfer-Operate-Transfer (TOT) projects in a qualitative study, and their findings revealed 8 CSFs that are specifically important for PPP projects in China, including project profitability, asset quality, and risk allocation, etc.

During the life cycle of a PPP project, there are many risk factors when it comes to public and private sectors working together. Ke et al. (2010) identified 37 risks and put each risk into one of five categories determined by how it is shared between the public and private sector based on which sector would be best at managing the risk. These categories include: the government takes sole responsibility (e.g. expropriation and nationalization), the government takes the majority of responsibility (e.g. government's reliability, government's intervention, poor political decision-making, change in law and regulations, etc.), both parties take equal responsibility (e.g. public/political opposition, tariff change, payment risk, etc.), the private sector takes the majority of responsibility

(e.g. operation changes, residual assets risk, organization and coordination risk, etc.) and the private sector takes sole responsibility (e.g. financial risk). As for PPP projects in China the existing research highlights five main risk categories: government credit default risk, legal and policy risk, financing risk, operation risk, and exit risk (Wang et al., 2019; Tan et al., 2019; Lou et al., 2018; Chen and Wang, 2018; Sun et al., 2015; Zhou and Yan, 2017). These risks need to be clearly understood and agreed upon by both sides in order for a contract to be fairly established.

Rybnicek et al (2020) conducted a systematic literature review of risk factors in PPPs. Their findings highlight the importance of risk management and mitigation strategies. In order to reduce potential risks in the PPP model and their negative impact on project vitality, the literature has used different methods to study its risk formation and transmission mechanism from multiple dimensions. For example, based on the perspective of new institutional economics, an empirical study of the specific operation mode of PPP found that the best choice for the government of a country that does not have sufficient policy enforcement powers or power restraint mechanisms is to establish a Special Purpose Vehicle (SPV) (Tserng et al, 2012). Studies using the evolutionary game models to theoretically analyze the many risks and their propagation paths in the PPP model found that the establishment of a risk sharing contract between the government and private capital is important for many participants to jointly resist risks (Zhou and Yan, 2017). The Social Network Analysis (SNA) method is also used in the research on stakeholders in the transportation industry, and advocates that establishing a project risk analysis and management framework can provide reference for all participants to effectively prevent various risks (Lou et al., 2018). The existing studies are mainly from the perspective of the overall risk division of the PPP project, focusing on the design of the market risk bearer and the operational risk sharing scheme in the project execution phase. There is rarely analysis of the risk drivers and risk transmission between participants of PPP projects.

In order to stimulate the enthusiasm of private enterprises to participate in PPP projects, reduce their concerns about the government's creditworthiness, and ensure that they continue to focus and improve contract compliance in the PPP implementation process, the government usually adopts incentive policies such as feasible gap subsidies and financing guarantees. Summarizing previous cases, we find that the government usually needs to provide tax incentives and project subsidies to encourage private capital to participate in PPP projects (Ke et al., 2009). Following the principal-agent analysis, and studying the changes in the effort levels of enterprises throughout the life cycle, it was found that the government needs to establish a dynamic incentive mechanism for PPP projects (Xu and Song, 2010). However, previous studies have focused more on the rights and obligations restriction mechanism of project contracts on government actions, and few have studied the practical issues of private capital participation initiative, project financing difficulties, etc., determined by government credit risk.

To fill the aforementioned gaps in the literature, this study theoretically analyzes the cause and transmission process of government credit risk in the PPP project implementation stage based on a standardized game theory model. It focuses on revealing the mechanism that affects the integration of private capital into PPP, and deeply investigates the government's initiative to implement the PPP model. It also puts forward theoretical hypotheses and further examines the source of private capital's participation in PPP with the help of empirical research.

### **3. Theoretical analysis and basic hypotheses**

#### **3.1 Static Game with Complete Information**

At present, the PPP demonstration projects selected by the Ministry of Finance for storage are all evaluated by the Value for Money (VfM) method for government revenue assessment (Cai Jin [2015] No. 167).<sup>3</sup> The VfM is obtained by comparing the Public Sector Comparator (PSC) value of the expenditure responsibility when the government independently completes the project with the PPP value of the government's self-responsibility when the government cooperates:  $VfM = PSC - PPP$ . When  $PPP \leq PSC$ , the government uses the PPP mode for project construction; when  $PPP > PSC$ , the government completes the project itself without introducing private capital. The following game model is based on the VfM evaluation principle.

The government has two options for a project: one is to implement PPP, conduct public bidding for government procurement, and introduce private capital, wherein its profit is  $\pi_1$ ; the other is to not implement PPP, which is completed independently by the government and the project fund is raised all from the government, wherein the profit is  $\pi_1'$ . If an enterprise does not cooperate but the government still intends to adopt the PPP model, then it needs to choose from other cooperation entities. This incurs some search cost  $FC$ , and the revenue will decrease to  $\pi_1 - FC$ . There are also two options for private capital: one is to participate in the government bidding and complete the project with the government, wherein the profit is  $\pi_2$ ; the second is not to participate in the government bidding, but to make other investments, and the profit is  $\pi_2'$ . Assuming the VfM is positive at this time,  $R_1$  and  $R_2$  are the expected investment returns of the government and private capital, respectively, and  $C$  is the cost of private capital participating in the project, then the constraint conditions are listed as below:

<sup>3</sup> "Guidelines for the Evaluation of PPP Value for Money (Trial)" (Cai Jin [2015] No. 167)

$$VfM = PSC - PPP > 0, \pi_1 = R_1 - PPP, \pi_1' = R_1 - PSC, \pi_2 = R_2 - C,$$

$\pi_2'$  is private capital's opportunity cost without participation in PPP.  $\pi_1 > \pi_1 - FC > \pi_1' > 0, R_2 > C > 0, FC > 0.$

A complete information static game is established in which the payoff for the government (the private capital) to implement PPP is  $\pi_1(\pi_2)$  with the participation of private capital and  $\pi_1 - FC (\pi_2')$  without the private capital's participation, respectively. If the government does not implement PPP, its payoff would be  $\pi_1'$  no matter the private capital invests in this project owning a payoff of  $\pi_2$  or makes other investments owning a payoff of  $\pi_2'$ .

The game equilibrium is derived for the following circumstances:

(1) When  $\pi_2' > \pi_2$ : because  $\pi_1 > \pi_1', \pi_1 - FC > \pi_1'$ , the dominant strategy of the government is to implement PPP, and the dominant strategy of private capital is not to participate in PPP. At this time, the Nash equilibrium solution is  $(\pi_1 - FC, \pi_2')$ . At this time, if the government wants to avoid new search costs, it needs to provide certain policy support (such as tax relief, credit support, etc.) to motivate the intended private capital partners to actively cooperate in the PPP project, and the support is not less than the difference between  $\pi_2$  and  $\pi_2'$ .

(2) When  $\pi_2' < \pi_2$ : because  $\pi_1 > \pi_1', \pi_1 - FC > \pi_1'$ , the government's dominant strategy is to implement PPP, and private capital's dominant strategy is to participate in PPP. At this time, the Nash equilibrium solution is  $(\pi_1, \pi_2)$ . At this point, both parties can make the most profit.

(3) When  $\pi_2' = \pi_2$ : Because  $\pi_1 > \pi_1', \pi_1 - FC > \pi_1'$ , the government's dominant strategy is to implement PPP. There is no dominant strategy for private capital. At this time, there is no pure Nash equilibrium solution to the game, and if the government wants private capital to participate in PPP, it needs to give it policy support.

The above analysis reveals that as long as the VfM is positive, the government will implement PPP no matter the private capital is willing to participate or not. Whether or not the private capital would participate in PPP projects depends on the comparison of the profits and the opportunity costs.

Based on the static game, hypothesis H1 is proposed: the heavier the local government debt burden, the more actively it will respond to the central government's call for implementation of the PPP model and increase the turnover of PPP projects.

### 3.2 Dynamic Game with Incomplete Information

Considering the information asymmetry between the cooperation parties of the PPP project, we adopt a signal transmission dynamic game with incomplete information to explain how the government credit risk influences the transmission mechanism of private capital's decision making in the process of bidding and execution of a PPP project.

In this game, it is assumed that there are two participants, namely, government and private capital. The government has a dominant position and is the sender of the signal, while private capital is the receiver of the signal. The type of government is private information (that is, the government itself knows its type while private capital does not know), and the type of private capital is public information (that is, only one type). Therefore, a signaling game between the government and private capital is shown in Figure 1.

[insert Figure 1 here]

The game sequence is as follows:

(1) "Nature" first selects the type of government  $\theta \in \Theta$ , where  $\Theta = \{\text{no government credit risk, recorded as } \theta_1; \text{ with government credit risk, recorded as } \theta_2\}$  is the type space of the government, and the government knows its type. But the private sector only knows that the prior probability that the government belongs to  $\theta_1$  is  $P$ , and the prior probability that belongs to  $\theta_2$  is  $1-P$ ; ( $0 \leq P \leq 1$ );

(2) After observing its own type  $\theta$ , the government takes action  $\alpha \in A$ , where  $A = \{\text{gives private capital policy support, recorded as } \alpha_1; \text{ without private capital policy support, recorded as } \alpha_2\}$  is the government's space for action;

(3) Private capital judges according to the above actions, uses Bayes' rule to obtain the posterior probability  $\tilde{P}$ , and then selects action  $\beta \in B$ , where  $B = \{\text{participates in PPP projects, recorded as } \beta_1; \text{ non-participated PPP projects, recorded as } \beta_2\}$  is the space for action of private capital;

(4)  $\pi_1$  is the promised investment profit and social benefits for the government, and  $\pi_2$  is the expected investment profit of private capital. PPP projects involve more public goods, which theoretically have greater social benefits than economic benefits (Shen and Xie, 2009). So,  $\pi_1 > \pi_2$ .  $S$  is the government's expenditure responsibility for policy support in the PPP project, and  $W$  is the gain of authoritative reputation obtained by the government after performing the project contract.  $L_1$  is the loss of government authority credibility caused by the government's dishonesty, and  $L_2$  is the loss of private capital in the event of a government breach of trust. Taking into account the

importance of government authority and credibility (wherein breach of trust may prevent PPP policies from being implemented locally) and the effectiveness of policy support (which needs to effectively compensate for the loss of private capital caused by government breach of trust), we have  $L_1 > \pi_1 > S > L_2 > \pi_2 > 0$ .

The inverse induction method is used to solve the above incomplete information dynamic game. Because of the non-dominant position of private capital in PPP projects, the government credit risk is considered in the first place for risk aversion. At this time, the prior probability  $P = 0$ .

First, through the prior probability  $P$ , private capital can know its return when the government takes different actions. If the government takes action  $\alpha_1$ , private capital will take action  $\beta_1$ , participate in PPP, and the return will be  $(\pi_2 + S - L_2)$ , which is superior to the zero return given by the non-participation action  $\beta_2$ . If the government takes action  $\alpha_2$ , then the private capital will take action  $\beta_2$ , will not participate in PPP, and the return is 0, which is preferred to the participation action  $\beta_1$  whose return will be  $(\pi_2 - L_2)$ . At this stage, the optimal strategy of private capital is  $(\beta_1, \beta_2)$ .

Next, the government has observed that the optimal strategy of the above-mentioned private capital is  $(\beta_1, \beta_2)$ . Therefore, the optimal strategy of the government is as follows: When the government type is  $\theta_1$ , it takes action  $\alpha_1$ , provides policy support for the PPP project, and the return is  $(\pi_1 - S + W)$ , which is preferred to action  $\alpha_2$  that leads to a return of zero. In contrast, the type  $\theta_2$  government will take action  $\alpha_2$ , not provide policy support, and its return is 0, which is superior to action  $\alpha_1$  that leads to a return of  $(\pi_1 - S - L_1 + L_2)$ .

In the end, private capital observed the government's decision-making method and obtained the posterior probability  $\tilde{P}$ . When the project is not subject to government credit risk, it will receive the relevant policy support; otherwise, it will not obtain any policy support. We therefore derived the following separation equilibrium. When the government type is  $\theta_1$ , the government's action is  $\alpha_1$  and provides the policy support; otherwise, the government will take action  $\alpha_2$  without supporting the project. Furthermore, the optimal strategy for private capital is  $(\beta_1, \beta_2)$ : if the government takes action  $\alpha_1$ , private capital will take action  $\beta_1$  and participate in the bidding of PPP projects, earning a final return of  $(\pi_2 + S)$ , which is preferred to the non-participation action  $\beta_2$  that leads to a return of zero. Otherwise, if the government takes action  $\alpha_2$ , private capital will take action  $\beta_2$  and not participate in the bidding. Although this yields a return of zero, it is superior to the participation action whose return is  $(\pi_2 - L_2)$ .

The model equilibrium reveals that, due to concerns about the government credit risk, only when the government provides effective policy support to protect the normal profits of private capital even in the event of losses due to the government credit risk, private capital will be motivated to participate in PPP projects for profit-seeking purposes. Based on this dynamic game, hypothesis H2 is proposed: In order to avoid the government credit risk, private capital will cooperate and participate in PPP projects only when it is observed that the government has the ability to protect its normal profits.

#### 4. Empirical Analysis

##### 4.1 Variable Selection and Data Sources

In order to truly reflect the participation of private partners in PPP projects, considering that the statistical coverage of the landing rate of PPP projects has been changing, this study constructs the ratio of PPP project transaction landing amount (that is, the value of private funds invested in the PPPs that win bidding)<sup>4</sup> to GDP as the dependent variable,  $PPP_{size}$ , to measure the enthusiasm of private capital participation. The primary explanatory variable, *deficit*, is constructed as the ratio of public deficit over GDP to measure the government's ability to protect private capital profits.

The following explanatory variables are selected according to the literature. First, the speed of economic development is the main influencing factor for the successful implementation of PPP projects in developing countries (Chakraborty and Nandi, 2011; Narayana, 2011). Generally speaking, the developing countries have relatively restricted public funds and face constraints in infrastructure and other bottlenecks for economic growth that urgently needed to be addressed. Therefore, they have higher demands for PPP projects than developed countries. Second, China's current financing system still has many problems, such as the lack of clear boundaries between the government and the market, which cannot match the financing needs of PPP projects. The more optimized the regional financing environment, the more enthusiastic the private capital tends to be in participating in PPP projects (Sun et al., 2015).

<sup>4</sup> Data source: Mingshu Database ([http://bridata.com/project?type=cjld&in\\_cPPPc=1](http://bridata.com/project?type=cjld&in_cPPPc=1)).

In addition, many external macroeconomic factors affect whether private capital participates in PPP projects (Osei-Kyei and Chan, 2015). Specifically, the higher the degree of economic openness, the stronger the ability to use foreign capital, which may have a crowding effect on private capital (Wang et al., 2019). The more vigorous the demand for investments in the market, the greater the amount of PPP investment by private capital (Tan et al., 2019). When the economy faces downward pressure, in order to boost the employment (reduce unemployment) and stimulate the economy, the government will increase PPP projects and increase private capital investment (Wang et al., 2019). Lastly, as illustrated in Figure 2 below, PPP projects are mostly distributed in the tertiary industry.

[insert Figure 2 here]

The third hypothesis is thus proposed as H3: the participation of private capital in PPP projects has a positive relationship with a region's development of urban infrastructure, maturity of the tertiary industry, economic openness, financing environment, and market demand. It has a negative relationship with the region's employment level and the level of economic development.

Following the literature, we also included variables to measure the age and educational attainment of each governor to control for the possible strong influence from individual characteristics of the provincial officials in China. Table 1 provides details on the names and construction method of all variables. A provincial level panel data for the period 2013-2018 is utilized and data descriptive statistics are also shown in Table 1.

[insert Table 1 here]

#### 4.2 Regression Analysis

The empirical specification is presented by the equation below, where  $i$  represents the region and  $t$  represents the year:

$$PPPsize_{it} = \beta_0 + \beta_1 deficit_{it} + \beta_2 city_{it} + \beta_3 service_{it} + \beta_4 people_{it} + \beta_5 FD_{it} + \beta_6 natural_{it} + \beta_7 unemployment_{it} + \beta_8 FDI_{it} + \beta_9 pergdpgrowth_{it} + \beta_{10} age_{it} + \beta_{11} education_{it} + \sum Year + \mu_i + \varepsilon_{it}$$

Concerning the corner solution in the regression data (that is, the dependent variable may be zero), the panel Tobit model is used for regression. We controlled for the time dummy variables,  $year_t$ , to examine the impact of macroeconomic policy and trends on the participation of private capital in PPP projects. We also controlled for the possible regional heterogeneity of each province, captured by  $\mu_i$ . The regression results are shown in Table 2 for Model 1.

[insert Table 2 here]

The government deficit in Model 1 is found to have a significant negative relationship with the PPP landing amount, indicating the greater the government financial pressure, the smaller the PPP landing amount, which is contrary to the hypothesis H1. An explanation is that although the government facing financial pressure tends to initiate PPP projects as a way to finance infrastructure construction, private capital realizes that the heavier the government's debt burden, the more difficult to guarantee the expected return promised by the government in the PPP contract. This leads to the fear of risk by private capital who choose not to participate in PPP projects. This result validates hypothesis H2.

Not all of the estimated coefficients for the control variables in Model 1 support hypothesis H3. On one hand, the PPP landing amount is found to have a significant negative relationship with the urbanization rate and foreign direct investment. This means that areas with low levels of urbanization tend to use PPP projects for financing the urgent needs of infrastructure construction and public service provision, which leads to an increase in the PPP landing amounts. The higher the proportion of foreign direct investment, the smaller the amount of PPP landing transactions, indicating that foreign direct investment has a significant crowd out impact on private capital, which is in line with the H3. It's worth noting that in China, foreign investment accounts for a relatively low proportion of PPP investment and is subject to many restrictions (such as not being able to directly control or "own" the project companies), so the regression results should be used with caution.

On the other hand, the PPP landing amount does not seem to have significant relationships with the proportion of tertiary industry in the economy, population density and growth, financial development level, unemployment, per capita GDP growth, and the characteristics of provincial officials, meaning they are not the main concerns of private capital's participation in PPP projects. In general, this may be attributed to the limited sample size and the fact that China's PPP practice is not completely consistent with the conventional PPP theory. Specifically, the insignificant effect of the financial development variable may be due to the fact that there is no restriction on the sources of financing for private partners in PPP projects, so projects in areas with less developed financial systems can also be financed by funds from other regions (Chen and Wang, 2018).

Finally, the regression results highlight the importance of the nationwide macroeconomic trends on private capital's participation in PPP projects. As shown in Model 1,  $year_2$  is estimated to have a positive relationship with the amount of private capital PPP investment at the 10% significance level while  $year_3$ - $year_6$  all have a positive

relationship at the 1% significance level. This means the participation of private capital in PPP projects is mainly affected by the time-lag effects of the national macroeconomic trend policies aimed at improving the modern public financial system and the supply-side structural reform, such as the selection of PPP demonstration projects for storage, promulgation of the new Budget Law, and the issuance of special bonds by local governments. Even the related follow-up measures of these policies affect private capital's participation in PPP projects.

#### 4.3 Robustness Check

In the benchmark Model 1, the core explanatory variable, namely the government's ability to protect private partners' profit, is measured by the ratio of a provincial government's fiscal deficit to the region's GDP. There is concern about the endogeneity of this policy variable because on one hand, the fiscal deficit as a ratio of GDP can influence the PPP transaction landing amounts, and on the other hand, private capital's participation in PPP projects could impact a region's GDP and thus alter its fiscal deficit rate. Therefore, fiscal pressure (FP) is adopted as a proxy variable for *deficit*. FP is measured by the ratio of (fiscal revenue – expenditure) to the fiscal revenue of a province's general public budget. The estimation results with FP replacing *deficit* are reported in the Model 2 of Table 2.

The second concern about the benchmark estimation lies in the possible heterogeneity between provinces that have fiscal deficits and those that have fiscal surpluses. Because provinces with considerable fiscal pressure tend to be more motivated to invite private capital to participate in the PPP projects, we exclude samples that do not have fiscal deficits from Model 2 and report the estimation results in the Model 3 of Table 2.

The regression results of both Model 2 and Model 3 are consistent with those of Model 1. Specifically, the coefficients of the government's financial pressure variable are negative and statistically significant, suggesting the larger the government's deficit in relation to its revenue, the lower the participation of private capital in the PPP projects due to their concerns about the government's ability to guarantee the expected returns. Meanwhile, the level of urbanization and economic openness to the foreign investments are also estimated to have significant negative relationships with private capital investment in PPP projects. The year dummies are all estimated to be positively related with the PPP transactions' landing amount, same with the results for Model 1, highlighting the importance of the central government's efforts to develop a modern public financial system and facilitate supply-side structural reform during the period of study.

The last concern about benchmark Model 1 is the multi-collinearity among the explanatory variables. Studies have found that local governments have a strong incentive to fully develop the tertiary industry to relieve their fiscal pressures under the central government's fiscal stimulus and support (Xie et al., 2017). Since the development of the tertiary industry helps maintain the rigidity of fiscal revenue, it also has an impact on the fiscal deficit, which is the core explanatory variable, leading to the possibility of multi-collinearity among the explanatory variables. Therefore, it is important that the Variance Inflation Factor (VIF) is adopted to examine the degree of multi-collinearity. The VIF value for *service* is 2.94, much smaller than the empirical threshold of 10 that indicates the multi-collinearity is problematic. Moreover, the VIF values for all independent variables vary from 1.11 for *education* to 4.59 for *city*, with a mean VIF of 2.23.

#### 5. Conclusion and Policy Implication

Government credit risk is one of the many risks in the implementation of the PPP model. Private partners' concern about the government's failure to perform contractual agreements directly hinders the promotion of the PPP model. This paper uses game theory to study the motivations for the government and private capital to participate in PPP projects. It is found that weakening the fiscal deficit budget constraints and responding to the central government's macro-control policies are the main motivations for local governments to initiate PPP projects. Supply-side structural reform and public policy support are the main motivations for private capital to participate in PPP projects. Hypotheses are put forward accordingly. A Tobit panel regression analysis, using the provincial data from 2013 to 2018, is conducted to examine the impact of the government behavior and macroeconomic policies on the private capital participation in PPP projects. The empirical results suggest that the most important factor restricting the participation of private capital in PPP is the government credit risk, and under the conditions of national macroeconomic policies, the policy support of local governments plays a significant positive role.

Findings of this study provide significant policy implications to be drawn by both public and private sectors. On the one hand, contracts could be an effective strategy for mitigating risk in PPP projects. In contracts, partners can agree on the goals of a project, fix a strategy to achieve those goals, and determine the administration and operation of the project (Rybnicek et al, 2020). To promote the participation of private capital in PPP and achieve the goal of "good governance" in the provision of infrastructure, governments at all levels should cultivate the spirit of contract, constrain their power, improve their credibility by hedging their credit risk, and change from a traditional

"regulator" to a trustworthy "partner" and "supervisor". In this way, private capital can choose the PPP projects that meet its own risk tolerance to participate in and give full play to its technological advantages.

China currently lacks a mature legal environment for PPP projects. The behavioral norms of all parties involved are mostly the policy documents issued by the Ministry of Finance and the Development and Reform Commission, which brings confusion to the entry of private capital. In addition, the government has the information advantage throughout the life cycle of the project, which makes it difficult for private capital that has low risk tolerance to deal with the government credit risks. However, considering that the introduction of a new "PPP Bill" would take too long, so it may be prudent to consider adding a series of branch clauses about the Code of Conduct for Government and Market Subject in the PPP Projects while revising the "Bidding Law" (Zhang, 2005). This could help mitigate or prevent government credit risk at the institutional level.

Government credit risk occurs mostly in the initial stage of bidding for PPP projects, because the government only considers using private funds to improve the efficiency and quality of public goods supply and to improve the sustainability of fiscal operations by resolving the stock of local government debts. The outlook and design of the profits for the private sector is not clear, so the sector is unable to create sufficient profits and thus forced to default (Ruuska and Teigland, 2009). As of the end of 2019, the commonly agreed return mechanism adopted by most PPP projects is the Viability Gap Funding mechanism. A reasonable sharing ratio in revenue and risk between the government and private partners during the project implementation process can effectively reduce the government's credit risk and thereby increase participation of private capital in PPP projects.

To effectively hedge the credit risk of local governments, modernization of local governance should be the main motivation to implement PPP projects, as opposed to treating PPP only as a tool for government financing (Brinkerhoff & Brinkerhoff, 2011). Theoretically, the PPP model helps solve the problem of uneven economic development across regions, which is particularly important for China. When implementing PPP projects, local governments should target people's social welfare and livelihood, and ensure that the deleverage policy from the central government is not alienated in the transmission process (Tan et al., 2019). In practice, however, there has been a tendency for PPP to become a new form of public financing which adds hidden liabilities to government. For example, the local government violates budget law and promises a minimum return to private partners. For another example, the PPP contract stipulates that when private capital withdraws, the government will assume its financing responsibility. Once the commitment cannot be fulfilled, it escalates the government credit risk and inhibits the enthusiasm of private capital, which in turn boosts the risk of public deficits. This causes a vicious circle and burdens the local debt leverage.

On the other hand, private capital should prudently respond to the government credit risk. Playing a major role in the PPP project implementation stage, its decisions should be based on sufficient market research in the early stage (Caselli et al, 2009). Private capital cannot blindly rely on the government, nor can it require the local government to make commitments or even financial guarantees, which is in violation of budget law. Meanwhile, the private partner should abide by laws and regulations, actively assume its responsibilities as stipulated in the contract agreement, and fulfill its promises to the market. In the worst case scenario, if private capital foresees the emergence of government credit risk during the contract execution process, it should take immediate action such as asset securitization or reinsurance to protect its own rights and interests (Kakabadse et al., 2007).

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Table 1. Variables Description and Descriptive Statistics (Sample Size = 186)

Measurement	Variable	Construction Method	Mean	Std. Dev.	Min	Max
The enthusiasm of private capital to participate in PPP projects	<i>PPPsiz</i>	(PPP Transaction Landing Amount / GDP) * 100	2.470	4.042	0	28.958
The Government's ability to protect private partner's profit	<i>deficit</i>	(Public Spending – Public Revenue) / GDP	0.169	0.209	0.036	1.243
Urban infrastructure development	<i>city</i>	Urban Population / Total Population	0.572	0.127	0.240	0.900
Tertiary industry development level	<i>service</i>	Service GDP/Overall GDP	0.474	0.089	0.320	0.809
Market Demand	<i>population</i>	Urban population density per square kilometer / 1000	2.823	1.121	1.059	5.541
Financing Environment	<i>FD</i>	Period-end loan / GDP	0.171	0.096	0.034	0.803
Market Demand	<i>natural</i>	Natural Growth Rate = Birth Rate-Mortality	5.436	2.903	-1	11.470
Employment	<i>unemployment</i>	Number of unemployed / (number of employed + number of unemployed)	3.230	0.640	1.210	4.470
Degree of economic openness	<i>FDI</i>	(Actual amount of foreign direct investment * Annual average exchange rate of one dollar to RMB) / GDP	0.021	0.024	0.000	0.176
Level of Economic Development	<i>pergdp growth</i>	GDP per capita in the current period / GDP per capita in the previous period	1.072	0.042	0.777	1.183
Governor's Age	<i>age</i>	Current Year – Birth Year	61.005	3.039	50	69
Governor's Educational Attainment	<i>edu</i>	1: high school degree and below; 2: associate degree; 3: bachelor's degree; 4. master's degree; 5. doctoral degree.	4.075	0.677	2	5

Note: The average annual exchange rate of US dollar against RMB is calculated from the annual exchange rate statement on the website of the People's Bank of China (<http://www.pbc.gov.cn/>).

Table 2. Regression Results and Robustness Check: Dependent Variable is PPP size.

Variables	Model 1		Model 2		Model 3	
	Coef.	Std Err	Coef.	Std. Err.	Coef.	Std. Err.
deficit	-9.648**	3.69				
FP			-1.166**	0.3808	-1.307***	0.3831
city	-20.29***	5.9562	-20.78***	5.5477	-22.60***	5.4157
service	8.598	6.798	7.955	6.394	8.695	6.1292
population	-0.406	0.3123	-0.31	0.296	-0.321	0.2823
FD	0.611	6.4903	-0.376	5.9781	0.776	5.9749
natural	-0.0157	0.1464	-0.0568	0.1408	-0.0597	0.1346
unemployment	-0.58	0.6432	-0.579	0.6149	-0.549	0.589
FDI	-53.73*	23.5378	-58.81**	22.2825	-61.21**	22.0184
pergdpgrowth	6.691	7.0645	6.219	7.0436	6.573	7.0404
age	0.197	0.1009	0.202*	0.0993	0.208*	0.098
education	0.517	0.4293	0.508	0.4274	0.356	0.4406
year2	2.460*	1.0081	2.428*	1.01	2.457*	1.0206
year3	4.106***	1.0534	4.083***	1.0535	4.138***	1.0631
year4	7.867***	1.034	7.982***	1.0359	8.075***	1.0452
year5	9.051***	1.0606	9.235***	1.0633	9.370***	1.0724
year6	6.392***	1.0817	6.493***	1.0781	6.789***	1.1071
Constant	-11.42	11.4269	-10.28	11.3416	-9.818	11.2739

Notes: \*, \*\*, and \*\*\* indicate significance at the levels of 10%, 5%, and 1%, respectively.

Figure 1. Game tree of a dynamic game with incomplete information

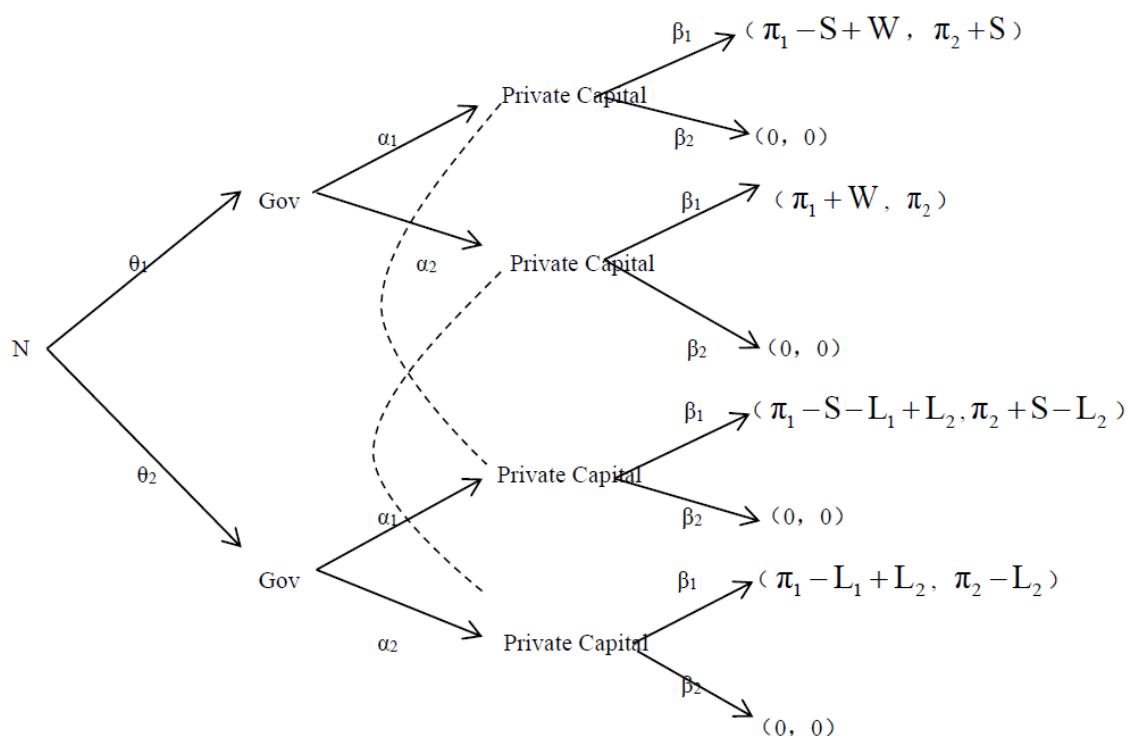


Figure 2. Amount and Count of PPP Project Transactions by Industry (Data source: Mingshu Database ([http://www.bridata.com/project?type=hylx&in\\_cPPPC=1](http://www.bridata.com/project?type=hylx&in_cPPPC=1))).

